USGIN
U.S. Geoscience Information Network

USGIN Metadata Profile: Use of ISO metadata specifications to describe geoscience information resources

Version 1.2

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USGIN Metadata Profile: Use of ISO metadata specifications to describe geoscience information resources

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This document describes recommended practices for using ISO19139 xml encoding of ISO 19115 and ISO 19119 metadata to describe a broad spectrum of geoscience resources. The document provides guidance for the population of ISO19139 encoded metadata documents to enable interoperability of catalog service clients with multiple servers conforming to this profile.

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Revision History

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1 Introduction

A key component of a distributed information network is a catalog system, a collection of resources that allow data and service providers to register resources, and data consumers to locate and use those resources. Currently, many online catalogs are web pages with collections of URLs for services, or services are discovered accidently or by word of mouth. The vision is to enable a web client (portal) to search across one or more metadata registries without having to configure the client individually for each of the registries that will be searched. Thus, metadata providers can focus on data development, without having to also develop web clients to enable search of that metadata.

The Open Geospatial Consortium (OGC) Catalog Service for the Web (CSW) specification defines a collection of basic operations for searching catalogs of metadata via the web. Engineering the desired interoperability requires adding additional constraints on CSW operation; one of the major constraints is selection of the xml schema that will be used to encode metadata for the service. The core CSW specification requires use of a basic xml schema that includes content defined by the Dublin Core Metadata specification [Dublin Core, 2008-01-14]. This document concerns use of the ISO19115 and ISO19119 content models implemented using the ISO19139 xml schema for encoding of metadata content. Some more specific constraints on use of this implementation may be included in a separate document (USGIN, 2012) describing metadata constraints for different kinds of resources.

1.1 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19115 designates these two normative references:

- ISO 19115:2005, *Geographic information - Metadata*
- ISO 19115/Cor.1:2006, *Geographic information – Metadata, Technical Corrigendum*

ISO 19119 designates these normative references:

- ISO 19119:2005, *Geographic information - Services*
- ISO 19119:2005/Amd 1:2008, *Extensions of the service metadata model ISO 19108 designates*:
- ISO 19108:2005, *Geographic information – Temporal Schema*

ISO 639-2, Codes for the representation of names of languages - Part 2: Alpha-3 code control ISO 8601, Data elements and interchange formats - Information interchange - Representation of dates and times

ISO/TS 19139:2007, Geographic information - Metadata – XML Schema Implementation

OGC 07-006r1, OpenGIS Catalog Services Specification version 2.0.2, Corrigendum 2 release, 2007

OGC 07-045, OpenGIS Catalogue Services Specification 2.0.2 - ISO Metadata Application Profile, Version 1.0.0, 2007

INCITS 453-2009, North American Profile of ISO 19115:2003 – Geographic Information – Metadata (NAP-Metadata), 2009, American National Standards Institute, Inc.

ISO 10646-1, Information technology — Universal Multiple-Octet Coded Character Set (UCS) — Part 1: Architecture and Basic Multilingual Plane

RFC 2119, Key words for use in RFCs to Indicate Requirement Levels, Network Working Group, 1997.

1.2 Purpose

The USGIN uses the ISO 19115/19119 specifications for metadata content, and the ISO 19139 XML schema for encoding this content search results provided by USGIN CSW services. This profile conforms to most of the provisions of the North American Profile of ISO metadata (INCITS 453-2009, referred to as NAP), except it allows multiple distributor-format-transferOptions bindings for resource distribution, and recommends use of ISO19115 codelist values. This USGIN document is meant to provide guidance on the use of the ISO19139 XML schema to encode metadata for geoscience resources, with sufficient detail that application developers can produce software clients that utilize the metadata for automated discovery, evaluation, and utilization workflows. The focus of the profile is to enable interoperable catalog services for discovery, evaluation, and access to information resource of interest to geoscientists.

1.3 Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in Internet RFC 2119.

Application profile: a schema that consists of data elements drawn from one or more namespaces, combined together by implementers, and optimized for a particular local application. (Rachel Heery and Manjula Patel, 2000, http://www.ariadne.ac.uk/issue25/app-profiles/)

Catalog application: Software that implements a searchable metadata registry. The application must support the ability to register information resources, to search the registered metadata, to support the discovery and binding to registered information resources within an information community.

Codelist (also as Code list): a controlled vocabulary that is used to populate values for an XML element.

Data product specification: a definition of the data schema and value domains for a dataset. The data schema specifies entities (features), properties associated with each entity, the data type used to specify property values, cardinality for property values, and if applicable, other logical constraints that determine data validity. Value domains are specified for simple data types—strings or numbers, and may include controlled vocabularies for terminology required to specify some properties.

Dataset series: collection of datasets sharing the same product specification (ISO 19115). ISO 19115 does not define product specification. For the purposes of USGIN, a product specification defines a data schema, any required controlled vocabularies, and recommended practices for use of schema (see Data product specification).

Dataset: an identifiable collection of data (ISO19115). USGIN extends the concept of data items to include physical artifacts like books, printed maps and diagrams, photographs, and material samples--any identifiable resource of interest. DCMI definition is "Data encoded in a defined structure" with additional comment "Examples include lists, tables, and databases. A dataset may be useful for direct machine processing." A digital dataset is a collection of data items in which individual data items are identified and accessible. Metadata for the collection is a different type than metadata for individual items in the collection (dataset vs. features). Criteria for what unifies the collection are variable (topic, area, author...). Data items may represent intellectual content -- information content and

organization (data schema) -- or may represent particular manifestations (formats) of an intellectual artifact.

Interoperability: "The capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units." ISO/IEC 2382-01 (SC36 Secretariat, 2003)

Metadata element: a discrete unit of metadata (ISO 19115), an attribute of a metadata entity. A metadata element contains some content specifying the value of the element; this content may be simple—a number or string, or may be another metadata entity.

Metadata entity: a named set of metadata elements describing some aspect of a resource.

Metadata register: an information store that contains a collection of registered metadata records, maintained by a metadata registry. (ISO 11179)

Metadata registry: an information system for assignment of unambiguous identifiers to administered metadata records. (ISO 11179)

Metadata section: Part of a metadata document consisting of a collection of related metadata entities and metadata elements (ISO 191115).

Metadata: data about a resource in some context. Generalize from ISO 11179 definition of metadata, which constrains the scope to data about data. For USGIN purposes, metadata may describe any resource—including electronic, intellectual, and physical artifacts. Metadata specify characteristics that can be queried and presented for evaluation and further processing by both humans and software.

Profile: set of one or more base standards and - where applicable - the identification of chosen clauses, classes, subsets, options and parameters of those base standards that are necessary for accomplishing a particular function [ISO 19101, ISO 19106]

Resource: An identifiable thing that fulfills a requirement. Usage here is closer to definition used in RDF (www.w3.org/TR/REC-rdf-syntax*),* generalized from ISO19115, which defines resource as an 'asset or means that fulfills a requirement' without defining asset or means. "An object or artifact that is described by a record in the information model of a catalogue" (OGC 07-006r1)

Service metadata: metadata describing the operations and information available from a server.

Source Specification: The specification or standard that is the subject of a profile.

User Community: A group of agents who decide to make a similar usage of a source specification in order to be able to interoperate.

Note that throughout this document, the names of XML elements are shown in `this typecase`. Long X-paths have been broken with non-breaking hyphen characters. Note that hyphens are not used in any XML attribute or element name, so if they appear in the text, they are strictly for better text wrapping. In Xpath expressions `/../` indicates that some elements have been omitted from the path.

1.4 ISO Schemas Location

ISO I9139 xml schemas are hosted by the International Organization for Standardization (ISO) at http://standards.iso.org/ittf/PubliclyAvailable-Standards/ISO_19139_Schemas/gmd/. The ISO Technical Committee 211 (TC211) also hosts the schemas at http://www.isotc211.org/2005/gmd/. These schema implement ISO Technical Specification 19139:2007 (dated 2007 Apr 17), which appears to include the changes from ISO 19115:2003 Cor 1;2006(E), but do not include any of the service metadata content.

The Open Geospatial Consortium (OGC) hosts a copy of the schemas in an online repository at http://schemas.opengis.net/iso/19139/. In the OGC repository, two versions are posted: 20060504 and 20070417. Unfortunately, these two directories both contain schema with the same target namespace, so there is no clear way to distinguish applications that are based on one or the other. The medatadaEntity.xsd in the two directories is identical; other schema have not been compared (but see discussion paper gin2009-005 at http://lab.usgin.org/node/269). The 20070417 directory contains schema implementing ISO Technical Specification 19139:2007 (dated 2007 Apr 17), apparently identical to that in the ISO repositories, but this is not declared in any included documentation (need metadata on the metadata schema!).

The 20070417 version of the ISO 19139 schemas references GML 3.2.1. However, there is no mention of the SRV namespace (http://www.isotc211.org/2005/srv) in this schema. The SRV namespace is required to specify information about dynamic, online services such as WFS and WMS, so the 20070417 version is not useful for metadata catalogs that register services.

In order to create metadata for both static datasets and dynamic, online services and for use with CSW, the OGC created an xml schema that merges the schema for ISO19115 (dataset metadata) and ISO19119 (service metadata) (see section D.1.5, page 105 in OGC 07-045). The way that was accomplished was by creating a schema located at http://schemas.opengis.net/csw/2.0.2/profiles/apiso/1.0.0/apiso.xsd. This schema simply imports .. iso/19139/20060504/gmd/gmd.xsd and .. iso/19139/20060504/srv/srv.xsd. Thus for CSW 2.0.2 implementations, the 20060504 versions of the ISO19139 schema must be used.

2 Overview of the Profile

2.1 Quick Reference

This section provides a summary of the rules for an ISO 19139 XML document to be considered a valid USGIN metadata record

1. MD_Metadata/fileIdentifier/gco:CharacterString must be present, and may be interpreted by client applications as a string that is unique to each particular metadata record in the scope of the catalog from which it was obtained. This is typically a UUID autogenerated by the metadata editing tool or import process
2. MD_Metadata/language/gco:CharacterString will be assumed to be 'eng' (English) unless another value is specified. Any characters after the first three letters in this character string may be ignored by client applications.
3. Unless otherwise specified, the character set element will be assumed to be:

```
<gmd:characterSet>
    <gmd:MD_CharacterSetCode codeListValue="utf8">UTF-8</gmd:MD_CharacterSetCode>
</gmd:characterSet>
```

Unless otherwise specified MD_Metadata/hierarchyLevel/MD_ScopeCode will be assumed to be:

```
<gmd:hierarchyLevel>
  <gmd:MD_ScopeCode  codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/
   ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_ScopeCode"
    codeListValue="dataset">dataset</gmd:MD_ScopeCode>
</gmd:hierarchyLevel>
```

Metadata with scope code values that are not in the set {`collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, fieldSession, software, service, model, tile`} will be considered out of scope and may be ignored by a harvesting catalog.

4. MD_Metadata/hierarchyLevelName/gco:CharacterString is mandatory to identify the USGIN resource type from

5. Table 1 (above). Default value is "Dataset". Encode hierarchy by including `hierarchyLevelName` elements for all broader resource categories. E.g. default should also include a `hierarchyLevelName`="Collection" element.

USGIN Hierarchy level name	**Broader Resource Type**
Collection	
Dataset	Collection
Catalog	Dataset
Physical artifact collection	Collection
Document	
Image	Document
StillImage	Image
Human-generated image	StillImage
Photograph	StillImage
Remote sensing Earth image	StillImage
Map	Human-generated image | StillImage
MovingImage	Image
Sound	Document
Text	Document
Hypertext document	Text
Model	
Physical artifact	
Service	
Software	
Stand-AloneApplication	Software
WebApplication	Software

6. USGIN requires at least one MD_Metadata/contact/CI_ResponsibleParty with role.CI_RoleCode@codeListValue = "originator" (CI_RoleCode element value = "originator") that identifies the original source of the metadata record. The CI_ResponsibleParty element must include a contact e-mail address (electronicMailAddress) or telephone number (voiceTelephone), and one of individualName, organisationName, or positionName must be present.
7. USGIN profile requires a MD_Metadata/dateStamp/gco:DateTime (Note this contrasts with INSPIRE mandate to use dateStamp/gco:Date) that specifies the date and time when the metadata record was created or last updated.
8. MD_Metadata/metadataStandardName/gco:CharacterString must be the string "ISO-USGIN" to identify a metadata record as conforming to this profile.
9. MD_Metadata/metadataStandardVersion/gco:CharacterString must be the string "1.2" to identify a metadata record as conforming to this profile.
10. MD_Metadata/identificationInfo/*MD_Identification*/citation/CI_Citation/title is mandatory. A meaningful title that is unique within the scope of the catalog should be provided for each resource that is described by a metadata record. This may be in a MD_DataIdentification or SV_ServiceIdentification element.
11. MD_Metadata/identificationInfo/*MD_Identification*/citation/CI_Citation/date is mandatory, and must be specified as an xml DataTime data type: `YYYY-MM-DDThh:mm:ssZ`. Some validators

require time zone as well; recommend GMT indicated by 'Z', other time zones are indicated by "+" or "-" integer offset from GMT, e.g. "+7" for US MST.

12. MD_Metadata/identificationInfo/*MD_Identification*/citation/CI_Citation/responsibleParty is mandatory with role CI_RoleCode@codeListValue one of {originator, principalInvestigator, processor, author}. This element identifies the agent responsible for the intellectual content of the described resource. The CI_ResponsibleParty element must include a contact e-mail address (electronicMailAddress) or telephone number (voiceTelephone), and one of individualName, organisationName, or positionName must be present.
13. identificationInfo/*MD_Identification*/abstract is mandatory, but nilable. Should include a description of resource content and any other information that will help users evaluate and use the resource.
14. `identificationInfo/MD_Identification/-extent/EX_Extent/-geographicElement/-EX_GeographicBoundingBox` is mandatory if the resource has a geographic footprint. Geographic extent must be represented by bounding box in WGS 84 decimal degrees. Non-geographic resources are given a location keyword 'non-geographic'.

2.1.1 Non-service resources

Any resource that is not a service is described by a metadata record with a `MD_DataIdentification` as the concrete implementation of the abstract `MD_Identification` element.

1. If the metadata describes a physical resource, identificationInfo/MD_DataIdentification/-pointOfContact/CI_ResponsibleParty must provide contact information for the agent who is the resource steward. Count of (individualName + organisationName + positionName) must be > 0. The CI_ResponsibleParty/role/CI_RoleCode is from CI_RoleCode codelist. ISO role codes for physical resource point of contact are {custodian, owner, pointOfContact}.
2. MD_Metadata/distributionInfo/MD_Distribution/distributor/MD_Distributor/distributorContact/-CI_ResponsibleParty is mandatory with role.CI_RoleCode@codeListValue = "pointOfContact" (CI_RoleCode element value = "pointOfContact") that provides a contact point to report problems with accessing the resource through distributions associated with the distributor. The CI_ResponsibleParty element must include a contact e-mail address (electronicMailAddress) or telephone number (voiceTelephone), and one of individualName, organisationName, or positionName must be present.
3. MD_Metadata/distributionInfo/MD_Distribution/distributor/MD_Distributor/distributionOrderProcess/MD_StandardOrderProcess is mandatory if the described resource is not available online. This should be a free text explanation of how to access the described resource.
4. MD_Metadata/distributionInfo/MD_Distribution/distributor/MD_Distributor/distributorTransferOptions/-MD_DigitalTransferOptions/online/CI_OnlineResource/linkage/URL is mandatory if the described resource is available online. Note that if online access is through a service, additional CI_OnlineResource properties may be required to provide sufficient information to allow software agents to use the metadata to connect to the service.

2.1.2 Service Resources

Service metadata records in the USGIN profile are intended to describe a particular service instance from the point of view of a service implementation and enpoint. Each dataset exposed by the service should be described by a separate metadata record with MD_HierarachyLevel = 'Dataset'.

1. The srv:ServiceType element value must be populated from a string in the USGIN ServiceType codelist (Table 11).

2. Service status is required. Value is from MD_ProgressCode codelist. ISO Code names applicable to services include {`completed, obsolete, onGoing, planned, required, underDevelopment`}.
3. Service metadata records must provide a coupling type attribute specifying 'tight', 'mixed', or 'loose' coupling with particular data.
4. If coupling type is 'tight' or 'mixed' a at least one `coupledResource` element is mandatory.
5. At least one service operation MUST be described with the `operationDescription/CharacterString` = 'serviceDescription'. The `identificationInfo/SV_ServiceIdentification/containsOperations/SV_OperationMetadata/connectpoint` link for this operation MUST retrieve the service-specific self description document (e.g. WSDL, GetCapabilities, WADL). The `CI_OnlineResource` in this connectPoint elment must have `CI_OnlineResource/name` = "serviceDescription" (from the table in section 7.2 Linkage name conventions).

2.2 USGIN specification constraints and recommendations

Recommended practices

- DatasetURI if there is one. Nilable if not available.
- All resources should have a point of contact responsible party thaqt specifies the agent currently responsible for curation and maintenance of the resource.
- Allow multiple distributor-format-transfer option combinations for a single resource. This is critical information for enabling automated access to resources based on the metadata content. The ISO metadata model allows different approaches to binding between a distributor and resource distributions from that distributor when there are multiple distributors and distributions. This profile defines conventions for documenting those bindings.
- Representation of aggregated resources done using `identificationInfo/MD_DataIdentification/aggregationInfo/MD_AggregateInformation`, not `MD_Metadata/parentIdentifier`
- Vertical resource extent may use an elevation convention or a depth convention. CRS referenced to mean sea level, meters, measured positive up.
- Resolution expressed using `equivalentScale/MD_RepresentativeFraction/denominator` is mandatory.
- Recommended distribution format codes (Table 6) for `distributionFormat/name` introduced for categorization of physical resources, like a book, rock sample, paper document. USGIN recommends use of MIME types if they are registered for the format, and provides a recommended syntax for file formats that do not have corresponding MIME types.
- Table 12 is a list of recommended `CI_OnlineResource/name` strings used to identify special online resources link icons for branding.
- Use of a controlled vocabulary for a CharacterString data type value is indicated by including an xsi:type=" gml:CodeType" on the gco:characterString element, which then requires a codeSpace attribute (see 4.15.2-Non digital resources and 7.2-Linkage name conventions). This codeSpace should be the URI for the vocabulary used. The CharacterString element value MUST then be an identifier from that vocabulary. This convention turns the gco:CharacterString value into a GML scoped name or gco:LocalName element.

- If the metadata resource is not specific to a geographic extent, the *`MD_identification/`*`extent/EX_Extent/geographicElement/` should have a nilReason="inapplicable" and nil="true" attributes and the place keyword 'non-geographic' should be included in the descriptiveKeywords element.

2.3 USGIN specification extensions

Extensions to ISO19115, ISO119, ISO19139 introduced by USGIN profile:

Allow use of `identificationInfo/SV_ServiceIdentification/coupledResource/-SV_CoupledResource/ScopedName` defined by OGC 07-045 ISO profile for CSW 2.0.2, use to provide WMS layer names or WFS feature names for service requests.

2.4 General Objectives

The Profile defines:

- mandatory and conditional metadata sections, metadata entities, and metadata elements
- the minimum set of metadata elements for any resource in order to conform to the Profile
- the core metadata for geographic datasets
- optional metadata elements that allow for a more extensive standard description of resources
- some recommended practices to increase the utility and interoperability of metadata.

2.5 Requirements

M (mandatory). Metadata element must have a valid value.

C (conditional). Metadata element is mandatory based on values of other metadata elements in the metadata record.

O (optional). Metadata element may be null in a valid document.

X (not used). Metadata element is not used by a Profile. The element may be included where it is schema valid, but may be ignored by applications implementing the profile.

2.6 Use cases to be supported

This section includes a number of user scenarios for how we intend USGIN metadata to be used, and discussion of several basic approach requirements that guide metadata content recommendations. At its heart, the problem is to find resources of interest via the internet, based on criteria of topic, place, or time, evaluate resources for an intended purpose, and learn how to access those resources. Detailed metadata describing a resource data schema, describing service or application operation, or providing detailed descriptions of analytical techniques and parameter are outside the scope intended for USGIN metadata. Our contention is that this more domain/resource specific type information is better accounted for with linked documents utilizing schema appropriate to those specific resource. Some examples include OGC getCapabilities, WSDL, and ISO 19110 feature catalogs. For more in depth discussion of use cases, scenarios, and requirements, see Metadata Recommendations for Geoscience Resources (Richard and Grunberg, 2010).

- A user specifies a geographic bounding box or one or more text keywords to constrain the resources of interest, and searches a metadata catalog using these criteria. The user is presented with a web page containing a list of resources that meet the criteria, with links for each resource that provide additional detailed metadata, and direct access to the resource if an online version is accessible, e.g. as a web page, Adobe Acrobat document, or online application (see Accessing Resources, below).
- A client application provides user with a map window that contains some simple base map information (political boundaries, major roads and rivers). User wishes to assemble a variety of other data layers for a particular area for some analysis or data exploration, e.g. slope steepness, geologic units, bedding orientation, and vegetation type for a hazard assessment. User

centers map view on area of interest, then using an ‘add data’ tab, accesses a catalog application that allows them to search for web services that provide the desired datasets. After obtaining the results and reviewing the metadata for the located services, user selects one or more to add to the table of contents for the client application. Response from catalog has sufficient information to enable the client application to load and use the resource (e.g. serviceType, OnlineResourceLinkage). More concrete instances of this case would be finding Web Map services to add as layers in an ESRI ArcMap project, borehole Web Feature Services to post borehole logs in a 3-D mapping application, or water chemistry data Web Feature Service to bring data into a spreadsheet or database.

- A catalog operator wishes to import and cache catalog records from a collaborating catalog that have been inserted or updated during the last month (harvest). This operation requires knowledge of the metadata standard and version used for the returned records.
- A user discovers an error in a metadata record for a resource that they have authored, and wishes to contact the metadata producer to request correction.
- A search returns several results that appear to contain the desired content, and user must select the most likely to meet their needs. Metadata should provide sufficient information to guide this decision.
- A project geologist at Company X is searching for data relevant to a new exploration target, and wishes to restrict the search to resources that are publicly available.

2.7 Resources of interest

Table 1 summarizes the geoscience information resources of interest to the community that can be registered and discovered using this metadata profile. Note that this collection of resource types includes several kinds of resources that are not typically associated with ISO19115/ISO19119, which were created specifically for geospatial resources.

*Table 1. Summary of resource types described by metadata for US Geoscience Information Network catalogs. Resource type **names in bold** have been prioritized for implementation in version one catalogs. The Resource type names include the type hierarchy encoded with the broader (parent) resource type indicated in the Broader Resource Type column.*

Resource Type hierarchy	Broader Resource Type	Source	Definition
Collection		DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	An aggregation of resources. A collection is described as a group; its parts may also be separately described. (from http://www.ukoln.ac.uk/metadata/-dcmi/collection-application-profile/): The term "collection" can be applied to any aggregation of physical or digital items. Those items may be of any type, so examples might include aggregations of natural objects, created objects, "born-digital" items, digital surrogates of physical items, and the catalogs of such collections (as aggregations of metadata records). The criteria for aggregation is arbitrary. Collections may contain any number of items and may have varying levels of permanence. A "collection-level description" provides a description of the collection as a unit: the resource described by a collection-level description is the collection, rather than the individual items within that collection. Collection-level descriptions are referred to in Heaney [2000] as "unitary finding-aids".
Dataset	Collection	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A collection of data items in which individual data items are identified and accessible. DCMI definition is "Data encoded in a defined structure." with additional comment "Examples include lists, tables, and databases. A dataset may be useful for direct machine processing." The container may be a stand-alone digital file (mdb, spreadsheet, table in a Word document), a web service, or an enterprise database; these are called different 'distributions'. Synonym: structured data collection. This resource type represents the intellectual artifact (FRBR 'work') -- the information content and organization; the dataset may have more than one manifestation (format) -- as a list, a table, databases, using different software implementations.

Catalog	Dataset	USGIN	A collection of data items that index resources, as in metadata records; a metadata registry. The resource represents the information content and organization. Catalogs are accessed using other resources, like an interactiveResource or Service, and may have different formats. This Resource type should be used to categorize web applications and services that are interfaces to metadata catalogs.
Physical artifact collection	Collection	USGIN	A collection of identifiable physical objects, unified based on some criteria. Criteria for defining a collection may be who collected, where curated, why collected, kind of material…
Document		USGIN	A packaged body of intellectual work; has an author, title, some status with respect to Review/authority/quality. USGS peer reviewed would be a 'status property'. A document may have a variety of physical manifestations (pdf file, hardbound book, tiff scan, Word processor document...), and versions may exist as the document is traced through some publication process. May be map, vector graphics, text. Sound, moving images are included as document types.
Image	Document	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A visual representation other than text. Examples include images and photographs of physical objects, paintings, prints, drawings, other images and graphics, animations and moving pictures, film, diagrams, maps, musical notation. Note that Image may include both electronic and physical representations.
StillImage	Image	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A static visual representation. Examples include paintings, drawings, graphic designs, plans and maps. Recommended best practice is to assign the type Text to images of textual materials if the intent of the image is to capture the textual content as opposed to the appearance of the medium containing the text. Instances of the type Still Image must also be describable as instances of the broader type Image. Subtype of Image.
Human-generated image	StillImage	USGIN	Image produced by human drawing or painting, using any media. May be entirely product of human imagination, human perception of the world, or a human-modified photographic image.

Photograph	StillImage	USGIN	Image produced by optical device with chemical or electronic image capture; represents things in the field of view directly as captured by the device. Photographs may be modified by human processing; there is a continuum between photographs and human-generated image. Distinction between the two is largely based on intention
Remote sensing Earth image	StillImage	USGIN	Image of Earth surface acquired by an air born or earth-orbiting sensor. May be georeferenced such that location in the image directly corresponds to location on the earth.
Map	Human-generated image	USGIN	Human-generated depiction of some part of the earth using a mathematical system of correspondence between geometry in the image and location on the earth.
MovingImage	Image	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A series of visual representations imparting an impression of motion when shown in succession. Examples include animations, movies, television programs, videos, zoetropes, or visual output from a simulation. Instances of the type Moving Image must also be describable as instances of the broader type Image. Subtype of Image. Commonly include sound
Sound	Document	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A resource primarily intended to be heard. Various media and encoding schemes may be used, e.g. vinyl disks, digital files, magnetic tape recordings.
Text	Document	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A resource consisting primarily of words for reading. Examples include books, letters, dissertations, poems, newspapers, articles, archives of mailing lists. Note that facsimiles or images of texts are still of the genre Text.
Hypertext document	Text	USGIN	A body of text that contains navigable links allowing non-linear reading paths through the work. Links to documents or other resources outside of the document are possible; and the document itself may be packaged in discrete parts (e.g. pages, files). The criteria for determining document membership are somewhat arbitrary, but in general the document (analogous to a single web site) should contain related parts authored and managed by the same agent.

Event		DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A non-persistent, time-based occurrence (perdurant). Metadata for an event provides descriptive information that is the basis for discovery of the purpose, location, duration, and responsible agents associated with an event. Examples include an exhibition, webcast, conference, workshop, open day, performance, battle, trial, wedding, tea party, and conflagration.
Project	Event	USGIN	A termporally extended event characterized by activity that has some stated purpose; projects typically have associated spatial extents, which represent the area of interest for the project. This extent serves as a mechanism to filter descriptions and concepts in the information system for those that may be related to the project based on spatial relationships. Projects in a large organization will likely have hierarchical (part-whole) relationships.
Model		USGIN	Algorithm, workflow; an abstract representation of a collection of related processes, objects and relationships. A model resource may be related to various kinds of document that portray the model, or to software that implements the model, or with datasets as input or output.
Physical artifact		DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	General category for physical resources that are indexed by metadata records; also root of an artifact type hierarchy. An identifiable physical object. Identification is always a function of some human intention, thus differentiating an artifact from other 'natural' things. Note that digital representations of these objects that are accessible on the WWW will be Images, Text or one of the other types.
Service		DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A resource that provides one or more functions via a network interface designed for machine interaction. An implementation of an interface to some sort of digital resource, using either a 'pull' model in which client requests some content from the service, and receives that content in a single 'response' package, or a ‘push’ model in which client establishes connection and monitors for change events (update, new data…) from service. Difficult to draw line on when a service provides 'files' and when it provides 'data', because responses are always in a form that could be considered a file. Also includes interfaces to digital resources that provide a continuous (with some sampling interval and unit of packaging for distribution) feed of some sort of data.

Software		USGIN	A computer program in source or compiled form. Examples include a C source file, MS-Windows .exe executable, or Perl script. Identity is associated with function, authorship, and programming environment.
Stand-Alone-Application	Software	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	Identifiable stand alone software application. Identity of resource is based on function performed, input and output requirements, and authorship. The same application may be packaged in different file formats to run in different software environments; thus an application might have one or more associated digital files. For this catalog scheme, stand alone applications are software that can be packaged in a single file and transferred between machines, unpackaged and compiled or installed on a computer meeting specified hardware and software environment conditions, to execute the described function on that computer, independent of any network connection.
Interactive-Resource	Software	DCMI resource Types http://dublincore.org/documents/dcmi-type-vocabulary/	A resource requiring interaction from the user to be understood, executed, or experienced. Comment: Examples include forms on Web pages, applets, multimedia learning objects, chat services, or virtual reality environments. Interactive resources are software driven. From the point of view of the catalog, they are accessed by a URL to a web site that is the interface for operating the application. The application operates by interaction with one or more human participants. The application requires network connection to operate, is accessible via the internet, and requires human interaction.
Structured digital data item		USGIN	An individually identifiable item in a structured digital data collection. Characterized by a schema, and some particular values. In ISO11179 terms, this is an instance of a data element. Tagging, commenting, reviewing, rating community interaction with catalog will probably require metadata records about particular data items in cataloged datasets (including metadata items in catalogs.)
Sampling point, site, station	Structured digital data item	From ScienceBase item types, SMR redux	A resource that is a location-based container/base for observation data. These represent OGC O&M sampling features, and can be generalized to include other sampling geometry (borehole, image footprint)... Analogous in function to a keyword, but carries metadata on who located, when, why, how...

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3 USGIN Usage of Metadata Elements

3.1 Core spatial dataset, dataset series, and service elements

Table 2 is a listing of ISO19115 metadata elements used to describe any resource. Tables 3 and 4 provide specifics for describing datasets and services. Note that in the USGIN context, dataset is construed quite broadly to include any kind of georeferenced information resource, including physical samples and hard copy documents. The service metadata elements are defined by ISO19119. The root element of ISO XML-encoded metadata is MD_Metadata. Elements are discussed in this table in the order that they appear in the metadata document. Not all elements are discussed in detail. In a number of places where USGIN makes no specific provisions, we defer to recommendations in the North American Profile for ISO metadata (INCITS 453, referred to as NAP). Note that throughout this and the subsequent tables, the names of XML elements are shown in `this typecase`. Long X-paths have been broken with non-breaking hyphen characters. Hyphens are not used in any XML attribute or element name, so if they appear in the text, they are strictly for text wrapping.

Table 2. Description best practices for ISO19139 metadata elements in USGIN profile. This table includes base elements.Elements are in the order that they appear in a metadata instance.

ISO 19115 (M/C/O) xPath from MD_Metadata	**NAP-USGIN M/C/O**	**Comments**
Metadata file identifier (O) `fileIdentifier`	M-M	Identifier for the metadata record, as opposed to `DatasetURI`, which identifies the described resource. A unique metadata record identifier must be included to allow CSW operations such as GetRecordById or harvest transactions. This identifier should be copied during harvest operations. Ideally there is one metadata record describing each resource, such that there should be a one-to-one mapping between metadata fileIdentifiers and DatasetURIs. However, not all described resources will have a DatasetURI, and the metadata record is a different resource from the resource it describes, and thus should not have the same identifier. The protocol used to generate the identifier does not matter, as long as it generates globally unique identifier strings. Services that rely on natural keys (e.g. serviceURL and layerID) are expected to put the key values in this field. Although there is technically no limit on the length of the identifier string, suggested best practice is to keep the string length less than 255 so the string will fit in legacy database string value fields. USGIN, ANZLIC, and the OGC CSW profiles for ISO metadata (OGC 07-045) recommend the use of the UUID (Universally Unique Identifier) for the `fileIdentifier`. The `fileIdentifier` is used to identify duplicate copies of metadata records, to reference one metadata record from another (via `MD_DataIdentification/aggregationInfo`), or to reference metadata from a described resource (e.g. `DS_Dataset/has/MD_Metadata`). If there is a difference between the

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
		two metadata records then one can determine the appropriate version by the content of other elements in the metadata record. The authoritative metadata record should be the only one made publicly available in metadata search systems such as a catalog service.
Metadata language (M) `language`	M-M	The language string is composed of a three lower-case letter language code (ISO639-2/T). Most CSW client and server applications only support the three letter language code. (Note: The recommended USGIN practice is different from the NAP, which recommends including an alpha3 country code (ISO3166-1), given in uppercase, with syntax "<ISO639-2/T three letter language code><;><blank space><ISO3166-1 three letter country code>", e.g. fra; CAN. Language searches for the three letter ISO639 code and a wildcard character will work with either convention.)
Metadata character set (C) `characterSet`	M-M	USGIN recommends use of ISO codelists: codeListValue=”utf8” codelist= ”http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/-Codelist/ML_gmxCodelists.xml#CI_CharacterSetCode. See 4.18.3 Codelists for discussion of codelist usage. USGIN requires that a character set code is specified, but this will normally be a default value for all records in a catalog.
Parent metadata record (O) `parentIdentifier`	O-X	Not used in USGIN profile. USGIN CSW service implementations do not require clients to be able to navigate parent links to obtain inherited metadata properties, or to process filters using parent links, so this element is not used. To represent relationships between described resources use `MD_Identification/aggregationInfo`.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource type (C) `hierarchyLevel`	M-M	Cardinality is 1...*. NAP and ISO codelists are equivalent. See 4.18.3 *Codelists* for discussion of encoding of codelist values. Due to interoperability problems, USGIN mandates use of ISO codelists. At least one MD_ScopeCode codelist value is required; default is 'dataset'. For USGIN catalog metadata, the codelist is {`collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, fieldSession, software, service, model, tile`}; other values from the ISO 19115 Scope Code list will be considered out of scope for USGIN catalog metadata and the metadata record may be ignored by harvesting catalogs. The European INSPIRE Implementing Rules (MD_IR_and_ISO_20090218) proscribes the code list for the first hierarchyLevel xml element in an MD_Metadata document to be one of {`dataset, service, series`}, or the metadata set will be considered out of scope for the directive (see section 4.6 Resource Type); in order to maintain compatibility with INSPIRE catalogs, it is recommended to use a scope code from this subset. ISO Example – dataset metadata: <gmd:hierarchyLevel> <gmd:MD_ScopeCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_ScopeCode" codeListValue="dataset">dataset</gmd:MD_ScopeCode> </gmd:hierarchyLevel>

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource hierarchy level name (C) `hierarchyLevelName`	O-M	USGIN makes this property mandatory to identify the USGIN resource type from **Error! Not a valid result for table.** (above). Default USGIN `hierarchyLevelName.CharacterString` is "Dataset". Encode hierarchy by including `hierarchyLevelName` elements for all broader resource categories. E.g. default should also include a `hierarchyLevelName`="Collection" element. For services USGIN `hierarchyLevelName.CharacterString` is "Service". As use cases develop that provide rationale for definition of sub-categories of service, the resource category list will be expanded. (ISO 19115 assumes that the metadata hierarchy level name defaults to "dataset" if it is not documented. NAP does not use it.) Example – dataset metadata: <gmd:hierarchyLevelName> <gco:CharacterString>Dataset</gco:CharacterString> </gmd:hierarchyLevelName> <gmd:hierarchyLevelName> <gco:CharacterString>Collection</gco:CharacterString> </gmd:hierarchyLevelName>

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Metadata point of contact (M) `contact/CI_ResponsibleParty`	M-M	Cardinality on contact is 1..*. USGIN requires at least one `CI_ResponsibleParty` with `role.CI_RoleCode@codeListValue` = "originator" (CI_RoleCode element value = "`originator`") that identifies the original source of the metadata record. If the point of contact for users to report errors, updates to metadata, etc. is different than the originator, an additional `contact/CI_ResponsibleParty` element may be included with `role.CI_RoleCode@codeListValue` = "pointOfContact" (CI_RoleCode element value="`pointOfContact`"). If the service providing the metadata records wishes to identify itself in result records, this information should be included in an additional `MD_Metadata/contact/CI_ResponsibleParty` element, with `role.CI_RoleCode@codeListValue` = "`distributor`". See 4.18.3 *Codelists* for discussion of encoding of codelist values. ISO Role codes applicable in this context include: {`distributor, originator, pointOfContact`}. The `CI_ResponsibleParty` element must include a contact e-mail address (`electronicMailAddress`) or telephone number `phone/CI_Telephone/voice`), and count of (individualName + organisationName + positionName) > 0. If the `contactInfo/CI_Contact/onlineResource/CI_OnlineResource` element for the `CI_ResponsibleParty` with `role.CI_RoleCode@codeListValue` = "`originator`" has `CI_OnlineResource/name` = "icon", the `CI_OnlineResource/linkage/URL` will be assumed to points to an icon image file (e.g. tif, png, jpg) for the metadata originator. This Icon will be displayed in search results to credit the metadata originator. Metadata harvesters must harvest and maintain all metadata originator information so that the origin of metadata records can be credited, and should harvest the point of contact information if it is different. Other responsible party roles applying to the metadata record (not the described resource) may be ignored by harvesting catalogs.
Metadata date stamp (M) `dateStamp`	M-M	USGIN profile requires use of `dateStamp/gco:DateTime` (Note this contrasts with INSPIRE mandate to use `dateStamp/gco:Date`). This is the date and time when the metadata record was created or updated (following NAP). The `dateStamp` is assumed to be updated to reflect any change in the metadata record that the metadata publisher wishes to propagate through the USGIN catalog system. This is the time stamp that will be used by harvesters to determine if a metadata needs to be updated in a harvesting catalog.
Metadata standard name (O) `metadataStandardName`	M-M	USGIN profile conformant metadata is indicated by using "ISO-USGIN." The string "ISO-NAP-USGIN" has been used in the past and will also be recognized, but its use should be discontinued. Use is mandatory to indicate that the metadata record conforms to this profile.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Metadata standard version (O) `metadataStandardVersion`	O-M	For this version of the USGIN profile, Must use the string "1.2". Use is mandatory to specify the version of the profile used
DataSet Identifier (O) `dataSetURI`	O-O	This is a string that uniquely identifies the described resource. If the resource has an identifier, it should be included here; if the resource will be referenced from other metadata, it must have an identifier here. Any kind of resource (not only datasets) may have an identifier. The protocol for the identifier is not specified, but some sort of documented scheme to assure uniqueness should be used (UUID, URN…). USGIN is attempting to make the semantics of identifiers clear, with the provision (see Unique resource identifier in Table 3, below) that the identifier in `MD_DataIdentification/citation/CI_Citation/identifier/MD_Identifier` identifies the cited resource. This may be identical with the resource described by the metadata, in which case its value is identical to `MD_Metadata/dataSetURI`, or it may be a publication that is the intellectual source of the described resource, in which case it is a different identifier. The `MD_Distribution/transferOptions/MD_DigitalTransferOptions/online/CI_OnlineResource` is used to specify URLs for access to the resource, even if the datasetURI is an HTTP URI that will dereference to obtain a representation of the described resource. The dataSetURI should be considered an opaque identifier. This will avoid ambiguity about where to find URLs for online access to a described resource. If the dataset is coupled to a service, the value of the `MD_Metadata/dataSetURI` attribute is the unique resource identifier used by srv:coupledResource to link the service with the dataset. The *OpenGIS® Catalogue Services Specification 2.0.2 - ISO Metadata Application Profile* (OGC 07-045) Annex F recommends that `MD_DataIdentification/citation/CI_Citation/identifier/MD_Identifier/code` match the identifiers specified by `SV_ServiceIdentification/operatesOn` and `SV_ServiceIdentification/coupledResource` for linking a described service to datasets that the service operates on. As discussed for `fileIdentifier` (above), this requires that a `MD_DataIdentification/citation/CI_Citation/identifier` that identifies the described resource is included in the metadata record; its value must be the same as `MD_Metadata/dataSetURI`.
Other languages (C) `locale`	C-X	Other languages used in metadata free text description. If description in more than one language is provided, this property should indicate what those languages are. The primary language used for metadata description is identified with `MD_Metadata/language` and `characterSet` and any additional languages are identified by `MD_Metadata/locale/PT_locale` ele-

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
		ments, in which the language is provided according to ISO 639-2/T three-letter terminology codes in lowercase, and an optional country is provided according to ISO 3166-1 three-letter codes in uppercase, and mandatory characterEncoding. See 4.18.3 *Codelists* for discussion of encoding of codelist values. USGIN Catalogs must harvest and process metadata content in the primary language specified by MD_Metadata/language and characterSet, and may ignore other language localized content.
[role] Resource spatial representation (O) `spatialRepresentationInfo`	O-O	Best practice is to include metadata for spatial representation if the described resource is a georeferenced dataset. Metadata for Spatial data representation are derived from ISO 19107. Metadata is instantiated as one or more of `MD_GridSpatialRepresentation`, `MD_VectorSpatialRepresentation`, `MD_Georectified`, or `MD_Georeferenceable` classes. USGIN profile follows NAP for spatial representation metadata. Vector Spatial Representation should be provided if point or vector objects exist in the dataset. If `MD_VectorSpatialRepresentation` is used, either `spatialRepresentationInfo/MD_VectorSpatialRepresentation/topologyLevel` or `spatialRepresentationInfo/MD_VectorSpatialRepresentation/geometricObjects` shall be provided, or both." (NAP) `MD_GridSpatialRepresentation` or one of its subtypes (`MD_Georectified`, or `MD_Georeferenceable`) should be provided if dataset objects are gridded. `MD_Georectified` should be used if the grid (image) is georeferenced, and `MD_Georeferenceable` is used if the grid (image) can be georeferenced. Follow NAP optionality if these elements are used.
Resource spatial representation vector topology (O) `spatialRepresentationInfo/MD_VectorSpatialRepresentation/topologyLevel`	C-C	Code that specifies the degree of complexity of spatial relationships between features in a dataset. Value is from ISO codelist `MD_TopologyLevelCode`. (Code names in this list include {`geometryOnly`, `topology1D`, `planarGraph`, `fullPlanarGraph`, `surfaceGraph`, `fullSurfaceGraph`, `topology3D`, `fullTopology3D`, `abstract`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values. It is unclear precisely what these values mean in terms of the topology encoding. To be useful, assertion that topology is present should indicate that topological relationships that may be implicit in the encoded vector geometry are explicitly represented (e.g. by correlation tables—left poly, right poly for a polyline) in the data. This clarification should be included in the resource abstract. Mandatory if `MD_VectorSpatialRepresentation` is present.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource spatial representation vector geometric objects (O) `spatialRepresentationInfo/-MD_VectorSpatialRepresentation/geometricObjects`	C-C	"Identification of the objects used to represent features in the dataset." Provides a geometry type and count for the number of objects of each type. Use the ISO `MD_GeometricObjectTypeCode` codelist. Code names in this list are: {`complex, composite, curve, point, solid, surface`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values. Mandatory if `MD_VectorSpatialRepresentation` is present.
[role] Resource's spatial reference system (O) `referenceSystemInfo`	O-O?	Description of the spatial and/or temporal reference systems used in the dataset. Follow NAP rule: { (`identificationInfo/spatialRepresentationType/MD_SpatialRepresentationTypeCode`= "`vector`") or (`../MD_SpatialRepresentationTypeCode` = "`grid`") or (`../MD_SpatialRepresentationTypeCode` = "`tin`") implies count `referenceSystemInfo` >= 1) }. See 4.18.3 Codelists for discussion of encoding of codelist values. Use ISO codelist.
Reference System identifier code (O) `referenceSystemInfo/-MD_ReferenceSystem/-referenceSystemIdentifier/-RS_Identifier/code`	C-C	If `referenceSystemInfo` is included, then the `RS_Identifier` element must include at least a code value. For USGIN the code should be a value from the EPSG Geodetic Parameter Dataset register (http://www.epsg-registry.org/) in the form "EPSG:nnnn" where nnnn is the EPSG code number for the CRS. If the CRS is not defined in the EPSG registry, then the procedure specified in the NAP profile should be followed, e.g. the CRS shall be described according to ISO 19111 and ISO/TS 19127, assigned an identifier, and registered with an authority such that it may be referenced here. The `RS_Identifier/codespace` in this case should identify the registry authority where the CRS definition is registered, such that the definition can be located. Best Practice for USGIN purposes is to provide georeferenced data using one of the EPSG defined coordinate reference systems if this is possible.
Metadata extension information (O) `metadataExtensionInfo`	X-X	Not used in this profile.
Resource identification information (M) `identificationInfo`	M-M	Cardinality 1..*. The content of this element identifies the described resource. For resources that are not services, use `MD_DataIdentification` (**see Table 3**), otherwise `SV_ServiceIdentification` is required (**see Table 4)**.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
[role] Content information (O) `contentInfo`	O-O	Characteristics describing the feature catalog, coverage, or image data. `MD_ContentInformation` is an abstract class. One or more of `MD_FeatureCatalogueDescription` or `MD_CoverageDescription` or `MD_ImageDescription` elements may be used to specify this content. `MD_FeatureCatalogueDescription` describes content in a feature service or dataset like an ESRI geodatabase that may have more than one feature, e.g. geologic unit outcrop polygons, fault line features, and point observation locations for strike and dip data. Entity-attribute metadata for dataset should be documented using ISO19110; XML schema are located at http://www.isotc211.org/2005/gfc/gfc.xsd. The ISO19139 XML implementation of ISO19115 does not allow inclusion of the feature catalog inside the metadata record, but provides a citation element in the `gmd:contentInfo/gmd:MD_FeatureCatalogueDescription` element. The USGIN profile provision is to link to the feature catalog using an xlink:href attribute on the `gmd:featureCatalogueCitation`, identified as such by an accompanying xlink:title attribute with the value "Link to ISO19110 feature catalog". Code Example 2 shows recommended encoding. An example feature catalog description using ISO19110 XML is included in section 8.3, ISO19110 Feature Catalog example. `MD_CoverageDescription` is for datasets that are one of the types listed in MD_CoverageContentTypeCode: image, thematicClassification, physicalMeasurement. A coverage is a data structure that acts as a function to return values from its range for any direct position within its spatiotemporal domain (OGC 07-067r5). Image coverages return values for light intensity in a given wavelength range, thematicClassification coverages return codes corresponding to some domain concept, and physicalMeasurement coverages return values representing some physical quantity like magnetic susceptibility, density, resistivity.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
[role] Resource distribution information (O) `distributionInfo`	O-M	This element provides information to inform users how to obtain or access the described resource, which is considered part of the minimum useful content that should be provided by a metadata record. USGIN profile specifies that at least one `MD_Distribution/distributor` and one `MD_Distribution/transferOptions` element are required, and the specified distributor provides the specified transfer options. See section 4.13 '*Content information: Entities and Attributes* *One* of the major deficiencies of the ISO 19115/19139 specifications is the absence of model elements to describe the entities and attributes in standard tabular datasets. Description of dataset schema using the ISO Technical Committee 211 (TC211) framework requires use of ISO19110. A standard XML schema for implementing this specification has recently become available, and entity-attribute metadata for dataset should be documented using the schemas located at `http://www.isotc211.org/2005/gfc/gfc.xsd`. The ISO19139 XML implementation of ISO19115 does not allow inclusion of the feature catalog inside the metadata record, but provides a citation element in the `gmd:contentInfo/gmd:MD_FeatureCatalogueDescription` element. The USGIN profile provision is to link to the feature catalog using an xlink:href attribute on the `gmd:featureCatalogueCitation`, identified as such by an accompanying xlink:title attribute with the value "Link to ISO19110 feature catalog". Code Example 2 shows recommended encoding. Section 8.3, ISO19110 Feature Catalog example, provides an example encoding of entity-attribute information for a feature dataset. <gmd:contentInfo> <gmd:MD_FeatureCatalogueDescription> <gmd:includedWithDataset> <!-- true if a FeatureCatalog document is packaged with the dataset --> <gco:Boolean>false</gco:Boolean> </gmd:includedWithDataset> <!-- a dataset may contain multiple feature types. For an MS Access type database, each table could be considered a featue type --> <gmd:featureTypes> <!-- the codespace is the namespace URI, should dereference to obtain XML schema (if applicable)--> <gco:LocalName codeSpace=" http://xmlns.geosciml.org/geosciml-portrayal/2.0">GeologicContact_2</gco:LocalName> </gmd:featureTypes> <!-- follow pattern used by Stanford library http://opengeoportal.org/archives/category/-uncategorized); href is to an ISO19110 feature catalog, with featuretype identified by fragment ID --> <gmd:featureCatalogueCitation xlink:href=" http://schemas.usgin.org/featurecatalog/12.xml#geologiccontact" xlink:title="Link to ISO19110 feature catalog"/>

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource distribution format (O) `distributionInfo/-MD_Distribution/-distributionFormat`	O-O	Information on the format or physical manifestation of the resource. • If the resource is a physical (not electronic) resource, like a book, rock sample, paper document, the `distributionFormat/MD_Format/name` is mandatory, and must be from the Table 6. USGIN Distribution formats for non digital resources. URI for this codelist is http://resources.usgin.org/registry/distributionFormatNames201001. • For digital resources, the format specifies the file type, either using a MIME type, or formatted string. Pattern for digital resources that do not have a registered MIME type: `[vendor:applicationName]/fileExtension`. The vendor and application names may not be applicable, and could be omitted, but the '/' and file extension should always be present. • If the format consists of a single file, the file extension is a three letter file-type abbreviation assigned by the vendor.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments

Resource distributor information (O)
`distributionInfo/-MD_Distribution/-distributor/-MD_Distributor/`
	O-C	*USGIN differs from NAP* in this case (but not with ISO19115) by allowing multiple distributors, and binding between distributors, transfer options, and formats. For USGIN profile, each `distributor/MD_Distributor` is a binding between one or more transfer options and the distributor formats that are available through that/those transfer options (`MD_DigitalTransferOptions/onLine/CI_OnlineResource` in particular). If different formats are available from the same distributor, or have different transfer options, these should be represented as different `distributor/MD_Distributor` instances. See section 4.13 '*Content information: Entities and Attributes*
		One of the major deficiencies of the ISO 19115/19139 specifications is the absence of model elements to describe the entities and attributes in standard tabular datasets. Description of dataset schema using the ISO Technical Committee 211 (TC211) framework requires use of ISO19110. A standard XML schema for implementing this specification has recently become available, and entity-attribute metadata for dataset should be documented using the schemas located at `http://www.isotc211.org/2005/gfc/gfc.xsd`. The ISO19139 XML implementation of ISO19115 does not allow inclusion of the feature catalog inside the metadata record, but provides a citation element in the `gmd:contentInfo/gmd:MD_FeatureCatalogueDescription` element. The USGIN profile provision is to link to the feature catalog using an xlink:href attribute on the `gmd:featureCatalogueCitation`, identified as such by an accompanying xlink:title attribute with the value "Link to ISO19110 feature catalog". Code Example 2 shows recommended encoding. Section 8.3, ISO19110 Feature Catalog example, provides an example encoding of entity-attribute information for a feature dataset.
		`<gmd:contentInfo>`
		`<gmd:MD_FeatureCatalogueDescription>`
		`<gmd:includedWithDataset>`
		`<!-- true if a FeatureCatalog document is packaged with the dataset -->`
		`<gco:Boolean>false</gco:Boolean>`
		`</gmd:includedWithDataset>`
		`<!-- a dataset may contain multiple feature types. For an MS Access type database, each table could be considered a featue type -->`
		`<gmd:featureTypes>`
		`<!-- the codespace is the namespace URI, should dereference to obtain XML schema (if applicable)-->`
		`<gco:LocalName codeSpace=" http://xmlns.geosciml.org/geosciml-portrayal/2.0">GeologicContact_2</gco:LocalName>`
		`</gmd:featureTypes>`
		`<!-- follow pattern used by Stanford library http://opengeoportal.org/archives/category/-uncategorized); href is to an ISO19110 feature catalog,`
		`with featuretype identified by fragment ID -->`
		`<gmd:featureCatalogueCitation xlink:href="`

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource distributor responsible party (O) `distributionInfo/-MD_Distribution/-distributor/MD_Distributor/-distributorContact/-CI_ResponsibleParty`	C-M	`MD_Distributor` is required, which requires one `CI_ResponsibleParty`. A responsible party with role.CI_RoleCode@codeListValue = "`pointOfContact` " (CI_RoleCode element value = "`pointOfContact` ") is mandatory, to provide a contact point to report problems with accessing the resource through distributions associated with the distributor. The CI_ResponsibleParty element must include a contact e-mail address (electronicMailAddress) or telephone number (electronicMailAddress), and one of individualName, organisationName, or positionName must be present. Other distributorContacts with different roles may be ignored by USGIN catalogs. ISO Role codes applicable in this context include: {`resourceProvider, distributor, pointOfContact`}. See section 4.18.3 '*Codelists'* for details on codelist encoding.
Resource distributor order process (O) `distributionInfo/-MD_Distribution/distributor/-MD_Distributor/-distributionOrderProcess/-MD_StandardOrderProcess`	O-C	Information on the availability of the resource including at least one of fees, available date and time, ordering instructions, or turnaround. For physical resources, ordering instructions are mandatory as these will typically indicate the method of accessing the resource.
Resource distributor format (O) `distributionInfo/-MD_Distribution/distributor/-MD_Distributor/-distributorFormat/MD_Format`	O-O	See section 4.15 ‘Distribution Format ’ for instructions on use of these elements.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments

Resource distribution transfer options (O)
`distributionInfo/-MD_Distribution/-transferOptions/-MD_DigitalTransferOptions`
	C-C	`MD_DigitalTransferOptions` provides information on digital distribution of resource. See section 4.13 '*Content information: Entities and Attributes*
		One of the major deficiencies of the ISO 19115/19139 specifications is the absence of model elements to describe the entities and attributes in standard tabular datasets. Description of dataset schema using the ISO Technical Committee 211 (TC211) framework requires use of ISO19110. A standard XML schema for implementing this specification has recently become available, and entity-attribute metadata for dataset should be documented using the schemas located at `http://www.isotc211.org/2005/gfc/gfc.xsd`. The ISO19139 XML implementation of ISO19115 does not allow inclusion of the feature catalog inside the metadata record, but provides a citation element in the `gmd:contentInfo/gmd:MD_FeatureCatalogueDescription` element. The USGIN profile provision is to link to the feature catalog using an xlink:href attribute on the `gmd:featureCatalogueCitation`, identified as such by an accompanying xlink:title attribute with the value "Link to ISO19110 feature catalog". Code Example 2 shows recommended encoding. Section 8.3, ISO19110 Feature Catalog example, provides an example encoding of entity-attribute information for a feature dataset.
		`<gmd:contentInfo>`
		`<gmd:MD_FeatureCatalogueDescription>`
		`<gmd:includedWithDataset>`
		`<!-- true if a FeatureCatalog document is packaged with the dataset -->`
		`<gco:Boolean>false</gco:Boolean>`
		`</gmd:includedWithDataset>`
		`<!-- a dataset may contain multiple feature types. For an MS Access type database, each table could be considered a featue type -->`
		`<gmd:featureTypes>`
		`<!-- the codespace is the namespace URI, should dereference to obtain XML schema (if applicable)-->`
		`<gco:LocalName codeSpace=" http://xmlns.geosciml.org/geosciml-portrayal/2.0">GeologicContact_2</gco:LocalName>`
		`</gmd:featureTypes>`
		`<!-- follow pattern used by Stanford library http://opengeoportal.org/archives/category/-uncategorized); href is to an ISO19110 feature catalog, with featuretype identified by fragment ID -->`
		`<gmd:featureCatalogueCitation xlink:href="http://schemas.usgin.org/featurecatalog/12.xml#geologiccontact" xlink:title="Link to ISO19110 feature catalog"/>`
		`</gmd:MD_FeatureCatalogueDescription>`
		`</gmd:contentInfo>`
		Code Example 2. Encoding of feature catalog link for entity attribute description of da-

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource distributor online distribution linkage (O) `distributionInfo/-MD_Distribution/-transferOptions/-MD_DigitalTransferOptions/-online/-CI_OnlineResource/linkage`	M-M	Digital transfer options are "Technical means and media by which a dataset is obtained from the distributor." The `CI_OnlineResource/linkage/URL` element must contain the complete URL to access the resource directly (see sections 4.13 to 4.16 for more explanation).
Resource distributor online distribution linkage (O) `distributionInfo/-MD_Distribution/-transferOptions/-MD_DigitalTransferOptions/-online/-CI_OnlineResource/protocol`	M-O	The `CI_OnlineResource/protocol` element is mandatory if access to the resource requires additional protocol information that is stacked on the protocol specified by the `CI_OnlineResource/linkage/URL` prefix (e.g. http:, ftp:). Typically this will be service type like WMS-1.3.0, OpenSearch-1.1, or DAP-2.0. Ideally these strings should be URIs that can be dereferenced to learn something about the service specification.
Resource distributor online distribution linkage (O) `distributionInfo/-MD_Distribution/-transferOptions/-MD_DigitalTransfer-Options/online/-CI_OnlineResource/name`	O-O	The `CI_OnlineResource/name` element may duplicate the file name if the URL is a link to a file, but it is recommended to provide a user-friendly label for the file that could be presented in a user interface. For links to resource distribution end points (`distributionIn-fo//CI_OnlineResource`) that are not simple file access URLs, like services, online order forms, mailto links to e-mail a request for the resource, the name property has special val-ues defined in Table 12.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Resource distributor online distribution application profile (O) `distributionInfo/-MD_Distribution/-transferOptions/-MD_DigitalTransferOptions/-online/CI_OnlineResource/-applicationProfile`	C-O	`applicationProfile` is mandatory if the `CI_OnlineResource/linkage` does not connect to an HTML web page (or other standard format that will be recognized by web browsers), if another software application is needed to use a linked file resource, or the target resource is a service instance conforming to a profile. The `applicationProfile` character string should specify the software using the following recommended syntax: "vendor:application name/application version", e.g. "Microsoft:Word/2007", or "ESRI:ArcGIS/9.3". For links to documents for which the service type and base protocol prefix on the link URL do not provide sufficient information to guide client software, the applicationProfile property is used to indicate a profile on the serviceType or some variation in document encoding or content conventions. See section 4.16 CI_OnlineResource for more explanation.
Resource distributor online distribution function (O) `distributionInfo/-MD_Distribution/-transferOptions/-MD_DigitalTransferOptions/-online/CI_OnlineResource/-function`	O-O	`CI_OnlineResource/function` is mandatory if the linkage is not a simple HTTP link to a downloadable file. USGIN recommended values for CI_OnlineFunctionCode in this role are summarized in Table 8. If the resource is accessible as a web service, the metadata for the service should be separate metadata record with the dataset(s) exposed through the service identified in the service metadata record as coupledResources.
[role] Data quality information (O) `dataQualityInfo`	C-O	Either `dataQualityInfo/DQ_DataQuality/report` or `dataQualityInfo/DQ_DataQuality/lineage` is mandatory if a dataQualityInfo element is present. `dataQualityInfo/DQ_DataQuality/scope` is required, with value from MD_ScopeCode: {`collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, fieldSession, software, service, model, tile`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values. See section 4.19 Data Quality for discussion of data quality with resource parts.
Data quality scope (O) `dataQualityInfo/DQ_DataQuality/scope`	C-C	Mandatory if `DQ_DataQuality` is not null. Specifies the extent of characteristics for which data quality information is reported. Value is from MD_ScopeCode: {`collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, fieldSession, software, service, model, tile`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Data quality scope level description (O) `dataQualityInfo/-DQ_DataQuality/-scope/levelDescription`	C-X	Not used by USGIN. See section 4.20 *Data Quality* for more discussion of levelDescription.
Data quality report (O) `dataQualityInfo/-DQ_DataQuality/report`	C-C	In this profile, data quality information is optional, but if included, the mandatory content for data quality information is a free text explanation of data quality considerations. The `DQ_DataQuality[1]//report[1]//explanation/CharacterString` element should contain a free text discussion/description of data quality considerations for the indicated scope. The use of any specific data quality element to contain this explanation is arbitrary and should not be considered meaningful in this context. Other data quality information should be preserved by USGIN catalogs harvesting metadata that includes these elements, and presented when the user views the full metadata record. Each `DQ_DataQuality/report` element requires that at least one of the 15 possible data quality elements must be present, and multiple report elements are allowed within each `DQ_DataQuality` element. Each of these *`AbstractDQ_element`* subtypes has optional `nameOfMeasure`, `measureIdentification`, `measureDescription`, `evaluationMethodType`, `evaluationMethodDescription`, `evaluationProcedure`, and `dateTime` elements, and one or two required result elements. The *`AbstractDQ_element`* `/result` is either a `DQ_ConformanceResult` or a `DQ_QuantitativeResult`, each of which has required and optional sub-elements. Inclusion of this report metadata should follow recommendations in NAP.
Data quality lineage (O) `dataQualityInfo/-DQ_DataQuality/lineage`	C-O	Not applicable to services. USGIN recommended practice is described in section 4.20.
Data quality lineage statement (O) `dataQualityInfo/-DQ_DataQuality/lineage/-LI_Lineage/statement`	C-C	If lineage information is included, a `lineage/LI_Lineage/statement` is mandatory, which specifies a "General explanation of the data producer's knowledge of the dataset lineage" (NAP). USGIN recommended practice is described in section 4.20.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
Data quality lineage source (O) `dataQualityInfo/-DQ_DataQuality/lineage/-LI_Lineage/source`	C-O	Each `source/LI_Source` element describes a source data resource that is input into a processStep. NAP provision is that `LI_Source/description` is mandatory if `LI_Source/sourceCitation` and `LI_Source/sourceExtent` are not provided. If used, the `LI_Source/description` includes the source medium name from the CodeList MD_MediumNameCode, followed by <;><blank space> and a free text description, e.g. "dvd; source satellite image." If the source is part of a processing chain, the `LI_Source/processStep/LI_ProcessStep` provides "Information about an event related to the creation process for the source data." (INCITS 453). This is interpreted to mean that the link from a source to a process step is to a process step for which the described source is an output. USGIN recommended practice is described in section 4.20.
Data quality lineage process step (O) `dataQualityInfo/-DQ_DataQuality/lineage/-LI_Lineage/processStep`	C-O	An event in the development of the dataset. Each step requires a free text description, and may have a free text `rationale`, `dateTime` stamp when process was complete, 0 to many `CI_ResponsibleParty` elements identifying parties involved in the process, and finally 0 to many `source/LI_Source` associations to identify data that is input into the process step. Best practice recommended for USGIN is that source association from a process step is to inputs to a process, and `processStep` associations from a source element link an output resource to a process step that produced it. See USGIN recommended practice is described in section 4.20.
[role] Portrayal catalog information (O) `portrayalCatalogueInfo`	O-O	`portrayalCatalogueInfo/MD_PortrayalCatalogReference/portrayalCatalogueCitation/CI_Citation` element identifying a catalogue that contains symbols and rules to depict a resource. A portrayal catalog is a collection of defined symbols used to depict, to humans, features on a map. No documentation in ISO19115 about how this is supposed to work. ISO 19117 defines the structure of a Portrayal Catalogue. No USGIN recommended practices have been adopted.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
[role] Metadata constraint information (O) `metadataConstraints`	O-O	This element specifies use constraints for access to the metadata record. Use constraints for accessing the describe resource are in `resourceConstraint/MD_Constraint` in `MD_DatasetIdentification` or `MD_ServiceIdentification`. Follow NAP for specification of access constraints. NAP provision is that `metadataConstraints/MD_Constraints/useLimitation` is mandatory when `MD_Constraints` is used to specify `metadataConstraints`. When one of the subtypes `MD_LegalConstraints` or `MD_SecurityConstraints` is used, `useLimitation` is optional. `MD_LegalConstraints` are specified by MD_RestrictionCode. ISO codelist values are {`copyright, patent, patentPending, trademark, license, intellectualProperty Rights, restricted, otherRestrictions`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values. `otherConstraints` is a free text element required if `accessConstraints` or `useConstraints` is set to "otherRestrictions." For an example: "Data only to be used for the purposes for which they were collected." `MD_SecurtyConstraints` has various optional free text values, and a required `MD_SecurityConstraints/classification` from ISO MD_ClassificationCode: {`unclassified, restricted, confidential, secret, topSecret`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values.
[role] Application schema information (O) `applicationSchemaInfo`	O-O	Information about the information schema of the resource `applicationSchemaInfo/MD_ApplicationSchemaInformation` element has mandatory `name/CI_Citation`, `schemaLanguage` free text, and `constraintLanguage` free text. The `MD_ApplicationSchemaInformation` element also allows inclusion of an actual schema document as ASCII, or a binary `graphicsFile` or `softwareDevelopmentFile`. Multiple applicationSchemaInfo elements may be used for different presentations of a single schema, or for different kinds of schema (e.g. physical, logical, conceptual).

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments
[role] Metadata maintenance information (O) `metadataMaintenance`	O-O	This element provides information about the maintenance schedule or history of the metadata record. Only one `MD_MaintenanceInformation` element may be included, with a required MD_MaintenanceFrequencyCode. The ISO codelist is {`continual, daily, weekly, fortnightly, monthly, quarterly, biannually, annually, asNeeded, irregular, notPlanned, unknown`}. See 4.18.3 *Codelists* for discussion of encoding of codelist values. Additional metadataMaintenance/MD_MaintenanceInformation/maintenanceNotes may be added to metadata records to document updates to the the content of the record. USGIN catalogs should use metadata maintenance notes to document any modifications made to harvested metadata records; ideally a link to the original metadata record should be provided.
[role] Series information (O) `series`	X-X	The `MD_Metadata/series` element that appears in the ISO19139 schema appears to implement the metadata application model in ISO19115:2003 Figure 3, which is a UML class diagram defining the classes of geographic information to which metadata applies. Not Used by USGIN.
[role] Described resource (O) `describes`	X-X	The `MD_Metadata/describes` element that appears in the ISO19139 schema appears to implement the metadata application model in ISO19115:2003 Figure 3, which is a UML class diagram defining the classes of geographic information to which metadata applies. Not used by USGIN.
[role] Property type description (O) `propertyType`	X-X	The `MD_Metadata/propertyType` element that appears in the ISO19139 schema appears to implement the metadata application model in ISO19115:2003 Figure 3, which is a UML class diagram defining the classes of geographic information to which metadata applies. Not used by USGIN.
[role] Feature type description (O) `featureType`	X-X	Although an `MD_Metadata/featureType` element that appears in the ISO19139 schema appears to implement the metadata application model in ISO19115:2003 Figure 3, which is a UML class diagram defining the classes of geographic information to which metadata applies. Not used by USGIN.
[role] Feature attributes (O) `featureAttribute`	X-X	Although an `MD_Metadata/featureAttribute` element that appears in the ISO19139 schema appears to implement the metadata application model in ISO19115:2003 Figure 3, which is a UML class diagram defining the classes of geographic information to which metadata applies. Not used by USGIN.

3.2 Dataset Identification properties (MD_DataIdentification)

The difference between metadata for services, and metadata for other resources is in the `identificationInfo` part of the ISO19139 xml schema. This section documents use of `MD_DataIdentification` for metadata describing resources of interest in the geoscience information network that are not services. Service metadata utilizes the `SV_ServiceIdentification` element to provide a description and identification of a service (see 3.3 Service identification elements (SV_ServiceIdentification).

Note that the USGIN approach to metadata is predicated on the idea that the users first interest is finding information about some particular topic; how that information is accessed or acquired is a secondary consideration. Thus metadata records are about information resources (mostly datasets and other data products or publications) at the FRBR work level [FRBR, 2004]. Information on accessing data resources through service interfaces is considered a kind of distribution of the resource. The MD_DataIdentification part of a metadata record describes the information resource, and multiple `distributionInformation` elements specify access to that data through one or more services, or as various kinds of packaged, downloadable files. Given that a metadata record is about exactly one 'work', each metadata record has exactly one `MD_DataIdentification` element. Metadata records about services are targeted for the rather unusual situation in which a user is primarily interested in a specific kind of service and the details of its operation, typically this will be for web processing or brokering services. In practice, service protocols typically specify some kind of service specific self-description document (e.g. WSDL, WADL, OGC GetCapabilities, OpenSearch Description) that client software is more likely to understand than an ISO SV_ServiceIdentification element.

Table 3. Dataset Identification properties (MD_DataIdentification)

ISO 19115 (M/C/O) xPath from MD_Metadata	**NAP-USGIN M/C/O**	**Comments on MD_DataIdentification**
Resource citation (M) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation`	M-M	CI_Citation cardinality exactly one required. The citation attribute provides information that identifies the intellectual origin of the content in the described resource, along the lines of a citation in a scientific journal. Required content for a `CI_Citation` element are `title`, `date`, and `responsibleParty`. NOTE: if multiple identificationInfo sections are provided, USGIN catalogs may ignore all but the first instance.
Resource title (M) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/title`	M-M	A meaningful title that is unique within the scope of the catalog should be provided for each resource that is described by a metadata record. USGIN recommends using titles that inform the human reader about the dataset's content as well as its context.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource reference date (M) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/date/-CI_Date/date/`	M-M	Best practice is to include at least the date of publication or creation of the resource. The date of the resource reported in the citation corresponds to the most recent update of the resource's content. `CI_Date` content includes a `date` and `dateType`. Date for USGIN profile uses xs:dateTime data type, The dateTime data type is specified in the following form "YYYY-MM-DDThh:mm:ss". `timezoneOffset` is optional (http://www.w3.org/TR/xmlschema11-2). Example date encoding: 2000-12-12T12:00:00+13:00, 2006-10-01T03:27:00Z. If the month or day is not known, encode as '01', for example '2006-01-01'. `DateType` specifies the event used for the temporal aspect of the resource, and must be a value from the list {creation, publication, revision}, which is a subset of the ISO DateTypeCode codelist. This date is distinct from the `dateStamp` for the metadata record (date and time of most recent metadata update), or the `EX_Extent/temporalElement` that specifies the time period to which the resource content is applicable.
Unique resource identifier (O) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/-identifier/MD_Identifier`	C-C	For USGIN, if the Citation has an identifier that is different from the identifier for the described resource (`MD_Metadata/dataSetURI`), it must be included here. This element content value should be an identifier for the cited resource, without any assumption that it will use http protocol. The identifier may be resolvable to a URL, if a protocol prefix specifies an identifier scheme that is resolvable (e.g. http, doi…), but this is not necessary for a valid document, and should not be assumed when processing metadata documents. The USGIN profile requires the use of MD_Identifier element to identify resources; RS_Identifier must not be used. If additional codespace and version content is associated with the identifier, it should be encoded as `MD_Identifier/authority/CI_Citation/-alternateTitle` and `MD_Identifier/authority/CI_Citation/edition`

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource responsible party (O) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/-citedResponsibleParty`	M-M	USGIN requires that the citation include at least one `CI_ResponsibleParty` for which the count of (individualName + organisationName + positionName) must be > 0. The citation responsible party should identify the agent responsible for the intellectual content of the described resource. In this context, the `CI_ResponsibleParty/role/CI_RoleCode@codeListValue` is from {originator, principalInvestigator, processor, author}, a subset of the ISO CI_RoleCode codelist. See 4.18.3 *Codelists* for discussion of encoding of codelist values. For most intellectual content, the responsible party is what would normally be considered the author of a work. Best practice is to include point of contact information for the resource in `MD_DataIdentification/pointOfContact/CI_ResponsibleParty`. Guidance on use of role codes would be helpful for consistency, but has not been developed as yet. {author, coauthor, editor, contributor} View compiler and editor as equivalent roles, since codelist do not include compiler. Use the ISO19115-1 codelist.
Resource presentation form (O) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/-presentationForm`	O-O	The form in which the original cited resource is available. Note that the citation is to the original source of intellectual content in the described resource, and its presentation may be different from the format for distribution described in the metadata. This element should be specified if there is a difference between the cited resource presentation format and the distribution format(s) listed in the `distributionInfo/MD_Distribution` section of the metadata record. This information is mostly for documentation; for discovery and data access, the distribution formats are more relevant. `presentationForm` uses CodeList = CI_PresentationFormCode, with ISO code names {`documentDigital, documentHardcopy, imageDigital, imageHardcopy, mapDigital, mapHardcopy, modelDigital, modelHardcopy, profileDigital, profileHardcopy, tableDigital, tableHardcopy, videoDigital, videoHardcopy, audioDigital`}. See section 4.18.3 *Codelists* for details on codelist encoding.
Resource series (O) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/series`	O-O	Information about the (publication) series or collection of which the resource is a part. NAP rule (name + issueIdentification) > 0 should be followed.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource other citation details (O) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/-otherCitationDetails`	O-O	A complete recommended bibliographic citation should be specified in this element.
Resource collective title (O) `identificationInfo/-MD_DataIdentification/-citation/CI_Citation/-collectiveTitle`	O-C	Title of the combined resource that the cited resource is part of, for example the cited resource may be a paper in an anthology, in which case the anthology title would be the collective title. Required if the cited resource is part of such a collective work.
Resource abstract (M) `identificationInfo/-MD_DataIdentification/abstract`	M-M	A free text summary of the content, significance, purpose, scope, etc. of the resource. Exactly one value. Content from metadata harvested in other formats (EML, FGDC CSDGM…) that does not map into ISO metadata elements can be included as free text in the abstract.
Resource purpose (O) `identificationInfo/-MD_DataIdentification/purpose`	O-O	"Summary of the intentions for which the dataset was developed. Purpose includes objectives for creating the dataset and what the dataset is to support." Free text.
Resource status (O) `identificationInfo/-MD_DataIdentification/status`	O-O	Value is from MD_ProgressCode codelist. ISO values are {`completed, historicalArchive, deprecated, onGoing, planned, required, underdevelopment`}. For USGIN discovery metadata, values should be restricted to {`completed, onGoing, deprecated`}. See section 4.18.3 *Codelists* for details on codelist usage.
Resource point of contact (O) `identificationInfo/-MD_DataIdentification/-pointOfContact`	O-C	Contact information for the agent who is currently the steward for the resource. This information is mandatory for physical resources such as core, cuttings, samples, manuscripts. Count of (individualName + organisationName + positionName) must be > 0. The `CI_ResponsibleParty/role/CI_RoleCode` is from CI_RoleCode codelist. ISO role codes for physical resource point of contact are {`custodian, owner, pointOfContact`}; other point of contact role codes may apply for other resources. See section 4.18.3 *Codelists* for details on codelist usage.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource maintenance (O) `identificationInfo/-MD_DataIdentification/-resourceMaintenance`	O-O	This element provides information about the maintenance schedule or history of the resource (or some subset/part of the resource specified by the scope and scope description) described by the metadata record. 0 to many `MD_MaintenanceInformation` elements may be included. Different `MD_MaintenanceInformation` elements are required to have different napMD_ScopeCode or `MD_ScopeDescription`. Usage of `MD_ScopeDescription` is poorly described, and no actual examples of usage could be found; it would appear to allow identification of a set of attribute or features (by name?), or feature instances or attribute instances (identified how?), or a dataset, to which the maintenance information applies. Use MD_MaintenanceFrequencyCode codelist. ISO values are {`continual, daily, weekly, fortnightly, monthly, quarterly, biannually, annually, asNeeded, irregular, notPlanned, unknown`}. See section 4.18.3 *Codelists* for details on codelist usage.
Graphic overview of resource (O) `identificationInfo/-MD_DataIdentification/-graphicOverview`	O-O	Highly recommended to include a URL providing a web-accessible visual representation of the resource if it is applicable to the described resource, particularly for geographic datasets that may be represented by maps. If `MD_BrowseGraphic` is included, `MD_BrowseGraphic/filename` character string is mandatory. USGIN Recommended practice is to provide a complete URL as a gco:characterString value for the `filename` property. `fileType/CharacterString` should be a registered MIME type or standard file extension abbreviation (e.g. napMD_FileFormatCode). This is a repeatable element; multiple values may present different resolutions, or different parts of resource. Names associated with overview should provide sufficient information for user to distinguish these.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification

Resource format (O)
`identificationInfo/-MD_DataIdentification/-resourceFormat`
	X-X	This element is not used by NAP or USGIN; this information is encoded in `MD_Metadata/distributionInfo/MD_Distribution/` in USGIN metadata (see 4.13 *Content information: Entities and Attributes*
		One of the major deficiencies of the ISO 19115/19139 specifications is the absence of model elements to describe the entities and attributes in standard tabular datasets. Description of dataset schema using the ISO Technical Committee 211 (TC211) framework requires use of ISO19110. A standard XML schema for implementing this specification has recently become available, and entity-attribute metadata for dataset should be documented using the schemas located at `http://www.isotc211.org/2005/gfc/gfc.xsd`.
		The ISO19139 XML implementation of ISO19115 does not allow inclusion of the feature catalog inside the metadata record, but provides a citation element in the `gmd:contentInfo/gmd:MD_FeatureCatalogueDescription` element. The USGIN profile provision is to link to the feature catalog using an xlink:href attribute on the `gmd:featureCatalogueCitation`, identified as such by an accompanying xlink:title attribute with the value "Link to ISO19110 feature catalog". Code Example 2 shows recommended encoding. Section 8.3, ISO19110 Feature Catalog example, provides an example encoding of entity-attribute information for a feature dataset.
		`<gmd:contentInfo>`
		`<gmd:MD_FeatureCatalogueDescription>`
		`<gmd:includedWithDataset>`
		`<!-- true if a FeatureCatalog document is packaged with the dataset -->`
		`<gco:Boolean>false</gco:Boolean>`
		`</gmd:includedWithDataset>`
		`<!-- a dataset may contain multiple feature types. For an MS Access type database, each table could be considered a featue type -->`
		`<gmd:featureTypes>`
		`<!-- the codespace is the namespace URI, should dereference to obtain XML schema (if applicable)-->`
		`<gco:LocalName codeSpace=" http://xmlns.geosciml.org/geosciml-portrayal/2.0">GeologicContact_2</gco:LocalName>`
		`</gmd:featureTypes>`
		`<!-- follow pattern used by Stanford library http://opengeoportal.org/archives/-category/uncategorized); href is to an ISO19110 feature catalog, with featuretype identified by fragment ID -->`
		`<gmd:featureCatalogueCitation xlink:href="http://schemas.usgin.org/featurecatalog/12.xml#geologiccontact" xlink:title="Link to ISO19110 feature catalog"/>`
		`</gmd:MD_FeatureCatalogueDescription>`
		`</gmd:contentInfo>`

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource keywords (O) `identificationInfo/-MD_DataIdentification/-descriptiveKeywords/MD_Keyword`	O-O	Keywords should be provided to facilitate the discovery of metadata records relevant to the user. Keywords should be grouped according to Keyword Type - allowed values from MD_KeywordTypeCode {`discipline, place, stratum, temporal, theme`}, and the thesaurus in which they are defined (if applicable). See section 4.18.3 Codelists for details on codelist usage. USGIN requires that `MD_Keyword/keyword` contain a `CharacterString` (see section 4.16.5). USGIN best practice is to include keywords in English.
Condition applying to access and use of resource (O) `identificationInfo/-MD_DataIdentification/-resourceConstraints/`	O-O	Restrictions on the access and use of a resource or metadata. Follow NAP for specification of `resourceConstraints`. This attribute provides information for access control to the described resource itself. In some situations, the metadata may allow a user to learn of the existence of a resource that they may not actually be able to access without further clearance. Constraints may be represented by `MD_Constraint`, `MD_LegalConstraint`, or `MD_SecurityConstraint`.
Aggregation information (O) `identificationInfo/-MD_DataIdentification/-aggregationInfo/-MD_AggregateInformation`	O-O	This element includes either a citation for or identifier of an associated dataset, along with the type of association between the datasets, and optionally the activity that produced the dataset. `MD_AggregateInformation` requires either `aggregateDataSetName/CI_Citation` or `aggregateDataSetIdentifier/MD_Identifier`. `MD_AggregateInformation/associationType` is mandatory, from DS_AssociationTypeCode. ISO codelist includes {`crossReference, largerWorkCitation, partOfSeamlessDatabase, source, stereoMate`}. See section 4.18.3 *Codelists* for details on codelist usage. If the related resource has an associated metadata record, USGIN recommended practice is to include a dereferenceable URI for that metadata record in `aggregateDataSetIdentifier/MD_Identifier`. For related resources that do not have a metadata record, `aggregateDataSetName/CI_Citation` may be used; this element is optional if `aggregateDataSetIdentifier` has a value. For USGIN profile, this property, rather than `MD_Metadata/parentIdentifier`, should be used to indicate relationships between described resources.
Spatial Representation Type (O) `MD_DataIdentification/spatialRepresentationType/`	O-O	value from MD_SpatialRepresentationTypeCode list. ISO codelist includes {`vector, grid, textTable, tin, stereoModel, video`}. See section 4.18.3 *Codelists* for details on codelist usage.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource spatial resolution (O) `MD_DataIdentification/-spatialResolution/-MD_resolution/equivalentScale/MD_RepresentativeFraction/-denominator`	C-C	If the spatial representation type code is `vector, grid, textTable` or `tin`, an `equivalentScale/../denominator` MUST be provided to express spatial resolution (this is an arbitrary convention proposed to facilitate interoperablity). If a `equivalentScale/../distance` is available, that should be supplied as well. The resolution distance represents the smallest length between two resolvable points in the dataset. To calculate `equivalentScale` given a resolution distance, recommended practice is to divide the resolution distance in meters by 0.0005. This assumes that the smallest distance resolvable in a map display for human usage is 0.5 mm.
Resource language (O) `identificationInfo/-MD_DataIdentification/language`	M-O	Language for content of described resource. Default value is 'eng'. If language is not applicable to the described resource, a nilReason='notApplicable' attribute can be included on an empty language element. Multiple instances of this element indicate that the linguistic content of the resource is available in multiple languages. Use the three-letter language code from the ISO 639-2/T three letter language codelist, in lowercase. ISO 639 codelists are available at http://www.loc.gov/standards/iso639-2/php/code_list.php.
Topic category `identificationInfo/-MD_DataIdentification/-topicCategory`	C-C	A topicCategory code must be provided when hierarchyLevel is set to "dataset" or "dataset series". Codes are from MD_TopicCategoryCode, the ISO codelist includes {`farming, biota, boundaries, climatologyMeterologyAtmosphere, economy, elevation, environment, geoscientificInformation, health, imageryBaseMapsEarthCover, intelligenceMilitary, inlandWater, location, oceans, planningCadastre, society, structure, transportation, utilitiesCommunication`}. See section 4.18.3 *Codelists* for details on codelist usage. Most USGIN resources will have MD_TopicCategoryCode = "`geoscientificInformation`", which is the default value for this profile. More specific topic categorization should be done using keywords.
Resource content extent `identificationInfo/-MD_DataIdentification/extent/-EX_Extent`	C-C	Defines the spatial (horizontal and vertical) and temporal region to which the content of the resource applies. For USGIN, a `geographicElement/geographicBoundingBox` must be provided for any resource with content related to some geographic location. For geoscience resources, temporal extent expressed using named time ordinal eras from a geologic time scale should be specified as thematic keywords. If the described resource is not related to a geographic area, the place keyword 'non-geographic' should be included in the descriptiveKeywords element. In some situations, geographic location may be indicated using location keywords, but this is strongly discouraged because location-based searches using geographic coordinates will not find such records. In such cases, geocoding tools from services like Google can often be used to obtain an approximate bounding box.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource content extent description `identificationInfo/-MD_DataIdentification/extent/-EX_Extent/description`	C-O	Free text that describes the spatial and temporal extent of the dataset. Note that if geographic place names are used to express the geographic extent, USGIN profile specifies that these should be encoded using keyword with keyword type code = '`place`.' Geographic names may be duplicated in the `EX_Extent/description`.
Resource content extent bounding box `identificationInfo/-MD_DataIdentification/extent/-EX_Extent/geographicElement/-EX_GeographicBoundingBox`	O-C	USGIN profile requires that if an `EX_Extent/geographicElement` is supplied, it include a geographic bounding box with bounding latitude and longitude expressed using World Geodesic System WGS 84 decimal degrees. The corner coordinates for the geographic bounding box must not coincide in one point, because this may result in fatal errors with some CSW implementations. Point locations must thus be represented as tiny rectangles. USGIN recommended practice is to place the actual point location in the lower left corner of the rectangle.
Resource content extent geographic description `identificationInfo/-MD_DataIdentification/extent/-EX_Extent/geographicElement/-EX_GeographicDescription`	C-X	Not used by USGIN profile. In USGIN metadata this information should be encoded using keywords for which the MD_KeywordTypeCode = '`place`'; the `thesaurus/CI_Citation` has the same content as `EX_GeographicDescription/authority/CI_Citation`, and the keyword is the same as the `EX_GeographicDescription/code`.
Resource content extent bounding polygon `identificationInfo/-MD_DataIdentification/extent/-EX_Extent/geographicElement/-EX_BoundingPolygon`	C-O	To improve interoperability, USGIN mandates the use of Geographic Bounding Box instead of bounding polygon, if a bounding polygon is included it may be ignored by harvesting catalogs. If only a bounding polygon is provided, a minimum bounding box must be calculated and inserted in the EX_GeographicBoundingBox element when the record is harvested into a USGIN catalog.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification

Resource temporal extent (O)
`identificationInfo/-MD_DataIdentification/extent/-EX_Extent/temporalElement/-EX_TemporalExtent/extent/-TimePeriod`
	O-O	Property contains information about temporal extent to which resource is applicable. For many geoscience resources, this would be the geologic time period(s) to which the resource applies. USGIN mandates use of `TimePeriod` for all temporal extents. The default time extent for `beginPosition@frame` and `endPosition@frame` attributes are #ISO-8601. For geologic time extents, USGIN requires the values for `beginPosition@frame` and `endPosition@frame` to be populated using numeric time coordinates in Ma, measured positive increasing older with an origin at 1950 CE (see Temporal extents). The default frame attribute value for geologic time coordinates is "urn:cgi:trs:CGI:StandardGeologicTimeMa"
		ISO 8601 Default Example:
		
		`<gml:TimePeriod gml:id="IdModern">`
		`<gml:name>Y2kX</gml:name>`
		`<gml:beginPosition`
		`frame="#ISO-8601">2010-01-00T00:00:00</gml:beginPosition>`
		`<gml:endPosition`
		`frame="#ISO-8601">2010-12-31T24:00:00</gml:endPosition>`
		`</gml:TimePeriod>`
		
		Geologic Time Example:
		
		`<gml:TimePeriod gml:id="IdJurassic">`
		`<gml:name>Jurassic</gml:name>`
		`<gml:beginPosition frame="urn:cgi:trs:CGI:StandardGeologicTimeMa">203`
		`</gml:beginPosition>`
		`<gml:endPosition`
		`frame="urn:cgi:trs:CGI:StandardGeologicTimeMa ">135`
		`</gml:endPosition>`
		`</gml:TimePeriod>`

Resource spatio-temporal extent (O) `identificationInfo/-MD_DataIdentification/extent/-EX_Extent/temporalElement/-EX_SpatialTemporalExtent/`	O-X	Not used. Although use of `EX_SpatialTemporalExtent` is allowed by ISO19139 and NAP, USGIN mandates encoding space time location with `EX_TemporalExtent` and `EX_GeographicBoundingBox`.

ISO 19115 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on MD_DataIdentification
Resource vertical extent (O) `identificationInfo/-MD_DataIdentification/extent/-EX_Extent/verticalElement/-EX_VerticalExtent`	O-O	Vertical extent is used to describe the elevation location of resource content, if applicable. Common geoscience examples are resources related to vertical location in a borehole or depth in a water body. The borehole trace is the vertical coordinate reference system (CRS) within which described resources are located using coordinates measured in linear distance from the collar (or ground level, or Kelly bushing) of the borehole. `EX_VerticalExtent` has `minimumValue`, `maximumValue` that are real numbers, and a `verticalCRS`. For interoperability, USGIN mandates that if vertical extent is specified as an elevation, the `verticalCRS` xlink:href attribute value must be "http://www.spatialreference.org/ref/epsg/5714/" (replaces URN "urn:ogc:def:crs:EPSG::5714", this value may appear in older metadata); this is the VerticalCRS with origin at World mean sea level (MSL), with elevations measured up positive in meters(http://www.epsg-registry.org/). If vertical extent is specified using depth, the `verticalCRS` xlink:href attribute value must be an identifier for a well or depth sounding that can be dereferenced to get information on the borehole or sounding geometry.

3.3 Service identification elements (SV_ServiceIdentification)

Table 4. Service Identification properties (SV_ServiceIdentification). See discussion of the use of MD_DataIdentification and SV_ServiceIdentification preceding Table 3.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource service citation (M) `identificationInfo[1]/-SV_ServiceIdentification/-citation/CI_Citation`	M-M	The citation attribute provides information for citing the described service. Note that for scientific citation purposes, a citation for the intellectual content of the information presented by the service would be found in the `MD_DataIdentification/citation/CI_Citation` for datasets identified in the `operatesOn` section of `SV_ServiceIdentification`. Citation is defined by Webster as "an act of quoting". For USGIN purposes, this should be viewed as information to identify the intellectual origin or authority for the content in the described resource, along the lines of a citation in a scientific journal. The purpose of the citation for the service is to identify a particular service instance as a unique entity. Required content for a `CI_Citation` element are `title`, `date`, and `responsibleParty`.
Resource title (M) `identificationInfo[1]/-SV_ServiceIdentification/-citation/CI_Citation/title`	M-M	USGIN recommends that the title in a service identification citation should uniquely identify the particular service instance, and inform the human reader about the service content, function, and context.
Resource reference date (M) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/date/-CI_Date/date/`	M-M	The citation date for a service may indicate the creation date, when the service first became operational, the publication date, when the service first became public, or the revision date, which specifies the date of most recent update. If the service is no longer online, a notAvailable or superseded date may be specified. The `DateType` attribute is used to specify the signficance of a reported date. This date is distinct from the `dateStamp` for the metadata record, or the `EX_Extent/temporalElement` that specifies the time period to which the resource content is applicable. The data type for the `date` element is xs:date, defined thus "date uses the date/timeSevenPropertyModel, with *:hour:*, *:minute:*, and *:second:* required to be ***absent***. *:timezoneOffset:* remains :optional" (http://www.w3.org/TR/xmlschema11-2). Example date encoding: 2000-12-12+13:00, 2006-10-01. If the month or day is not known, encode as '01', for example '2006-01-01'. ISO CI_DateTypeCode names that apply to services include {`creation, publication, revision`}. See section 4.18.3 *Codelists* for details on codelist usage.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Unique resource identifier (O) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/-identifier/MD_Identifier`	C-O	For USGIN, because the Citation is for the service, this identifier should be identical to `MD_Metadata/dataSetURI`, and is therefore optional. For USGIN purposes, this element content value is only an identifier for the citation; it is not a URL for accessing the service. The USGIN profile requires the use of MD_Identifier element to identify resources. RS_Identifier may substitute for MD_Identifier in the ISO19139 schema, but the USGIN profile requires use of MD_Identifer. If additional codespace and version content is associated with the identifier, it should be encoded as `MD_Identifier/authority/CI_Citation/alternateTitle` and `MD_Identifier/authority/CI_Citation/edition`
Resource responsible party (O) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/-citedResponsibleParty`	M-M	USGIN requires at least one `CI_ResponsibleParty` with a rule that count of (individualName + organisationName + positionName) > 0. For a service, the point of contact information for questions or reporting problems should be in `SV_ServiceIdentification/pointOfContact/CI_ResponsibleParty`. The service citation responsible party should identify the parties responsible for creating (implementing) and publishing the service. ISO Role code names applicable to a service citation include {`originator, principalInvestigator, processor, author, publisher`}. Other ISO codelist values {`resourceProvider, custodian, owner`} should be specified in the `SV_ServiceIdentification/pointOfContact` element. See section 4.18.3 *Codelists* for details on codelist usage.
Resource presentation form (O) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/-presentationForm`	O-O	The form in which the service is available, which in the case of a service is only through the service implementation described by the metadata record, so the information here is not generally very useful. This profile specifies no convention for its use. Note that the citation to the original source of intellectual content in the datasets operated on by the service should be in `MD_DataIdentification/citation/CI_Citation` elements that are the target of srv:operatesOn associations. `presentationForm` uses the CI_PresentationFormCode codelist; ISO code names that are applicable to a service citation include {`documentDigital, imageDigital, mapDigital, modelDigital, profileDigital, tableDigital, videoDigital, audioDigital`}. NAP adds {`multimediaDigital, diagramDigital`}. See section 4.18.3 *Codelists* for details on codelist usage.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource series (O) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/series`	O-O	Information about the series or collection of which the cited service is a part. NAP rule: (name + issueIdentification) > 0. At this point there is not much precedent for aggregating services into a formal series, so in general this element is probably not applicable to services. This profile specifies no convention for its use.
Resource other citation details (O) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/-otherCitationDetails`	O-O	Free text information useful to identify and cite the described service instance. This profile specifies no convention for its use.
Resource collective title (O) `identificationInfo/-SV_ServiceIdentification/-citation/CI_Citation/-collectiveTitle`	O-O	Free text title of a "combined resource of which the service is a part." At this point there is not much precedent for aggregating services into a collections, so in general this element is probably not applicable to services. This profile specifies no convention for its use.
Resource abstract (M) `identificationInfo/-SV_ServiceIdentification/-abstract`	M-M	A free text summary of the content, significance, purpose, scope, etc. of the service described by this metadata. Exactly one value.
Resource purpose (O) `identificationInfo/-SV_ServiceIdentification/-purpose`	O-O	Text summary of the intentions for which the service was developed, including objectives for creating the service and use cases it is designed to support. One value optional.
Resource status (O) `identificationInfo/-SV_ServiceIdentification/-status`	M-M	Value is from MD_ProgressCode codelist. ISO Code names applicable to services include {`completed, obsolete, onGoing, planned, required, underDevelopment`}. Obsolete is synonymous with deprecated for this profile. See section 4.18.3 *Codelists* for details on codelist usage.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource point of contact (O) `identificationInfo/-SV_ServiceIdentification/-pointOfContact`	O-**O**^{R}	`pointOfContact/CI_ResponsibleParty` element for service metadata should contain information for a point of contact to report problems with the service. Element is optional but highly recommended! USGIN rule that count of (individualName + organisationName + positionName) > 0. The `CI_ResponsibleParty/role/CI_RoleCode@codeListValue` is from CI_RoleCode; applicable name for the point of contact party are from the ISO codelist {`resourceProvider, custodian, owner`}. Due to interoperability problems with NAP identifiers different from ISO identifiers for the same codelist elements, USGIN mandates use of ISO codelists. See section 4.18.3 *Codelists* for details on codelist usage.
Resource maintenance (O) `identificationInfo/-SV_ServiceIdentification/-resourceMaintenance`	O-O	This element provides information about the maintenance schedule or history of the service described by the metadata record. For a service, only one `MD_MaintenanceInformation` elements may be included; for which the `MD_ScopeDescription` MD_ScopeCode will be 'service'. If `MD_MaintenanceInformation` is present, then `maintenanceAndUpdateFrequency` is mandatatory, populated by a MantenanceFrequencyCode; ISO names in this codelist are {`continual, daily, weekly, fortnightly, monthly, quarterly, biannually, annually, asNeeded, irregular, notPlanned, unknown`}. See section 4.18.3 *Codelists* for details on codelist usage. USGIN recommends following the NAP-specified best practice that when `SV_ServiceIdentification/status` is set to "onGoing," either the attribute `MD_MaintenanceInformation/dateOfNextUpdate` or `MD_MaintenanceInformation/userDefined-MaintenanceFrequency` must be provided. Maintenance information specific to particular data the service presents should be included in the dataset metadata for coupleResources associated with the service.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Graphic overview of resource (O) `identificationInfo/-SV_ServiceIdentification/-graphicOverview`	O-**O**^{R}	Highly recommended to include a small image visual representation of the resource provided by a map or image service. For geographic feature or data services, a graphic overview might show the geographic distribution of available data. If `MD_BrowseGraphic` is included, `MD_BrowseGraphic/filename` character string is mandatory. USGIN Recommended practice is to provide a complete URL as a gco:characterString value for the `filename` property. Use napMD_FileFormatCode code values (http://www.fgdc.gov/nap/metadata/-register/codelists.html#IC_115) in `fileType/CharacterString`. See section 4.18.3 *Codelists* for details on encoding of the file format code, which is special because this is a NAP extension to the ISO base specification. Repeatable element; multiple values may present different resolutions, or different parts of resource. Names associated with overview should provide sufficient information for user to distinguish these.
Resource format (O) `identificationInfo/-SV_ServiceIdentification/-resourceFormat`	O-X	The format of service response documents varies at the operation level, and for a particular operation, different output formats may be requested. A listing of all possible options here without bindings to the operations that respond with that format is not useful.
Resource keywords (O) `identificationInfo/-SV_ServiceIdentification/-descriptiveKey-words/MD_Keyword`	O-O	Best Practice for USGIN profile metadata is to supply keywords to facilitate the discovery of metadata records relevant to the user. **USGIN Keywords**: USGIN keyword vocabularies are in development. Future versions of this profile may include required keyword vocabularies. **Other Keywords**: Keyword Type - allowed ISO values from MD_KeywordTypeCode: {`discipline, place, stratum, temporal, theme`}. See section 4.18.3 Codelists for details on codelist usage. `MD_Keyword/keyword` MUST contain a `CharacterString` element (see section 4.16.5); USGIN best practice is to include keywords in English.
Resource specific usage (O) `identificationInfo/-SV_ServiceIdentification/-resourceSpecificUsage/`	O-X	Property not used by USGIN. Content may be ignored by clients.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Condition applying to access and use of resource (O) `identificationInfo/-SV_ServiceIdentification/-resourceConstraints/`	O-O	Information specifying restrictions on the access to and use of the described service. Constraints may be represented by `MD_Constraint`, `MD_LegalConstraint`, or `MD_SecurityConstraint`. The attribute `MD_Constraint/useLimitation` is mandatory unless `MD_LegalConstraint` or `MD_SecurityConstraint` is provided. ISO19119 duplicates this property as `SV_ServiceIdentification/restrictions`. Follow NAP specification that `SV_ServiceIdentification/-resourceConstraints` is to be used, and `SV_ServiceIdentification/restrictions` is not to be used. The `metadataConstraints` may allow a user to learn of the existence of a resource that they may not actually be able to access without further clearance.
Aggregation information (O) `identificationInfo/-SV_ServiceIdentification/-aggregationInfo/-MD_AggregateInformation`	O-O	This element includes either a citation for or identifier of an associated service or dataset, along with the type of association, and optionally the activity that produced the dataset. `MD_AggregateInformation` requires either `aggregateDataSetName/CI_Citation` or `aggregateDataSetIdentifier/MD_Identifier`. `associationType` is mandatory, from DS_AssociationTypeCode. ISO code names deemed applicable to service aggregation by this profile are {`crossReference, largerWorkCitation, source,` }. See section 4.18.3 *Codelists* for details on codelist usage. Aggregation might be used to associate metadata for individual layers with metadata for a service that provides a collection of layers (largerWorkCitation), to cross reference services that can be chained, or to identify a resource that provides input to a service. If the related resource has an associated metadata record, USGIN recommended practice is to include the identifier for that metadata record in `aggregateDataSetIdentifier/MD_Identifier`. For related resources that do not have a metadata record, `aggregateDataSetName/CI_Citation` may be used; this element is optional if `aggregateDataSetIdentifier` has a value. For USGIN profile, this property, rather than `MD_Metadata/parentIdentifier`, should be used to indicate relationships between described resources. No testing has been done on use of this element, or examples found for actual usage.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource service type (M) `identificationInfo/-SV_ServiceIdentification/-serviceType`	M-M	Exactly one value required. USGIN mandates use of a `LocalName` value (http://schemas.opengis.net/iso/19139/20060504/srv/serviceMetadata.xsd allows either localName or ScopedName). There is not as yet a standard registry of service types and identifiers that can serve as an authority for serviceTypes. An interim list of service types and identifiers is included in section 7.1 ServiceType (with the ad hoc codespace URI 'http://resources.usgin.org/registry/serviceType201001'). Valid values for OGC services are {`WMS, WFS, WCS, CSW, …`} Example: <srv:serviceType> <gco:LocalName codeSpace= "http://resources.usgin.org/registry/serviceType201001">WMS</gco:LocalName> </srv:serviceType>
Resource service type version (O) `identificationInfo/-SV_ServiceIdentification/-serviceTypeVersion`	O-C	Multiple serviceTypeVersion tags may not be implemented in some harvesting server applications - USGIN recommends a reverse chronological order for supported versions. Constraint: if various versions are available, it is mandatory to list versions that are supported. Default is oldest version of service.
Resource service access properties (O) `identificationInfo/-SV_ServiceIdentification/-accessProperties`	O-O	Optional MD_StandardOrderProcess element to provide information on the availability of the service which include: fees, available date and time, ordering instructions, turnaround. Ordering instructions and turnaround are not applicable to web services.
Resource service restrictions (O) `identificationInfo/-SV_ServiceIdentification/-restrictions`	O-X	Not used by USGIN; use `resourceConstraints` as per NAP.
Keywords (O) `identificationInfo/-SV_ServiceIdentification/-keywords`	O-X	Not used by USGIN; use `descriptiveKeywords` as per NAP

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource service content extent (O) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent`	C-C	Defines the spatial (horizontal and vertical) and temporal region to which resources offered by the service apply. USGIN requires. Best Practice for USGIN is to include a geographic bounding box that specifies the extent to which resource content applies for any resource related to some geographic location. For geoscience resources, the temporal extent may be expressed using time ordinal eras from a geologic time scale if the resource is related to some particular geologic time. USGIN specifies count(`description` + `geographicElement` + `temporalElement`) >0
Resource service content extent description ( ) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/description`	C-C	Free text that describes the spatial and temporal extent of the dataset. USGIN specifies that `description` is mandatory if a `geographicElement` or `temporalElement` is not provided. If geographic place names are used to express the geographic extent they MUST be encoded using keywords with keyword type code = '`place`'. Geographic names may be duplicated in the `EX_Extent/description`.
Resource service content extent bounding box ( ) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/-geographicElement/-EX_GeographicBoundingBox`	O-C	USGIN profile requires that if an `EX_Extent/geographicElement` is supplied, it include a geographic bounding box with bounding latitude and longitude expressed using WGS 84 decimal degrees. The corner coordinates for the geographic bounding box must not coincide in one point, because this may result in fatal errors with some CSW implementations. Point locations must thus be represented as tiny rectangles. USGIN recommended practice is to place the actual point location in the lower left corner of the rectangle.
Resource service content extent geographic description ( ) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/geographic-Element/EX_Geographic-Description`	C-X	Not used by USGIN profile, use keyword with type code = '`place`'. For USGIN metadata, this information should be encoded using keywords, for which the MD_KeywordTypeCode = '`place`'; the `thesaurus/CI_Citation` has the same content as `EX_GeographicDescription/-authority/CI_Citation`, and the keyword is the same as the `EX_GeographicDescription/code`.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource service content extent bounding polygon ( ) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/-geographicElement/-EX_BoundingPolygon`	C-X	To improve interoperability, USGIN mandates use of Geographic Bounding Box; bounding polygons may be present, but may be ignored by harvesters.
Resource service temporal extent (O) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/temporalElement/EX_TemporalExtent/-extent/TimePeriod`	O-O	Information specifying the temporal extent to which resource is applicable. For many geoscience resources, this would be the geologic time period(s) to which the resource applies. Although the ISO19139 xml schema allows temporal extents to be instants, intervals, or ordered eras, `TimePeriod` MUST be used for temporal extent in USGIN profile metadata in order to make metadata interoperable. Values for `beginPosition@frame` and `endPosition@frame` MUST be populated if a temporal extent is provided. The default frame property value is "#ISO-8601", for standard calendar date and time. For geologic time extents, USGIN requires the values for `beginPosition@frame` and `endPosition@frame` to be populated using numeric time coordinates in Ma, measured positive increasing older with an origin at 1950 CE (see *Temporal extents*). The default frame attribute value for geologic time coordinates is "urn:cgi:trs:CGI:StandardGeologicTimeMa". See section 4.22, below.
Resource service spatio-temporal extent (O) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/-temporalElement/-EX_SpatialTemporalExtent/`	O-X	Although use of `EX_SpatialTemporalExtent` is allowed by ISO19139 and NAP, USGIN best practice is to encode space time location with `EX_TemporalExtent` and `EX_GeographicBoundingBox`. Other optional extent elements may be included, but they may be ignored by client implementations processing the metadata document.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Resource service vertical extent (O) `identificationInfo/-SV_ServiceIdentification/-extent/EX_Extent/-verticalElement/-EX_VerticalExtent`	O-O	Vertical extent is used to describe the elevation location of resources offered by the described service instance, if applicable. Common geoscience examples are resources related to vertical location in a borehole or depth in a water body. The borehole trace is the vertical coordinate reference system (CRS) within which described resources are located using coordinates measured in linear distance from the collar (or ground level, or Kelly bushing) of the borehole. `EX_VerticalExtent` has `minimumValue`, `maximumValue` that are real numbers, and a `verticalCRS`. For interoperability, USGIN mandates that if vertical extent is specified as an elevation, the `verticalCRS` xlink:href attribute value must be "http://www.spatialreference.org/ref/epsg/5714/"; this is the VerticalCRS with origin at World mean sea level (MSL), with elevations measured up positive in meters (http://www.epsg-registry.org/). If vertical extent is specified using depth, the `verticalCRS` xlink:href attribute value must be an identifier for a well or depth sounding that can be dereferenced to get information on the borehole or sounding geometry. In the absence of other information, reported depths should be assumed to be true vertical depth relative to the mean elevation of the geographic extent reported for the resource. In the absence of other information, reported depths should be assumed to be true vertical depth relative to the mean elevation of the geographic extent reported for the resource.
Coupled Resource ( ) `identificationInfo/-SV_ServiceIdentification/-coupledResource`	O-O	This element correlates operations (identified by `operationName`) with datasets (identified by `identifier`). For logical consistenty, and `SV_coupledResource/identifier` values should be equal to `MD_DataIdentification/citation/CI_Citation/identifier/MD_Identifier/code` for a dataset that is the target of a `SV_ServiceIdentification/operatesOn` element (either in an inline `MD_DataIdentification/citation../code` element, or a `@uuidref` attribute). This element is necessary to implement the many-to-many relationship between data sources and operations in a single service.
Coupled Resource operation name (M) `identificationInfo/-SV_ServiceIdentification/-coupledResource/-SV_CoupledResource/-operationName`	M-C	Mandatory if operations are specific to particular coupled resources. String, the name of the service operation: GetMap, GetFeature, etc. There is no internal check in the metadata record that the given operation name is valid.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Coupled Resource identifier (M) `identificationInfo/-SV_ServiceIdentification/-coupledResource/-SV_CoupledResource/identifier`	M-C	Mandatory in service metadata record if coupling type is tight or mixed. Identifier of a given tightly coupled dataset. Equal to `MD_DataIdentification/citation/CI_Citation/ identifier/MD_Identifier/code` for a dataset that is the target of a `SV_ServiceIdentification/-operatesOn` element (either in an inline `MD_DataIdentification/citation../code` element, or a `@uuidref` attribute).
Coupled Resource scoped name (X) `identificationInfo/-SV_ServiceIdentification/-coupledResource/-SV_CoupledResource/ScopedName`	X-O	OGC 07-045 application profile for ISO metadata using CSW 2.0.2 extends SV_CoupledResource with a ScopedName, defined as a scoped identifier of the resource in the context of the given service instance (e.g. layer name or featureTypeName). This is necessary for users to generate service requests (like GetMap or GetFeature) based on ISO service metadata.
Service coupling type (M) `identificationInfo/-SV_ServiceIdentification/-couplingType`	M-M	Type of coupling between service and associated data, if applicable. Codelist values used by USGIN: • loose - Service instance is not associated with a specific dataset or datasetcollection. Loosely coupled services may have an association with data types through the service type definition; no MD_DataIdentification class has to be described. • mixed - Service instance is associated with a specific dataset or dataset collection, but this can also be used with external data (i.e. data that is not described by the operatesOn association). MD_DataIdentification describes the associated data instance. • tight - Service instance only operates with specific data; MD_DataIdentification element MUST be provided for the coupled data.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Service operations (M) `identificationInfo/-SV_ServiceIdentification/-containsOperations`	M-M	This element describes operations performed by the service, but the ISO19119 model includes insufficient detail to completely describe all parameters necessary to automate connection to a service. Widely used xml formats exist to describe service function, including OGC getCapabilities.xml and W3C Web Service Description Language (WSDL). `srv:containsOperations` is a required element in a valid `SV_ServiceIdentification` element instance. At least one service operation MUST be described with the `operationDescription/-CharacterString` = 'serviceDescription'. The `identificationInfo/SV_ServiceIdentification/-containsOperations/SV_OperationMetadata/connectpoint` link for this operation MUST retrieve the service-specific self description document (e.g. WSDL, GetCapabilities, WADL).
Service operation name (M) `identificationInfo/-SV_ServiceIdentification/-containsOperations/-SV_OperationMetadata/-operationName`	M-M	Operation name following convention of the described service; mandatory instance is associated with SV_OperationMetadata element with the `operationDescription/Character-String` = 'serviceDescription'.
Service operation distributed computing platforms (M) `identificationInfo/-SV_ServiceIdentification/-containsOperations/-SV_OperationMetadata/DCP`	M-M	mandatory instance is associated with SV_OperationMetadata element with the `opera-tionDescription/CharacterString` = 'serviceDescription'. USGIN profile makes no provision for use of this element.
Service operation description (O) `identificationInfo/-SV_ServiceIdentification/-containsOperations/-SV_OperationMetadata/-operationDescription`	O-M	mandatory instance is associated with SV_OperationMetadata element with the `opera-tionDescription/CharacterString` = 'serviceDescription'.

ISO 19115 and 19119 (M/C/O) xPath from MD_Metadata	NAP-USGIN M/C/O	Comments on SV_ServiceIdentification
Service operation invocation name (O) `identificationInfo/-SV_ServiceIdentification/-containsOperations/-SV_OperationMetadata/-invocationName`	O-O	service instance specific string to use in requests to invoke an operation.
Service operation online resource (M) `identificationInfo/-SV_ServiceIdentification/-containsOperations/-SV_OperationMetadata/-connectpoint`	M-C	For loosely coupled services, operations and endpoints need to be described. A service information endpoint (`CI_OnlineResource`) that returns a service self description document MUST always be provded. The `CI_OnlineResource/linkage` URL should be a complete request if a single http GET request is sufficient. If the request requires special headers, or message package, or does not use standard web protocols, the `CI_OnlineResource/description` MUST provide instructions for executing the request.
Service operates on (O) `identificationInfo/-SV_ServiceIdentification/-operatesOn`	O-C	"Provides information on the datasets that the service operates on" (ISO 19119). If `SV_ServiceIdentification/-couplingType` is 'tight' or 'mixed', then `operatesOn` elements must include a valid `MD_DataIdentification` element inline or by `@uuidref` attribute value that explicitly links to an existing dataset metadata record that describes the coupled dataset. The value of `SV_ServiceIdentification/operatesOn@uuidref` or `SV_ServiceIdentification/operatesOn/MD_DataIdentification/citation/CI_Citation/identifier/MD_Identifier/code` must correspond to one of the `SV_ServiceIdentification/coupledResource/MD_CoupledResource/identifier` values. If the metadata record for the coupled dataset is a separate gmd:MD_Metadata record, the service described in the service metadata record should be identified as a distribution for the dataset. Explicitly linked reference example: `<srv:operatesOn uuidref="13ce1e84-c887-4fd8-b888-8d021b1fa4c2" xlink:href=http://resources.azgs.org/geonetwork/srv/en/metadata.show?id=8717 xlink:title="azgs:azgeochron"/>`

4 Usage notes for Metadata Elements

This section presents additional information and discussion to supplement that in Table 2, Table 3, and Table 4.

4.1 Metadata file identifier

`MD_Metadata/fileIdentifier` is unique identifier for the metadata file. Some metadata profiles suggest that the metadata file identifier ID should be the same as the ID for the described resource. In the USGIN scheme, the metadata record is considered a separate resource, with a distinct identifier, from the resource it describes. The described resource identifier is the Unique resource identifier (`DatasetURI`, 4.8, below).

4.2 Metadata hierarchy

The ISO19115 specification (especially Annex H) discusses the use of metadata hierarchy, in which a resource may inherit metadata properties from parent metadata records in the hierarchy. For example a `dataset` in a dataset series might inherit all of the metadata content from the parent dataset series metadata record, except for dataset-specific data quality metadata. The linkage would be made through `MD_Metadata/parentIdentifier`. This kind of nesting, effectively database normalization, makes sense in a data management environment, but in a discovery environment, it present problems. Many queries would require joins with the parent metadata record, and software clients would be required to navigate the parent links to acquire 'inherited' properties from 'parent' records. For catalog service purposes, USGIN mandates that in metadata records returned by services, all inherited properties in such a hierarchy should be included explicitly in the metadata document, as opposed to implicitly through the `parentIdentifier` link. Internal document links may be used where allowed by the xml schema for identified elements repeated in a single response document. Resolvable xlink:href links to external resource are technically possible, but require that client software is xlink-aware, which is not always the case.

4.3 Metadata Contact vs. Resource Citation vs. Resource Contact

There are various locations to store contact information within an ISO 19139 metadata record. Here is a summary of the required contact properties and their significance as it pertains to the USGIN Profile.

- `MD_Metadata/contact/CI_ResponsibleParty` or "metadata point of contact" describes how to contact the party responsible for the **metadata** record to allow users to report errors, updates to metadata etc. The mandatory `CI_RoleCode` is set to "`pointOfContact`".
- `MD_Metadata/identificationInfo/`[`MD_DataIdentification` || `SV_ServiceIdentification`]`/-citation/CI_Citation/citedResponsibleParty/CI_ResponsiblerParty` provides information to identify the **intellectual origin** of the content in the described resource. This is straight forward when citing library resources (books, journals, etc.) but less clear when defining the intellectual origin of, for example, physical samples. The mandatory `CI_RoleCode` is set to one of the ISO codelist values {`custodian, owner, distributor, originator, pointOfContact, principalInvestigator, publisher, author`}.
- `MD_Metadata/identificationInfo/`[`MD_DataIdentification` || `SV_ServiceIdentification`]`/-pointOfContact/CI_ResponsibleParty` or "resource point of contact" contains information on who to contact to **access** the described resource. The mandatory `CI_RoleCode` is set to one of the

ISO codelist values {`resourceProvider, custodian, owner, user, distributor, originator, pointOfContact, principalInvestigator, processor, publisher, author`}.

Additional contact information in the distribution section of the metadata provides point of contact for individual distribution processes to report problems with access to resources via different distributions.

4.4 Resource Title

Resource titles should provide sufficient information to distinguish the resource from other similar resources. They are not required to be globally unique, but bear in mind that users will be presented only with the resource title in typical brief search response documents. It is thus a disservice to have significant duplication of title strings or uninformative titles.

4.5 Resource Abstract

Ideally the resource abstract provides a succinct summary of the content of the resource, the purpose for which it was originally created, some indication of important quality parameters to help evaluate fitness for other purposes, any significant constraints on use of the resource, and a list of distribution options. After reading the abstract a user should have a good idea of whether the described resource contains the information they need and is accessible in a fashion that they can use.

4.6 Resource Type

The ISO 19115 `MD_Metadata/hierarchyLevel` property provides a high level categorization of resource types. The European INSPIRE Implementing Rules (MD_IR_and_ISO_20090218) proscribes the code list for the first hierarchyLevel xml element in an MD_Metadata document to be one of {`dataset, service, series`}, or the metadata set will be considered out of scope for the directive. Thus, metadata meant to be utilized by INSPIRE catalogs must follow this rule. The full ISO MD_ScopeCode list has a wider (and more useful) variety of resource categories; one or more hierarchyLevel elements using these codes could follow the first one with an INSPIRE-valid code in the first element to maintain INSPIRE compliance.

Table 1 in this document includes a more geoscience-domain-specific list of resource types, and values from this list should be used in one or more `hierarchyLevelName` elements. To enable resource-category-type searches to find narrower subcategories without complex query processing, `hierarchyLevelName` elements for the resource type and all broader/more general resource type categories should be included. The hierarchical categorization of the resources is encoded with the most specific category first, and progressively broader categories listed subsequently. Thus, harvesters that only take the first `hierarchyLevelName` element will get the most specific value. For example, if the resource is a photograph:

```
<gmd:hierarchyLevelName>
  <gco:CharacterString>Photograph</gco:CharacterString>
</gmd:hierarchyLevelName>
<gmd:hierarchyLevelName>
  <gco:CharacterString>StillImage</gco:CharacterString>
</gmd:hierarchyLevelName>
<gmd:hierarchyLevelName>
  <gco:CharacterString>Image</gco:CharacterString>
</gmd:hierarchyLevelName>
<gmd:hierarchyLevelName>
  <gco:CharacterString>Document</gco:CharacterString>
</gmd:hierarchyLevelName>
```

Note that the distinction of resource type and format is not always clear. Table 1 attempts to define resource types that are not specifically bound to a particular format, but are defined based on the kind of content. Format is interpreted as relating to specific approaches to encoding content and committing it to some sort of media.

4.7 Resource Locator

URL's for online access to resources are encoded in USGIN ISO 19139 metadata documents in the element `MD_Distribution/transferOptions/MD_DigitalTransferOptions/online/CI_OnlineResource.` Consistent use of this rule eliminates ambiguity on where to locate the URL to access a resource. Conventions for use of the `CI_OnlineResource` subelements `protocol`, `applicationProfile`, `name`, `description`, and `function` to enable metadata clients to reliably access referenced resources are discussed in section 4.16 CI_OnlineResource.

4.8 Unique Resource Identifier

The `MD_Metadata/DataSetURI` property should be a globally unique identifier for the described resource. The protocol used for this identifier is not specified by the USGIN Profile, but if it does not have a know resolution service, the capabilities document for a CSW service providing the metadata should have at least a text explanation of how to resolve URI's used by the service. Protocols with available resolvers include http (use the WWW DNS system) and doi (http://dx.doi.org/). Some authorities using urn: protocols are also implementing or have resolver services in place.

4.9 Browse Graphics

Links to browse graphics are useful to assist users evaluate resources that have a graphical aspect. The `MD_BrowseGraphic` element includes a fileType attribute that is important to inform client software accessing and displaying the graphic. For the USGIN profile, use standard MIME types in the `gmd:fileType/gco:CharacterString`. See the official Internet Assigned Numbers Authority (IANA) Mime Media Type registry at http://www.iana.org/assignments/media-types for a list of registered MIME types and their scope.

```
<gmd:MD_BrowseGraphic>
  <gmd:fileName>
        <gco:CharacterString>http://publicdocs.mnr.gov.on.ca/View.asp?-
          Document_ID=9632&Attachment_ID=18204</gco:CharacterString>
  </gmd:fileName>
  <gmd:fileDescription>
        <gco:CharacterString>Base Map from OMNR</gco:CharacterString>
  </gmd:fileDescription>
  <gmd:fileType>                <!-- This is a MIME Type -->
        <gco:CharacterString>image/jpg</gco:CharacterString>
  </gmd:fileType>
</gmd:MD_BrowseGraphic>
```

Code example 1. Encoding url, display name and file type for browse graphic.

4.10 Resolution and equivalentScale

For spatial datasets, some indication of the resolution of the data is very useful for evaluating fitness for use. From a data perspective, resolution in a spatial dataset specifies the the smallest resolvable distance between two points in the Earth for that dataset. For a grid or coverage, this would be the average distance between sample points. From data portrayal perspective, an `equivalentScale` is reported, representing the scale at which the portrayal was intended to be viewed when it was constructed. If the spatial representation type code is `vector, grid, textTable` or `tin`, an `equivalentScale/../denominator` MUST be provided to express spatial resolution. This is an arbitrary convention adopted to facilitate interoperablity. If a `equivalentScale/../distance` is available, that should be supplied as well. To calculate `equivalentScale` given a resolution distance, recommended practice is to divide the resolution distance in meters by 0.0005. This assumes that the smallest visually resolvable distance in a map display for human usage is 0.5 mm.

4.11 Resource Language

USGIN metadata is assumed to use American English and metadata documents should be returned in that language. The ISO 19139 XML includes elements and provisions to implement multiple languages in a single metadata package using `PT_Text` and `LocalizedCharacterString`, but in order to avoid complexity with USGIN recommended practice is to implement metadata search for different languages as different services. Each service would provide `CharacterStrings` in the same, single language, specified by the `MD_Metadata/language` element in returned metadata records.

4.12 Encoding of Vertical Extents

`EX_VerticalExtent` has `minimumValue`, `maximumValue` that are real numbers, and a `verticalCRS`. The vertical coordinate reference system (CRS) specifies how the bounds of the vertical extent are georeferenced. The USGIN profile accepts two approaches. Elevation is reported with reference to Earth mean sea level, measured positive upward. On the other hand, subsurface or subaqueous data are typically referenced relative to a borehole trace or sounding, measured positive downward from a local datum at the borehole or sounding orgin. The origin is typically a borehole collar at the ground surface, the Kelly bushing or drill floor on a drilling rig, or a ship deck., For to facilitate interoperability.

For interoperability, USGIN mandates that both elevation and depth vertical extent bounds MUST be specified in meters. In addition, if vertical extent is specified as an elevation, the `verticalCRS` xlink:href attribute value MUST be "http://www.spatialreference.org/ref/epsg/5714/"; this is the VerticalCRS with origin at World mean sea level (MSL), with elevations measured up positive in meters (http://www.epsg-registry.org/). If vertical extent is specified using depth, the `verticalCRS` xlink:href attribute value must be an identifier for a well or depth sounding that can be dereferenced to get information on the borehole or sounding geometry.

4.13 Content information: Entities and Attributes

One of the major deficiencies of the ISO 19115/19139 specifications is the absence of model elements to describe the entities and attributes in standard tabular datasets. Description of dataset schema using the ISO Technical Committee 211 (TC211) framework requires use of ISO19110. A standard XML schema for implementing this specification has recently become available, and entity-attribute metadata for dataset should be documented using the schemas located at `http://www.isotc211.org/2005/gfc/gfc.xsd`. The ISO19139 XML implementation of ISO19115 does not allow inclusion of the feature catalog inside the metadata record, but provides a citation element in the `gmd:contentInfo/gmd:MD_FeatureCatalogueDescription` element. The USGIN profile provision is to link to the feature catalog using an xlink:href attribute on the `gmd:featureCatalogueCitation`, identified as such by an accompanying xlink:title attribute with the value "Link to ISO19110 feature catalog". Code Example 2 shows recommended encoding. Section 8.3, ISO19110 Feature Catalog example, provides an example encoding of entity-attribute information for a feature dataset.

```
<gmd:contentInfo>
  <gmd:MD_FeatureCatalogueDescription>
    <gmd:includedWithDataset>
   <!-- true if a FeatureCatalog document is packaged with the dataset -->
      <gco:Boolean>false</gco:Boolean>
    </gmd:includedWithDataset>
  <!-- a dataset may contain multiple feature types. For an MS Access type database, each table
   could be considered a featue type -->
        <gmd:featureTypes>
   <!-- the codespace is the namespace URI, should dereference to obtain XML schema (if
   applicable)-->
          <gco:LocalName codeSpace=" http://xmlns.geosciml.org/geosciml-
  portrayal/2.0">GeologicContact_2</gco:LocalName>
        </gmd:featureTypes>
   <!-- follow pattern used by Stanford library http://opengeoportal.org/archives/category/-
   uncategorized); href is to an ISO19110 feature catalog,
   with featuretype identified by fragment ID -->
        <gmd:featureCatalogueCitation xlink:href="
  http://schemas.usgin.org/featurecatalog/12.xml#geologiccontact"
          xlink:title="Link to ISO19110 feature catalog"/>
    </gmd:MD_FeatureCatalogueDescription>
 </gmd:contentInfo>
```

Code Example 2. Encoding of feature catalog link for entity attribute description of datasets. See 8.3 ISO19110 Feature Catalog example for and example instance document.

4.14 Use of MD_Distribution and MD_Distributor

The ISO19115 model provides two possible paths for specifying information about how a user can access the resource. The `MD_Distribution` element may have 0 to many `distributionFormat`, `distributor`, and `transferOptions` child elements (see Figure 1). On the other hand, each of the `distributor` child elements may have 0 to many `distributorFormat` and `distributorTransferOption` elements. Several major existing applications that consume ISO19139 xml metadata files are configured to expect format and transfer option information to be at the `MD_Distribution/distributionFormat` and `MD_Distribution/transferOptions` path. This works fine as long as there are not different format or transfer options from different distributors, or different transfer options for different formats. In these cases, a binding between distributor, format, and transfer options necessitates use of the `MD_Distribution/distributor/MD_Distributor` path to `distributorFormat` and `distributorTransferOptions` (and `distributionOrderProcess`) information that works together.

In order to accommodate both existing applications that utilize content in the `MD_Distribution/distributionFormat` and `MD_Distribution/transferOptions` elements, and situations that require binding between distributor, order process, format, and transfer options, the USGIN profile mandates that if multiple `MD_Distribution/distributionFormat` or `MD_Distribution/transferOptions` elements are included in a document, all formats must be available via all the specified transfer options, and the content of these elements should be included in line. If multiple `MD_Distribution/distributor` elements are present, without child `MD_Distributor/distributorFormat` or `MD_Distributor/distributorTransferOptions` elements, then all formats and transfer options are available from all distributors.

To specify different bindings between distributor, order process, format, and transfer options, a separate `MD_Distribution/distributor/MD_Distributor` instance is included for each binding. At least one `MD_Distribution/distributionFormat` and one `MD_Distribution/transferOptions` element MUST be included for applications that expect content in these elements, and the format and transfer options specified by these elements should apply to the first `distributor/MD_Distributor` element. Repeated `CI_ResponsibleParty`, `MD_StandardOrderProcess`, `MD_Format` or `MD_DigitalTransferOption` elements in the `distributor/MD_Distributor` elements should be specified by reference (xlink:href to gml:id of first occurrence of the element within the document). The implication is that the `distributionOrderProcess/MD_StandardOrderProcess`, `distributorFormat/MD_Format`, and `distributorTransferOptions/MD_DigitalTransferOptions` child elements of a single `MD_Distributor` are all compatible with each other. Following this convention will produce schema valid metadata, and the distributor elements after the first can be ignored by applications expecting only a single `distributor` element.

In summary, for the USGIN profile, each `distributor/MD_Distributor` is a binding between one or more transfer options and the distributor formats that are available through that/those transfer options (`MD_DigitalTransferOptions/onLine/CI_OnlineResource` in particular). If different formats are available from the same distributor, but have different transfer options, these should be represented as different `distributor/MD_Distributor` instances.

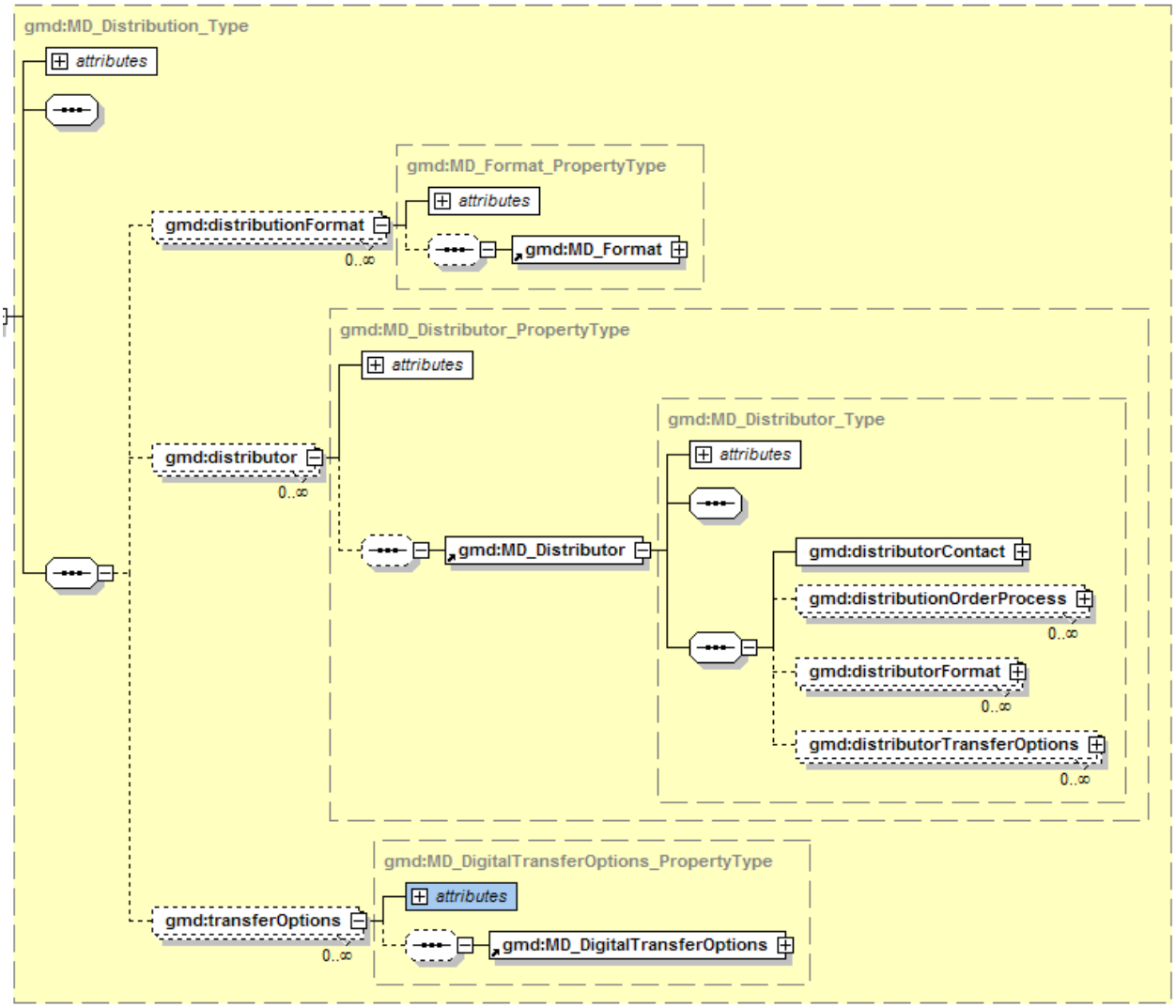

Figure 1. gmd:MD_Distribution_Type diagram

4.15 Distribution Format

If the resource distribution is a physical object, like a book, rock sample, paper document, the `distribution/../MD_Format/name` MUST be a term from the USGIN distribution format codelist (see Table 6). Note that format is partially orthogonal from resource type (

Table 1). A document may be available in various digital (pdf, tiff, doc, txt) or non-digital (book, loose sheets) formats.

4.15.1 Digital resources

The format vocabulary needs to be designed to work in the framework of the `distribution/../-MD_DigitalTransferOptions`, which provides protocol, applicationProfile, name, and function subelements for online resources (CI_OnlineResource), and `MD_MediumNameCode` and `MD_MediumFormatCode` for offline electronic resources (`MD_Medium`). For digital resources it provides terms to specify file-format information that does not have any other obvious home. Examples in INCITS 453, INSPIRE 19115/19, and ANZLIC 2007 populate `MD_Format/name` with values like 'ESRI ARC/INFO Coverage', 'ESRI shapefile', 'ESRI ARC/INFO Export e00', and 'MapInfo MID/MIF' all pertain to digital resources. If a MIME format (http://www.iana.org/assignments/media-types/) is defined for a digital file format, the MIME media-type code should be used. If no appropriate MIME type is registered with IANA, USGIN mandates that the distribution format for digital resources should specify the file format using a pattern that includes vendor, application name, and file extension.

Pattern for digital resources: `[vendor:applicationName]/fileExtension`. The vendor and application names may not be applicable, and could be omitted, but the '/' and file extension should always be present. If the format consists of a single file, the file extension is a three letter file-type abbreviation assigned by the vendor. If the format consists of a package of files (e.g. an ArcGIS file geodatabase), the file extension is a name that in most cases should be obvious from vendor usage. The accompanying `MD_Format/version` value should indicate the version of application software if the format is specific to some version.

Service metadata describes a service as a resource, in which case distribution is effectively equivalent to the set of operations accessible at the service instance endpoint. The ISO 19119 service metadata model does not provide a clear way to associate individual operation responses with possible output formats for those responses. If all output formats are applicable to all service requests, they can be listed in `distributioninfo` as a collection of `distributionFormat/MD_Format` elements, but this is not a general solution. Another approach (e.g. GeoNetwork OpenSource, v. 2.4) to documenting output formats is to put format information in a collection of `srv:connectPoint/CI_OnlineResource/protocol` elements, with `connectPoint` elements for each format available on each operation. The USGIN profile convention is that operation metadata is best conveyed to metadata consumers by providing a link to a service-specific description file (getCapabilities or WSDL, see 4.23 Operation metadata), and this MUST be provided in a service metadata record by a `SV_OperationMetadata` element with an `operationDescription` value of 'serviceDescription'. The output formats offered by the service should be listed in a `distributionInfo` element as a collection of `distributionFormat/MD_Format` elements if all formats are applicable to all service requests, or if the mapping between requests and formats is obvious. Encoding of the format name should use whatever convention is used by the service to specify that output format in requests made to the service.

Table 5. Example format strings for digital files. These are to be used only if an appropriate MIME type is not defined.

ESRI:ARCINFO/Coverage
/shapefile
ESRI:ARCINFO/e00
PitneyBowes:MapInfo/mid

ESRI:ArcGIS/mdb
ESRI:ArcGIS/fileGeodatabase
Microsoft:Access/mdb

4.15.2 Non digital resources

The `MD_Format` element is the only format information for resources that do not have digital transfer options, and USGIN proposes Table 6 as a vocabulary for use to specify format of non-digital resources. Although this codelist could be implemented as a schema extension, for the time being we propose to use it as a controlled vocabulary specified by profile and practice, rather than schema. Use of such controlled vocabulary can be indicated by using xsi:type on the gco:characterString element to make the type gml:CodeType, which then requires a codeSpace attribute. The distribution format Identifier from Table 6 should be used as the element value. Example encoding:

```
<gmd:MD_Format>
  <gmd:name>
    <gco:CharacterString xsi:type=”gml:CodeType”
     codeSpace="http://resources.usgin.org/registry/distributionFormatNames201001">
     sample:core</gco:CharacterString>
  </gmd:name>
  <gmd:version nilReason="notapplicable"/>
<gmd:MD_Format>
```

Table 6. USGIN Distribution formats for non digital resources. URI for this codelist is http://resources.usgin.org/registry/distributionFormatNames201001

Identifier	Name	Parent format	Scope
physicalArtifact	Physical artifact		described resource is a physical object
sample	Sample	physicalArtifact	Use for uncategorized sample.
sample:core	Core	sample	Cylindrical rock sample extracted from Earth with a coring drill
sample:cuttings	Cuttings	sample	Small rock fragments recovered from drilling process as sample of material being drilled
sample:fluid	Fluid	sample	Sample of a fluid
sample:handSample	Hand sample	sample	Single piece or pieces of material.
hardCopy	page-size document	physicalArtifact	A physical copy of a document on paper, film, or other

Identifier	Name	Parent format	Scope
			similar material.
hardCopy:book	Book	hardcopy	Manuscript printed on paper, bound into a single volume
hardCopy:manuscript	Manuscript	hardCopy	Other printed or written representation on physical media, usually paper or mylar, includes unbound books, index cards, loose notes, file folders of papers
hardCopy:printedImage	Printed image	hardCopy	Image on paper or other opaque or semi-opaque media.
printedImage:paperMap	oversize sheet	printedImage	Map image on a single sheet
hardCopy:filmImage	photographic film	hardCopy	Image on film, viewed by passing light through the film. Includes single still images and collections of connected images for a movie.
audioRecording:tape	magnetic tape	physicalArtifact	use for sound resources that are recorded on magnetic tape.
audioRecording:otherMedia	vinyl disk, wax cylinders	physicalArtifact	

4.16 CI_OnlineResource

The CI_OnlineResource element is used in a variety of contexts in ISO19115 content (see Table 7). This complex-content-element provides a linkage to some online resource related to the metadata or the described context resource. It is thus analogous to atom:link (IETF RFC-4287) or the link element described in IETF RFC-5988. For links that locate online documents accessible using standard browser and file type resolution technology, the link can be as simple as a single URL element that retrieves a representation of the resource. There are many other kinds of related resources that the onlineResource element may point to, including web services that provide access to a dataset resource, metadata for related or source resources, specifications for standards or extensions to standards.

Table 7. Contexts for CI_OnlineResource elements

Context	usage
contactInfo/onlineResource	Link to online resource to assist contacting a referenced individual or organization.
distributionInfo/transferOptions	link to a representation of the resource that is the subject of the metadata record

metadataExtension	link to document describing specifications for elements and attributes extending the base standard.

For the USGIN, it is desired that such links are accompanied by sufficient description that the linked resource can be accessed and provided to the metadata user automatically, with little or no operator intervention other than clicking on a link in a presentation of the metadata. A content specification for such machine-actionable links is discussed in a separate USGIN discussion paper. This approach essentially considers the metadata as a sort of hypermedia in which the CI_OnlineResource elements define the 'affordances', or actions that are available to a client.

The CI_OnlineResource element contains 6 child elements. The only required content is a URL that will access the online resource. All other properties are optional. The `protocol`, `applicationProfile`, `name` and `description` properties are all free text with loosely defined semantics as indicated by the element names.

4.16.1 CI_OnlineResource protocol

Since the base level web locator scheme (ftp, http) is indicated by the prefix of the URL (IETF RFC 1738), USGIN metadata uses the `protocol` attribute to specify a higher-level protocol in the network stack, e.g. a serviceType for data accessed through remote-procedure-call-on-HTTP type services.

4.16.2 CI_OnlineResource applicationProfile

The use of `applicationProfile` for file-based resources accessed via URL is discussed in Table 2. For links to documents for which the service type (encoded in the `CI_OnlineResource/protocol` property) and base protocol prefix in the `CI_OnlineResource/link` URL (e.g. 'http:') do not provide sufficient information to guide client software, the `applicationProfile` property is used to indicate a profile on the serviceType or some variation in document encoding or content conventions. For example WFS services may offer different features in different namespaces or encoding schemes, a catalog may offer different metadata encoding, or a resource-oriented service may offer representations using different encoding schemes. The same scheme may be used with different conventions, for instance different profiles for the use of ISO19139 or csw:record XML metadata encoding. RDF representations may be offered in XML, Turtle, or N3 encoding. Although these variations may be deducible using content negotiation or by accessing and parsing a service description document, much simple client logic is possible if the information is provided up front with the link. The actual string value that should be provided to specify an application profile should be defined by the agent originating the profile.

4.16.3 CI_OnlineResource name and description

In order to provide further clarity and guidance for the utilization of linked resources USGIN recommends use of the `CI_OnlineResource/name` property as indicated in Table 12. In order to identify the linkage element that locates the service description document (see 4.23 Operation metadata), USGIN mandates using `CI_OnlineResource/name` = "serviceDescription" in the `CI_OnlineResource` element with the linkage to the service description. The assumption is that any client that can connect to the service will know what to expect as the service description provided by that service.

The `description` property may be used to provide information about the online resource, and more usefully, to provide an explanation of how the other content of the `CI_OnlineResource` element is to be used to access the resource. The `linkage/description` should provide any necessary additional information in a text narrative as well. In some cases the protocol, applicationProfile and name properties may be insufficient to enable machine access to the resource through the provided link. The `CI_OnlineResource/description` element may include key values pairs to provide additional necessary

information. USGIN recommendataion is to encode these in a 'parameter' object using JSON syntax. The parameters value is a list of key:value pairs enclosed in curly brackets ('{key:"value", key1:"value1"…}'). The keys should be the exact string that is required for the data access request parameter. For example, a dataset distributed through a particular layer in a multi-layer WMS:

```
<gmd:description>
  <gco:CharacterString>
    Whatever descriptive text you want.
    parameters:{layers:"gtp_datagap_well_data_collection"}
  </gco:CharacterString>
</gmd:description>
```

In the case of a dataset distributed through a particular feature type in a multi-feature WFS:

```
<gmd:description>
  <gco:CharacterString>
    Whatever descriptive text you want.
    parameters:{ typeName:"BoreholeLithInterval2.0"}
  </gco:CharacterString>
</gmd:description>
```

4.16.4 CI_OnlineResource function property

The `function` property is populated from a codelist (see Table 8) and is used to indicate the expected action that actuating the link will trigger. (see section 4.18.3 *Codelists*).

Table 8. OnlineFunctionCode values from NAP (INCITS 453) and ISO 19115. '(ISO)' after the text in column 2 indicates function codes from ISO19115 (2006).

OnLineFunctionCode	USGIN profile usage
browsing	`CI_OnlineResource/linkage` is a valid URL for a web application that enables user to explore and seek information about the resource from a Web browser
download	`CI_OnlineResource/linkage` is a valid URL that will initiate transfer of a file containing the described resource to the local system. (ISO)
emailService	`CI_OnlineResource/linkage` is a valid mailto: link that will initiate an e-mail message to the correct party to request access to the described resource. (NAP)
information	`CI_OnlineResource/linkage` is a valid URL that will access a resource that provides information about the resource content, for example an explanatory web page, a downloadable document with narrative text describing the resource, or an XML encoded metadata document. (ISO)
offlineAccess	`CI_OnlineResource/linkage` is a valid URL that will access a web page providing instructions for requesting the resource from the provider. (ISO)
order	`CI_OnlineResource/linkage` is a valid URL that will access a web page to initiate an ordering process for obtaining the resource. (ISO)

OnLineFunctionCode	USGIN profile usage
search	CI_OnlineResource/linkage is a valid URL that will access a search interface for seeking out specific information content contained by resource, e.g. the metadata describes a database, and this linkage accesses a search interface to search the database (ISO)
upload	CI_OnlineResource/linkage is a valid URL for a web interface to transfer data from a local storage device or system to be included in the described resource. (NAP)
webService	CI_OnlineResource/linkage is a URL that accesses a standard web service. If the CI_OnlineResource/name is 'ServiceDescription' then the link is to a machine-readable standard service description document as defined by the service specification. Example description document may be a Web Services Description Language (WSDL) file or OGC getCapabilities file. (NAP)

4.16.5 Scoped name in service distributions

A distribution option for a dataset might be through a Web Map Service that contains one or more layers portraying the described dataset, along with layers portraying other datesets. Likewise, a dataset may be distributed as a particular feature type in a Web Feature Service that offers multiple features. Analogous internal knowledge may be required for various other service protocols. To completely specify access to the correct data representation requires knowing the layer name, feature type name, or some other information in addition to the base service connection information provided by the existing properties. USGIN recommended practice for this common situation is to include a parameters section in the linkage/description (see 4.16.3 CI_OnlineResource name and description, above).

4.17 Responsible parties and logos

Metadata should include a URL that locates a thumbnail logo for organizations related to the metadata origination, the organization hosting the catalog that returned the metadata, the organization that originated the data, and the organization hosting online services that provide access to the data. The standard place to put URL's in ISO19139 metadata is in the CI_Contact/onlineResource/-CI_OnlineResource/linkage attribute. For URL's that indicate icon thumbnails, the CI_OnlineResource/name should be 'icon'.

The metadata originator information should be in a MD_Metadata/contact/CI_ResponsibleParty element with role code 'originator' to identify the original source of the metadata record, for which the CI_Contact/../CI_OnlineResource/linkage is a URL that points to an Icon for the metadata originator. This Icon will be displayed in search results to credit the metadata originator. Metadata harvesters should harvest and maintain this information so that the origin of metadata records can be credited.

The organization hosting the catalog that returned the metadata record should specified in a MD_Metadata/contact/CI_ResponsibleParty element with role code 'distributor', for which the CI_Contact/../CI_OnlineResource/linkage is a URL that points to an Icon for the metadata server hosting organization. This information need not be harvested, because it will be replaced by information describing the harvesting catalog service.

The organization that originated the data is specified by MD_Metadata/identificationInfo/MD_Data-Identification/citation/../CI_ResponsibleParty with RoleCode ='originator', and /CI_Online-Resource/name='icon'. This will distinguish the citation responsible party element containing the icon

linkage from `CI_ResponsibleParty` elements with RoleCode='author' or 'editor', which would provide an online linkage directly to the responsible party as specified by `CI_OnlineResource` `protocol`, `applicationProfile`, `name`, `function`, and `description` elements.

The organization hosting a service providing online access to described data is specified by `MD_Metadata/distributionInfo/MD_Distribution/distributor/MD_Distributor/distributorContact/CI_ResponsibleParty` with RoleCode ='`resourceProvider`' or '`distributor`', and `../CI_OnlineResource/name`='icon'. Because the cardinality of distributorContact responsible party and online resources is 1, only one linkage can be provided for a distributor, and the metadata author must decide whether that will be a link to an icon, or a link to a web site or other resource related to the distributor.

```
<gmd:contact>
  <gmd:CI_ResponsibleParty>
    <gmd:organisationName>
      <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
    </gmd:organisationName>
    <gmd:contactInfo>
      <gmd:CI_Contact>
        <gmd:onlineResource>
          <gmd:CI_OnlineResource>
            <gmd:linkage>
              <gmd:URL>http://www.azgs.az.gov/logo/metadata/azgs.png</gmd:URL>
            </gmd:linkage>
            <gmd:name>
              <gco:CharacterString>icon</gco:CharacterString>
            </gmd:name>
          </gmd:CI_OnlineResource>
        </gmd:onlineResource>
      </gmd:CI_Contact>
    </gmd:contactInfo>
    <gmd:role>
      <gmd:CI_RoleCode codeL-
        ist="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
        codeListValue="originator">originator</gmd:CI_RoleCode>
    </gmd:role>
  </gmd:CI_ResponsibleParty>
</gmd:contact>
```

4.18 Extensions to CharacterString

4.18.1 Web extensions

ISO 19139 defines several extensions to `gco:CharacterString` in the gmx namespace. These are defined as members of an xml substitution group for `gco:CharacterString`, and include `gmx:Anchor`, `gmx:FileName`, and `gmx:MimeFileType`. `gmx:Anchor` is used for URL's linking to online web resources, and include a URI attribute associated with the character string that is the human-readable label for the link. `gmx:FileName` adds a filename URI attribute that specifies a machine-readable absolute path to the location of the file, the human readable file name specified by the character string. `gmx:MimeFileType` adds a MIME type/subtype attribute to a character string that specifies a human readable file type. The gmx namespace is not imported into other ISO19139 schema in the normative schema. In order to create schema-valid documents that use these extensions, explicit

namespace-declaration must be made to the gmx schema in instance documents. For the USGIN profile, these extension classes are not recommended, and may be ignored by client software.

4.18.2 Language localization

ISO 19139 defines an extension to `gco:CharacterString` that allows substitution by `PT_FreeText` or `LocalisedCharacterString`. `LocalisedCharacterString` adds a `locale/PT_Locale` property to the `CharacterSTring` element that can specify the language, country, and character encoding for the string. `PT_FreeText` allow substitution of a collection of `LocalisedCharacterString` elements for any `CharacterString`, each localized to a different language/country.

These various possibilities create potential to break interoperability. To avoid this problem, and to avoid complexity with `PT_Text` and `LocalizedCharacterString`, USGIN profile practice is to implement services for different languages as different catalog service instances, each of which serves CharacterStrings in a single language specified by the `MD_Metadata/language` element.

4.18.3 Codelists

ISO 19139 defines a "CodeListValue_Type" XML Class Type with three attributes:

`codeList`: contains a URL that references a codeList definition within a registry or a codelist catalogue. As currently used in the metadata services we have studied, the codeList is not used to identify a vocabulary; rather it provides a locator (functionally equivalent to xlink:href) for an online resource, typically a web page or xml file, that contains a listing of the codelist with the code values and scope notes. Different services provide different URL's, possibly linking to different kinds of resources (e.g. web page or xml file), for the same codelist. Thus, in practice, the values in this attribute can not be used for automated determination of the code list in use in a metadata document.

`codeListValue`: carries the value from the 'name' column of the codelist tables in ISO 19115, Annex B. This value serves to identify the codelist meaning in the context of the codelist catalogue (or registry) located by the `codeList` attribute. The codelist catalogue is expected to contain an explicit name and definition of the value in the default language of the metadata, as well as alternate expressions in different code spaces, some of them corresponding to the different locales supported by the metadata.

The `codeSpace` attribute is an optional identifier (URI); when present it refers to an alternative expression of the codelist value definition. In the example in ISO19139, section 8.5.5.1 (p. 30), the codeSpace URI for the domain code is the string "domainCode", and the value from the domainCode column in a codelist definition table in ISO 19115, Annex B is included as the value of the xml CodeList element in this case. This appears to be an attempt to allow alternate codeListValue strings to be associated with the codelist value concept for language localization or use of alternate identifiers.

Codelist elements in the ISO19139 XML schema are assigned to type CodeListValue_Type, and also included in a substitution group for `gco:CharacterString`. These codeList elements are thus substitutable for elements typed `gco:CharacterString`. Consequently, any CodeList instance is an XML element that takes a string value (corresponding to the element value for a gco:CharacterString), and has three XML attributes defined by the CodeListValue_Type XML Class Type. A corresponding XML Class Property Type is defined for each of these CodeList elements, and this property type is used to restrict the values in XML `CharacterString` attributes to the code list.

The ISO specification uses an unfortunate choice of name for the 'codeListValue' attribute that is defined to be a identifier, apparently with the intention that it is a language-neutral concept identifier that might be associated with various language-localized labels for the concept. NAP CodeList registries (http://www.fgdc.gov/nap/metadata/register) contrast with the codelists defined in the tables in

ISO 19115 Annex B in that the identifier (the ‘name’ column the ISO19115 Annex B tables) is an integer identifier with the prefix ‘RI_’. This would appear to correspond functionally to the ‘domainCode’ values in the ISO19115 Annex B tables, which ISO19139 indicates should be the codeListValue when the `codeSpace`="domainCode".

NAP and INSPIRE usage is consistent with the ISO19139 definition of codeListValue as an identifier, with the name or label for the codeList concept included as the value of the CodeListValue attribute. The ‘name’ column in ISO 19115, Annex B tables, which is described as the content for the codeListValue by ISO19139, contains English words that are the same as the labels one would use in English. In the CT_CodeListCatalogues in the ISO publicly available standards registry for ISO 19139 (http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/), the CodeListDictionary/codeEntry/CodeDefinition elements only include gml:description and gml:identifier elements, but no gml:name elements. Based on this ISO guidance, USGIN profile mandates that controlled vocabulary terms from codelists are encoded thus:

Example 1:

```
<gmd:CI_DateTypeCode codeList=" http://standards.iso.org/ittf/PubliclyAvailableStandards/-
    ISO_19139_Schemas/resources/#CI_DateTypeCode"
    codeListValue="creation"/>
```

Example 2

```
<gmd:MD_CharacterSetCode
    codeList="
    http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="utf8"/>
```

Or

```
<gmd:MD_CharacterSetCode
    codeList="
    http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="utf8">UTF-8</gmd:MD_CharacterSetCode>
```

The alternate version of example 2 includes label string for the codelist concept as the element value string. Most applications appear to use only the codeListValue string for querying and content inspection. In order to indicate that standard ISO codelists are being used, the `codeList` attribute value MUST be " http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml ", which is the web location for the authoritative codelist dictionary XML document. Including the fragment identifier name for the particular codelist is informative only; this is the terminal token of the URL after the '#' character, and will be ignored by browsers.

The use of other codelists is implemented by providing a `codeList` attribute that points to the codelist actually used. The following example shows use of a DateTypeCode from the code list in the North American Profile:

```
<gmd:CI_DateTypeCode
    codeList="http://www.fgdc.gov/nap/metadata/register/registerItemClasses.html#IC_87"
    codeListValue="superseded">superseded</gmd:CI_DateTypeCode>
```

Note that the ISO codelists use the name value for the `codeListValue` attribute. This is consistent with ISO codelist practice but is in contrast to the NAP codeList example encoding in Appendix E of NAP profile document (INCITS 453, 2009). In these examples the codeListValue is the 'Item identifier' from the NAP registry specified by the codeList, with the prefix ‘RI_’ added.

The ISO codelists are in much wider use at this time than the NAP codelists (as far as we can tell from surveying existing services), but we recognize that some of the terms added in the NAP codelists may be required for metadata describing some of the resources in the USGIN scope (

Table 1). Table 9 summarizes differences between the ISO and NAP codelists. The recommended practice is to use ISO codelists wherever possible, encoded as in the examples above. NAP codes may be used where necessary, with the appropriate codeList URL: " http://www.fgdc.gov/nap/metadata/register/registerItemClasses.html" and optional codelist-specific document fragment token (e.g. #IC_87)

If a new codelist is created to restrict text in an ISO element whose type is simply CharacterString (e.g. HierarchyLevelName), then `characterString` element values are encoded by soft-typing the element that takes the character string using the xsi:type attribute. The following example uses the FileFormatCodeList, which is the only code list vocabulary added to the collection of codelists defined by ISO 19115 by the North American Profile.

```
<gmd:fileType xsi:type="gml:CodeType"
        codeList="http://www.fgdc.gov/nap/metadata/register/registerItemClasses.html#IC_115"
        codeListValue="jpg">
  <gco:CharacterString>jpg</gco:CharacterString>
</gmd:fileType>
```

As a convention for using controlled vocabularies on `gco:characterString` elements without the overhead of a defining a new namespace and xml schema, USGIN proposes that use of a controlled vocabulary be indicated by adding the attribute `xsi:type="gml:CodeType"` on the `gco:CharacterString` element. The type gml:CodeType requires a codeList attribute (see 4.15.2 Non digital resources and 7.2 Linkage name conventions), which MUST be the URI for the vocabulary used, with the implication that the `gco:CharacterString` element value and the codeListValue attribute will then be an identifier from that vocabulary. This essentially turns the CharacterString into a GML scoped name or gco:LocalName element.

Table 9. Codelist crosswalk between ISO, NAP and USGIN.

Codelist (ISO / NAP)	Coded Values/Names	Comments
`CI_DateTypeCode` `napCI_DateTypeCode`	`creation, publication, revision`	ISO 19115 (B.5.2)
	`…, notAvailable, inForce, adopted, deprecated, superseded`	NAP expansion
`CI_OnLineFunction-Code` `nap-CI_OnLineFunction-Code`	`download, information, offlineAccess, order, search`	ISO 19115 (B.5.3)
	`…, upload, webService, emailService, browsing, fileAccess, webMapService`	NAP expansion
`CI_PresentationForm-Code` `nap-CI_PresentationForm-Code`	`documentDigital, documentHardcopy, imageDigital, imageHardcopy, mapDigital, mapHardcopy, modelDigital, modelHardcopy, profileDigital, profileHardcopy, tableDigital, tableHardcopy, videoDigital, videoHardcopy, audioDigital`	ISO 19115 (B.5.4)
	`…, audioHardcopy, multimediaDigital, multimediaHardcopy, diagramDigital, diagramHardcopy`	NAP expansion
`CI_RoleCode` `napCI_RoleCode`	`resourceProvider, custodian, owner, user, distributor, originator, pointOfContact, principalInvestigator, processor, publisher, author`	ISO 19115 (B.5.5)

Codelist (ISO / NAP)	Coded Values/Names	Comments
	…, collaborator, editor, mediator, rightsHolder	NAP expansion
DQ_EvaluationMethod-TypeCode napDQ_Evaluation-MethodTypeCode	directInternal, directExternal, indi-rect	ISO 19115 (B.5.6)
DS_AssociationType-Code napDS_Association-TypeCode	crossReference, largerWorkCitation, partOfSeamlessDatabase, source, stere-oMate	ISO 19115 (B.5.7)
	…, isComposedOf	NAP expansion
DS_InitiativeType-Code napDS_Initiative-TypeCode	campaign, collection, exercise, exper-iment, investigation, mission, sensor, operation, platform, process, program, project, study, task, trial	ISO 19115 (B.5.8)
MD_CellGeometryCode napMD_CellGeometry-Code	point, area	ISO 19115 (B.5.9)
	…, voxel	NAP expansion
MD_CharacterSetCode napMD_CharacterSet-Code	ucs2, ucs4, utf7, utf8, utf16, 8859part1, 8859part2, 8859part3, 8859part4, 8859part5, 8859part6, 8859part7, 8859part8, 8859part9, 8859part10, 8859part11, 8859part13, 8859part14, 8859part15, 8859part16, jis, shiftJIS, eucJP, usAscii, ebcdic, eucKR, big5, GB2312	ISO 19115 (B.5.10)
MD_Classification-Code napMD_Classification Code	unclassified, restricted, confiden-tial, secret, topSecret	ISO 19115 (B.5.11)
	…, sensitive, forOfficialUseOnly	NAP expansion
MD_CoverageContent-TypeCode napMD_Coverage-ContentTypeCode	image, thematicClassification, physi-calMeasurement	ISO 19115 (B.5.12)
MD_DataTypeCode not used by NAP and USGIN	class, codelist, enumeration, codel-istElement, abstractClass, aggregate-Class, specifiedClass, datatypeClass, interfaceClass, unionClass, metaClass, typeClass, characterString, integer, association	ISO 19115 (B.5.13) – The MD_MetadataExtension Information element and its codelists are not used by NAP and USGIN.
MD_DimensionName-TypeCode napMD_DimensionName-TypeCode	row, column, vertical, track, cross-Track, line, sample, time	ISO 19115 (B.5.14)

Codelist (ISO / NAP)	Coded Values/Names	Comments
MD_GeometricObject-TypeCode napMD_Geometric-ObjectTypeCode	complex, composite, curve, point, sol-id, surface	ISO 19115 (B.5.15)
MD_ImagingCondition-Code napMD_Imaging-ConditionCode	blurredImage, cloud, degrad-ingObliquitty, fog, heavySmokeOrDust, night, rain, semiDarkness, shadow, snow, terrainMasking	ISO 19115 (B.5.16)
MD_KeywordTypeCode napMD_KeywordType-Code	discipline, place, stratum, temporal, theme	ISO 19115 (B.5.17)
	…, product, subTopicCategory	NAP expansion
MD_Maintenance-FrequencyCode napMD_Maintenance-FrequencyCode	continual, daily, weekly, fortnightly, monthly, quarterly, biannually, annu-ally, asNeeded, irregular, notPlanned, unknown	ISO 19115 (B.5.18)
	…, semimonthly	NAP expansion
MD_MediumFormatCode napMD_MediumFormat-Code	cpio, tar, highSierra, iso9660, iso9660RockRidge, iso9660AppleHFS	ISO 19115 (B.5.19)
	…, UDF	NAP expansion
MD_MediumNameCode napMD_MediumNameCode	cdRom, dvd, dvdRom, 3halfinchFloppy, 5quarterInchFloppy, 7trackTape, 9trackTape, 3480Cartridge, 3490Cartridge, 3580Cartridge, 4mmCartridgeTape, 8mmCartridgeTape, digitalLinearTape, onLine, satellite, telephoneLink, hardcopy, hardcopyDi-azoPolyester08, hardcopyCardMicrofilm, hardcopyMicrofilm240, hardcopyMicro-film35, hardcopyMicrofilm70, hard-copyMicrofilmGeneral, hardcopyMicro-filmMicrofiche, hardcopyNegativePhoto, hardcopyPaper	ISO 19115 (B.5.20)
	…, hardcopyDiazo, hardcopyPhoto, hard-copyTracedPaper, hardDisk, USBFlash-Drive, 1quarterInchCartridgeTape	NAP expansion
MD_ObligationCode not used by NAP and USGIN	mandatory, optional, conditional	ISO 19115 (B.5.21) - The MD_MetadataExtension Information element and its codelists are not used by NAP and USGIN.

Codelist (ISO / NAP)	Coded Values/Names	Comments
MD_PixelOrientation-Code napMD_Pixel-OrientationCode	center, lowerLeft, lowerRight, upper-Right, upperLeft	ISO 19115 (B.5.22)
MD_ProgressCode napMD_ProgressCode	completed, historicalArchive, obso-lete, onGoing, planned, required, un-derDevelopment	ISO 19115 (B.5.23)
	…, proposed	NAP expansion
MD_RestrictionCode napMD_Restriction-Code	copyright, patent, patentPending, trademark, license, intellectualProp-ertyRights, restricted, otherRe-strictions	ISO 19115 (B.5.24)
	…, licenseUnrestricted, licenseEndUs-er, licenseDistributor, privacy, stat-utory, confidential, sensitivity	NAP expansion
MD_ScopeCode napMD_ScopeCode	attribute, attributeType, collection-Hardware, collectionSession, dataset, series, nonGeographicDataset, dimen-sionGroup, feature, featureType, prop-ertyType, fieldSession, software, ser-vice, model, tile	ISO 19115 (B.5.25)
MD_Spatial-RepresentationType-Code napMD_Spatial-RepresentationType-Code	vector, grid, textTable, tin, stereo-Model, video	ISO 19115 (B.5.26)
MD_TopicCategoryCode napMD_TopicCategory-Code	farming, biota, boundaries, climatolo-gyMeterologyAtmosphere, economy, ele-vation, environment, geoscientificIn-formation, health, imageryBase-MapsEarthCover, intelligenceMilitary, inlandWater, location, oceans, plan-ningCadastre, society, structure, transportation, utilitiesCommunication	ISO 19115 (B.5.27)
MD_TopologyLevelCode napMD_TopologyLevel-Code	geometryOnly, topology1D, planarGraph, fullPlanarGraph, surfaceGraph, fullSurfaceGraph, topology3D, fullTo-pology3D, abstract	ISO 19115 (B.5.28)
SV_CouplingType napSV_CouplingType	loose, mixed, tight	ISO 19119 (Amendment 1; C.2.8)
SV_Parameter-Direction napSV_Parameter-Direction	in, out, in/out	ISO 19119 (Amendment 1; C.2.9

Codelist (ISO / NAP)	Coded Values/Names	Comments
LanguageCode	see http://www.loc.gov/standards/iso639-2/php/code_list.php	no complete NAP or ISO registry found
not used by ISO `nap_DCPList`	`XML, CORBA, JAVA, COM, SQL, Web-Services`	NAP specific codelist – not used by USGIN due to poorly defined semantics and use.
not used by ISO `napMD_FileFormatCode`	`bil, bmp, bsq, bzip2, cdr, cgm, cover, csv, dbf, dgn, doc, dwg, dxf, e00, ecw, eps, ers, gdb, geotiff, gif, gml, grid, gzip, html, jpg, mdb, mif, pbm, pdf, png, ps, rtf, sdc, shp, sid, svg, tab, tar, tiff, txt, xhtml, xls, xml, xwd, zip, wpd`	NAP specific codelist – not formally used by USGIN, but these character strings should are to be used to populate fileType elements.

4.19 Geographic bounding box

USGIN profile requires that if an `EX_Extent/geographicElement` is supplied, at least one geographic bounding box with bounding latitude and longitude expressed using WGS 84 decimal degrees MUST be provided.

The corner coordinates for the geographic bounding box must not coincide in one point, because this may result in fatal errors with some CSW implementations. Point locations must thus be represented as tiny rectangles. USGIN recommended practice is to place the actual point location in the lower left corner of the rectangle.

4.20 Data Quality

4.20.1 Simple quality statement

For resource evaluation purposes, to answer a user's question 'is the described resource good enough for my purposes?', a free text statement is generally sufficient in place of a detailed xml document. For example, this might be a statement something like "*These data were compiled by the authors from field sheets and notes by scanning paper copies, georeferencing and digitizing on screen. Station locations are based on Garmin 12 GPS readings, except locally where they have been adjusted for consistency with the base map. Original GPS coordinates are reported in the station table. These data have been reviewed for completeness of description and internal consistency, but have not been independently field checked.*" This is the only kind of quality information available for many resources; it is neither a quantitative measure nor technically a conformance result. A simple qualityStatement would suffice and provide significant value. There is no ISO19115 element for such a quality statement.

To implement this simple case, the proposed solution is that the first report conformance explanation in each DQ_DataQuality element instance would contain a free text discussion of data quality considerations for the indicated scope for that element. Thus, text at the XPath `DQ_DataQuality//report[1]//result[1]//explanation/CharacterString` will be interpreted as a self-explanatory quality statement. The use of any specific data quality element (e.g. DQ_QuantitativeAttributeAccuracy, DQ_RelativeInternalPositionalAccuracy..) to contain this explanation is arbitrary and may be ignored by client applications.

4.21 Lineage

Lineage in data quality section is a collection of processing steps that describe the provenance of a resource. Each step has some input resources, identified by source citations associated with the process step. The `LI_ProcessStep` element does not directly identify its output resource, so in a lineage that involves a chain of steps with intermediate resources, the sourceStep association from `LI_Source` links a resource to a processing step that it is output from.

A `LI_Lineage` element that contains a `source` but no `processStep` elements is redundant; this source information should be represented with the `MD_DataIdentification/citation/CI_Citation` element.

A GIS dataset originally digitized from a published geologic map, put online, obtained by an online download, and reprojected would report one `processStep` (reprojection) with `source/LI_Source` that has a `CI_Citation` for the downloaded data. This `LI_Source` would have a `sourceStep` pointing to an `LI_ProcessStep` for the original digital conversion from the paper map, and the `LI_ProcessStep/source/LI_Source` would contain the citation for the original paper map.

In order to enable XPath queries for any of the sources or processSteps in a processing chain, all related `LI_Source` and `LI_ProcessStep` elements should be directly nested within the `LI_Lineage`

element, and the `processStep/source` and `LI_Source/sourceStep` associations should be by internal document references (see Code Example 3).

Code Example 3: A complex processing and source history using LI_Lineage.

```
<?xml version="1.0" encoding="UTF-8"?>
<LI_Lineage
  xmlns="http://www.isotc211.org/2005/gmd"
  xmlns:gco="http://www.isotc211.org/2005/gco"
  xmlns:xlink="http://www.w3.org/1999/xlink"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.isotc211.org/2005/gmd
 http://schemas.opengis.net/iso/19139/20070417/gmd/dataQuality.xsd">
  <statement>
    <CharacterString>The digital data described by this metadata was originally compiled digitally
          from two published maps; this digital dataset was then reprojected to produce the
          described resource.</CharacterString>
 </statement>
 <processStep>
    <LI_ProcessStep id="1">
      <description>
        <CharacterString>digital compilation of 2 Maps</CharacterString>
      </description>
      <source xlink:href="#10"/>
      <source xlink:href="#20"/>
    </LI_ProcessStep>
  </processStep>
  <processStep>
    <LI_ProcessStep id="2">
      <description>
        <CharacterString>digital map compilation reprojected, should have some way to specify
          projection parameters?, output is LI_Source id=70 </CharacterString>
      </description>
      <source xlink:href="#40"/>
    </LI_ProcessStep>
  </processStep>
  <source>
    <LI_Source id="40">
      <description>
        <CharacterString>a digital compilation of 2 maps, output of processStep ID=1, input into
          reprojection process</CharacterString>
      </description>
      <sourceStep xlink:href="1"/>
    </LI_Source>
  </source>
  <source>
    <LI_Source id="10">
      <description>
        <LocalisedCharacterString>ultimate source--
          somepublishedmap</LocalisedCharacterString>
      </description>
<!--no source processing recorded for production of paper map so no sourceStep-->
```

```
    </LI_Source>
  </source>
  <source>
    <LI_Source id="20">
      <description>
        <LocalisedCharacterString>another published map</LocalisedCharacterString>
      </description>
    </LI_Source>
  </source>
  <source>
    <LI_Source id="70">
      <description>
        <LocalisedCharacterString>a reprojected version of the digital
              compilation</LocalisedCharacterString>
      </description>
      <sourceStep xlink:href="2"/>
    </LI_Source>
  </source>
</LI_Lineage>
```

An `LI_Lineage` may be constructed that involves a number of resources and processing steps, and this lineage may be referenced by metadata for all the resources involved in the processing. The `LI_Lineage/source/LI_Source/sourceCitation/CI_Citation/identifier/MD_Identifier` is a reference to the `MD_Metadata/fileIdentifier` for the metadata for each resource in the chain. This approach allows the metadata record to record relationships through process steps between resources.

4.22 Temporal extents

Resource temporal extent (`identificationInfo/MD_DataIdentification/extent/EX_Extent/temporalElement/EX_TemporalExtent/extent/TimePeriod`) is used to specify the temporal interval to which the content of a resource applies. Default reference frame for time is calendar date and time encoded using ISO-8601:

```
<gml:TimePeriod gml:id="Id2010">
  <!-- Note that gml:TimePeriod requires a gml:id string that must be unique
    in the scope of the instance document, and must have an alphabet
    character ('a-z', 'A-Z') as its first character -->
  <!-- USGIN requires the beginPosition and endPosition's frame property to be defined.
  The default value is #ISO-8601. -->
    <gml:beginPosition frame="#ISO-8601">2010-01-00T00:00:00Z </gml:beginPosition>
    <gml:endPosition frame="#ISO-8601">2010-12-31T24:00:00Z</gml:endPosition>
</gml:TimePeriod>
```

<gml:endPosition indeterminatePosition="now"/> is the correct way to represent "Present" in ISO or GML as one of the boundaries of a timePeriod.

The ISO 19139 xml schema allows temporal location to be quantified by a gml:TimeInstant or gml:TimePeriod element. In order to promote interoperability, the USGIN profile mandates use of gml:TimePeriod for specifying temporal extent for a resource.

For geologic time extents, the time coordinates for the beginPosition and endPosition should be expressed numerically in Ma. This convention allows search for resources pertinent to intervals of geologic time using simple numeric comparisons instead of the complex hierarchical concept

expansions that would be necessary to use named eras from a stratigraphic time scale. Encoding example:

```
<EX_TemporalExtent>
  <extent>
    <gml:TimePeriod gml:id="y34096">
      <gml:beginPosition
        frame="urn:CGI:TemporalCRS:cgi:standardGeologyMa">220</gml:beginPosition>
      <gml:endPosition
        frame="urn:CGI:TemporalCRS:cgi:standardGeologyMa">140 </gml:endPosition>
    </gml:TimePeriod>
  </extent>
</EX_TemporalExtent>
```

The frame for the beginPosition and endPosition is a URI for standard geologic time, measured positive getting older, with an origin at 1950 CE, in units of millions of years.

4.23 Operation metadata

See the discussion on the use of service metadata in the USGIN profile above, preceding Table 3. The srv namespace elements based on ISO 19119 provide insufficient information and guidelines to access data through services without apriori knowledge of the service protocol. This is due in part to weakly defined semantics and use cases for the elements that are there (DCP, applicationProfile, protocol, MD_Format, serviceType, operationName vs. invocationName, connectPoint), and partly due to incomplete content model (where to put allowed outputFormat parameter values or supported query operations for CSW or WMS, what is syntax for delimiting parameters, are http request headers used). The ISO 19119 model for service metadata does not include a mechanism to specify valid values for operation parameters. For instance, OGC WMS and CSW services both support an output format parameter, and OGC capabilities documents provide a listing of the supported output formats, but where do these go in ISO19139 xml documents? Does the described service support http POST or GET method? This information is necessary in order to compose valid service requests.

Based on these considerations, the USGIN profile mandates that a service metadata record MUST include at least one service operation with the `operationDescription/CharacterString` = 'serviceDescription'. The `identificationInfo/SV_ServiceIdentification/containsOperations/-SV_OperationMetadata/connectpoint` link for this operation MUST retrieve the service-specific self description document (e.g. WSDL, GetCapabilities, WADL). The `CI_OnlineResource` in this connectPoint elment must have `CI_OnlineResource/name` = "serviceDescription" (from the table in section 7.2 Linkage name conventions).

WSDL and getCapabilities were designed to describe service operation, and it seems counterproductive to invent another scheme to do the same thing. Service metadata for processing services that are not coupled to particular input datasets should provide `srv:SV_OperationMetadata` to describe the operations offered by the service to inform human users. Because of the difficulty in creating usable abstract model that accounts for any and all possible services, it makes more sense to allow service description documents specific to different service frameworks to describe all the details in a machine-actionable format.

5 Abbreviations

CSW	Metadata Catalog for the Web. Also abbreviated as CS-W and CS/W
GeoSciML	Geoscience Markup Language
GML	Geographic Markup Language
GUID	Global Unique Identifier
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
UML	Unified Modeling Language
URI	Universal Resource Identifier
USGIN	U.S. Geoscience Information Network
WCS	Web coverage Service
WFS	Web Feature Service
XML	eXtensible Markup Language
XSD	XML Schema Definition
XSL	eXtensible Stylesheet Language
XSLT	XSL Transformations
XLink	XML Linking Language

6 References

6.1 Cited literature

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7 Codelists

7.1 ServiceType

INSPIRE metadata Implementing Rules (*OJ L 326, 4.12.2008)* section D3 mandate the use of the value domain listed in Table 10 to categorize spatial data service types. These values are better suited for CI_OnlineFunctionCode used to specify CI_OnlineResource/online/Function. The USGIN team interprets the ISO scope notes to allow more useful content for service type, specifying an actual service specification like OGC WMS. USGIN draft ServiceType vocabulary is reported in Table 11.

Table 10. INSPIRE SPATIAL DATA SERVICE TYPE (for information only, not used by USGIN)

Type	Description
discovery	Discovery Service
view	View Service
download	Download Service
transformation	Transformation Service
invoke	Invoke Spatial Data Service
other	Other Services

Table 11. USGIN service type vocabulary. This is an interim listing of serviceTypes. The code list URI for this registry is http://resources.usgin.org/registry/serviceType201001. See also http://dclite4g.xmlns.com/ws.rdf for another rdf-based vocabulary. These should probably be merged.

Identifier	Name	Description
WMS	OGC Web Map service	provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not. (http://www.opengeospatial.org/standards/wms)
WFS	OGC Web Feature service	WFS offers direct fine-grained access to geographic information at the feature and feature property level; allows clients to retrieve or modify specific data items. That data can then be used for a wide variety of purposes, including purposes other than their producers' intended ones. http://www.opengeospatial.org/standards/wfs

Identifier	Name	Description
WCS	OGC Web coverage service	interface and operations that enable interoperable access to geospatial "coverages" [http://www.opengeospatial.org/ogc/glossary/c]. The term "grid coverages" typically refers to content such as satellite images, digital aerial photos, digital elevation data, and other phenomena represented by values at each measurement point.
CSW	OGC Web catalog service	publish and search collections of descriptive information (metadata) about geospatial data, services and related resources. Providers of resources use catalogues to register metadata that conform to the provider's choice of an information model; such models include descriptions of spatial references and thematic information. (http://www.opengeospatial.org/standards/cat)
SOS	OGC Sensor observation service	manage deployed sensors and retrieve sensor data, specifically "observation" data. E.g. in-situ sensors (e.g., water monitoring) or dynamic sensors (e.g., satellite imaging). (http://www.opengeospatial.org/standards/sos)
WPS	OGC Web Processing service	rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay, are exchanged on the web to link services; defines how a client can request the execution of a process, and how the output from the process is handled, and an interface to register geospatial processes and for client to discovery and bind to those processes. (http://www.opengeospatial.org/standards/wps)
SPS	OGC Sensor planning service	interfaces for exchanging information about the capabilities of a sensor and how to task the sensor; designed to support queries to determine the feasibility of a sensor planning request, to submit such a request, to inquire about the status of such a request, to update or cancel such a request, and to request information about other OGC Web services that provide access to the data collected by the requested task.
OpenDAP	Open source data access protocol	(http://opendap.org/) a protocol for requesting and transporting data across the web. DAP 2.0 uses HTTP to frame the requests and responses. For details on DAP, see Data Access Protocol (DAP), version 2 which is a technical description of the Data Access Protocol.
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting	provides an application-independent interoperability framework based on metadata harvesting.

Example usage:

```
<srv:serviceType>
  <gco:LocalName
codeSpace="http://resources.usgin.org/registry/serviceType201001">WMS</gco:Local
Name>
</srv:serviceType>
```

7.2 Linkage name conventions

The cardinality of the `online` element in DigitalTransferOptions is 0..*. In order to distinguish the nature of various linkages that might be provided, above and beyond function, protocol, and applicationProfile, USGIN profile mandates use of the following names to associate with links to identify important linkages.

Table 12. USGIN Names to identify special linkage URL's for CI_Online Resource. CodeList URI = http://resources.usgin.org/registry/linkageName201001

Identifier	Name (eng)	Usage
icon	Icon	linkage url is link to a thumbnail icon. Icon pixel height and width range?
serviceDescription	web service description	linkage url is link to getCapabilities or WSDL that describes a service using a formal syntax such that computer programs can automate connection to the service. OnlineFunctionCode for CI_OnlineResource should be 'Information'
baseURL	web service endpoint	Base url for service. Assumes that ServiceType specifies a well know service type such that requests can be constructed without significant additional information. OnlineFunctionCode for CI_OnlineResource should be 'webService'
serviceClient	web application	URL is linkage to a web application that allows the user to access the service. OnlineFunctionCode for CI_OnlineResource should be 'Browsing'
webpage	access information	URL locates a web page with instructions for accessing the service. This provides the user with information to implement a connection to the service, but does not enable automated service access. OnlineFunctionCode for CI_OnlineResource should be 'Information'
~~serviceMetadata~~	~~Service Metadata~~	~~linkage URL is link to a complete service metadata record. Use for distribution linkage to a service for which more information that can be provided by the CI_OnlineResource element is necessary to successfully automate access to the context resource through the service. OnlineFunctionCode for CI_OnlineResource~~

		~~should be 'Information'~~
download		
email request		
offline access		

Example usage:

```
<gmd:CI_OnlineResource>
  <gmd:linkage>
    <gmd:URL>http://75.101.143.247:8080/gsvr/wms?SERVICE=WMS&amp;REQUEST=getCa
      pabilities</gmd:URL>
  </gmd:linkage>
  <gmd:protocol>
    <gco:CharacterString>OGC:WMS</gco:CharacterString>
  </gmd:protocol>
  <gmd:name>
    <gco:CharacterString xsi:type=”gml:CodeType”
      codeSpace="http://resources.usgin.org/registry/linkageName201001">
      serviceDescription</gco:CharacterString>
  </gmd:name>
</gmd:CI_OnlineResource>
```

Use of such controlled vocabulary can be indicated by using xsi:type on the gco:characterString element to make the type gml:CodeType, which then requires a codeSpace attribute. The distribution format Identifier from Table 6 should be used as the element value. For compatibility with systems that can not process this encoding, the code identifier should be included as the element value as well as the codeListValue.

8 Examples

8.1 USGIN ISO 19139 Minimum Dataset Metadata

In the following listing, text in `green` is comments; XML elements are in `blue`, XML attributes are in `black`, and attribute values are in `purple`.

This example metadata record describes itself.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--*********************************************************************************************
*** Minimum example of a ISO 19139 Geospatial Dataset Metadata
*** based on the USGIN v1.2 Profile
*** by USGIN Standards and Protocols Drafting Team
*** U.S. Geoscience Information System (USGIN) - http://lab.usgin.org
*** Contributors: Wolfgang Grunberg, Stephen M Richard
*** 2013-06-13
***
*** DISCLAIMER: this is not an authoritative metadata example but an aide to get started.
*** Refer to the USGIN profile document for more specific and complete guidelines.
***
*** Validated against http://www.isotc211.org/2005/gmd (ISO 19115, CSW 2.0.2 AP ISO 1.0).
*** Follows the USGIN ISO 19139 Dataset Metadata Profile v1.2.
***
*** NOTES:
*** - Codelists:
*** Most ISO metadata profiles and applications use ISO codelists or codelists that use ISO's
                codelist names.
***
*** - Language code:
*** Use ISO <ISO639-2/T three letter language code - lower case> formatting.
***
*** KEY: (NAP-USGIN) - M/C/O/X (Mandatory, Conditional, Optional, Not Used)
***
*********************************************************************************************-->
     <!-- USGIN ISO 19139 geospatial dataset metadata record -->
<gmd:MD_Metadata
              xmlns:gmd="http://www.isotc211.org/2005/gmd"
              xmlns:gco="http://www.isotc211.org/2005/gco"
              xmlns:gml="http://www.opengis.net/gml"
              xmlns:xlink="http://www.w3.org/1999/xlink"
              xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
              xsi:schemaLocation="http://www.isotc211.org/2005/gmd
               http://schemas.opengis.net/csw/2.0.2/profiles/apiso/1.0.0/apiso.xsd">
     <!-- (M-M) Metadata file identifier - A unique File Identifier (GUID) - USGIN recommends
                using a valid Universally Unique Identifier (UUID) -->
  <gmd:fileIdentifier>
    <gco:CharacterString>08fb00c8-0882-4bf7-b07f-fd37050c5efc</gco:CharacterString>
  </gmd:fileIdentifier>
```

```
1279          <!-- (M-M) Metadata language - ISO <ISO639-2/T three letter language code - lower case
1280          formatting. -->
1281     <gmd:language>
1282       <gco:CharacterString>eng</gco:CharacterString>
1283     </gmd:language>
1284
1285          <!-- (M-M) Metadata character set  - USGIN requires that a character set code is defined to
1286                facilitate CSW servers (deegree, GeoNetwork, etc.).  -->
1287     <gmd:characterSet>
1288       <!-- MD_CharacterSetCode names: {ucs2, ucs4, utf7, utf8, utf16, 8859part1, 8859part2,
1289       8859part3, 8859part4, 8859part5, 8859part6, 8859part7, 8859part8, 8859part9, 8859part10,
1290       8859part11, 8859part13, 8859part14, 8859part15, 8859part16, jis, shiftJIS, eucJP, usAscii,
1291       ebcdic, eucKR, big5, GB2312} -->
1292       <gmd:MD_CharacterSetCode
1293        codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Charact
1294        erSetCode" codeListValue="utf8">UTF-8</gmd:MD_CharacterSetCode>
1295     </gmd:characterSet>
1296          <!-- (M-M) Resource type - Define if this record is a: dataset (default), service, feature,
1297          software, etc. -->
1298     <gmd:hierarchyLevel>
1299          <!-- MD_ScopeCode code names: {attribute, attributeType,
1300       collectionHardware,collectionSession, dataset, series, nonGeographicDataset,
1301       dimensionGroup, feature, featureType, propertyType, fieldSession, software, service, model,
1302       tile}. -->
1303       <gmd:MD_ScopeCode
1304         codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Scope
1305         Code" codeListValue="dataset">dataset</gmd:MD_ScopeCode>
1306     </gmd:hierarchyLevel>
1307          <!-- (O-M) Resource hierarchy level name - USGIN makes this property mandatory to
1308                identify the USGIN resource type (see USGIN Profile, "Resources of Interest").
1309                Default CharacterString is “Dataset” Encode hierarchy by including
1310                hierarchyLevelName elements for all broader resource categories. E.g. default
1311                should also include a hierarchyLevelName=”Collection” element. For services
1312                USGIN hierarchyLevelName/CharacterString is “Service”. -->
1313     <gmd:hierarchyLevelName>
1314       <gco:CharacterString>Dataset</gco:CharacterString>
1315     </gmd:hierarchyLevelName>
1316     <gmd:hierarchyLevelName>
1317       <gco:CharacterString>Collection</gco:CharacterString>
1318     </gmd:hierarchyLevelName>
1319          <!-- (M-M) Metadata point of contact - Point of contact for the metadata record, e.g. for
1320                users to report errors, updates to metadata, etc. -->
1321     <gmd:contact>
1322       <gmd:CI_ResponsibleParty>
1323        <!-- (M-M) (individualName + organisationName + positionName) > 0 -->
1324        <!-- only one is mandatory, this example has organisationName -->
1325          <gmd:organisationName>
1326            <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
1327          </gmd:organisationName>
1328
1329       <!-- Metadata contact information, either a phone number or e-mail address is required.
1330       This example has an e-mail address. ISO19115 makes contact role mandatory as well. -->
```

```
1331          <gmd:contactInfo>
1332            <gmd:CI_Contact>
1333              <gmd:address>
1334                <gmd:CI_Address>
1335        <!-- (O-M) Metadata point of contact e-mail address to meet profile requirement -->
1336                  <gmd:electronicMailAddress>
1337                    <gco:CharacterString>metadata@azgs.az.gov</gco:CharacterString>
1338                  </gmd:electronicMailAddress>
1339                </gmd:CI_Address>
1340              </gmd:address>
1341            </gmd:CI_Contact>
1342          </gmd:contactInfo>
1343        <!-- (M-M) ISO 19139 Mandatory: contact role -->
1344          <gmd:role>
1345        <!-- CI_RoleCode names: {resourceProvider, custodian, owner, user, distributor, originator,
1346         pointOfContact, principalInvestigator, processor, publisher, author}  -->
1347          <gmd:CI_RoleCode
1348            codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleC
1349            ode" codeListValue="pointOfContact">point of contact</gmd:CI_RoleCode>
1350          </gmd:role>
1351        </gmd:CI_ResponsibleParty>
1352      </gmd:contact>
1353         <!-- (M-M) Metadata date stamp - USGIN profile requires use of dateStamp/gco:DateTime
1354         (Note this contrasts with INSPIRE mandate to use dateStamp/gco:Date). This is the date
1355         and time when the metadata record was created or most recently updated (following NAP).
1356         -->
1357      <gmd:dateStamp>
1358        <!-- Requires an extended ISO 8601 formatted combined UTC date and time string (YYYY-
1359         MM-DDTHH:MM:SS) Some validators require time zone as well; recommend using GMT
1360         indicated by 'Z' -->
1361         <gco:DateTime>2010-01-14T10:00:00Z</gco:DateTime>
1362      </gmd:dateStamp>
1363        <!-- (M-M) metadata standard - USGIN profile conformant metadata is indicated by the string
1364                  “ISO-USGIN" -->
1365      <gmd:metadataStandardName>
1366         <gco:CharacterString>ISO-USGIN</gco:CharacterString>
1367      </gmd:metadataStandardName>
1368        <!-- (O-M) USGIN profile version -->
1369      <gmd:metadataStandardVersion>
1370         <gco:CharacterString>1.2</gco:CharacterString>
1371      </gmd:metadataStandardVersion>
1372         <!-- (M-M) Resource identification information - At least one of MD_DataIdentification
1373                  (dataset, dataset series) or SV_ServiceIdentification (service) is required.  -->
1374      <gmd:identificationInfo>
1375        <!-- Resource Dataset or Dataset Series Identification -->
1376         <gmd:MD_DataIdentification>
1377         <!-- (M-M) Resource citation - Information to identify the intellectual origin of the content in
1378                  the described resource, along the lines of a citation in a scientific journal. Required
1379                  content for a CI_Citation element are title, date, and responsibleParty. If the
1380                  subject of the metadata record is derived from other sources, such that it is not
1381                  considered identical with those sources, the provenance should be documented in
1382                  LI_Lineage//LI_Source elements. -->
```

```
1383          <gmd:citation>
1384            <gmd:CI_Citation>
1385         <!-- (M-M) Resource title - Use titles that inform the human reader about the dataset's
1386                   content; titles should be unique in the context of the metadata catalog that
1387                   contains the metadata record. -->
1388              <gmd:title>
1389                <gco:CharacterString>USGIN minimum metadata example XML
1390                 file.</gco:CharacterString>
1391              </gmd:title>
1392        <!-- (M-M) Resource reference date - Best practice is to include at least the date of
1393                   publication or creation of the resource. The date of the resource reported in the
1394                   citation corresponds to the resource's last update version according to its update
1395                   frequency. CI_Date content includes a date and dateType. Date for USGIN profile
1396                   uses gco:DateTime. -->
1397              <gmd:date>
1398                <gmd:CI_Date>
1399                  <gmd:date>
1400       <!-- Requires an extended ISO 8601 UTC date and time string (YYYY-MM-DDTHH:MM:SS)
1401        Some validators require time zone as well; recommend GMT indicated by 'Z' -->
1402                    <gco:DateTime>2010-01-14T09:30:47Z</gco:DateTime>
1403                  </gmd:date>
1404       <!-- dateType is mandatory per ISO19115 -->
1405                  <gmd:dateType>
1406       <!-- CI_DateTypeCode names: {creation, publication, revision}. -->
1407                    <gmd:CI_DateTypeCode
1408                      codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#
1409                      CI_DateTypeCode"codeListValue="publication">publication</gmd:CI_DateTyp
1410                      eCode>
1411                  </gmd:dateType>
1412                </gmd:CI_Date>
1413              </gmd:date>
1414         <!-- (M-M) Resource responsible party - The citation attribute provides information for citing
1415                   the intellectual origin of the described resource, analogous to a citation in a
1416                   scientific journal. The citedResponsibleParty should specify the individual(s) and
1417                   organizations responsible for the creation or origination of the resource. For most
1418                   intellectual content, the responsible party is what would normally be considered
1419                   the author of a work.  -->
1420              <gmd:citedResponsibleParty>
1421                <gmd:CI_ResponsibleParty>
1422         <!-- (M-M) (individualName + organisationName + positionName) > 0 -->
1423         <!-- only one is mandatory, this example has organisationName -->
1424                  <gmd:organisationName>
1425                    <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
1426                  </gmd:organisationName>
1427           <!-- cited responsible party contact information, either a phone number or e-mail address
1428                   is required. This example has a voice telephone number. ISO19115 makes contact
1429                   role mandatory as well. -->
1430                  <gmd:contactInfo>
1431                    <gmd:CI_Contact>
1432                      <gmd:phone>
1433                        <gmd:CI_Telephone>
1434                          <gmd:voice>
```

```
                        <gco:CharacterString>520-770-3500</gco:CharacterString>
                      </gmd:voice>
                    </gmd:CI_Telephone>
                  </gmd:phone>
                </gmd:CI_Contact>
              </gmd:contactInfo>
    <!-- (M-M) ISO 19139 Mandatory: contact role  -->
              <gmd:role>
    <!-- CI_RoleCode names: {resourceProvider, custodian, owner, user, distributor, originator,
    pointOfContact, principalInvestigator, processor, publisher, author} -->
                <gmd:CI_RoleCode
                  codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#
                  CI_RoleCode"codeListValue="pointOfContact">point of
                  contact</gmd:CI_RoleCode>
              </gmd:role>
            </gmd:CI_ResponsibleParty>
          </gmd:citedResponsibleParty>
        </gmd:CI_Citation>
      </gmd:citation>

    <!-- (M-M) Resource Abstract - A free text summary of the content, significance, purpose,
              scope, etc. of the resource. Exactly one value. -->
      <gmd:abstract>
        <gco:CharacterString>Example for the minimum required elements in a USGIN dataset
          metadata record. Note that this example includes conditional minimum elements that
          may or may not apply to a specific resource and its metadata. Although the resource is
          non-geographic, and extent element is included for example
          purposes.</gco:CharacterString>
      </gmd:abstract>
    <!-- (O-C) Resource point of contact (access contact) - CI_ResponsibleParty element here
              would contain information for point of contact to access the resource. This
              information is mandatory for physical resources such as core, cuttings, samples,
              manuscripts. This example metadata record is not about a physical resource, so
              the element is empty (included here only to anchor this comment... -->
  <gmd:pointOfContact/>
    <!-- (O-C) Descriptive Keywords - Only required if the described resource is non-geographic,
              in which case the single keyword 'non-geographic' is mandatory. This example
              instance is about itself, and example metadata record, and is thus non-geographic
              so the keyword is mandatory. Note that and example bounding box is included for
              information purposes as well. -->
    <gmd:descriptiveKeywords>
      <gmd:MD_Keywords>
        <gmd:keyword>
          <gco:CharacterString>non-geographic</gco:CharacterString>
        </gmd:keyword>

        <gmd:type>
    <!-- Keyword Type - allowed values from MD_KeywordTypeCode names: {discipline, place,
    stratum, temporal, theme} -->
          <gmd:MD_KeywordTypeCode
            codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Ke
            ywordTypeCode" codeListValue="place">place</gmd:MD_KeywordTypeCode>
```

```
            </gmd:type>
          </gmd:MD_Keywords>
        </gmd:descriptiveKeywords>
        <!-- (M-M) Resource language - Multiple instances of this element indicate that the linguistic
        content of the resource is available in multiple languages -->
          <gmd:language>
        <!-- ISO 639-2/T three-letter language code (http://www.loc.gov/standards/iso639-2/). -->
            <gco:CharacterString>eng</gco:CharacterString>
          </gmd:language>
        <!-- (C-C) Topic category - A topicCategory code must be provided when hierarchyLevel is
                    set to "dataset" (this example document) or "dataset series". Most USGIN
                    resources will have MD_TopicCategoryCode = "geoscientificInformation", which is
                    the default value for this profile.  More specific topic categorization should be done
                    using keywords. -->
          <gmd:topicCategory>
        <!-- MD_TopicCategoryCode names: {farming, biota, boundaries,
        climatologyMeterologyAtmosphere, economy, elevation, environment,
        geoscientificInformation, health, imageryBaseMapsEarthCover, intelligenceMilitary,
        inlandWater, location, oceans, planningCadastre, society, structure, transportation,
        utilitiesCommunication} -->
            <gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
          </gmd:topicCategory>
        <!-- (C-C) Resource content extent - Defines the spatial (horizontal and vertical) and
                    temporal region to which the content of the resource applies. For USGIN, a
                    geographicElement/geographicBoundingBox must be provided for any resource
                    with content related to some geographic location. If the described resource is not
                    related to a geographic area, the place keyword 'non-geographic' should be
                    included in the descriptiveKeywords element. -->
        <!-- note that although this example record is about a non-geographic resource, bounding
                    boxes are anticipated for most resources so an example element is included, but it
                    is not required. -->
          <gmd:extent>
            <gmd:EX_Extent>
        <!-- (O-C) Resource content extent bounding box -USGIN profile requires that if an
                    EX_Extent/geographicElement is supplied, it include a geographic bounding box
                    with bounding latitude and longitude expressed using WGS 84 decimal degrees.
                    The corner coordinates for the geographic bounding box must not coincide in one
                    point, because this may result in fatal errors with some CSW implementations.
                    Point locations must thus be represented as tiny rectangles. USGIN recommended
                    practice is to place the actual point location in the lower left corner of the rectangle.
                    -->
              <gmd:geographicElement>
                <gmd:EX_GeographicBoundingBox>
                  <gmd:westBoundLongitude>
                    <gco:Decimal>-109.911001</gco:Decimal>
                  </gmd:westBoundLongitude>
                  <gmd:eastBoundLongitude>
                    <gco:Decimal>-109.910999</gco:Decimal>
                  </gmd:eastBoundLongitude>
                  <gmd:southBoundLatitude>
                    <gco:Decimal>34.772899</gco:Decimal>
                  </gmd:southBoundLatitude>
```

```
                <gmd:northBoundLatitude>
                  <gco:Decimal>34.772901</gco:Decimal>
                </gmd:northBoundLatitude>
              </gmd:EX_GeographicBoundingBox>
            </gmd:geographicElement>
          </gmd:EX_Extent>
        </gmd:extent>
      </gmd:MD_DataIdentification>
    </gmd:identificationInfo>
      <!-- Distribution (O-M) This element provides information to inform users how to obtain or
                access the described resource, which is considered part of the minimum useful
                content that should be provided by a metadata record. USGIN profile specifies that
                at least one MD_Distribution/distributor and one MD_Distribution/transferOptions
                element are required, and that the specified distributor provides the specified
                transfer options. -->
    <gmd:distributionInfo>
      <gmd:MD_Distribution>
        <gmd:distributor>
          <gmd:MD_Distributor>
       <!-- (O-C) distributor point of contact - CI_ResponsibleParty element here would contain
                information on who to contact if there is a problem with accessing the resource
                following the instructions in this distribution element. This information is
                mandatory, requiring at least a name (one of individual, organization, or position)
                and a voice telephone number or e-mail address. This example includes a position
                name and e-mail address. -->
              <gmd:distributorContact>
                <gmd:CI_ResponsibleParty>
                  <gmd:positionName>
                    <gco:CharacterString>Web Master</gco:CharacterString>
                  </gmd:positionName>
                  <gmd:contactInfo>
                    <gmd:CI_Contact>
                      <gmd:address>
                        <gmd:CI_Address>
                          <gmd:electronicMailAddress>
                            <gco:CharacterString>webmaster@usgin.org</gco:CharacterString>
                          </gmd:electronicMailAddress>
                        </gmd:CI_Address>
                      </gmd:address>
                    </gmd:CI_Contact>
                  </gmd:contactInfo>
                  <gmd:role>
      <!-- CI_RoleCode names: pointOfContact is mandatory for at least one distributor
                responsible party -->
                      <gmd:CI_RoleCode
                        codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.x
                        ml#CI_RoleCode"codeListValue="pointOfContact">point of
                        contact</gmd:CI_RoleCode>
                  </gmd:role>
                </gmd:CI_ResponsibleParty>
              </gmd:distributorContact>
            </gmd:MD_Distributor>
```

```
1591            </gmd:distributor>
1592            <gmd:transferOptions>
1593               <gmd:MD_DigitalTransferOptions>
1594                  <gmd:onLine>
1595                     <gmd:CI_OnlineResource>
1596         <!-- The CI_OnlineResource/linkage/URL element must contain complete URL to access the
1597                        resource -->
1598                        <gmd:linkage>
1599                           <gmd:URL>http://repository.usgin.org/uri_gin/usgin/dlio/337</gmd:URL>
1600                        </gmd:linkage>
1601                     </gmd:CI_OnlineResource>
1602                  </gmd:onLine>
1603               </gmd:MD_DigitalTransferOptions>
1604            </gmd:transferOptions>
1605         </gmd:MD_Distribution>
1606      </gmd:distributionInfo>
1607   </gmd:MD_Metadata>
```

8.2 USGIN ISO 19139 Dataset Metadata

In the following listing, text in green is comments; XML elements are in blue, XML attributes are in red, and attribute values are in purple.

This example metadata record describes a scanned well log document.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--*********************************************************************************************
*** Example ISO 19139 Geospatial Dataset Metadata based on the USGIN v1.2 Profile
*** by USGIN Standards and Protocols Drafting Team
*** U.S. Geoscience Information System (USGIN) - http://lab.usgin.org
*** Contributors: Wolfgang Grunberg, Stephen M Richard
*** 2013-06-14
***
*** DISCLAIMER: this is not an authoritative metadata example but an aide to get started; refer
                to
*** the USGIN profile document for more specific and complete guidelines.
***
*** Validated against http://www.isotc211.org/2005/gmd (ISO 19115, CSW 2.0.2 AP ISO 1.0).
*** Follows the USGIN ISO 19139 Dataset Metadata Profile v1.2.
***
*** NOTES:
*** - Codelists:
*** Most ISO metadata profiles and applications use ISO codelists. The codeList attribute points
                to a Uniform Resource Locator (URL) that locates a resource describing the code
                list values. It can be a URN or a URL.
***
*** KEY: - M/C/O/X (Mandatory, Conditional, Optional, Not Used)
***
*********************************************************************************************-->
     <!-- USGIN ISO 19139 geospatial dataset metadata record -->
<gmd:MD_Metadata  xmlns=”http://www.isotc211.org/2005/gmd”
                  xmlns:gco="http://www.isotc211.org/2005/gco"
                  xmlns:gmd="http://www.isotc211.org/2005/gmd"
                  xmlns:gmi="http://www.isotc211.org/2005/gmi"
                  xmlns:gml="http://www.opengis.net/gml"
                  xmlns:gmx="http://www.isotc211.org/2005/gmx"
                  xmlns:gts="http://www.isotc211.org/2005/gts"
                  xmlns:srv="http://www.isotc211.org/2005/srv"
                  xmlns:xlink="http://www.w3.org/1999/xlink"
                  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                  xsi:schemaLocation="http://www.isotc211.org/2005/gmd
                  http://schemas.opengis.net/csw/2.0.2/profiles/apiso/1.0.0/apiso.xsd">
      <!-- (M) Unique Identifier for the metadata record - USGIN recommends using a valid
                Universally Unique Identifier (UUID) -->
  <gmd:fileIdentifier>
    <gco:CharacterString>00C02E67-F1ED-473DA240068CCB041A73</gco:CharacterString>
  </gmd:fileIdentifier>
    <!-- (M) Metadata language ISO639-2/T three letter language code - lower case. -->
  <gmd:language>
    <gco:CharacterString>eng</gco:CharacterString>
  </gmd:language>
```

```
1658                <!-- (M) Metadata character set  - default is "utf8", USGIN requires that a character
1659                set code is defined to facilitate CSW servers (deegree, GeoNetwork, etc.). -->
1660    <gmd:characterSet>
1661                <!-- MD_CharacterSetCode names: {ucs2, ucs4, utf7, utf8, utf16, 8859part1,
1662                8859part2, 8859part3, 8859part4, 8859part5, 8859part6, 8859part7, 8859part8,
1663                8859part9, 8859part10, 8859part11, 8859part13, 8859part14, 8859part15,
1664                8859part16, jis, shiftJIS, eucJP, usAscii, ebcdic, eucKR, big5, GB2312}.  -->
1665      <gmd:MD_CharacterSetCode
1666      codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Charact
1667      erSetCode" codeListValue="utf8">UTF-8</gmd:MD_CharacterSetCode>
1668    </gmd:characterSet>
1669
1670               <!-- (M-M) Resource type - Define if this record is a: dataset (default), service,
1671                feature, software, etc. -->
1672    <gmd:hierarchyLevel>
1673                <!-- MD_ScopeCode code names: {attribute, attributeType, collectionHardware,
1674                col-lectionSession, dataset, series, nonGeographicDataset, dimensionGroup,
1675                feature, fea-tureType, propertyType, fieldSession, software, service, model, tile}. --
1676                >
1677      <gmd:MD_ScopeCode
1678        codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Scope
1679        Code" codeListValue="dataset">dataset</gmd:MD_ScopeCode>
1680    </gmd:hierarchyLevel>
1681               <!-- (O-M) Resource hierarchy level name - USGIN makes this property mandatory
1682                to identify the USGIN resource type (see USGIN Profile, "Resources of Interest").
1683                Default USGIN hierarchyLevelName CharacterString is “Dataset”. Encode
1684                hierarchy by including hierarchyLevelName elements for all broader resource
1685                categories. E.g. default should also include a hierarchyLevelName=”Collection”
1686                element. For services USGIN hierarchyLevelName.CharacterString is “Service” -->
1687    <gmd:hierarchyLevelName>
1688      <gco:CharacterString>Dataset</gco:CharacterString>
1689    </gmd:hierarchyLevelName>
1690    <gmd:hierarchyLevelName>
1691      <gco:CharacterString>Collection</gco:CharacterString>
1692    </gmd:hierarchyLevelName>
1693               <!-- (M-M) Metadata point of contact - Point of contact use- to report errors,
1694                updates to metadata -->
1695    <gmd:contact>
1696      <gmd:CI_ResponsibleParty>
1697                <!-- (M-M) (individualName + organisationName + positionName) > 0 -->
1698        <gmd:individualName>
1699          <gco:CharacterString>Stephen Richard</gco:CharacterString>
1700        </gmd:individualName>
1701        <gmd:organisationName>
1702          <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
1703        </gmd:organisationName>
1704        <gmd:positionName>
1705          <gco:CharacterString>Metadata Czar</gco:CharacterString>
1706        </gmd:positionName>
1707        <gmd:contactInfo>
1708          <gmd:CI_Contact>
1709            <gmd:phone>
```

```
1710              <gmd:CI_Telephone>
1711                <gmd:voice>
1712                  <gco:CharacterString>520.770.3500</gco:CharacterString>
1713                </gmd:voice>
1714                <gmd:facsimile>
1715                  <gco:CharacterString>520.770.3505</gco:CharacterString>
1716                </gmd:facsimile>
1717              </gmd:CI_Telephone>
1718            </gmd:phone>
1719            <gmd:address>
1720              <gmd:CI_Address>
1721                <gmd:deliveryPoint>
1722                  <gco:CharacterString>416 W. Congress St., Suite 100</gco:CharacterString>
1723                </gmd:deliveryPoint>
1724                <gmd:city>
1725                  <gco:CharacterString>Tucson</gco:CharacterString>
1726                </gmd:city>
1727                <gmd:administrativeArea>
1728                  <gco:CharacterString>Arizona</gco:CharacterString>
1729                </gmd:administrativeArea>
1730                <gmd:postalCode>
1731                  <gco:CharacterString>85701-1381</gco:CharacterString>
1732                </gmd:postalCode>
1733                <gmd:country>
1734                  <gco:CharacterString>USA</gco:CharacterString>
1735                </gmd:country>
1736                <!-- (O-M) Metadata point of contact e-mail address - mandatory if voice phone
1737                 number not supplied -->
1738                <gmd:electronicMailAddress>
1739                  <gco:CharacterString>metadata@azgs.az.gov</gco:CharacterString>
1740                </gmd:electronicMailAddress>
1741              </gmd:CI_Address>
1742            </gmd:address>
1743                <!-- (O-O) online resources - this is the online resource to contact the metadata
1744                 person-->
1745            <gmd:onlineResource>
1746              <gmd:CI_OnlineResource>
1747                <gmd:linkage>
1748                  <gmd:URL>http://www.azgs.az.gov</gmd:URL>
1749                </gmd:linkage>
1750                <gmd:protocol>
1751                  <gco:CharacterString>http</gco:CharacterString>
1752                </gmd:protocol>
1753                <gmd:description>
1754                   <gco:CharacterString>Arizona Geological Survey Web
1755                    Site</gco:CharacterString>
1756                </gmd:description>
1757              </gmd:CI_OnlineResource>
1758            </gmd:onlineResource>
1759            <gmd:hoursOfService>
1760                  <gco:CharacterString>8 AM to 5 PM Mountain Standard time (no daylight
1761                  savings)</gco:CharacterString>
```

```
            </gmd:hoursOfService>
            <gmd:contactInstructions>
              <gco:CharacterString>Contact Steve Rauzi [Ste-ve.Rauzi@azgs.az.gov] or call Oil
                and Gas Commission Staff at Arizona Geological Survey, 520-770-
                3500.</gco:CharacterString>
            </gmd:contactInstructions>
          </gmd:CI_Contact>
        </gmd:contactInfo>
              <!-- (M-M) ISO 19139 Mandatory: contact role -->
        <gmd:role>
              <!-- a responsible party with role=pointOfContact is manda-tory for metadata
              contact -->
          <gmd:CI_RoleCode
            codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_Rol
            eCode" codeListValue="pointOfContact">pointOfContact</gmd:CI_RoleCode>
        </gmd:role>
      </gmd:CI_ResponsibleParty>
    </gmd:contact>
              <!-- (X-O) Metadata should include a URL that locates a thumbnail logo for
              organizations related to the metadata origination, the organization hosting the
              catalog that returned the metadata, the organization that originated the data, and
              the organization hosting online services that provide access to the data. -->
    <gmd:contact>
      <gmd:CI_ResponsibleParty>
        <gmd:organisationName>
          <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
        </gmd:organisationName>
        <gmd:contactInfo>
          <gmd:CI_Contact>
            <gmd:address>
              <gmd:CI_Address>
                <gmd:electronicMailAddress gco:nilReason="missing">
                  <gco:CharacterString>metadata@usgin.org</gco:CharacterString>
                </gmd:electronicMailAddress>
              </gmd:CI_Address>
            </gmd:address>
            <gmd:onlineResource>
              <gmd:CI_OnlineResource>
                <!-- Icon image file (e.g. tif, png, jpg, gif) for the metadata originator. This Icon will
                be displayed in search results to credit the metadata originator. -->
                <gmd:linkage>
                  <gmd:URL>http://www.azgs.az.gov/logo/metadata/azgs.png</gmd:URL>
                </gmd:linkage>
                <!-- URL that locates an icon thumbnails, the CI_OnlineResource/name MUST be
                'icon' -->
                <gmd:name>
                  <gco:CharacterString>icon</gco:CharacterString>
                </gmd:name>
              </gmd:CI_OnlineResource>
            </gmd:onlineResource>
          </gmd:CI_Contact>
        </gmd:contactInfo>
```

```
                <!-- none of the codelist roles are applicable -->
          <gmd:role gco:nilReason="inapplicable"/>
        </gmd:CI_ResponsibleParty>
    </gmd:contact>
                <!-- (M-M) Metadata date stamp - USGIN profile requires use of dateS-
                 tamp/gco:DateTime (Note this contrasts with INSPIRE mandate to use dateS-
                 tamp/gco:Date). This is the date and time when the metadata record was created
                 or up-dated (following NAP). -->
    <gmd:dateStamp>
      <gco:DateTime>2009-11-17T10:00:00</gco:DateTime>
    </gmd:dateStamp>
                <!-- (M-M) USGIN profile conformant metadata is indicated by using “ISO-USGIN"
                -->
    <gmd:metadataStandardName>
      <gco:CharacterString>ISO-USGIN</gco:CharacterString>
    </gmd:metadataStandardName>
                <!-- (O-M) USGIN profile version, mandatory in this profile -->
    <gmd:metadataStandardVersion>
      <gco:CharacterString>1.2</gco:CharacterString>
    </gmd:metadataStandardVersion>
                <!-- (O-C) Dataset Identifier - For USGIN, this is a string that uniquely identifies the
                 de-scribed resource. If the resource has an identifier, it should be included here; if
                 the re-source will be referenced from other metadata, it must have an identifier
                 here. If the da-taset is coupled to a service, the value of the
                 MD_Metadata/dataSetURI attribute is the unique resource identifier used by
                 srv:coupledResource to link the service with the da-taset. For the USGIN profile,
                 the MD_Distribution/transferOptions/MD_DigitalTransferOptions/
                 online/CI_OnlineResource is used to specify URLs for access to the resource. -->
    <gmd:dataSetURI>
      <gco:CharacterString>http://azgs.az.gov/resource/00C02E67-F1ED-473D-A240-
        068CCB041A73</gco:CharacterString>
    </gmd:dataSetURI>
                <!-- gmd:local would be here, but USGIN profile convention is that each catalog
                 service is specific to one language, rather that expecting clients to be able to
                 process gmd:PT_Locale and gmd:LocalisedCharacterString. gmd:local elements
                 may be ignored by USGIN clients -->
                <!-- (O-O) Resource spatial representation - Spatial representation information for
                 the da-taset (resource). Best practice is to include metadata for spatial
                 representation if the de-scribed resource is a georeferenced dataset. -->
                <!-- in this example, the described resource is a document that does not contain
                 geolo-cated data items, so spatial representation is not applicable -->
    <gmd:spatialRepresentationInfo gco:nilReason="inapplicable"/>
                <!-- (O-O) Resource’s spatial reference system - Description of the spatial and/or
                 tem-poral reference systems used in the dataset. If
                 {/MD_SpatialRepresentationTypeCode = "vector") or
                 (../MD_SpatialRepresentationTypeCode = "grid") or
                 (../MD_SpatialRepresentationTypeCode = "tin") then count referenceSystemInfo
                 >= 1) }not applicable to the document described by this record -->
    <gmd:referenceSystemInfo gco:nilReason="inapplicable"/>
                <!-- ********************************************************************************* -->
```

```
                <!-- (M-M) Resource identification information - At least one of
                MD_DataIdentification (da-taset, dataset series) or SV_ServiceIdentification
                (service) is required.  -->
  <gmd:identificationInfo>
                <!-- Resource Dataset or Dataset Series Identification. In practice, anything that is
                not a service is described using MD_DataIdentification -->
    <gmd:MD_DataIdentification>
                <!-- (M-M) Resource citation - Information to identify the intellectual origin of the
                content in the described resource, along the lines of a citation in a scientific
                journal. Required content for a CI_Citation element are title, date, and
                responsibleParty. If the subject of the metadata record is derived from other
                sources, such that it is not considered identical with those sources, the
                provenance should be documented in LI_Lineage//LI_Source elements. -->
      <gmd:citation>
        <gmd:CI_Citation>
                <!-- (M-M) Resource title - Use titles that inform the human reader about the da-
                taset's content; titles should be unique in the context of the metadata catalog that
                contains the metadata record. -->
          <gmd:title>
            <gco:CharacterString>
              Scanned Borehole Compensated Sonic Log for 0391, Kerr-McGee08 Navajo
            </gco:CharacterString>
          </gmd:title>
                <!-- (M-M) Resource reference date - Best practice is to include at least the date of
                publi-cation or creation of the resource. The date of the resource reported in the
                citation corre-sponds to the resource's last update version according to its update
                frequency. CI_Date content includes a date and dateType. Date for USGIN profile
                uses gco:DateTime. -->
          <gmd:date>
            <gmd:CI_Date>
              <gmd:date>
              <!-- Requires an extended ISO 8601 UTC date and time string (YYYY-MM
              DDTHH:MM:SS) Some validators require time zone as well; recommend GMT
              indicated by 'Z' -->
                <gco:DateTime>2001-12-17T09:30:47</gco:DateTime>
              </gmd:date>
              <gmd:dateType>
              <!-- dateType is mandatory per ISO19115 -->
              <!-- CI_DateTypeCode values in citation context: {creation, publication, revision}. --
              >
                <gmd:CI_DateTypeCode
                   codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#
                   CI_DateTypeCode"
                   codeListValue="publication">publication</gmd:CI_DateTypeCode>
              </gmd:dateType>
            </gmd:CI_Date>
          </gmd:date>
                <!-- (C-C) Unique resource identifier  - For USGIN purposes, this element content
                value should be considered an identifier for the citation, without any assumption
                that it will use http protocol. The identifier may be resolvable to a URL, if a protocol
                prefix specifies an identifier scheme that is resolvable (e.g. http, doi…), but this is
                not necessary for a valid document, and should not be assumed when processing
```

```
1916                metadata documents. IF the Ci-tation has an identifier that is different from the
1917                identifier for the described resource (MD_Metadata/dataSetURI), it must be
1918                included here. The USGIN profile requires use of MD_Identifer. If additional
1919                codespace and version content is associated with the identifier, it should be
1920                encoded as MD_Identifier/authority/ CI_Citation/ alternateTitle and MD_Identifier/
1921                authority/ CI_Citation/ edition  -->
1922            <gmd:identifier>
1923              <gmd:MD_Identifier>
1924                <gmd:code>
1925                <!-- 13 digit ISBN example -->
1926                  <gco:CharacterString>isbn:000-0-000-00000-0</gco:CharacterString>
1927                </gmd:code>
1928              </gmd:MD_Identifier>
1929            </gmd:identifier>
1930                <!-- (M-M) Resource responsible party - The citation attribute provides information
1931                for cit-ing the intellectual origin of the described resource, analogous to a citation
1932                in a scientific journal. The citedResponsibleParty should specify the individual(s)
1933                and organizations re-sponsible for the creation or origination of the resource. For
1934                most intellectual content, the responsible party is what would normally be
1935                considered the author of a work.  -->
1936                <!-- in the context of the well log described by this example, the originator should
1937                be considered the operator who ran the log (individualName), or the logging
1938                company that ran the log; the drilling operator migh also be considered as
1939                originator. Unfortuantely, in this case that information is missing, so the provided
1940                contact information is for the custodian, not the author or originator. -->
1941            <gmd:citedResponsibleParty>
1942              <gmd:CI_ResponsibleParty>
1943                <!-- (M-M) (individualName + organisationName + positionName) > 0 -->
1944                <gmd:individualName>
1945                  <gco:CharacterString>Steve Rauzi</gco:CharacterString>
1946                </gmd:individualName>
1947                <gmd:organisationName>
1948                  <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
1949                </gmd:organisationName>
1950                <gmd:positionName>
1951                  <gco:CharacterString>Oil and Gas Administrator</gco:CharacterString>
1952                </gmd:positionName>
1953                <!-- cited responsible party contact information, either a voice phone number or e-
1954                mail address is required. Everything else is optional -->
1955                <gmd:contactInfo>
1956                  <gmd:CI_Contact>
1957                    <gmd:phone>
1958                      <gmd:CI_Telephone>
1959                        <gmd:voice>
1960                          <gco:CharacterString>520-770-3500</gco:CharacterString>
1961                        </gmd:voice>
1962                        <gmd:facsimile>
1963                          <gco:CharacterString>520-770-3505</gco:CharacterString>
1964                        </gmd:facsimile>
1965                      </gmd:CI_Telephone>
1966                    </gmd:phone>
1967                    <gmd:address>
```

```
                    <gmd:CI_Address>
                      <gmd:deliveryPoint>
                        <gco:CharacterString>416 W. Congress St., Suite
                          100</gco:CharacterString>
                      </gmd:deliveryPoint>
                      <gmd:city>
                        <gco:CharacterString>Tucson</gco:CharacterString>
                      </gmd:city>
                      <gmd:administrativeArea>
                        <gco:CharacterString>Arizona</gco:CharacterString>
                      </gmd:administrativeArea>
                      <gmd:postalCode>
                        <gco:CharacterString>85701</gco:CharacterString>
                      </gmd:postalCode>
                      <gmd:country>
                        <gco:CharacterString>USA</gco:CharacterString>
                      </gmd:country>
                      <gmd:electronicMailAddress>
                        <gco:CharacterString>Steve.rauzi@azgs.az.gov</gco:CharacterString>
                      </gmd:electronicMailAddress>
                    </gmd:CI_Address>
                  </gmd:address>
                </gmd:CI_Contact>
              </gmd:contactInfo>
              <!-- (M-M) ISO 19139 Mandatory: contact role  -->
              <gmd:role>
              <!-- CI_RoleCode values in this context:  {originator, principalInvestigator,
              processor, author, custodian} -->
                <gmd:CI_RoleCode
                    codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#
                    CI_RoleCode" codeListValue="custodian">custodian</gmd:CI_RoleCode>
              </gmd:role>
            </gmd:CI_ResponsibleParty>
          </gmd:citedResponsibleParty>
              <!-- (O-C) Dataset Presentation Form - The form in which the original cited
              resource is available. Note that the citation is to the original source of intellectual
              content in the de-scribed resource, and its presentation may be different from the
              format for distribution de-scribed in the metadata. This element should be specified
              if there is a difference between the cited resource presentation format and the
              distribution format(s) listed in the distribu-tionInfo/MD_Distribution section of the
              metadata record. This information is mostly for documentation; for discovery and
              data access, the distribution formats are more relevant. -->
              <!-- in this example, the original log was acquired by a pen on a strip chart
              recorder... -->
        <gmd:presentationForm>
              <!-- CI_PresentationFormCode names: {documentDigital, documentHardcopy, im-
              ageDigital, image-Hardcopy, mapDigital, mapHardcopy, modelDigital, model-
              Hardcopy, profileDigital, profileHardcopy, tableDigital, tableHardcopy, videoDigital,
              videoHardcopy, audioDigital} -->
            <gmd:CI_PresentationFormCode
              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_
```

```
                PresentationFormCode" codeListValue="documentHardcopy">hardcopy on pa-
                per</gmd:CI_PresentationFormCode>
            </gmd:presentationForm>
                <!-- (O-O) Resource series - Information about the series or collection of which the
                cited resource is a part. -->
              <gmd:series>
                <gmd:CI_Series>
                  <gmd:name>
                  <!-- Name of the publication series or aggregate dataset of which the referenced
                  dataset is a part. -->
                    <gco:CharacterString>AZGS well log library</gco:CharacterString>
                  </gmd:name>
                </gmd:CI_Series>
              </gmd:series>
                <!-- (O-O) Resource other citation details; Recommended practice: a complete
                recommended bibliographic citation should be specified in this element. -->
              <gmd:otherCitationDetails>
                <gco:CharacterString>
                  Scanned Borehole Compensated Sonic Log for 0391, Kerr-McGee08 Navajo,1967:
                  Tucson, AZ, Arizona Geological Survey Well Log Li-brary, scanned log file, 1 pdf
                  document.
                </gco:CharacterString>
              </gmd:otherCitationDetails>
                <!-- (O-C) Resource collective title - Title of the combined resource that the cited
                resource is part of, for example the cited resource may be a paper in an anthology,
                in which case the anthology title would be the collective title. Required if the cited
                resource is part of such a collective work. -->
              <gmd:collectiveTitle gco:nilReason="inapplicable"/>
            </gmd:CI_Citation>
          </gmd:citation>
                <!-- (M-M) Resource Abstract - A free text summary of the content, significance,
                purpose, scope, etc. of the resource. Exactly one value. -->
          <gmd:abstract>
            <gco:CharacterString>Digital files containing Tiff images of scanned logs. Scanned
              using Neutra scanner hardware. Well penetrates Co-conino, Hermosa, Mississippian,
              Devonian (McCraken, Aneth) and bottoms in Precambrian. Total depth 3647 feet. No
              other logs were run. Well abandoned in 1973. </gco:CharacterString>
          </gmd:abstract>
                <!-- (O-O) Resource purpose - Summary of the intentions for which the dataset
                was developed. Purpose includes objectives for creating the dataset and what the
                dataset is to support. No USGIN conventions for use of this element. -->
          <gmd:purpose/>
                <!-- (O-O) Resource Status -  -->
          <gmd:status>
                <!-- MD_ProgressCode: For USGIN discovery metadata, values should be re-
                stricted to {completed, onGoing, deprecated}. Obsolete is synonymous with
                deprecated.  -->
            <gmd:MD_ProgressCode
              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Pr
              ogressCode" codeListValue="completed">completed</gmd:MD_ProgressCode>
          </gmd:status>
```

```
                <!-- (O-C) Resource point of contact - CI_ResponsibleParty element contains
                information for point of contact to access the resource. This information is
                mandatory for physical resources such as core, cuttings, samples, manuscripts -->
        <gmd:pointOfContact>
          <gmd:CI_ResponsibleParty>
            <!-- (M-M) (individualName + organisationName + positionName) > 0 -->
            <gmd:individualName>
              <gco:CharacterString>Steve Rauzi</gco:CharacterString>
            </gmd:individualName>
            <gmd:organisationName>
              <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
            </gmd:organisationName>
            <gmd:positionName>
              <gco:CharacterString>Oil and Gas Administrator</gco:CharacterString>
            </gmd:positionName>
                <!-- (O-C) Contact Information - If a resource point of contact is required then
                (phone + deliveryPoint + electronicMailAddress) > 0. -->
            <gmd:contactInfo>
              <gmd:CI_Contact>
                <gmd:phone>
                  <gmd:CI_Telephone>
                    <gmd:voice>
                      <gco:CharacterString>520-770-3500</gco:CharacterString>
                    </gmd:voice>
                    <gmd:facsimile>
                      <gco:CharacterString>520-770-3505</gco:CharacterString>
                    </gmd:facsimile>
                  </gmd:CI_Telephone>
                </gmd:phone>
                <gmd:address>
                  <gmd:CI_Address>
                    <gmd:deliveryPoint>
                      <gco:CharacterString>416 W. Congress St., Suite
                          100</gco:CharacterString>
                    </gmd:deliveryPoint>
                    <gmd:city>
                      <gco:CharacterString>Tucson</gco:CharacterString>
                    </gmd:city>
                    <gmd:administrativeArea>
                      <gco:CharacterString>Arizona</gco:CharacterString>
                    </gmd:administrativeArea>
                    <gmd:postalCode>
                      <gco:CharacterString>85701</gco:CharacterString>
                    </gmd:postalCode>
                    <gmd:country>
                      <gco:CharacterString>USA</gco:CharacterString>
                    </gmd:country>
                    <gmd:electronicMailAddress>
                      <gco:CharacterString>Steve.rauzi@azgs.az.gov</gco:CharacterString>
                    </gmd:electronicMailAddress>
                  </gmd:CI_Address>
                </gmd:address>
```

```
2122              </gmd:CI_Contact>
2123            </gmd:contactInfo>
2124                <!-- (M-M) ISO 19139 Mandatory: contact role -->
2125            <gmd:role>
2126                <!-- CI_RoleCode names: ISO role codes for physical resource point of contact are
2127                {custodian, owner, pointOfContact}; other point of contact role codes may apply for
2128                other resources.   -->
2129              <gmd:CI_RoleCode
2130                codeList=http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_
2131                RoleCode codeListValue="pointOfContact">point of contact</gmd:CI_RoleCode>
2132            </gmd:role>
2133          </gmd:CI_ResponsibleParty>
2134        </gmd:pointOfContact>
2135
2136                <!-- (O-O) Resource Maintenance - This element provides information about the
2137                mainte-nance schedule or history of the resource (or some subset/part of the
2138                resource specified by the scope and scope description) described by the metadata
2139                record. 0 to many MD_MaintenanceInformation elements may be included.   -->
2140        <gmd:resourceMaintenance>
2141          <gmd:MD_MaintenanceInformation>
2142            <gmd:maintenanceAndUpdateFrequency>
2143                <!-- MD_MaintenanceFrequencyCode names: {continual, daily, weekly, fort-nightly,
2144                monthly, quarterly, biannually, annually, asNeeded, irregular, not-Planned, un-
2145                known} -->
2146              <gmd:MD_MaintenanceFrequencyCode
2147                codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD
2148                _MaintenanceFrequencyCode" codeListValue="asNeeded">as need-
2149                ed</gmd:MD_MaintenanceFrequencyCode>
2150            </gmd:maintenanceAndUpdateFrequency>
2151          </gmd:MD_MaintenanceInformation>
2152        </gmd:resourceMaintenance>
2153                <!-- (O-O) Graphic overview of resource - USGIN best practice is to provide
2154                xlink:href URL to file if it is available online, as an attribute of the
2155                MD_BrowseGraphic element. If  MD_BrowseGraphic is included,
2156                MD_BrowseGraphic/filename character string is manda-tory. Recommended
2157                practice is to use the Anchor extension of CharacterString xml ele-ment from
2158                ISO19139, which provides a url as an attribute and a text string as a label for the
2159                link.  -->
2160        <gmd:graphicOverview>
2161          <gmd:MD_BrowseGraphic>
2162                <!-- file name is required. USGIN Recommended practice is to provide a com-plete
2163                URL as the CharacterString value -->
2164            <gmd:fileName>
2165              <gco:CharacterString>
2166                http://azgs.az.gov/resource/00C02E67-F1ED-473D-A240-
2167                068CCB041A73/preview.jpg
2168              </gco:CharacterString>
2169            </gmd:fileName>
2170            <gmd:fileDescription>
2171              <gco:CharacterString>preview of scanned well log</gco:CharacterString>
2172            </gmd:fileDescription>
2173                <!-- Recommended practice is to provide a registered MIME type -->
```

```
            <gmd:fileType>
              <gco:CharacterString>image/jpg</gco:CharacterString>
            </gmd:fileType>
          </gmd:MD_BrowseGraphic>
        </gmd:graphicOverview>
                <!-- (X-X) Resource Format - This element is not used by NAP or USGIN; this
                information is encoded in MD_Metadata/distributionInfo/MD_Distribution/ in USGIN
                metadata. -->
        <gmd:resourceFormat/>
                <!-- (O-O) Resource keywords - Best Practice for USGIN profile metadata is to
                supply keywords to facilitate the discovery of metadata records relevant to the
                user. USGIN re-quires that MD_Keyword/keyword contain a CharacterString.
                USGIN best practice is to include keywords in English -->
        <!-- Theme keywords -->
        <gmd:descriptiveKeywords>
          <gmd:MD_Keywords>
            <gmd:keyword>
              <gco:CharacterString>Scanned Gamma Ray Neutron</gco:CharacterString>
            </gmd:keyword>
            <gmd:keyword>
              <gco:CharacterString>NMAL</gco:CharacterString>
            </gmd:keyword>
            <gmd:keyword>
              <gco:CharacterString>borehole</gco:CharacterString>
            </gmd:keyword>
                <!-- Keyword Type: allowed values from MD_KeywordTypeCode names:{discipline,
                place, stratum, temporal, theme}  -->
            <gmd:type>
              <gmd:MD_KeywordTypeCode
                codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD
                KeywordTypeCode"
                codeListValue="theme">theme</gmd:MD_KeywordTypeCode>
            </gmd:type>
          </gmd:MD_Keywords>
        </gmd:descriptiveKeywords>
        <!-- Temporal keywords -->
        <gmd:descriptiveKeywords>
          <gmd:MD_Keywords>
            <gmd:keyword>
              <gco:CharacterString>Frasian</gco:CharacterString>
            </gmd:keyword>
            <gmd:keyword>
              <gco:CharacterString>Upper Devonian</gco:CharacterString>
            </gmd:keyword>
            <gmd:keyword>
              <gco:CharacterString>Devonian</gco:CharacterString>
            </gmd:keyword>
            <gmd:keyword>
              <gco:CharacterString>Paleozoic</gco:CharacterString>
            </gmd:keyword>
                <!-- Keyword Type - allowed values from MD_KeywordTypeCode names:
                {discipline, place, stratum, temporal, theme} -->
```

```
            <gmd:type>
              <gmd:MD_KeywordTypeCode
                codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD
                _KeywordTypeCode"
                codeListValue="temporal">temporal</gmd:MD_KeywordTypeCode>
            </gmd:type>
          </gmd:MD_Keywords>
        </gmd:descriptiveKeywords>
              <!-- Place keywords; if a resource is not associated with a spatial location, the key-
              word 'non-geographic' should be included as a place keyoword -->
        <gmd:descriptiveKeywords>
          <gmd:MD_Keywords>
            <gmd:keyword>
              <gco:CharacterString>Arizona</gco:CharacterString>
            </gmd:keyword>
            <gmd:keyword>
              <gco:CharacterString>T41N R27E S22 NE NE</gco:CharacterString>
            </gmd:keyword>
            <gmd:type>
                <!-- Keyword Type - allowed values from MD_KeywordTypeCode names:
                {discipline, place, stratum, temporal, theme} -->
              <gmd:MD_KeywordTypeCode
                codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD
                _KeywordTypeCode"
                codeListValue="place">place</gmd:MD_KeywordTypeCode>
            </gmd:type>
          </gmd:MD_Keywords>
        </gmd:descriptiveKeywords>
              <!-- (O-O) Condition applying to access and use of resource - Follow NAP for
              specifica-tion of resourceConstraints. This attribute provides information for access
              control to the described resource itself. In some situations, the metadata may allow
              a user to learn of the existence of a resource that they may not actually be able to
              access without further clearance. Constraints may be represented by
              MD_Constraint, MD_LegalConstraint, or MD_SecurityConstraint. -->
        <gmd:resourceConstraints>
          <gmd:MD_LegalConstraints>
            <gmd:useLimitation>
              <gco:CharacterString>none</gco:CharacterString>
            </gmd:useLimitation>
          </gmd:MD_LegalConstraints>
        </gmd:resourceConstraints>
              <!-- (O-O) Aggregation information - The citation for or name of an aggregate
              dataset, the type of aggregate dataset, and optionally the activity which produced
              the dataset. -->
        <gmd:aggregationInfo>
              <!-- MD_AggregateInformation requires either aggregateDataSetName/CI_Citation
              or aggregateDataSetIdentifier/MD_Identifier.   -->
          <gmd:MD_AggregateInformation>
              <!-- Related dataset name -->
            <gmd:aggregateDataSetName>
              <gmd:CI_Citation>
                <gmd:title>
```

```
                <gco:CharacterString>Related Resource's Title</gco:CharacterString>
              </gmd:title>
              <gmd:date>
                <gmd:CI_Date>
                  <gmd:date>
                    <gco:DateTime>2001-12-17T09:30:47</gco:DateTime>
                  </gmd:date>
                  <gmd:dateType>
                    <gmd:CI_DateTypeCode
                       codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.
                       xml#CI_DateTypeCode"
                       codeListValue="publication">publication</gmd:CI_DateTypeCode>
                  </gmd:dateType>
                </gmd:CI_Date>
              </gmd:date>
            </gmd:CI_Citation>
          </gmd:aggregateDataSetName>
              <!-- Data Set Identifier -->
          <gmd:aggregateDataSetIdentifier>
            <gmd:MD_Identifier>
              <gmd:code>
                <gco:CharacterString>00000000-0000-0000-0000-
                   000000000000</gco:CharacterString>
              </gmd:code>
            </gmd:MD_Identifier>
          </gmd:aggregateDataSetIdentifier>
              <!-- (M-M) Association Type is mandatory.. -->
          <gmd:associationType>
              <!-- Use DS_AssociationTypeCode names: {crossReference, largerWorkCitation,
              partOfSeamlessDatabase, source, stereoMate}  -->
            <gmd:DS_AssociationTypeCode
              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#DS
              _AssociationTypeCode" codeListValue="crossReference">cross
              reference</gmd:DS_AssociationTypeCode>
          </gmd:associationType>
        </gmd:MD_AggregateInformation>
      </gmd:aggregationInfo>
              <!-- (M-M) Resource language - Multiple instances of this element indicate that the
              lin-guistic content of the resource is available in multiple languages -->
      <gmd:language>
              <!-- use ISO639-2/T three letter language code in lower case. -->
        <gco:CharacterString>eng</gco:CharacterString>
      </gmd:language>
              <!-- character encoding of resource content. Not applicable to scanned image -->
      <gmd:characterSet gco:nilReason="inapplicable"/>
              <!-- (C-C) Topic category - A topicCategory code must be provided when
              hierarchyLevel is set to "dataset" (this example document) or "dataset series".
              Most USGIN resources will have MD_TopicCategoryCode =
              "geoscientificInformation", which is the default value for this profile.  More specific
              topic categorization should be done using keywords. -->
      <gmd:topicCategory>
```

```
            <!-- MD_TopicCategoryCode names: {farming, biota, boundaries,
             climatologyMeterol-ogyAtmosphere, economy, elevation, environment,
             geoscientificInformation, health, im-ageryBaseMapsEarthCover,
             intelligenceMilitary, inlandWater, location, oceans, planning-Cadastre, society,
             structure, transportation, utilitiesCommunication} -->
        <gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
        </gmd:topicCategory>
            <!-- (C-C) Resource content extent - Defines the spatial (horizontal and vertical)
             and tem-poral region to which the content of the resource applies. For USGIN, a
             ge-ographicElement/¬geographic-BoundingBox must be provided for any resource
             with con-tent related to some geographic location. If the described resource is not
             related to a geo-graphic area, the place keyword 'non-geographic' should be
             included in the descriptive-Keywords element. -->
        <gmd:extent>
          <gmd:EX_Extent>
            <!-- (C-C) Resource Content extent description - Free text that describes the
             spatial and temporal extent of the dataset. Note that if geographic place names are
             used to express the geographic extent, USGIN profile specifies that these should
             be encoded using key-word with keyword type code = ‘place.’ Geographic names
             may be duplicated in EX_Extent/description.-->
            <gmd:description>
              <gco:CharacterString>Some spatial/temporal description.</gco:CharacterString>
            </gmd:description>
            <gmd:geographicElement>
              <!-- (O-C) Resource content extent bounding box -USGIN profile requires a
               geographic bounding box with bounding latitude and longitude expressed using
               WGS 84 decimal de-grees. The corner coordinates for the geographic bounding
               box must not coincide in one point, because this may result in fatal errors with
               some CSW implementations. Point loca-tions must thus be represented as tiny
               rectangles. USGIN recommended practice is to place the actual point location in
               the lower left corner of the rectangle. -->
              <gmd:EX_GeographicBoundingBox>
                <gmd:extentTypeCode>
                  <gco:Boolean>1</gco:Boolean>
                </gmd:extentTypeCode>
                <gmd:westBoundLongitude>
                  <gco:Decimal>-109.911001</gco:Decimal>
                </gmd:westBoundLongitude>
                <gmd:eastBoundLongitude>
                  <gco:Decimal>-109.910999</gco:Decimal>
                </gmd:eastBoundLongitude>
                <gmd:southBoundLatitude>
                  <gco:Decimal>34.772899</gco:Decimal>
                </gmd:southBoundLatitude>
                <gmd:northBoundLatitude>
                  <gco:Decimal>34.772901</gco:Decimal>
                </gmd:northBoundLatitude>
              </gmd:EX_GeographicBoundingBox>
            </gmd:geographicElement>
          </gmd:EX_Extent>
```

```
2380                <!-- (C-X) Resource content extent geographic description - Not used by USGIN
2381                profile, use keyword with type code = 'place' (with thesaurus if necessary). -->
2382                <!-- (C-X) Resource content extent bounding polygon - Not used by USGIN profile.
2383                To improve interoperability, USGIN mandates the use of Geographic Bounding
2384                Box; if bounding polygons are available they may be included, but clients may
2385                ignore content in this element. -->
2386              <!--
2387                <gmd:geographicElement>
2388                  <gmd:EX_BoundingPolygon/>
2389                </gmd:geographicElement>      -->
2390            </gmd:extent>
2391                  <!-- (O-O) Resource temporal extent -  -->
2392            <gmd:extent>
2393              <gmd:EX_Extent>
2394                <gmd:temporalElement>
2395                  <gmd:EX_TemporalExtent>
2396                    <gmd:extent>
2397                    <!-- Geologic time frame example -->
2398                      <gml:TimePeriod gml:id="IdJurassic">
2399                        <gml:name>Jurassic</gml:name>
2400                    <!-- USGIN requires the beginPosition and endPosition's frame property to be
2401                    defined. urn:cgi:trs:CGI:StandardGeologicTimeMa identifies the standard Geologic
2402                    time scale frame. -->
2403                        <gml:beginPosition
2404                          frame="urn:cgi:trs:CGI:StandardGeologicTimeMa">203</gml:beginPosition>
2405                        <gml:endPosition frame="urn:cgi:trs:CGI:StandardGeologicTimeMa
2406                          ">135</gml:endPosition>
2407                      </gml:TimePeriod>
2408                    </gmd:extent>
2409                  </gmd:EX_TemporalExtent>
2410                </gmd:temporalElement>
2411              </gmd:EX_Extent>
2412            </gmd:extent>
2413                  <!-- (O-X) Resource spatio-temporal extent - Not used. USGIN mandates encoding
2414                  space time location with EX_TemporalExtent and EX_GeographicBoundingBox -->
2415                  <!-- (O-O) Resource vertical extent  -->
2416            <gmd:extent>
2417              <gmd:EX_Extent>
2418                <gmd:verticalElement>
2419                  <gmd:EX_VerticalExtent>
2420                    <gmd:minimumValue>
2421                      <gco:Real>-100</gco:Real>
2422                    </gmd:minimumValue>
2423                    <gmd:maximumValue>
2424                      <gco:Real>200</gco:Real>
2425                    </gmd:maximumValue>
2426                    <!-- Use EPSG register of geodetic parameters such as at http://www.epsg-
2427                    registry.org/. The default VerticalCRS is World mean sea level (MSL):
2428                    http://www.spatialreference.org/ref/epsg/5714/ (replaces
2429                    urn:ogc:def:crs:EPSG::5714) -->
2430                    <gmd:verticalCRS xlink:href="http://www.spatialreference.org/ref/epsg/5714/">
2431                    </gmd:verticalCRS>
```

```
            </gmd:EX_VerticalExtent>
          </gmd:verticalElement>
        </gmd:EX_Extent>
      </gmd:extent>
    </gmd:MD_DataIdentification>
  </gmd:identificationInfo>
              <!-- ============================================================== -->
              <!-- (O-O) Content information - Characteristics describing the feature
               cataloguecatalog, coverage, or image data. Not applicable to this resource. -->
  <gmd:contentInfo gco:nilReason="inapplicable"/>
              <!-- (O-O) Resource distribution information - This element provides information to
               inform users how to obtain or access the described resource.  NOTE: there are
               several ways el-ements can be nested within MD_Distribution, please read the
               MD_Distribution sections in the USGIN profile document.  -->
  <gmd:distributionInfo>
    <gmd:MD_Distribution>
              <!-- (O-O)  Resource distribution format - Information on the format or physical
               manifesta-tion of the resource. If the resource is a physical resource, like a book,
               rock sample, paper document, the distributionFormat/MD_Format/name is
               mandatory, and must be from the USGIN distribution format codelist. Value is
               optional for this document resource. -->
      <gmd:distributionFormat>
        <gmd:MD_Format>
          <gmd:name>
            <gco:CharacterString>application/pdf</gco:CharacterString>
          </gmd:name>
          <gmd:version>
            <gco:CharacterString>8.0</gco:CharacterString>
          </gmd:version>
        </gmd:MD_Format>
      </gmd:distributionFormat>
              <!-- (O-C) Resource distributor information - USGIN differs from NAP in this case
               (but not with ISO19115) by allowing multiple distributors, and binding between
               distributors, transfer options, and formats.  -->
      <gmd:distributor>
              <!-- For USGIN profile, each distributor/MD_Distributor is a binding between one or
               more transfer options and the distributor formats that are available through
               that/those transfer options (MD_DigitalTransferOptions/onLine/CI_OnlineResource
               in particular). If different formats are available from the same distributor, or have
               different transfer options, these should be represented as different
               distributor/MD_Distributor instances. See the USGIN Profile section 'Use of
               MD_Distribution and MD_Distributor' for instructions on use of these elements. -->
        <gmd:MD_Distributor>
          <gmd:distributorContact>
              <!-- contact point for questions, comments, problems with accessing the resource
               through this distribution -->
            <gmd:CI_ResponsibleParty>
              <gmd:organisationName>
                <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
              </gmd:organisationName>
              <gmd:contactInfo>
                <gmd:CI_Contact>
```

```
                    <gmd:address>
                      <gmd:CI_Address>
                        <gmd:electronicMailAddress>
                          <gco:CharacterString>metadata@usgin.org</gco:CharacterString>
                        </gmd:electronicMailAddress>
                      </gmd:CI_Address>
                    </gmd:address>
                  </gmd:CI_Contact>
                </gmd:contactInfo>
                <gmd:role>
                 <!-- CI_RoleCode codes applicable in this context include: {resourceProvider, dis-
                 tributor, pointOfContact} -->
                   <gmd:CI_RoleCode
                      codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#
                      CI_RoleCode" codeListValue="distributor">distributor</gmd:CI_RoleCode>
                </gmd:role>
              </gmd:CI_ResponsibleParty>
            </gmd:distributorContact>
               <!-- (O-C) Resource distributor format - USGIN profile specifies that the
               distributionIn-fo/MD_Distribution/distributionFormat may be included in the
               document (its schema val-id...), but distribution format information must be
               duplicated in a distributionInfo/distributor/MD_Distributor/distributorFormat element
               or the content can be lost -->
            <gmd:distributorFormat>
              <gmd:MD_Format>
                <!-- Use USGIN distribution format code values. See "Online resource format
                names" in USGIN Profile -->
                <gmd:name>
                <-- registered MIME type IETF RFC-3778 -->
                  <gco:CharacterString>application/pdf</gco:CharacterString>
                </gmd:name>
                <gmd:version>
                  <gco:CharacterString>8.0</gco:CharacterString>
                </gmd:version>
              </gmd:MD_Format>
            </gmd:distributorFormat>
            <gmd:distributorTransferOptions>
              <gmd:MD_DigitalTransferOptions>
                <gmd:onLine>
                  <gmd:CI_OnlineResource>
                    <gmd:linkage>
                      <!-- The linkage element should contain the complete URL to access the
                      resource direct-ly. CI_OnlineResource requires a Linkage element that is a
                      gmd:URL. -->
                      <gmd:URL>http://azgs.az.gov/resource/00C02E67-F1ED-473D-A240-
                      068CCB041A73/borehole_report.pdf</gmd:URL>
                    </gmd:linkage>
                    <gmd:protocol>
                  <!-- The protocol element defines a valid internet protocol used to access the
                  resource. Recommended best practice (NAP) is that the protocol mnemonic
                  should be taken from the controlled list of Official Internet Protocol Standards at
```

```
2535                http://www.rfc-editor.org/rfcxx00.html or the Internet Assigned Numbers Authority
2536                (IANA) at http://www.iana.org/protocols. 'ftp' or 'http' are common values. -->
2537                    <gco:CharacterString>http</gco:CharacterString>
2538                </gmd:protocol>
2539                <gmd:name>
2540               <!-- The CI_OnlineResource/name element may duplicate the file name if the URL
2541                is a link to a file, but it is recommended to provide a user-friendly label for the file
2542                for presenta-tion in a user interface.  -->
2543                    <gco:CharacterString>borehole_report.pdf</gco:CharacterString>
2544                </gmd:name>
2545               <!-- The CI_OnlineResource/description element may include a [[CDATA] section
2546                with key values pairs to provide additional necessary information. USGIN
2547                recommendataion is to encode these using JSON syntax. -->
2548                <gmd:description>
2549                    <gco:CharacterString>Downloadable PDF document</gco:CharacterString>
2550                </gmd:description>
2551               <!-- (O-C) Resource distributor online distribution function -
2552                CI_OnlineResource/function is required by USGIN to indicate how linkage is to be
2553                used. If the resource is accessible as a web service, the metadata for the service
2554                should be separate metadata record with the dataset(s) exposed through the
2555                service identified in the service metadata record as cou-pledResources. -->
2556                <gmd:function>
2557               <!-- CI_OnlineFunctionCode names: {download, information, offlineAccess, order,
2558                search} -->
2559                    <gmd:CI_OnLineFunctionCode
2560                        codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.
2561                        xml#CI_OnLineFunctionCode"
2562                        codeListValue="download">download</gmd:CI_OnLineFunctionCode>
2563                </gmd:function>
2564              </gmd:CI_OnlineResource>
2565            </gmd:onLine>
2566          </gmd:MD_DigitalTransferOptions>
2567        </gmd:distributorTransferOptions>
2568      </gmd:MD_Distributor>
2569    </gmd:distributor>
2570            <!-- (C-C) Resource distribution transfer options - MD_DigitalTransferOptions
2571            provides in-formation on digital distribution of resource. See USGIN Profile 'Use of
2572            MD_Distribution and MD_Distributor' for instructions on use of this element.
2573            Details on encoding for MD_DigitalTransferOptions are above in the
2574            distributorTransferOptions elements description. -->
2575    <gmd:transferOptions>
2576      <gmd:MD_DigitalTransferOptions>
2577        <gmd:onLine>
2578          <gmd:CI_OnlineResource>
2579            <gmd:linkage>
2580            <!-- The linkage element should contain the complete URL to access the resource
2581            directly. CI_Online-Resource requires a Linkage element that is a gmd:URL. -->
2582              <gmd:URL>http://azgs.az.gov/resource/00C02E67-F1ED-473D-A240-
2583                  068CCB041A73/borehole_report.pdf</gmd:URL>
2584            </gmd:linkage>
2585            <gmd:protocol>
```

```
                <!-- The protocol element defines a valid internet protocol used to access the
                resource. Recommended best practice (NAP) is that the protocol mnemonic
                should be taken from the controlled list of Official Internet Protocol Standards at
                http://www.rfc-editor.org/rfcxx00.html or the Internet Assigned Numbers Authority
                (IANA) at http://www.iana.org/protocols. 'ftp' or 'http' are common values. -->
                  <gco:CharacterString>http</gco:CharacterString>
                </gmd:protocol>
                <!-- (C-C) Resource distributor online distribution application profile -
                applicationProfile is required if the CI_OnlineResource/linkage does not connect to
                a web page, and another software application is needed to use the indicated file
                resource. The applicationProfile character string should specify the software using
                the following recommended syntax: "vendor:application name/application version",
                e.g. "Microsoft:Word/2007", or "ESRI:ArcGIS/9.3" -->
                <gmd:applicationProfile>
                  <gco:CharacterString>Adobe:Acrobat/8.0</gco:CharacterString>
                </gmd:applicationProfile>
                <gmd:name>
                <!-- The CI_OnlineResource/name element may duplicate the file name if the URL
                is a link to a file, but it is recommended to provide a user-friendly label for the file
                that could be presented in a user interface.  -->
                  <gco:CharacterString>borehole_report.pdf</gco:CharacterString>
                </gmd:name>
                <gmd:description>
                  <gco:CharacterString>Downloadable PDF document</gco:CharacterString>
                </gmd:description>
                <!-- (O-C) Resource distributor online distribution function -
                CI_OnlineResource/function is required by USGIN to indicate how linkage is to be
                used. If the resource is accessible as a web service, the metadata for the service
                should be separate metadata record with the dataset(s) exposed through the
                service identified in the service metadata record as cou-pledResources. -->
                <gmd:function>
                <!-- CI_OnlineFunctionCode names: {download, information, offlineAccess, order,
                search}  -->
                  <gmd:CI_OnLineFunctionCode
                    codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#
                    CI_OnLineFunctionCode"
                    codeListValue="download">download</gmd:CI_OnLineFunctionCode>
                </gmd:function>
              </gmd:CI_OnlineResource>
            </gmd:onLine>
          </gmd:MD_DigitalTransferOptions>
        </gmd:transferOptions>
      </gmd:MD_Distribution>
    </gmd:distributionInfo>
    <gmd:dataQualityInfo>
                <!-- In this profile, data quality information is optional, but if included, the
                mandatory content for data quality information is a free text explanation of data
                quality considerations. The
                DQ_DataQuality[1]//report[1]//explanation/CharacterString element should contain
                a free text discussion/description of data quality considerations for the indicated
                scope. The use of any specific data quality element to contain this explanation is
                arbitrary and should not be considered meaningful in this context.  -->
```

```
2638        <gmd:DQ_DataQuality>
2639          <gmd:scope>
2640            <gmd:DQ_Scope>
2641              <gmd:level>
2642                  <!-- MD_ScopeCode values for discovery metadata: {collectionHardware, collec-
2643                  tionSession, dataset, series, dimensionGroup, fieldSession, software, service,
2644                  model, tile} -->
2645                <gmd:MD_ScopeCode
2646                  codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD
2647                  _ScopeCode" codeListValue="dataset">dataset</gmd:MD_ScopeCode>
2648              </gmd:level>
2649                  <!-- (C-C) Data quality scope level description - Not used by USGIN -->
2650            </gmd:DQ_Scope>
2651          </gmd:scope>
2652          <report>
2653                  <!-- This is a container for a free text discussion/description of data quality
2654                  considerations for the indicated scope. The use of any specific data quality
2655                  element (e.g. DQ_DomainConsistency here) to contain this explanation is arbitrary
2656                  and should not be considered meaningful in this context.  -->
2657            <DQ_DomainConsistency>
2658              <result>
2659                <DQ_ConformanceResult>
2660                  <specification gco:nilReason="notApplicable"/>
2661                  <explanation>
2662                    <gco:CharacterString>Quality Statement: Original paper quality was poor quality,
2663                        parts of scan are difficult to read. Scan resolution is 300 dpi.
2664                    </gco:CharacterString>
2665                  </explanation>
2666                  <pass gco:nilReason="inapplicable"/>
2667                </DQ_ConformanceResult>
2668              </result>
2669            </DQ_DomainConsistency>
2670          </report>
2671                  <!-- (C-C) Resource lineage -  count(lineage/LI_Lineage/source + line-
2672                  age/LI_Lineage/sourceStep + lineage/LI_Lineage/statement ) >0  for spatial
2673                  dataset and spatial dataset series. Not applicable to services. -->
2674          <gmd:lineage>
2675            <gmd:LI_Lineage>
2676                  <!-- (C-C) Data quality lineage statement - General explanation of the data
2677                  producer's knowledge of the dataset lineage. This is probably the most useful thing
2678                  to supply. -->
2679              <gmd:statement>
2680                <gco:CharacterString>
2681                  This dataset is maintained by the Arizona Geological Survey. Paper logs were
2682                  obtained from the permitee and are on file at the Arizona Geological Survey. Logs
2683                  were scanned in 2005 by S. J. Rauzi. Digital files are archived at the Arizona
2684                  Geological Survey.
2685                </gco:CharacterString>
2686              </gmd:statement>
2687                  <!-- (C-C) Data quality lineage process step - An event in the development of the
2688                  dataset. Best practice recommended for USGIN is that source association from a
```

```
                process step is to inputs to a process, and processStep associations from a
                source element link an output resource to a process step that produced it.  -->
            <gmd:processStep>
              <gmd:LI_ProcessStep>
                <gmd:description>
                  <gco:CharacterString>A detailed description of the scanning process could be
                    included here. </gco:CharacterString>
                </gmd:description>
              </gmd:LI_ProcessStep>
            </gmd:processStep>
                <!-- (C-C) Data quality lineage source - not applicable in this example  -->
            <gmd:source/>
          </gmd:LI_Lineage>
        </gmd:lineage>
      </gmd:DQ_DataQuality>
    </gmd:dataQualityInfo>
                <!-- (O-O) Metadata constraint information - This element specifies use constraints
                for access to the metadata record.  -->
    <gmd:metadataConstraints>
                <!-- Constraints -->
      <gmd:MD_Constraints>
                <!-- metadataConstraints/MD_Constraints/useLimitation is mandatory when
                MD_Constraints is used to specify metadataConstraints.  -->
        <gmd:useLimitation>
          <gco:CharacterString>fair use</gco:CharacterString>
        </gmd:useLimitation>
      </gmd:MD_Constraints>
    </gmd:metadataConstraints>
                <!-- Legal constraint -->
    <gmd:metadataConstraints>
      <gmd:MD_LegalConstraints>
                <!-- When one of the subtypes MD_LegalConstraints or MD_SecurityConstraints is
                used, useLimitation is optional. -->
        <gmd:useLimitation>
          <gco:CharacterString>one</gco:CharacterString>
        </gmd:useLimitation>
        <gmd:accessConstraints>
                <!-- MD_RestrictionCode names: {copyright, patent, patentPending, trademark,
                license, intellectualPropertyRights, restricted, otherRestrictions} - NAP expands
                with {licenseUnrestricted, licenseEndUser, licenseDistributor, privacy, statutory,
                confidential, sensitivity}. -->
          <gmd:MD_RestrictionCode
              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_R
              estrictionCode" codeListValue="otherRestrictions">other
              restrictions</gmd:MD_RestrictionCode>
        </gmd:accessConstraints>
        <gmd:useConstraints>
                <!-- MD_RestrictionCode names: {copyright, patent, patentPending, trademark,
                license, intellectualPropertyRights, restricted, otherRestrictions} -->
          <gmd:MD_RestrictionCode
              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_R
```

```
2740              estrictionCode" codeListValue="otherRestrictions">other
2741              restrictions</gmd:MD_RestrictionCode>
2742          </gmd:useConstraints>
2743                <!-- (C-C) otherConstraints is a free text element required by NAP if
2744                 accessConstraints or useConstraints is set to "otherRestrictions." -->
2745          <gmd:otherConstraints>
2746            <gco:CharacterString>
2747              Data only to be used for the purposes for which they were collected.
2748            </gco:CharacterString>
2749          </gmd:otherConstraints>
2750        </gmd:MD_LegalConstraints>
2751      </gmd:metadataConstraints>
2752      <gmd:metadataConstraints>
2753            <!-- Security constraints; in general these will be in applicable to USGIN resources -->
2754        <gmd:MD_SecurityConstraints>
2755          <gmd:classification>
2756                <!-- MD_SecurtyConstraints has various optional free text values, and a required
2757                 MD_SecurityConstraints/classification from MD_ClassificationCode names:
2758                 {unclassified, restricted, confidential, secret, topSecret}  -->
2759            <gmd:MD_ClassificationCode
2760              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_Cl
2761              assificationCode"
2762              codeListValue="unclassified">unclassified</gmd:MD_ClassificationCode>
2763          </gmd:classification>
2764        </gmd:MD_SecurityConstraints>
2765      </gmd:metadataConstraints>
2766                <!-- (O-O) Metadata maintenance information - This element provides information
2767                 about the maintenance schedule or history of the metadata record.  -->
2768      <gmd:metadataMaintenance>
2769        <gmd:MD_MaintenanceInformation>
2770          <gmd:maintenanceAndUpdateFrequency>
2771                <!-- Only one MD_MaintenanceInformation element may be included, with a
2772                 required MD_MaintenanceFrequencyCode names: {continual, daily, weekly,
2773                 fortnightly, monthly, quarterly, biannually, annually, asNeeded, irregular, not-
2774                 Planned, unknown} -->
2775            <gmd:MD_MaintenanceFrequencyCode
2776              codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_M
2777              aintenanceFrequencyCode" codeListValue="asNeeded">as
2778              needed</gmd:MD_MaintenanceFrequencyCode>
2779          </gmd:maintenanceAndUpdateFrequency>
2780          <gmd:maintenanceNote>
2781            <gco:CharacterString>This metadata record has been processed by the iso-19115-to-
2782                usgin-19115-data XSLT to ensure that all mandatory content for USGIN profile has
2783                been added.2013-04-04T12:00:00</gco:CharacterString>
2784          </gmd:maintenanceNote>
2785        </gmd:MD_MaintenanceInformation>
2786      </gmd:metadataMaintenance>
2787    </gmd:MD_Metadata>
2788
2789
2790
2791
```

8.3 ISO19110 Feature Catalog example

Example encoding of entity attribute information using the xml implementation of ISO 19110. Comments in green provide some explanation.

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<gfc:FC_FeatureCatalogue xmlns=”http://www.isotc211.org/2005/gfc”
xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:gfc=”http://www.isotc211.org/2005/gfc”
xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns:gml=”http://www.opengis.net/gml/3.2”
xmlns:gmx=”http://www.isotc211.org/2005/gmx” xmlns:gsr="http://www.isotc211.org/2005/gsr"
xmlns:gss="http://www.isotc211.org/2005/gss" xmlns:gts="http://www.isotc211.org/2005/gts"
xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi=”http://www.w3.org/2001/XMLSchema-
instance” id="FC001" xsi:schemaLocation=”http://www.isotc211.org/2005/gfc
http://www.isotc211.org/2005/gfc/gfc.xsd” uuid="99ffdfd0-775a-11e0-a1f0-0800200c9a34">

   <!-- mandatory -->
   <gmx:name>
      <gco:CharacterString>Feature Catalogue for Provisional Processed CTD Data from the
Deepwater Horizon Incident Response in the Gulf of Mexico May 08, 2010 through November
15 ,2010
</gco:CharacterString>
   </gmx:name>
   <!-- mandatory 1..* -->
   <gmx:scope gco:nilReason="unknown"/>

   <!-- mandatory -->
   <gmx:versionNumber gco:nilReason="unknown"/>
   <!-- mandatory -->
   <gmx:versionDate gco:nilReason="unknown"/>
   <gmx:language>
      <gco:CharacterString>eng</gco:CharacterString>
   </gmx:language>
   <gmx:characterSet>
      <gmd:MD_CharacterSetCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_CharacterSe
tCode" -"utf8">UTF-8</gmd:MD_CharacterSetCode>
   </gmx:characterSet>
   <!-- can put subCatalog here, but its unclear what the use case is -->
   <!-- mandatory -->
   <gfc:producer>
      <!-- could use xlink:href to resource contact -->
      <gmd:CI_ResponsibleParty>
         <gmd:individualName>
            <gco:CharacterString>No Name Was Given</gco:CharacterString>
         </gmd:individualName>
         <gmd:organisationName>
            <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
         </gmd:organisationName>
         <gmd:contactInfo>
            <gmd:CI_Contact>
```

```
                <gmd:phone>
                  <gmd:CI_Telephone>
                    <gmd:voice>
                      <gco:CharacterString>520-770-3500</gco:CharacterString>
                    </gmd:voice>
                  </gmd:CI_Telephone>
                </gmd:phone>
                <gmd:address>
                  <gmd:CI_Address>
                    <gmd:deliveryPoint>
                      <gco:CharacterString>
                                  416 W. Congress St., Suite 100
                      </gco:CharacterString>
                    </gmd:deliveryPoint>
                    <gmd:city>
                      <gco:CharacterString>Tucson</gco:CharacterString>
                    </gmd:city>
                    <gmd:administrativeArea>
                      <gco:CharacterString>AZ</gco:CharacterString>
                    </gmd:administrativeArea>
                    <gmd:postalCode>
                      <gco:CharacterString>85701</gco:CharacterString>
                    </gmd:postalCode>
                    <gmd:electronicMailAddress>
                      <gco:CharacterString>metadata@azgs.az.gov</gco:CharacterString>
                    </gmd:electronicMailAddress>
                  </gmd:CI_Address>
                </gmd:address>
              </gmd:CI_Contact>
            </gmd:contactInfo>
            <gmd:role>
              <gmd:CI_RoleCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
codeListValue="curator">curator</gmd:CI_RoleCode>
            </gmd:role>
          </gmd:CI_ResponsibleParty>
        </gfc:producer>
        <!-- mandatory 1..* -->
        <gfc:featureType>
          <!-- the id attribute should be used as a fragment identifer in URLs for the feature catalog
citation in ISO 19115 metadata -->
          <gfc:FC_FeatureType id="fragmentIdentifer">
            <!-- mandatory -->
            <gfc:typeName>
              <gco:LocalName>Name of the feature</gco:LocalName>
            </gfc:typeName>
            <gfc:definition>
              <gco:CharacterString>CTD Header Information</gco:CharacterString>
            </gfc:definition>
            <gfc:code>
              <gco:CharacterString>URI for feature type--handy if there is a
registry</gco:CharacterString>
```

```
2894            </gfc:code>
2895            <!-- mandatory. Indicates if the feature type is abstract or not. default is FALSE-->
2896            <gfc:isAbstract>
2897               <gco:Boolean>false</gco:Boolean>
2898            </gfc:isAbstract>
2899    <!-- mandatory. pointer to containing catalog; UUID is defined in root element for this catalog-->
2900            <gfc:featureCatalogue uuidref="87ffdfd0-775a-11e0-a1f0-0800200c9a66"/>
2901            <gfc:carrierOfCharacteristics>
2902               <gfc:FC_FeatureAttribute>
2903                  <!-- mandatory -->
2904                  <gfc:memberName>
2905                     <gco:LocalName>Name of attribute1</gco:LocalName>
2906                  </gfc:memberName>
2907                  <gfc:definition>
2908                     <gco:CharacterString>explanation of attribute 1</gco:CharacterString>
2909                  </gfc:definition>
2910                  <!-- mandatory -->
2911                  <gfc:cardinality>
2912                     <gco:Multiplicity>
2913                        <gco:range>
2914                           <gco:MultiplicityRange>
2915                              <gco:lower>
2916                                 <gco:Integer>0</gco:Integer>
2917                              </gco:lower>
2918                              <gco:upper>
2919     <!-- I guess this is how one would say as many as you want... -->
2920                                 <gco:UnlimitedInteger isInfinite="true">
2921                                                      5</gco:UnlimitedInteger>
2922                              </gco:upper>
2923                           </gco:MultiplicityRange>
2924                        </gco:range>
2925                     </gco:Multiplicity>
2926                  </gfc:cardinality>
2927                  <!-- optional -->
2928                  <gfc:definitionReference>
2929                     <gfc:FC_DefinitionReference>
2930                        <gfc:definitionSource>
2931                           <gfc:FC_DefinitionSource>
2932            <!-- most likely this will be the same as the citation for the catalog producer -->
2933                              <gfc:source
2934                                 xlink:href="#UUID of citation for containing catalog"/>
2935                           </gfc:FC_DefinitionSource>
2936                        </gfc:definitionSource>
2937                     </gfc:FC_DefinitionReference>
2938                  </gfc:definitionReference>
2939               <!-- optional -->
2940                  <code>
2941                    <gco:CharacterString>
2942
2943            URI for this attribute if it is registered somewhere
```

```
                        </gco:CharacterString>
                    </code>
                     </gfc:valueMeasurementUnit>
                <!-- optional -->
                    <valueType>
                       <gco:TypeName>
                <!-- its unclear how this scheme is supposed to be used for complex datatypes -->
                          <gco:Name>
                             <gco:CharacterString>
            datatype name for quantifying this attribute suggest using xs:types if applicable,
but might be URI for a complex element
                                          </gco:CharacterString>
                          </gco:Name>
                       </gco:TypeName>
                    </valueType>
<!-- if valueType is an enumeration, there may be collection of FC_listedValues documenting
the choices  -->
                 </gfc:FC_FeatureAttribute>
              </gfc:carrierOfCharacteristics>
              <carrierOfCharacteristics>
                 <FC_FeatureAttribute>
                    <memberName>
                          <gco:LocalName codeSpace="http://stategeothermaldata.org/uri-
gin/aasg/xmlschema/activefault/1.2">FeatureURI</gco:LocalName>
                       </memberName>
                    <definition>
                          <gco:CharacterString>
                          unique identifier for this feature. Best practice is to define an http
                            URI that will dereference to a normative description of the feature
                          </gco:CharacterString>
                       </definition>
                    <cardinality>
                       <gco:Multiplicity>
                          <gco:range>
                             <gco:MultiplicityRange>
                                <gco:lower>
                                   <gco:Integer>1</gco:Integer>
                                </gco:lower>
                                <gco:upper>
                                   <gco:UnlimitedInteger>1</gco:UnlimitedInteger>
                                </gco:upper>
                             </gco:MultiplicityRange>
                          </gco:range>
                       </gco:Multiplicity>
                    </cardinality>
                    <valueType>
                       <gco:TypeName>
                          <gco:Name>
                                <gco:CharacterString>xs:string</gco:CharacterString>
                             </gco:Name>
                       </gco:TypeName>
                    </valueType>
```

```
                </FC_FeatureAttribute>
            </carrierOfCharacteristics>
            <!-- other attributes  -->
        </gfc:FC_FeatureType>
    </gfc:featureType>
    <!-- the catalog may document many feature types -->
</gfc:FC_FeatureCatalogue>
```