

**DDE STANDARD**

**DDE-DS01**

**Edition 1.0**

2023-11-07

Deep-time Digital Earth Program of The International Union of Geological Sciences

**Geoscience Information Metadata**

CONTENTS

[Foreword 2](#_Toc150165236)

[*Document history* 2](#_Toc150165237)

[Geosciences Information Metadata 4](#_Toc150165238)

[1. Scope 4](#_Toc150165239)

[2. Compatibility 4](#_Toc150165240)

[3. Normative references 5](#_Toc150165241)

[4. Terms and definitions 5](#_Toc150165242)

[4.1 attribute 5](#_Toc150165243)

[4.2 coverage 5](#_Toc150165244)

[4.3 data 5](#_Toc150165245)

[4.4 dataset 5](#_Toc150165246)

[4.5 dataset series 5](#_Toc150165247)

[4.6 feature 5](#_Toc150165248)

[4.7 grid 5](#_Toc150165249)

[4.8 image 6](#_Toc150165250)

[4.9 imagery 6](#_Toc150165251)

[4.10 metadata 6](#_Toc150165252)

[4.11 metadata element 6](#_Toc150165253)

[4.12 metadata entity 6](#_Toc150165254)

[4.13 resource 6](#_Toc150165255)

[4.14 service 6](#_Toc150165256)

[5. Metadata structure and content 6](#_Toc150165257)

[5.1 Metadata structure 6](#_Toc150165258)

[5.2 Metadata core entities 7](#_Toc150165259)

[5.3 Metadata element value entities 13](#_Toc150165260)

[5.4 Data dictionary 17](#_Toc150165261)

[Annex A - Geosciences Information Metadata Code List (Normative) 32](#_Toc150165262)

[1. AcquisitionCode <<CodeList>> 32](#_Toc150165263)

[2. CharacterSetCode <<CodeList>> 34](#_Toc150165264)

[3. CountryCode <<CodeList>> 34](#_Toc150165265)

[4. DateTypeCode <<CodeList>> 34](#_Toc150165266)

[5. FunctionCode <<CodeList>> 34](#_Toc150165267)

[6. LanguageCode <<CodeList>> 35](#_Toc150165268)

[7. ProcessedLevelCode <<CodeList>> 35](#_Toc150165269)

[8. ReferenceSystemTypeCode <<CodeList>> 35](#_Toc150165270)

[9. ResourceTypeCode <<CodeList>> 37](#_Toc150165271)

[10. RestrictionCode <<CodeList>> 39](#_Toc150165272)

[11. RoleTypeCode <<CodeList>> 39](#_Toc150165273)

[12. ServiceTypeCode <<Codelist>> 40](#_Toc150165274)

[13. SpatialRepresentationTypeCode <<CodeList>> 41](#_Toc150165275)

[14. TopicCategoryCode <<CodeList>> 43](#_Toc150165276)

[Annex B - XML Schema definition for DDE geoscience information metadata 63](#_Toc150165277)

[References 76](#_Toc150165278)

# Foreword

Geoscience data acquired in the present is the key to understanding the geological past. The Big Science Program Deep-time Digital Earth (DDE) of the International Union of Geological Sciences (IUGS) aims to transform Earth science by harmonizing global digital Earth data and sharing global geoscience knowledge to help understand evolution of life, evolution of matter, evolution of geography, evolution of climate, and find solutions to contemporary problems and challenges like climate change, ecological renewal, water supply, and energy transformation.

Geoscience data standards for implementing the DDE program are essential for data, service and knowledge findable, accessible, interoperable and reusable[1] across globally distributed multi-disciplinary heterogeneous geoscience databases and providing access to efficient digital interoperable cross disciplinary geoscience standards, knowledge systems, tools and methodologies in convenient forms for scientists, public and industry, for better insights into the distribution and value of earth’s resources and materials.

An efficient practical metadata standard based on existing world-wide implemented International Organization (ISO) and [Open Geospatial Consortium](https://www.osgeo.org/partners/ogc/)(OGC) standards and web application technologies is of essential importance to DDE data, service and knowledge findable, and helpful to fairness. DDE Geoscience Information Metadata Standard is thus issued as a core metadata standard for DDE program. It sets out the requirements for the creation, sharing and maintenance of metadata of geoscience data resources and services of various themes of the DDE. It can be extended for different geoscience related disciplines and domains to foster findability and accessibility of geosciences data, service and knowledge through the web and the DDE platform, as well.

# *Document history*

This standard was drafted and revised by the following experts and scientists both from and outside the DDE Standards Task Group (DDE-STG) in 2021, 2022 and 2023 with the collaboration of DDE Data Science Group, DDE Knowledge Group and other DDE Working Groups and Task Groups.

The initial version of this DDE metadata standard was drafted and proposed in Aug.2021 by Prof Dr Zhang Minghua, Dr Liu Rongmei, Dr Ren Wei, Dr Zhang Sheng, Dr Yu Hailong and Prof Jiang Zuoqin from China.

The first revision, update 1, of this standard document was made by Dr Tim Duffy and Edd Lewis from British Geological Survey(BGS), Dr Mark Rattenbury form GNS Science New Zealand, Gabriel Asato from Argentina Geological Survey (SEGEMAR), Francisco Valdir from Brazil Geological Survey (CPRM), Afraz Shah from University of Brunei, Prof Ma Chao from Chengdu University of Technology, Prof Dr Wang Juanle, Dr. Li Kai and Fan Haiming form the Institute of Geographic Sciences and Natural Resources Research, China Academy of Science, and prof Li Xianhua from the institute of geology and geophysics, China Academy of Science, Dr Alena Rybkina from geophysical center, Russian Academy of Science in Sep and Oct. 2021.

The second revision, the update2 of the draft version of this standard was then made by Dr Stephen M. Richard from US Geoscience Information (USGIN) Foundation in Nov. 2021, and following edits by Dr Yu Hailong, Dr. Federica Foglini and Dr. Caterina Bergami from ISMAR-CNR (Institute of Marine Sciences, National Research Council of Italy), and Prof Hu Xiumian and Dr Xu Yiwei form Nanjing university in Sep. and Oct. 2022.

Further revision was made as the version update3 by Jiang Zuoqin, Edd Lewis, and Prof Bai Yuqi from Tsinghua University till May, 2023, and edited by Zhang Minghua and Yu Hailong in June,2023. Final updates to this version following the team meeting in August 2023, were made by S.M. Richard, Zhang Minghua, Yu Hailong and Caterina Bergami.

Final edition of this standards document was completed on 5 November by Yu Hailong, Zhang Minghua and Stephen Richard following the finalization meeting on 31Aug and final discussion on 24 Oct of the team and relevant DDE working groups and task groups.

XSD file of the standard is prepared by Dr Yu Hailong and Dr. S. M. Richard.

This standard is released by DDE.

# Geosciences Information Metadata

## Scope

This standard defines the information content and XML serialization for metadata descriptions of geoscience information resources supporting the DDE program. It provides information about the identification, quality, contents, spatial reference, lineage, and distribution of the data. This standard applies to the description of geoscience data resources including a variety of geoscientific disciplinary spatial and non-spatial data, to ensure they are Findable, Accessible and with sufficient documentation to make them Reusable. The scope of DDE Geosciences Information metadata is defined to include the resource types listed in the resourceType codelist. See the ResourceTypeCode <<CodeList>> in Annex A. Conformance with this standard will ensure that DDE metadata are interoperable, facilitating metadata searching, harvesting and sharing.

## Compatibility

This standard is developed with reference to ISO19115-1:2014E[2,3] as the core metadata information model to meet the needs of DDE program development, particularly the demands from DDE Working Groups and Task Groups. The metadata content is intended to be compatible with metadata standards implemented by international initiatives and regional programs like OneGeology Metadata Standard[4], INSPIRE Metadata Standard[5], Dublin Core metadata element set (ISO15836:2003(E)) [6,7], CCOP Geoinformation Metadata Standard[8], Schema.org[8a], and the W3C Data Catalog (DCAT)[8b]. DDE metadata content includes all core metadata elements of ISO19115:2014E. Many element and entity names from ISO19115:2014E have been used to make correspondence explicit, but entity content and element value domains have been simplified in most cases..

Content related to geosciences has been extended in several ways:

* The topic category codelist defined in ISO19115-1:2014(E) MD\_TopicCategoryCode <<Enumeration>> is extended by adding 1 top level concept ‘data science’ and 41 second level concepts refining the ‘geoscientificInformation’ category to cover all the themes and disciplinaries of DDE. See listing at TopicCategoryCode <<CodeList>>
* Data acquisition observation methods are specified using a new codelist, which contains concepts for commonly used geosciences data acquisition methods. These methods are mostly compatible with CGI’s Observation Method Vocabulary ([http://resource.geosciml.org/classifier/cgi/featureobservationmethod](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod)). The codelist is defined in AcquisitionCode <<CodeList>>
* A code list for service types is defined in ServiceTypeCode <<Codelist>> to populate the serviceType property.

The identifiers for DDE data resources are specified using a DOI, DDE code, or other character string, using the pattern defined by the ISO19115-1 MD\_Identifier that enables specifying a codespace, and identifier authority in addition to the actual identifier code. A DOI is a unique and persistent (never-changing) string assigned to [online](https://www.scribbr.com/citing-sources/cite-a-website/) [articles](https://www.scribbr.com/citing-sources/cite-a-journal-article/), [books](https://www.scribbr.com/citing-sources/cite-a-book/), and other works[9]. These identifiers are maintained by the DOI Foundation (https://www.doi.org/). This specification defines an identifier syntax for DDE identifier code strings for use if other identifiers are not available.

Calendar Date and DateTime are serialized using syntax based on ISO8601 (see Calendar Date and Time). Geological ages are reported using named time intervals from the International Commission on Stratigraphy International Chronostratigraphic Chart (<https://stratigraphy.org/chart>).

This specification uses plain text and Unified Modeling Language (UML) for presentation purposes.

## Normative references

No documents are normatively referenced in this specification

## Terms and definitions

For the purpose of this document, the following terms and definitions apply.

### attribute

named property of an entity

Note: Describes a geometrical, topological, thematic, or other characteristic of an entity.

[SOURCE: ISO19115-2:2019(E),3.1]

Note: as used in this specification, attribute refers to a property independent of the entity to which it applies. A metadata element is an attribute in the context of particular metadata entity or entities, with a defined cardinality and value type. For example, ‘responsibility’ would be an attribute, and ‘metadataResponsibleParty’, ‘distributionResponsibleParty’ and ‘resourceResponsibleParty’ would be elements that implement that attribute.

### coverage

feature that acts as a function to return values from its range for any direct position within its spatial, temporal or spatiotemporal domain.

EXAMPLE Raster image (4.8), polygon overlay, or digital elevation matrix.

[SOURCE: ISO 19115-2:2019,3.4]

### data

data is a collection of discrete values that convey information, describing quantity, quality, fact, statistics, other basic units of meaning, or simply sequences of symbols that may be further interpreted.

[SOURCE: Wikipedia, 2022 (https://en.wikipedia.org/wiki/Data)]

### dataset

identifiable collection of data

Note: a dataset can either be a whole database or part of a database. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart can be considered a dataset.

[SOURCE: ISO19115-1:2014(E), 4.3]

### dataset series

collection of datasets sharing common characteristics

[SOURCE: ISO19115-1:2014(E),4.4]

### feature

abstraction of real world phenomena

Note: example- fault is a feature in geology.

[SOURCE: ISO19115-1:2014(E),4.5]

### grid

network composed of two or more sets of curves in which the members of each set intersect the members of the other sets in an algorithmic way

Note 1 to entry: The curves partition a space into grid cells.

[SOURCE: ISO 19115-2:2019, 3.13]

### image

gridded coverage (4.2) whose attribute values are a numerical representation of a physical parameter.

Note 1 to entry: The physical parameters are the result of measurement by a sensor or a prediction from a model.

[SOURCE: ISO 19115-2:2019, 3.18]

### imagery

representation of phenomena as images (4.8) produced by electronic and/or optical techniques.

Note 1 to entry: In this document, it is assumed that the objects and phenomena have been sensed or detected by radar, cameras, photometers, and infrared and multispectral scanners, or similar devices.

[SOURCE: ISO 19101-2:2008, 4.14]

### metadata

information about a resource, or data about data. It provides information about the resource, including its content, extent, quality, status, management, owner, and distribution.

[SOURCE: ISO19115-1:2014(E),4.10; ISO19115:2003(E); CCOP S01:2010]

### metadata element

discrete unit of metadata.

Note 1 Metadata elements are unique within a metadata entity definition.

Note 2 A metadata entity contains a set of metadata elements that implement the attributes defined in the content model for that entity.

[SOURCE: ISO19115-1:2014(E),4.11]

Note: As used in this specification, a metadata element is an attribute in the context of a particular metadata entity, with a defined cardinality and value type. An attribute is a property independent of the entity to which it applies.

### metadata entity

set of metadata elements describing the same aspect of a resource

[SOURCE: ISO19115-1:2014(E),4.12]

### resource

identifiable asset or means that fulfills a requirement

Note 1 for example: dataset, dataset series, service, document, initiative, software, person or organization.

[SOURCE: ISO19115-1:2014(E),4.17]

### service

distinct part of the functionality that is provided by an entity through interfaces

Note 1 The functionality of the entity is characterized by a set of operations.

[SOURCE: ISO 19119:2016,4.1.12]

Note 2 A service is a mechanism to enable access to one or more capabilities, where the access is provided using a prescribed interface and is exercised consistent with constraints and policies as specified by the service description.

## Metadata structure and content

### Metadata structure

DDE Geosciences information metadata comprises six major topics: Metadata information, Resource identification information, Service identification information, Spatial representation information, Imagery information, and Distribution information, each with a root metadata entity, and a set of metadata elements. There are six metadata entities used as the value for metadata elements in the model: Responsibility, Identifier, Online Resource, Geographic Extent, Temporal Extent, and Date. Strings, dates and numbers provide the values for other metadata elements. There are 88 total elements, 22 of which are mandatory (the exact value depends on the resource type described), and 14 code lists. 6 code lists are adopted from ISO-19115-3; 3 of the code lists are maintained by outside authorities (IETF, ISO), and 5 codelists are new for this specification. Tables 1-13 define the entities and elements. Code lists are documented in Annex A. Annex B provides an XML schema implementing the content items defined in this specification. Figure 1 diagrams the structure of the DDE metadata using UML notation.

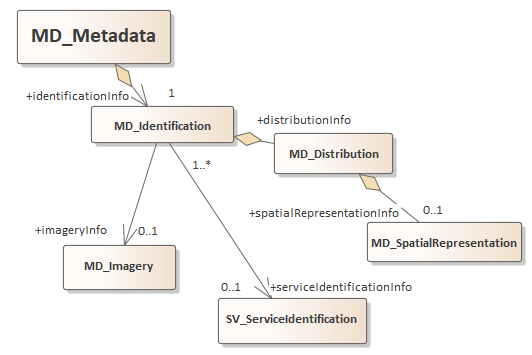


Figure . The structure diagram of DDE Geosciences Information Metadata

### Metadata core entities

#### 5.2.1 Metadata information

The MD\_Metadata entity is the mandatory root entity for a metadata object. The UML diagram in Figure 2 depicts the entities, elements, roles and codelists directly associated with the MD\_Metadata entity. The MD\_Metadata entity contains 4 elements that specify information about the metadata record itself, an optional element that links to a browse graphic for the described resource, and a resourceType element that specifies the kind of resource the metadata object documents. Roles link the MD\_Metadata entity to a resource identification entity and one or more distribution entities. The resource identification entity contains detailed information about the resource that is the subject of the metadata record, and the distribution entities specify how the resource content can be accessed. Entities specified in the following List 1, are linked as element values from MD\_Metadata. Table 1 in the dictionary provides more detailed information about the elements.

List 1. Top level entities and elements contained in MD\_Metadata element.

Mandatory entities:

MD\_Identification

CI\_Responsibility

CI\_Date

MD\_Identifier

Mandatory elements:

metadataIdentifier

metadataStandardName

metadataDate

metadataResponsibility

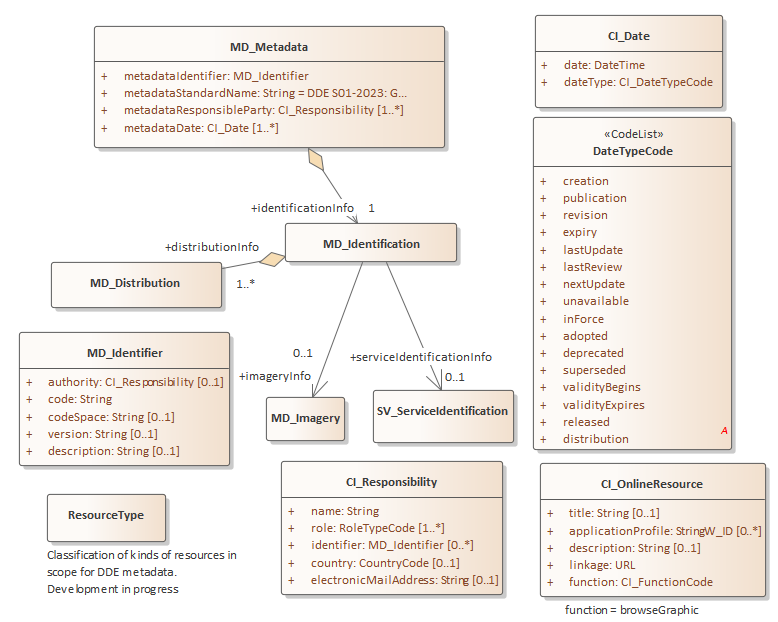


Figure 2. Metadata information classes. See ResourceTypeCode <<CodeList>> for listing of resource type values.

#### 5.2.2 Resource identification information

The MD\_Identification entity provides information to identify and describe an information resource. The mandatory MD\_Identification entity contains a mandatory MD\_Constraints entity, 23 elements, and two conditional entities, MD\_Imagery and SV\_ServiceIdentification, for metadata describing imagery data or services. The MD\_Constraints must minimally indicate what restrictions there are for access and usage of the described resource. The content is shown in List 2, defined in Table 2 in the dictionary, and represented in UML in Figure 3.

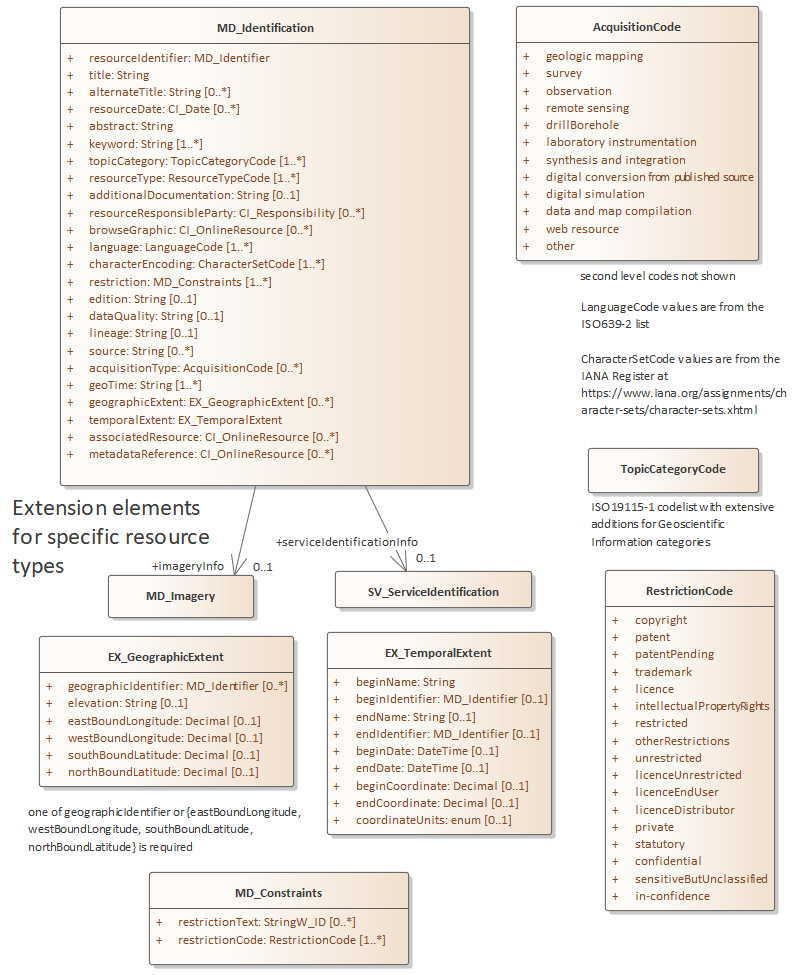


Figure 3. Identification information entities, elements and codelists.

List 2. Entities and elements in MD\_Identification

Mandatory entity:

MD\_Identification

MD\_Constraints

Conditional entity:

MD\_Imagery

SV\_ServiceIdentification

Mandatory elements:

resourceIdentifier

title

abstract

keyword

topicCategory

resourceType

language

characterEncoding

restrictionCode

geoTime

Conditional elements:

dataQuality

lineage

source

acquisitionType

associatedResource

metadataReferenceOptional elements:

geographicExtent

temporalExtent

alternateTitle

resourceDate

edition

additionalDocumentation

restrictionText

#### 5.2.3 Service identification information

Service identification information is a conditional entity that provides a description of the functionality of a service. The basic identification information for the service is included in the identificationInfo/ MD\_Identification element in the metadata record. The functionality of the service is represented by SV\_ServiceIdentification and consists of one conditional entity, MD\_Identifier, and the 6 elements, shown in List 3, and defined in Table 3 and represented in UML in Figure 4. If there are other resources (not the data provided by the service) required by the service (coupledResource), they should be linked using the MD\_Identification/ associatedResource element. The operatedDataset/MD\_Identifier entity specifies datasets that the service can provide access to or uses in its processing.

List 3. Entities and elements in SV\_ServiceIdentification

Conditional entity:

MD\_Identifier

Mandatory elements:

serviceType

Optional element:

accessProperties

containsOperations

endpointDescription

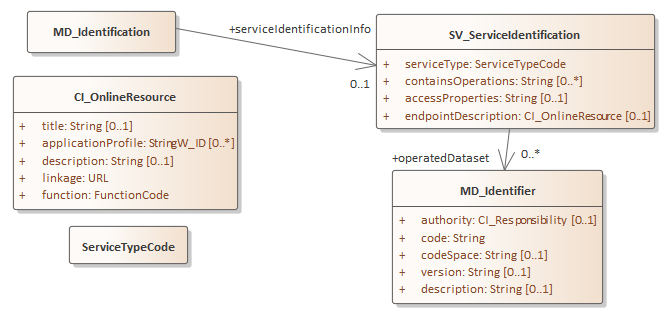


Figure 4. SV\_ServiceIdentification entities, elements and codelist.

#### 5.2.4 Imagery information

Imagery information is a conditional entity required when the resourceType is image or one of the subtypes of image. The entity provides additional information specific to raster or image data. It consists of the 9 elements in List 4, defined in Table 4 and represented in UML in Figure 5 with relations and relevant codelists..

List 4. Elements contained in MD\_Imagery

Optional elements:

sensor

platform

equipment

collector

startTime

endTime

signalGenerator

processedLevel

wavelength

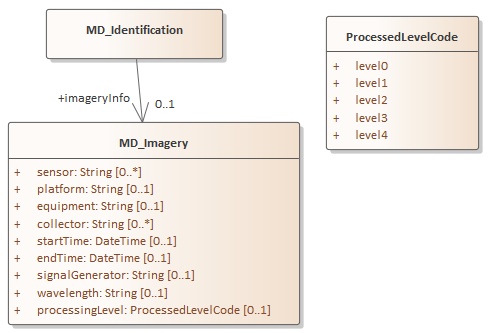


Figure . Imagery entity, elements and codelist

#### 5.2.5 Distribution information

Distribution information is a required entity that describes format and options for obtaining the resource, and contact information for the distributor. It’s represented by MD\_Distribution and consists of the 4 elements shown in List 5, defined in Table 5, and represented in UML in Figure 6 with relations and relevant codelists.

List 5. Elements contained in MD\_Distribution

Mandatory elements:

onlineResource

distributionFormat

Optional element:

distributionResponsibleParty

spatialRepresentationInfo



Figure . Distribution and Spatial Representation entities, elements and codelists.

#### 5.2.6 Spatial representation information

Spatial representation information is a conditional entity that is required to describe the representation of location in a spatial dataset, including geographical location and spatial resolution and reference system. This entity is represented by MD\_SpatialRepresentation and is an aggregation of the following 4 elements shown in List 6, defined in Table 6 and denoted in Figure 6 for the elements, relations and relevant codelists.

List 6. Entities and elements in MD\_SpatialRepresentation

Mandatory element:

spatialResolution

spatialRepresentationType

referenceSystemType

referenceSystemIdentifier

### Metadata element value entities

#### 5.3.1 Dates

Date values are used in two contexts for DDE metadata. Date values are used to specify calendar dates with optional clock times for events in the production, review, publication and revision of a resource. Dates are also used to specify the time interval (temporal extent) related to the information content of the resource. This second use might specify an interval with a begin and end calendar date or date and time, might specify an interval using begin and end named time intervals from the geologic time scale, or might specify the interval using numeric time coordinates in thousands, millions or billion years before present.

##### Calendar Date and Time

Calendar dates are specified using strings based on ISO 8601 The precision of the date can be defined by showing a combination of century plus year plus month plus day, e.g. YY (century), YYYY (year), YYYY-MM (year-month), YYYY-MM-DD (year, month and day).

A time is specified by appending an hour, minute and second to a year, month and day string, based on ISO 8601. The DateTime definition allows the less precise values. For example YYYY-MM-DDThh (year, month, day, hour), YYYY-MM-DDThh:mm (year, month, day, hour, minute), YYYY-MM-DDThh:mm:ss.d (year, month, day, hour, minute, second and decimals of seconds). The time zone should also be added, e.g. YYYY-M-DDThh:mm:ss.d+hh:mm. Inclusion of the punctuation in the date or dateTime strings is critical to enabling parsing of the time position values.

##### Named Geological Time Intervals

Gives values for geological time period or age in smallest resolvable geologic time scale unit, from the International Stratigraphic Chart released and updated by International Commission on Stratigraphy of the International Union of Geological Sciences. For example, Upper Jurassic, Holocene, etc. Use the International Stratigraphic Chart (https://stratigraphy.org/chart).

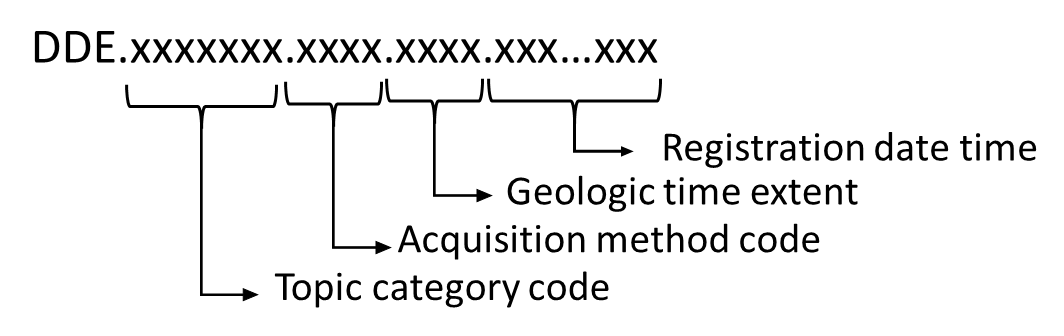
##### Numeric temporal positions

Geologists typically report a temporal location as a temporal position with coordinates in thousand, million or billion (10^9) years (ka, Ma or Ga) before present. Present is typically take as the year 1950 CE. Values should be reported as decimal numbers for interoperability.

EXAMPLE 201.3 Ma (the age is 201.3 million years). The time point.

#### 5.3.2 DDE Identifier convention

Identifiers for registered DDE data resources that can be generated automatically using the following pattern.



For the Topic Category and Acquisition method, a ‘s’ prefix indicates a single code value; ‘m’ prefix indicates multiple code value. Geologic time extent should be a named era from the DDE geologic time scale most applicable to the identified resource. The registration date and time is the ISO8601 DateTime with punctuation removed; registrations in the same second are numbered sequentially with the last three digits(in red in the example). Spaces (if present) are removed from all code values, and all characters are lower case. Example:

DDE.stratigraphy.[*outcropobservation*](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/outcrop_observation).jurassic.20210518114948001

#### 5.3.3 String with identifier

The XML implementation adds a type named ‘StringW\_ID’, analogous to the ISO19115-1 ‘Anchor’ type. This is a string value that can have an XML attribute URI. This enables a labeled link to a named resource, where the string value is the name of the resource, and the URI is a resolvable identifier for that resource.

#### 5.3.4 Online resource information

Online resource information is a common class represented by CI\_OnlineResource. This entity contains 5 elements shown in List 7, 2 of which are mandatory. Elements are described in Table 10 and depicted in Figure 7.

List 7. Elements contained in CI\_OnlineResource

Mandatory element:

linkage

function

Optional elements:

title

applicationProfile

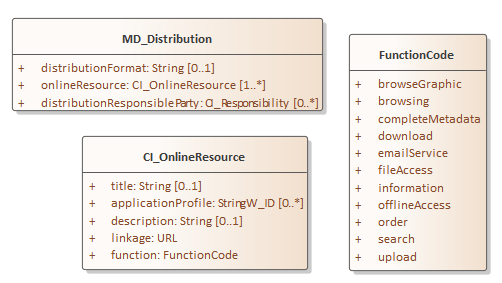
description

Figure 7. CI\_OnlineResource entity, elements and codelist.

#### 5.3.5 Responsible party information

Responsible party information is a common class represented by CI\_Responsibility, which describes the information about the party and their roles. The entity CI\_Responsibility consists of the 4 elements in List 8, and defined in Table 11 in the dictionary, and represented in UML in Figure 8 with relations and relevant codelists.

List 8. Elements contained in CI\_Responsibility

Mandatory element:

name

roleType

identifier

Optional elements:

country

electronicMailAddress

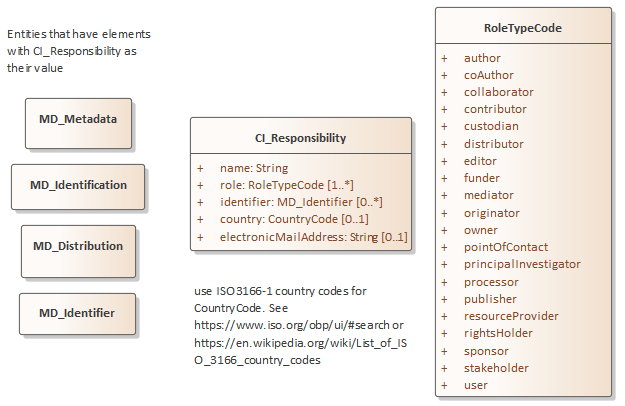


Figure . CI\_Responsibility entity, elements, and codeList

#### 5.3.6 Extent

Extent entities specify spatial or temporal location(s) related to the described resource. There are separate entities for geographic extent and temporal extent, depicted in Figure 9.

##### 5.3.6.1 Geospatial Extent

Figure 9. Geographic and Temporal Extent entities

Geographic extent information is a common class represented by EX\_GeographicExtent, which describes the information about the geospatial location of the resource content. An extent can be specified with an identifier for the location, or with a bounding box specified by the latitude and longitude coordinates of the southwest and northeast corners of the box. For interoperability, coordinates must be specified in decimal degrees using WGS84 (EPSG 4326) coordinate reference system. At least one of geographicIdentifier or the bounding box corner coordinates must be specified. This entity consists of the 6 elements in List 9, and defined in Table 8 in the dictionary, and represented in UML in Figure 9.

List 9. Elements contained in EX\_GeographicExtent

Mandatory element:

geographicIdentifier

eastBoundLongitude

westBoundLongitude

southBoundLatitude

northBoundLatitude

Optional element

Elevation

##### 5.3.6.1 Temporal extent

The EX\_temporalExtent entity provides interoperable information about the time interval related to the resource content. The interval has a beginning and an ending. The temporal positions can be specified with a calendar date or dateTime, a named geologic time interval from the ICS Chronostratigraphic Chart, or a numeric time coordinate in thousand, million or billion years before present. If the best temporal extent is a single time position, only the beginning value should be provided. If the beginning is specified with a calendar date or dateTime, then the end must also be a calendar date or dateTime. A beginName from the International Chronostratigraphic Chart (2020) is required. This entity consists of the 9 elements in List 10, defined in Table 12 in the dictionary, and represented in UML in Figure 9.

List 10. Elements contained in EX\_TemporalExtent

Mandatory element:

beginName

Optional element

beginIdentifier

endName

endIdentifier

beginDate

endDate

beginCoordinate

endCoordinate

coordinateUnits

### Data dictionary

This data dictionary describes the details of Geosciences Information metadata entities, elements and classes with names, short names, definitions, obligation/condition, maximum occurrence, types and domain. The dictionary contains 12 tables together with 14 codelists in Annex A. The column headings in the data dictionary tables are described in the following sections.

#### 5.4.1 Explanation

##### 5.4.1.1 Name/role name

* A label assigned to a metadata entity(class) or to a metadata element. Metadata entity names start with an upper case letter. Spaces do not appear in a metadata entity or element names. Instead, multiple words are concatenated, with each new subword starting with a capital letter (upper camel case, example: XnnnYmmm). Use of the two letter prefixes (e.g. MD\_, CI\_, EX\_) are used to emphasize connection to elements in the ISO19115-1 model, recognizing that implementation of these entities in DDE metadata is simplified; although the name of the entity might match the name of an ISO19115-1 entity, the DDE entities are in the DDE metadata namespace and are not the same.
* Metadata entity names are unique within the entire data dictionary of this DDE Metadata Standard. Metadata element names are unique within a metadata entity, not the entire data dictionary of this standard.
* Metadata elements start with a lower case letter, i.e. lower camel case.
* Metadata element names are made unique, within an application, by the combination of the metadata entity and metadata element names (example: MD\_Identifier/description).
* Role names are used to identify metadata elements shown as associations in the UML diagrams and are preceded by “Role name:” in the dictionary tables. Depiction as an element contained in an entity ‘box’ or as an association connecting entities is a matter of convenience and clarity in constructing the UML diagrams; the implementation in XML is the same.

##### 5.4.1.2 Definition

Definition provides a description of a metadata entity or metadata element.

##### 5.4.1.3 Obligation/Condition

This is a descriptor indicating whether a metadata entity or metadata element shall always be documented in the metadata or sometimes be documented (i.e. contain value(s)). This descriptor may have the following values: M (mandatory), C (conditional), or O (optional).

Mandatory (M)

This value indicates a metadata entity or metadata element that must always be documented.

Conditional (C)

This value indicates a metadata entity or element that must be documented if a particular condition is met.

Optional (O)

This value indicates a metadata entity or element that may or may not be documented. If an optional entity is not used, all the elements contained within that entity (including mandatory elements) will also not be used. Optional entities may have mandatory elements; those elements only become mandatory if the optional entity is used.

##### 5.4.1.4 Maximum occurrence

This descriptor specifies the maximum number of instances the metadata entity or the metadata element may have. Single occurrence is shown by “1”; repeating occurrences are represented by “N”.

##### 5.4.1.5 Data type

This descriptor specifies the kinds of values that may be used to specify a metadata element. For example, integer, real, string, DateTime, and Boolean.

##### 5.4.1.6 Domain

The domain specifies the values allowed, such as entity or class name, codelist name, data type names, or the use of free text. “Free text” indicates that no restrictions are placed on the content of the field.

#### 5.4.2 Tables

##### Table 1 – Metadata information (MD\_Metadata)

Root entity for a metadata object describing an information resource in scope of DDE Metadata

| No. | Name / Role name | Definition | Obligation/Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | metadataIdentifier | unique Identifier for this metadata record | M | 1 | Class | MD\_ Identifier (Table 9) |
| 2 | metadataStandardName | Name of the metadata standard (including profile name or version) used  Required: "DDE S01-2023: Geosciences Information Metadata" | M | 1 | CharacterString | Free Text/default: DDE S01-2021: Geosciences Information Metadata |
| 3 | metadataResponsibleParty | information about the party who is responsible for creation or maintenance of the metadata. | M | N | Class | CI\_Responsibility (Table 11) |
| 4 | metadataDate | date(s) associated with the metadata, update date must be provided; others can also be provided. | M | N | Class | CI\_Date (Table 7) |
| 5 | Role name: identificationInfo | Identifier for the resource described by this metadata record | M | 1 | Class | MD\_Identification (Table 2) |

Table . MD\_Metadata elements

##### Table 2 – Resource identification information (MD\_Identification)

The MD\_Identification entity provides basic information required to identify a resource. This is mandatory as the value of the identificationInfo element.

| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 6 | resourceIdentifier | Unique identifier information of the data resource | C/if unique identifier code exists | 1 | Class | MD\_ Identifier (Table 9) |
| 7 | title | name by which the dataset or resource is known | M | 1 | CharacterString | Free text |
| 8 | alternateTitle | short name or other language name by which the dataset or resource information is known  EXAMPLE “DDE” or in Chinese “深时数字地球@cn” as an alternative title for “Deep-time Digital Earth” | O | N | CharacterString | Free text |
| 9 | resourceDate | reference date for the dataset or resource | O | N | Class | CI\_Date (Table 7) |
| 10 | abstract | brief narrative summary of the resource | M | 1 | CharacterString | Free text.  At least 100 words |
| 11 | keyword | commonly used word(s) or formalized word(s) or phrase(s) used to describe the subject | M | N | CharacterString | Free text or from DDE knowledge system and other relevant vocabularies.  At least 3 keywords |
| 12 | topicCategory | main theme(s) of the resource. DDE codelist includes the topic categories from ISO19115-1, with extensions for more specific geoscience information topics. | M | N | Code | **Error! Not a valid result for table.** |
| 13 | resourceType | Classification of the kind of resource described by this metadata, e.g. Dataset, Service, Model, Document. | M | 1 | Code | ResourceTypeCode <<CodeList>> |
| 14 | resourceResponsible­Party | Agents responsible for or related to the intellectual content of the described resource: author, creator, editor, contributor, funder, pointOfContact | O | N | Class | CI\_Responsibility (Table 11) |
| 15 | browseGraphic | link to browse graphic that illustrates the data resource  NOTE Should include a legend for the graphic, if possible.  EXAMPLE A dataset, an organization logo, security constraint or citation graphic. | O | N | Class | CI\_OnlineResource (Table 10) |
| 16 | additionalDocumentation | other documentation associated with the resource  EXAMPLE Related articles, publications, user guides, data dictionaries | O | N | CharacterString | Free text |
| 17 | language | designation of the language in the resource content. Use ISO639-2 three letter codes. (see <https://www.loc.gov/standards/iso639-2/php/English_list.php>). Use multiple entries if the resource is available in more than one language, or if the content uses more than one language. | M | N | Code | LanguageCode <<CodeList>> ( ISO 639-2) |
| 18 | characterEncoding | designation of the character set to be used to encode the textual value of the resource content. Use multiple entries if the resource is available in more than one encoding, or if the content uses more than one encoding. | M | N | Code | CharacterSetCode <<CodeList>> (IANA character set register) |
| 19 | restriction | Entity that contains controlled codes and URIs for kind of access or usage restrictions, and optional text explanation of the restrictions | 1 | N | Class | MD\_Constraints ( Table 13) |
| 20 | edition | version of the cited resource | O | 1 | CharacterString | Free text |
| 21 | dataQuality | quality information for the described resource | O | 1 | CharacterString | Free text/Quality report and certification should be stated if exist |
| 22 | lineage | information about the events, source data, and/or the production process used in construction of the data resource specified | O | N | CharacterString | Free text |
| 23 | source | information about the source data used in creating the specified data resource | O | N | CharacterString | Free text |
| 24 | acquisitionType | acquisition or observation method of the original source of the dataset or resource or the related resource from which the described data or resource is derived | O | N | Code | AcquisitionCode <<CodeList>> |
| 25 | geoTime | temporal extent of the resource content, expressed as free text, particularly its geological historical time point or time duration period with time unit addressed or covered by the dataset or resource. | M | 1 | CharacterString | Named Geological Time Intervals or free text |
| 26 | geographicExtent | Specification of the geographic location related to the resource content | O | N | Class | EX\_GeographicExtent (Table 8) |
| 27 | temporalExtent | Specification of the temporal location related to the resource content, expressed as the beginning and ending of a time interval, bounded by a calendar date, geologic time scale unit, or temporal position in thousand, million or billion years before present. | O | N | Class | EX\_TemporalExtent (Table 12) |
| 28 | associatedResource | citation information about the associated resource that describes association between resources to allow users to navigate between related resources in a discovery context  NOTE Using the name element. | O | N | Class | CI\_OnlineResource (Table 10) |
| 29 | metadataReference | link to metadata for this resource in other formats or conforming to other conventions. | O | N | Class | CI\_OnlineResource (Table 10) |
| 30 | Role name: distributionInfo | information documenting how to obtain the resource. | M | N | Class | MD\_Distribution (Table 5) |
| 31 | Role name: serviceIdentification­Info | identification of capabilities which a service provider makes available to a service user through a set of interfaces that define a behavior. | C/resourceType = service | 1 | Class | SV\_ServiceIdentification (Table 3) |
| 32 | Role name:  imageryInfo | Additional information about image data of either remote sensing, microscope, photography or other images | C/resourceType =imagery or a subtype of imagery | 1 | Class | MD\_Imagery (Table 4) |

Table . MD\_Identification elements

##### Table 3 – Service Identification information (SV\_ServiceIdentification)

Documentation of capabilities available through a service endpoint, including the type of service, the operations that can be invoked, any restrictions or conditions to access the service, and data that the service operates on. Information about accessing the service should be included in the distribution/onlineResource element.

NOTE See ISO 19119 for further information

| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 33 | serviceType | a code value that specifies the kind of operations offered by the service. EXAMPLE ‘discovery’, ‘view’, ‘download’, ‘transformation’, or ‘invoke’’ | M | 1 | Code | ServiceTypeCode <<Codelist>> |
| 34 | containsOperations | provides information about the operation offered by the service | O | N | CharacterString | Free Text |
| 35 | accessProperties | information about the availability of the service, including fees, planned available data and time, ordering instructions, turnaround, etc. | O | 1 | CharacterString | Free Text |
| 36 | operatedDataset | identification of data resource used for the operation of the service. Could be a specific dataset, or identifier for a file format or information interchange file format profile. | C/data as a service exists | N | Class | MD\_Identifier (Table 2) |
| 37 | endpointDescription | Link to a service-specific online resource that describes the operation of the service in a format for machine parsing, e.g. an OpenAPI document (<https://swagger.io/specification/>) or OGC capabilities document. | O | N | Class | CI\_OnlineResource (Table 10) |

Table . SV\_ServiceIdentification elements

##### Table 4 – Imagery information (MD\_Imagery)

Information about raster image data or resource that collected or interpreted about an object without being in physical contact with the object. Data processing should be described in the MD\_Identification/lineage element.

| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 38 | sensor | Type of the sensor used to acquire the image. Include specific model number if available. In an RGB image, different sensors might be associated with each color channel. | O | N | CharacterString | Free text |
| 39 | platform | Name, type and description of the platform from which the data were acquired | O | 1 | CharacterString | Free text |
| 40 | equipment | instruments for the image data collection  EXAMPLE X-ray Powder Diffraction, Raman Spectroscopy, Single Crystal CCD Diffractometer, Electron Microprobe, Hand Camera | O | N | CharacterString | Free text |
| 41 | collector | Name or information of the image data collector | O | N | CharacterString | Free text |
| 42 | startTime | start time of data collection | O | 1 | DateTime | Calendar Date and Time |
| 43 | endTime | end time of data collection | O | 1 | DateTime | Calendar Date and Time |
| 44 | signalGenerator | The key property of signal source that produces the imagery.  EXAMPLE: LA-ICP-MS Mapping: (Energy density, Beam diameter, Scan speed, Line space), Microscope (Single polarized light, Reflected light, Transmitted light), SEM (Secondary electron image, backscattered electron image) | O | N | CharacterString | Free text |
| 45 | wavelength | width of a band. it refers to the spectral channel of the sensor response, which is the width of each band  EXAMPLE 0.45-0.52μm | O | N | CharacterString | Free text |
| 46 | processedLevel | processing level of the source data | O | 1 | Code | ProcessedLevelCode <<CodeList>> |

Table 4. MD\_Imagery elements

##### Table 5 – Distribution information (MD\_Distribution)

MD\_Distribution entity provides information about format, constraints, URLs to obtain the resource, contact information for the resource provider.

| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 47 | distributionFormat | provides a description of the format of the data to be distributed  EXAMPLE ArcGIS shp files, csv, dbf | O | N | CharacterString | Free text |
| 48 | onlineResource | on-line information that can be used to contact the individual or organization and online reference to the dataset or resource which provides basic connection information, and also typical information linking to the documents of the distribution. | M | N | Class | CI\_OnlineResource (Table 10) |
| 49 | distributionResponsibleParty | party from whom the distributed or released data resource may be obtained. This list need not be exhaustive | O | N | Class | CI\_Responsibility (Table 11) |
| 50 | Role name: spatialRepresentationInfo | digital representation of spatial information in the data resource | C/resourceType = geographicDataset | 1 | Class | MD\_SpatialRepresentation (Table 6) |

Table . MD\_Distribution elements

##### Table 6 – Spatial representation information (MD\_SpatialRepresentation)

Documentation of the method used to represent location in a distribution that includes spatial data. A dataset might have distributions with different resolutions, or vector vs. raster spatial representation, so this entity is associated with MD\_Distribution.

| No. | Name / Role name | Definition | Obligation/Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 51 | spatialRepresentationType | method used to spatially represent geographic information | C/resourceType = geographicDataset | 1 | Code | SpatialRepresentationTypeCode <<CodeList>> |
| 52 | spatialResolution | factor that provides a general understanding of the density of spatial data in the resource or describes the range of resolutions in which a digital resource should be useful.  NOTE This element should be repeated when describing upper and lower range.  EXAMPLE 1 1:50000. EXAMPLE 2 15m | O | N | CharacterString | Free text |
| 53 | referenceSystemType | type of reference system used  EXAMPLE compoundGeographic2D- Parametric | O | 1 | Code | ReferenceSystemTypeCode <<CodeList>> |
| 54 | referenceSystemIdentifier | Identifier for the spatial reference system used to represent location in the spatial data. Recommend using EPSG SRS identifiers (https://spatialreference.org/ref/epsg/) | C/resourceType = geographicDataset | 1 | Class | MD\_Identifier (Table 9) |

Table . MD\_SpatialRepresentation elements

##### Table 7 – Date information (CI\_Date)

Entity that associates a calendar date or date time with a date type that specifies the event associated with the date. See Calendar Date and Time for information about date formatting.

| No. | Name / Role name | Definition | Obligation/Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 55 | date | ISO8601 formatted string specifying a calendar date and time. | M | 1 | Date or DateTime | See Calendar Date and Time |
| 56 | dateType | Code term that specifies the event that occurred on the provided date | M | 1 | Code | DateTypeCode <<CodeList>> |

Table . CI\_Date elements

##### Table 8 – Geographic extent (EX\_GeographicExtent)

Entity that specifies a geographic location related to the resource content. Either at least one geographicIdentifier or the coordinates for the corners of a bounding box are required.

| No. | Name / Role name | Definition | Obligation/Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 57 | geographicIdentifier | identifier used to represent a geographic area  NOTE A geographic identifier as described in ISO 19112. | C/westBoundLongitude not provided | N | CharacterString | Free text |
| 58 | Elevation | range of the elevation or bathymetry about the dataset or resource EXAMPLE “-3000.00m to 2021.58m relative to mean sea level’; string should include the vertical reference system used | O | 1 | CharacterString | Free text |
| 59 | westBoundLongitude | western-most coordinate of the limit of the resource extent, expressed in longitude in WGS84 decimal degrees (positive east)  EXAMPLE -120.1234 | C/geographicIdentifier not provided | 1 | Decimal | -180.0<= West Bounding Longitude Value <= 180.0 |
| 60 | eastBoundLongitude | eastern-most coordinate of the limit of the resource extent, expressed in longitude in WGS84 decimal degrees (positive east) | C/westBoundLongitude is documented | 1 | Decimal | -180.0 <= East Bounding Longitude Value <= 180.0 |
| 61 | southBoundLatitude | southern-most coordinate of the limit of the resource extent, expressed in latitude in WGS84 decimal degrees (positive north)  EXAMPLE -45.5678 | C/westBoundLongitude is documented | 1 | Decimal | -90.0 <= South Bounding Latitude Value <= 90.0; South Bounding Latitude Value <= North bounding Latitude Value |
| 62 | northBoundLatitude | northern-most coordinate of the limit of the resource extent expressed in latitude in WGS84 decimal degrees (positive north) | C/westBoundLongitude is documented | 1 | Decimal | -90,0 <= North Bounding Latitude Value <= 90,0; North Bounding Latitude Value >= South Bounding Latitude Value |

Table . EX\_GeographicExtent elements

##### Table 9 – Identifier information (MD\_ Identifier)

Entity that provide information for the authority and description associated with an identifier string. If the identifier is a URI, is it provided in the code element. If the identifier is locally defined, the identifier string is the code, and the codespace string specifies a namespace, such that the combination of the codespace and code is a globally unique identifier.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| 63 | authority | the person or party responsible for maintenance of that namespace | O | 1 | Class | CI\_Responsibility (Table 11) |
| 64 | code | alphanumeric value identifying an instance in the namespace NOTE Avoid characters that are not legal in URLs. EXAMPLE: EPSG:4326 | M | 1 | CharacterString | DOI, 5.3.2 DDE Identifier convention, other URI, or a specified character string |
| 65 | codeSpace | identifier or namespace in which the code is valid | O | 1 | CharacterString | No specified domain |
| 66 | version | version identifier for the namespace | O | 1 | CharacterString | No specified domain |
| 67 | description | natural language description of the meaning of the code value. EXAMPLE For codeSpace = EPSG, code = 4326, description = WGS-84. | O | 1 | CharacterString | No specified domain |

Table . MD\_Identifier elements

##### Table 10 – Online resource information (CI\_OnlineResource)

Information documenting a link to access a resource.

| No. | Name / Role name | Definition | Obligation/Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 68 | title | title to label this distribution option in user interface | O | 1 | CharacterString | Free text |
| 69 | applicationProfile | Identifier for profile implemented at this distribution point | O | N | CharacterString | Free text |
| 70 | description | description of this distribution | O | 1 | CharacterString | Free text |
| 71 | linkage | A web locator to access this distribution. | M | 1 | URL |  |
| 72 | function | code for function performed by the online resource, e.g. download, landingPage, queryPage, accessRequest, accessServiceDescription | M | N | Code | FunctionCode <<CodeList>> |

Table . CI\_OnlineResource elements

##### Table 11 – Responsible party information (CI\_Responsibility)

Information about an agent, including individuals, organizations, or automated agents, responsible for some aspect of the resource. The roleType specifies the relation of the agent to the resource.

| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 73 | Name | name of the party (individual, organization or automated agent) | M | 1 | CharacterString | Free text/full name or recognized short name |
| 74 | identifier | identifier for this agent. Recommend ORCID for people, ROR or organizations. Should be a resolvable URI. | O | 1 | Class | MD\_Identifier (Table 9) |
| 75 | country | country of the address | O | 1 | Code | CountryCode <<CodeList>> – ISO 3166-1 |
| 76 | electronicMailAddress | address of the electronic mailbox of the responsible organization or individual | O | N | CharacterString | No specified domain |
| 77 | roleType | types of roles played by the responsible party | M | N | Code | **Error! Reference source not found.** |

Table . CI\_Responsibility elements

##### Table 12 – Temporal extent (EX\_TemporalExtent)

Entity that specifies the time interval to which the resource content is related. A begin name is required to provide at least a single named geologic era for interoperability.

| No. | Name / Role name | Definition | Obligation/ Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 78 | beginName | Name of a time interval that starts the temporal extent interval. Should be a name from the International Stratigraphic Chart (https://stratigraphy.org/chart) | M | 1 | CharacterString | Name from the International Chronostratigraphic Chart (2020) |
| 79 | beginIdentifier | Identifier for time interval from geologic time scale that starts the temporal extent interval. URIs can be obtained from http://resource.geosciml.org/vocabulary/timescale/gts2020 | O | 1 | Class | MD\_Identifier (Table 9) |
| 80 | endName | Informal name of a time interval that ends the temporal extent interval. Should be a name from the International Stratigraphic Chart (https://stratigraphy.org/chart) | O | 1 | CharacterString | Name from the International Chronostratigraphic Chart (2020) |
| 81 | endIdentifier | Identifier for time interval from geologic time scale that ends the temporal extent interval. URIs can be obtained from http://resource.geosciml.org/vocabulary/timescale/gts2020 | O | 1 | Class | MD\_Identifier (Table 9) |
| 82 | beginDate | A calendar date or dateTime position that begins the temporal extent interval | O | 1 | Date or DateTime | Calendar Date and Time |
| 83 | endDate | A calendar date or dateTime position that ends the temporal extent interval | O | 1 | Date or DateTime | Calendar Date and Time |
| 84 | beginCoordinate | A decimal number that is the time position that begins the temporal extent interval. Units of measure are specified by the coordinateUnits element. | O | 1 | Decimal | >0 |
| 85 | endCoordinate | A decimal number that is the time position that ends the temporal extent interval. Units of measure are specified by the coordinateUnits element. | O | 1 | Decimal | >0 |
| 86 | coordinateUnits | A code value that specifies the units of measure for numeric time coordinate positions | O | 1 | enum | {Ka, Ma, Ga} |

Table , EX\_TemporalExtent elements

##### Table 13 – Access and Usage contraints (MD\_Constraint)

Entity that associates a restriction code with the resource and an optional text explanation of the restriction(s)

| No. | Name / Role name | Definition | Obligation/Condition | Maximum occurrence | Data type | Domain |
| --- | --- | --- | --- | --- | --- | --- |
| 87 | restrictionText | Text explanation of restrictions asserted by the associated restriction codes. | O | 1 | Date or DateTime | See Calendar Date and Time |
| 88 | restrictionCode | Code term that specifies the kind of restriction asserted on usage or access to the resource | M | N | Code | DateTypeCode <<CodeList>> |

Table . MD\_Constraint elements

# Annex A - Geosciences Information Metadata Code List (Normative)

This standard specifies the following conventions and code lists for element values in DDE metadata.

## AcquisitionCode <<CodeList>>

Codes for specifying data collection method, based on CGI Feature observation method vocabulary ([http://resource.geosciml.org/classifier/cgi/featureobservationmethod](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod)).

|  | Code/Concept name (English) | Code/2nd category concept name | Definition |
| --- | --- | --- | --- |
| 1. | geologicalMapping | Data collected and acquisition mostly in the field by profiling and stationary observation, sampling, and following laboratory analysis, etc., typically, regional field geological mapping | |
| 2. | survey | Data collected with equipment records and following processing with planned profile, or areal/regional data acquisition activity, etc., typically, aeromagnetic survey. | |
| 3. | observation | Data collected by stationary measurement, etc. like ground water monitoring. | |
| 3.1/[direct observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/direct_observation) | (CGI) Feature observation is result of direct visual observation by a geologist (<http://resource.geosciml.org/classifier/cgi/featureobservationmethod/direct_observation>). Direct observation may include observation using a remote camera (e.g. downhole viewer, submarine camera). |
| 3.2/[indirect observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/indirect_method) | (CGI) Feature observation based on inference from proxy observation([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/indirect\_method](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/indirect_method) ) |
| 3.3/[outcrop observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/outcrop_observation) | (CGI) Data collected in field through direct observation of a single outcrop. Observer defines scope of 'single outcrop' - may be one point location, or averaged over an extended but connected area, e.g. a single polygon on a map ([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/outcrop\_observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/outcrop_observation)). |
| 4. | remoteSensing | Data collected with satellites, airplane platform on drone, etc., typically aero-photography and radar.  Also, (CGI) Geologic unit or structure characterized based on remotely sensed data([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/remotely\_sensed\_data](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/remotely_sensed_data) ) | |
| 5. | drillBorehole | Collection or records of drills and boreholes. | |
| 5.1/borehole [borehole cuttings observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/borehole_cuttings_observation) | (CGI) Data based on interpretation of borehole cuttings([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/borehole\_cuttings\_observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/borehole_cuttings_observation)) |
| 5.2/ [borehole geophysical log measurements](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/borehole_geophysical_log_measurements) | (CGI) Data based on interpretation of geophysical measurement obtained by borehole logging tools([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/borehole\_geophysical\_log\_measurements](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/borehole_geophysical_log_measurements)). |
| 5.3/drill core observation | (CGI) Data collected through observation of a single drill core interval([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/drill\_core\_observation](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/drill_core_observation)). |
| 6. | laboratoryInstrumentation | Data or resource from rock specimen and chemical element analyses in laboratories. | |
| 7. | dataIntegrationSynthesis | Data or resource are the result of synthesis from other data or resources, or as the integration of other data or resources. | |
|  |  | 7.1/[data from single published description](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/data_from_single_published_description) | (CGI) Data are extracted from a published description of the feature([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/data\_from\_single\_published\_description](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/data_from_single_published_description)) |
|  |  | 7.2/ synthesis from multiple sources | (CGI) Feature observation is based on a synthesis of other observations by some compiler. The compiler may be the same individual that made the source observations ([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis\_from\_multiple\_sources](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis_from_multiple_sources)). |
|  |  | 7.3/ synthesis of multiple outcrop observations | (CGI) Data are the result of synthesis from multiple direct observations, possibly by more than one observer([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis\_of\_multiple\_outcrop\_observations](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis_of_multiple_outcrop_observations)). |
|  |  | 7.4/synthesis of multiple published descriptions | (CGI) Data are the result of synthesis from multiple published descriptions([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis\_of\_multiple\_published\_descriptions](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/synthesis_of_multiple_published_descriptions)). |
| 8. | digital conversion from published source | (CGI) Feature observation is based on published information, converted to a digital representation for database apapplication ([http://resource.geosciml.org/classifier/cgi/featureobservationmethod/digital\_conversion\_from\_published\_source](https://cgi.vocabs.ga.gov.au/object?uri=http%3A//resource.geosciml.org/classifier/cgi/featureobservationmethod/digital_conversion_from_published_source)). | |
| 9. | digitalSimulation | Data generated by digital analyses and simulations with software rather than physical acquisitions. | |
| 10. | data and map compilation | Geoscience data and map compilation from existing data, maps and other resources that are usually scattered and in larger scale and of higher spatial resolution.  Or the collation of raw data and their transformation into a format that can be easily manipulated or combined with other data in preparation for further analysis(EiE [Glossary](https://inee.org/eie-glossary), https://inee.org/eie-glossary/data-compilation). | |
| 11. | Webweb rResource | Data and resources obtained from the web. | |
| 12. | other | Data and resources obtained from other source other than the above. | |

## CharacterSetCode <<CodeList>>

Use IANA Character Set register: http://www.iana.org/assignments/character-sets. These are the official names for character sets that may be used on the Internet and may be referred to in Internet documentation. These names are expressed in ANSI\_X3.4-1968 which is commonly called US-ASCII or simply ASCII

## CountryCode <<CodeList>>

Use ISO 3166 Codes for the representation of names of countries and their subdivisions Part 1: Country codes or equivalent.

## DateTypeCode <<CodeList>>

Extended from <https://wiki.esipfed.org/ISO_19115-3_Codelists#CI_DateTypeCode>. CI\_OnlineResource is used for all links, and the function element indicates the relationship type.

|  | Code | Concept name (English) | Definition |
| --- | --- | --- | --- |
|  | adopted | Adopted | date identifies when resource was adopted |
|  | creation | Creation | start date of a data collection, start date of a cruise.. |
|  | deprecated | Deprecated | date identifies when resource was deprecated |
|  | distribution | Distribution | date identifies when an instance of the resource was distributed |
|  | inForce | In force | date identifies when resource became in force |
|  | lastRevision | Last revision | date identifies when resource was last reviewed |
|  | lastUpdate | Last update | date identifies when resource was last updated |
|  | nextUpdate | Next update | date identifies when resource will be next updated |
|  | publication | publication | date identifies when the resource was issued |
|  | released | released | the date that the resource shall be released for public access |
|  | revision | revision | date identifies when the resource was examined or re-examined and improved or amended |
|  | superseded | superseded | date identifies when resource was superseded or replaced by another resource |
|  | unavailable | unavailable | date identifies when resource became not available or obtainable |
|  | validityBegins | Validity begins | time at which the data are considered to become valid.  NOTE: There could be quite a delay between creation and validity begins |
|  | validityExpires | Validity expires | time after which the resource will no longer be considered to be valid |

## FunctionCode <<CodeList>>

Extended from <https://wiki.esipfed.org/ISO_19115-3_Codelists#CI_OnLineFunctionCode>. CI\_OnlineResource is used for all links, and the function element indicates the relationship type.

|  | Code | Concept name (English) | Definition |
| --- | --- | --- | --- |
|  | browseGraphic | Browse graphic | browse graphic provided (ISO\_19115-3) |
|  | browsing | Browsing | online browsing provided (ISO\_19115-3) |
|  | completeMetadata | Complete metadata | Link is to a metadata resource with more complete information, or serialized using a different format or metadata profile, as indicated by the application profile in the CI\_OnlineResource element. (based on ISO\_19115-3) |
|  | coupledResource | Coupled resource | Link is to a resource required by the described service. Only applicable if resourceType = service. CI\_OnlineResource/description should explain the nature of the dependency. |
|  | download | Download | Link will get the content of the described resource as a file (based on ISO\_19115-3) |
|  | emailService | Email service | online email service provided (ISO\_19115-3) |
|  | fileAccess | File access | online file access provided (ISO\_19115-3) |
|  | order | Order | online order process for obtaining the resource (ISO\_19115-3) |
|  | search | Search | online search interface for seeking out information about the resource (ISO\_19115-3) |
|  | information | Information | online information about the resource (ISO\_19115-3) |
|  | offlineAccess | Offline Access | online instructions for requesting the resource from the provider (ISO\_19115-3) |
|  | upload | Upload | online resource upload capability provided (ISO\_19115-3) |

## LanguageCode <<CodeList>>

Use ISO 639-2. ISO 639-2 is the alpha-3 code in Codes for the representation of names of languages. See https://www.loc.gov/standards/iso639-2/php/code\_list.php.

## ProcessedLevelCode <<CodeList>>

|  |  |  |  |
| --- | --- | --- | --- |
|  | Code | Concept name (English) | Definition |
| 1 | Level 0 | Level 0 | Raw images |
| 2 | Level 1 | Level 1 | After radiation correction |
| 3 | Level 2 | Level 2 | After systematic geometric correction and radiation correction |
| 4 | Level 3 | Level 3 | After fine geometric correction using ground control points |
| 5 | Level 4 | Level 4 | Data products |

## ReferenceSystemTypeCode <<CodeList>>

Codes that specify kinds of coordinate reference systems use to identify locations.

|  | Concept name (English) | Code | Definition |
| --- | --- | --- | --- |
| 1. | compoundEngineering- Parametric | compoundEngineering Parametric | compound spatio-parametric coordinate reference system containing an engineering coordinate reference system and a parametric reference system  EXAMPLE [local] x, y, pressure |
| 2. | compoundEngineering- Parametric Temporal | compoundEngineering ParametricTemporal | compound spatio-parametric-temporal coordinate reference system containing an engineering, a parametric, and a temporal coordinate reference system  EXAMPLE [local] x, y, pressure, time |
| 3. | compoundEngineer- ingTemporal | compoundEngineering Temporal | compound spatio-temporal coordinate reference system containing an engineering and a temporal coordinate reference system  EXAMPLE [local] x, y, time |
| 4. | compoundEngineeringVer- tical | compoundEngineering  Vertical | compound spatial reference system containing a horizontal engineering coordinate reference system and a vertical coordinate reference system  EXAMPLE [local] x, y, height |
| 5. | compoundEngineeringVer- tical Temporal | compoundEngineeringVerticalTemporal | compound spatio-temporal coordinate reference system containing an engineering, a vertical, and a temporal coordinate reference system  EXAMPLE [local] x, y, height, time |
| 6. | compoundGeographic2D Parametric | compoundGeographic 2DParametric | compound spatio-parametric coordinate reference system containing a 2 dimensional geographic horizontal coordinate reference system and a parametric reference system  EXAMPLE latitude, longitude, pressure |
| 7. | compoundGeographic2D ParametricTemporal | compoundGeographic 2DParametricTem poral | compound spatio-parametric-temporal coordinate reference system containing a 2 dimensional geographic horizontal, a parametric and a temporal coordinate reference system  EXAMPLE latitude, longitude, pressure, time |
| 8. | compoundGeographic2D  Temporal | compoundGeographic 2DTemporal | compound spatio-temporal coordinate reference sys- tem containing a 2 dimensional geographic horizontal coordinate reference system and a temporal reference system  EXAMPLE latitude, longitude, time |
| 9. | compoundGeographic2D- Vertical | compoundGeographic 2DVertical | compound coordinate reference system in which one constituent coordinate reference system is a horizontal geodetic coordinate reference system and one is a vertical coordinate reference system  EXAMPLE latitude, longitude, [gravity-related] height  or depth |
| 10. | compoundGeographic2Dvertical Temporal | compoundGeographic VerticalTemporal | compound spatio-temporal coordinate reference system containing a 2 dimensional geographic horizontal, a vertical, and a temporal coordinate reference system  EXAMPLE latitude, longitude, height, time |
| 11. | compoundGeographic3D  Temporal | compoundGeographic 3DTemporal | compound spatio-temporal coordinate reference system containing a 3 dimensional geographic and a temporal coordinate reference system  EXAMPLE latitude, longitude, ellipsoidal height, time |
| 12. | compoundProjected2DParametric | compoundProjected 2DParametric | compound spatio-parametric coordinate reference system containing a projected horizontal coordinate reference system and a parametric reference system  EXAMPLE easting, northing, density |
| 13. | compoundProjected2DParametricTemporal | compoundProjected 2DParametricTem poral | compound spatio-parametric-temporal coordinate reference system containing a projected horizontal, a parametric, and a temporal coordinate reference system  EXAMPLE easting, northing, density, time |
| 14. | compoundProjectedTemporal | compoundProjected Temporal | compound spatio-temporal coordinate reference system containing a projected horizontal and a temporal coordinate reference system  EXAMPLE easting, northing, time |
| 15. | compoundProjectedVertical | compoundProjected  Vertical | compound spatial reference system containing a horizontal projected coordinate reference system and a vertical coordinate reference system  EXAMPLE easting, northing, [gravity-related] height  or depth |
| 16. | compoundProjectedVertical Temporal | compoundProjected  VerticalTemporal | compound spatio-temporal coordinate reference system containing a projected horizontal, a vertical, and a temporal coordinate reference system  EXAMPLE easting, northing, height, time |
| 17. | engineering | engineering | coordinate reference system based on an engineering datum (datum describing the relationship of a coordinate system to a local reference)  EXAMPLE [local] x,y |
| 18. | engineeringDesign | engineeringDesign | engineering coordinate reference system in which the base representation of a moving object is specified  EXAMPLE [local] x,y |
| 19. | engineeringImage | engineeringImage | coordinate reference system based on an image datum (engineering datum which defines the relationship of a coordinate system to an image)  EXAMPLE row, column |
| 20. | geodeticGeocentric | geodeticGeocentric | geodetic CRS having a Cartesian 3D coordinate system  EXAMPLE [geocentric] X,Y,Z |
| 21. | geodeticGeographic2D | geodeticGeographic2D | geodetic CRS having an ellipsoidal 2D coordinate system  EXAMPLE latitude, longitude |
| 22. | geodeticGeographic3D | geodeticGeographic3D | geodetic CRS having an ellipsoidal 3D coordinate system  EXAMPLE latitude, longitude, ellipsoidal height |
| 23. | geographicIdentifier | geographicIdentifier | spatial reference in the form of a label or code that identifies a location  EXAMPLE post code |
| 24. | linear | linear | reference system that identifies a location by reference to a segment of a linear geographic feature and distance along that segment from a given point  EXAMPLE x km along road |
| 25. | parametric | parametric | coordinate reference system based on a parametric datum (datum describing the relationship of a parametric coordinate system to an object)  EXAMPLE pressure |
| 26. | projected | projected | coordinate reference system derived from a two-dimensional geodetic coordinate reference system by applying a map projection  EXAMPLE easting, northing |
| 27. | temporal | temporal | reference system against which time is measured  EXAMPLE time |
| 28. | vertical | vertical | one-dimensional coordinate reference system based on a vertical datum (datum describing the relation of gravity-related heights or depths to the Earth)  EXAMPLE [gravity-related] height or depth |

## ResourceTypeCode <<CodeList>>

Includes a subset of ISO19115-3 scope codes[[1]](#footnote-2) applicable to DDE resources in the scope of this specification, with extensions defined here, based on subclasses of CreativeWork in Schema.org, and Dublin Core resource types.

|  | Code | Level 1 concept name | Level 2 concept name | Definition or description |
| --- | --- | --- | --- | --- |
|  | aggregate | Aggregate |  | Set of resources of various types that are grouped into a single resource for some purpose. Component resources do not necessarily share the same format or information model. Source ISO19115-3, this vocabulary |
|  | application | Application |  | See schema.org/SoftwareApplication. An executable unit of functionality. Typically an implementation of some software on a particular platform. Source ISO19115-3, this vocabulary |
|  | webApplication |  | Web Application | An application that executes on a server via interaction with a human user through a web interface. Source this vocabulary. |
|  | collection | Collection |  | A set of related resource that share a similar format .(rev from ISO19115-3, schema.org, Dublin Core) |
|  | dataset | Dataset |  | a collection of numeric or categorical values that convey information, describing the quantity, quality, fact, statistics, other basic units of meaning, or simply sequences of symbols that may be further interpreted formally. Sourcce ISO19115-3, schema.org, Dublin Core, definition based on https://en.wikipedia.org/wiki/Data |
|  | dataCatalog |  | Data catalog | a kind of dataset in which the records are documentation for datasets. A metadata dataset. schema.org |
|  | geographicDataset |  | Geographic dataset | Dataset in which the data are related to a geographic location |
|  | nonGeographicDataset |  | Non-geographic dataset | Dataset containing data that is not associated with a geographic location.(rev from ISO19115-3) |
|  | document | Document |  | a written, drawn, presented, or memorialized representation of thought, the manifestation of non-fictional or imaginary content. Source ISO19115-3, https://en.wikipedia.org/wiki/Document |
|  | article |  | Article | a document that is published in a print or electronic medium as part of a larger work or series. Source schema.org, <https://en.wikipedia.org/wiki/Article_(publishing)>, this vocabulary. |
|  | thesis |  | Thesis | a document submitted in support of candidature for an academic degree or professional qualification presenting the author's research and findings. Source schema.org, <https://en.wikipedia.org/wiki/Thesis>, ISO 7144 |
|  | book |  | Book | a document that records information in the form of writing or images, typically composed of many pages bound together and protected by a cover. Source schema.org, https://artsandculture.google.com/entity/book/m0bt\_c3 |
|  | poster |  | Poster | a document intended for display on a large screen or printed sheet. Source schema.org, Merriam-Webster |
|  | webPage |  | Web page | a document accessible on the world wide web, formatted for viewing on a computer screen. Source schema.org, this vocabulary, |
|  | image | Image |  | visual representation of something. Source Dublin Core |
|  | map |  | Map | symbolic visual representation of a spatial region. Source schema.org, https://en.wikipedia.org/wiki/Map |
|  | photograph |  | Photograph | image created by light falling on a photosensitive surface, usually photographic film or an electronic image sensor, such as a CCD or a CMOS chip. Source schema.org, https://en.wikipedia.org/wiki/Photograph |
|  | explanatoryFigure |  | Explanatory figure | Diagrams, data plots, flow charts, other kinds of graphics generated to present or explain ideas or data. Source this vocabulary. |
|  | initiative | Initiative |  | activity that produces information resources or artifacts that might be cataloged. Source ISO19115-3 |
|  | fieldSession |  | Field session | initiative that involves collecting data outside of a fixed laboratory environment, in situ, at the location where the subject of the observation is located (e.g. cruise) . Source ISO19115-3, this vocabulary |
|  | learningResource | LearningResource |  | a resource intended to instruct a user about some topic or procedure. Often a composite of text, images, sound, and movie. Source schema.org, this vocabulary |
|  | guide |  | Guide | a kind of learningResource. Source schema.org |
|  | model | Model |  | information applies to a copy or imitation of an existing or hypothetical object ISO19115-3, Dublin Core |
|  | movie | Movie |  | a sequence of consecutive still images recorded in a series to be viewed on a screen in such rapid succession as to give the illusion of natural movement. Source schema.org, https://www.dictionary.com/browse/movie |
|  | repository | Repository |  | a container for other resources. Source ISO19115-3, this vocabulary |
|  | semanticResource | Semantic resource |  | resource that defines and information model or vocabulary used for information interchange, e.g. glossary, ontology, data model. . Source this vocabulary. |
|  | definedTermSet |  | DefinedTermSet | a set of terms with definitions, typically with identifiers for each term, and all related to some scope. Source schema.org, this vocabulary |
|  | series | Series |  | a collection of related resources. Source ISO19115-3, this vocabulary. |
|  | service | Service |  | a capability that a provider makes available to a user through an interface that define a input and output requirements and offered functionality. (based on ISO19115-3, Dublin Core). This general service category includes services that are invoked via any communication channel. Service is distinguished from Application in that a service is not intended to be interactive in real time. An Application might be constructed using one or more Services. |
|  | webAPI |  | WebAPI | A service that communicates with the service user via HTTP operations. See https://schema.org/WebAPI |
|  | software | Software |  | information applies to a computer program or routine ISO19115-3, Dublin Core. See SoftwareSourceCode schema.org |
|  | sound | Sound |  | resource is a reproducible representation of recorded acoustic phenomena. DublinCore, this vocabulary |

## RestrictionCode <<CodeList>>

Codes to specify limitation(s) placed upon the access or use of the described resource.

|  | Code | Concept name (English) | Definition |
| --- | --- | --- | --- |
| 1 | confidential | confidential | not available to the public  NOTE Contains information that could be prejudicial to a commercial, industrial, or national interest. |
| 2 | copyright | copyright | exclusive right to the publication, production, or sale of the rights to a literary, dramatic, musical, or artistic work, or to the use of a commercial print or label, granted by law for a specified period of time to an author, composer, artist, distributor |
| 3 | inConfidence | in-confidence | with trust |
| 4 | intellectualPropertyRights | Intellectual property rights | rights to financial benefit from and control of distribution of non-tangible property that is a result of creativity |
| 5 | licence | licence | formal permission to do something |
| 6 | licenceDistributor | Licence distributor | formal permission required for a person or an entity to commercialize or distribute the resource |
| 7 | licenceEndUser | Licence end user | formal permission required for a person or an entity to use the resource and that may differ from the person that orders or purchases it |
| 8 | licenceUnrestricted | Licence unrestricted | formal permission not required to use the resource |
| 9 | otherRestrictions | Other restrictions | limitation not listed |
| 10 | patent | Patent | government has granted exclusive right to make, sell, use or license an invention or discovery |
| 11 | patentPending | Patent pending | produced or sold information awaiting a patent |
| 12 | private | Private | protects rights of individual or organizations from  observation, intrusion, or attention of others |
| 13 | restricted | Restricted | withheld from general circulation or disclosure |
| 14 | sbu | Sensitive but unclassified | although unclassified, requires strict controls over its  distribution. |
| 15 | statutory | Statutory | prescribed by law |
| 16 | trademark | Trademark | a name, symbol, or other device identifying a product, officially registered and legally restricted to the use of the owner or manufacturer |
| 17 | unrestricted | unrestricted | no constraints exist |

## RoleTypeCode <<CodeList>>

(copied from https://wiki.esipfed.org/ISO\_19115-3\_Codelists#CI\_RoleCode)

|  | Code | Concept name (English) | Definition |
| --- | --- | --- | --- |
| 1 | author | Author | party who authored the resource |
| 2 | coAuthor | Co-Author | party who jointly authors the resource |
| 3 | collaborator | Collaborator | party who assists with the generation of the resource other than the principal investigator |
| 4 | contributor | Contributor | party contributing to the resource |
| 5 | custodian | Custodian | party that accepts accountability and responsibility for the data and ensures appropriate care and maintenance of the resource |
| 6 | distributor | Distributor | party who distributes the resource |
| 7 | editor | Editor | party who reviewed or modified the resource to improve the content |
| 8 | funder | Funder | party providing monetary support for the resource |
| 9 | mediator | Mediator | a class of entity that mediates access to the resource and for whom the resource is intended or useful |
| 10 | originator | Originator | party who created the resource |
| 11 | owner | Owner | party that owns the resource |
| 12 | pointOfContact | Point of contact | party who can be contacted for acquiring knowledge about or acquisition of the resource |
| 13 | principalInvestigator | Principal Investigator | key party responsible for gathering information and conducting research |
| 14 | processor | Processor | party who has processed the data in a manner such that the resource has been modified |
| 15 | publisher | Publisher | party who published the resource |
| 16 | resourceProvider | Resource provider | party that supplies the resource |
| 17 | rightsHolder | Rights holder | party owning or managing rights over the resource |
| 18 | sponsor | Sponsor | party that sponsors the resource |
| 19 | stakeholder | Stakeholder | party who has an interest in the resource or the use of the resource |
| 20 | user | User | party who uses the resource |

## ServiceTypeCode <<Codelist>>

This is a set of categories to populate DDE serviceType for metadata records for which the resourceType is ‘Service’. ISO19115-1 does not define a serviceType vocabulary. This vocabulary has been defined by the DDE metadata workgroup.

|  | Code | Concept name (English) | 2nd category concept name | Definition |
| --- | --- | --- | --- | --- |
| 1 | DataService>DataAccess | Data service | 1.1/Data Access Service | Service provide filtering and subsetting functions on one or more datasets, based on URL parameters. Operates on a data store provided by the service backend. Includes services for  graph queries (e.g. GQL, Cypher) against a graph database  and SPARQL queries against an RDF triple store |
| DataService>DataWorkflow | 1.2/Data workflow service | the service provided for geoscience data acquisition/collection, transfer, integration, storage, modelling, analysis and visualization, etc. |
| DataService>DataProcessing | 1.3/Data processing service | services provided on geoscience data processing, including disciplinary data processing tools software service (APP), data processing modules (API), data processing web Apps. |
| DataService>MapView | 1.4/Map service | services to provide a client view, access, or obtain to a geoscientific map product, the graphic data, a vector data map or image map in the format of WMS, WFS, png/jpeg/tiff, etc., for example. |
| DataService>Other | 1.7/Other data service | data service(s) provided not defined above. |
| 2 | DDE\_GeoscienceKnowledgeDirectory | Knowledge service | 2.1/Geoscience knowledge catalogue service | provides services to return the DDE geoscience knowledge directory of specific disciplines/sub disciplines, or keywords. |
| DDE\_GeoscienceKnowledgeContent | 2.2/Geoscience knowledge content service | provides services to return the DDE geoscience knowledge content (knowledge tuples) of specific disciplines/sub disciplines, or keywords. |
| DDE\_KnowledgeReasoning | 2.3Knowledge reasoning service | provide services to return the related knowledge content (knowledge tuples) obtained by reasoning for the specific keywords |
| DDE\_DeepShovel | 2.4/Deep shovel | provides services of searching and finding information and/or knowledge form published papers. |
| DDE\_Scholar | 2.5/DDE scholar | provides scholar portrait service (literatures and relationships) thru data mining from published journal papers. |
| DDE\_OtherKnowledge | 2.6/Other knowledge service | Other services provided by DDE geoscience knowledge not defined above. |
| 3 | DDE\_PlatformCatalogue | Platform service | 3.1/Catalogue service | provides discovery and management services on DDE platform of metadata about instances. The metadata may be for dataset instances, e.g. dataset catalogue, or may contain service metadata, e.g. service catalogue. |
| DDE\_PlatformRegistry | 3.2/Registry service | provides access to DDE platform. Example registries are information community registries, type dictionaries, service registries and schema registries. |
| DDE\_PlatformModel | 3.3/Model Service | provides discovery and management services on DDE platform of metadata about models. |
| DDE\_PlatformCloudComputing | 3.4/Cloud computing resource service | provides web-based computing facilities discovery and management services on DDE platform and DDE Cloud. |
| DDE\_PlatformAnnotation | 3.5Annotation Service | provides discovery and management services on DDE platform of metadata about annotations used on the platform. |
| DDE\_API\_Information | 3.6/API Service | provides discovery services on DDE platform of metadata about API information provided by the DDE platform. |
| DDE\_EarthExplorer | 3.7/Earth Explorer | provides a search engine service to search and visualize information, data and knowledge form DDE platform. |
| DDE\_Platform>DataEvaluation | 3.8/Data evaluation service | service for DDE accessible data evaluation based on six aspects/metrics of authority, quality, volume, openness, service capability and user scale metrics. |
| DDE\_Platform> DataIdentifier | 3.9/DDE identifier service | automatically generation of a DDE data code [resourceIdentifier?] to the data resource registered to be DDE resource |
| DDE\_Platform>Other | 3.10/Other platform service | Other services provided by the DDE platform not defined above. |
| 4 | Theme>MineralResourceAssessment | Thematic service | 4.1/Mineral resource assessment service | service for the regional assessment of specific minerals resources, porphyry copper for example. |
| Theme>GeologicMapping | 4.9/Geologic mapping service (Global layer) | services for view, access, and obtain geological map products, as well as complete online mapping and publishing, including relevant symbol libraries, etc. |
| Theme>GeologicalTime | 4.3/Geological timeline service | service for accurate geological timing. |
| Theme>GeologicalOccurrence | 4.4/Digital geological occurrence service | provides service of visualization of geological observation spots and rock occurrence, etc. |
| Theme>Dinosaur | 4.5/Dinosaur service | provides service of visualized living scenes of a group of specific dinosaurs in geological history. |
| Theme>GeographicName | 4.6/Global naming service | services for name(s) globally with geographic position. |
| Theme>GeomorphologyMapping | 4.7/Geomorphologic mapping service | service for geomorphologic mapping online with relevant data resources. |
| Theme>GeoscienceStandard | 4.8/Geoscience standards service | service for DDE geoscience standards access and download. |
| Theme>Other | 4.9/Other thematic service | thematic service(s) provided not defined above. |
| 5 | VocabularyService | Vocabulary service |  | Service implements vocabulary services based on SKOS properties. This category is for generic service provided from source other than DDE platform. Resolve concept URI to preferred label, definitions, related terms; test if a label is present in a vocabulary, return URI for label, etc. |
| 6 | RegistryService | Registry service |  | Service provides interface to interact with a non-DDE resource registry; provides capabilities e.g. to resolve URIs to return descriptions of a registered resource, return resource descriptions based on search criteria including labels, free text, or other properties included in registered resource descriptions. |
| 7 | DiscoveryService | Discovery service |  | Service supports searching a non-DDE metadata catalog to locate resources of interest and return metadata records describing those resources. |
| 8 | ViewService | View service |  | Service provides visualizations of geospatial or tabular data. Works with geospatial data not integrated in DDE platform, in which case service type would be 1.4 DataService/MapService |
| 9 | OtherService | Other service |  | Service that does not fit in any other category. |

## SpatialRepresentationTypeCode <<CodeList>>

Codes that specify the method used to represent geographic information in the resource

|  |  |  |  |
| --- | --- | --- | --- |
|  | Code | Concept name (English) | Definition |
| 1. | vector | Vector | vector data are used to represent geographic data |
| 2. | grid | Grid | grid data are used to represent geographic data |
| 3. | textTable | Text table | textual or tabular data are used to represent geographic data |
| 4. | tin | Tin | triangulated irregular network |
| 5. | stereoModel | Stereo model | three-dimensional view formed by the intersecting homologous rays of an overlapping pair of images |
| 6. | video | Video | scene from a video recording |

## TopicCategoryCode <<CodeList>>

This codelist extends the ISO19115-1 codelist (see <https://wiki.esipfed.org/ISO_19115-3_Codelists#MD_TopicCategoryCode>) with more granular topic categories for geoscience resources. The categories in the 1st concept name column are from the ISO19115-3 codelist, except for DataScience, which is added in this vocabulary. Strings in the ‘Code’ column are those that are used to populate the ‘MD\_Identification/resourceType’ property in metadata instance. The 3rd concept names are more detailed and should be included as keywords.

|  | Code | 1st concept name | 2nd concept name | 3rd concept name | Definition or description |
| --- | --- | --- | --- | --- | --- |
| 1. | farming | Farming |  |  | rearing of animals and/or cultivation of plants. EXAMPLES Agriculture, irrigation, aquaculture, plantations, herding, pests and diseases affecting crops and livestock. |
| 2. | biota | Biota |  |  | flora and/or fauna in natural environment. EXAMPLES Wildlife, vegetation, biological sciences, ecology, wilderness, sea life, wetlands, habitat. |
| 3. | boundaries | Boundaries |  |  | legal land descriptions, maritime boundaries EXAMPLES Political and administrative boundaries, territorial seas, EEZ, port security zones. |
| 4. | climatologyMeteorologyAtmosphere | Climatology meteorology atmosphere |  |  | processes and phenomena of the atmosphere EXAMPLES Cloud cover, weather, climate, atmospheric conditions, climate change, precipitation. |
| 5. | economy | Economy |  |  | economic activities, conditions and employment EXAMPLES Production, labor, revenue, commerce, industry, tourism and ecotourism, forestry, fisheries, commercial or subsistence hunting, exploration and exploitation of resources such as minerals, oil and gas. |
| 6. | elevation | Elevation |  |  | height above or below a vertical datum. EXAMPLES Altitude, bathymetry, digital elevation models, slope, derived products. |
| 7. | environment | Environment |  |  | environmental resources, protection and conservation. EXAMPLES Environmental pollution, waste storage and treatment, environmental impact assessment, monitoring environmental risk, nature reserves, landscape. |
| 8. | geoscientificInformation | Geoscientific information | information pertaining to earth sciences EXAMPLES Geophysical features and processes, geology, minerals, sciences dealing with the composition, structure and origin of the earth’s rocks, risks of earthquakes, volcanic activity, landslides, gravity information, soils, permafrost, hydrogeology, erosion. (from ISO19115-2014[E]) | | |
| 8\_01-stratigraphy | 8.1/stratigraphy | The study of rock layers (strata) and layering (stratification), dealing with the description of all rock bodies form the Earth’s crust— sedimentary, igneous, and metamorphic— and their organization into distinctive, useful, mappable units based on their inherent properties or attributes. Stratigraphic procedures include the description, classification, naming, and correlation of these units for the purpose of establishing their relationship in space and their succession in time. | |
| 8.1.1/magnetostratigraphy | Description: The element of stratigraphy that deals with the magnetic characteristics of rock units. |
| 8.1.2/cyclostratigraphy | Description: Cyclostratigraphy is the subdiscipline of stratigraphy that deals with the identification, characterization, correlation, and interpretation of cyclic (periodic or quasi-periodic) variations in the stratigraphic record and, in particular, with their application in geochronology by improving the accuracy and resolution of time-stratigraphic frameworks. It uses astronomical cycles of known periodicities to date and interpret the sedimentary record. |
| 8.1.3/chronostratigraphy | Description: The element of stratigraphy that deals with the relative time relations and ages of rock bodies. |
| 8.1.4/sequence stratigraphy | Description: The study of genetically related facies within a framework of chrono- stratigraphically significant surfaces |
| 8.1.5/lithotratigraphy | Description: The element of stratigraphy that deals with the description and nomenclature of the rocks of the Earth based on their lithology and their stratigraphic relations. |
| 8.1.6/biostratigraphy | Description: The element of stratigraphy that deals with the distribution of fossils in the stratigraphic record and the organization of strata into units on the basis of their contained fossils. |
| 8.1.7/chemostratigraphy | Description: The element of stratigraphy that deals with the geochemical signals, such as carbonate cycles and isotope cycles, as recorded in the stratigraphic record. |
| 8.1.8/event stratigraphy | Event stratigraphy comprises the study of stratigraphical traces of relatively short-lived events (instant to thousands of years) compared to those normally observed on a geological time-scale. Events may be represented by depositional, erosional or geochemical features.  *(*<http://quaternary.stratigraphy.org/stratigraphic-guide/event-stratigraphy/>*)* |
| 8.1.9/geologic time scale | Geological time scale (GTS) is a representation of time based on the rock record of Earth. It is a system of chronological dating that uses chronostratigraphy and geochronology. It is used primarily to describe the timing and relationships of events in geologic history. (From Wikipedia, the free encyclopedia) |
| 8\_02-paleontology | 8.2/paleontology | The study of life in the geologic past, based on examination of fossilized remains of once living organisms to clarify their taxonomic classification and interactions with each other and their environments (their paleoecology). | |
| 8.2.1/Paleoecology | Description: paleoecology is the study of interactions between organisms and/or interactions between organisms and their environments across geologic timescales. As a discipline, paleoecology interacts with, depends on and informs a variety of fields including paleontology, ecology, climatology and biology. |
| 8.2.2/Fossil | remnant, impression, or trace of an [animal](https://www.britannica.com/animal/animal) or [plant](https://www.britannica.com/plant/plant) of a past geologic age that has been preserved in Earth’s crust. The complex of data recorded in fossils worldwide—known as the [fossil record](https://www.britannica.com/science/fossil-record)—is the primary source of information about the history of [life](https://www.britannica.com/science/life) on [Earth](https://www.britannica.com/place/Earth). (<https://www.britannica.com/science/fossil>) (CGI: material fossil: The preserved remains or replaced remains (casts) of plants and animals. A fossil type may have one or more described associated organisms. If particle type is materia lFossil, an additional type property element may provide a reference to a Paleontologic description of the fossil) |
| 8.2.3/Evolutionary paleontology | Description: Evolutionary paleontology (also called evolutionary paleobiology) is paleontology’s intersection with evolutionary biology. Its main aims are to reconstruct the history of life on earth (historical paleontology, phylogeny) and the patterns and causes of evolutionary change and extinction (biological and physical processes and unique historical events). |
| 8.2.4/Biostratigraphy | Description: Biostratigraphy is also the branch of stratigraphy and focuses on correlating and assigning relative ages of rock strata by using the fossil assemblages contained within them. The primary objective of biostratigraphy is correlation, demonstrating that a particular horizon in one geological section represents the same period of time as another horizon at a different section. |
| 8.2.5/Paleoanthropology | Description: Paleoanthropology is the study to understand the early development of anatomically modern humans, a process known as hominization, through the reconstruction of evolutionary kinship lines within the family Hominidae, working from biological evidence (such as petrified skeletal remains, bone fragments, footprints) and cultural evidence (such as stone tools, artifacts, and settlement localities). |
| 8.2.6/Ichnology | Description: Ichnology is the study of fossils traces, which record biological activity but not the preserved remains of the plant or animal itself, including the tracks, borings, trails, burrows, impressions, and others left by ancient organisms. The study of Ichnology is to gain insight into ancient organisms' behavior and ecology. |
| 8.2.7/Invertebrate Paleontology | Description: Invertebrate paleontology (also as invertebrate paleozoology or invertebrate paleobiology) is the study of ancient invertebrates by analyzing invertebrate fossils in the geologic record. |
| 8.2.8/Molecular Paleontology | Description: Molecular paleontology refers to the recovery and analysis of DNA, proteins, carbohydrates, or lipids, and their diagenetic products from ancient human, animal, and plant remains. |
| 8.2.9/Geobiology | Description: Geobiology is a field of scientific research that explores the interactions between the physical Earth and the biosphere. Geobiology focuses on microorganisms, and on the role that life plays in altering the chemical and physical environment of the pedosphere, which exists at the intersection of the lithosphere, atmosphere, hydrosphere and/or cryosphere. |
| 8.2.10/Paleobotany | Description: Paleobotany is the study dealing with the recovery and identification of plant remains from geological contexts, and their use for the biological reconstruction of past environments, and the evolutionary history of plants, with a bearing upon the evolution of life in general. Paleobotany includes the study of terrestrial plant fossils and prehistoric marine photoautotrophs, such as photosynthetic algae, seaweeds or kelp. |
| 8.2.11/Palynology | Description: Palynology is the study of microscopic objects of macromolecular organic composition (i.e., compounds of carbon, hydrogen, nitrogen and oxygen), not capable of dissolution in hydrochloric or hydrofluoric acids". It studies contemporary and fossil palynomorphs, including pollen, spores, orbicules, dinocysts, acritarchs, chitinozoans and scolecodonts, together with particulate organic matter and kerogen found in sedimentary rocks and sediments. |
| 8.2.12/Taphonomy | Description: Taphonomy studies how organism decay and become fossilized or preserved in the fossil record. |
| 8.2.13/Micropaleontology | Description: Micropaleontology studies microfossils (generally smaller than 1 mm) that require using microscope to observe and to study organism's morphology and characteristic details. |
| 8.2.14/Paleobiogeography | Description:Biogeography within the venue of the fossil record in which fossils provide the data. Incorporates ecology, evolution, and geological processes, and use of the fossil record provides a time component that results in multiple time slices to examine biogeographic pattern. |
| 8\_03-geochronology | 8.3/geochronology | the science of determining the age of rocks, fossils, and sediments using signatures inherent in the rocks themselves. Absolute geochronology can be accomplished through radioactive isotopes, whereas relative geochronology is provided by tools such as paleomagnetism and stable isotope ratios. By combining multiple geochronological (and biostratigraphic) indicators the precision of the recovered age can be improved. | |
| 8.3.1/radio isotopic dating | Description: a dating method based on the rates of radiogenic decay which is proportional to time. |
| 8.3.2/non-radio isotopic dating | Description: dating method that does not rely on the measurements of radiogenic decay. |
| 8\_04-sedimentology | 8.4/sedimentology | Description: Sedimentology is a scientific discipline concerned with the physical and chemical properties of sedimentary rocks as well as the processes involved in their formation, such as sediment transportation, deposition, and lithification (conversion to rock). The interpretation of ancient environmental conditions in sediment source areas and depositional sites is a key objective of such sedimentological study. Sedimentologists examine the constituents, textures, structures, and fossil content of deposits formed in various geographic environments. They can distinguish between continental, littoral, and marine deposits in the geologic record. *(*[*https://www.vedantu.com/geography/sedimentology*](https://www.vedantu.com/geography/sedimentology)*)* (CGI: sedimentary material: Material formed by accumulation of solid fragmental material deposited by air, water or ice, or material that accumulated by other natural agents such as chemical precipitation from solution or secretion by organisms. Includes both sediment and sedimentary rock. Includes epiclastic deposits.). | |
| 8.4.1/sedimentary rock | The study of sedimentary rocks, which formed by accumulation and cementation of solid fragmental material deposited by air, water or ice, or as a result of other natural agents, such as precipitation from solution, the accumulation of organic material, or from biogenic processes, including secretion by organisms. Includes epiclastic deposits. *(CGI)* |
| 8.4.2/sedimentary physical property | The study of physical features of a sedimentary environment includes water depth and the velocity and persistence of currents. Chemical characteristics of an environment include the salinity (proportion of dissolved salts), acidity or basicity (pH), oxidation potential (Eh), pressure, and temperature. *(Wikipedia)* |
| 8.4.3/sedimentary geochemistry | Sedimentary geochemistry has been in use to understand the conditions of deposition, climatic variations, tectonic setting, provenance, reservoir characteristics, etc. *However, characterization of depositional units for distinction and correlation based on stratigraphic variation of geochemical traits and usage of the term “chemostratigraphy” have been more frequent only from the 1980s. (ScienceDirect)* |
| 8.4.4/sedimentary process | The study of how sedimentary rocks are formed, including erosion, weathering, dissolution, lithification, precipitation, etc. *(WorldAtlas)* |
| 8\_05-magmaticPetrology | 8.5/ magmatic petrology | Description: magmatic or igneous petrology is the study of macroscopic and microscopic mineralogical and chemical composition of igneous rocks (or magmatic rocks)—formed through the cooling and solidification of molten material (magma or lava) either within the earth’s crust or at crust the surface of the earth.  The modern study of igneous rocks utilizes many techniques, some of them developed in the fields of chemistry, physics, or other earth sciences. Mineralogy, crystallography, and isotopy studies are common methods used in igneous petrology. *(from “Igneous rocks” by Jerram D. and Petford N. (2004), Robin Gill (2010) and Wikipedia).* | |
| 8.5.1/Composition and classification | The compositions include mineral and geochemical compositions of igneous rocks. The classification of igneous rocks refers to classifying igneous rocks according to their mineral and geochemical compositions. The rocks are generally classified into ultramafic, mafic, intermediate, and acidic igneous rocks, and some special and unclassified igneous rocks. *(from “Igneous rocks” by Tomkeieff S.T.(1983), R.W.Le Maitre (2002), Best M G (2003) and Wikipedia)* |
| 8.5.2/Geochemical properties | Geochemical properties of igneous rocks include major and trace elements and isotopic compositions; etc. The chemistry of igneous systems provides clues to many important whole-earth evolution processes, including the origins of igneous, processes and timing of planetary differentiation, the production and destruction of the lithosphere, and the relationships between magmatic styles, composition, crust growth, mantle-crust convection, and plate-tectonic environment. |
| 8.5.3/Physical properties | The physical properties of igneous rocks are observable, measurable, and describable physical properties of igneous rocks and magma processes, including the occurrence in the field, texture, (ductile and brittle) structure of igneous rocks, as well as the physical properties of magma, such as temperature, pressure, and rheology etc. *(from “Igneous rocks” by Jerram D. and Petford N. (2004) and Wikipedia)* |
| 8.5.4/Magmatism and origin | Magmatism or magmatic activity is the emplacement of magma within and at the surface of the outer layers of a terrestrial planet, which solidifies as igneous rocks. It does so through magmatic activity or igneous activity, the production, intrusion, and extrusion of magma or lava. Volcanism is the surface expression of magmatism. The origin of igneous rocks is to study the source of magma, magma generation, magmatism, and other properties related to igneous formation. *(from “Igneous rocks” by Robin Gill (2010) and Wikipedia)* |
| 8\_06-metamorphicPetrology | 8.6/metamorphic petrology | The study of metamorphic rock arises from the transformation of existing rock to new types of rock in a process called metamorphism, which includes solid-state mineralogical, chemical and/or structural changes. | |
| 8.6.1/metamorphic fabrics | Description: The relative orientation of parts of a metamorphic rock mass. Broadly, it also refers metamorphic textures and structures.  Metamorphic textures develop in the solid state as mineral grains interact with their neighbors during deformation, recrystallization, and/or growth. Structure is the arrangement of the parts of a rock mass irrespective of scale, including spatial relationships between the parts, their relative size and shape and the internal features of the parts. |
| 8.6.2/dynamic metamorphism | Description: A type of metamorphism of local extent, associated with fault zones or shear zones. |
| 8.6.3/impact metamorphism | Description: A type of metamorphism of local extent caused by the passage of a shock wave due to the impact of a planetary body (projectile or impactor) on a planetary surface (target). It includes melting and vaporization of the target rock(s). |
| 8.6.4/contact metamorphism | Description: A type of metamorphism of local extent that affects the country rocks around magma bodies emplaced in a variety of environments from volcanic to upper mantle depths, in both continental and oceanic settings. |
| 8.6.5/metasomatism | Description: Metasomatism: is a metamorphic process by which the chemical composition of a rock or rock portion is altered in a pervasive manner and which involves the introduction and/or removal of chemical components as a result of the interaction of the rock with aqueous fluids (solutions). During metasomatism the rock remains in a solid state. |
| 8.6.6/regional metamorphism | Description: A type of metamorphism which occurs over an area of wide extent, that is, affecting a large rock volume, and is associated with large-scale tectonic processes, such as ocean-floor spreading, crustal thickening related to plate collision, deep basin subsidence, etc. |
| 8.6.7/ocean-floor metamorphism | Description: A type of metamorphism of regional or local extent related to the steep geothermal gradient occurring near spreading centers in oceanic environments. |
| 8.6.8/burial metamorphism | Description: A type of metamorphism, mostly of regional extent, which affects rocks deeply buried under a sedimentary-volcanic pile and is typically not associated with deformation or magmatism. |
| 8.6.9/magmatism | Description: A composite silicate metamorphic rock, pervasively heterogeneous on a meso- to megascopic scale. It typically consists of darker and lighter parts. The darker parts usually exhibit features of metamorphic rocks whereas the lighter parts are of igneous-looking appearance (see also leucosome, melanosome, mesosome, neosome, palaeosome). Wherever minerals other than silicates and quartz are substantially involved, it should be explicitly mentioned. |
| 8.6.10/metamorphic history | Description: Metamorphic history includes the metamorphic facies, metamorphic series, metamorphic zones, and P-T-t paths of a rock or a geological unit. A metamorphic facies is a set of metamorphic mineral assemblages, repeatedly associated in time and space and showing a regular relationship between mineral composition and bulk chemical composition. A series of metamorphic facies developed under a particular range of P/T. A succession of metamorphic zones characterized by distinctive index minerals. The surfaces separating the zones, represented by lines on a metamorphic map, are isograds. |
| 8\_07-structureGeology | 8.7/structure geology | Description: the study of the three-dimensional distribution of rock units with respect to their deformational histories. The primary goal of structural geology is to use measurements of present-day rock geometries to uncover information about the history of deformation (strain) in rocks, and ultimately, to understand the stress field that resulted in the observed strain and geometries. | |
| 8.7.1/historical structure | Description: the study of deformational histories of rock units in deep time period. Basically, historical structure deals with deformation that occurs before Quaternary. |
| 8.7.2/active structure(neo-structure) | Neo-Structure and Active Structure are sub-disciplines of tectonics that study the process of recent tectonic deformation and tectonic geomorphic evolution on the Earth. The time scale of neo-structure research is closely related to the geodynamics of a specific region; it typically concerns geological processes at time scales from Ma to ka, and emphasizes on the relationship between the past and present tectonic deformation. On the other hand, research in active tectonics pays greater attention to geological–geomorphological processes since 100˜150ka, and focuses on present and future tectonic deformation. That is, in comparison with neo-structure, active structure is typically used to describe those movement that have occurred over the time-span of human history and it deals with the societal implications of neo-structure, such as seismic-hazard assessment, future sea-level rise, etc., because it focuses on crustal movements that can be expected to recur within a future interval of concern to society. |
| 8\_08-tectonics | 8.8/tectonics | The study of the processes that control the structure and properties of the Earth's crust and its evolution through time. | |
| 8.8.1/plate tectonics | Description: Plate tectonics, also known as the theory of plate tectonics, a unifying theory developed to explain Earth’s dynamics. lithosphere. The theory of plate tectonics describes these motions and accounts for most observable tectonic activity in the Earth, as well as the tectonic history recorded in the ocean basins. The theory holds that the Earth's lithosphere is divided at present into seven major and several minor plates that are in motion with respect to one another and that the motion of each plate is, to a first approximation, a rigid-body motion. |
| 8.8.2/deep Earth tectonics | Description: the study of Earth's interior layers and related features, including mantle, core, subducting slab, plume, LLSVPs, discontinuities etc., beneath the depth of the Moho surface. |
| 8.8.3/thermochronology | Description: the study of the thermal evolution of a region of a planet. Thermochronology uses radiometric dating along with the concept of closure temperature that represents the temperature of the mineral being studies at the time given by the date recorded to understand the thermal history of a specific rock, mineral, or geologic unit. Thermochronology is closely associated with geochronology. |
| 8.8.4/geodynamics | Description: geodynamics is subfield of Tectonics or Geophysics dealing with dynamics of the Earth. It applies physics, chemistry, geology, and mathematics to the understanding of how mantle convections lead to plate tectonics and geologic phenomena such as seafloor spreading, mountain building, volcanoes, earthquakes, faulting etc. Methods of Geodynamics are also applied to exploration other planets. |
| 8\_09-geologicMapping | 8.9/geologic mapping | The interpretive, geoscientific process that produces a range of map products for many different uses, including assessing ground-water quality and contamination risks; predicting earthquake, volcano, and landslide hazards; characterizing energy and mineral resources and their extraction costs; waste repository siting; land management and land-use planning; and general education. The products include geological, tectonic, seismological, geophysical and geochemical maps at different scales. | |
| 8.9.1/geological survey | It is the processes of collecting geological data and study geology by a variety of methods as field profiling, drilling, remote sensing and sampling etc. |
| 8.9.2/geological compilation | The study of geoscience map compilation. A geological map may be compiled from other maps, usually of larger scale, or may be produced from original geoscientific surveys and photogrammetric compilations. |
| 8.9.3/digital geological mapping | Description: digital geological mapping refers to the process of using computer software to form digital geological map or to construct database of geological maps. |
| 8\_10-hydrogeology | 8.10/hydrogeology | The area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust, commonly in aquifers. Geology of ground water and hydrology, also including ground water dynamic, mining hydrogeology, regional hydrogeology, etc. | |
| 8.10.1/Storage of groundwater | Description: Occurring state and hydrological properties of groundwater in rock and soil. |
| 8.10.2/Groundwater flow | Description: The movement of water through interconnected voids in the phreatic zone |
| 8.10.3/groundwater quality. | Description: A general term for the physical, chemical and biological properties of groundwater. |
| 8.10.4/Geological processes of groundwater | Description: The occurrence and movement of groundwater affects a wide range of geologic processes in diverse environments. |
| 8.10.5/Groundwater dependent ecosystems | Description: Ecosystems which depend on groundwater permanently or intermittently to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. |
| 8\_11-engineeringGeologyGeotechnology | 8.11/engineering geology(geotechnology) | Description: Engineering Geology is the science devoted to the investigation, study and solution of the engineering and environmental problems which may arise as the result of the interaction between geology and the works and activities of man as well as to the prediction and of the development of measures for prevention or remediation of geological hazards. | |
| 8.11.1/regional engineering geology | Description: Regional Stability is defined as the degree of stability of a particular region which may be affected by crustal movements with differential vertical displacements and horizontal movements, volcanic activities, and fault activities. It is especially associated with those strong activities which may trigger earthquakes and consequent regional mass wasting processes such as rock falls, landslides, debris flow, liquefaction, plastic flows of clay, and uneven surface subsidence. |
| 8.11.2/soil mass engineering geology | Description: Soil Mass Engineering Geology is the science that studies the engineering properties of soil to solve engineering geological problems related to engineering activities, predict and demonstrate the occurrence and development laws of engineering geological problems, and propose technical measures for their improvement and prevention, for the planning, design, construction, use and development of engineering activities. |
| 8.11.3/rock mass engineering geology | Description: Rock Mass Engineering Geology is the scientific domain of Engineering Geology and Rock Mechanics, which focuses on the laws of formation and evolution of rock masses and their engineering behavior through the theories and methods of geomechanics. |
| 8.11.4/applied engineering geology | Description: Applied Engineering Geology is an applied geology discipline that provides data indispensable to the design and geotechnical solution for engineering structures. The subject comprises the modes of application of engineering geology, case histories, evaluation of investigations, design and realization of structures as well as their observation during and after construction. |
| 8.11.5/geological hazards | Description: geological hazards are those natural geologic processes or man-made geologic conditions that represent a present-day or future hazard to man's life, health, or property. Six typical geological hazards, i.e., landslides, debris flows, rockfalls, avalanches, earthquakes, and volcanoes. |
| 8.11.6/intelligent engineering geology | Description: Intelligent Engineering Geology (IEG) is to combine innovative concepts with the new generation of information technology to intelligently collect EG information, mine the existing EG knowledge, reveal the spatial-temporal characteristics and the evolution of engineering geological bodies, and predict their future development trends. |
| 8\_12-environmentalGeology | 8.12/environmental geology |  | an applied science concerned with the practical application of the principles of geology in the solving of environmental problems created by man. It is a multidisciplinary field that is closely related to engineering geology and, to a lesser extent, to environmental geography *(Wikipedia)* |
| 8\_13-petroleumGeology | 8.13/petroleum geology | The study of origin, occurrence, movement, accumulation, and exploration of hydrocarbon fuels. It refers to the specific set of geological disciplines that are applied to the search for hydrocarbons (oil exploration). | |
| 8.13.1/Oil and gas resources assessment | Description: Oil and gas resource evaluation refers to the process of estimating or analyzing the subsurface oil and gas endowment in a specific geological entity. |
| 8.13.2/Geological elements | Description: Petroleum exploration is largely concerned with the search for oil and gas. Geological elements in petroleum geology include source rocks, reservoirs, seals and traps. |
| 8.13.3/Petroleum accumulation | Description: Petroleum accumulation refers to the geological process of oil and gas entrapment in sedimentary basins through migration in the carrier beds and finally filling into traps following the generation of oil and gas. |
| 8\_14-mathematicalGeoscience | 8.14/mathematical geoscience | The study of the application of mathematical methods to solve problems in geosciences. | |
| 8.14.1/data visualization‎ | Description: Data visualization is the graphical representation of information and data. |
| 8.14.2/analysis | Description: Analysis is the process of breaking a complex topic or substance into smaller parts in order to gain a better understanding of it. |
| 8.14.3/modelling | Description: A formal expression of an idea which may be used to try to explain a set of observed data, by comparing its deduced behavior to the actual observed data, or to predict the outcome of an event. |
| 8.14.5/computation | Description: Computation is any type of calculation that includes both arithmetical and non-arithmetical steps and follows a well-defined model |
| 8\_15-marineGeology | 8.15/marine geology | The study of the history and structure of the ocean floor from shorelines to the continental shelf and deep sea. It involves geophysical, geochemical, sedimentological and paleontological investigations of the ocean floor and coastal zone. | |
| 8.15.1/Submarine Geomorphology | Description: Submarine geomorphology investigates the morphology and evolution of seafloor landforms, and the processes responsible for their formation, in particular erosion and depositional processes, sediment movement and deformation, volcanic activity, fluid migration, and anthropogenic impacts. |
| 8.15.2/Marine sedimentology | Description: Marine sedimentology involves the description, classification, modeling, and interpretation of marine sediments so as to determine the physical, chemical, and biological processes by which they formed. |
| 8.15.3/Marine sediment dynamics | Description: Marine sediment dynamics aims at studying the motion of sediment particles during their formation, transport, and settling processes *(Zhang, 2014)*. |
| 8.15.4/Paleoceanography and paleoclimatology | Description: Paleoceanography and paleoclimatology are the study of the oceans (with regard to circulation, chemistry, biology, geology and patterns of sedimentation and biological productivity) and climates as they were in the past, from a few hundred years to billions of years ago *(Thomas, 2009).* |
| 8.15.5/Marine geochronology | Description: The geochronology is the determination of ages and time intervals for geologic materials, including marine sediments, and processes on geologic, archeologic, and historic time scales. It is the science of investigating the chronology of the earth constituents as induced from geologic data, based on absolute and relative dating methods. |
| 8.15.6/Marine petrology | Description: Marine petrology studies the mineralogy, textures, and chemical composition of igneous, sedimentary, and metamorphic rocks, since their composition reflects the conditions at which they were formed and the time they needed to develop. |
| 8.15.7/Marine geochemistry | Description: Marine geochemistry is the study of the chemistry of geological materials such as rocks, sediments and water. |
| 8.15.8/Seafloor tectonics and geodynamics | Description: Seafloor tectonics and geodynamics study the genesis, aging, motion, and destruction of oceanic plates *(Koppers and Coggon, 2020)* and their interactions with the earth’s interior. |
| 8.15.9/ Marine Geohazards | Description: Marine geohazards are geological conditions at the sea floor or within sub-bottom sediments that, if unrecognized, could result in dangerous or catastrophic events with attendant risks to life and/or infrastructure. The major marine geohazards are coastal erosion, seawater intrusion, earthquakes, submarine landslides, subsidence, tsunamis, natural gas hydrate dissociation, seabed sand waves, shallow gas, overpressure strata, gas chimneys, mud volcanoes and mud diapirism |
| 8.15.10/ Coastal Morpho dynamics | Description: Understanding and predicting the changes in the morphology of the coastal zone, including the topography of the sea bed and the shoreline planform, in connection with waves, currents, tides and sea level rise. |
| 8.15.11/ Marine Paleontology and Micropaleontology | Description: Marine Paleontology and Micropaleontology is the study of ancient fossils and microfossils in the sediments in order to reconstruct past conditions of oceans and environments. |
| 8.15.12 Seafloor habitat | Description: a combination of elements that include both physical structure and dimension, and biological characteristics of specific species or groups of species under consideration *(Diaz et al. 2004)*. |
| 8.15.13 Subseafloor biosphere | Description: The Subseafloor biosphere represents the subseafloor ecosystems themselves and the environments (e.g., hydrothermal systems and cold seeps) that sustain them. |
| 8\_16-mineralogy | 8.16/mineralogy | The study of natural minerals that formed on Earth and delivered from other planets as meteorites, which underpins and supports the whole earth science system. | |
| 8.16.1/mineral properties and its applications | Description: The properties of minerals are extremely important in understanding geological phenomena and in synthesizing new materials. |
| 8.16.2/crystallography | Description: Crystallography is the study of the external form and the crystal structure of crystalline solids and the principles that govern their growth, shape, and internal atomic arrangement. |
| 8.16.3/mineral genesis and Its Occurrence | Description: The mineral genesis and its occurrence is an important part of mineralogy, mainly through the study of minerals characteristics, mineral species and mineral assemblages to reflect the formation conditions and processes. |
| 8.16.4/mineral classification and description | Description: study of the scheme of mineral classifications that are determined in the light of chemical composition and internal structure. |
| 8.16.5/chemical composition and crystal structure | Description: Chemical composition refers to identity and number of the chemical elements that make up any particular compound. Crystal structure is a description of the ordered arrangement of atoms, ions or molecules in a crystalline material. |
| 8\_17-gravimetricAndGravityExploration | 8.17/gravimetric and gravity exploration | The study of the measurement and application of the strength of a gravitational field or the properties of matter responsible for its creation for solid earth and geological exploration. Gravity exploration is one of the common and primary geophysical exploration methods. It is based on the density difference between the target object and its surroundings. By eliminating the influence due to the factors unrelated to the studied targets on the gravity measurements, the gravity anomalies caused by ore bodies, structure or other density inhomogeneous bodies can be obtained. | |
| 8\_18-geomagnetismAndMagneticExploration | 8.18/geomagnetism and magnetic exploration | The study of measurement and application of the Earth’s total [magnetic field](https://www.britannica.com/science/geomagnetic-field) or of components of the field in various directions to solve problems of geosciences and for exploration.  Magnetic exploration is to investigate subsurface geology on the basis of anomalies in the Earth’s magnetic field resulting from the magnetic properties of the underlying rocks. It can be performed on land, at sea and in the air. | |
| 8\_19-geoelectricityAndElectricalExploration | 8.19/geoelectricity and electrical exploration | The study of measurement and application of the electrical parameters of the underground geological structures and subsurface media and bodies (rocks, sediments, water, voids, etc.) both with passive or active to solve problems of geosciences and for exploration. Electrical exploration is an applied discipline that observes and studies electric and electromagnetic fields established naturally or artificially underground, and solves various geological problems related to the difference in the electrical properties of rocks and ores. | |
| 8\_20-seismologyAndSeismicExploration | 8.20/seismology and seismic exploration | The study of the propagation of elastic waves through the Earth or through other planet-like bodies, including studies for petroleum and other resources exploration, and study of earthquake and relevant environmental effects such as tsunamis as well as diverse seismic sources such as volcanic, tectonic, glacial, fluvial, oceanic, atmospheric, and artificial processes such as explosions. | |
| 8\_21-nuclearGeophysicsandRadioactiveExploration | 8.21/nuclear geophysics and radioactive exploration | nuclear geophysics is the study of changing law of natural and artificial nuclear radiation fields in the medium through corresponding methods and instruments, on the basic theory of atomic and nuclear physics, geology, geophysics, radiochemistry and other disciplines, so as to achieve methods for mineral exploration and to solve related geological problems. Radioactive exploration is the studies of measurement and application of the radioactive characteristics of subsurface media and radioactive values of rocks and minerals in exploration and geological dating to solve problems of geosciences. | |
| 8\_22-drillAndGeophysicalLogging | 8.22/drill and geophysical logging | Description: geological drills and collecting data for physical and petrophysical properties. Geophysical logging is based on physics (electric, nuclear, magnetic, etc.), mathematics and geology as the theoretical basis, with the borehole and its surrounding media as the object of research, using a variety of specialized instruments and equipment, along the drilling profile to measure relevant physical parameters for oil and gas, coal, mineral resources, groundwater exploration, etc. | |
| 8.22.1/Instruments for drilling and well logging | Description: by using specially drilling tools and processing, colleting rock and sediment samples and then measuring properties of the samples at laboratory |
| 8.22.2/Coring and core analysis | Description: by using specially drilling tools and processing, colleting rock and sediment samples and then measuring properties of the samples at laboratory |
| 8.22.3/Logging data analysis | the process of interpreting computer-generated records called logs or logging data. interpretation handles the correlation between logs and geological events, in addition, to explore geological resources and to support geological engineering. |
| 8\_23-paleomagnetism | 8.23/paleomagnetism | The study of the record of the Earth's magnetic field in rocks, sediment, or archeological materials to reveal the past behavior of Earth’s magnetic field and the past location of tectonic plates. | |
| 8\_24-rockphysics | 8.24/ rock physics | Description: Rock physics studies the behavior and physicochemical properties of reservoir rocks in different environments such as surface and underground, including the characteristics of reservoir rocks themselves, as well as their interactions with oil, gas and water, and is a comprehensive marginal discipline that mainly describes the physical properties of pore geology, the interaction between different fluids and rock pore surfaces. It is the theoretical basis of logging, geophysical exploration and reservoir engineering. | |
| 8\_25-integratedgeophysics | 8.25/integrated geophysics | Description: integrated geophysics is the application of geophysical methods, including gravity, electrical, magnetic, seismic and other methods, which can be used in the ocean, energy, environmental and other geophysical exploration problems. In order to achieve the best exploration effect, the combination of multiple geophysical methods can effectively reduce the multi-solution problem in the interpretation of a single geophysical exploration method and improve the reliability of geophysical exploration interpretation. | |
| 8\_26-geochemistry | 8.26/geochemistry | Description: the science that uses the tools and principles of chemistry to study the geoscience. It includes isotope geochemistry, biogeochemistry, organic geochemistry, regional, environmental and exploration geochemistry, such as rock geochemical exploration, soil geochemical exploration, stream sediment geochemical exploration, atmospheric geochemical exploration, biogeochemical exploration, water geochemical exploration, geo-gas survey, chemical analysis, geochemical mapping, geothermal manifestation, radiometric dating, etc. | |
| 8.18.1/surficial geochemistry | Description: The chemical principles and processes on the Earth surface |
| 8\_27-remoteSensing | 8.27/remote sensing | The acquisition of information about an object or phenomenon without making physical contact with the object, especially to acquiring information about the Earth for the study of hydrology, ecology, meteorology, oceanography, glaciology, geology, etc. | |
| 8.27.1/Remote Sensing Infrastructure | Description: Remote Sensing Infrastructure is the study focused on the mechanism, hardware, and software for remote sensing technology. It is especially associated with those devices and data analysis and process methods of the remote sensing system, including the sensors, sensing platforms, electromagnetic spectrum characteristics, and remote sensing data algorithms. |
| 8.27.2/Applied Remote Sensing | Description: Applied remote sensing is the study that to obtain target information by using remote sensing technology or to obtain target attributes by analyzing remote sensing data. |
| 8.27.3/Photogrammetry | Description: Photogrammetry is to obtain the shape, size, position, characteristics, and relationships of the subject by the remote sensing images. Its main task is to measure topographic maps of various scales, establish topographic databases, provide spatial basic data for various geographic information systems, land information systems, and various projects, and serve non-topographic fields. |
| 8\_28-geomorphology | 8.28/geomorphology | The study of the origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface. | |
| 8.28.1/special geomorphology | Description: Special geomorphology is a discipline that takes the landforms and its geomorphic evolution formed by some geological agents (such as fluvial landforms, aeolian landform, glacial landform, karst landform, coastal landform, etc) as its independent research object. |
| 8.28.2/dynamical geomorphology | Description: Dynamic geomorphology is a discipline that studies the role of various geomorphic dynamics in geomorphic processes.It can be divided into endodynamic geomorphology and exokinetic geomorphology.It applies the principles and methods of basic sciences such as mathematics, physics and chemistry to study the mechanism of landform formation, focusing on the modern process of landform formation and the relationship between landform and various action variables. |
| 8.28.3/regional geomorphology | Description: Regional geomorphology studies the geomorphology of an area. It analyzes its topographic characteristics, genetic dynamics, geomorphic evolution, geographical distribution and composition characteristics, including regional geomorphology studies at different spatial scales, such as global geomorphology, intercontinental geomorphology, plate geomorphology, national geomorphology, and local regional geomorphology etc. |
| 8.28.4/applied geomorphology | Description: Applied geomorphology is a discipline that studies how to apply the principles and methods of geomorphology to solve production practice. It links the study of geomorphology closely to the transformation of nature and its decision-making processes. It relates to environmental studies, resource surveys, disaster prevention, soil and water conservation, etc. Applied geomorphology includes multiple sub-fields, for example, agricultural geomorphology, engineering geomorphology and mining geomorphology. |
| 8.28.5/experimental geomorphology | Description: Experimental geomorphology is the science of natural observation or indoor modelling of a selected geomorphic body or process with the aid of certain observational tools and controlled conditions. Its objective is to reveal the relationship between the development of landforms and different factors, and to represent mathematically the mechanism of the development of landforms. Experimental geomorphology has developed rapidly in recent years. In addition to the early physical model experiment, it also includes quantitative geomorphology, which uses mathematical methods to study the surface morphology and its formation and evolution through the analysis of various geographical physical quantities, digital geomorphology, which is a branch of geomorphology that studies geomorphic morphology, landform types, spatial distribution, geomorphic formation and evolution process through comprehensive analysis of remote sensing images, digital terrain model (DTM) and other relevant geomorphic data under the geographic information system environment. |
| 8.28.6/geomorphological mapping | Description: Geomorphological mapping is the process of visualizing the scale, spatial distribution, classification or regionalization of various geomorphological objects and phenomena on a map. It is an important method and tool for geomorphological investigation and research, as well as a powerful illustration and supplement to the written description of geomorphological phenomena. The results of geomorphological mapping include geomorphological classification maps, geomorphological regionalization maps, etc. |
| 8.28.7/climatic geomorphology | Description: Climatic geomorphology is the study of the processes of landform formation and their evolution under different climatic conditions, and is an important branch of geomorphology. |
| 8.28.8/quantitative geomorphology | Description: Quantitative geomorphology is the study of land surface morphology, its formation and development through the analysis of quantitative data using mathematical methods. It includes the acquisition of quantitative data, the quantification of non-quantitative information, the processing and analysis of data, the creation of models and the simulation of geomorphological processes. |
| 8.28.9/fractal geomorphology | Description: The science of using fractal methods and principles to study the surface morphology and its occurrence, development and distribution is called fractal geomorphology. |
| 8.28.10/historical geomorphology | Description: The science of using fractal methods and principles to study the surface morphology and its occurrence, development and distribution is called fractal geomorphology. |
| 8\_29-paleoclimatology | 8.29/paleoclimatology | The study of reconstruction of ancient climate to understand natural variation and the evolution of the current climate, for which direct measurements were not taken. It utilize variety of proxy methods from Earth and life sciences to obtain data previously preserved within rocks, sediments, boreholes, ice sheets, tree rings, corals, shells, and microfossils. Combined with techniques to date the proxies, the paleoclimate records are used to determine the past states of Earth's atmosphere. | |
| 8\_30-paleogeography | 8.30/paleogeography | The study of historical geography, generally physical landscapes. It can also include the study of human or cultural environments. | |
| 8.30.1/lithofacies paleogeography | Description: lithofacies paleogeography is a discipline that uses lithofacies analysis to reconstruct sedimentary environments and landforms during geological history and to study the distribution and evolution of sedimentary facies, with the task of providing basic theory and applied methods for resource prediction. |
| 8.30.2/tectono-paleogeography | Description: Tectono-paleogeography (Plate tectonic) illustrates the plate tectonic development of the Earth , including the location of active plate boundaries and the changing extent of both oceanic and continental plates. |
| 8.30.3/climate paleogeography | Description: climate paleogeography refers to adding climatic information to the traditional paleogeography maps by using deep time climate classifications. |
| 8.30.4/paleobiogeography | Description: paleobiogeography is the study of the geographical distribution of faunas and floras in the past. |
| 8\_31-earthResource | 8.31/earth resource | It contains two main resources: renewable resources and non-renewable resources. Non-renewable resources are the naturally resources that cannot be readily replaced by natural means such as oil and gas, minerals and metal ores, ground water, etc. | |
| 8.31.1/mineral resource | Mineral resources of the earth, including mineral geology, mineral exploration, mineral exploitation, etc. |
| 8.31.2/groundwater | Groundwater of the Earth in [aquifers](http://en.wikipedia.org/wiki/Aquifer), including groundwater exploration, groundwater production, etc. |
| 8.31.3/oil and gas | It includes oil and gas exploration, exploitation or production, and oil and gas field, etc. |
| 8.31.4/shale gas and oil shale | It includes geology, exploration, production and others of oil shale or shale gas. |
| 8.31.5/coal and coalbed methane | It includes coal geology and coalbed methane geology, coal and coalbed methane exploration, coal and coalbed methane production and products, etc. |
| 8.31.6/gas hydrate | It includes both natural and experimental gas hydrate, gas hydrate geology, gas hydrate exploration, gas hydrate exploitation, etc. |
| 8.31.7 organic material | It is related to Earth material composed of organic compounds derived from the remains of dead organisms and their waste products in the environment. *(CGI)* |
| 8\_32-geothermics | 8.32/geothermics | It is related to energy and may refer to heat that comes from within the Earth. It includes geothermal geology, geothermal exploration, geothermal exploitation, geothermal tourism, etc. | |
| 8.32.1/Theoretical geothermics | Description: Theoretical geotherm is a subject to explore the fundamental topics such as the thermal structure of crust and mantle, the deep thermal state and the formation mechanism and control factors of the thermal evolution of lithosphere structure. |
| 8.32.2/Applied geothermics | Description: Applied geotherm is a subject to investigate the geothermal resource types, origin and distribution, geothermal resource exploration, geothermal resource evaluation, geothermal resource development and utilization, and geothermal disaster. |
| 8.32.3/geothermal energy | It is the heat energy that comes from the subsurface of the earth which contained in the rocks and fluids beneath the crust and originates from the formation of the planet or geological movements and radioactive decay of mass materials. |
| 8.32.4/dry hot rock | It includes underground dry hot rock exploration and utility, etc. |
| 8\_33-geoexploration | 8.33/geo-exploration | Activities of searching for or discovery of Earth resources. It includes mineral exploration activities such as reconnaissance, assessment and surface and subsurface exploration, ore geology, mining pilot, mining regulation and law, and relevant administration. | |
| 8\_34-mining | 8.34/mining | The activities of extraction of valuable minerals or other geological materials form the earth. | |
|  | 8\_35-economicalGeology |  | 8.35/economical geology | the study of fuels, metals, and other materials from the earth that are of interest to industry or the economy in general. It is concerned with the distribution of resources, the costs and benefits of their recovery, and the value and availability of existing materials. *(Wikipedia)* | |
| 8.35.1/characteristics of ore deposits | Description: The systematically information describing the attributes of the mineral deposits. |
| 8.35.2/deposit type | Description: A class representing all the recognized mineral deposits that are defined by physical and genetic factors that can be consistently differentiated from those of other classes or deposit types. *(Bureau of Mines. Dictionary of mining, mineral, and related terms[M]. American Geological Institute, 1997)* |
| 8.35.3/ore genesis | Description: The origin of ores. @ United States. Bureau of Mines. Dictionary of mining, mineral, and related terms[M]. American Geological Institute, 1997. |
| 8.35.4/metallogeny | Description: Metallogeny is the study of the genesis and regional-to-global distribution of mineral deposits, with emphasis on their relationship in space and time to regional petrologic and tectonic features of the Earth's crust. *(Gilbert J M, Park Jr C F. The geology of ore deposits[M]. Waveland Press, 2007)* |
| 8\_36-geologicalLiterature | 8.36/geological literature | Literatures of and about geology | |
| 8.36.1/dinosaur | The study and presentation of dinosaurs for geoscience and the public. |
| 8.36.2/geopark | The study and management of the UNESCO Geopark that are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development. |
| 8.36.3/geo-education | Geo-education involves both in-school and out-of-school learning. In school, geo-education takes place across many subjects in the traditional curriculum. Outside of school, geo-education takes place through guided experience in both the human and natural worlds. |
| 8.36.4/geological publications | Publications of geology, such as books, periodicals, magazines, etc. |
| 8.29.5/geological Archives | Geological reports and written materials that mostly are not published |
| 8\_37-planetaryGeology | 8.37/planetary geology | Description: Planetary geology, alternatively known as astrogeology or exogeology, is a planetary science discipline concerned with the geology of the celestial bodies such as the planets and their moons, asteroids, comets, and meteorites. | |
| 8\_38-biogeology | 8.38/biogeology | the study of the interactions between the Earth's biosphere and the [lithosphere](https://geology.fandom.com/wiki/Lithosphere). | |
| 8\_39-volcanology | 8.39/volcanology | the study of volcanoes, lava, magma and related geological, geophysical and geochemical phenomena (volcanism). *(Wikipedia)* | |
| 8\_40-forensicGeology | 8.40/forensic geology | Forensic geology can be considered to be any aspect of geologic science that is subject to public debate in a court of law. Forensic geology applies the defining principles of the geologic sciences to the identification/evaluation of geologic materials that may be related to forensic problems.*(John W. Lindemann: ENVIRONMENTAL AND ENGINEERING GEOLOGY - Vol. III)* | |
| 8\_41-otherGeoscientificTopics | 8.41/other geoscientific topics | any topic(s) related with geosciences that cannot be defined by the above categories. | |
| 9. | health | Health |  |  | health, health services, human ecology, and safety EXAMPLES Disease and illness, factors affecting health, hygiene, substance abuse, mental and physical health, health services. |
| 10. | imageryBaseMapsEarthCover | Imagery base maps earth cover |  |  | base maps EXAMPLES Land cover, topographic maps, imagery, unclassified images, annotations. |
| 11. | intelligenceMilitary | Intelligence military |  |  | military bases, structures, activities EXAMPLES Barracks, training grounds, military transportation, information collection. |
| 12. | inlandWaters | Inland waters |  |  | inland water features, drainage systems and their characteristics EXAMPLES Rivers and glaciers, salt lakes, water utilization plans, dams, currents, floods, water quality, hydrologic information. |
| 13. | location | Location |  |  | positional information and services EXAMPLES Addresses, geodetic networks, control points, postal zones and services, place names. |
| 14. | oceans | Oceans |  |  | features and characteristics of salt water bodies (exclud- ing inland waters). EXAMPLES Tides, tsunamis, coastal information, reefs. |
| 15. | planningCadastre | Planning cadastre |  |  | information used for appropriate actions for future use of the land. EXAMPLES Land use maps, zoning maps, cadastral surveys, land ownership. |
| 16. | society | Society |  |  | characteristics of society and cultures. EXAMPLES Settlements, anthropology, archaeology, education, traditional beliefs, manners and customs, demographic data, recreational areas and activities, social impact assessments, crime and justice, census information. |
| 17. | structure | Structure |  |  | man-made construction. EXAMPLES Buildings, museums, churches, factories, housing, monuments, shops, towers. |
| 18. | transportation | Transportation |  |  | means and aids for conveying persons and/or goods EXAMPLES Roads, airports/airstrips, shipping routes, tunnels, nautical charts, vehicle or vessel location, aero- nautical charts, railways. |
| 19. | utilitiesCommunication | Utilities Communication |  |  | energy, water and waste systems and communications infrastructure and services. EXAMPLES Hydroelectricity, geothermal, solar and nuclear sources of energy, water purification and distribution, sewage collection and disposal, electricity and gas distribution, data communication, telecommunication, radio, communication networks. |
| 20. | extraTerrestrial | Extra-terrestrial |  |  | region more than 100 km above the surface of the Earth |
| 21. | disaster | Disaster |  |  | information related to disasters. EXAMPLES Site of the disaster, evacuation zone, disaster-prevention facility, disaster relief activities. |
| 22 | dataScience | Data science |  |  | an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract or extrapolate knowledge and insights from noisy, structured and unstructured data, and apply knowledge from data across a broad range of application domains. NOTE data science is related to data mining, machine learning and big data. |

# Annex B - XML Schema definition for DDE geoscience information metadata

<?xml version="1.0" encoding="UTF-8"?>  
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" elementFormDefault="qualified"  
 targetNamespace="https://www.ddeworld.org/resource/metadata/1.0"  
 xmlns:metadata="https://www.ddeworld.org/resource/metadata/1.0"  
 xmlns:xlink="http://www.w3.org/1999/xlink">  
 <xs:element name="MD\_Metadata">  
 <xs:complexType>  
 <xs:sequence>  
 <xs:element name="metadataIdentifier" type="metadata:MD\_Identifier"/>  
 <xs:element name="metadataStandardName" type="xs:string"  
 default="DDE S01-2023: Geosciences Information Metadata"/>  
 <xs:element name="metadataResponsibleParty" type="metadata:CI\_Responsibility"  
 maxOccurs="unbounded"/>  
 <xs:element name="metadataDate" type="metadata:CI\_Date" minOccurs="1" maxOccurs="unbounded"/>  
 <xs:element name="identificationInfo" type="metadata:MD\_Identification"/>  
 </xs:sequence>  
 </xs:complexType>  
 </xs:element>  
  
 <xs:complexType name="MD\_Identifier">  
 <xs:sequence>  
 <xs:element name="authority" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="code" type="xs:anyURI"/>  
 <xs:element name="codeSpace" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="version" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="MD\_Identification">  
 <xs:sequence>  
 <xs:element name="resourceIdentifier" type="metadata:MD\_Identifier"/>  
 <xs:element name="title" type="xs:string"/>  
 <xs:element name="alternateTitle" type="xs:string" minOccurs="0" maxOccurs="unbounded"/>  
 <xs:element name="resourceDate" type="metadata:CI\_Date" minOccurs="0" maxOccurs="unbounded"/>  
 <xs:element name="abstract" type="xs:string "/>  
 <xs:element name="keyword" type="metadata:StringW\_ID" minOccurs="1" maxOccurs="unbounded"/>  
 <xs:element name="topicCategory" type="metadata:TopicCategoryCode" minOccurs="1"  
 maxOccurs="unbounded"/>  
 <xs:element name="resourceType" type="metadata:ResourceTypeCode" maxOccurs="unbounded"/>  
 <xs:element name="resourceResponsibleParty" type="metadata:CI\_Responsibility" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="browseGraphic" type="metadata:CI\_OnlineResource" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="additionalDocumentation" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="language" type="xs:string" minOccurs="1" maxOccurs="1"/>  
 <xs:element name="characterEncoding" type="xs:string" minOccurs="1" maxOccurs="1"  
 default="utf8">  
 <xs:annotation>  
 <xs:documentation>Use IANA Character Set register:  
 http://www.iana.org/assignments/character-sets. These are the official names for  
 character sets that may be used on the Internet and may be referred to in Internet  
 documentation. These names are expressed in ANSI\_X3.4-1968 which is commonly called  
 US-ASCII or simply ASCII</xs:documentation>  
 </xs:annotation>  
 </xs:element>  
 <xs:element name="restriction" type="metadata:MD\_Constraints" minOccurs="1"  
 maxOccurs="unbounded"/>  
 <xs:element name="edition" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="dataQuality" type="metadata:StringW\_ID" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="lineage" type="metadata:StringW\_ID" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="source" type="metadata:StringW\_ID" minOccurs="0" maxOccurs="unbounded"/>  
 <xs:element name="acquisitionType" type="metadata:AcquisitionCode" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="geoTime" type="xs:string" minOccurs="1" maxOccurs="1"/>  
 <xs:element name="geographicExtent" type="metadata:EX\_GeographicExtent" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="temporalExtent" type="metadata:EX\_TemporalExtent" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="associatedResource" type="metadata:CI\_OnlineResource" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="metadataReference" type="metadata:CI\_OnlineResource" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="distributionInfo" type="metadata:MD\_Distribution" maxOccurs="unbounded"/>  
 <xs:element name="serviceIdentificationInfo" type="metadata:SV\_ServiceIdentification"  
 minOccurs="0" maxOccurs="1"/>  
 <xs:element name="imageryInfo" type="metadata:MD\_Imagery" minOccurs="0" maxOccurs="1"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="EX\_TemporalExtent">  
 <xs:sequence>  
 <xs:element name="beginName" type="xs:string"/>  
 <xs:element name="beginIdentifier" type="metadata:MD\_Identifier" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="endName" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="endIdentifier" type="metadata:MD\_Identifier" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="beginDate" type="metadata:DateTime" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="endDate" type="metadata:DateTime" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="beginCoordinate" type="xs:decimal" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="endCoordinate" type="xs:decimal" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="coordinateUnits" type="metadata:TemporalUnitsEnum" minOccurs="0"  
 maxOccurs="1"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:simpleType name="TemporalUnitsEnum">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="Ka"/>  
 <xs:enumeration value="Ma"/>  
 <xs:enumeration value="Ga"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:complexType name="EX\_GeographicExtent">  
 <xs:sequence>  
 <xs:element name="geographicIdentifier" type="metadata:MD\_Identifier" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="westBoundLongitude" type="xs:decimal" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="eastBoundLongitude" type="xs:decimal" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="southBoundLatitude" type="xs:decimal" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="northBoundLatitude" type="xs:decimal" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="elevation" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="SV\_ServiceIdentification">  
 <xs:sequence>  
 <xs:element name="serviceType" type="xs:string" maxOccurs="unbounded"/>  
 <xs:element name="containOperations" type="xs:string" minOccurs="0" maxOccurs="unbounded"/>  
 <xs:element name="accessProperties" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="operatedDataset" type="metadata:MD\_Identifier" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <!-- see https://www.energistics.org/sites/default/files/2023-03/EIP\_v1.1.pdf section 4.6.2 -->  
 <xs:element name="endpointDescription" type="metadata:CI\_OnlineResource" minOccurs="0"  
 maxOccurs="1"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="MD\_Imagery">  
 <xs:sequence>  
 <xs:element name="sensor" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="platform" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="startTime" type="metadata:DateTime" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="endTime" type="metadata:DateTime" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="signalGenerator" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="wavelength" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="processingLevel" type="metadata:ProcessedLevelCode" minOccurs="0"  
 maxOccurs="1"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="MD\_Distribution">  
 <xs:sequence>  
 <xs:element name="distributionFormat" type="metadata:StringW\_ID" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="onlineResource" minOccurs="1" maxOccurs="unbounded"  
 type="metadata:CI\_OnlineResource"/>  
 <xs:element ref="metadata:spatialRepresentationInfo" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="distributionResponsibleParty" type="metadata:CI\_Responsibility"  
 minOccurs="0" maxOccurs="unbounded"/>  
 </xs:sequence>  
 </xs:complexType>  
  
  
 <xs:element name="spatialRepresentationInfo">  
 <xs:complexType>  
 <xs:sequence>  
 <xs:element name="spatialRepresentationType" type="metadata:SpatialRepresentationTypeCode"/>  
 <xs:element name="spatialResolution" type="xs:string" minOccurs="0" maxOccurs="unbounded"/>  
 <xs:element name="referenceSystemType" minOccurs="0" type="metadata:ReferenceSystemTypeCode"/>  
 <xs:element name="referenceSystemIdentifier" type="metadata:MD\_Identifier"/>  
 </xs:sequence>  
 </xs:complexType>  
 </xs:element>  
  
 <xs:complexType name="CI\_OnlineResource">  
 <xs:sequence>  
 <xs:element name="title" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="applicationProfile" type="metadata:StringW\_ID" minOccurs="0"  
 maxOccurs="unbounded"/>  
 <xs:element name="description" type="xs:string" minOccurs="0" maxOccurs="1"/>  
 <xs:element name="linkage" type="xs:anyURI"/>  
 <xs:element name="function" type="metadata:FunctionCode" minOccurs="0"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="StringW\_ID">  
 <xs:simpleContent>  
 <xs:extension base="xs:string">  
 <xs:attribute name="uri" type="xs:anyURI" use="optional"/>  
 </xs:extension>  
 </xs:simpleContent>  
 </xs:complexType>  
  
 <xs:complexType name="CI\_Date">  
 <xs:sequence>  
 <xs:element name="date" type="metadata:DateTime"/>  
 <xs:element name="dateType" type="metadata:DateTypeCode"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="CI\_Responsibility">  
 <xs:sequence>  
 <xs:element name="name" type="xs:string"/>  
 <xs:element name="role" type="metadata:RoleTypeCode" minOccurs="1" maxOccurs="1"/>  
 <xs:element name="identifier" minOccurs="0" type="metadata:MD\_Identifier"/>  
 <xs:element name="country" type="xs:NCName"/>  
 <xs:element name="electronicMailAddress" type="xs:string" nillable="true"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:complexType name="MD\_Constraints">  
 <xs:sequence>  
 <xs:element name="restrictionText" type="metadata:StringW\_ID" minOccurs="0"/>  
 <xs:element name="restrictionCode" type="metadata:RestrictionCode" minOccurs="0"  
 maxOccurs="unbounded"/>  
 </xs:sequence>  
 </xs:complexType>  
  
 <xs:simpleType name="DateTime">  
 <xs:annotation>  
 <xs:documentation>DateTime element for DDE allows YYYY, YYYY-MM, YYYY-MM-DD, and  
 YYYY-MM-DDThh:mm:ss </xs:documentation>  
 </xs:annotation>  
 <xs:union memberTypes="xs:date xs:dateTime xs:gYear xs:gYearMonth"/>  
 </xs:simpleType>  
  
 <!-- \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* -->  
 <!-- \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*codelists \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* -->  
  
 <xs:simpleType name="AcquisitionCode">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="geological mapping"/>  
 <xs:enumeration value="survey"/>  
 <xs:enumeration value="observation"/>  
 <xs:enumeration value="direct observation"/>  
 <xs:enumeration value="indirect observation"/>  
 <xs:enumeration value="outcrop observation"/>  
 <xs:enumeration value="remote sensing"/>  
 <xs:enumeration value="drill borehole"/>  
 <xs:enumeration value="borehole cuttings observation"/>  
 <xs:enumeration value="geophysical log measurements"/>  
 <xs:enumeration value="drill core observation"/>  
 <xs:enumeration value="laboratory instrumentation"/>  
 <xs:enumeration value="data integration synthesis"/>  
 <xs:enumeration value="single published description"/>  
 <xs:enumeration value="multiple sources"/>  
 <xs:enumeration value="multiple outcrop observations"/>  
 <xs:enumeration value="multiple published descriptions"/>  
 <xs:enumeration value="digital conversion from published source"/>  
 <xs:enumeration value="digital simulation"/>  
 <xs:enumeration value="data and map compilation"/>  
 <xs:enumeration value="web resource"/>  
 <xs:enumeration value="other"/>  
 <xs:enumeration value="missing"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="DateTypeCode">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="adopted"/>  
 <xs:enumeration value="creation"/>  
 <xs:enumeration value="deprecated"/>  
 <xs:enumeration value="distribution"/>  
 <xs:enumeration value="inForce"/>  
 <xs:enumeration value="lastRevision"/>  
 <xs:enumeration value="lastUpdate"/>  
 <xs:enumeration value="nextUpdate"/>  
 <xs:enumeration value="publication"/>  
 <xs:enumeration value="released"/>  
 <xs:enumeration value="revision"/>  
 <xs:enumeration value="superseded"/>  
 <xs:enumeration value="unavailable"/>  
 <xs:enumeration value="validityBegins"/>  
 <xs:enumeration value="validityExpires"/>  
  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="FunctionCode">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="browseGraphic"/>  
 <xs:enumeration value="browsing"/>  
 <xs:enumeration value="completeMetadata"/>  
 <xs:enumeration value="coupledResource"/>  
 <xs:enumeration value="download"/>  
 <xs:enumeration value="emailService"/>  
 <xs:enumeration value="fileAccess"/>  
 <xs:enumeration value="order"/>  
 <xs:enumeration value="search"/>  
 <xs:enumeration value="information"/>  
 <xs:enumeration value="offlineAccess"/>  
 <xs:enumeration value="upload"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="ProcessedLevelCode">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="Level\_0"/>  
 <xs:enumeration value="Level\_1"/>  
 <xs:enumeration value="Level\_2"/>  
 <xs:enumeration value="Level\_3"/>  
 <xs:enumeration value="Level\_4"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="ReferenceSystemTypeCode ">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="compoundEngineeringParametric"/>  
 <xs:enumeration value="compoundEngineeringParametricTemporal"/>  
 <xs:enumeration value="compoundEngineeringTemporal"/>  
 <xs:enumeration value="compoundEngineeringVertical"/>  
 <xs:enumeration value="compoundEngineeringVerticalTemporal"/>  
 <xs:enumeration value="compoundGeographic2DParametric"/>  
 <xs:enumeration value="compoundGeographic2DParametricTemporal"/>  
 <xs:enumeration value="compoundGeographic2DTemporal"/>  
 <xs:enumeration value="compoundGeographic2DVertical"/>  
 <xs:enumeration value="compoundGeographicVerticalTemporal"/>  
 <xs:enumeration value="compoundGeographic3DTemporal"/>  
 <xs:enumeration value="compoundProjected2DParametric"/>  
 <xs:enumeration value="compoundProjected2DParametricTemporal"/>  
 <xs:enumeration value="compoundProjectedTemporal"/>  
 <xs:enumeration value="compoundProjectedVertical"/>  
 <xs:enumeration value="compoundProjectedVerticalTemporal"/>  
 <xs:enumeration value="engineering"/>  
 <xs:enumeration value="engineeringDesign"/>  
 <xs:enumeration value="engineeringImage"/>  
 <xs:enumeration value="geodeticGeocentric"/>  
 <xs:enumeration value="geodeticGeographic2D"/>  
 <xs:enumeration value="geodeticGeographic3D"/>  
 <xs:enumeration value="geographicIdentifier"/>  
 <xs:enumeration value="linear"/>  
 <xs:enumeration value="parametric"/>  
 <xs:enumeration value="projected"/>  
 <xs:enumeration value="temporal"/>  
 <xs:enumeration value="vertical"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="ResourceTypeCode">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="Aggregate"/>  
 <xs:enumeration value="Application"/>  
 <xs:enumeration value="Web Application"/>  
 <xs:enumeration value="Collection"/>  
 <xs:enumeration value="Dataset"/>  
 <xs:enumeration value="DataCatalog"/>  
 <xs:enumeration value="GeographicDataset"/>  
 <xs:enumeration value="NonGeographicDataset"/>  
 <xs:enumeration value="Document"/>  
 <xs:enumeration value="Article"/>  
 <xs:enumeration value="Thesis"/>  
 <xs:enumeration value="Book"/>  
 <xs:enumeration value="Poster"/>  
 <xs:enumeration value="WebPage"/>  
 <xs:enumeration value="Image"/>  
 <xs:enumeration value="Map"/>  
 <xs:enumeration value="Photograph"/>  
 <xs:enumeration value="ExplanatoryFigure"/>  
 <xs:enumeration value="Initiative"/>  
 <xs:enumeration value="FieldSession"/>  
 <xs:enumeration value="LearningResource"/>  
 <xs:enumeration value="Guide"/>  
 <xs:enumeration value="Model"/>  
 <xs:enumeration value="Movie"/>  
 <xs:enumeration value="Repository"/>  
 <xs:enumeration value="Semantic resource"/>  
 <xs:enumeration value="DefinedTermSet"/>  
 <xs:enumeration value="Series"/>  
 <xs:enumeration value="Service"/>  
 <xs:enumeration value="WebAPI"/>  
 <xs:enumeration value="Software"/>  
 <xs:enumeration value="Sound"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="RestrictionCode">  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="copyright"/>  
 <xs:enumeration value="patent"/>  
 <xs:enumeration value="patentPending"/>  
 <xs:enumeration value="trademark"/>  
 <xs:enumeration value="licence"/>  
 <xs:enumeration value="intellectualPropertyRights"/>  
 <xs:enumeration value="restricted"/>  
 <xs:enumeration value="otherRestrictions"/>  
 <xs:enumeration value="unrestricted"/>  
 <xs:enumeration value="licenceUnrestricted"/>  
 <xs:enumeration value="licenceEndUser"/>  
 <xs:enumeration value="licenceDistributor"/>  
 <xs:enumeration value="private"/>  
 <xs:enumeration value="statutory"/>  
 <xs:enumeration value="confidential"/>  
 <xs:enumeration value="SBU"/>  
 <xs:enumeration value="in-confidence"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="RoleTypeCode ">  
 <xs:annotation>  
 <xs:documentation>Specifies the relationship of an agent to some aspect of a described  
 resource. Copied from  
 https://wiki.esipfed.org/ISO\_19115-3\_Codelists#CI\_RoleCode</xs:documentation>  
 </xs:annotation>  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="author">  
 <xs:annotation>  
 <xs:documentation>party who authored the resource</xs:documentation>  
 </xs:annotation>  
 </xs:enumeration>  
 <xs:enumeration value="coAuthor"/>  
 <xs:enumeration value="collaborator"/>  
 <xs:enumeration value="contributor"/>  
 <xs:enumeration value="custodian"/>  
 <xs:enumeration value="distributor"/>  
 <xs:enumeration value="editor"/>  
 <xs:enumeration value="funder"/>  
 <xs:enumeration value="mediator"/>  
 <xs:enumeration value="originator"/>  
 <xs:enumeration value="owner"/>  
 <xs:enumeration value="pointOfContact"/>  
 <xs:enumeration value="principalInvestigator"/>  
 <xs:enumeration value="processor"/>  
 <xs:enumeration value="publisher"/>  
 <xs:enumeration value="resourceProvider"/>  
 <xs:enumeration value="rightsHolder"/>  
 <xs:enumeration value="sponsor"/>  
 <xs:enumeration value="stakeholder"/>  
 <xs:enumeration value="user"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="ServiceTypeCode ">  
 <xs:annotation>  
 <xs:documentation>Codes to categorize service types. DDE- specific serivce types have  
 DDE\_prefix.</xs:documentation>  
 </xs:annotation>  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="DataService>DataAccess"/>  
 <xs:enumeration value="DataService>DataWorkflow"/>  
 <xs:enumeration value="DataService>DataProcessing"/>  
 <xs:enumeration value="DataService>MapView"/>  
 <xs:enumeration value="DataService>Other"/>  
 <xs:enumeration value="DDE\_GeoscienceKnowledgeDirectory"/>  
 <xs:enumeration value="DDE\_GeoscienceKnowledgeContent"/>  
 <xs:enumeration value="DDE\_KnowledgeReasoning"/>  
 <xs:enumeration value="DDE\_DeepShovel"/>  
 <xs:enumeration value="DDE\_Scholar"/>  
 <xs:enumeration value="DDE\_OtherKnowledge"/>  
 <xs:enumeration value="DDE\_PlatformCatalogue"/>  
 <xs:enumeration value="DDE\_PlatformRegistry"/>  
 <xs:enumeration value="DDE\_PlatformModel"/>  
 <xs:enumeration value="DDE\_PlatformCloudComputing"/>  
 <xs:enumeration value="DDE\_PlatformAnnotation"/>  
 <xs:enumeration value="DDE\_API\_Information"/>  
 <xs:enumeration value="DDE\_EarthExplorer"/>  
 <xs:enumeration value="DDE\_Platform>DataEvaluation"/>  
 <xs:enumeration value="DDE\_Platform>DataIdentifier"/>  
 <xs:enumeration value="DDE\_Platform>Other"/>  
 <xs:enumeration value="Theme>MineralResourceAssessment"/>  
 <xs:enumeration value="Theme>GeologicMapping"/>  
 <xs:enumeration value="Theme>GeologicalTime"/>  
 <xs:enumeration value="Theme>GeologicalOccurrence"/>  
 <xs:enumeration value="Theme>Dinosaur"/>  
 <xs:enumeration value="Theme>GeographicName"/>  
 <xs:enumeration value="Theme>GeomorphologyMapping"/>  
 <xs:enumeration value="Theme>GeoscienceStandards"/>  
 <xs:enumeration value="Theme>Other"/>  
 <xs:enumeration value="VocabularyService"/>  
 <xs:enumeration value="RegistryService"/>  
 <xs:enumeration value="DiscoveryService"/>  
 <xs:enumeration value="ViewService"/>  
 <xs:enumeration value="OtherService"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="SpatialRepresentationTypeCode">  
 <xs:annotation>  
 <xs:documentation>Codes that specify the method used to represent geographic information in  
 the resource</xs:documentation>  
 </xs:annotation>  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="vector"/>  
 <xs:enumeration value="grid"/>  
 <xs:enumeration value="textTable"/>  
 <xs:enumeration value="tin"/>  
 <xs:enumeration value="stereoModel"/>  
 <xs:enumeration value="video"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
 <xs:simpleType name="TopicCategoryCode">  
 <xs:annotation>  
 <xs:documentation>This codelist extends the ISO19115-1 codelist (see  
 https://wiki.esipfed.org/ISO\_19115-3\_Codelists#MD\_TopicCategoryCode) with more granular  
 topic categories for geoscience resources. The categories that do not have an '8\_' prefix  
 are from the ISO19115-3 codelist, except for DataScience, which is added in this  
 vocabulary.</xs:documentation>  
 </xs:annotation>  
 <xs:restriction base="xs:token">  
 <xs:enumeration value="farming"/>  
 <xs:enumeration value="biota"/>  
 <xs:enumeration value="boundaries"/>  
 <xs:enumeration value="climatologyMeteorologyAtmosphere"/>  
 <xs:enumeration value="economy"/>  
 <xs:enumeration value="elevation"/>  
 <xs:enumeration value="environment"/>  
 <xs:enumeration value="geoscientificInformation"/>  
 <xs:enumeration value="8\_01-stratigraphy"/>  
 <xs:enumeration value="8\_02-paleontology"/>  
 <xs:enumeration value="8\_03-geochronology"/>  
 <xs:enumeration value="8\_04-sedimentology"/>  
 <xs:enumeration value="8\_05-magmaticPetrology"/>  
 <xs:enumeration value="8\_06-metamorphicPetrology"/>  
 <xs:enumeration value="8\_07-structureGeology"/>  
 <xs:enumeration value="8\_08-tectonics"/>  
 <xs:enumeration value="8\_09-geologicMapping"/>  
 <xs:enumeration value="8\_10-hydrogeology"/>  
 <xs:enumeration value="8\_11-engineeringGeologyGeotechnology"/>  
 <xs:enumeration value="8\_12-environmentalGeology"/>  
 <xs:enumeration value="8\_13-petroleumGeology"/>  
 <xs:enumeration value="8\_14-mathematicalGeoscience"/>  
 <xs:enumeration value="8\_15-marineGeology"/>  
 <xs:enumeration value="8\_16-mineralogy"/>  
 <xs:enumeration value="8\_17-gravimetricAndGravityExploration"/>  
 <xs:enumeration value="8\_18-geomagnetismAndMagneticExploration"/>  
 <xs:enumeration value="8\_19-geoelectricityAndElectricalExploration"/>  
 <xs:enumeration value="8\_20-seismologyAndSeismicExploration"/>  
 <xs:enumeration value="8\_21-nuclearGeophysicsandRadioactiveExploration"/>  
 <xs:enumeration value="8\_22-drillAndGeophysicalLogging"/>  
 <xs:enumeration value="8\_23-paleomagnetism"/>  
 <xs:enumeration value="8\_24-rockphysics"/>  
 <xs:enumeration value="8\_25-integratedgeophysics"/>  
 <xs:enumeration value="8\_26-geochemistry"/>  
 <xs:enumeration value="8\_27-remoteSensing"/>  
 <xs:enumeration value="8\_28-geomorphology"/>  
 <xs:enumeration value="8\_29-paleoclimatology"/>  
 <xs:enumeration value="8\_30-paleogeography"/>  
 <xs:enumeration value="8\_31-earthResource"/>  
 <xs:enumeration value="8\_32-geothermics"/>  
 <xs:enumeration value="8\_33-geoexploration"/>  
 <xs:enumeration value="8\_34-mining"/>  
 <xs:enumeration value="8\_35-economicalGeology"/>  
 <xs:enumeration value="8\_36-geologicalLiterature"/>  
 <xs:enumeration value="8\_37-planetaryGeology"/>  
 <xs:enumeration value="8\_38-biogeology"/>  
 <xs:enumeration value="8\_39-volcanology"/>  
 <xs:enumeration value="8\_40-forensicGeology"/>  
 <xs:enumeration value="8\_41-otherGeoscientificTopics"/>  
 <xs:enumeration value="health"/>  
 <xs:enumeration value="imageryBaseMapsEarthCover"/>  
 <xs:enumeration value="intelligenceMilitary"/>  
 <xs:enumeration value="inlandWaters"/>  
 <xs:enumeration value="location"/>  
 <xs:enumeration value="oceans"/>  
 <xs:enumeration value="planningCadastre"/>  
 <xs:enumeration value="society"/>  
 <xs:enumeration value="structure"/>  
 <xs:enumeration value="transportation"/>  
 <xs:enumeration value="utilitiesCommunication"/>  
 <xs:enumeration value="extraTerrestrial"/>  
 <xs:enumeration value="disaster"/>  
 <xs:enumeration value="dataScience"/>  
 <xs:enumeration value="missing"/>  
 </xs:restriction>  
 </xs:simpleType>  
  
</xs:schema>

**References**

[1] ISO 19115-1:2014(E), Geographic information —Metadata —Part 1: Fundamentals

[2] ISO 19115-1:2014/Amd.1:2018(E), Geographic information —Metadata —Part 1: Fundamentals AMENDMENT 1

ISO 19115-2:2019(E)，Geographic information—Metadata —Part 2: Extensions for acquisition and processing

ISO 19115-3:2016(E)，Geographic information — Metadata — Part 3: XML schema implementation for fundamental concepts

[3] ISO 19119:2016(E), Geographic information — Services

[4] ISO 19108:2002(E), Geographic information — Temporal schema

[5] OneGeology: How to serve a OneGeology level 1 conformant Web Map Service (WMS) - Cookbook 1

[6] INSPIRE: Technical Guidance for the implementation of INSPIRE dataset and service metadata based on ISO/TS 19139:2007

[7] Dublin Core metadata; <https://www.dublincore.org/resources/userguide/creating_metadata>, [May,30,2023]

[8] CCOP Geosciences Information Metadata Standard- CCOP S01, 2009.

[8a] https://schema.org.

[8b] Data Catalog Vocabulary (DCAT) - Version 3, 2023-03, https://www.w3.org/TR/vocab-dcat-3/.

[9] ISO 15836:2003(E), Information and documentation — The Dublin Core metadata element set

[10] ISO 3166-1 Codes for the representation of names of countries and their subdivisions – Part 1: Country codes

[11] ISO 3166-3 Codes for the representation of names of countries and their subdivisions – Part 3: Code for formerly used names of countries.

[12] ISO 639.2 Codes for the representation of names of languages-- Part 2

[13] IETF RFC1738 - Uniform Resource Locators (URL)

[14] IETF RFC2056: Uniform Resource Locators for Z39.50

[15] DOI: <https://www.doi.org/>, April 28,2021

[16] FAIR data principle: [https://www.go-fair.org/fair-principles](https://www.go-fair.org/fair-principles/), [April 28, 2021]

1. <http://standards.iso.org/iso/19115/resources/Codelist/cat/codelists.xml#MD_ScopeCode> [↑](#footnote-ref-2)