INSPIREInfrastructure for Spatial Information in Europe

D2.8.III.21 Data Specification on *Mineral Resources* – Technical Guidelines

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Foreword

How to read the document?

This document describes the *"INSPIRE data specification on Mineral Resources – Technical Guidelines"* version 3.0 rc3 as developed by the Thematic Working Group (TWG) *Mineral Resources* using both natural and a conceptual schema language.

The data specification is based on a common template[1] used for all data specifications, which has been harmonised using the experience from the development of the Annex I, II and III data specifications.

This document provides guidelines for the implementation of the provisions laid down in the Implementing Rule for spatial data sets and services of the INSPIRE Directive. It also includes additional requirements and recommendations that, although not included in the Implementing Rule, are relevant to guarantee or to increase data interoperability.

Two executive summaries provide a quick overview of the INSPIRE data specification process in general, and the content of the data specification on *Mineral Resources* in particular. We highly recommend that managers, decision makers, and all those new to the INSPIRE process and/or information modelling should read these executive summaries first.

The UML diagrams (in Chapter 5) offer a rapid way to see the main elements of the specifications and their relationships. The definition of the spatial object types, attributes, and relationships are included in the Feature Catalogue (also in Chapter 5). People having thematic expertise but not familiar with UML can fully understand the content of the data model focusing on the Feature Catalogue. Users might also find the Feature Catalogue especially useful to check if it contains the data necessary for the applications that they run. The technical details are expected to be of prime interest to those organisations that are responsible for implementing INSPIRE within the field of *Mineral Resources*, but also to other stakeholders and users of the spatial data infrastructure.

The technical provisions and the underlying concepts are often illustrated by examples. Smaller examples are within the text of the specification, while longer explanatory examples and descriptions of selected use cases are attached in the annexes.

In order to distinguish the INSPIRE spatial data themes from the spatial object types, the INSPIRE spatial data themes are written in *italics*.

The document will be publicly available as a 'non-paper'. It does not represent an official position of the European Commission, and as such cannot be invoked in the context of legal procedures.

Interoperability of Spatial Data Sets and Services – General Executive Summary

The challenges regarding the lack of availability, quality, organisation, accessibility, and sharing of spatial information are common to a large number of policies and activities and are experienced across the various levels of public authority in Europe. In order to solve these problems it is necessary to take measures of coordination between the users and providers of spatial information. The Directive 2007/2/EC of the European Parliament and of the Council adopted on 14 March 2007 aims at establishing an Infrastructure for Spatial Information in the European Community (INSPIRE) for environmental policies, or policies and activities that have an impact on the environment.

INSPIRE is based on the infrastructures for spatial information that are created and maintained by the Member States. To support the establishment of a European infrastructure, Implementing Rules addressing the following components of the infrastructure have been specified: metadata, interoperability of spatial data sets (as described in Annexes I, II, III of the Directive) and spatial data services, network services, data and service sharing, and monitoring and reporting procedures.

INSPIRE does not require collection of new data. However, after the period specified in the Directive[2] Member States have to make their data available according to the Implementing Rules.

Interoperability in INSPIRE means the possibility to combine spatial data and services from different sources across the European Community in a consistent way without involving specific efforts of humans or machines. It is important to note that "interoperability" is understood as providing access to spatial data sets through network services, typically via Internet. Interoperability may be achieved by either changing (harmonising) and storing existing data sets or transforming them via services for publication in the INSPIRE infrastructure. It is expected that users will spend less time and efforts on understanding and integrating data when they build their applications based on data delivered in accordance with INSPIRE.

In order to benefit from the endeavours of international standardisation bodies and organisations established under international law their standards and technical means have been utilised and referenced, whenever possible.

To facilitate the implementation of INSPIRE, it is important that all stakeholders have the opportunity to participate in specification and development. For this reason, the Commission has put in place a consensus building process involving data users, and providers together with representatives of industry, research and government. These stakeholders, organised through Spatial Data Interest Communities (SDIC) and Legally Mandated Organisations (LMO)[3], have provided reference materials, participated in the user requirement and technical[4] surveys, proposed experts for the Data Specification Drafting Team[5], the Thematic Working Groups[6] and other ad-hoc cross-thematic technical groups and participated in the public stakeholder consultations on draft versions of the data specifications. These consultations covered expert reviews as well as feasibility and fitness-for-purpose testing of the data specifications[7].

This open and participatory approach was successfully used during the development of the data specifications on Annex I, II and III data themes as well as during the preparation of the

Implementing Rule on Interoperability of Spatial Data Sets and Services[8] for Annex I spatial data themes and of its amendment regarding the themes of Annex II and III.

The development framework elaborated by the Data Specification Drafting Team aims at keeping the data specifications of the different themes coherent. It summarises the methodology to be used for the development of the data specifications, providing a coherent set of requirements and recommendations to achieve interoperability. The pillars of the framework are the following technical documents[9]:

- The *Definition of Annex Themes and Scope* describes in greater detail the spatial data themes defined in the Directive, and thus provides a sound starting point for the thematic aspects of the data specification development.
- The *Generic Conceptual Model* defines the elements necessary for interoperability and data harmonisation including cross-theme issues. It specifies requirements and recommendations with regard to data specification elements of common use, like the spatial and temporal schema, unique identifier management, object referencing, some common code lists, etc. Those requirements of the Generic Conceptual Model that are directly implementable are included in the Implementing Rule on Interoperability of Spatial Data Sets and Services.
- The *Methodology for the Development of Data Specifications* defines a repeatable methodology. It describes how to arrive from user requirements to a data specification through a number of steps including use-case development, initial specification development and analysis of analogies and gaps for further specification refinement.
- The *Guidelines for the Encoding of Spatial Data* defines how geographic information can be encoded to enable transfer processes between the systems of the data providers in the Member States. Even though it does not specify a mandatory encoding rule it sets GML (ISO 19136) as the default encoding for INSPIRE.
- The *Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE Annex II and III data specification development* provides guidelines on how the "Observations and Measurements" standard (ISO 19156) is to be used within INSPIRE.
- The *Common data models* are a set of documents that specify data models that are referenced by a number of different data specifications. These documents include generic data models for networks, coverages and activity complexes.

The structure of the data specifications is based on the "ISO 19131 Geographic information - Data product specifications" standard. They include the technical documentation of the application schema, the spatial object types with their properties, and other specifics of the spatial data themes using natural language as well as a formal conceptual schema language[10].

A consolidated model repository, feature concept dictionary, and glossary are being maintained to support the consistent specification development and potential further reuse of specification elements. The consolidated model consists of the harmonised models of the relevant standards from the ISO 19100 series, the INSPIRE Generic Conceptual Model, and the application schemas[11] developed for each spatial data theme. The multilingual INSPIRE Feature Concept Dictionary contains the definition and description of the INSPIRE themes together with the definition of the spatial object types present in the specification. The INSPIRE Glossary defines all the terms (beyond the spatial object types) necessary for understanding the INSPIRE documentation including the terminology of other components (metadata, network services, data sharing, and monitoring).

By listing a number of requirements and making the necessary recommendations, the data specifications enable full system interoperability across the Member States, within the scope of the application areas targeted by the Directive. The data specifications (in their version 3.0) are published as technical guidelines and provide the basis for the content of the Implementing Rule on Interoperability of Spatial Data Sets and Services[12]. The content of the Implementing Rule is extracted from the data specifications, considering short- and medium-term feasibility as well as cost-benefit considerations. The requirements included in the Implementing Rule are legally binding for the Member States according to the timeline specified in the INSPIRE Directive.

In addition to providing a basis for the interoperability of spatial data in INSPIRE, the data specification development framework and the thematic data specifications can be reused in other environments at local, regional, national and global level contributing to improvements in the coherence and interoperability of data in spatial data infrastructures.

Mineral Resources – Executive Summary

In the INSPIRE Directive, *Mineral Resources* theme is defined as "Mineral resources including metal ores, industrial minerals, etc., where relevant including depth/height information on the extent of the resource".

To specify the scope of *Mineral Resources* for INSPIRE, the terms contained in the definition have been clearly explained in the informal description section. Reference material has been analysed, and particularly:

- two legal texts providing requirements for the data specification:
  - The EU Raw Materials Initiative;
  - The Management of waste from extractive industries;
- the standard data model EarthResourceML for Mineral resources;
- the work currently done in raw materials related to European projects.

The EU Raw Materials Initiative (2008)

In this document, the Commission notices that there has been no integrated policy response at EU level up to now to ensure that it has sufficient access to raw materials at fair and undistorted prices. It is proposed that the EU should agree on an integrated raw materials strategy. Such a strategy should be based on the following 3 pillars:

- ensure **access to raw materials** from international markets under the same conditions as other industrial competitors;
- set the right **framework conditions** within the EU in order to foster sustainable supply of raw materials from European sources;
- boost overall resource efficiency and promote recycling to **reduce the EU's consumption of primary raw materials** and decrease the relative import dependence.

Two points are of particular interest for INSPIRE:

- The sustainable supply of raw materials based in the EU requires that **the knowledge base** of mineral deposits within the EU will be improved. In addition, the long term access to these deposits should be taken into account in land use planning.
- The Commission recommends better networking between the national geological surveys to facilitate the exchange of information and improve the interoperability of data and their dissemination, with particular attention to the needs of SMEs.

Any **land use policy for minerals** must utilise a robust digital geological knowledge base ensuring fair and equal consideration of all potential uses of land including the eventual extraction of raw materials.

To **improve the knowledge base** of mineral deposits in the EU the need for harmonised EU level data sets stands out.

The Management of waste from extractive industries (Directive 2006/21/EC)

One of the properties the waste characterisation shall include, where appropriate and in accordance with the category of the waste facility, is the description of expected physical and chemical characteristics of the waste to be deposited in the short and the long term, with particular reference to its stability under surface atmospheric/meteorological conditions, taking account of the type of mineral or minerals to be extracted and the nature of any overburden and/or gangue minerals that will be displaced in the course of the extractive operations.

A communication of the European Commission (COM(2011) 25 final) entitled 'TACKLING THE CHALLENGES IN COMMODITY MARKETS AND ON RAW MATERIALS' presents an overview of what has been achieved in each of these areas and of the steps which are planned to take the work forward. This document sets out targeted measures to secure and improve access to raw materials for the EU, and it also confirms that the needs expressed above are more than never of actuality.

Examples of use of mineral resources

The initial analysis of reference material and related activities has been completed by the description of the most relevant examples of use of mineral resources in various domains:

- Management of resources and exploitation activities: Providing information on inventoried mineral resources.
- Environmental impact assessments: mapping and measuring environmental geological parameters at desk, in the field and in laboratory, for assessing geological material to be used for construction and rehabilitation at the mine site.
- Mineral exploration: the quantitative assessment of undiscovered mineral resources, the modelling of mineral deposits, the mapping of lithological areas and units potentially hosting mineral deposits, the use of by-products from natural stone quarrying as "secondary aggregates" or as raw material for other industries.
- Promotion of private sector investment: providing geodata and services for mining and exploration companies.

From these examples, **four use cases are detailed:**

- Where to find germanium in Europe?
- What is the gold potential of Central and Southeastern Europe?
- Looking for the closest producers of Ground Calcium Carbonate (GCC), allowing elaborating filler for the paper industry.
- Environmental uncertainties related to mining wastes.

This overview shows the wide range of use with various sets of mineral resources properties according to the use: the management of resources and exploitation activities does not request (most of the time) the same type of information about mineral resources than the assessment of the impact on environment, but some parameters may strongly interact on both domains.

The information about the location of the mine or mineral occurrence and some key attributes like the type of rocks or minerals mined (e.g. silicate – sulphide – radioactive) of *Mineral Resources* can have a significant impact on the environment. This impact can be more or less strong depending on several other factors/parameters, and an appropriate knowledge about the *Mineral Resources* can

thus play an important role, as for example:

- The type of exploitation: the environmental impact of an open-pit in terms of surface area used/land use problems / visual pollution is not the same as for an underground exploitation (which also sometimes can store wastes depending on the exploitation method).
- The geometry of the deposit (extent, shape, dip, width) – and also the grades of reserves and resources– which will strongly influence the type of exploitation.
- The type of ore, which will determine the type of mineral processing and therefore the type and quantity of wastes.

The **core data model for Mineral Resources,** which is based on the GeoSciML and EarthResourceML developed by the international geosciences community, in particular Geological Survey Organisations (http://www.geosciml.org/), provides the main object types and properties requested by all examples of use: the location of mineral resources (Mines and Earth Resources), the main commodities, and the exploitation type.

The TWG has also elaborated the first draft of a data model that conceptually extends the data scope of the INSPIRE Mineral Resource core data model to address the requirements from the Raw Materials Initiative and the Mining Waste Directive utilizing the GeoSciML and Earth ResourceML community data models (see the Annex D of this document).

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The Thematic Working Group Geology and Mineral Resources (TWG-GE-MR) included:

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Also contributed:

Invited external expert for geoscience interoperability: Francois Robida.

For the final version of the document: Chris Schubert

Other contributors to the INSPIRE data specifications are the Drafting Team Data Specifications, the JRC Data Specifications Team and the INSPIRE stakeholders - Spatial Data Interested Communities (SDICs) and Legally Mandated Organisations (LMOs).

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Table of contents

1. Scope

This document specifies a harmonised data specification for the spatial data theme *Mineral Resources* as defined in Annex III of the INSPIRE Directive.

This data specification provides the basis for the drafting of Implementing Rules according to Article 7 (1) of the INSPIRE Directive [Directive 2007/2/EC]. The entire data specification is published as implementation guidelines accompanying these Implementing Rules.

2. Overview

2.1. Name

INSPIRE data specification for the theme *Mineral Resources*.

2.2. Informal description

Definition:

Mineral resources including metal ores, industrial minerals, etc., where relevant including depth/height information on the extent of the resource. [Directive 2007/2/EC]

Description:

From the definition, we detail each word.

Mineral resource means a naturally occurring concentration/accumulation of organic or inorganic material of intrinsic economic interest in or on the Earth's crust such as energy fuels, metal ores, industrial minerals and construction minerals, but excluding water, in such form and quality that there are reasonable prospects for eventual economic extraction

Mineral raw material (not in the definition) is a natural inorganic or organic substance, such as metallic ores, industrial minerals, construction materials or energy fuels, but excluding water.

Metal ores the usage favors the wording "**Metallic ores**" instead of "Metal ores".

Ore (sensu lato): Any naturally occurring (raw) material from which a mineral or aggregate can be extracted at a profit.

Although more than 4,400 mineral species are known, only about 100 are considered ore minerals. The term 'ore' originally applied only to metallic minerals but now includes such non-metallic substances as sulphur, calcium fluoride (fluorite), and barium sulfate (barite). Ore is always mixed with unwanted rocks and minerals, known collectively as gangue. The ore and the gangue are mined together and then separated. The desired element (often a metal which is usually contained in chemical combination with some other element in addition to various impurities) is then extracted from the ore. It may be still further refined (purified) or alloyed with other metals.

A Metal (metallic) ore is thus a type of rock (mineral raw material) from which metal can be extracted at a profit.

Metals may be present in ores in the native form (such as native copper), or as noble metals (not usually forming compounds, such as gold), but more commonly they occur combined as oxides, sulphides, sulphates, silicates, etc. Actually, the generic wording 'metals' covers 'true' metals (see Periodic Table of Elements) but also includes semi-metallic substances or metalloids such as 'As' and 'Ge' which are often intimately associated with metals.

Industrial minerals and rocks are minerals which are neither metallic nor used as fuels, but which are mined and processed for their economic use. A broader definition describes an

industrial mineral as any rock, mineral, or naturally occurring substance of economic value, exclusive of metallic ores and mineral fuels, and gemstones. In essence, they are the raw materials used in many industrial, agricultural and construction products. However, **for convenience**, gemstones are frequently grouped together with industrial minerals under one umbrella.

Depth/height information: This information, if provided alone, is of limited interest. It should be linked with information related to the type and the morphology of the deposit (e.g., vein, massive deposit, layer, etc.) and its geometry, in particular the dip. The depth/height of the deposit, combined with information related to the morphology and the geometry, will contribute to define the operating method (e.g., open pit vs. underground mining) and notably the thickness of overburden to remove in case of open pit mining.

2.2.1. The main spatial object / data types of *Mineral Resources* data specification

The main spatial object / data types are Mineral Occurrence, the Commodity, the Mine and the Exploration activity, and the Mining activity.

The MineralResources data model:

The **Mining Feature** class represents a conceptual feature that exists coherently in the world and corresponds with a "**Mine**" or a "**Mining Activity**", locatable and identifiable features in time and/or space. The **Mining Feature Occurrence** is an occurrence of a Mining Feature, it carries some properties and the geometry and/or location.

- A **Mine** is an excavation for the extraction of mineral deposits. 'True' mines are underground workings and open-pit workings (also called open-sky mines) generally for the extraction of metallic commodities. The Mine spatial object type also includes open workings generally for the extraction of industrial minerals, commonly referred to as quarries.
- The **Mining Activity**, related to a Mine, describes the process of extracting metallic or non-metallic mineral deposits from the Earth.

The **Earth Resource** identifies the kinds of observable or inferred phenomena required to classify economic and sub-economic earth resources:

- The **Mineral Occurrence** could be a prospect, an occurrence, a mineral deposit, an ore deposit, etc. (but not a lode, a field, a district, or a province).
- The **Commodity** describes the material of economic interest in the Earth Resource.
- The **Ore Measure** is an estimated or calculated amount of ore and grade that exist within an Earth Resource, in terms of its resource, reserve and endowment.
- The **Mineral Deposit Model** describes the essential attributes of a class of mineral deposits used to classify the Earth Resource.
- An Earth Resource has an associated **Exploration Activity** to describe the process leading to the discovery and assessment of the resource.

The MineralResources data model uses classes from the INSPIRE Geology Data Model: an Earth Resource is a Geologic Feature, which has a geometry (a MappedFeature) and an age

(GeologicEvent).

Exploration history is needed for quantitative assessment of possibly existing, yet undiscovered mineral resources of an area (e.g. USGS predictivity approach). Such information can also help to evaluate the potential of an occurrence (e.g. sampling survey; drilling survey).

The notion of metallogenic district is particularly useful and is present in several databases. It allows a deposit to be placed in a more general frame and to tackle the concept of mining potential at a regional scale. In the MineralResources model this can be described using the MineralOccurrence type property.

Mineral resource anomalies

Anomalies are defined in the D2.3 Document D2.3 Definition of Annex Themes and Scope:

"Anomalies: locations where background concentrations of potentially valuable elements in soils, stream sediments or rocks onshore or offshore exceed the normal background values expected given the local geological context. Such maps are widely used in mineral exploration. Attributes are location, chemical elements, nature of the sampled element (s), analytical value(s)"

Anomalies are not only of geochemical nature, but can also be geophysical. An anomaly has no intrinsic value until it has been properly characterized through (i) a detailed geological survey, (ii) a more detailed geophysical/geochemical survey ("tactical" grids with a smaller cell size for measurement/sampling) and (iii) if the interest is confirmed, a reconnaissance drilling survey.

A majority of anomalies never open onto the discovery of a deposit, being often related to lithological heterogeneities in the crust. In some cases, they may indicate that a mineralizing process started but rapidly aborted, leading to no mineral concentration. On the other hand, many deposits are not (or never) marked by geophysical/geochemical anomalies for several reasons: depth, overburden screen, lack of contrast between the host rock and the ore body, etc..

Even if geochemical/geophysical surveys are useful for "predictivity" mapping, most of the time, only large-scale surveys published by public bodies are available. Their interest is generally very limited. Detailed surveys made by private companies are rarely accessible because of their strategic importance.

All these reasons together do not invite to include "Anomalies" in the scope of *Mineral Resources*. An "Anomaly" database would be a huge collection of objects for which nobody would have a clear idea of the meaning. Most of the Geological Surveys do not maintain such a database.

Definition:

Mineral resources including metal ores, industrial minerals, etc., where relevant including depth/height information on the extent of the resource. [Directive 2007/2/EC]

Description:

The Mineral resources data theme refers to the description of natural concentrations of very diverse mineral resources of potential or proven economic interest. The important attributes such as the nature, genesis, location, extent, mining and distribution of resources reflect the two main identified categories of potential use. These are:

* Management of resources and their exploitation and exploration activities: provision of information on inventoried mineral resources as well as on the quantitative assessment of undiscovered mineral resources and the modelling of mineral deposits.

* Environmental impact assessments: mapping and measuring environmental geological parameters for assessing geological material to be used for construction and rehabilitation at the mine site.

The Mineral resources data model is organised around two major categories of information: description and location of mines and mining activities; the description and location of "earth resources" including their classification, estimates of amount, as well as a description of the main market commodities. The energy resources such as coal, oil and gas are excluded in this theme, as they are found in theme "energy resources".

Entry in the INSPIRE registry: *http://inspire.ec.europa.eu/theme/mr/*

2.3. Normative References

[Directive 2007/2/EC] Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)

[ISO 19107] EN ISO 19107:2005, Geographic Information – Spatial Schema

[ISO 19108] EN ISO 19108:2005, Geographic Information – Temporal Schema

[ISO 19108-c] ISO 19108:2002/Cor 1:2006, Geographic Information – Temporal Schema, Technical Corrigendum 1

[ISO 19111] EN ISO 19111:2007 Geographic information - Spatial referencing by coordinates (ISO 19111:2007)

[ISO 19113] EN ISO 19113:2005, Geographic Information – Quality principles

[ISO 19115] EN ISO 19115:2005, Geographic information – Metadata (ISO 19115:2003)

[ISO 19118] EN ISO 19118:2006, Geographic information – Encoding (ISO 19118:2005)

[ISO 19123] EN ISO 19123:2007, Geographic Information – Schema for coverage geometry and functions

[ISO 19125-1] EN ISO 19125-1:2004, Geographic Information – Simple feature access – Part 1: Common architecture

[ISO 19135] EN ISO 19135:2007 Geographic information – Procedures for item registration (ISO 19135:2005)

[ISO 19138] ISO/TS 19138:2006, Geographic Information – Data quality measures

[ISO 19139] ISO/TS 19139:2007, Geographic information – Metadata – XML schema implementation

[ISO 19157] ISO/DIS 19157, Geographic information – Data quality

[OGC 06-103r4] Implementation Specification for Geographic Information - Simple feature access – Part 1: Common Architecture v1.2.1

NOTE This is an updated version of "EN ISO 19125-1:2004, Geographic information – Simple feature access – Part 1: Common architecture".

[Regulation 1205/2008/EC] Regulation 1205/2008/EC implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata

[Regulation 976/2009/EC] Commission Regulation (EC) No 976/2009 of 19 October 2009 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards the Network Services

[Regulation 1089/2010/EC] Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services

Raw Materials Initiative:[Communication 2008/699/EC] The raw materials initiative — Meeting our critical needs for growth and jobs in Europe \{SEC(2008) 2741}. Communication COM(2008) 699

Mining Waste Directive: [Regulation 2006/21/EC] DIRECTIVE 2006/21/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC

Web sites describing the two data models standards used to provide the INSPIRE data model for *Mineral Resources*:

- **EarthResourceML:** *www.earthresourceml.org*
- **GeoSciML:** *www.geosciml.org*

2.4. Terms and definitions

General terms and definitions helpful for understanding the INSPIRE data specification documents are defined in the INSPIRE Glossary[13].

Specifically, for the theme *Mineral Resources*, the following terms are defined:

1. **Commodity**

A material of economic interest in an earth resource.

2. **Mine**

An excavation for the extraction of mineral deposits, including underground workings and open-pit workings (also called open-sky mines) for the extraction of metallic commodities, as well as open workings for the extraction of industrial minerals, (which are commonly referred to as quarries).

3. **Mining activity**

The process of extracting metallic or non-metallic mineral deposits from the Earth.

2.5. Symbols and abbreviations

AMD	Acid Mine Drainage
ARD	Acid Rock Drainage
ATS	Abstract Test Suite
BMD	Basic Mine Drainage
CCGC	Australian Chief Government Geologists Committee
CGI	Commission for Geoscience Information (IUGS Commission)
CRIRSCO	Committee for Mineral Reserves International Reporting Standards
EC	European Commission
EEA	European Environmental Agency
ERML	EarthResource Markup Language
ETRS89	European Terrestrial Reference System 1989
ETRS89-LAEA	Lambert Azimuthal Equal Area
EVRS	European Vertical Reference System
GCC	Ground Calcium Carbonate
GCM	General Conceptual Model
GeoSciML	GeoScience Markup Language
GML	Geography Markup Language
IR	Implementing Rule
ISDSS	Interoperability of Spatial Data Sets and Services
ISO	International Organization for Standardization
ITRS	International Terrestrial Reference System

IUGS	International Union of Geological Sciences
LAT	Lowest Astronomical Tide
LMO	Legally Mandated Organisation
MR	Mineral Resources
NMD	Neutral Mine Drainage
PERC	Pan European Reserves and Resources Reporting Committee
PGE	Platinum group elements
RAW	RUN-OF-MINE
SDIC	Spatial Data Interest Community
SEDEX	Sedimentary Exhalative Deposits
TG	Technical Guidance
UML	Unified Modeling Language
UTC	Coordinated Universal Time
VMS	Volcanogenic Massive Sulphides
XML	EXtensible Markup Language

2.6. How the Technical Guidelines map to the Implementing Rules

The schematic diagram in Figure 1 gives an overview of the relationships between the INSPIRE legal acts (the INSPIRE Directive and Implementing Rules) and the INSPIRE Technical Guidelines. The INSPIRE Directive and Implementing Rules include legally binding requirements that describe, usually on an abstract level, *what* Member States must implement.

In contrast, the Technical Guidelines define *how* Member States might implement the requirements included in the INSPIRE Implementing Rules. As such, they may include non-binding technical requirements that must be satisfied if a Member State data provider chooses to conform to the Technical Guidelines. Implementing these Technical Guidelines will maximise the interoperability of INSPIRE spatial data sets.

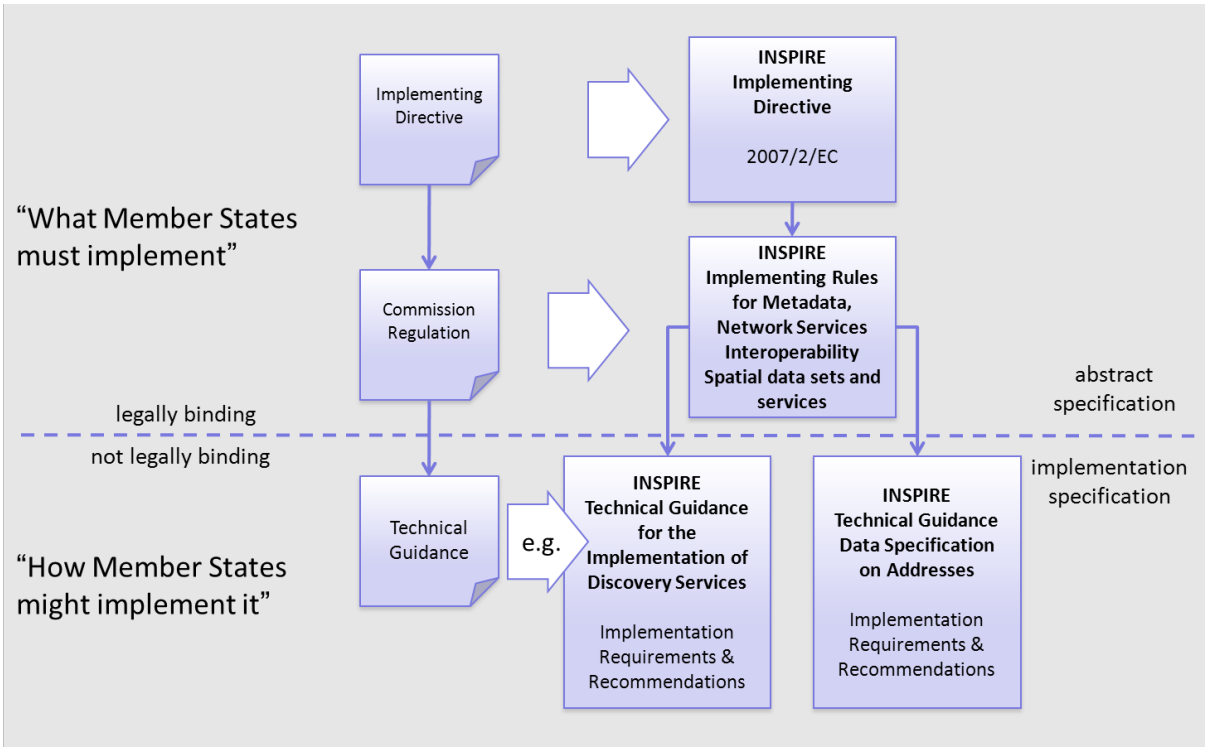

Figure 1 - Relationship between INSPIRE Implementing Rules and Technical Guidelines

2.6.1. Requirements

The purpose of these Technical Guidelines (Data specifications on *Mineral Resources*) is to provide practical guidance for implementation that is guided by, and satisfies, the (legally binding) requirements included for the spatial data theme *Mineral Resources* in the Regulation (Implementing Rules) on interoperability of spatial data sets and services. These requirements are highlighted in this document as follows:

IR Requirement
Article / Annex / Section no.
Title / Heading

This style is used for requirements contained in the Implementing Rules on interoperability of spatial data sets and services (Commission Regulation (EU) No 1089/2010).

For each of these IR requirements, these Technical Guidelines contain additional explanations and examples.

NOTE The Abstract Test Suite (ATS) in Annex A contains conformance tests that directly check conformance with these IR requirements.

Furthermore, these Technical Guidelines may propose a specific technical implementation for satisfying an IR requirement. In such cases, these Technical Guidelines may contain additional technical requirements that need to be met in order to be conformant with the corresponding IR requirement *when using this proposed implementation*. These technical requirements are highlighted as follows:

TG Requirement X

This style is used for requirements for a specific technical solution proposed in these Technical Guidelines for an IR requirement.

NOTE 1 Conformance of a data set with the TG requirement(s) included in the ATS implies conformance with the corresponding IR requirement(s).

NOTE 2 In addition to the requirements included in the Implementing Rules on interoperability of spatial data sets and services, the INSPIRE Directive includes further legally binding obligations that put additional requirements on data providers. For example, Art. 10(2) requires that Member States shall, where appropriate, decide by mutual consent on the depiction and position of geographical features whose location spans the frontier between two or more Member States. General guidance for how to meet these obligations is provided in the INSPIRE framework documents.

2.6.2. Recommendations

In addition to IR and TG requirements, these Technical Guidelines may also include a number of recommendations for facilitating implementation or for further and coherent development of an interoperable infrastructure.

Recommendation X

Recommendations are shown using this style.

NOTE The implementation of recommendations is not mandatory. Compliance with these Technical Guidelines or the legal obligation does not depend on the fulfilment of the recommendations.

2.6.3. Conformance

Annex A includes the abstract test suite for checking conformance with the requirements included in these Technical Guidelines and the corresponding parts of the Implementing Rules (Commission Regulation (EU) No 1089/2010).

3. Specification scopes

This data specification does not distinguish different specification scopes, but just considers one general scope.

NOTE For more information on specification scopes, see [ISO 19131:2007], clause 8 and Annex D.

4. Identification information

These Technical Guidelines are identified by the following URI:

http://inspire.ec.europa.eu/tg/mr/3.0 rc3

NOTE ISO 19131 suggests further identification information to be included in this section, e.g. the title, abstract or spatial representation type. The proposed items are already described in the document metadata, executive summary, overview description (section 2) and descriptions of the application schemas (section 5). In order to avoid redundancy, they are not repeated here.

5. Data content and structure

5.1. Application schemas – Overview

5.1.1. Application schemas included in the IRs

Articles 3, 4 and 5 of the Implementing Rules lay down the requirements for the content and structure of the data sets related to the INSPIRE Annex themes.

IR Requirement

Article 4

Types for the Exchange and Classification of Spatial Objects

1. For the exchange and classification of spatial objects from data sets meeting the conditions laid down in Article 4 of Directive 2007/2/EC, Member States shall use the spatial object types, associated data types and code lists that are defined in Annexes II, III and IV to this Regulation for the themes the data sets relate to.
2. When exchanging spatial objects, Member States shall comply with the definitions and constraints set out in the Annexes and provide values for all attributes and association roles set out for the relevant spatial object types and data types in the Annexes. For voidable attributes and association roles for which no value exists, Member States may omit the value.

The types to be used for the exchange and classification of spatial objects from data sets related to the spatial data theme *Mineral Resources* are defined in the following application schemas (see section 5.3)):

- MineralResources application schema describes the core normative concepts that build up the INSPIRE Mineral resources data theme

The application schemas specify requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc.

NOTE The application schemas presented in this section contain some additional information that is not included in the Implementing Rules, in particular multiplicities of attributes and association roles.

TG Requirement 1

Spatial object types and data types shall comply with the multiplicities defined for the attributes and association roles in this section.

An application schema may include references (e.g. in attributes or inheritance relationships) to common types or types defined in other spatial data themes. These types can be found in a sub-section called "Imported Types" at the end of each application schema section. The common types referred to from application schemas included in the IRs are addressed in Article 3.

IR Requirement
Article 3
Common Types

Types that are common to several of the themes listed in Annexes I, II and III to Directive 2007/2/EC shall conform to the definitions and constraints and include the attributes and association roles set out in Annex I.

NOTE Since the IRs contain the types for all INSPIRE spatial data themes in one document, Article 3 does not explicitly refer to types defined in other spatial data themes, but only to types defined in external data models.

Common types are described in detail in the Generic Conceptual Model [DS-D2.7], in the relevant international standards (e.g. of the ISO 19100 series) or in the documents on the common INSPIRE models [DS-D2.10.x]. For detailed descriptions of types defined in other spatial data themes, see the corresponding Data Specification TG document [DS-D2.8.x].

5.1.2. Additional recommended application schemas

In addition to the application schema listed above, the following additional application schema have been defined for the theme *Mineral Resources* (see Annex D):

- ***MineralResourcesExtension*** application schema represents a conceptual extension of the data scope of the core MR data model. However this extension is using the GeoSciML and EarthResourceML classes to address additional requirements of EU Raw Materials Initiative and the Mining Waste Directive.

These additional application schemas are not included in the IRs. They typically address requirements from specific (groups of) use cases and/or may be used to provide additional information. They are included in this specification in order to improve interoperability also for these additional aspects and to illustrate the extensibility of the application schemas included in the IRs.

5.2. Basic notions

This section explains some of the basic notions used in the INSPIRE application schemas. These explanations are based on the GCM [DS-D2.5].

5.2.1. Notation

5.2.1.1. Unified Modeling Language (UML)

The application schemas included in this section are specified in UML, version 2.1. The spatial object types, their properties and associated types are shown in UML class diagrams.

NOTE For an overview of the UML notation, see Annex D in [ISO 19103].

The use of a common conceptual schema language (i.e. UML) allows for an automated processing of application schemas and the encoding, querying and updating of data based on the application

schema – across different themes and different levels of detail.

The following important rules related to class inheritance and abstract classes are included in the IRs.

IR Requirement
Article 5
Types

(…)

2. Types that are a sub-type of another type shall also include all this type's attributes and association roles.
3. Abstract types shall not be instantiated.

The use of UML conforms to ISO 19109 8.3 and ISO/TS 19103 with the exception that UML 2.1 instead of ISO/IEC 19501 is being used. The use of UML also conforms to ISO 19136 E.2.1.1.1-E.2.1.1.4.

NOTE ISO/TS 19103 and ISO 19109 specify a profile of UML to be used in conjunction with the ISO 19100 series. This includes in particular a list of stereotypes and basic types to be used in application schemas. ISO 19136 specifies a more restricted UML profile that allows for a direct encoding in XML Schema for data transfer purposes.

To model constraints on the spatial object types and their properties, in particular to express data/data set consistency rules, OCL (Object Constraint Language) is used as described in ISO/TS 19103, whenever possible. In addition, all constraints are described in the feature catalogue in English, too.

NOTE Since "void" is not a concept supported by OCL, OCL constraints cannot include expressions to test whether a value is a *void* value. Such constraints may only be expressed in natural language.

5.2.1.2. Stereotypes

In the application schemas in this section several stereotypes are used that have been defined as part of a UML profile for use in INSPIRE [DS-D2.5]. These are explained in Table 1 below.

Table 1 – Stereotypes (adapted from [DS-D2.5])

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
leaf	Package	A package that is not an application schema and contains no packages.
featureType	Class	A spatial object type.

Stereotype	Model element	Description
type	Class	A type that is not directly instantiable, but is used as an abstract collection of operation, attribute and relation signatures. This stereotype should usually not be used in INSPIRE application schemas as these are on a different conceptual level than classifiers with this stereotype.
dataType	Class	A structured data type without identity.
union	Class	A structured data type without identity where exactly one of the properties of the type is present in any instance.
codeList	Class	A code list.
import	Dependency	The model elements of the supplier package are imported.
voidable	Attribute, association role	A voidable attribute or association role (see section 5.2.2).
lifeCycleInfo	Attribute, association role	If in an application schema a property is considered to be part of the life-cycle information of a spatial object type, the property shall receive this stereotype.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

5.2.2. Voidable characteristics

The «voidable» stereotype is used to characterise those properties of a spatial object that may not be present in some spatial data sets, even though they may be present or applicable in the real world. This does *not* mean that it is optional to provide a value for those properties.

For all properties defined for a spatial object, a value has to be provided – either the corresponding value (if available in the data set maintained by the data provider) or the value of *void*. A *void* value shall imply that no corresponding value is contained in the source spatial data set maintained by the data provider or no corresponding value can be derived from existing values at reasonable costs.

Recomendation 1

The reason for a *void* value should be provided where possible using a listed value from the VoidReasonValue code list to indicate the reason for the missing value.

The VoidReasonValue type is a code list, which includes the following pre-defined values:

- *Unpopulated*: The property is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world. For example when the "elevation of the water body above the sea level" has not been included in a dataset containing lake spatial objects, then

the reason for a void value of this property would be 'Unpopulated'. The property receives this value for all spatial objects in the spatial data set.

- *Unknown*: The correct value for the specific spatial object is not known to, and not computable by the data provider. However, a correct value may exist. For example when the "elevation of the water body above the sea level" *of a certain lake* has not been measured, then the reason for a void value of this property would be 'Unknown'. This value is applied only to those spatial objects where the property in question is not known.
- *Withheld*: The characteristic may exist, but is confidential and not divulged by the data provider.

NOTE It is possible that additional reasons will be identified in the future, in particular to support reasons / special values in coverage ranges.

The «voidable» stereotype does not give any information on whether or not a characteristic exists in the real world. This is expressed using the multiplicity:

- If a characteristic may or may not exist in the real world, its minimum cardinality shall be defined as 0. For example, if an Address may or may not have a house number, the multiplicity of the corresponding property shall be 0..1.
- If at least one value for a certain characteristic exists in the real world, the minimum cardinality shall be defined as 1. For example, if an Administrative Unit always has at least one name, the multiplicity of the corresponding property shall be 1..*.

In both cases, the «voidable» stereotype can be applied. In cases where the minimum multiplicity is 0, the absence of a value indicates that it is known that no value exists, whereas a value of void indicates that it is not known whether a value exists or not.

EXAMPLE If an address does not have a house number, the corresponding Address object should not have any value for the «voidable» attribute house number. If the house number is simply not known or not populated in the data set, the Address object should receive a value of *void* (with the corresponding void reason) for the house number attribute.

5.2.3. Code lists

Code lists are modelled as classes in the application schemas. Their values, however, are managed outside of the application schema.

5.2.3.1. Code list types

The IRs distinguish the following types of code lists.

IR Requirement
Article 6
Code Lists for Spatial Data Sets

1. The code lists included in this Regulation set out the multilingual thesauri to be used for the key attributes, in accordance with Article 8(2), point (c), of Directive 2007/2/EC.

2. The Commission shall establish and operate an INSPIRE code list register at Union level for managing and making publicly available the values that are included in the code lists referred to in paragraph 1.
3. The Commission shall be assisted by the INSPIRE Commission expert group in the maintenance and update of the code list values.
4. Code lists shall be one of the following types:
    a. code lists whose values comprise only the values specified in the INSPIRE code list register;
    b. code lists whose values comprise the values specified in the INSPIRE code list register and narrower values defined by data providers;
    c. code lists whose values comprise the values specified in the INSPIRE code list register and additional values at any level defined by data providers;
    d. code lists, whose values comprise any values defined by data providers.
5. Code lists may be hierarchical. Values of hierarchical code lists may have a more general parent value.
6. Where, for an attribute whose type is a code list as referred to in paragraph 4, points (b), (c) or (d), a data provider provides a value that is not specified in the INSPIRE code list register, that value and its definition and label shall be made available in another register.

The type of code list is represented in the UML model through the tagged value *extensibility*, which can take the following values:

- *none*, representing code lists whose allowed values comprise only the values specified in the IRs (type a);
- *narrower*, representing code lists whose allowed values comprise the values specified in the IRs and narrower values defined by data providers (type b);
- *open*, representing code lists whose allowed values comprise the values specified in the IRs and additional values at any level defined by data providers (type c); and
- *any*, representing code lists, for which the IRs do not specify any allowed values, i.e. whose allowed values comprise any values defined by data providers (type d).

Recomendation 2

Additional values defined by data providers should not replace or redefine any value already specified in the IRs.

NOTE This data specification may specify recommended values for some of the code lists of type (b), (c) and (d) (see section 5.2.4.3). These recommended values are specified in a dedicated Annex.

In addition, code lists can be hierarchical, as explained in Article 6(2) of the IRs.

IR Requirement
Article 6

Code Lists

(…)

2. Code lists may be hierarchical. Values of hierarchical code lists may have a more generic parent value. Where the valid values of a hierarchical code list are specified in a table in this Regulation, the parent values are listed in the last column.

The type of code list and whether it is hierarchical or not is also indicated in the feature catalogues.

5.2.3.2. Obligations on data providers

IR Requirement
Article 6
Code Lists

(….)

3. Where, for an attribute whose type is a code list as referred to in points (b), (c) or (d) of paragraph 1, a data provider provides a value that is not specified in this Regulation, that value and its definition shall be made available in a register.
4. Attributes or association roles of spatial object types or data types whose type is a code list may only take values that are allowed according to the specification of the code list.

Article 6(4) obliges data providers to use only values that are allowed according to the specification of the code list. The "allowed values according to the specification of the code list" are the values explicitly defined in the IRs plus (in the case of code lists of type (b), (c) and (d)) additional values defined by data providers.

For attributes whose type is a code list of type (b), (c) or (d) data providers may use additional values that are not defined in the IRs. Article 6(3) requires that such additional values and their definition be made available in a register. This enables users of the data to look up the meaning of the additional values used in a data set, and also facilitates the re-use of additional values by other data providers (potentially across Member States).

NOTE Guidelines for setting up registers for additional values and how to register additional values in these registers is still an open discussion point between Member States and the Commission.

5.2.3.3. Recommended code list values

For code lists of type (b), (c) and (d), this data specification may propose additional values as a recommendation (in a dedicated Annex). These values will be included in the INSPIRE code list register. This will facilitate and encourage the usage of the recommended values by data providers since the obligation to make additional values defined by data providers available in a register (see section 5.2.4.2) is already met.

Recomendation 3

Where these Technical Guidelines recommend values for a code list in addition to those specified in the IRs, these values should be used.

NOTE For some code lists of type (d), no values may be specified in these Technical Guidelines. In these cases, any additional value defined by data providers may be used.

5.2.3.4. Governance

The following two types of code lists are distinguished in INSPIRE:

- *Code lists that are governed by INSPIRE (INSPIRE-governed code lists).* These code lists will be managed centrally in the INSPIRE code list register. Change requests to these code lists (e.g. to add, deprecate or supersede values) are processed and decided upon using the INSPIRE code list register's maintenance workflows.

  INSPIRE-governed code lists will be made available in the INSPIRE code list register at *http://inspire.ec.europa.eu/codelist/<CodeListName*>. They will be available in SKOS/RDF, XML and HTML. The maintenance will follow the procedures defined in ISO 19135. This means that the only allowed changes to a code list are the addition, deprecation or supersession of values, i.e. no value will ever be deleted, but only receive different statuses (valid, deprecated, superseded). Identifiers for values of INSPIRE-governed code lists are constructed using the pattern *http://inspire.ec.europa.eu/codelist/<CodeListName*>/<value>.

- *Code lists that are governed by an organisation outside of INSPIRE (externally governed code lists).* These code lists are managed by an organisation outside of INSPIRE, e.g. the World Meteorological Organization (WMO) or the World Health Organization (WHO). Change requests to these code lists follow the maintenance workflows defined by the maintaining organisations. Note that in some cases, no such workflows may be formally defined.

  Since the updates of externally governed code lists is outside the control of INSPIRE, the IRs and these Technical Guidelines reference a specific version for such code lists.

  The tables describing externally governed code lists in this section contain the following columns:

  - The *Governance* column describes the external organisation that is responsible for maintaining the code list.
  - The *Source* column specifies a citation for the authoritative source for the values of the code list. For code lists, whose values are mandated in the IRs, this citation should include the version of the code list used in INSPIRE. The version can be specified using a version number or the publication date. For code list values recommended in these Technical Guidelines, the citation may refer to the "latest available version".
  - In some cases, for INSPIRE only a subset of an externally governed code list is relevant. The subset is specified using the *Subset* column.
  - The *Availability* column specifies from where (e.g. URL) the values of the externally governed code list are available, and in which formats. Formats can include machine-

readable (e.g. SKOS/RDF, XML) or human-readable (e.g. HTML, PDF) ones.

Code list values are encoded using http URIs and labels. Rules for generating these URIs and labels are specified in a separate table.

Recomendation 4

The http URIs and labels used for encoding code list values should be taken from the INSPIRE code list registry for INSPIRE-governed code lists and generated according to the relevant rules specified for externally governed code lists.

NOTE Where practicable, the INSPIRE code list register could also provide http URIs and labels for externally governed code lists.

5.2.3.5. Vocabulary

For each code list, a tagged value called "vocabulary" is specified to define a URI identifying the values of the code list. For INSPIRE-governed code lists and externally governed code lists that do not have a persistent identifier, the URI is constructed following the pattern <a href="http://inspire.ec.europa.eu/codelist/<UpperCamelCaseName>" class="bare">http://inspire.ec.europa.eu/codelist/<UpperCamelCaseName&gt;.

If the value is missing or empty, this indicates an empty code list. If no sub-classes are defined for this empty code list, this means that any code list may be used that meets the given definition.

An empty code list may also be used as a super-class for a number of specific code lists whose values may be used to specify the attribute value. If the sub-classes specified in the model represent all valid extensions to the empty code list, the subtyping relationship is qualified with the standard UML constraint "\{complete,disjoint}".

5.2.4. Identifier management

IR Requirement
Article 9
Identifier Management

1. The data type Identifier defined in Section 2.1 of Annex I shall be used as a type for the external object identifier of a spatial object.
2. The external object identifier for the unique identification of spatial objects shall not be changed during the life-cycle of a spatial object.

NOTE 1 An external object identifier is a unique object identifier which is published by the responsible body, which may be used by external applications to reference the spatial object. [DS-D2.5]

NOTE 2 Article 9(1) is implemented in each application schema by including the attribute *inspireId* of type Identifier.

NOTE 3 Article 9(2) is ensured if the *namespace* and *localId* attributes of the Identifier remains the same for different versions of a spatial object; the *version* attribute can of course change.

5.2.5. Geometry representation

IR Requirement
Article 12
Other Requirements & Rules

1. The value domain of spatial properties defined in this Regulation shall be restricted to the Simple Feature spatial schema as defined in Herring, John R. (ed.), OpenGIS® Implementation Standard for Geographic information – Simple feature access – Part 1: Common architecture, version 1.2.1, Open Geospatial Consortium, 2011, unless specified otherwise for a specific spatial data theme or type.

NOTE 1 The specification restricts the spatial schema to 0-, 1-, 2-, and 2.5-dimensional geometries where all curve interpolations are linear and surface interpolations are performed by triangles.

NOTE 2 The topological relations of two spatial objects based on their specific geometry and topology properties can in principle be investigated by invoking the operations of the types defined in ISO 19107 (or the methods specified in EN ISO 19125-1).

5.2.6. Temporality representation

The application schema(s) use(s) the derived attributes "beginLifespanVersion" and "endLifespanVersion" to record the lifespan of a spatial object.

The attributes "beginLifespanVersion" specifies the date and time at which this version of the spatial object was inserted or changed in the spatial data set. The attribute "endLifespanVersion" specifies the date and time at which this version of the spatial object was superseded or retired in the spatial data set.

NOTE 1 The attributes specify the beginning of the lifespan of the version in the spatial data set itself, which is different from the temporal characteristics of the real-world phenomenon described by the spatial object. This lifespan information, if available, supports mainly two requirements: First, knowledge about the spatial data set content at a specific time; second, knowledge about changes to a data set in a specific time frame. The lifespan information should be as detailed as in the data set (i.e., if the lifespan information in the data set includes seconds, the seconds should be represented in data published in INSPIRE) and include time zone information.

NOTE 2 Changes to the attribute "endLifespanVersion" does not trigger a change in the attribute "beginLifespanVersion".

IR Requirement
Article 10
Life-cycle of Spatial Objects

(…)

3. Where the attributes beginLifespanVersion and endLifespanVersion are used, the value of endLifespanVersion shall not be before the value of

beginLifespanVersion.

NOTE The requirement expressed in the IR Requirement above will be included as constraints in the UML data models of all themes.

Recomendation 5

If life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unpopulated".

5.3. Application schema Mineral Resources

5.3.1. Description

5.3.1.1. Narrative description and UML Overview

An overview of the MineralResourcesCore application schema is given in Figure 2. This figure shows only the spatial object types, data types and their relationships. The properties are not visible at this stage but are described in following figures.

As can be seen the data model has two principal components: one, centred on EarthResource, describes the natural material of potential economic value (Figure 3 and Figure 4), and the other, centred on MiningFeature (Figure 5), describes the working of the EarthResource.

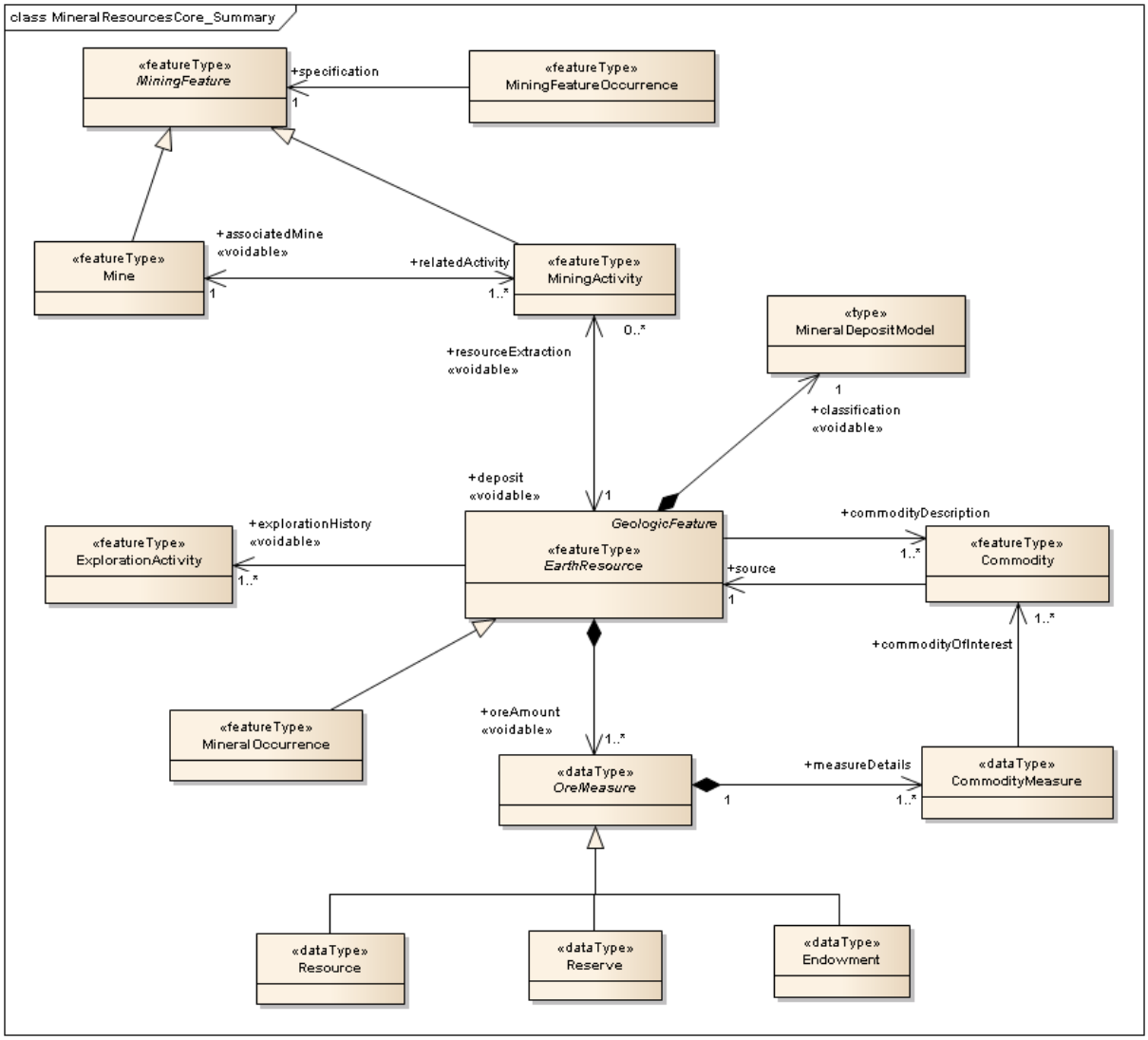

Figure 2 – UML class diagram: Overview of the MineralResources application schema

The Earth Resource identifies the kinds of observable or inferred phenomena required to classify economic and sub-economic earth resources:

- The MineralOccurrence could be a prospect, an occurrence, a mineral deposit, an ore deposit (but not a lode, a field, a district or a province)
- The Commodity describes the material of economic interest in the EarthResource
- CommodityMeasure provides a measure of the amount of the commodity (as opposed to the amount of ore) based on a Reserve, Resource or Endowment calculation
- The OreMeasure is an estimated or calculated amount of ore and grade that exist within an EarthResource, in terms of its resource, reserve and endowment
- The MineralDepositModel describes the essential attributes of a class of mineral deposits used to classify the EarthResource
- An EarthResource has an associated ExplorationActivity to describe the process leading to the discovery and assessment of the resource.

The abstract MiningFeature class represents a conceptual feature that exists coherently in the world. This corresponds with a Mine or a Mining Activity, locatable and identifiable features in time and/or space.

The resourceExtraction association from EarthResource to MiningActivity enables the Mining Activity which extracts the Earth Resource to be described.

EarthResource:

The diagram for EarthResource is split in two figures for better readability (Figure 3 and Figure 4).

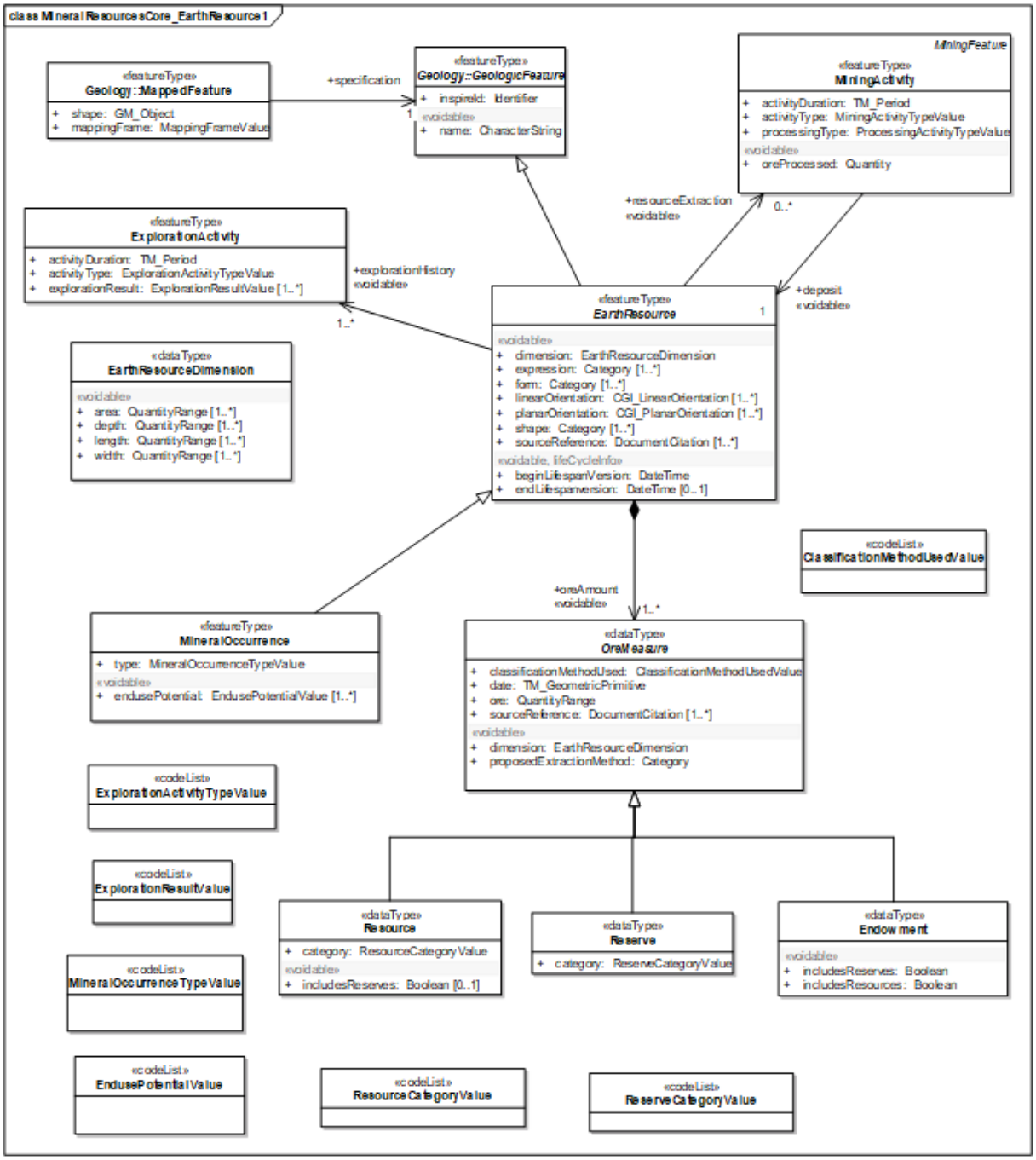

Figure 3 – UML class diagram: MineralResources (EarthResource) – part I

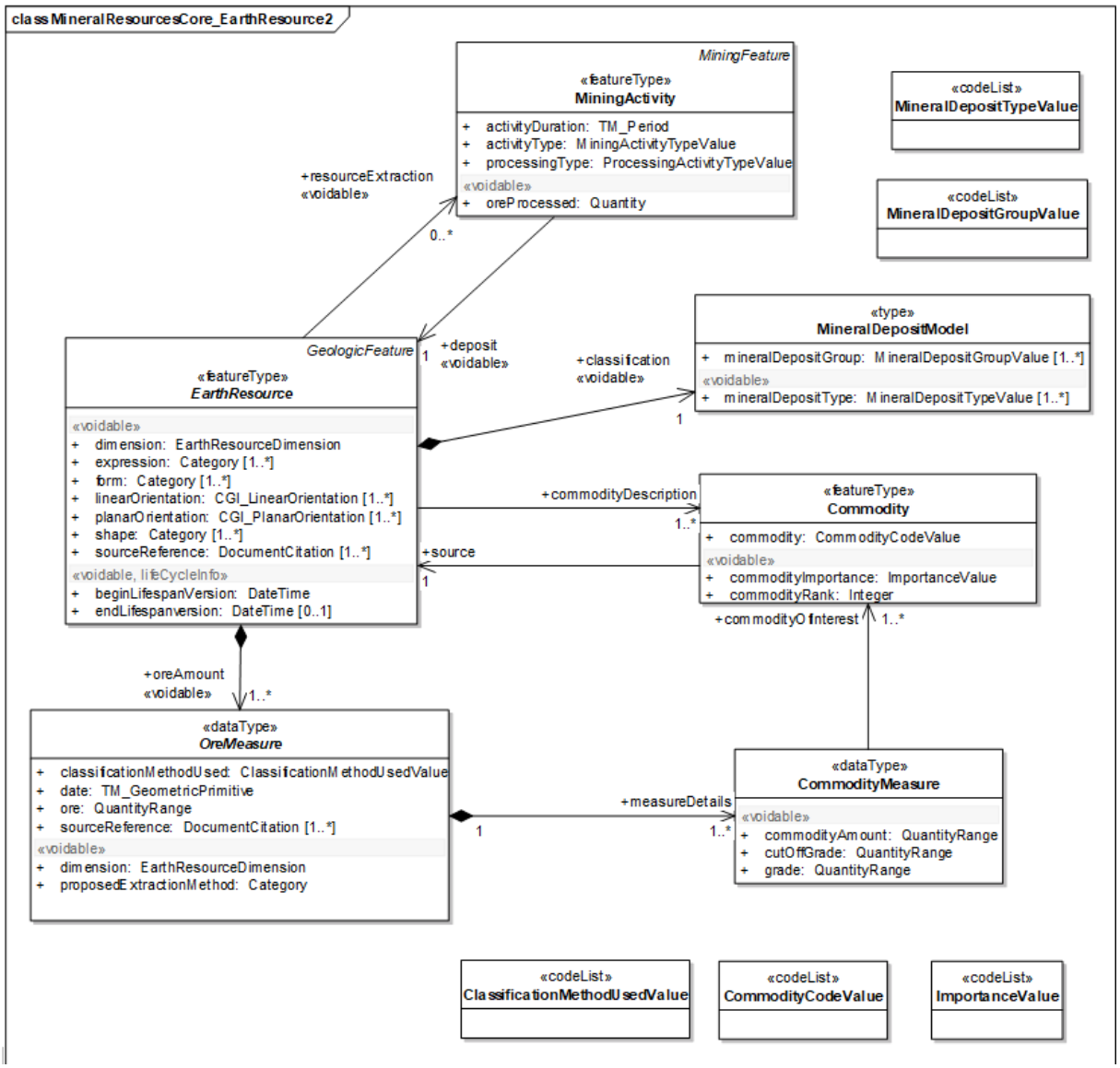

Figure 4 – UML class diagram: MineralResources (EarthResource) – part II

A MineralOccurrence is a type of EarthResource, and the explorationHistory association from EarthResource to ExplorationActivity describes which kinds of works were carried out to find, and evaluate the MineralOccurrence.

The MineralResources data model uses the INSPIRE Geology Data Model to describe geological components. The EarthResource class inherits the super class GeologicFeature from Geology. Geometry is provided by the occurrence association between GeologicFeature and MappedFeature shown in the Geology data specification.

The commodityDescription association from EarthResource to Commodity describes the material of economic interest in the Earth Resource.

The oreAmount association from EarthResource to OreMeasure provides the estimate of the amount and dimension of the Earth Resource.

The OreMeasure can be a Resource, Reserve or Endowment. The category for Resource indicates if the resource is measured, indicated, proved, probable, or inferred, and for Reserve identifies the level of confidence of the estimate. An indicator ("includes reserves and/or resources") states what is included or not in the estimate.

The measureDetails association from OreMeasure to CommodityMeasure provides a measure of the amount of the commodity (as opposed to the amount of ore) based on a Reserve, Resource or Endowment calculation. This measure is obtained by multiplying the ore tonnage by the average grade of the commodity within the ore (generally expressed in tons of metal).

The commodityOfInterest association from CommodityMeasure to Commodity states which commodity may be of interest inside a deposit. A deposit may be a very large deposit for one commodity (this commodity is the main one) and only a medium-sized deposit for some other commodities. Such a ranking necessitates a (statistical) comparison with a large set of deposits throughout the world to ensure that it is valid.

The classification association from EarthResource to MineralDepositModel provides the systematically arranged information describing the essential attributes of a class of mineral deposits. This may be empirical (descriptive) or theoretical (genetic).

The resourceExtraction association from EarthResource to MiningActivity enables the Mining Activity which extracts the Earth Resource to be described. Figure 3 illustrates the part of the core data specification that describes the working of the Earth Resource.

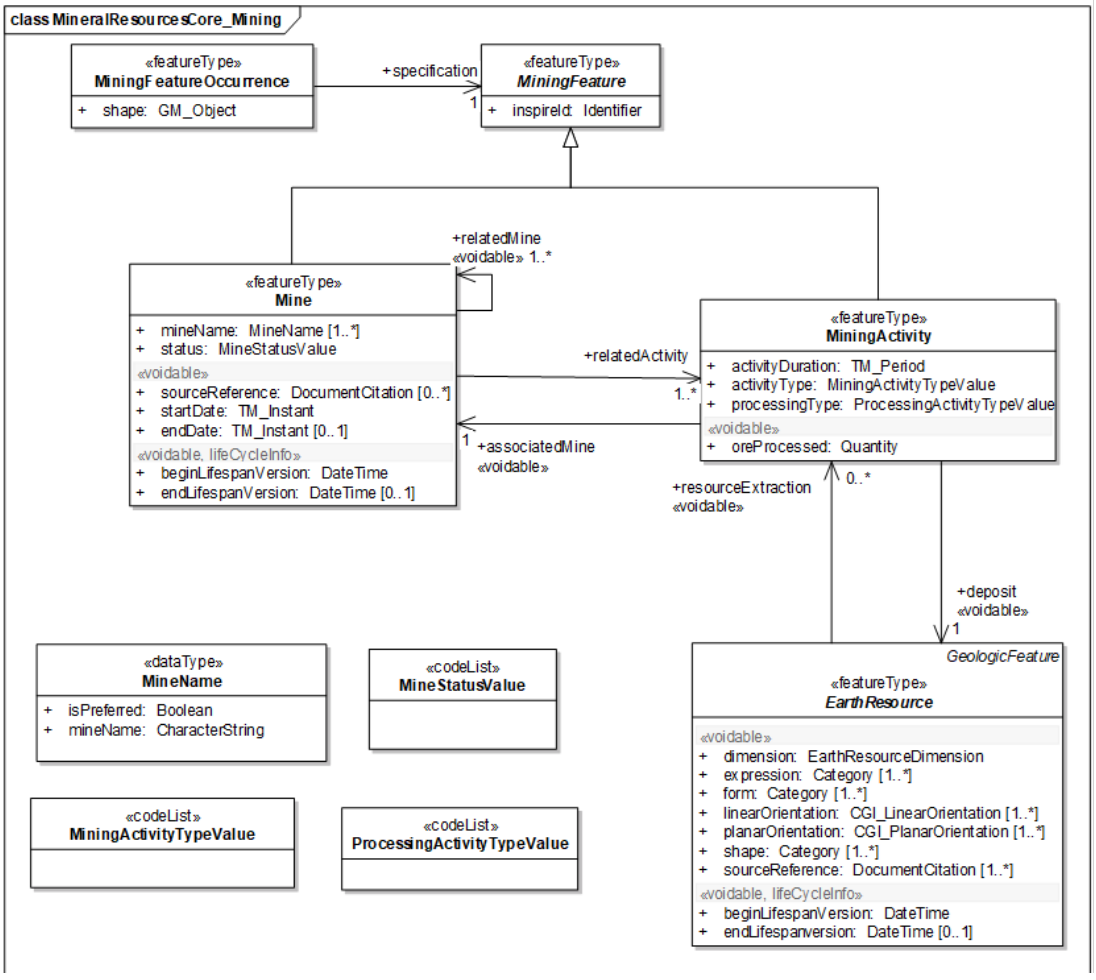

Figure 5 – UML class diagram: MineralResources (Mining)

The abstract MiningFeature class represents a conceptual feature that exists coherently in the world. This corresponds with a Mine or a Mining Activity, locatable and identifiable features in time and/or space.

- A Mine is an excavation for the extraction of mineral deposits. 'True' mines are underground workings and open-pit workings (also called open-sky mines) generally for the extraction of metallic commodities. The Mine feature also includes open workings generally for the extraction of industrial minerals, commonly referred to as quarries.
- The Mining Activity, related to a Mine, describes the process of extracting metallic or non-metallic mineral deposits from the Earth.

The MiningFeatureOccurrence carries the geometry of a MiningFeature.

The relatedActivity association from Mine to MiningActivity describes one or more periods of activity of the Mine. The reverse association, associatedMine, describes the Mine associated with a particular period of activity.

The deposit association from MiningActivity to EarthResource allows the detailed description of the deposit worked during the Mining Activity.

5.3.1.2. Consistency between spatial data sets

The observation location is specified by its coordinates.

5.3.2. Feature catalogue

Feature catalogue metadata

Application Schema	INSPIRE Application Schema MineralResources
Version number	3.0

Types defined in the feature catalogue

Type	Package	Stereotypes
ClassificationMethodUsedValue	MineralResources	«codeList»
Commodity	MineralResources	«featureType»
CommodityCodeValue	MineralResources	«codeList»
CommodityMeasure	MineralResources	«dataType»
EarthResource	MineralResources	«featureType»
EarthResourceDimension	MineralResources	«dataType»
Endowment	MineralResources	«dataType»
EndusePotentialValue	MineralResources	«codeList»
ExplorationActivity	MineralResources	«featureType»
ExplorationActivityTypeValue	MineralResources	«codeList»
ExplorationResultValue	MineralResources	«codeList»
ImportanceValue	MineralResources	«codeList»

Type	Package	Stereotypes
Mine	MineralResources	«featureType»[% autowidth]
MineName	MineralResources	«dataType»
MineStatusValue	MineralResources	«codeList»
MineralDepositGroupValue	MineralResources	«codeList»
MineralDepositTypeValue	MineralResources	«codeList»
MineralOccurrence	MineralResources	«featureType»
MineralOccurrenceTypeValue	MineralResources	«codeList»
MiningActivity	MineralResources	«featureType»
MiningActivityTypeValue	MineralResources	«codeList»
MiningFeature	MineralResources	«featureType»
MiningFeatureOccurrence	MineralResources	«featureType»
OreMeasure	MineralResources	«dataType»
ProcessingActivityTypeValue	MineralResources	«codeList»
Reserve	MineralResources	«dataType»
ReserveCategoryValue	MineralResources	«codeList»
Resource	MineralResources	«dataType»
ResourceCategoryValue	MineralResources	«codeList»

5.3.2.1. Spatial object types

5.3.2.1.1. Commodity

Commodity	
Definition:	The material of economic interest in the EarthResource
Stereotypes:	«featureType»

Commodity

Attribute: commodityImportance

Value type:	ImportanceValue
Definition:	The importance of the deposit for the commodity.
Description:	Several commodities may be of interest inside a deposit. A deposit may be a very large deposit for one commodity (this commodity is the main one) and only a medium-sized deposit for some other commodities. Such a ranking is based on a statistical study of a large set of deposits throughout the world to ensure that it is valid. It is made using histograms allowing for each commodity to define class boundaries and what is a super large, a large, a medium-sized etc deposit for this commodity. This classification is based on the potential or endowment: reserves resources.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: commodity

Value type:	CommodityCodeValue
Definition:	The earth resource commodity.
Description:	EXAMPLE: Cu, Au, Dimension Stone etc.
Multiplicity:	1

Attribute: commodityRank

Value type:	Integer
Definition:	The rank of the commodity.
Description:	Commodity rank is based on endowment, i.e. (cumulated) past production reserves (not including past production) resources, or if the deposit has never been exploited, reserves resources. A statistical comparison with a large set of deposits throughout the world enables the determination of the deposit as class A (very large), B (large), or C (medium-sized) for a particular commodity, and also which commodity is the main one, the 2nd one, etc. The rank of a commodity is thus not based on political or economic considerations.
Multiplicity:	1
Stereotypes:	«voidable»

Commodity	
Association role: source	
Value type:	EarthResource
Definition:	The deposit/resource from which the commodity comes.
Multiplicity:	1

5.3.2.1.2. EarthResource

EarthResource (abstract)	
Subtype of:	GeologicFeature
Definition:	The kinds of observable or inferred phenomena required to classify economic and non-economic earth resources.
Stereotypes:	«featureType»
Attribute: dimension	
Value type:	EarthResourceDimension
Definition:	The size/volume of the earth resource.
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: expression	
Value type:	Category
Definition:	An indicator of whether an EarthResource appears on the surface or has been detected under cover rocks.
Multiplicity:	1..*
Stereotypes:	«voidable»

EarthResource (abstract)

Attribute: form

Value type:	Category
Definition:	The orebody's typical physical and structural relationship to wallrocks and associated rocks.
Description:	EXAMPLE: stratiform, stratabound, cross-cutting, vein, intrusive contact etc.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: linearOrientation

Value type:	CGI_LinearOrientation
Definition:	The linear orientation of the Earth Resource.
Description:	EXAMPLE: Plunge etc.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: planarOrientation

Value type:	CGI_PlanarOrientation
Definition:	The planar orientation of the Earth Resource.
Description:	EXAMPLE: Dip/Dip Direction etc.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: shape

Value type:	Category
Definition:	The typical geometrical shape of the Earth Resource.
Description:	EXAMPLE: lenticular, pipelike, irregular etc.
Multiplicity:	1..*
Stereotypes:	«voidable»

EarthResource (abstract)

Attribute: sourceReference

Value type:	DocumentCitation
Definition:	The source or reference for the Earth Resource.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: beginLifespanVersion

Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»

Attribute: endLifespanversion

Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»

Association role: oreAmount

Value type:	OreMeasure
Definition:	The estimated or calculated amount of ore with the identification of the commodities contained and their grade.
Multiplicity:	1..*
Stereotypes:	«voidable»

EarthResource (abstract)

Association role: commodityDescription

Value type:	Commodity
Definition:	The commodities present in the resource ranked by importance order.
Description:	Determining the rank of a commodity is not as simple as it may look: not only the tonnage (expressed in tons of metal) has to be taken into account, but also the scarcity and thus the price of the commodity. A deposit containing 500,000 t Cu and only 50 t Au will be classified as an Au-(Cu) deposit.
Multiplicity:	1..*

Association role: explorationHistory

Value type:	ExplorationActivity
Definition:	Chronological list of surveys undertaken to better define the potential of a mineral occurrence.
Description:	Recaps the work which has been done from regional reconnaissance, surface detailed prospecting, subsurface prospecting, assessment of the resource, to evaluation of the ore deposit. Depending on the work done on occurrences and prospects, allows an estimate of the 'still to be discovered' potential of an area. A detailed assessment with no result would lead to a pessimistic opinion.
Multiplicity:	1..*
Stereotypes:	«voidable»

Association role: classification

Value type:	MineralDepositModel
Definition:	Classification of the EarthResource.
Description:	Systematically arranged information describing the essential attributes of a class of mineral deposits. May be empirical (descriptive) or theoretical (genetic).
Multiplicity:	1
Stereotypes:	«voidable»

EarthResource (abstract)	
Association role: resourceExtraction	
Value type:	MiningActivity
Definition:	One or more periods of mining activity of the earth resource.
Description:	Indicates if this resource is the subject of exploitation, and if so of which type. Depending on several factors (type of mineralization, size, grade, shape, depth, etc.) one or several (combined) methods may be used, including off site methods, surface mining (among which methods related to the exploitation of alluvial/elluvial deposits), underground mining. Knowledge about these methods is important as it may be strongly related to the quantity and type of wastes and environmental impacts generated by the extraction.
Multiplicity:	0..*
Stereotypes:	«voidable»

5.3.2.1.3. ExplorationActivity

ExplorationActivity	
Definition:	A period of exploration activity.
Stereotypes:	«featureType»
Attribute: activityDuration	
Value type:	TM_Period
Definition:	Period, or extent in time, of the exploration activity.
Description:	The beginning of the activity links the TM_Period to the TM_Instant at which it starts. The ending links the TM_Period to the TM_Instant at which it ends. For a variety of reasons, the position of the TM_Instant designated by 'begin' or 'end' may be inderterminate.
Multiplicity:	1

ExplorationActivity	
Attribute: activityType	
Value type:	ExplorationActivityTypeValue
Definition:	The type of exploration activity.
Description:	EXAMPLE: geological mapping, drilling, geophysical surveys, geochemical mapping, etc.
Multiplicity:	1
Attribute: explorationResult	
Value type:	ExplorationResultValue
Definition:	The result of the exploration activity.
Multiplicity:	1..*

5.3.2.1.4. Mine

Mine	
Subtype of:	MiningFeature
Definition:	An excavation carried out for the extraction of mineral deposits.
Description:	'True' mines are underground workings and open-pit workings (also called open-sky mines) generally for the extraction of metallic commodities. The Mine feature also includes open workings generally for the extraction of industrial minerals, commonly referred to as quarries.
Stereotypes:	«featureType»
Attribute: mineName	
Value type:	MineName
Definition:	Data type indicating the Mine Name and whether it is the preferred name.
Multiplicity:	1..*
Attribute: status	
Value type:	MineStatusValue
Definition:	Operational status value of the mine.
Description:	EXAMPLE: Care & Maintenance; Pending Approval; Operating continually.
Multiplicity:	1

Mine

Attribute: sourceReference

Value type:	DocumentCitation
Definition:	The source reference for the mine.
Description:	Allows citing mine plans etc.
Multiplicity:	0..*
Stereotypes:	«voidable»

Attribute: startDate

Value type:	TM_Instant
Definition:	Date on which the mine commenced operation.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: endDate

Value type:	TM_Instant
Definition:	Date on which the mine ceased operation.
Multiplicity:	0..1
Stereotypes:	«voidable»

Attribute: beginLifespanVersion

Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was inserted or changed in the spatial data set.
Multiplicity:	1
Stereotypes:	«voidable,lifeCycleInfo»

Mine

Attribute: endLifespanVersion

Value type:	DateTime
Definition:	Date and time at which this version of the spatial object was superseded or retired in the spatial data set.
Multiplicity:	0..1
Stereotypes:	«voidable,lifeCycleInfo»

Association role: relatedMine

Value type:	Mine
Definition:	A related mine.
Description:	A mine currently exploited may result from the resumption and the extension of a – or several – former or older (abandoned) mine(s). Mines need not aggregate to form other mines, they may just be associated in some way or another (eg the Kalgoorlie SuperPit is associated with its preceding mines).
Multiplicity:	1..*
Stereotypes:	«voidable»

Association role: relatedActivity

Value type:	MiningActivity
Definition:	The MiningActivity associated with the Mine.
Multiplicity:	1..*

5.3.2.1.5. MineralOccurrence

MineralOccurrence

Subtype of:	EarthResource
Definition:	<font color="#400040">A mineral accumulation in the lithosphere.
Stereotypes:	«featureType»

MineralOccurrence	
Attribute: type	
Value type:	MineralOccurrenceTypeValue
Definition:	The type of mineral occurrence.
Description:	EXAMPLE: prospect, occurrence, mineral deposit, ore deposit.
Multiplicity:	1
Attribute: endusePotential	
Value type:	EndusePotentialValue
Definition:	The end-use potential of the mineral.
Description:	EXAMPLE: for energy, fertilizer, building raw material.
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.1.6. MiningActivity

MiningActivity	
Subtype of:	MiningFeature
Definition:	The process of extracting metallic, non-metallic mineral, or industrial rock deposits from the Earth.
Description:	The term may also include preliminary treatment eg. cleaning or sizing.
Stereotypes:	«featureType»
Attribute: activityDuration	
Value type:	TM_Period
Definition:	Period, or extent in time, of the mining activity.
Description:	The beginning of the activity links the TM_Period to the TM_Instant at which it starts. The ending links the TM_Period to the TM_Instant at which it ends. For a variety of reasons, the position of the TM_Instant designated by 'begin' or 'end' may be inderterminate.
Multiplicity:	1

MiningActivity

Attribute: activityType

Value type:	MiningActivityTypeValue
Definition:	The type of mining activity.
Description:	EXAMPLE: Open Pit, Underground Mine, multiple, unspecified) or processing activity (eg Ore Processing) or production. Using activity to distinguish between the extraction, processing and production activities allows distinguishing between ore mined/grade/recovery, ore treated/grade/recovery and produced payable/plant recovery.
Multiplicity:	1

Attribute: oreProcessed

Value type:	Quantity
Definition:	The amount of ore processed by the activity.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: processingType

Value type:	ProcessingActivityTypeValue
Definition:	The type of processing carried out during the mining activity.
Multiplicity:	1

Association role: associatedMine

Value type:	Mine
Definition:	The mine where the mining activity takes, or took, place.
Multiplicity:	1
Stereotypes:	«voidable»

Association role: deposit

Value type:	EarthResource
Definition:	The deposit to which the mining activity is associated.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.1.7. MiningFeature

MiningFeature (abstract)	
Definition:	Spatial object type grouping the common properties of mines and mining activities.
Stereotypes:	«featureType»

Attribute: inspireId

Value type:	Identifier
Definition:	External object identifier of the spatial object.
Multiplicity:	1

5.3.2.1.8. MiningFeatureOccurrence

MiningFeatureOccurrence	
Definition:	A spatial representation of a MiningFeature.
Description:	A MiningFeatureOccurrence provides a link between a notional feature (description package) and one spatial representation of it, or part of it. The MiningFeatureOccurrence carries a geometry and the association with a Mining Feature provides specification of all the other descriptors.
Stereotypes:	«featureType»

Attribute: shape

Value type:	GM_Object
Definition:	The geometry of the MiningFeature.
Multiplicity:	1

Association role: specification

Value type:	MiningFeature
Definition:	Indicates the MiningFeature that the MiningFeatureOccurrence specifies.
Multiplicity:	1

5.3.2.2. Data types

5.3.2.2.1. CommodityMeasure

CommodityMeasure

Definition:	A measure of the amount of the commodity based on a Reserve, Resource or Endowment calculation.
Description:	Where OreMeasure is Resource or Reserve CommodityMeasure is mandatory
Stereotypes:	«dataType»

Attribute: commodityAmount

Value type:	QuantityRange
Definition:	The amount of the commodity.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: cutOffGrade

Value type:	QuantityRange
Definition:	The cut off grade used for calculating the commodity measure.
Description:	The lowest concentration of a mineralized material that qualifies as ore in a given deposit (adapted from Neuendorf, 2005).
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: grade

Value type:	QuantityRange
Definition:	The grade of the commodity.
Multiplicity:	1
Stereotypes:	«voidable»

Association role: commodityOfInterest

Value type:	Commodity
Definition:	The commodity to which the CommodityMeasure refers.
Multiplicity:	1..*

5.3.2.2.2. EarthResourceDimension

EarthResourceDimension

Definition:	The size and volume of the earth resource.
Stereotypes:	«dataType»

Attribute: area

Value type:	QuantityRange
Definition:	The area of the Earth Resource.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: depth

Value type:	QuantityRange
Definition:	The depth of the Earth Resource.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: length

Value type:	QuantityRange
Definition:	The length of the Earth Resource.
Multiplicity:	1..*
Stereotypes:	«voidable»

Attribute: width

Value type:	QuantityRange
Definition:	The width of the Earth Resource.
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.2.3. Endowment

Endowment	
Subtype of:	OreMeasure
Definition:	The quantity of a mineral (or a group of minerals for industrial rocks) in accumulations (deposits) meeting specified physical characteristics such as quality, size and depth.
Description:	Usually includes Resources, as unlike the latter, it does not have to have prospects for "eventual economic extraction". It often includes the total amount of a commodity originally introduced to a particular location during the deposit forming processes - and thus can include resources, reserves, past production and mining and metallurgical losses.
Stereotypes:	«dataType»

Attribute: includesReserves

Value type:	Boolean
Definition:	A flag indicating if the estimate includes the reserves value.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: includesResources

Value type:	Boolean
Definition:	A flag indicating if the estimate includes the resources value.
Multiplicity:	1
Stereotypes:	«voidable»

5.3.2.2.4. MineName

MineName	
Definition:	A data type indicating the Mine Name and whether it is the preferred name.
Stereotypes:	«dataType»

Attribute: isPreferred

Value type:	Boolean
Definition:	A boolean operator indicating if the value in mineName is the preferred name of the mine.
Multiplicity:	1

MineName	
Attribute: mineName	
Value type:	CharacterString
Definition:	The name of the mine.
Multiplicity:	1

5.3.2.2.5. MineralDepositModel

MineralDepositModel	
Definition:	Systematically arranged information describing the essential attributes of a class of mineral deposits. It may be empirical (descriptive) or theoretical (genetic).
Stereotypes:	«type»
Attribute: mineralDepositGroup	
Value type:	MineralDepositGroupValue
Definition:	A grouping of mineral deposits defined by generic characteristics
Description:	EXAMPLE: host rock, host structure, commodity, association with similar mineral processes e.g. porphyry. Regional, national and more universal lists e.g. Cox and Singer 1986.
Multiplicity:	1..*
Attribute: mineralDepositType	
Value type:	MineralDepositTypeValue
Definition:	Style of mineral occurrence or deposit.
Description:	Generally a local or regional term. Should be referenced for definitions and descriptions. Single deposit terms may form member of a Mineral Deposit Group in local and regional schemas.
Multiplicity:	1..*
Stereotypes:	«voidable»

5.3.2.2.6. OreMeasure

OreMeasure (abstract)

Definition:	The estimate of the Reserve, Resource or Endowment ore amount.
Stereotypes:	«dataType»

Attribute: classificationMethodUsed

Value type:	ClassificationMethodUsedValue
Definition:	Means of calculating the measurement.
Description:	EXAMPLE: JORC, PERC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Multiplicity:	1

Attribute: date

Value type:	TM_GeometricPrimitive
Definition:	Date of calculated or estimated value.
Description:	This may be a single date or a range.
Multiplicity:	1

Attribute: dimension

Value type:	EarthResourceDimension
Definition:	Size of the body used in the calculation.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: ore

Value type:	QuantityRange
Definition:	Amount of ore.
Multiplicity:	1

Attribute: proposedExtractionMethod

Value type:	Category
Definition:	The method proposed to extract the commodity.
Multiplicity:	1
Stereotypes:	«voidable»

Attribute: sourceReference

Value type:	DocumentCitation
Definition:	The reference for the OreMeasure values.
Multiplicity:	1..*

OreMeasure (abstract)	
Association role: measureDetails	
Value type:	CommodityMeasure
Definition:	A measure of the amount of each commodity, based on a reserve, resource or endowment calculation.
Description:	This measure is obtained by multiplying the ore tonnage by the average grade of the commodity within the ore (generally expressed in tons of metal).
Multiplicity:	1..*

5.3.2.2.7. Reserve

Reserve	
Subtype of:	OreMeasure
Definition:	The economically mineable part of a Measured and/or Indicated Mineral Resource.
Description:	It includes diluting materials and allowances for losses, which may occur when the material is mined. 'Marketable Coal Reserves' maybe reported in conjunction with, but not instead of, reports of Ore (Coal) Reserves. 'Saleable product' (e.g. for industrial minerals) can be reported in conjunction with ore reserve. Synonyms: Ore Reserve; Coal Reserve (s); Diamond (or gemstone) Ore Reserve; Mineral Reserves (not preferred, should be stated that used to mean the same as JORC's Ore Reserve); Mineable production estimates
Stereotypes:	«dataType»
Attribute: category	
Value type:	ReserveCategoryValue
Definition:	The level of confidence of the estimate (proved, probable).
Multiplicity:	1

5.3.2.2.8. Resource

Resource	
Subtype of:	OreMeasure
Definition:	An accumulation of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable prospects for economic extraction.
Description:	Synonyms: Mineral Resource; Coal Resource (s); Diamond (Gemstone) Resource; Potentially Mineable Mineralisation.
Stereotypes:	«dataType»

Attribute: category

Value type:	ResourceCategoryValue
Definition:	Indication of whether the resource is measured, indicated, or inferred.
Multiplicity:	1

Attribute: includesReserves

Value type:	Boolean
Definition:	A flag indicating whether the estimate of resources includes reserve values.
Multiplicity:	0..1
Stereotypes:	«voidable»

5.3.2.3. Code lists

5.3.2.3.1. ClassificationMethodUsedValue

ClassificationMethodUsedValue	
Definition:	Codes indicating the means used to calculate the ore measurement.
Description:	EXAMPLE: JORC, PERC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ClassificationMethodUsedValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.2. CommodityCodeValue

CommodityCodeValue	
Definition:	Values indicating the type of commodity.
Description:	EXAMPLE: Cu, Au, Dimension Stone etc.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/CommodityCodeValue
Values:	The allowed values for this code list comprise any values defined by data providers. INSPIRE Registry includes recommended values that may be used by data providers.

5.3.2.3.3. EndusePotentialValue

EndusePotentialValue	
Definition:	Values indicating the end-use potential of the mineral.
Description:	EXAMPLE: for energy, fertilizer, building raw material etc.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/EndusePotentialValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.4. ExplorationActivityTypeValue

ExplorationActivityTypeValue	
Definition:	Types of exploration activity carried out.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ExplorationActivityTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.5. ExplorationResultValue

ExplorationResultValue	
Definition:	Values indicating the result of the exploration activity.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ExplorationResultValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.6. ImportanceValue

ImportanceValue	
Definition:	Values indicating the importance of the commodity for the Earth Resource.
Description:	Such a ranking is based on a statistical study of a large set of deposits throughout the world to ensure that it is valid. It is made using histograms allowing for each commodity to define class boundaries and what is a very large, a large, a medium-sized etc deposit for this commodity.. This classification is based on the potential or endowment: reserves resources.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/ImportanceValue
Values:	The allowed values for this code list comprise any values defined by data providers. INSPIRE Registry includes recommended values that may be used by data providers.

5.3.2.3.7. MineralDepositGroupValue

MineralDepositGroupValue	
Definition:	Values indicating the grouping of mineral deposits on the basis of their generic characteristics.
Description:	EXAMPLE: host rock, host structure, commodity, association with similar mineral processes e.g. porphyry.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/MineralDepositGroupValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.8. MineralDepositTypeValue

MineralDepositTypeValue	
Definition:	Values indicating the style of mineral occurrence or deposit.
Description:	Generally a local or regional term. Should be referenced for definitions and descriptions. Single deposit terms may form member of a Mineral Deposit Group in local and regional schemas.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/MineralDepositTypeValue
Values:	The allowed values for this code list comprise any values defined by data providers. More information about the use of MineralDepositTypeValue will be available at: http://www.earthresourceml.org

5.3.2.3.9. MineralOccurrenceTypeValue

MineralOccurrenceTypeValue	
Definition:	The type of mineral occurrence.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/MineralOccurrenceTypeValue
Values:	The allowed values for this code list comprise any values defined by data providers. INSPIRE Registry includes recommended values that may be used by data providers.

5.3.2.3.10. MineStatusValue

MineStatusValue	
Definition:	Values indicating the operational status of the mine.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/MineStatusValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.11. MiningActivityTypeValue

MiningActivityTypeValue	
Definition:	The type of mining activity, processing activity, or production.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/MiningActivityTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.12. ProcessingActivityTypeValue

ProcessingActivityTypeValue	
Definition:	Values indicating the type of processing carried out during a mining activity.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ProcessingActivityTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers. INSPIRE Registry includes recommended values that may be used by data providers.

5.3.2.3.13. ReserveCategoryValue

ReserveCategoryValue	
Definition:	The level of confidence of the estimate of the reserve.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ReserveCategoryValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.3.14. ResourceCategoryValue

ResourceCategoryValue	
Definition:	Indication whether the resource is measured, indicated, or inferred.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ResourceCategoryValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

5.3.2.4. Imported types (informative)

This section lists definitions for feature types, data types and code lists that are defined in other application schemas. The section is purely informative and should help the reader understand the feature catalogue presented in the previous sections. For the normative documentation of these types, see the given references.

5.3.2.4.1. Boolean

Boolean	
Package:	Truth
Reference:	Geographic information — Conceptual schema language [ISO/TS 19103:2005]

5.3.2.4.2. CGI_LinearOrientation

CGI_LinearOrientation	
Package:	CGI_Value
Reference:	CGI Interoperability Working Group, Geoscience Markup Language (GeoSciML), version 3.0.0, Commission for the Management and Application of Geoscience Information (CGI) of the International Union of Geological Sciences, 2011 [GeoSciML2]

5.3.2.4.3. CGI_PlanarOrientation

CGI_PlanarOrientation	
Package:	CGI_Value
Reference:	CGI Interoperability Working Group, Geoscience Markup Language (GeoSciML), version 3.0.0, Commission for the Management and Application of Geoscience Information (CGI) of the International Union of Geological Sciences, 2011 [GeoSciML2]

5.3.2.4.4. Category

Category	
Package:	valueObjects
Reference:	Geographic information — Geography Markup Language (GML) [ISO 19136:2007]

5.3.2.4.5. CharacterString

CharacterString	
Package:	Text
Reference:	Geographic information — Conceptual schema language [ISO/TS 19103:2005]

5.3.2.4.6. DateTime

DateTime	
Package:	Date and Time
Reference:	Geographic information — Conceptual schema language [ISO/TS 19103:2005]

5.3.2.4.7. DocumentCitation

DocumentCitation	
Package:	Base Types 2
Reference:	INSPIRE Generic Conceptual Model, version 3.4 [DS-D2.5]
Definition:	Citation for the purposes of unambiguously referencing a document.

5.3.2.4.8. GM_Object

GM_Object (abstract)	
Package:	Geometry root
Reference:	Geographic information — Spatial schema [ISO 19107:2003]

5.3.2.4.9. GeologicFeature

GeologicFeature (abstract)	
Package:	Geology
Reference:	INSPIRE Data specification on Geology [DS-D2.8.II.4]
Definition:	A conceptual geological feature that is hypothesized to exist coherently in the world.
Description:	This corresponds with a "legend item" from a traditional geologic map. While the bounding coordinates of a Geologic Feature may be described, its shape is not. The implemented Geologic Feature instance acts as the "description package"

5.3.2.4.10. Identifier

Identifier	
Package:	Base Types
Reference:	INSPIRE Generic Conceptual Model, version 3.4 [DS-D2.5]
Definition:	External unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object.
Description:	NOTE1 External object identifiers are distinct from thematic object identifiers. NOTE 2 The voidable version identifier attribute is not part of the unique identifier of a spatial object and may be used to distinguish two versions of the same spatial object. NOTE 3 The unique identifier will not change during the life-time of a spatial object.

5.3.2.4.11. Integer

Integer	
Package:	Numerics
Reference:	Geographic information — Conceptual schema language [ISO/TS 19103:2005]

5.3.2.4.12. Quantity

Quantity	
Package:	valueObjects
Reference:	Geographic information — Geography Markup Language (GML) [ISO 19136:2007]

5.3.2.4.13. QuantityRange

QuantityRange	
Package:	Simple Components
Reference:	Robin, Alexandre (ed.), OGC®SWE Common Data Model Encoding Standard, version 2.0.0, Open Geospatial Consortium, 2011 [OGC 08-094r1]

5.3.2.4.14. TM_GeometricPrimitive

TM_GeometricPrimitive	
Package:	Temporal Objects
Reference:	Geographic information — Temporal schema [ISO 19108:2002/Cor 1:2006]

5.3.2.4.15. TM_Instant

TM_Instant	
Package:	Temporal Objects
Reference:	Geographic information — Temporal schema [ISO 19108:2002/Cor 1:2006]

5.3.2.4.16. TM_Period

TM_Period	
Package:	Temporal Objects
Reference:	Geographic information — Temporal schema [ISO 19108:2002/Cor 1:2006]

5.3.3. Externally governed code lists

The *Mineral Resources* application schema does not contain externally governed code lists.

6. Reference systems, units of measure and grids

6.1. Default reference systems, units of measure and grid

The reference systems, units of measure and geographic grid systems included in this sub-section are the defaults to be used for all INSPIRE data sets, unless theme-specific exceptions and/or additional requirements are defined in section 6.2.

6.1.1. Coordinate reference systems

6.1.1.1. Datum

IR Requirement
Annex II, Section 1.2
Datum for three-dimensional and two-dimensional coordinate reference systems

For the three-dimensional and two-dimensional coordinate reference systems and the horizontal component of compound coordinate reference systems used for making spatial data sets available, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, or the datum of the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well documented relationship between both systems, according to EN ISO 19111.

6.1.1.2. Coordinate reference systems

IR Requirement
Annex II, Section 1.3
Coordinate Reference Systems

Spatial data sets shall be made available using at least one of the coordinate reference systems specified in sections 1.3.1, 1.3.2 and 1.3.3, unless one of the conditions specified in section 1.3.4 holds.

1.3.1. Three-dimensional Coordinate Reference Systems

- Three-dimensional Cartesian coordinates based on a datum specified in 1.2 and using the parameters of the Geodetic Reference System 1980 (GRS80) ellipsoid.
- Three-dimensional geodetic coordinates (latitude, longitude and ellipsoidal height) based on a datum specified in 1.2 and using the parameters of the

GRS80 ellipsoid.

1.3.2. Two-dimensional Coordinate Reference Systems

- Two-dimensional geodetic coordinates (latitude and longitude) based on a datum specified in 1.2 and using the parameters of the GRS80 ellipsoid.
- Plane coordinates using the ETRS89 Lambert Azimuthal Equal Area coordinate reference system.
- Plane coordinates using the ETRS89 Lambert Conformal Conic coordinate reference system.
- Plane coordinates using the ETRS89 Transverse Mercator coordinate reference system.

1.3.3. Compound Coordinate Reference Systems

1. For the horizontal component of the compound coordinate reference system, one of the coordinate reference systems specified in section 1.3.2 shall be used.
2. For the vertical component, one of the following coordinate reference systems shall be used:

- For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights within its geographical scope. Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS.
- For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere, or other linear or parametric reference systems shall be used. Where other parametric reference systems are used, these shall be described in an accessible reference using EN ISO 19111-2:2012.
- For the vertical component in marine areas where there is an appreciable tidal range (tidal waters), the Lowest Astronomical Tide (LAT) shall be used as the reference surface.
- For the vertical component in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200 meters, the Mean Sea Level (MSL) or a well-defined reference level close to the MSL shall be used as the reference surface.

1.3.4. Other Coordinate Reference Systems

Exceptions, where other coordinate reference systems than those listed in 1.3.1, 1.3.2 or 1.3.3 may be used, are:

1. Other coordinate reference systems may be specified for specific spatial data themes.
2. For regions outside of continental Europe, Member States may define suitable

coordinate reference systems.

The geodetic codes and parameters needed to describe these other coordinate reference systems and to allow conversion and transformation operations shall be documented and an identifier shall be created in a coordinate systems register established and operated by the Commission, according to EN ISO 19111 and ISO 19127.
The Commission shall be assisted by the INSPIRE Commission expert group in the maintenance and update of the coordinate systems register.

6.1.1.3. Display

IR Requirement
Annex II, Section 1.4
Coordinate Reference Systems used in the View Network Service

For the display of spatial data sets with the view network service as specified in Regulation No 976/2009, at least the coordinate reference systems for two-dimensional geodetic coordinates (latitude, longitude) shall be available.

6.1.1.4. Identifiers for coordinate reference systems

IR Requirement
Annex II, Section 1.5
Coordinate Reference System Identifiers

1. Coordinate reference system parameters and identifiers shall be managed in one or several common registers for coordinate reference systems.
2. Only identifiers contained in a common register shall be used for referring to the coordinate reference systems listed in this Section.

These Technical Guidelines propose to use the http URIs provided by the Open Geospatial Consortium as coordinate reference system identifiers (see identifiers for the default CRSs in the INSPIRE coordinate reference systems register). These are based on and redirect to the definition in the EPSG Geodetic Parameter Registry (*http://www.epsg-registry.org/*).

TG Requirement 2

The identifiers listed in the INSPIRE coordinate reference systems register (https://inspire.ec.europa.eu/crs) shall be used for referring to the coordinate reference systems used in a data set.

NOTE CRS identifiers may be used e.g. in:

- data encoding,
- data set and service metadata, and
- requests to INSPIRE network services.

6.1.2. Temporal reference system

IR Requirement
Article 11
Temporal Reference Systems

1. The default temporal reference system referred to in point 5 of part B of the Annex to Commission Regulation (EC) No 1205/2008 ([14]) shall be used, unless other temporal reference systems are specified for a specific spatial data theme in Annex II.

NOTE 1 Point 5 of part B of the Annex to Commission Regulation (EC) No 1205/2008 (the INSPIRE Metadata IRs) states that the default reference system shall be the Gregorian calendar, with dates expressed in accordance with ISO 8601.

NOTE 2 ISO 8601 *Data elements and interchange formats – Information interchange – Representation of dates and times* is an international standard covering the exchange of date and time-related data. The purpose of this standard is to provide an unambiguous and well-defined method of representing dates and times, so as to avoid misinterpretation of numeric representations of dates and times, particularly when data is transferred between countries with different conventions for writing numeric dates and times. The standard organizes the data so the largest temporal term (the year) appears first in the data string and progresses to the smallest term (the second). It also provides for a standardized method of communicating time-based information across time zones by attaching an offset to Coordinated Universal Time (UTC).

EXAMPLE 1997 (the year 1997), 1997-07-16 (16th July 1997), 1997-07-16T19:20:3001:00 (16th July 1997, 19h 20' 30'', time zone: UTC1)

6.1.3. Units of measure

IR Requirement
Article 12
Other Requirements & Rules

(…)

2. All measurement values shall be expressed using SI units or non-SI units accepted for use with the International System of Units, unless specified otherwise for a specific spatial data theme or type.

6.1.4. Grids

IR Requirement
Annex II, Section 2.2
Grids

Either of the grids with fixed and unambiguously defined locations defined in Sections 2.2.1 and 2.2.2 shall be used as a geo-referencing framework to make

gridded data available in INSPIRE, unless one of the following conditions holds:

1. Other grids may be specified for specific spatial data themes in Annexes II-IV. In this case, data exchanged using such a theme-specific grid shall use standards in which the grid definition is either included with the data, or linked by reference.
2. For grid referencing in regions outside of continental Europe Member States may define their own grid based on a geodetic coordinate reference system compliant with ITRS and a Lambert Azimuthal Equal Area projection, following the same principles as laid down for the grid specified in Section 2.2.1. In this case, an identifier for the coordinate reference system shall be created.

2.2 Equal Area Grid

The grid is based on the ETRS89 Lambert Azimuthal Equal Area (ETRS89-LAEA) coordinate reference system with the centre of the projection at the point 52^{o} N, 10^{o} E and false easting: x_0 = 4321000 m, false northing: y_0 = 3210000 m.

The origin of the grid coincides with the false origin of the ETRS89-LAEA coordinate reference system (x=0, y=0).

Grid points of grids based on ETRS89-LAEA shall coincide with grid points of the grid.

The grid is hierarchical, with resolutions of 1m, 10m, 100m, 1000m, 10000m and 100000m.

The grid orientation is south-north, west-east.

The grid is designated as Grid_ETRS89-LAEA. For identification of an individual resolution level the cell size in metres is appended.

For the unambiguous referencing and identification of a grid cell, the cell code composed of the size of the cell and the coordinates of the lower left cell corner in ETRS89-LAEA shall be used. The cell size shall be denoted in metres ("m") for cell sizes up to 100m or kilometres ("km") for cell sizes of 1000m and above. Values for northing and easting shall be divided by 10^{n}, where n is the number of trailing zeros in the cell size value.

6.2. Theme-specific requirements and recommendations

There are no theme-specific requirements or recommendations on reference systems and grids.

7. Data quality

This chapter includes a description of the data quality elements and sub-elements as well as the corresponding data quality measures that should be used to evaluate and document data quality for data sets related to the spatial data theme *Mineral Resources* (section 7.1).

It may also define requirements or recommendations about the targeted data quality results applicable for data sets related to the spatial data theme *Mineral Resources* (sections 7.2 and 7.3).

In particular, the data quality elements, sub-elements and measures specified in section 7.1 should be used for

- evaluating and documenting data quality properties and constraints of spatial objects, where such properties or constraints are defined as part of the application schema(s) (see section 5);
- evaluating and documenting data quality metadata elements of spatial data sets (see section 8); and/or
- specifying requirements or recommendations about the targeted data quality results applicable for data sets related to the spatial data theme *Mineral Resources* (see sections 7.2 and 7.3).

The descriptions of the elements and measures are based on Annex D of ISO/DIS 19157 Geographic information – Data quality.

7.1. Data quality elements

Table 3 lists all data quality elements and sub-elements that are being used in this specification. Data quality information can be evaluated at level of spatial object, spatial object type, dataset or dataset series. The level at which the evaluation is performed is given in the "Evaluation Scope" column.

The measures to be used for each of the listed data quality sub-elements are defined in the following sub-sections.

Table 3 – Data quality elements used in the spatial data theme *Mineral Resources*

Section	Data quality element	Data quality sub-element	Definition	Evaluation Scope
7.1.1	Logical consistency	Conceptual consistency	adherence to rules of the conceptual schema	dataset series; dataset; spatial object type; spatial object
7.1.2	Logical consistency	Domain consistency	adherence of values to the value domains	dataset series; dataset; spatial object type; spatial object

7.1.1. Logical consistency – Conceptual consistency

The Application Schema conformance class of the Abstract Test Suite in Annex I defines a number of tests to evaluate the conceptual consistency (tests A.1.1-A.1.8) of a data set including the theme specific test (A1.8).

Recomendation 6

For the tests on conceptual consistency, it is recommended to use the *Logical consistency – Conceptual consistency* data quality sub-element and the measure *Number of items not compliant with the rules of the conceptual schema* as specified in the table below.

Name	
Alternative name	-
Data quality element	logical consistency
Data quality sub-element	conceptual consistency
Data quality basic measure	error count
Definition	count of all items in the dataset that are not compliant with the rules of the conceptual schema
Description	If the conceptual schema explicitly or implicitly describes rules, these rules shall be followed. Violations against such rules can be, for example, invalid placement of features within a defined tolerance, duplication of features and invalid overlap of features.
Evaluation scope	spatial object / spatial object type
Reporting scope	data set
Parameter	-
Data quality value type	integer
Data quality value structure	-
Source reference	ISO/DIS 19157 Geographic information – Data quality
Example	
Measure identifier	10

7.1.2. Logical consistency – Domain consistency

The Application Schema conformance class of the Abstract Test Suite in Annex I defines a number of tests to evaluate the domain consistency (tests A1.1-A.1.8) of a data set.

Recomendation 7

For the tests on domain consistency, it is recommended to use the *Logical consistency – Domain consistency* data quality sub-element and the measure

> *Number of items not in conformance with their value domain* as specified in the table below.

Name	**Number of items not in conformance with their value domain**
Alternative name	-
Data quality element	logical consistency
Data quality sub-element	domain consistency
Data quality basic measure	error count
Definition	count of all items in the dataset that are not in conformance with their value domain
Description	
Evaluation scope	spatial object / spatial object type
Reporting scope	data set
Parameter	-
Data quality value type	integer

7.2. Minimum data quality requirements

No minimum data quality requirements are defined for the spatial data theme *Mineral Resources*.

7.3. Minimum data quality recommendations

No minimum data quality recommendations are defined for the spatial data theme *Mineral Resources*.

8. Dataset-level metadata

This section specifies dataset-level metadata elements, which should be used for documenting metadata for a complete dataset or dataset series.

NOTE Metadata can also be reported for each individual spatial object (spatial object-level metadata). Spatial object-level metadata is fully described in the application schema(s) (section 5).

For some dataset-level metadata elements, in particular those for reporting data quality and maintenance, a more specific scope can be specified. This allows the definition of metadata at sub-dataset level, e.g. separately for each spatial object type (see instructions for the relevant metadata element).

8.1. Metadata elements defined in INSPIRE Metadata Regulation

Table 4 gives an overview of the metadata elements specified in Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata).

The table contains the following information:

- The first column provides a reference to the relevant section in the Metadata Regulation, which contains a more detailed description.
- The second column specifies the name of the metadata element.
- The third column specifies the multiplicity.
- The fourth column specifies the condition, under which the given element becomes mandatory.

Table 4 – Metadata for spatial datasets and spatial dataset series specified in Regulation 1205/2008/EC

Metadata Regulation Section	Metadata element	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if a URL is available to obtain more information on the resource, and/or access related services.
1.5	Unique resource identifier	1..*	
1.7	Resource language	0..*	Mandatory if the resource includes textual information.

Metadata Regulation Section	Metadata element	Multiplicity	Condition
2.1	Topic category	1..*	
3	Keyword	1..*	
4.1	Geographic bounding box	1..*	
5	Temporal reference	1..*	
6.1	Lineage	1	
6.2	Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance can be specified.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Responsible organisation	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

Generic guidelines for implementing these elements using ISO 19115 and 19119 are available at *https://knowledge-base.inspire.ec.europa.eu/publications/technical-guidance-implementation-inspire-dataset-and-service-metadata-based-isots-191392007_en*. The following sections describe additional theme-specific recommendations and requirements for implementing these elements.

8.1.1. Conformity

The *Conformity* metadata element defined in Regulation 1205/2008/EC requires to report the conformance with the Implementing Rule for interoperability of spatial data sets and services. In addition, it may be used also to document the conformance to another specification.

Recomendation 8

Dataset metadata should include a statement on the overall conformance of the dataset with this data specification (i.e. conformance with all requirements).

Recomendation 9

The *Conformity* metadata element should be used to document conformance with this data specification (as a whole), with a specific conformance class defined in the Abstract Test Suite in Annex A and/or with another specification.

The *Conformity* element includes two sub-elements, the *Specification* (a citation of the Implementing Rule for interoperability of spatial data sets and services or other specification), and the *Degree* of conformity. The *Degree* can be *Conformant* (if the dataset is fully conformant with the cited specification), *Not Conformant* (if the dataset does not conform to the cited specification) or *Not Evaluated* (if the conformance has not been evaluated).

Recomendation 10

If a dataset is not yet conformant with all requirements of this data specification, it is recommended to include information on the conformance with the individual conformance classes specified in the Abstract Test Suite in Annex A.

Recomendation 11

If a dataset is produced or transformed according to an external specification that includes specific quality assurance procedures, the conformity with this specification should be documented using the *Conformity* metadata element.

Recomendation 12

If minimum data quality recommendations are defined then the statement on the conformity with these requirements should be included using the *Conformity* metadata element and referring to the relevant data quality conformance class in the Abstract Test Suite.

NOTE Currently no minimum data quality requirements are included in the IRs. The recommendation above should be included as a requirement in the IRs if minimum data quality requirements are defined at some point in the future.

Recomendation 13

When documenting conformance with this data specification or one of the conformance classes defined in the Abstract Test Suite, the *Specification* sub-element should be given using the http URI identifier of the conformance class or using a citation including the following elements:

- title: "INSPIRE Data Specification on *Mineral Resources* – Draft Guidelines – <name of the conformance class>"
- date:
  - dateType: publication
  - date: 2013-02-05

EXAMPLE 1: The XML snippets below show how to fill the *Specification* sub-element for documenting conformance with the whole data specification on Addresses v3.0.1.

```
<gmd:DQ_ConformanceResult>
    <gmd:specification href="http://inspire.ec.europa.eu/conformanceClass/ad/3.0.1/tg"
```

```
/>
    <gmd:explanation> (...) </gmd:explanation>
    <gmd:pass> (...) </gmd:pass>
</gmd:DQ_ConformanceResult>
```

or (using a citation):

```
<gmd:DQ_ConformanceResult>
    <gmd:specification>
        <gmd:CI_Citation>
            <gmd:title>
                <gco:CharacterString>INSPIRE Data Specification on Mineral Resources 
Draft Guidelines</gco:CharacterString>
            </gmd:title>
            <gmd:date>
                <gmd:date>
                    <gco:Date>2013-02-05</gco:Date>
                </gmd:date>
                <gmd:dateType>
                    <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/r
esou
rces/Codelist/ML_gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                </gmd:dateType>
            </gmd:date>
        </gmd:CI_Citation>
    </gmd:specification>
    <gmd:explanation> (...) </gmd:explanation>
    <gmd:pass> (...) </gmd:pass>
</gmd:DQ_ConformanceResult>
```

EXAMPLE 2: The XML snippets below show how to fill the *Specification* sub-element for documenting conformance with the CRS conformance class of the data specification on Addresses v3.0.1.

```
<gmd:DQ_ConformanceResult>
    <gmd:specification
href="http://inspire.ec.europa.eu/conformanceClass/ad/3.0.1/crs" />
    <gmd:explanation> (...) </gmd:explanation>
    <gmd:pass> (...) </gmd:pass>
</gmd:DQ_ConformanceResult>
```

or (using a citation):

```
<gmd:DQ_ConformanceResult>
    <gmd:specification>
```

```
        <gmd:CI_Citation>
            <gmd:title>
                <gco:CharacterString>INSPIRE Data Specification on Mineral Resources 
Draft Guidelines  CRS</gco:CharacterString>
            </gmd:title>
            <gmd:date>
                <gmd:date>
                    <gco:Date>2013-02-05</gco:Date>
                </gmd:date>
                <gmd:dateType>
                    <gmd:CI_DateTypeCode
codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/r
esou
rces/Codelist/ML_gmxCodelists.xml#CI_DateTypeCode"
codeListValue="publication">publication</gmd:CI_DateTypeCode>
                </gmd:dateType>
            </gmd:date>
        </gmd:CI_Citation>
    </gmd:specification>
    <gmd:explanation> (...) </gmd:explanation>
    <gmd:pass> (...) </gmd:pass>
</gmd:DQ_ConformanceResult>
```

8.1.2. Lineage

Recomendation 14

Following the ISO/DIS 19157 Quality principles, if a data provider has a procedure for the quality management of their spatial data sets then the appropriate data quality elements and measures defined in ISO/DIS 19157 should be used to evaluate and report (in the metadata) the results. If not, the *Lineage* metadata element (defined in Regulation 1205/2008/EC) should be used to describe the overall quality of a spatial data set.

According to Regulation 1205/2008/EC, lineage "is a statement on process history and/or overall quality of the spatial data set. Where appropriate it may include a statement whether the data set has been validated or quality assured, whether it is the official version (if multiple versions exist), and whether it has legal validity. The value domain of this metadata element is free text".

The Metadata Technical Guidelines based on EN ISO 19115 and EN ISO 19119 specifies that the statement sub-element of LI_Lineage (EN ISO 19115) should be used to implement the lineage metadata element.

Recomendation 15

To describe the transformation steps and related source data, it is recommended to use the following sub-elements of LI_Lineage:

- For the description of the transformation process of the local to the common

INSPIRE data structures, the LI_ProcessStep sub-element should be used.

- For the description of the source data the LI_Source sub-element should be used.

NOTE 1 In order to improve the interoperability, domain templates and instructions for using these free text elements (descriptive statements) may be specified here and/or in an Annex of this data specification.

8.1.3. Temporal reference

According to Regulation 1205/2008/EC, at least one of the following temporal reference metadata sub-elements shall be provided: temporal extent, date of publication, date of last revision, date of creation.

Recomendation 16

It is recommended that at least the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata sub-element.

8.2. Metadata elements for interoperability

IR Requirement
Article 13
Metadata required for Interoperability

The metadata describing a spatial data set shall include the following metadata elements required for interoperability:

1. Coordinate Reference System: Description of the coordinate reference system(s) used in the data set.
2. Temporal Reference System: Description of the temporal reference system(s) used in the data set.

   

   This element is mandatory only if the spatial data set contains temporal information that does not refer to the default temporal reference system.

3. Encoding: Description of the computer language construct(s) specifying the representation of data objects in a record, file, message, storage device or transmission channel.
4. Topological Consistency: Correctness of the explicitly encoded topological characteristics of the data set as described by the scope.

   This element is mandatory only if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.

5. Character Encoding: The character encoding used in the data set.

This element is mandatory only if an encoding is used that is not based on UTF-8.

6. Spatial Representation Type: The method used to spatially represent geographic information.

These Technical Guidelines propose to implement the required metadata elements based on ISO 19115 and ISO/TS 19139.

The following TG requirements need to be met in order to be conformant with the proposed encoding.

TG Requirement 3

Metadata instance (XML) documents shall validate without error against the used ISO 19139 XML schema.

NOTE Section 2.1.2 of the Metadata Technical Guidelines discusses the different ISO 19139 XML schemas that are currently available.

TG Requirement 4

Metadata instance (XML) documents shall contain the elements and meet the INSPIRE multiplicity specified in the sections below.

TG Requirement 5

The elements specified below shall be available in the specified ISO/TS 19139 path.

Recomendation 17

The metadata elements for interoperability should be made available together with the metadata elements defined in the Metadata Regulation through an INSPIRE discovery service.

NOTE While this not explicitly required by any of the INSPIRE Implementing Rules, making all metadata of a data set available together and through one service simplifies implementation and usability.

8.2.1. Coordinate Reference System

Metadata element name	Coordinate Reference System
Definition	Description of the coordinate reference system used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	mandatory

Metadata element name	Coordinate Reference System
INSPIRE multiplicity	1..*
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem
Domain	To identify the reference system, the referenceSystemIdentifier (RS_Identifier) shall be provided. NOTE More specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute should be agreed among Member States during the implementation phase to support interoperability.
Implementing instructions	
Example	referenceSystemIdentifier: code: ETRS_89 codeSpace: INSPIRE RS registry
Example XML encoding	<gmd:referenceSystemInfo> <gmd:MD_ReferenceSystem> <gmd:referenceSystemIdentifier> <gmd:RS_Identifier> <gmd:code> <gco:CharacterString>ETRS89 </gco:CharacterString> </gmd:code> <gmd:codeSpace> <gco:CharacterString>INSPIRE RS registry</gco:CharacterString> </gmd:codeSpace> </gmd:RS_Identifier> </gmd:referenceSystemIdentifier> </gmd:MD_ReferenceSystem> </gmd:referenceSystemInfo>
Comments	

8.2.2. Temporal Reference System

Metadata element name	Temporal Reference System
Definition	Description of the temporal reference systems used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.

Metadata element name	Temporal Reference System
INSPIRE multiplicity	0..*
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem
Domain	No specific type is defined in ISO 19115 for temporal reference systems. Thus, the generic MD_ReferenceSystem element and its reference SystemIdentifier (RS_Identifier) property shall be provided. NOTE More specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute should be agreed among Member States during the implementation phase to support interoperability.
Implementing instructions	
Example	referenceSystemIdentifier: code: GregorianCalendar codeSpace: INSPIRE RS registry

Example XML encoding	`<gmd:referenceSystemInfo>`
	`<gmd:MD_ReferenceSystem>`
	`<gmd:referenceSystemIdentifier>`
	`<gmd:RS_Identifier>`
	`<gmd:code>`
	`<gco:CharacterString>GregorianCalendar`
	`</gco:CharacterString>`
	`</gmd:code>`
	`<gmd:codeSpace>`
	`<gco:CharacterString>INSPIRE RS`
	`registry</gco:CharacterString>`
	`</gmd:codeSpace>`
	`</gmd:RS_Identifier>`
	`</gmd:referenceSystemIdentifier>`
	`</gmd:MD_ReferenceSystem>`
	`</gmd:referenceSystemInfo>`

Comments	

8.2.3. Encoding

Metadata element name	Encoding
Definition	Description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel
ISO 19115 number and name	271. distributionFormat
ISO/TS 19139 path	distributionInfo/MD_Distribution/distributionFormat
INSPIRE obligation / condition	mandatory

Metadata element name	Encoding
INSPIRE multiplicity	1..*
Data type (and ISO 19115 no.)	284. MD_Format
Domain	See B.2.10.4. The property values (name, version, specification) specified in section 5 shall be used to document the default and alternative encodings.
Implementing instructions	
Example	name: <Application schema name> GML application schema version: 4.0 rc3 specification: D2.8.III.21 Data Specification on *Mineral Resources* – Technical Guidelines
Example XML encoding	<gmd:MD_Format> <gmd:name> <gco:CharacterString>SomeApplicationSchema GML application schema</gco:CharacterString> </gmd:name> <gmd:version> <gco:CharacterString>3.0 rc3</gco:CharacterString> </gmd:version> <gmd:specification> <gco:CharacterString>D2.8.III.21 Data Specification on Mineral Resources Technical Guidelines</gco:CharacterString> </gmd:specification> </gmd:MD_Format>
Comments	

8.2.4. Character Encoding

Metadata element name	Character Encoding
Definition	The character encoding used in the data set.
ISO 19115 number and name	
ISO/TS 19139 path	
INSPIRE obligation / condition	Mandatory, if an encoding is used that is not based on UTF-8.
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	
Domain	
Implementing instructions	
Example	-

Metadata element name	Character Encoding
Example XML encoding	<gmd:characterSet> <gmd:MD_CharacterSetCode codeListValue="8859part2" codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codelist/ML_gmxCodelists.xml#CharacterSetCode">8859-2</gmd:MD_CharacterSetCode> </gmd:characterSet>
Comments	

8.2.5. Spatial representation type

Metadata element name	Spatial representation type
Definition	The method used to spatially represent geographic information.
ISO 19115 number and name	37. spatialRepresentationType
ISO/TS 19139 path	
INSPIRE obligation / condition	Mandatory
INSPIRE multiplicity	1..*
Data type (and ISO 19115 no.)	B.5.26 MD_SpatialRepresentationTypeCode
Domain	
Implementing instructions	Of the values included in the code list in ISO 19115 (vector, grid, textTable, tin, stereoModel, video), only vector, grid and tin should be used. NOTE Additional code list values may be defined based on feedback from implementation.
Example	-
Example XML encoding	
Comments	

8.2.6. Data Quality – Logical Consistency – Topological Consistency

See section 8.3.2 for instructions on how to implement metadata elements for reporting data quality.

8.3. Recommended theme-specific metadata elements

Recomendation 18

The metadata describing a spatial data set or a spatial data set series related to the theme *Mineral Resources* should comprise the theme-specific metadata elements

specified in Table 5.

The table contains the following information:

- The first column provides a reference to a more detailed description.
- The second column specifies the name of the metadata element.
- The third column specifies the multiplicity.

Table 5 – Optional theme-specific metadata elements for the theme *Mineral Resources*

Section	Metadata element	Multiplicity
8.3.1	Maintenance Information	0..1
8.3.2	Logical Consistency – Conceptual Consistency	0..*
8.3.2	Logical Consistency – Domain Consistency	0..*

Recomendation 19

For implementing the metadata elements included in this section using ISO 19115, ISO/DIS 19157 and ISO/TS 19139, the instructions included in the relevant sub-sections should be followed.

8.3.1. Maintenance Information

Metadata element name	Maintenance information
Definition	Information about the scope and frequency of updating
ISO 19115 number and name	30. resourceMaintenance
ISO/TS 19139 path	identificationInfo/MD_Identification/resourceMaintenance
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..1
Data type(and ISO 19115 no.)	142. MD_MaintenanceInformation

Metadata element name	Maintenance information
Domain	This is a complex type (lines 143-148 from ISO 19115). At least the following elements should be used (the multiplicity according to ISO 19115 is shown in parentheses): • maintenanceAndUpdateFrequency [1]: frequency with which changes and additions are made to the resource after the initial resource is completed / domain value: MD_MaintenanceFrequencyCode: • updateScope [0..*]: scope of data to which maintenance is applied / domain value: MD_ScopeCode • maintenanceNote [0..*]: information regarding specific requirements for maintaining the resource / domain value: free text
Implementing instructions	
Example	
Example XML encoding	
Comments	

8.3.2. Metadata elements for reporting data quality

Recomendation 20

For reporting the results of the data quality evaluation, the data quality elements, sub-elements and (for quantitative evaluation) measures defined in chapter 7 should be used.

Recomendation 21

The metadata elements specified in the following sections should be used to report the results of the data quality evaluation. At least the information included in the row "Implementation instructions" should be provided.

The first section applies to reporting quantitative results (using the element DQ_QuantitativeResult), while the second section applies to reporting non-quantitative results (using the element DQ_DescriptiveResult).

Recomendation 22

If a dataset does not pass the tests of the Application schema conformance class (defined in Annex A), the results of each test should be reported using one of the options described in sections 8.3.2.1 and 8.3.2.2.

NOTE 1 If using non-quantitative description, the results of several tests do not have to be reported

separately, but may be combined into one descriptive statement.

NOTE 2 The sections 8.3.2.1 and 8.3.2.2 may need to be updated once the XML schemas for ISO 19157 have been finalised.

The scope for reporting may be different from the scope for evaluating data quality (see section 7). If data quality is reported at the data set or spatial object type level, the results are usually derived or aggregated.

Recomendation 23

The scope element (of type DQ_Scope) of the DQ_DataQuality subtype should be used to encode the reporting scope.

Only the following values should be used for the level element of DQ_Scope: Series, Dataset, featureType.

If the level is featureType the levelDescription/MDScopeDescription/features element (of type Set< GF_FeatureType>) shall be used to list the feature type names.

NOTE In the level element of DQ_Scope, the value featureType is used to denote spatial object type.

8.3.2.1. Guidelines for reporting quantitative results of the data quality evaluation

Metadata element name	**See chapter** 7
Definition	See chapter 7
ISO/DIS 19157 number and name	3. report
ISO/TS 19139 path	dataQualityInfo/*/report
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO/DIS 19157 no.)	Corresponding DQ_xxx subelement from ISO/DIS 19157, e.g. 12. DQ_CompletenessCommission
Domain	Lines 7-9 from ISO/DIS 19157 7. DQ_MeasureReference (C.2.1.3) 8. DQ_EvaluationMethod (C.2.1.4.) 9. DQ_Result (C2.1.5.)

Metadata element name	See chapter 7
Implementing instructions	39. nameOfMeasure NOTE This should be the name as defined in Chapter 7. 42. evaluationMethodType 43. evaluationMethodDescription NOTE If the reported data quality results are derived or aggregated (i.e. the scope levels for evaluation and reporting are different), the derivation or aggregation should also be specified using this property. 46. dateTime NOTE This should be data or range of dates on which the data quality measure was applied. 63. DQ_QuantitativeResult / 64. value NOTE The DQ_Result type should be DQ_QuantitativeResult and the value(s) represent(s) the application of the data quality measure (39.) using the specified evaluation method (42-43.)
Example	See Table E.12 — Reporting commission as metadata (ISO/DIS 19157)
Example XML encoding	

8.3.2.2. Guidelines for reporting descriptive results of the Data Quality evaluation

Metadata element name	See chapter 7
Definition	See chapter 7
ISO/DIS 19157 number and name	3. report
ISO/TS 19139 path	dataQualityInfo/*/report
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO/DIS 19157 no.)	Corresponding DQ_xxx subelement from ISO/DIS 19157, e.g. 12. DQ_CompletenessCommission
Domain	Line 9 from ISO/DIS 19157 9. DQ_Result (C2.1.5.)

Metadata element name	**See chapter 7**
Implementing instructions	67. DQ_DescripitveResult / 68. statement NOTE The DQ_Result type should be DQ_DescriptiveResult and in the statement (68.) the evaluation of the selected DQ sub-element should be expressed in a narrative way.
Example	See Table E.15 — Reporting descriptive result as metadata (ISO/DIS 19157)
Example XML encoding	

9. Delivery

9.1. Updates

IR Requirement
Article 8
Updates

1. Member States shall make available updates of data on a regular basis.
2. All updates shall be made available at the latest 6 months after the change was applied in the source data set, unless a different period is specified for a specific spatial data theme in Annex II.

NOTE In this data specification, no exception is specified, so all updates shall be made available at the latest 6 months after the change was applied in the source data set.

9.2. Delivery medium

According to Article 11(1) of the INSPIRE Directive, Member States shall establish and operate a network of services for INSPIRE spatial data sets and services. The relevant network service types for making spatial data available are:

- *view services* making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata;
- *download services*, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly;
- *transformation services*, enabling spatial data sets to be transformed with a view to achieving interoperability.

NOTE For the relevant requirements and recommendations for network services, see the relevant Implementing Rules and Technical Guidelines[15].

EXAMPLE 1 Through the Get Spatial Objects function, a download service can either download a pre-defined data set or pre-defined part of a data set (non-direct access download service), or give direct access to the spatial objects contained in the data set, and download selections of spatial objects based upon a query (direct access download service). To execute such a request, some of the following information might be required:

- the list of spatial object types and/or predefined data sets that are offered by the download service (to be provided through the Get Download Service Metadata operation),
- and the query capabilities section advertising the types of predicates that may be used to form a query expression (to be provided through the Get Download Service Metadata operation, where applicable),
- a description of spatial object types offered by a download service instance (to be provided

through the Describe Spatial Object Types operation).

EXAMPLE 2 Through the Transform function, a transformation service carries out data content transformations from native data forms to the INSPIRE-compliant form and vice versa. If this operation is directly called by an application to transform source data (e.g. obtained through a download service) that is not yet conformant with this data specification, the following parameters are required:

Input data (mandatory). The data set to be transformed.

- Source model (mandatory, if cannot be determined from the input data). The model in which the input data is provided.
- Target model (mandatory). The model in which the results are expected.
- Model mapping (mandatory, unless a default exists). Detailed description of how the transformation is to be carried out.

9.3. Encodings

The IRs contain the following two requirements for the encoding to be used to make data available.

IR Requirement
Article 7
Encoding

1. Every encoding rule used to encode spatial data shall conform to EN ISO 19118. In particular, it shall specify schema conversion rules for all spatial object types and all attributes and association roles and the output data structure used.
2. Every encoding rule used to encode spatial data shall be made available.
2a. Every encoding rule used to encode spatial data shall also specify whether and how to represent attributes and association roles for which a corresponding value exists but is not contained in the spatial data sets maintained by a Member State, or cannot be derived from existing values at reasonable costs.

NOTE ISO 19118:2011 specifies the requirements for defining encoding rules used for interchange of geographic data within the set of International Standards known as the "ISO 19100 series". An encoding rule allows geographic information defined by application schemas and standardized schemas to be coded into a system-independent data structure suitable for transport and storage. The encoding rule specifies the types of data being coded and the syntax, structure and coding schemes used in the resulting data structure. Specifically, ISO 19118:2011 includes

- requirements for creating encoding rules based on UML schemas,
- requirements for creating encoding services, and
- requirements for XML-based encoding rules for neutral interchange of data.

While the IRs do not oblige the usage of a specific encoding, these Technical Guidelines propose to make data related to the spatial data theme *Mineral Resources* available at least in the default encoding(s) specified in section 0. In this section, a number of TG requirements are listed that need

to be met in order to be conformant with the default encoding(s).

The proposed default encoding(s) meet the requirements in Article 7 of the IRs, i.e. they are conformant with ISO 19118 and (since they are included in this specification) publicly available.

9.3.1. Default Encoding(s)

9.3.1.1. Specific requirements for GML encoding

This data specification proposes the use of GML as the default encoding, as recommended in sections 7.2 and 7.3 of [DS-D2.7]. GML is an XML encoding in compliance with ISO 19118, as required in Article 7(1). For details, see [ISO 19136], and in particular Annex E (UML-to-GML application schema encoding rules).

The following TG requirements need to be met in order to be conformant with GML encodings.

TG Requirement 6

Data instance (XML) documents shall validate without error against the provided XML schema.

NOTE 1 Not all constraints defined in the application schemas can be mapped to XML. Therefore, the following requirement is necessary.

NOTE 2 The obligation to use only the allowed code list values specified for attributes and most of the constraints defined in the application schemas cannot be mapped to the XML sch. They can therefore not be enforced through schema validation. It may be possible to express some of these constraints using other schema or rule languages (e.g. Schematron), in order to enable automatic validation.

9.3.1.2. Default encoding(s) for application schema MineralResources

Name: MineralResources GML Application Schema
Version: 4.0
Specification: D2.8.III.21 Data Specification on *Mineral Resources* – Technical Guidelines
Character set: UTF-8

The xml schema document is available on the INSPIRE website
https://inspire.ec.europa.eu/schemas/mr-core/4.0/MineralResourcesCore.xsd.

9.3.2. Recommended Encoding(s)

Recomendation 24

It is recommended that also the encodings specified in this section be provided for the relevant application schemas.

9.3.2.1. The use of EarthResourceML encoding

Name: EarthResourceML
Version: 2.0
Specification: http://*www.earthresourceml.org*
Character set: UTF-8
EarthResourceML v 2.0 is the community developed exchange format for providing detailed information on earth resources including waste as a secondary resource. It also served as the basis for both the more simplified INSPIRE Mineral Resource core data model and the Mineral Resource extension model. More information about the use of EarthResourceML for INSPIRE will be available at: http://*www.earthresourceml.org*

NOTE ***The difference between the INSPIRE core data model and EarthResourceML is very small since version 2.0 of EarthResourceML was influenced by the INSPIRE development. However the unique encoding solution to fully address both INSPIRE and EarthResourceML requirements still needs to be tested by the wider stakeholder community as part of the INSPIRE Maintenance and Implementation Framework. Based on the results, it should be discussed whether the current default INSPIRE encoding (see Section 9.3.1.) can be replaced by the EarthResourceML encoding.***

10. Data Capture

There is no specific guidance required with respect to data capture.

11. Portrayal

This clause defines the rules for layers and styles to be used for portrayal of the spatial object types defined for this theme. Portrayal is regulated in Article 14 of the IRs.

IR Requirement
Article 14
Portrayal

1. For the portrayal of spatial data sets using a view network service as specified in Commission Regulation No 976/2009 ([16]), the following shall be available:
   a. the layers specified in Annex II for the theme or themes the data set is related to;
   b. for each layer at least a default portrayal style, with as a minimum an associated title and a unique identifier.
2. For each layer, Annex II defines the following:
   a. a human readable title of the layer to be used for display in user interface;
   b. the spatial object type(s), or sub-set thereof, that constitute(s) the content of the layer.

In section 11.1, the *types* of layers are defined that are to be used for the portrayal of the spatial object types defined in this specification. A view service may offer several layers of the same type, one for each dataset that it offers data on a specific topic.

NOTE The layer specification in the IRs only contains the name, a human readable title and the (subset(s) of) spatial object type(s), that constitute(s) the content of the layer. In addition, these Technical Guidelines suggest keywords for describing the layer.

Recomendation 25

It is recommended to use the keywords specified in section 11.1 in the *Layers Metadata parameters* of the INSPIRE View service (see Annex III, Part A, section 2.2.4 in Commission Regulation (EC) No 976/2009).

Section 11.2 specifies one style for each of these layers. It is proposed that INSPIRE view services support this style as the default style required by Article 14(1b).

TG Requirement 7

For each layer specified in this section, the styles defined in section 11.2 shall be available.

NOTE The default style should be used for portrayal by the view network service if no user-defined style is specified in a portrayal request for a specific layer.

In section 11.3, further styles can be specified that represent examples of styles typically used in a thematic domain. It is recommended that also these styles should be supported by INSPIRE view services, where applicable.

Recomendation 26

In addition, it is recommended that, where applicable, INSPIRE view services also support the styles defined in section 11.3.

Where XML fragments are used in the following sections, the following namespace prefixes apply:

- sld="http://www.opengis.net/sld" (WMS/SLD 1.1)
- se="http://www.opengis.net/se" (SE 1.1)
- ogc="http://www.opengis.net/ogc" (FE 1.1)

11.1. Layers to be provided by INSPIRE view services

Layer Name	Layer Title	Spatial object type(s)	Keywords
MR.Mine	Mines	MiningFeatureOccurrence	Mineral resources, Mine, Ore Measure
MR.MineralOccurrence	Mineral Occurrences	MappedFeature (spatial objects whose specification property is of type MineralOccurrence)	Mineral resources, Mineral occurrence, Commodity

NOTE The table above contains several layers for the spatial object type(s) <spatial object type names>, which can be further classified using a code list-valued attribute. Such sets of layers are specified as described in Article 14(3) of the IRs.

IR Requirement
Article 14
Portrayal

(…)

3. For spatial object types whose objects can be further classified using a code list-valued attribute, several layers may be defined. Each of these layers shall include the spatial objects corresponding to one specific code list value. In the definition of such sets of layers in Annexes II-IV,
   a. the placeholder <CodeListValue> shall represent the values of the relevant code list, with the first letter in upper case,
   b. the placeholder <human-readable name> shall represent the human-

readable name of the code list values;

c. the spatial object type shall include the relevant attribute and code list, in parentheses;

d. one example of a layer shall be given.

11.1.1. Layers organisation

None.

11.2. Styles required to be supported by INSPIRE view services

None.

11.3. Styles recommended to be supported by INSPIRE view services

11.3.1. Styles for the layer MR.Mine

To be provided.

11.3.2. Styles for the layer MR. Mineral Occurrence

Table 6: Listed Layers for MR Commodity

Layer Type	Layer Title	Spatial Object types
MR.CommodityBaseMetals	Base Metals	Commodity where CommodityName= see legend below
MR.CommodityIronMetals	Iron and ferro-alloy metals	Idem
MR.CommodityRareMetals	Speciality and Rare metals	Idem
MR.CommodityEnergy	EnergeticMetalsOrMinerals	Idem
MR.CommodityPreciousMetals	Precious Metals	Idem
MR.CommodityPreciousGemstones	Precious and semi-precious gemstones	Idem
MR.CommodityChemicalUse	Mineral for chemical use	Idem
MR.CommodityCeramic	Ceramic and refractory minerals	Idem
MR.CommodityFertilizerMinerals	Fertilizer minerals	Idem
MR.CommodityBuildingMaterials	Building raw materials, dimension stones	Idem

Layer Type	Layer Title	Spatial Object types
MR.CommodityIndustrialMinerals	Speciality and other industrial rocks and minerals	Idem

11.3.2.1. Styles for the layer MR. Mineral Occurrence – Commodity Base Metals

Style Name	MR.MineralOccurrence.CommodityBaseMetals
Default Style	no
Style Title	Commodity Base Metals
Style Abstract	The size of each symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Base Metals					
Lead/Zinc (A-B-C-D Class)	Copper	Copper	Zinc only	Lead only	Aluminium

11.3.2.2. Styles for the layer MR. Mineral Occurrence – Commodity Iron and ferro – alloys metals

Style Name	MR. MineralOccurrence.Commodity.IronAndFerroAlloysMetals
Default Style	no
Style Title	Commodity Iron and ferro – alloys metals
Style Abstract	The size of each symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Iron and ferro-alloys metals					

Iron and ferro-alloys metals					
Fe, Cr, Mn, V (A-B-C-D Class)	W, Mo	Nickel/Cobalt	Nb		

11.3.2.3. Styles for the layer MR. Mineral Occurrence – Commodity Special and rare metals

Style Name	**MR. MineralOccurrence.Commodity.SpecialAndRareMetals**
Default Style	no
Style Title	Commodity Special and rare metals
Style Abstract	The size of each symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Special and rare metals					
Li, Be, Ta, REE, Cs, Rb, Sc, Zr, Hf (A-B-C-D Class)	Ge, Ga, In, Cd, Se, Re	Bi, Te, Hg	Sb	Ti	

11.3.2.4. Styles for the layer MR. Mineral Occurrence – Commodity Energetic metals or minerals

Style Name	**MR. MineralOccurrence.Commodity.EnergeticMetalsOrMinerals**
Default Style	no
Style Title	Commodity Energetic metals or minerals
Style Abstract	The size of each symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Special and rare metals					

Special and rare metals					
Uranium/Thorium (A-B-C-D Class)	Coal, lignite, peat	Oil shale			

11.3.2.5. Styles for the layer MR. Mineral Occurrence – Commodity Precious Metals

Style Name	**MR. MineralOccurrence.Commodity.PreciousMetals**
Default Style	no
Style Title	Commodity Precious Metals
	The size of each symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Precious Metals					
Gold (A-B-C-D Class)	Silver	PGE			

11.3.2.6. Styles for the layer MR. Mineral Occurrence – Commodity Precious and Semi-precious Gemstones

Style Name	**MR. MineralOccurrence.Commodity.PreciousAndSemi-preciousGemstones**
Default Style	no
Style Title	Commodity Precious and Semi-precious Gemstones
Style Abstract	The symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Precious and Semi-precious Gemstones					

Precious and Semi-precious Gemstones					
Precious gemstones	semi-precious gemstones				

11.3.2.7. Styles for the layer MR. Mineral Occurrence – Commodity Minerals for chemical use

Style Name	**MR. MineralOccurrence.Commodity.MineralsForChemicalUse**
Default Style	no
Style Title	Commodity Minerals for chemical use
Style Abstract	The symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Minerals for chemical use					

11.3.2.8. Styles for the layer MR. Mineral Occurrence – Commodity Ceramic and refractory minerals

Style Name	**MR. MineralOccurrence.Commodity.CeramicAndRefractoryMinerals**
Default Style	no
Style Title	Commodity Ceramic and refractory minerals
Style Abstract	The symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Ceramic and refractory minerals					

11.3.2.9. Styles for the layer MR. Mineral Occurrence – Commodity Fertilizer minerals

Style Name	**MR. MineralOccurrence.Commodity.FertilizerMinerals**
Default Style	no

Style Name	**MR. MineralOccurrence.Commodity.FertilizerMinerals**
Style Title	Commodity Fertilizer minerals
Style Abstract	The symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Fertilizer minerals					

11.3.2.10. Styles for the layer MR Mineral Occurrence – Building raw materials, dimension stones

To be provided.

11.3.2.11. Styles for the layer MR. Mineral Occurrence – Commodity Specialty and other industrial rocks and minerals

Style Name	**MR. MineralOccurrence.Commodity .SpecialtyAndOtherIndustrialRocksAndMinerals**
Default Style	no
Style Title	Commodity Specialty and other industrial rocks and minerals
Style Abstract	The symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D: A=very large B=large C=Medium D = small) is defined with the commodities code-list (see Annex F).
Symbology	See the symbol and colour schema below.
Minimum & maximum scales	None

Specialty and other industrial rocks and minerals					

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Annex A: Abstract Test Suite - (normative)

Disclaimer

While this Annex refers to the Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services, it does not replace the legal act or any part of it.

The objective of the Abstract Test Suite (ATS) included in this Annex is to help the conformance testing process. It includes a set of tests to be applied on a data set to evaluate whether it fulfils the requirements included in this data specification and the corresponding parts of Commission Regulation No 1089/2010 (implementing rule as regards interoperability of spatial datasets and services, further referred to as ISDSS Regulation). This is to help data providers in declaring the conformity of a data set to the "degree of conformity, with implementing rules adopted under Article 7(1) of Directive 2007/2/EC", which is required to be provided in the data set metadata according to Commission Regulation (EC) No 2008/1205 (the Metadata Regulation).

Part 1 of this ATS includes tests that provide **input for assessing conformity with the ISDSS regulation.** In order to make visible which requirements are addressed by a specific test, references to the corresponding articles of the legal act are given. The way how the cited requirements apply to mr specification is described under the testing method.

In addition to the requirements included in ISDSS Regulation this Technical guideline contains TG requirements too. TG requirements are technical provisions that need to be fulfilled in order to be conformant with the corresponding IR requirement when the specific technical implementation proposed in this document is used. Such requirements relate for example to the default encoding described in section 9. **Part 2** of the ATS presents tests necessary for assessing the **conformity with TG requirements**.

NOTE Conformance of a data set with the TG requirement(s) included in this ATS implies conformance with the corresponding IR requirement(s).

The **ATS is applicable to the data sets that have been transformed** to be made available through INSPIRE download services (i.e. the data returned as a response to the mandatory "Get Spatial Dataset" operation) rather than the original "source" data sets.

The requirements to be tested are grouped in several *conformance classes*. Each of these classes covers a specific aspect: one conformance class contains tests reflecting the requirements on the application schema, another on the reference systems, etc. **Each conformance class is identified by a URI** (uniform resource identifier) according to the following pattern:

http://inspire.ec.europa.eu/conformance-class/ir/mr/<conformance class identifier>

EXAMPLE 1 The URI *http://inspire.ec.europa.eu/conformance-class/ir/ef/rs* identifies the Reference Systems ISDSS conformance class of the Environmental Monitoring Facilities (EF) data theme.

The results of the tests should be published referring to the relevant conformance class (using its URI).

When an INSPIRE data specification contains **more than one application schema,** the requirements tested in a conformance class may differ depending on the application schema used as a target for the transformation of the data set. This will always be the case for the application schema conformance class. However, also other conformance classes could have different requirements for different application schemas. In such cases, a separate conformance class is defined for each application schema, and they are distinguished by specific URIs according to the following pattern:

http://inspire.ec.europa.eu/conformance-class/ir/mr/<conformance class identifier>/
<application schema namespace prefix>

EXAMPLE 2 The URI *http://inspire.ec.europa.eu/conformance-class/ir/el/as/el-vec* identifies the conformity with the application schema (*as*) conformance class for the Elevation Vector Elements (*el-vec*) application schema.

An overview of the conformance classes and the associated tests is given in the table below.

Table 7. Overview of the tests within this Abstract Test Suite.

A.1 Application Schema Conformance Class
A.1.1 Schema element denomination test
A.1.2 Value type test
A.1.3 Value test
A.1.4 Attributes/associations completeness test
A.1.5 Abstract spatial object test
A.1.6 Constraints test
A.1.7 Geometry representation test
A.1.8 MappedFeature geometry test
A.2 Reference Systems Conformance Class
A.2.1 Datum test
A.2.2 Coordinate reference system test
A.2.3 View service coordinate reference system test
A.2.4 Temporal reference system test
A.2.5 Units of measurements test
A.3 Data Consistency Conformance Class
A.3.1 Unique identifier persistency test
A.3.2 Version consistency test
A.3.3 Life cycle time sequence test
A.3.4 Validity time sequence test
A.3.5 Update frequency test

A.4 Metadata IR Conformance Class
A.4.1 Metadata for interoperability test
A.5 Information Accessibility Conformance Class
A.5.1 Code list publication test
A.5.2 CRS publication test
A.5.3 CRS identification test
A.6 Data Delivery Conformance Class
A.6.1 Encoding compliance test
A.7 Portrayal Conformance Class
A.7.1 Layer designation test
A.8 Technical Guideline Conformance Class
A.8.1 Multiplicity test
A.8.2 CRS http URI test
A.8.3 Metadata encoding schema validation test
A.8.4 Metadata occurrence test
A.8.5 Metadata consistency test
A.8.6 Encoding schema validation test
A.8.7 Style test

In order to be conformant to a conformance class, a data set has to pass **all** tests defined for that conformance class.

In order to be conformant with the ISDSS regulation the inspected data set needs to be conformant to **all** conformance classes in Part 1. The conformance class for overall conformity with the ISDSS regulation is identified by the URI *http://inspire.ec.europa.eu/conformance-class/ir/mr/*.

In order to be conformant with the Technical Guidelines, the dataset under inspection needs to be conformant to all conformance classes included both in Part 1 and 2. Chapter 8 describes in detail how to publish the result of testing regarding overall conformity and conformity with the conformance classes as metadata. The conformance class for overall conformity with the Technical Guidelines is identified by the URI *http://inspire.ec.europa.eu/conformance-class/tg/mr/3.0 rc3*.

It should be noted that data providers are not obliged to integrate / decompose the original structure of the source data sets when they deliver them for INSPIRE. It means that a conformant dataset can contain less or more spatial object / data types than specified in the ISDSS Regulation.

A dataset that contains less spatial object and/or data types can be regarded conformant when the corresponding types of the source datasets after the necessary transformations fulfil the requirements set out in the ISDSS Regulation.

A **dataset that contain more spatial object and/or data types** may be regarded as conformant when

- all the spatial object / data types that have corresponding types in the source dataset after the necessary transformations fulfil the requirements set out in the ISDSS Regulation and
- all additional elements of the source model (spatial object types, data types, attributes, constraints and code lists together with their values) do not conflict with any rule defined in the interoperability target specifications defined for any theme within INSPIRE.

> **Open issue 1:** Even though the last condition can be derived from Art. 8(4) of the Directive, the ISDSS Regulation does not contain requirements concerning the above issue. Therefore, no specific tests have been included in this abstract suite for testing conformity of extended application schemas. Annex F of the Generic Conceptual Model (D2.5) provides an example how to extend INSPIRE application schemas in a compliant way.

The ATS contains a detailed list of abstract tests. It should be noted that some tests in the Application schema conformance class can be automated by utilising xml **schema validation tools.** It should be noted that failing such validation test does not necessary reflect non-compliance to the application schema; it may be the results of erroneous encoding.

Each test in this suite follows the same structure:

- Requirement: citation from the legal texts (ISDSS requirements) or the Technical Guidelines (TG requirements);
- Purpose: definition of the scope of the test;
- Reference: link to any material that may be useful during the test;
- Test method: description of the testing procedure.

According to ISO 19105:2000 all tests in this ATS are basic tests. Therefore, this statement is not repeated each time.

Part 1 - (normative)

Conformity with Commission Regulation No 1089/2010

A.1. Application Schema Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/as/MineralResources

A.1.1. Schema element denomination test

a. Purpose: Verification whether each element of the dataset under inspection carries a name specified in the target application schema(s).
b. Reference: Art. 3 and Art.4 of Commission Regulation No 1089/2010
c. Test Method: Examine whether the corresponding elements of the source schema (spatial object types, data types, attributes, association roles and code lists) are mapped to the target schema with the correct designation of mnemonic names.

NOTE Further technical information is in the Feature catalogue and UML diagram of the application schema(s) in section 5.2.

A.1.2. Value type test

a. Purpose: Verification whether all attributes or association roles use the corresponding value types specified in the application schema(s).
b. Reference: Art. 3, Art.4, Art.6(1), Art.6(4), Art.6(5) and Art.9(1)of Commission Regulation No 1089/2010.
c. Test Method: Examine whether the value type of each provided attribute or association role adheres to the corresponding value type specified in the target specification.

NOTE 1 This test comprises testing the value types of INSPIRE identifiers, the value types of attributes and association roles that should be taken from code lists, and the coverage domains.

NOTE 2 Further technical information is in the Feature catalogue and UML diagram of the application schema(s) in section 5.2.

A.1.3. Value test

a. Purpose: Verify whether all attributes or association roles whose value type is a code list take the values set out therein.
b. Reference: Art.4 (3) of Commission Regulation No 1089/2010.
c. Test Method: When an attribute / association role has a code list as its type, compare the values of each instance with those provided in the application schema. To pass this tests any instance of an attribute / association role

1. shall take only values explicitly specified in the code list when the code list's extensibility is "none".
2. shall take only a value explicitly specified in the code list or shall take a value that is narrower (i.e. more specific) than those explicitly specified in the application schema when the code list's extensibility is "narrower".

NOTE 1 This test is not applicable to code lists with extensibility "open" or "any".

NOTE 2 When a data provider only uses code lists with narrower (more specific values) this test can be fully performed based on internal information.

A.1.4. Attributes/associations completeness test

a. Purpose: Verification whether each instance of spatial object type and data types include all attributes and association roles as defined in the target application schema.
b. Reference: Art. 3, Art.4(1), Art.4(2), and Art.5(2) of Commission Regulation No 1089/2010.
c. Test Method: Examine whether all attributes and association roles defined for a spatial object type or data type are present for each instance in the dataset.

NOTE 1 Further technical information is in the Feature catalogue and UML diagram of the application schema(s) in section 5.2.

NOTE 2 For all properties defined for a spatial object, a value has to be provided if it exists in or applies to the real world entity – either the corresponding value (if available in the data set maintained by the data provider) or the value of *void*. If the characteristic described by the attribute or association role does not exist in or apply to the real world entity, the attribute or association role does not need to be present in the data set.

A.1.5. Abstract spatial object test

a. Purpose: Verification whether the dataset does NOT contain abstract spatial object / data types defined in the target application schema(s).
b. Reference: Art.5(3) of Commission Regulation No 1089/2010
c. Test Method: Examine that there are NO instances of abstract spatial object / data types in the dataset provided.

NOTE Further technical information is in the Feature catalogue and UML diagram of the application schema(s) in section 5.2.

A.1.6. Constraints test

a. Purpose: Verification whether the instances of spatial object and/or data types provided in the dataset adhere to the constraints specified in the target application schema(s).
b. Reference: Art. 3, Art.4(1), and Art.4(2) of Commission Regulation No 1089/2010.
c. Test Method: Examine all instances of data for the constraints specified for the corresponding spatial object / data type. Each instance shall adhere to all constraints specified in the target

application schema(s).

NOTE Further technical information is in the Feature catalogue and UML diagram of the application schema(s) in section 5.2.

A.1.7. Geometry representation test

a. Purpose: Verification whether the value domain of spatial properties is restricted as specified in the Commission Regulation No 1089/2010.

b. Reference: Art.12(1) of Commission Regulation No 1089/2010

c. Test Method: Check whether all spatial properties only use 0, 1 and 2-dimensional geometric objects that exist in the right 2-, 3- or 4-dimensional coordinate space, and where all curve interpolations respect the rules specified in the reference documents.

NOTE Further technical information is in OGC Simple Feature spatial schema v1.2.1 [06-103r4].

A.1.8. MappedFeature geometry test

a. Purpose: Verification whether the MappedFeature type specified in Section 5.3.1 and 11.3 of Annex III (geology) is used to describe the geometric properties of MineralOccurrence spatial object type.

b. Reference: Annex IV. Section 20.4. of Commission Regulation No 1089/2010

c. Test Method: Check whether all instances of MineralOccurrence spatial object type use for providing geometric properties the attribute Shape (GM_Object) defined by MappedFeature spatial object type (in Geology Data Specification)

A.2. Reference Systems Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/rs

A.2.1. Datum test

a. Purpose: Verify whether each instance of a spatial object type is given with reference to one of the (geodetic) datums specified in the target specification.

b. Reference: Annex II Section 1.2 of Commission Regulation No 1089/2010

c. Test Method: Check whether each instance of a spatial object type specified in the application schema(s) in section 5 has been expressed using:

   - the European Terrestrial Reference System 1989 (ETRS89) within its geographical scope; or
   - the International Terrestrial Reference System (ITRS) for areas beyond the ETRS89 geographical scope; or
   - other geodetic coordinate reference systems compliant with the ITRS. Compliant with the ITRS means that the system definition is based on the definition of ITRS and there is a well-established and described relationship between both systems, according to the EN ISO

19111.

NOTE Further technical information is given in Section 6 of this document.

A.2.2. Coordinate reference system test

a. Purpose: Verify whether the two- and three-dimensional coordinate reference systems are used as defined in section 6.

b. Reference: Section 6 of Commission Regulation 1089/2010.

c. Test Method: Inspect whether the horizontal and vertical components of coordinates one of the corresponding coordinate reference system has been:

   - Three-dimensional Cartesian coordinates based on a datum specified in 1.2 and using the parameters of the Geodetic Reference System 1980 (GRS80) ellipsoid.
   - Three-dimensional geodetic coordinates (latitude, longitude and ellipsoidal height) based on a datum specified in 1.2 and using the parameters of the GRS80 ellipsoid.
   - Two-dimensional geodetic coordinates (latitude and longitude) based on a datum specified in 1.2 and using the parameters of the GRS80 ellipsoid.
   - Plane coordinates using the ETRS89 Lambert Azimuthal Equal Area coordinate reference system.
   - Plane coordinates using the ETRS89 Lambert Conformal Conic coordinate reference system.
   - Plane coordinates using the ETRS89 Transverse Mercator coordinate reference system.
   - For the vertical component on land, the European Vertical Reference System (EVRS) shall be used to express gravity-related heights within its geographical scope. Other vertical reference systems related to the Earth gravity field shall be used to express gravity-related heights in areas that are outside the geographical scope of EVRS.
   - For the vertical component in marine areas where there is an appreciable tidal range (tidal waters), the Lowest Astronomical Tide (LAT) shall be used as the reference surface.
   - For the vertical component in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200 meters, the Mean Sea Level (MSL) or a well-defined reference level close to the MSL shall be used as the reference surface."
   - For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere, or other linear or parametric reference systems shall be used. Where other parametric reference systems are used, these shall be described in an accessible reference using EN ISO 19111-2:2012.

NOTE Further technical information is given in Section 6 of this document.

A.2.3. View service coordinate reference system test

a. Purpose: Verify whether the spatial data set is available in the two dimensional geodetic coordinate system for their display with the INSPIRE View Service.

b. Reference: Annex II Section 1.4 of Commission Regulation 1089/2010

c. Test Method: Check that each instance of a spatial object types specified in the application

schema(s) in section 5 is available in the two-dimensional geodetic coordinate system

NOTE Further technical information is given in Section 6 of this document.

A.2.4. Temporal reference system test

a. Purpose: Verify whether date and time values are given as specified in Commission Regulation No 1089/2010.
b. Reference: Art.11(1) of Commission Regulation 1089/2010
c. Test Method: Check whether:
    4. the Gregorian calendar is used as a reference system for date values;
    5. the Universal Time Coordinated (UTC) or the local time including the time zone as an offset from UTC are used as a reference system for time values.

NOTE Further technical information is given in Section 6 of this document.

A.2.5. Units of measurements test

a. Purpose: Verify whether all measurements are expressed as specified in Commission Regulation No 1089/2010.
b. Reference: Art.12(2) of Commission Regulation 1089/2010
c. Test Method: Check whether all measurements are expressed in SI units or non-SI units accepted for use with the International System of Units.

NOTE 1 Further technical information is given in ISO 80000-1:2009.

NOTE 2 Degrees, minutes and seconds are non-SI units accepted for use with the International System of Units for expressing measurements of angles.

A.3. Data Consistency Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/dc

A.3.1. Unique identifier persistency test

a. Purpose: Verify whether the namespace and localId attributes of the external object identifier remain the same for different versions of a spatial object.
b. Reference: Art. 9 of Commission Regulation 1089/2010.
c. Test Method: Compare the namespace and localId attributes of the external object identifiers in the previous version(s) of the dataset with the namespace and localId attributes of the external object identifiers of current version for the same instances of spatial object / data types; To pass the test, neither the namespace, nor the localId shall be changed during the life-cycle of a spatial object.

NOTE 1 This test can be performed exclusively on the basis of the information available in the database of the data providers.

NOTE 2 When using URI this test includes the verification whether no part of the construct has been changed during the life cycle of the instances of spatial object / data types.

NOTE 3 Further technical information is given in section 14.2 of the INSPIRE Generic Conceptual Model.

A.3.2. Version consistency test

a. Purpose: Verify whether different versions of the same spatial object / data type instance belong to the same type.
b. Reference: Art. 9 of Commission Regulation 1089/2010.
c. Test Method: Compare the types of different versions for each instance of spatial object / data type

NOTE 1 This test can be performed exclusively on the basis of the information available in the database of the data providers.

A.3.3. Life cycle time sequence test

a. Purpose: Verification whether the value of the attribute beginLifespanVersion refers to an earlier moment of time than the value of the attribute endLifespanVersion for every spatial object / object type where this property is specified.
b. Reference: Art.10(3) of Commission Regulation 1089/2010.
c. Test Method: Compare the value of the attribute beginLifespanVersion with attribute endLifespanVersion. The test is passed when the beginLifespanVersion value is before endLifespanVersion value for each instance of all spatial object/data types for which this attribute has been defined.

NOTE 1 This test can be performed exclusively on the basis of the information available in the database of the data providers.

A.3.4. Validity time sequence test

a. Purpose: Verification whether the value of the attribute validFrom refers to an earlier moment of time than the value of the attribute validTo for every spatial object / object type where this property is specified.
b. Reference: Art.12(3) of Commission Regulation 1089/2010.
c. Test Method: Compare the value of the attribute validFrom with attribute validTo. The test is passed when the validFrom value is before validTo value for each instance of all spatial object/data types for which this attribute has been defined.

NOTE 1 This test can be performed exclusively on the basis of the information available in the database of the data providers.

NOTE 2 In case of the MineralResources application schema the attributes validFrom and validTo are replaced by startDate and endDate, but the definitions are the same.

A.3.5. Update frequency test

a. Purpose: Verify whether all the updates in the source dataset(s) have been transmitted to the dataset(s) which can be retrieved for the MR data theme using INSPIRE download services.
b. Reference: Art.8 (2) of Commission Regulation 1089/2010.
c. Test Method: Compare the values of beginning of life cycle information in the source and the target datasets for each instance of corresponding spatial object / object types. The test is passed when the difference between the corresponding values is less than 6 months.

NOTE 1 This test can be performed exclusively on the basis of the information available in the database of the data providers.

A.4. Metadata IR Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/md

A.4.1. Metadata for interoperability test

a. Purpose: Verify whether the metadata for interoperability of spatial data sets and services described in 1089/2010 Commission Regulation have been created and published for each dataset related to the MR data theme.
b. Reference: Art.13 of Commission Regulation 1089/2010
c. Test Method: Inspect whether metadata describing the coordinate reference systems, encoding, and spatial representation type have been created and published. If the spatial data set contains temporal information that does not refer to the default temporal reference system, inspect whether metadata describing the temporal reference system have been created and published. If an encoding is used that is not based on UTF-8, inspect whether metadata describing the character encoding have been created.

NOTE Further technical information is given in section 8 of this document.

A.5. Information Accessibility Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/ia

A.5.1. Code list publication test

a. Purpose: Verify whether all additional values used in the data sets for attributes, for which narrower values or any other value than specified in Commission Regulation 1089/2010 are allowed, are published in a register.

b. Reference: Art.6(3) and Annex IV Section 20.3.3.

c. Test method: For each additional value used in the data sets for code list-valued attributes, check whether it is published in a register.

NOTE Further technical information is given in section 5 of this document.

A.5.2. CRS publication test

a. Purpose: Verify whether the identifiers and the parameters of coordinate reference system are published in common registers.

b. Reference: Annex II Section 1.5

c. Test method: Check whether the identifier and the parameter of the CRS used for the dataset are included in a register. .

NOTE Further technical information is given in section 6 of this document.

A.5.3. CRS identification test

a. Purpose: Verify whether identifiers for other coordinate reference systems than specified in Commission Regulation 1089/2010 have been created and their parameters have been described according to EN ISO 19111 and ISO 19127.

b. Reference: Annex II Section 1.3.4

c. Test method: Check whether the register with the identifiers of the coordinate reference systems is accessible.

NOTE Further technical information is given in section 6 of this document.

A.6. Data Delivery Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/de

A.6.1. Encoding compliance test

a. Purpose: Verify whether the encoding used to deliver the dataset comply with EN ISO 19118.

b. Reference: Art.7 (1) of Commission Regulation 1089/2010.

c. Test Method: Follow the steps of the Abstract Test Suit provided in EN ISO 19118.

NOTE 1 Datasets using the default encoding specified in Section 9 fulfil this requirement.

NOTE 2 Further technical information is given in Section 9 of this document.

A.7. Portrayal Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/ir/mr/po

A.7.1. Layer designation test

a. Purpose: verify whether each spatial object type has been assigned to the layer designated according to Commission Regulation 1089/2010.

b. Reference: Art. 14(1), Art14(2) and Annex IV Section 20.5 .

c. Test Method: Check whether data is made available for the view network service using the specified layers respectively:

Layer Name
MR.Mine
MR.MineralOccurrence

NOTE Further technical information is given in section 11 of this document.

Part 2 - (informative)

Conformity with the technical guideline (TG) Requirements

A.8. Technical Guideline Conformance Class

Conformance class:

http://inspire.ec.europa.eu/conformance-class/tg/mr/3.0 rc3

A.8.1. Multiplicity test

a. Purpose: Verify whether each instance of an attribute or association role specified in the application schema(s) does not include fewer or more occurrences than specified in section 5.
b. Reference: Feature catalogue and UML diagram of the application schema(s) in section 5 of this guideline.
c. Test Method: Examine that the number of occurrences of each attribute and/or association role for each instance of a spatial object type or data type provided in the dataset corresponds to the number of occurrences of the attribute / association role that is specified in the application schema(s) in section 5.

A.8.2. CRS http URI test

a. Purpose: Verify whether the coordinate reference system used to deliver data for INSPIRE network services has been identified by URIs according to the EPSG register.
b. Reference: Section 6 of this technical guideline
c. Test Method: Compare the URI of the dataset with the URIs in the table.

NOTE 1 Passing this test implies the fulfilment of test A6.2

NOTE 2 Further reference please see *http://www.epsg.org/geodetic.html*

A.8.3. Metadata encoding schema validation test

a. Purpose: Verify whether the metadata follows an XML schema specified in ISO/TS 19139.
b. Reference: Section 8 of this technical guideline, ISO/TS 19139
c. Test Method: Inspect whether provided XML schema is conformant to the encoding specified in ISO 19139 for each metadata instance.

NOTE 1 Section 2.1.2 of the Metadata Technical Guidelines discusses the different ISO 19139 XML schemas that are currently available.

A.8.4. Metadata occurrence test

a. Purpose: Verify whether the occurrence of each metadata element corresponds to those specified in section 8.

b. Reference: Section 8 of this technical guideline

c. Test Method: Examine the number of occurrences for each metadata element. The number of occurrences shall be compared with its occurrence specified in Section 8:

NOTE 1 Section 2.1.2 of the Metadata Technical Guidelines discusses the different ISO 19139 XML schema

A.8.5. Metadata consistency test

a. Purpose: Verify whether the metadata elements follow the path specified in ISO/TS 19139.

b. Reference: Section 8 of this technical guideline, ISO/TS 19139

c. Test Method: Compare the XML schema of each metadata element with the path provide in ISO/TS 19137.

NOTE 1 This test does not apply to the metadata elements that are not included in ISO/TS 19139.

A.8.6. Encoding schema validation test

a. Purpose: Verify whether the provided dataset follows the rules of default encoding specified in section 9 of this document

b. Reference: section 9 of this technical guideline

c. Test Method: Inspect whether provided encoding(s) is conformant to the encoding(s) for the relevant application schema(s) as defined in section 9:

NOTE 1 Applying this test to the default encoding schema described in section 9 facilitates testing conformity with the application schema specified in section 5. In such cases running this test with positive result may replace tests from A1.1 to A1.4 provided in this abstract test suite.

NOTE 2 Using Schematron or other schema validation tool may significantly improve the validation process, because some some complex constraints of the schema cannot be validated using the simple XSD validation process. On the contrary to XSDs Schematron rules are not delivered together with the INSPIRE data specifications. Automating the process of validation (e.g. creation of Schematron rules) is therefore a task and an opportunity for data providers.

A.8.7. Style test

a. Purpose: Verify whether the styles defined in section 11.2 have been made available for each specified layer.

b. Reference: section 11.2.

c. Test Method: Check whether the styles defined in section 11.2 have been made available for each specified layer.

Annex B: Use cases - (informative)

This annex describes the use cases that were used as a basis for the development of this data specification. These are following:

B.1 - What is the gold potential of Central and Southeastern Europe?
B.2 - Ge in Europe: where to find it?
B.3 - A manufacturer looking for GCC?
B.4 - Environmental uncertainties related to mining wastes

B.1. What is the gold potential of Central and Southeastern Europe?

This use case is related to example of use:

- MR-01: Mineral exploration.

Overview and involved actors

This is one of the typical questions which can be asked for several commodities, and for any part of Europe. The user can be a technical manager from a mining company which wants to operate in EU, a PHD student comparing the potential of various geological/geodynamical settings, a geoscientist, a scientific journalist for a magazine, a politician technical adviser, …

Narrative description

Use Case Description	
Name	What is the gold potential of Central and South-Eastern Europe?
Primary actor	Public - economic sector, a politician technical/scientific adviser, geoscientist, scientific journalist
Goal	The user views a map (background can be a DEM with political boundaries, or a geographic map or a geological map) with all mineral deposits containing gold within the selected area. The information should deliver a detailed estimation of gold potential, with required parameters such as: Entry date; Revision date; Exploration history (essentially for occurrences); Standard according which the resources and reserves are calculated; Source of resources and reserves data. This information uses a vocabulary, which fits to the user’s requirements.
System under consideration	The (computer) system that the actor interacts with for executing the use case, a stand-alone or a web-based GIS or CAD system.
Importance	low

Use Case Description	
Description	For a comparative study, a user wants to get a precise idea of the gold potential of Central and Southeastern Europe. All deposits containing gold, either as a main commodity or as a secondary one are concerned. In order to properly evaluate the potential of the region and understand to which geological/geodynamic event(s) gold is related, the user will need to obtain information on (i) past production, reserves and resources, (ii) the metallogenic type of the deposit, (iii) its age, (iv) the host rock formation name, (v) the host rock type, and (vi) the host rock age. These last three data have to be extracted from the "Mineral deposit" database and not from the geological map used as background. The reason is that the host rock may cover a very small surface and thus not be represented on the geological background, depending of the scale/accuracy of this one. It is also possible that the host rock does not outcrop, and thus is not mapped.
Pre-condition	Mineral resources data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a "mapping" between geological /metallogenic/mining terms and user's terms done by the data provider.
Post-condition	The output should be detailed mineral resources data sets, exploration history, source of calculation methods, etc.. All given information should be delivered in an acceptable quality standard and multilingual. The user has a listing and a map of selected deposits
Flow of Events – Basic Path	
Step 1.	Selection of the area (by adding countries, or graphically)
Step 2.	Selection of the commodity, main secondary (i.e. selection of deposits containing gold as the main commodity or as a secondary commodity)
Step 3.	Selection of the class of deposit to visualize: class A (the largest) only, class AB, class ABC, all (including occurrences)
Step 4.	Selection of the other parameters to be displayed when clicking on a deposit: Name, country, past production, reserves and resources, metallogenic type of the deposit, its age, the host rock formation name, the host rock type, and the host rock age
Step 5.	The user checks the quality of information for some interesting deposits (clicking on the point)
Step 6.	The user downloads the selected deposits with the selected parameters.
Flow of Events – Alternative Paths	
Step 4.	For a very detailed estimation of gold potential, some other parameters may be required such as: Entry date, Revision date, Exploration history (essentially for occurrences), Standard according which the resources and reserves are calculated, Source of resources and reserves data.
Step m1.	…

Use Case Description	
…	
Data set: precious metals	
Description	Mineral deposit data from national sources.
Type	input|output|intermediate
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Mineral resources
Scale, resolution	Scale relevant to the application
Delivery	FTP download, WFS, or WCS according to "INSPIRE Mineral resources GML Application schema"
Documentation	Metadata about source, quality and source of archived historical exploration documents.

Requirements from the use case

Analysing the use case, there is a need to provide the following objects and attributes:

Mineral deposits with:

- ID
- (Entry date)
- (Revision date)
- Name
- Country
- (Exploration history)
- Main commodity
- Secondary commodity
- Past production, reserves and resources
- (Standard according which the resources and reserves are calculated)
- (Source of resources and reserves data)
- Metallogenic type of the deposit
- Age of the deposit
- Host rock formation name
- Host rock type
- Host rock age

Relationship with other INSPIRE Themes

This use case has some relationships with the following INSPIRE data themes:

- Protected sites: to open or to expand a quarry to extract building material it is mandatory to take into account Protected Sites
- Population distribution - demography: to know the future needs for building material a simple rule is to know the number of inhabitants
- Transport networks: the distance between production and consumption areas, and the road network capacity and constraints are very important to know.

B.2. Ge in Europe: where to find it?

This use case is related to example of use:

- MR-01: Mineral exploration.

Overview and involved actors

Ge (Germanium) is one of the 14 commodities listed by EU as critical (**The raw materials initiative - Critical raw materials for the EU.** Report of the Ad-hoc Working Group on defining critical raw materials). Answering the question "Where is Ge in Europe?" and the combined question "Is there any potential for Ge in Europe?" is of interest for several actors, including EU authorities, geological surveys and mining agencies, academics, and also the general public.

The same question can be asked for several other strategic, critical, high-tech, or green commodities.

Narrative description

Answering the question "Where is Ge in Europe?",implies to get information on both ancient mines for their wastes and on deposits currently exploited. Information on mineralogy (e.g., presence of Ge minerals, presence of low-iron sphalerite and other sulphur minerals known to be significant Ge sources in some deposits [enargite, bornite, tennantite-tetrahedrite, luzonite, sulvanite and colusite]) can also be important as it can help to identify deposits/occurrences where Ge, not yet identified, could be present.

Ge is most of the time a by-product or a secondary commodity (exception: Noailhac Saint-Salvy, France, where Ge is one of the two main commodities with Zn). For answering the question, the user will need to obtain information on (1) deposits: (i) status, (ii) past production, reserves and resources, (iii) the metallogenic type of the deposit, (iv) the mineralogy of the ore, (v) the host rock formation name, (vi) the host rock type, and (2) on mining wastes (mainly for ancient/abandoned mines) with: (i) the type of processing, (ii) the type of waste, (iii) the mineralogy of waste and (iv) the characterization of waste (volume, tonnage, grade).

Use Case Description	
	Name
Ge in Europe: where to find it?	Primary actor

Use Case Description	
Public - economic sector, a politician technical/scientific adviser, geoscientist, scientific journalist	Goal
The user will need to obtain information on (1) deposits: (i) status, (ii) past production, reserves and resources, (iii) the metallogenic type of the deposit, (iv) the mineralogy of the ore, (v) the host rock formation name, (vi) the host rock type, and (2) on mining wastes (mainly for ancient/abandoned mines) with: (i) the type of processing, (ii) the type of waste, (iii) the mineralogy of waste and (iv) the characterization of waste (volume, tonnage, grade).	System under consideration
The (computer) system that the actor interacts with for executing the use case, a stand-alone or a web-based GIS or CAD system.	Importance
High	Description

Use Case Description	
Answering the question "Where is Ge in Europe?",implies to get information on both ancient mines for their wastes and on deposits currently exploited. Information on mineralogy (e.g., presence of Ge minerals, presence of low-iron sphalerite and other sulphur minerals known to be significant Ge sources in some deposits [enargite, bornite, tennantite-tetrahedrite, luzonite, sulvanite and colusite]) can also be important as it can help to identify deposits/occurrences where Ge, not yet identified, could be present.	Pre-condition
Mineral resources data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a "mapping" between geological /metallogenic/mining terms and user's terms done by the data provider.	Post-condition
Step 1.	Selection of the area (by adding countries, or graphically)
Step 2.	Selection of the commodity (main / secondary)

Use Case Description	
Step 3.	Selection of the class of deposit to visualize: class A (the largest) only, class AB, class ABC, all (including occurrences)
Step 4.	Selection of the other parameters to be displayed when clicking on a deposit/waste: Name, Country, Status, Past production, reserves and resources, Metallogenic type of the deposit, Mineralogy of the ore, Host rock formation name (from the Mineral deposit database), Host rock type (from the Mineral deposit database), Type of processing, Type of waste, Mineralogy of waste, Characterization of waste
Step 5.	The user checks the quality of information for some interesting deposit/waste (clicking on the point)
Step 6.	The user wants (1) to plot deposits and wastes which could contain Ge, using mineralogy (from deposit AND from waste): selection of deposits and wastes based on the presence of certain minerals and (2) to add this new selection to the former one
Step 7.	The user checks the quality and the nature of information for some deposit/waste newly added (clicking on the point)
Step 8.	The user downloads the selected deposits/wastes with the selected parameters.
Flow of Events – Alternative Paths	
…	
Data set: precious metals	
Description	Mineral deposit and waste data from national sources.
Type	input|output|intermediate
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Mineral resources
Scale, resolution	Scale relevant to the application
Delivery	FTP download, WFS, or WCS according to "INSPIRE Mineral resources GML Application schema"
Documentation	Metadata about source, quality and source of archived historical exploration documents.

Requirements from the use case

Analysing the use case, there is a need to provide the following objects and attributes:

Mineral deposits with:

- ID

- Name
- Country
- Status
- Main Commodity
- Secondary commodity
- Past production, reserves and resources
- Metallogenic type of the deposit
- Mineralogy of the ore
- Host rock formation name (from the Mineral deposit database)
- Host rock type (from the Mineral deposit database)

Mining wastes (object "Mine") with:

- Type of processing
- Type of waste
- Mineralogy of waste
- Characterization of waste (for each commodity: Volume, Tonnage, Grade)

Relationship with other INSPIRE Themes

This use case has some relationships with the following INSPIRE data themes:

- Protected sites: to open or to expand a quarry to extract building material it is mandatory to take into account Protected Sites
- Population distribution - demography: to know the future needs for building material a simple rule is to know the number of inhabitants
- Transport networks: the distance between production and consumption areas, and the road network capacity and constraints are very important to know.

B.3. A manufacturer looking for GCC?

This use case is related to example of use:

- MR-01: Mineral exploration.

Overview and involved actors

This use case is dealing with Industrial Minerals and Rocks. A manufacturer is looking for the closest producers of Ground Calcium Carbonate (GCC), allowing elaborating filler for the paper industry.

Narrative description

Ground Calcium Carbonate is used as filler mainly in the paper industry. More precisely, the user is

looking for specific quality of GCC allowing elaborating coating. Geologically speaking, GCC correspond to white limestones. Such limestones have very distinct properties compared to all other limestones used in the industry (aggregates, lime, fertilizer, fluxing agent, etc.). Required physical properties are very precise:

- Whiteness: 88 to 96 %;
- Yellowness: 1.5 to 3 (no unit, it's a ratio);
- Aspect ratio: 10 m^2/g;

Abrasivity: 4 mg.

Use Case Description	
Name	A manufacturer looking for GCC.
Primary actor	Public - economic sector, a politician technical/scientific adviser, geoscientist, scientific journalist
Goal	The user will need to obtain information on (1) deposits: (i) status, (ii) past production, reserves and resources, (iii) the metallogenic type of the deposit, (iv) the mineralogy of the ore, (v) the host rock formation name, (vi) the host rock type, and (2) on mining wastes (mainly for ancient/abandoned mines) with: (i) the type of processing, (ii) the type of waste, (iii) the mineralogy of waste and (iv) the characterization of waste (volume, tonnage, grade).
System under consideration	The (computer) system that the actor interacts with for executing the use case, a stand-alone or a web-based GIS or CAD system.
Importance	High
Description	The user views a map (background can be a DEM with political boundaries, or a geographic map or a geological map) with all white limestone deposits having the required properties. This information uses a vocabulary which fits to the user's requirements.
Pre-condition	Mineral resources data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a "mapping" between geological /metallogenic (including Industrial Minerals & Rocks)/mining terms and user's terms done by the data provider (notably in this use case between GCC and limestone).
Post-condition	The user has a listing and a map of selected deposits
Flow of Events – Basic Path	
Step 1.	Selection of the area (by adding countries, or graphically)
Step 2.	Selection of the commodity
Step 3.	Selection of the status (operating mine/quarry)
Step 4.	Selection of the properties (at least, at this stage, a use)

Use Case Description	
Step 5.	Selection of the other parameters to be displayed when clicking on a deposit/waste: Entry date, Revision date, Name, Country, Status, Owner, Properties (physical properties including Color, Whiteness, Yellowness, Aspect ratio, Abrasivity), Production per year and reserves
Step 6.	The user checks the quality of information for closest deposits (clicking on the point)
Step 7.	The user downloads the selected deposits with the selected parameters.
Flow of Events – Alternative Paths	
…	
Data set: precious metals	
Description	Mineral deposit and waste data from national sources.
Type	input|output|intermediate
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Mineral resources
Scale, resolution	Scale relevant to the application
Delivery	FTP download, WFS, or WCS according to "INSPIRE Mineral resources GML Application schema"
Documentation	Metadata about source, quality and source of archived historical exploration documents.

Requirements from the use case

Analysing the use case, there is a need to provide the following objects and attributes:

Mineral deposits with:

- ID
- Entry date (to ensure that information is still valid)
- Revision date (to ensure that information is still valid)
- Name
- Country
- Status
- Owner
- Main commodity
- Properties (Use, physical properties including Color, Whiteness, Yellowness, Aspect ratio, Abrasivity)

- Production per year* / reserves / resources

**This is an example for which the production per year is required. In most of the cases, this is the cumulated past production which is required in order to be able to re-actualize the reserves figures.*

Relationship with other INSPIRE Themes

This use case has some relationships with the following INSPIRE data themes:

- Protected sites: to open or to expand a quarry to extract building material it is mandatory to take into account Protected Sites.
- Transport networks: the distance between production and consumption areas, and the road network capacity and constraints are very important to know.

B.4. Environmental uncertainties related to mining wastes

This use case is related to example of use:

- MR-01: Mineral exploration.

Overview and involved actors

This use case is strongly linked with the **DIRECTIVE 2006/21/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC.** The document gives a clear definition of wastes from the extractives industries: tailings (i.e. the waste solids or slurries that remain after the treatment of minerals by a number of techniques), waste rock and overburden (i.e. the material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage), and topsoil (i.e. the upper layer of the ground) provided that they constitute waste as defined in Council Directive 75/442/EEC of 15 July 1975 on waste.

In order to prevent major accidents, it is particularly important to get a precise idea both of the mineralogical composition of the ore and the presence of potentially harmful elements (e.g., As, Hg, Cd, Se, Ni, etc.) and of the type of processing and thus the products which were used. The mineralogical composition of the ore is important because the wastes may contain low grade mineralization.

Getting this information is of interest for several actors, including Regional authorities, environmental agencies, and also the general public.

Narrative description

In several mining countries and regions, mining wastes from ancient exploitations are more or less abandoned, without any real or efficient protection perimeter. Most of the time they were located in the countryside, surrounded by acres of grassland. However, population increase and the development of urban zones may seriously modify land use and strongly reduce the distance between the wastes and centers of human activity. In such cases, it becomes urgent to evaluate 'the

risk' for the population to live close to these anthropogenic concentrations.

For answering the question, the user will need to obtain information on (1) deposits: (i) name, (ii) main commodity, (iii) secondary commodities, (iv) the mineralogy of the ore, (v) harmful constituents, (2) on mining wastes with: (i) name, (ii) the type of processing, (iii) the type of waste, (iv) the mineralogy of waste and (v) the characterization of waste (volume, tonnage, grade – **per element/commodity**), and (3) environmental impacts already noticed (with - ideally - **per environmental impact**: a) pathways: type of environmental pathways, b) receptors: type of environmental receptors, c) water treatment: management and treatment processes and structures of water and d) restoration: description of restoration used).

Use Case Description	
Name	Environmental uncertainties related to mining wastes.
Primary actor	Public - economic sector, a politician technical/scientific adviser, geoscientist, scientific journalist
Goal	The user will need to obtain information on (1) deposits: (i) status, (ii) past production, reserves and resources, (iii) the metallogenic type of the deposit, (iv) the mineralogy of the ore, (v) the host rock formation name, (vi) the host rock type, and (2) on mining wastes (mainly for ancient/abandoned mines) with: (i) the type of processing, (ii) the type of waste, (iii) the mineralogy of waste and (iv) the characterization of waste (volume, tonnage, grade).
System under consideration	The (computer) system that the actor interacts with for executing the use case, a stand-alone or a web-based GIS or CAD system.
Importance	High
Description	The user views a map (background can be a DEM with political boundaries, or a geographic map or a geological map) with all mining wastes at the region scale or on a more limited area, select the parameters to be displayed when clicking, check information, select wastes sites of interest (multi-criteria selection) and related mineral deposits. This information uses a vocabulary which fits to the user's requirements.
Pre-condition	Mineral resources data are available in line with INSPIRE specifications. A specific vocabulary related to the user requirements is available with a "mapping" between geological /metallogenic/mining terms and user's terms done by the data provider.
Post-condition	The user has a listing and a map of selected deposits/wastes
Flow of Events – Basic Path	
Step 1.	Selection of the area (graphically) and display of mining wastes sites
Step 2.	Selection of parameters to be displayed when clicking waste site: Name, Type of processing, Type of waste, Mineralogy of waste, Characterization of waste (volume, tonnage, grade), and Environmental impacts
Step 3.	The user checks the information for waste sites (clicking on the point)

Use Case Description	
Step 4.	Selection of waste sites based on Mineralogy and on Element/commodity contained … (multi-criteria selection)
Step 5.	Selection of deposits related to this waste sites selection
Step 6.	Selection of parameters to be displayed when clicking mineral deposit: Name, Main commodity, Secondary commodities, Mineralogy of the ore, Harmful constituents
Step 7.	The user checks that information on both mineral deposits and related mining wastes sites is coherent (clicking on the point)
Step 8.	The user downloads the selected deposits/wastes with the selected parameters
Flow of Events – Alternative Paths	
…	
Data set: precious metals	
Description	Mineral deposit and waste data from national sources.
Type	input|output|intermediate
Data provider	Each Member State
Geographic scope	All EU Member States, with appropriate cross border cooperation where necessary
Thematic scope	Mineral resources
Scale, resolution	Scale relevant to the application
Delivery	FTP download, WFS, or WCS according to "INSPIRE Mineral resources GML Application schema"
Documentation	Metadata about source, quality and source of archived historical exploration documents.

Requirements from the use case

Analysing the use case, there is a need to provide the following objects and attributes:

Mineral deposits with:

- ID
- Name
- Main Commodity
- Secondary commodity
- Mineralogy of the ore
- Harmful constituants

Mining wastes (object "Mine") with:

- ID
- Name
- Type of processing
- Type of waste
- Mineralogy of waste
- Characterization of waste (for each commodity: Volume, Tonnage, Grade)
- Environmental impact

Relationship with other INSPIRE Themes

This use case has some relationships with the following INSPIRE data themes:

- Population distribution - demography: to estimate spreading of urban zones and possible juxtaposition to potentially dangerous sites
- Land use change in land use from agricultural to urban area

Annex C: Code list values - (normative)

INSPIRE Application Schema 'MineralResources'

Code List
ClassificationMethodUsedValue
CommodityCodeValue
EndusePotentialValue
ExplorationActivityTypeValue
ExplorationResultValue
ImportanceValue
MineStatusValue
MineralDepositGroupValue
MineralOccurrenceTypeValue
MiningActivityTypeValue
ProcessingActivityTypeValue
ReserveCategoryValue
ResourceCategoryValue

ClassificationMethodUsedValue

Definition:	Codes indicating the means used to calculate the ore measurement.
Description:	EXAMPLE: JORC, PERC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ClassificationMethodUsedValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

CommodityCodeValue

Definition:	Values indicating the type of commodity.
Description:	EXAMPLE: Cu, Au, Dimension Stone etc.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/CommodityCodeValue
Values:	The allowed values for this code list comprise any values defined by data providers.

The INSPIRE Registry includes recommended values that may be used by data providers. Before creating new terms, please check if one of them can be used.

EndusePotentialValue

Definition:	Values indicating the end-use potential of the mineral.
Description:	EXAMPLE: for energy, fertilizer, building raw material etc.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/EndusePotentialValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

The INSPIRE Registry includes additional recommended values that may also be used by data providers. Before creating new terms, please check if one of them can be used.

ExplorationActivityTypeValue

Definition:	Types of exploration activity carried out.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ExplorationActivityTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

ExplorationResultValue

Definition:	Values indicating the result of the exploration activity.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ExplorationResultValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

ImportanceValue

Definition:	Values indicating the importance of the commodity for the Earth Resource.
Description:	Such a ranking is based on a statistical study of a large set of deposits throughout the world to ensure that it is valid. It is made using histograms allowing for each commodity to define class boundaries and what is a very large, a large, a medium-sized etc. deposit for this commodity.. This classification is based on the potential or endowment: reserves resources.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/ImportanceValue
Values:	The allowed values for this code list comprise any values defined by data providers.

The INSPIRE Registry includes recommended values that may be used by data providers. Before creating new terms, please check if one of them can be used.

MineStatusValue

Definition:	Values indicating the operational status of the mine.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/MineStatusValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

MineralDepositGroupValue

Definition:	Values indicating the grouping of mineral deposits on the basis of their generic characteristics.
Description:	EXAMPLE: host rock, host structure, commodity, association with similar mineral processes e.g. porphyry.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/MineralDepositGroupValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

MineralOccurrenceTypeValue

Definition:	The type of mineral occurrence.
Extensibility:	any
Identifier:	http://inspire.ec.europa.eu/codelist/MineralOccurrenceTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

MiningActivityTypeValue

Definition:	The type of mining activity, processing activity, or production.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/MiningActivityTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

ProcessingActivityTypeValue

Definition:	Values indicating the type of processing carried out during a mining activity.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ProcessingActivityTypeValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

The INSPIRE Registry includes additional recommended values that may also be used by data providers. Before creating new terms, please check if one of them can be used.

ReserveCategoryValue

Definition:	The level of confidence of the estimate of the reserve.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ReserveCategoryValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

ResourceCategoryValue

Definition:	Indication whether the resource is measured, indicated, or inferred.
Extensibility:	open
Identifier:	http://inspire.ec.europa.eu/codelist/ResourceCategoryValue
Values:	The allowed values for this code list comprise the values specified in the INSPIRE Registry and additional values at any level defined by data providers.

Annex D: Data model extensions - (informative)

D.1. Introduction

The INSPIRE *Mineral Resources* data model provides the main object types and properties requested by all examples of use: the location of mineral resources (Mines and Earth Resources), the main commodities, and the exploitation type to be provided via INSPIRE services. However for many use cases a wider range of more detailed earth resource related information might be required.

D.2. Use of EarthResourceML

The data specification for *Mineral Resources* (MR) is based closely on the EarthResourceML v2 (*http://www.earthresourceml.org/*) model that describes Earth Resources independent of associated human activities, permitting description using mineral deposit models encompassing internationally recognised deposit classifications, mineral systems and processes. EarthResourceML v1 was developed by the Australian Chief Government Geologists Committee (CCGC) but is now under the governance of the Commission for Geoscience Information (CGI), a commission of the International Union of Geological Sciences (IUGS), which has developed EarthResourceML v2.

The current version of the EarthResourceML – v 2.0 integrates all the classes of the INSPIRE MR core data model. However the unique encoding solution to fully address both INSPIRE and EarthResourceML requirements still needs to be tested by the wider stakeholder community as part of the INSPIRE Maintenance and Implementation Framework. Based on the results, it should be discussed whether the current default INSPIRE encoding (see Section 9.3.1.) can be replaced by the EarthResourceML encoding. More information on the use of EarthResourceML for INSPIRE is at:

http://www.earthresourceml.org.

D.3. Mineral Resources Extension

In this Section the conceptual extension of the scope of the INSPIRE MR core data model is described. This model demonstrates the extensibility of the MR core data model (MineralResources) to meet additional requirements e.g. the Raw Materials Initiative and the Mining Waste Directive, both of which are described in Annex E.

NOTE ***For this conceptual extension the use of GeoSciML v3.2 is required. In order to make this extension fully INSPIRE-based further work as well as testing by the wider stakeholder community in the framework of the INSPIRE Maintenance and Implementation is needed.***

The following types/attributes describe **Mining Waste** and Mining Waste Measure:

- Waste type;
- Material;

- Storage type;
- Waste measures (density, grade per commodity, volume);
- Environmental Impact.

The following types/attributes describe **Products:**

- Product;
- Grade;
- Production;
- Recovery.

The following types/attributes describe **Mined Material:**

- Material;
- Raw Material Role;
- Proportion.

The following types/attributes describe the **composition** of the Earth Resource with Earth Resource

Material:

- Material as Earth Material utilizing the GeoSciML v3.2 definition.
- Proportion of the material in the earth resource
- Role of the material described (host rock, alteration product, …)

The MineralResourcesExtension model uses classes from the GeoSciML v3.2 EarthMaterial and PhysicalProperties packages.

- Inventory and **characterization of mining wastes**. Mining wastes and tailings represent a considerable potential source for strategic (high-tech, green, critical) commodities. Such commodities have not been taken into consideration by former exploitations for several reasons such as the lack of use of these commodities at that time, the lack of efficient industrial process for their recovery, or their cost. Locating and characterizing (industrial process used, grade, volume, etc.) these wastes is important and addresses EC questions about their recycling.
- Industrial minerals and rocks: besides the need for particular parameters for a proper description such as geological properties, mechanical behaviour, quality aspects, usage, some other parameters are required like commercial varieties and names.
- Importance of mineralogy for properly describing the ore, the gangue and hydrothermal alterations. Mineralogy data are for example of primordial importance when querying a database on the high-tech metal potential of certain deposits where they have not yet been identified.

D.3.1. Summary

In the MineralResourcesExtension schema there are additional Earth Resource classes: *MiningWaste and MiningWasteMeasure, MinedMaterial and Product and MineralSystem,*

SupergeneProcesses, and *EarthResourceMaterial.*

D.3.2. Mine Extension: Mining Waste, Product and Mined material

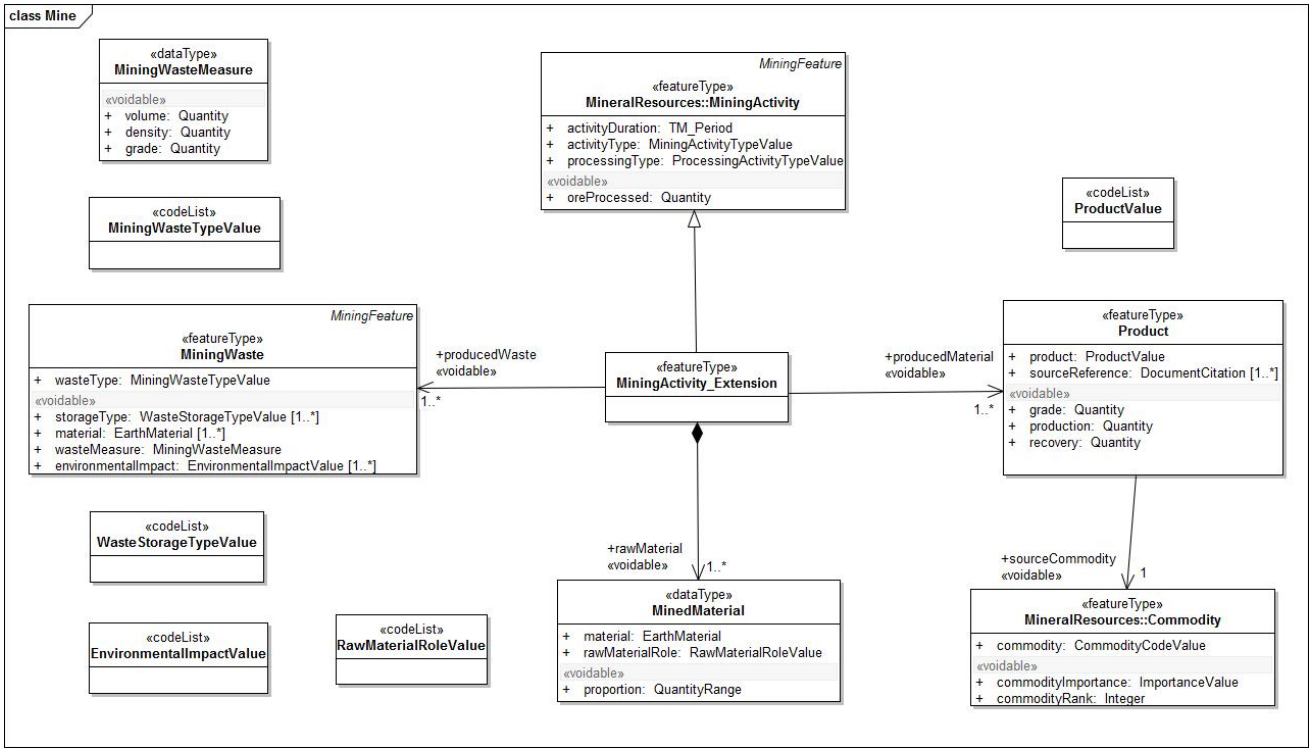

Figure 6 – UML class diagram: Mine Extension (Mining Waste, Product and Mined material)

MiningWaste is added as another type of *MiningFeature.* Mining waste can be defined as a part of the materials that result from the exploration, mining and processing of substances governed by legislation on mines and quarries.

The *producedMaterial* association from *MiningActivity* to *Product* allows the type and amount of end-use products associated with a Mining Activity to be described.

The *sourceCommodity* association from *Product* to *Commodity* describes the Commodity that was used to create the end-use Product.

The *rawMaterial* association from *MiningActivity* to *MinedMaterial* allows the description of the raw materials of a Mining Activity. The Raw Material can be composed of one or more Mined Materials.

D.3.3. EarthResource material, mineral system, and supergene process

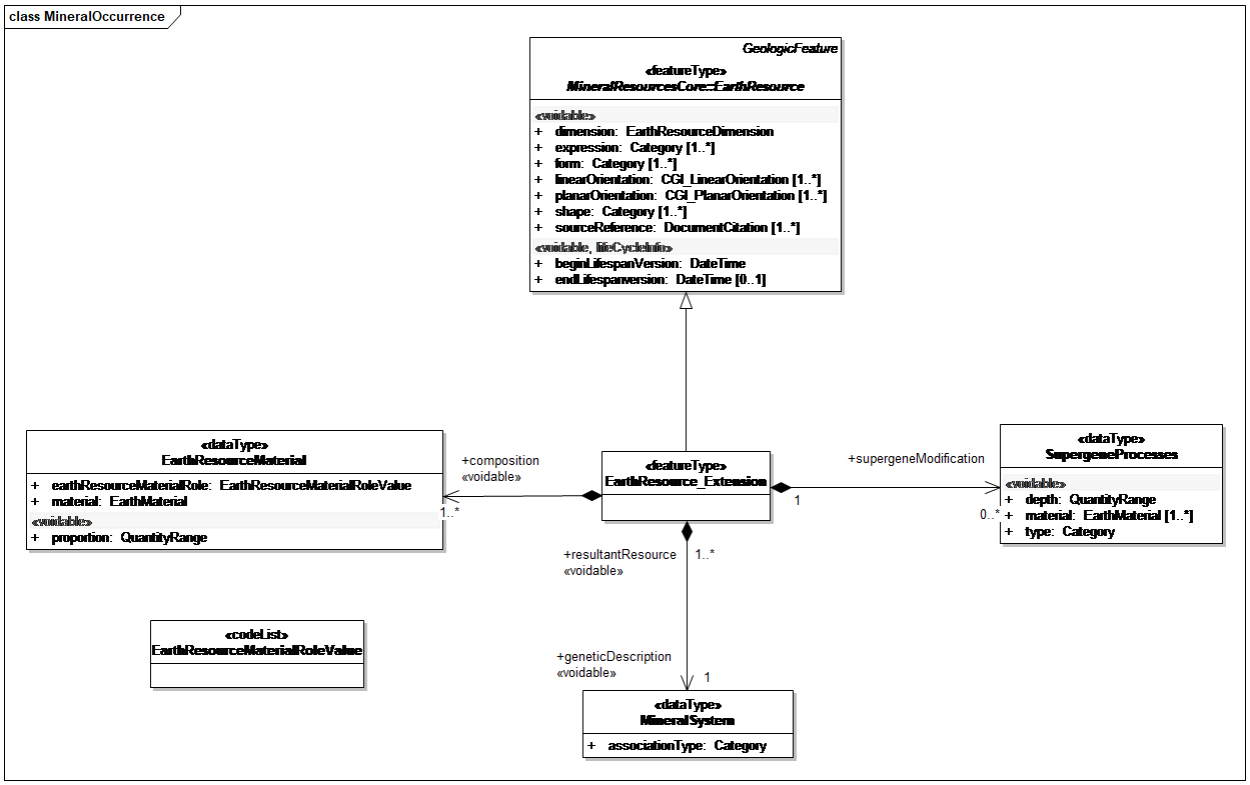

Figure 7 – UML class diagram: Earth Resource material

The *geneticDescription* association from *EarthResource* to *MineralSystem* allows all geological features that control the generation and preservation of the mineral deposits associated with the Earth Resource to be described.

The *supergeneModification* association from *EarthResource* to *SupergeneProcesses* allows the description of the metal enrichment produced by the chemical remobilisation of elements in an oxidised or transitional environment, if this has occurred.

The *composition* association from *EarthResource* to *EarthResourceMaterial* allows the material of economic interest found in the earth, or produced from the earth, to be described. The Earth Resource can be composed of one or more Earth Resource Materials.

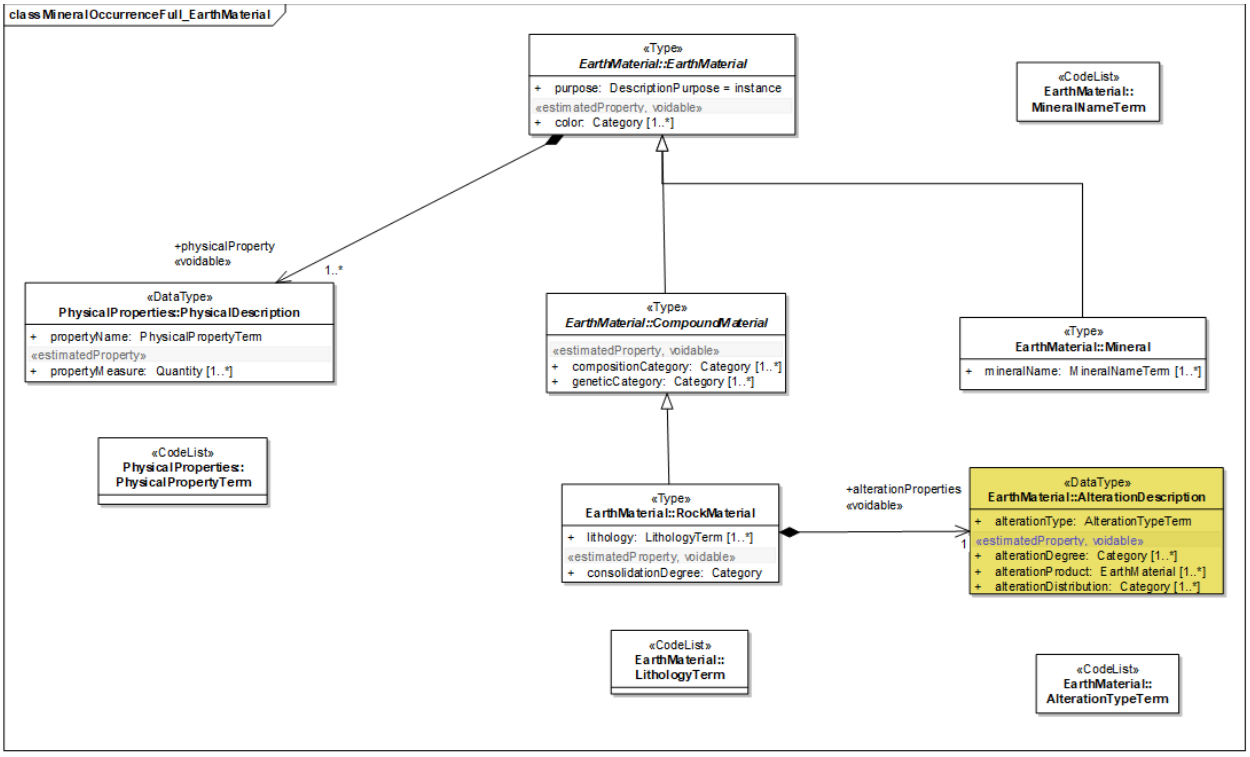

Figure 8 – UML class diagram: Earth Material

The MineralResourcesExtension application schema uses *EarthMaterial* from GeoSciML to allow a full description of rock and mineral materials. The figure illustrates the use of *EarthMaterial* in the application schema.

EarthMaterial is an abstract class which holds a description of a naturally occurring substance in the Earth. Earth Material represents material composition or substance, and is thus independent of quantity or location. Ideally, Earth Materials are defined strictly based on physical properties, but because of standard geological usage, genetic interpretations may enter into the description as well. *EarthMaterial* has two properties:

- Purpose: Specification of the intended purpose/level of abstraction for the given EarthMaterial.
- Color: Terms to specify color of the earth material. Color schemes such as the Munsell rock and soil color schemes could be used

The *physicalProperty* association from *EarthMaterial* to *PhysicalDescription* allows the description of any of the numeric physical properties of the Earth Material (eg; density, porosity, magnetic susceptibility, remanent magnetism). *PhysicalDescription* has two properties:

- Property Name: A term from a controlled vocabulary of physical properties of Earth Materials (eg; density, porosity, magnetic susceptibility, remanent magnetism, permeability, seismic velocity)
- Property Measure: A scalar or vector measurement of the physical property of an Earth Material

EarthMaterial has two sub-types which are relevant to *Mineral Resources*, *CompoundMaterial* and *Mineral*.

Mineral is defined as any naturally occurring inorganic element or compound having a periodically

repeating arrangement of atoms and a characteristic chemical composition or range of compositions, resulting in distinctive physical properties. Includes mercury as a general exception to the requirement of crystallinity. Also includes crypto-crystalline materials such as chalcedony and amorphous silica. Mineral has one property:

- Mineral Name: Name of the mineral (eg: orthoclase) or mineral family (eg: feldspar), approved by the International Mineralogical Association. (eg: http://www.mindat.org/mineralindex.php)

CompoundMaterial is an Earth Material composed of particles composed of other Earth Materials, possibly including other Compound Materials. *CompoundMaterial* has two properties:

- Composition Category: Term to specify the gross compositional character of a compound material. Composition as used here is loosely construed to include both chemical composition and petrograpic composition, thus multiple values may be applied to a single rock, e.g. metaluminous and alkalic, undersaturated and basic, etc. Terms would typically include broad chemical classifications such as silicate, carbonate, ferromagnesian, oxide. However, this attribute may have different terminology for different kinds of rocks - for example sandstone petrographic classification terms
- Genetic Category: A term that represents a summary geologic history of the material (ie, a genetic process classifier term). Examples include igneous, sedimentary, metamorphic, shock metamorphic, volcanic, pyroclastic

In the *Mineral Resources* data model the only type of *CompoundMaterial* included is *RockMaterial*, and it is expected that most Earth Material descriptions will be given in terms of *RockMaterial*. *RockMaterial* is a specialized *CompoundMaterial* that includes consolidated and unconsolidated materials as well as mixtures of consolidated and unconsolidated materials. It has two properties:

- Consolidation Degree: A property that specifies the degree to which an aggregation of EarthMaterial particles is a distinct solid material. Consolidation and induration are related concepts specified by this property. They define a continuum from unconsolidated material to very hard rock. Induration is the degree to which a consolidated material is made hard, operationally determined by how difficult it is to break a piece of the material. Consolidated materials may have varying degrees of induration
- Lithology: A controlled concept indicating the name of the RockMaterial type (eg, quartz sandstone, basalt, muscovite schist, sand, mud, soil, saprolite)

The *alterationProperties* association from *RockMaterial* to *AlterationDescription* allows the description of any alteration that the Rock Material has undergone. *AlterationDescription* has four properties:

- Alteration Type: a general description of the dominant alteration mineralogy or alteration type, in common usage. Examples include: argillic, phyllic, potassic, propylitic, calc-silicate, skarn, deuteric, greisen, serpenitisation, weathering, etc
- Alteration Degree: a term to specify degree of modification from original material, (eg: weak, moderate, strong, intense)
- Alteration Product: the material result of alteration processes, e.g. alteration minerals, saprolite, ferricrete, clay, calcrete, skarn, etc. Materials observed in a soil profile could be identified using this property.

- Alteration Distribution: the spatial distribution or geometry of alteration zones, eg: patchy, spotted, banded, veins, vein breccia, pervasive, disseminated, etc

Annex E: Analysis of related legislation - (informative)

Several directives, communications or documents published by the European Commission are concerned with or refer to mineral resources:

E.1. The raw materials initiative (2008)

The raw materials initiative — Meeting our critical needs for growth and jobs in Europe \{SEC(2008) 2741}. Communication COM(2008) 699. (text underlined in grey is of particular interest for INSPIRE)

In this document, the Commission notices that there has been no integrated policy response at EU level up to now to ensure that it has sufficient access to raw materials at fair and undistorted prices. It is proposed that the EU should agree on an integrated raw materials strategy. Such a strategy should be based on the following 3 pillars:

1. ensure **access to raw materials** from international markets under the same conditions as other industrial competitors;
2. set the right **framework conditions** within the EU in order to foster sustainable supply of raw materials from European sources;
3. boost overall resource efficiency and promote recycling to **reduce the EU's consumption of primary raw materials** and decrease the relative import dependence.

Two points are of particular interest for INSPIRE:

1. The sustainable supply of raw materials based in the EU requires that **the knowledge base** of mineral deposits within the EU will be improved. In addition, the long term access to these deposits should be taken into account in land use planning. Therefore the Commission recommends that the national **geological surveys** become more actively involved in land use planning within the Member States.
2. The Commission recommends better networking between the national geological surveys to facilitate the exchange of information and improve the interoperability of data and their dissemination, with particular attention to the needs of SMEs.

The document also stresses on the fact that the EU is highly dependent on imports of *"high-tech" metals* such as cobalt, platinum, rare earths, and titanium. Though often needed only in tiny quantities, these metals are increasingly essential to the development of technologically sophisticated products in view of the growing number of their functionalities. These metals play a critical role in the development of innovative "environmental technologies" for boosting energy efficiency and reducing greenhouse gas emissions. **It is worth knowing that these *"high-tech" metals* generally appear as secondary commodities in a deposit and that they may be present in mining wastes, tailings, smelter residues, etc., i.e. anthropogenic concentrations s.l.**

Furthermore, the Commission recommends that an integrated European strategy should, as a priority action, define critical raw materials for the EU.

The raw materials initiative - Critical raw materials for the EU. Report of the Ad-hoc Working Group on defining critical raw materials.

Although raw materials are essential for the EU economy, their availability is increasingly under pressure. Within the framework of the EU Raw Materials Initiative, it was decided to identify a list of critical raw materials at EU level, in close cooperation with Member States and stakeholders.

This report analyses a selection of 41 minerals and metals. In line with other studies, the report puts forward a **relative concept of criticality**. This means that raw material is labelled "critical" when the risks for supply shortage and their impacts on the economy are higher compared with most of the other raw materials. **Two types of risks** are considered: a) the **"supply risk"** taking into account the political-economic stability of the producing countries, the level of concentration of production, the potential for substitution and the recycling rate; and b) the **"environmental country risk"** assessing the risks that measures might be taken by countries with weak environmental performance in order to protect the environment and, in doing so, jeopardise the supply of raw materials to the EU. Building on existing approaches, this report sets out an innovative and pragmatic approach to determining criticality. In particular,

- It takes into **account the substitutability between materials**, i.e. the potential for substitution of a restricted raw material by another that does not face similar restrictions.
- It deals with **primary and secondary raw materials**, the latter being considered as similar to an indigenous European resource.
- It introduces a logical way to aggregate indicators and makes use of widely recognised indexes.
- It presents a transparent methodology.

Due to their high relative economic importance and to high relative supply risk, the Group has established a **list of 14 critical raw materials at EU level** (in alphabetical order):

Antimony	Indium
Beryllium	Magnesium
Cobalt	Niobium
Fluorspar	PGMs (Platinum Group Metals)
Gallium	Rare earths
Germanium	Tantalum
Graphite	Tungsten

Among the various recommendations made by the Group, one shall retain more particularly the following points:

- improving the availability of reliable, **consistent statistical information** in relation to raw materials;
- promoting the dissemination of this information, notably by preparing a **European Raw Materials Yearbook** with the involvement of national geological surveys and mining/processing industries. It should in particular aim at improving the knowledge on the availability of resources and on their flow into products through the value-added chains of the

EU economies;

- establishing indicators of **competition to land** in the Member States.

The Group recommends **policy actions** to improve **access to primary resources** aiming at:

- supporting the findings and recommendations resulting from the work carried out by the ad hoc working group on "Best practices in the area of land use planning and permitting" with the view to **securing better access to land**, fair treatment of extraction with other competing land uses and more streamlined permitting processes;
- **promoting exploration**, and ensuring that exploration by companies is regarded as research activities;
- **promoting research on mineral processing**, extraction from old mine dumps, mineral extraction from deep deposits, and mineral exploration in general, notably under EU RTD Framework Programmes.

The raw materials initiative - Actions 6 & 7. Improving framework conditions for extracting minerals from the EU. Exchanging best practice on land use planning, permitting and geological knowledge sharing

The work detailed in this report has been undertaken with regards to actions 6 and 7 of the Raw Materials Initiative, linked to the second pillar of the Initiative (Set the right **framework conditions** within the EU in order to foster sustainable supply of raw materials from European sources). Action 6 involves identifying actions to promote the exchange of best practices in the area of land use planning and administrative conditions for exploration and extraction. Action 7 involves better networking between national Geological Surveys with the aim of increasing the EU's know ledge base, and looking into the need to develop a medium to long term strategy for integrating sub-surface components into land services of the GMES Land Monitoring Core Service.

Recommendations of the working group (text underlined in grey is of particular interest for INSPIRE)

The group recommends a **National Minerals Policy** to ensure that the mineral resources are provided to society in an economically viable way, harmonised with other national policies, based on sustainable developments principles and including a commitment to provide a legal and information framework.

The **Minerals Planning Policy** is seen as key component of the national minerals policy. It should describe in detail the ways that future minerals supply will be secured and demonstrate a strong link to broader land use planning policy and regulation.

A **Sustainable Minerals Policy** shall be based on the principles of sustainable development and incorporate economic, environmental and social requirements.

Any land use policy for minerals must utilise a robust digital geological knowledge base ensuring fair and equal consideration of all potential uses of land including the eventual extraction of raw materials. Alongside information on the resource of local importance, a method for estimating the long term demand for these materials, and a means by which this can be translated into a spatial plan while recognising the contribution of recycled materials a needed.

The most important elements of the minerals exploration and extraction application process are: **clarity, understanding** and **certainty** of what needs to be provided in order to get authorisation for minerals exploration or extraction.

This can take the shape of a standardised application form or could be set out in legislation or guidance.

Speeding up the authorisation processes may be achieved through integrating the different permits required so that they are issued by one competent authority (a one -stop-shop) and with only one environmental impact assessment or by parallel assessment.

Codes of practice are important instruments to achieve **technical, social and environmental excellence**. Use of codes of practice, guidelines or equivalent by industry helps to ensure protection of the environment from adverse impacts of mineral extraction.

To improve the knowledge base of mineral deposits in the EU the need harmonised EU level data sets stands out. Better networking between the national Geological Surveys of Member States is the basis for cooperation between relevant institutions and the Geological Survey and driven by the need to:

- achieve synergies between the Geological Surveys;
- provide public data for policy making;
- facilitate investment in exploration and extraction;
- provide minerals intelligence;
- the networking must be structured, organised, long -term oriented and consensus based.

Standardised and accurate statistical data on world wide minerals production, imports and exports, and publication of this data on an annual basis. This would serve to analyse trends and help decision makers to better understand and monitor the EU's supply and demand situation and related risks.

GMES will provide parts of the needed satellite data for e.g. ground stability monitoring which could be processed into directly useful information for RMI by national institutes or value-adding industry in the Member States. Alternatively, GMES could also potentially directly provide such services while requiring an assessment of whether respecting the principle of subsidiarity, of costs, benefits, political priorities etc.

Medium to long term projects should base on experience gained (e.g. ProMine project) to develop future '3D-Europe' projects while focussing at first on the areas with known mineral potential.

The development of a pan-European programme of deep scientific boreholes data acquisition, processing and modelling should be considered as an important component of Europe's scientific infrastructure.

E.2. The Mining Waste Directive

DIRECTIVE 2006/21/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 March 2006 on the management of waste from extractive industries and amending Directive

2004/35/EC

The document reminds of decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme that sets as the objective for wastes that are still generated that the level of their hazardousness should be reduced and that they should present as little risk as possible, that preference should be given to recovery and especially to recycling, that the quantity of waste for disposal should be minimised and should be safely disposed of, and that waste intended for disposal should be treated as closely as possible to the place of its generation … Decision No 1600/2002/EC also sets as a priority action the promotion of sustainable management of extractive industries with a view to reducing their environmental impact.

The document also gives a clear definition of wastes from the extractives industries: tailings (i.e. the waste solids or slurries that remain after the treatment of minerals by a number of techniques), waste rock and overburden (i.e. the material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage), and topsoil (i.e. the upper layer of the ground) provided that they constitute waste as defined in Council Directive 75/442/EEC of 15 July 1975 on waste.

In article 5 "Waste management plan", it is clearly said that the objectives of the waste management plan shall be (among other) to encourage the recovery of extractive waste by means of recycling, reusing or reclaiming such waste, where this is environmentally sound in accordance with existing environmental standards at Community level and with the requirements of this Directive where relevant. **This point is particularly important because such wastes may contain *"high-tech / strategic metals"*. These wastes may represent under certain favourable conditions (volume, grade, …) not insignificant resources and thus might contribute to reduce the European deficit in these commodities.**

Annex II of the document deals with waste characterisation, and brings useful indications on how a "Mining waste" database should be structured:

The waste to be deposited in a facility shall be characterised in such a way as to guarantee the long-term physical and chemical stability of the structure of the facility and to prevent major accidents. The waste characterisation shall include, where appropriate and in accordance with the category of the waste facility, the following aspects:

1. **description of expected physical and chemical characteristics of the waste to be deposited in the short and the long term**, with particular reference to its stability under surface atmospheric/meteorological conditions, **taking account of the type of mineral or minerals to be extracted and the nature of any overburden and/or gangue minerals that will be displaced in the course of the extractive operations**;
2. classification of the waste according to the relevant entry in Decision 2000/532/EC, with particular regard to its hazardous characteristics;
3. description of the chemical substances to be used during treatment of the mineral resource and their stability;
4. description of the method of deposition;
5. waste transport system to be employed.

Annex F: Classification of Commodities - (informative)

The following table shows the combined CommodityValue and ImportanceValue code lists that is used for the Mineral resources layers styles recommended to be supported by INSPIRE view services (see Section 11.3).

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Abr	Abrasive minerals: garnet, staurolite (substance)	500 000	100 000	20 000	5 000	t (1,000 kg)
Ag	Silver (metal)	10 000	2 500	500	100	t (1,000 kg)
Aggr	Aggregate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrA	Alluvial aggregate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrC	Chert, siliceous concretion (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrM	Crushed aggregate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrMLst	Crushed aggregate from carbonate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrMMg	Crushed aggregate from magmatic rock (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrMSil	Crushed aggregate from sandstone, quartzite (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrSa	Sand, sand and gravel (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrSo	Very fine sand (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AgM	Aquamarine (substance)	10	5	0,5	0,1	t (1,000 kg)
Agt	Agata, chalcedony, jasper (substance)	1 000	100	10	1	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Al	Aluminium (Bauxite ore)	1 000 000 000	100 000 000	10 000 000	1 000 000	t (1,000 kg)
Alu	Alunite	5 000 000	1 000 000	200 000	10 000	t (1,000 kg)
Amb	Amber	10	5	0,5	0,1	t (1,000 kg)
Amt	Amethyst, quartz, citrine, aventurine (substance)	50	5	0,5	0,1	t (1,000 kg)
Amz	Amazonite, gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
And	Andalusite-kyanite group (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Anda	Andalusite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Ant	Antophyllite (Asbestos) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Apat	Apatite, gemstone ("cat’s eye"), (substance)	10 000 000	1 000 000	100 000	10 000	ct
As	Arsenic (metal)	200 000	20 000	2 000	200	t (1,000 kg)
Asb	Asbestos (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Attp	Attapulgite, sepiolite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Au	Gold (metal)	500	100	10	1	t (1,000 kg)
Be	Beryllium (BeO)	20 000	2 000	200	50	t (1,000 kg)
Bi	Bismuth (metal)	20 000	2 000	200	2	t (1,000 kg)
Bitum	Bituminous rocks (tons of oil)	1 000 000 000	100 000 000	10 000 000	1 000 000	t (1,000 kg)
Bnt	Bentonite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Bor	Borates (B2O3)	25 000 000	2 000 000	100 000	10 000	t (1,000 kg)
Br	Bromine (substance)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Brl	Beryl, gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
Brt	Barite (BaSO4)	5 000 000	1 000 000	200 000	50 000	t (1,000 kg)
Cal	Calcite, filler for paper (CaCO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Caopt	Calcite, optical use (CaCO3)	100	10	1	0,1	t (1,000 kg)
CBrl	Chrysoberyl, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Cd	Cadmium (metal)	10 000	2 000	500	100	t (1,000 kg)
Ce	Cerium (Ce2O3)	250 000	25 000	2 500	250	t (1,000 kg)
Chr	Chrysotile (Asbestos) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Chrys	Chrysoprase, green opal (substance)	10	1	0,1	0,01	t (1,000 kg)
Cly	Clays, unknown use (substance)	10 000 000	2 000 000	500 000	100 000	t (1,000 kg)
ClyC	Common clays for brick, tile (substance)	10 000 000	2 000 000	500 000	100 000	t (1,000 kg)
ClyCim	Clays for cement works (substance)	10 000 000	2 000 000	500 000	100 000	t (1,000 kg)
ClyR	White-firing clays (refractory & ceramic) (subst.)	5 000 000	1 000 000	200 000	50 000	t (1,000 kg)
Co	Cobalt (metal)	500 000	50 000	2 000	200	t (1,000 kg)
Coal	Coal, lignite (substance)	10 000 000 000	1 000 000 000	100 000 000	5 000 000	t (1,000 kg)
Cord	Iolite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
CorG	Corundum, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Cr	Chrome (Cr2O3)	25 000 000	5 000 000	1 000 000	200 000	t (1,000 kg)
Crn	Corundum (substance)	500 000	100 000	20 000	5 000	t (1,000 kg)
Cro	Crocidolite (Asbestos) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Cs	Cesium (Cs2O)	1 000	100	10	1	t (1,000 kg)
Cu	Copper (metal)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Diam	Diamond, industrial and gemstone (substance)	100 000 000	10 000 000	1 000 000	100 000	ct
Diop	Dioptase, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Dol	Dolomite (substance)	500 000 000	50 000 000	5 000 000	500 000	t (1,000 kg)
Dtm	Diatomite (kieselguhr) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Dum	Dumortierite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Em	Emerald (substance)	10 000 000	1 000 000	100 000	10 000	ct
Enst	Diopside-enstatite, gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
Eucl	Euclase, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Fe	Iron (metal)	1 000 000 000	100 000 000	10 000 000	1 000 000	t (1,000 kg)
Feld	Feldspar, nepheline (substance)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Fl	Fluorite or Fluospar (CaF2)	5 000 000	1 000 000	200 000	50 000	t (1,000 kg)
Ga	Gallium (metal)	100	50	10	1	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Gabb	Gabbro, dolerite, etc., ornamental (substance)	100 000 000	20 000 000	5 000 000	1 000 000	t (1,000 kg)
Ge	Germanium (metal)	500	100	20	5	t (1,000 kg)
GemP	Gemstones, general (substance)	10 000 000	1 000 000	100 000	10 000	ct
GemS	Semiprecious stone, general (substance)	10	5	0,5	0,1	t (1,000 kg)
Gp	Gypsum, anhydrite (substance)	500 000 000	50 000 000	5 000 000	500 000	t (1,000 kg)
Gr	Graphite (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Gran	Granite, syenite, etc., ornamental (substance)	100 000 000	20 000 000	5 000 000	1 000 000	t (1,000 kg)
Gres	Sandstone, quartzite (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
Gt	Garnet, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Hf	Hafnium (metal)	10 000	1 000	100	10	t (1,000 kg)
Hg	Mercury (metal)	50 000	5 000	500	100	t (1,000 kg)
HM	Heavy minerals, general (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
I	Iodine (substance)	10 000	1 000	100	10	t (1,000 kg)
In	Indium (metal)	500	100	25	5	t (1,000 kg)
Kimb	Kimberlite mineral markers	4	3	2	1	ct
Kln	Kaolin (substance)	50 000 000	10 000 000	2 000 000	500 000	t (1,000 kg)
Korn	Kornerupine, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Ky	Kyanite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Kya	Kyanite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Li	Lithium (Li2O)	1 000 000	100 000	50 000	5 000	t (1,000 kg)
Lst	Limestone, ornemental (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
LstC	Cement limestone (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
LstCr	Chalk (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
LstL	Limestone for lime (substance)	50 000 000	10 000 000	2 000 000	500 000	t (1,000 kg)
Lz	Lazulite, ornamental (substance)	500 000	200 000	50 000	10 000	t (1,000 kg)
Mal	Malachite (substance)	5 000	2 000	500	100	t (1,000 kg)
Mg	Magnesium, magnesite (MgCO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
MgCl	Magnesium, salts and brines (MgO)	100 000 000	20 000 000	5 000 000	500 000	t (1,000 kg)
Mica	Mica, sheet (substance)	100 000	20 000	5 000	500	t (1,000 kg)
Mn	Manganese (metal)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Mo	Molybdenum (metal)	500 000	100 000	5 000	1 000	t (1,000 kg)
Most	Moonstone (adularia), gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
Mrbl	Marble, ornemental (substance)	50 000 000	10 000 000	2 000 000	500 000	t (1,000 kg)
N/A	Commodity not available	0	0	0	0	t (1,000 kg)
Nasulf	Sodium sulphate (Na2SO4)	1 000 000	100 000	10 000	1 000	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Natr	Sodium carbonate (natron) (Na2CO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Nb	Niobium - columbium (Nb2O5)	1 000 000	100 000	10 000	2 000	t (1,000 kg)
Ni	Nickel (metal)	2 000 000	500 000	20 000	2 000	t (1,000 kg)
Nitr	Nitrates (NO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Olv	Peridot, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Opal	Opal, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Osir	Osmiridium (metal)	25	5	1	0,1	t (1,000 kg)
Ost	Other ornamental stone, except Gabb-Gran (subst.)	100 000 000	20 000 000	5 000 000	1 000 000	t (1,000 kg)
Pb	Lead (metal)	5 000 000	500 000	50 000	5 000	t (1,000 kg)
PbZn	Lead Zinc (metal)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Pd	Palladium (metal)	1000	100	10	1	t (1,000 kg)
Peat	Peat (substance)	500000000	50000000	5000000	500000	t (1000 kg)
Perl	Perlite (substance)	20 000 000	10 000 000	5 000 000	1 000 000	t (1,000 kg)
Phen	Phenakite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Phos	Phosphate (P2O5)	200 000 000	20 000 000	2 000 000	200 000	t (1,000 kg)
Pigmt	Mineral pigment (substance)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Pltd	Platinum group elements (PGE), group (metal)	1 000	100	10	1	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Pozz	Pumice, pozzolan (substance)	100 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
Pphy	Pyrophyllite (substance)	20 000 000	5 000 000	1 000 000	100 000	t (1,000 kg)
Pt	Platinum (metal)	1 000	100	10	1	t (1,000 kg)
Ptsh	Potash (sylvite, carnallite) (K20)	500 000 000	50 000 000	5 000 000	500 000	t (1,000 kg)
Py	Pyrite (FeS2)	100 000 000	20 000 000	5 000 000	200 000	t (1,000 kg)
Qtz	Massive quartz, blocks for ferrosilicon (SiO2)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Qtzopt	Quartz, optical & piezoelectrical use (SiO2)	100	10	1	0,1	t (1,000 kg)
QtzPk	Rose quartz (gemstone)	100	10	1	0,1	t (1,000 kg)
Rb	Rubidium (Rb2O)	1 000	100	10	1	t (1,000 kg)
Re	Rhenium (metal)	5 000	500	50	5	t (1,000 kg)
REE	Rare Earths (RE2O3)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Rh	Rhodium (metal)	25	5	1	0,1	t (1,000 kg)
Rhod	Rhodonite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Rub	Ruby (substance)	10 000 000	1 000 000	100 000	10 000	ct
S	Sulphur (substance)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
Salt	Rock salt (NaCl)	2 000 000 000	200 000 000	20 000 000	2 000 000	t (1,000 kg)
Saph	Sapphire (substance)	10 000 000	1 000 000	100 000	10 000	ct
Sb	Antimony (metal)	100 000	25 000	2 000	1 000	t (1,000 kg)
Sc	Scandium (metal)	1 000	100	10	1	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Scap	Scapolite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Se	Selenium (substance)	5 000	1 000	250	50	t (1,000 kg)
Silc	Silica, silica sand (substance)	10 000 000	2 500 000	500 000	100 000	t (1,000 kg)
Sill	Sillimanite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Sinh	Sinhalite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Slt	Slate (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Sn	Tin (metal)	200 000	25 000	1 000	100	t (1,000 kg)
Sod	Sodalite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Spl	Spinel, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Sr	Strontium (SrCO3 or SrSO4)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Suns	Sunstone, aventurine (Tiger’s eye), gemstone	10	1	0,1	0,01	t (1,000 kg)
Ta	Tantalum (Ta2O5)	25 000	2 000	1 000	200	t (1,000 kg)
Tanz	Tanzanite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Te	Tellurium (metal)	500	100	20	5	t (1,000 kg)
Th	Thorium (metal)	100 000	10 000	1 000	100	t (1,000 kg)
Ti	Titanium, general (TiO2)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
TiIlm	Titanium, ilmenite (TiO2)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
TiRt	Titanium, rutile (TiO2)	2 000 000	200 000	20 000	2 000	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Tl	Thallium (metal)	5 000	500	50	5	t (1,000 kg)
Tlc	Talc (substance)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
To	Tourmaline, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Tpz	Topaz (substance)	10	5	0,5	0,1	t (1,000 kg)
Trav	Travertine (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Trem	Tremolite-actinolite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Tsav	Tsavorite (green grossular), gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Turq	Turquoise (substance)	10	5	0,5	0,1	t (1,000 kg)
U	Uranium (metal)	100 000	20 000	5 000	500	t (1,000 kg)
V	Vanadium (metal)	2 000 000	200 000	20 000	2 000	t (1,000 kg)
Vesu	Vesuvianite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Vrm	Vermiculite (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
W	Wolfram (WO3)	200 000	50 000	5 000	500	t (1,000 kg)
Wol	Wollastonite (substance)	5 000 000	500 000	50 000	5 000	t (1,000 kg)
Y	Yttrium (Y2O3)	250 000	25 000	2 500	250	t (1,000 kg)
Zlt	Zeolites (substance)	1 000 000	200 000	50 000	10 000	t (1,000 kg)
Zn	Zinc (metal)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Zr	Zirconium (ZrO2)	1 000 000	100 000	10 000	1 000	t (1,000 kg)

Value	Name	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
ZrGm	Zircon, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)

[1] The common document template is available in the "Framework documents" section of the data specifications web page at http://inspire.jrc.ec.europa.eu/index.cfm/pageid/2

[2] For all 34 Annex I,II and III data themes: within two years of the adoption of the corresponding Implementing Rules for newly collected and extensively restructured data and within 5 years for other data in electronic format still in use

[3] The current status of registered SDICs/LMOs is available via INSPIRE website: http://inspire.jrc.ec.europa.eu/index.cfm/pageid/42

[4] Surveys on unique identifiers and usage of the elements of the spatial and temporal schema,

[5] The Data Specification Drafting Team has been composed of experts from Austria, Belgium, Czech Republic, France, Germany, Greece, Italy, Netherlands, Norway, Poland, Switzerland, UK, and the European Environment Agency

[6] The Thematic Working Groups have been composed of experts from Austria, Australia, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Romania, Slovakia, Spain, Slovenia, Sweden, Switzerland, Turkey, UK, the European Environment Agency and the European Commission.

[7] For Annex IIIII, the consultation and testing phase lasted from 20 June to 21 October 2011.

[8] Commission Regulation (EU) No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services, published in the Official Journal of the European Union on 8th of December 2010.

[9] The framework documents are available in the "Framework documents" section of the data specifications web page at http://inspire.jrc.ec.europa.eu/index.cfm/pageid/2

[10] UML – Unified Modelling Language

[11] Conceptual models related to specific areas (e.g. INSPIRE themes)

[12] In the case of the Annex IIIII data specifications, the extracted requirements are used to formulate an amendment to the existing Implementing Rule.

[13] The INSPIRE Glossary is available from http://inspire-registry.jrc.ec.europa.eu/registers/GLOSSARY

[14] OJ L 326, 4.12.2008, p. 12.

[15] The Implementing Rules and Technical Guidelines on INSPIRE Network Services are available at http://inspire.jrc.ec.europa.eu/index.cfm/pageid/5

[16] OJ L 274, 20.10.2009, p. 9.