INSPIRE
Infrastructure for Spatial Information in Europe

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

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Foreword
How to read the document?

This document describes the *"INSPIRE data specification on Mineral Resources - Guidelines"* version 2.0 as developed by the Thematic Working Group (TWG) ***Error! Unknown document property name.*** using both natural and a conceptual schema language. This version is now available for the public consultation. Based on the results of the consultation (received comments and the testing reports), the final version 3.0 will be prepared by the TWGs.

The data specification is based on a common template used for all data specifications and has been harmonised using the experience from the development of the Annex I data specifications.

This document provides guidelines for the implementation of the provisions laid down in the draft Implementing Rule for spatial data sets and services of the INSPIRE Directive.

This document includes two executive summaries that 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/will be responsible for implementing INSPIRE within the field of *Mineral Resources.*

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.*

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 will be 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 are being specified: metadata, interoperability of spatial data themes (as described in Annexes I, II, III of the Directive) and spatial data services, network services and technologies, 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[1] 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 within 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)[2], have provided reference materials, participated in the user requirement and technical[3] surveys, proposed experts for the Data Specification Drafting Team[4] and Thematic Working Groups[5].

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[1] 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

[2] Number of SDICs and LMOs on 8/6/2011 was 461 and 249 respectively

[3] Surveys on unique identifiers and usage of the elements of the spatial and temporal schema,

[4] 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 Environmental Agency

[5] The Thematic Working Groups of Annex II and III themes have been composed of experts from Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Romania, Slovakia, Spain, Sweden, Switzerland, Turkey, UK, the European Commission, and the European Environmental Agency

This open and participatory approach was successfully used during the development of the data specification on Annex I data themes as well as during the preparation of the Implementing Rule on Interoperability of Spatial Data Sets and Services[6] for Annex I spatial data themes.,

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 data specifications and provides a coherent set of requirements and recommendations to achieve interoperability. The pillars of the framework are four technical documents:

- The Definition of Annex Themes and Scope[7] 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[8] 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, a generic network model, some common code lists, etc. Those requirements of the Generic Conceptual Model that are directly implementable will be included in the Implementing Rule on Interoperability of Spatial Data Sets and Services.

- The Methodology for the Development of Data Specifications[9] 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"[10] 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.

Based on these framework documents and following the successful development of the Annex I Data specifications (Technical Guidelines) and the Implementing Rules, the new Thematic Working Groups have created the INSPIRE data specification for each Annex II and III theme. These documents – at the version 2.0 – are now publicly available for INSPIRE stakeholders for consultation. The consultation phase covers expert review as well as feasibility and fitness-for-purpose testing of the data specifications.

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[11].

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[12] developed for

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[6] 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.

[7] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.3_Definition_of_Annex_Themes_and_scope_v3.0.pdf*

[8] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.5_v3.3.pdf*

[9] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.6_v3.0.pdf*

[10] *http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/DataSpecifications/D2.7_v3.2.pdf*

[11] UML – Unified Modelling Language

[12] Conceptual models related to specific areas (e.g. INSPIRE themes)

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. They will be published (version 3.0) as technical guidelines and will provide the basis for the content of the Amendment of the Implementing Rule on Interoperability of Spatial Data Sets and Services for data themes included in Annex II and III of the Directive. The Implementing Rule Amendment will be extracted from the data specifications keeping in mind short and medium term feasibility as well as cost-benefit considerations. The Implementing Rule will be legally binding for the Member States.

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 description section. Reference material have been analysed, and particularly:

- Two legal texts providing requirements for the data specification:
  - The raw materials initiative
  - The management of waste from extractive industries
- The standard data model EarthResourceML for Mineral resources,
- The work currently done in European projects

The 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:
(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:

- 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 harmonised EU level data sets stands out.

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

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;

Examples of use of mineral resources

All this analysis 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 of invented and used peat resources, aggregate 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 modeling of mineral deposits, the mapping lithological areas and units potentially hosting mineral deposits, the use of left-overs 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 the same information about mineral resources than the assessment of the impact on environment.

So the TWG decided to provide **two application schemas**:

- the **core data model**, related to the main object types and properties requested by all examples of use: the location of mineral resources (Mines and Mineral Occurrences), the main commodities, and the exploitation type,
- the **extension**, to address more properties, but optional, able to provide more attributes describing mineral resources, specially to meet requirements from the Raw Materials Initiative and the Mining Waste Directive.

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The Thematic Working Group Geology and Mineral Resources (TWG-GE-MR) included:
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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) or Legally Mandated Organisations (LMOs).

Contact information
Vanda Nunes de Lima
European Commission Joint Research Centre
Institute for Environment and Sustainability
Spatial Data Infrastructures Unit
TP262, Via Fermi 2749
I-21027 Ispra (VA)
ITALY
E-mail: vanda.lima@jrc.ec.europa.eu
Tel.: +39-0332-7865052
Fax: +39-0332-7866325
http://ies.jrc.ec.europa.eu/
http://ec.europa.eu/dgs/jrc/
http://inspire.jrc.ec.europa.eu/

Table of contents

1 Scope

This document specifies a harmonised data specification for the spatial data theme *Mineral Resources* as defined in Annex II/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 will be published as implementation guidelines accompanying these Implementing Rules.

2 Overview

2.1 Name and acronyms

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

<definition> [Directive 2007/2/EC]

Description:

From the definition, we detail each word.

Mineral resource or 'mineral' means a naturally occurring deposit in the earth's crust of an organic or inorganic substance, such as energy fuels, metal ores, industrial minerals and construction minerals, but excluding water.

Metal ores: In short: an ore is a material that contains a metal in such quantities that it can be mined and worked commercially to extract that metal. The metal is usually contained in chemical combination with some other element in addition to various impurities.

More precisely: an ore is an aggregate of economically important minerals that is sufficiently rich to separate for a profit. Although more than 3,500 mineral species are known, only about 100 are considered ore minerals. The term originally applied only to metallic minerals (see native element) 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 is then extracted from the ore. The metal may be still further refined (purified) or alloyed with other metals.

It looks thus that there is some 'overlapping' between the definitions of 'ore' and 'metal ore'.
Metal ore is a type of rock from which metal can be extracted. Metals may be present in ores in the native form (such as native copper), or as noble metals (not usually forming coumpounds, such as gold), but more commonly they occur combined as oxides, sulphides, sulphates, silicates, etc.

Metal ores contain metals. Actually, this generic wording 'metals' covers 'true' metals (see Periodic Table of Elements) but also 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. 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 object types of Mineral Resources data specification

The main object types are Mineral Occurrence, the Commodity, the Mine and the Product, the Mining Waste, the Exploration activity, and the Mining activity.

Two application schemas are provided:

- the **core data model**, related to the main object types and properties requested by all examples of use: the location of mineral resources (Mines and Mineral Occurrences), the main commodities, and the exploitation type,
- the **extension**, to address more properties, but optional, able to provide more attributes describing mineral resources, specially to meet requirements from the Raw Materials Initiative and the Mining Waste Directive.

The core 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 or location.

- A **Mine** is an underground excavation for the extraction of mineral deposits, in contrast to surficial excavations such as quarries. The term is also applied to various types of open-pit workings.
- 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
- **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 **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 extension:
This extension of the core data model provides more attributes describing mineral resources, specially to meet requirements from the Raw Materials Initiative and the Mining Waste Directive.

To describe **Mining Waste** and **Mining Waste Measure**:

- Waste type
- Material
- Processing type
- Storage type
- Waste measures (density, grade per commodity, volume)
- Environmental Impact

To describe **Products** and **Mined Material.**

To describe the **composition** of the Earth Resource with Earth Resource Material:

- Material as Earth Material defined in GeoSciML
- Proportion of the material in the earth resource
- Role of the material described (host rock, alteration product, …)

This MR data model uses classes from GeoSciML (and then from the INSPIRE Geology Data Model): an Earth Resource is a Geologic Feature (from GeoSciML) which has a geometry (a Mapped Feature) and an age (Geologic Event).

Useful information taken into account:

- Exploration history: is needed for quantitative assessment of possibly existing, yet undiscovered mineral resources of an area (USGS predictivity approach). Such an information can also help to evaluate the potential of an occurrence (sampling survey? ; drilling survey?).
- Notion of metallogenic district is particularly useful and is present in several databases. It allows to replace a deposit in a more general frame and to tackle the concept of mining potential at a regional scale.
- Inventory and **characterization of mining wastes**. Mining wastes and tailings represent a not inconsiderable 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 also their cost. Locating and characterizing (industrial process used, grade, volume, etc.) these wastes is important and replies to EC questioning about their recycling
- Industrial minerals and rocks: besides the need of particular parameters for a proper description such as geological properties, mechanical behavior, 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.

2.2.2 Anomalies: not in the scope

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 orebody, 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 own such a database.

2.2.3 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 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

[OGC 06-103r3] Implementation Specification for Geographic Information - Simple feature access – Part 1: Common Architecture v1.2.0

NOTEThis is an updated version of "EN ISO 19125-1:2006, Geographic information – Simple feature access – Part 1: Common architecture". A revision of the EN ISO standard has been proposed.

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

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

2.2.4 Terms and definitions

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

2.2.5 Symbols and abbreviations

CGI	Commission for Geoscience Information (IUGS Commission)
IUGS	International Union of Geological Sciences
GeoSciML	GeoScience Markup Language
ERML	EarthResource Markup Language

2.3 Notation of requirements and recommendations

To make it easier to identify the mandatory requirements and the recommendations for spatial data sets in the text, they are highlighted and numbered.

IR Requirement X	Requirements that are reflected in the Implementing Rule on interoperability of spatial data sets and services are shown using this style.

DS Requirement X	Requirements that are not reflected in the Implementing Rule on interoperability of spatial data sets and services are shown using this style.

Recommendation 1 Recommendations are shown using this style.

[13] The INSPIRE Glossary is available from http://inspire-registry.jrc.ec.europa.eu/registers/GLOSSARY

2.4 Conformance

DS Requirement 1	Any dataset claiming conformance with this INSPIRE data specification shall pass the requirements described in the abstract test suite presented in Annex A.

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

NOTE Since the content of this chapter was redundant with the overview description (section 2) and executive summary, it has been decided that this chapter will be removed in v3.0.

5 Data content and structure

IR Requirement 1	Spatial data sets related to the theme **Mineral Resources** shall be provided using the spatial object types and data types specified in the application schema(s) in this section.

IR Requirement 2	Each spatial object shall comply with all constraints specified for its spatial object type or data types used in values of its properties, respectively.

Recommendation 1	The reason for a void value should be provided where possible using a listed value from the VoidValueReason code list to indicate the reason for the missing value.

NOTE The application schema specifies requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc. All properties have to be reported, if the relevant information is part of the data set. Most properties may be reported as “void”, if the data set does not include relevant information. See the Generic Conceptual Model [INSPIRE DS-D2.5] for more details.

5.1 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].

5.1.1 Placeholder and candidate types

INSPIRE data specifications may refer to types that thematically belong and might be fully specified in future (i.e. Annex II or III) spatial data themes. Two kinds of such types are distinguished:

- A *placeholder type* is a type that acts as a placeholder for a type (typically a spatial object type) that will be specified as part of a future spatial data theme, but is already used as a value type of an attribute or association role in this data specification.

  Placeholder types receive the stereotype «placeholder» and are placed in the application schema package of the future spatial data theme where they thematically belong. A definition for the placeholder type is specified based on the requirements of the Annex I theme. This definition shall be taken into account when the type is specified in the future spatial data theme, and the attributes or association roles in this data specification that have the placeholder as a value type shall be updated if necessary.

- A *candidate type* is a type (typically a spatial object type) for which already a preliminary specification is given. Candidate types do not receive a specific stereotype and is placed in the application schema package of the future spatial data theme where they thematically belong. A definition for the type and its attributes and association roles are specified based on the requirements of the Annex I theme.

  This specification shall be taken into account in the specification work of the Annex II or III theme. If the type cannot be incorporated in the Annex II or III data specification according to its preliminary specification, it shall be moved into the application schema of the Annex I theme where it has first been specified. In this case, the attributes or association roles in this data specification that have the type as a value type shall be updated if necessary.

Placeholders and candidate types are listed in a separate subsection of the Feature Catalogue.

5.1.2 Voidable characteristics

If a characteristic of a spatial object is not present in the spatial data set, but may be present or applicable in the real world, the property shall receive this stereotype.

If and only if a property receives this stereotype, the value of *void* may be used as a value of the property. A *void* value shall imply that no corresponding value is contained in the spatial data set maintained by the data provider or no corresponding value can be derived from existing values at reasonable costs, even though the characteristic may be present or applicable in the real world.

It is possible to qualify a value of void in the data with a reason using the VoidValueReason type. The VoidValueReason type is a code list, which includes the following pre-defined values:

- *Unpopulated*: The characteristic 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 characteristic receives this value for all 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 on an object-by-object basis in a spatial data set.

NOTE It is expected 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, an 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. A value (the real value or void) only needs to be made available for properties that have a minimum cardinality of 1.

5.1.3 Code lists and Enumerations

5.1.3.1. Style

All code lists and enumerations use the following modelling style:

- No initial value, but only the attribute name part, is used.
- The attribute name conforms to the rules for attributes names, i.e. is a lowerCamelCase name. Exceptions are words that consist of all uppercase letters (acronyms).

5.1.3.2. Governance

Two types of code lists can be distinguished:

- code lists that shall be managed centrally in the INSPIRE code list register and only values from that register may be used, and
- code lists that may be extended by data providers.

In the UML model, all code lists that are centrally managed have the tagged value "codeList" with the preliminary value "urn:x-inspire:def:codeList:INSPIRE:<name of the class>".

5.1.4 Stereotypes

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

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

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
featureType	Class	A spatial object type.
type	Class	A conceptual, abstract type that is not a spatial object type.
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.
enumeration	Class	A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
codeList	Class	A flexible enumeration that uses string values for expressing a list of potential values.
placeholder	Class	A placeholder class (see definition in section 5.1.1).
voidable	Attribute, association role	A voidable attribute or association role (see definition in section 5.1.2).
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 Application schema MineralResources

The data specification for Mineral Resources (MR) is based closely on EarthResourceML (http://www.earthresourceml.org/), a 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 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). In this version of the INSPIRE MR model the relevant parts of EarthResourceML have been incorporated into the MR package, but in subsequent versions it is intended to incorporate EarthResourceML into the INSPIRE foundation schema.

The MineralResources data specification has two application schemas, MineralResourcesCore and MineralResourcesExtension. The core of the data specification is designed to meet the use cases described in Annex B. These use cases, although illustrated with specific examples for clarity, are designed to be generic and meet the principal uses for which Mineral Resources data are required. The MineralResourcesExtension specification allows, optionally, for extra information to be provided principally to meet the requirements of the Raw Materials initiative and the Mining Waste Directive, both of which are described in Annex C.

Many properties in the data specification require constraint by code lists, and in many cases appropriate vocabularies already exist in the domain or have been developed in connection with EarthResourceML. These code lists often contain a large number of values and so cannot be incorporated into the UML. The recommended codelists, along with the code values and definitions, are listed in Annex D and, in most cases the codelist, in the UML has been left empty.

EarthResourceML uses GML v3.2 and this provides three properties for identifying, naming and describing features: gml:identifier, gml:name and gml:description. gml:identifier has an identical role to inspireID and should be used in place of inspireID in all features derived from EarthResourceML. Any class can have several gml:names if required. gml:description can be used to provide a brief human readable description of the feature.

5.2.1 Description of the MineralResourcesCore application schema

A summary of the MineralResourcesCore application schema is given in Figure 1. This figure shows only the feature-types, data types and their relationships. The properties are not visible at this stage but are described in Figures 2 & 3. As can be seen the data model has two principal components: one, centred on *EarthResource*, describes the natural material of potential economic value (Figure 2), and the other, centred on *MiningFeature* (Figure 3), describes the working of the *EarthResource*.

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 *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.

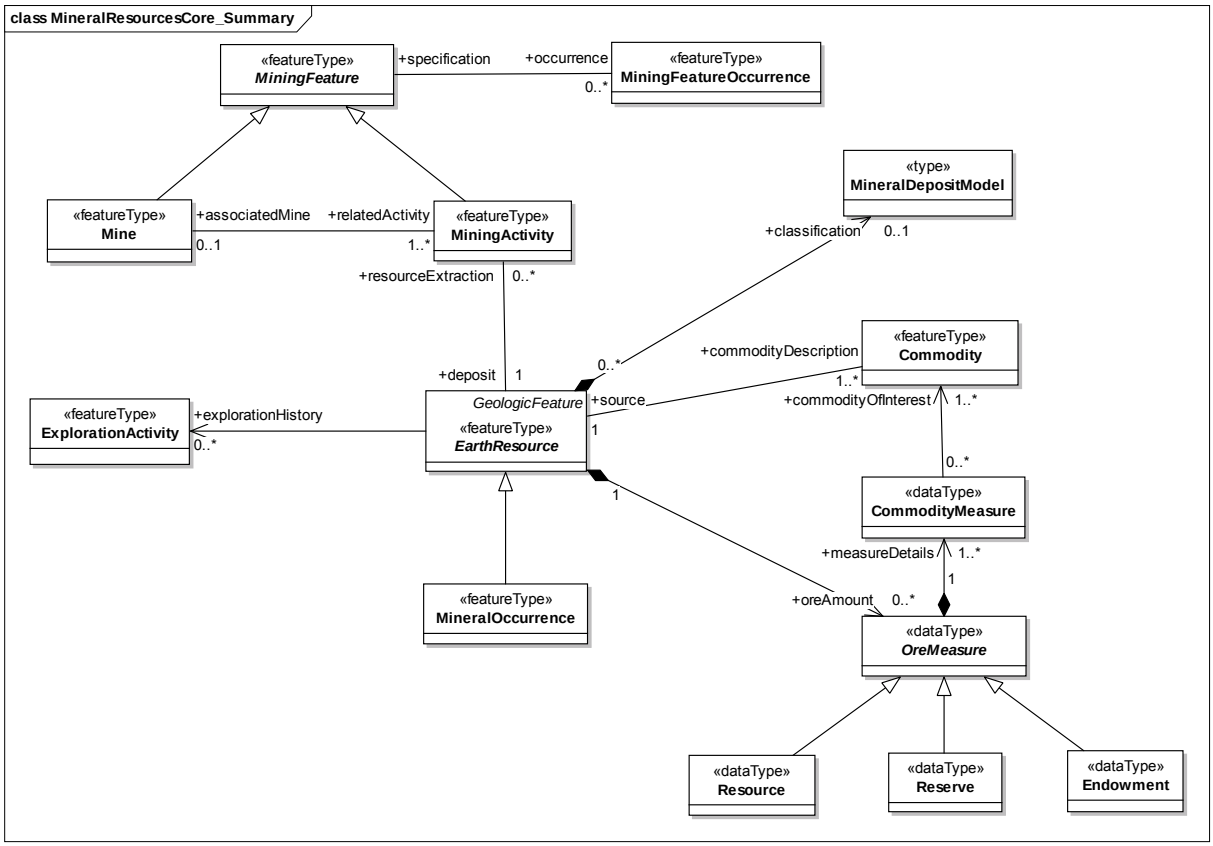


Figure 1: Summary of the core data model for Mineral Resources

A *MineralOccurrence* is a type of *EarthResource* with the following properties:

- A type: mineral deposit, ore deposit, occurrence etc
- A dimension defined by an area, a depth, a length, and a width
- The end-use potential of this mineral
- An expression: whether an Earth Resource has a surface expression or has been detected under cover rocks
- A form: the ore-body's typical physical and structural relationship to wall-rocks and associated rocks (e.g. strata-form, strata-bound, cross-cutting, vein, intrusive contact, etc.)
- A shape: the typical geometrical shape of the earth resource (e.g. lenticular, pipelike, irregular, etc.)
- Linear and planar orientations
- References of sources

The *explorationHistory* association from *EarthResource* to *ExplorationActivity* describes which kinds of works were carried out to find, and evaluate the *MineralOccurrence. ExplorationActivity* has three properties:

- Activity Duration: period, or extent in time, of the exploration activity
- Activity Type: the type of exploration activity (e.g. geological mapping, drilling, geophysical and/or geochemical surveys, etc.)
- Exploration Results: the result of the exploration activity (delineation of a mineralized body, geophysical anomaly, etc)

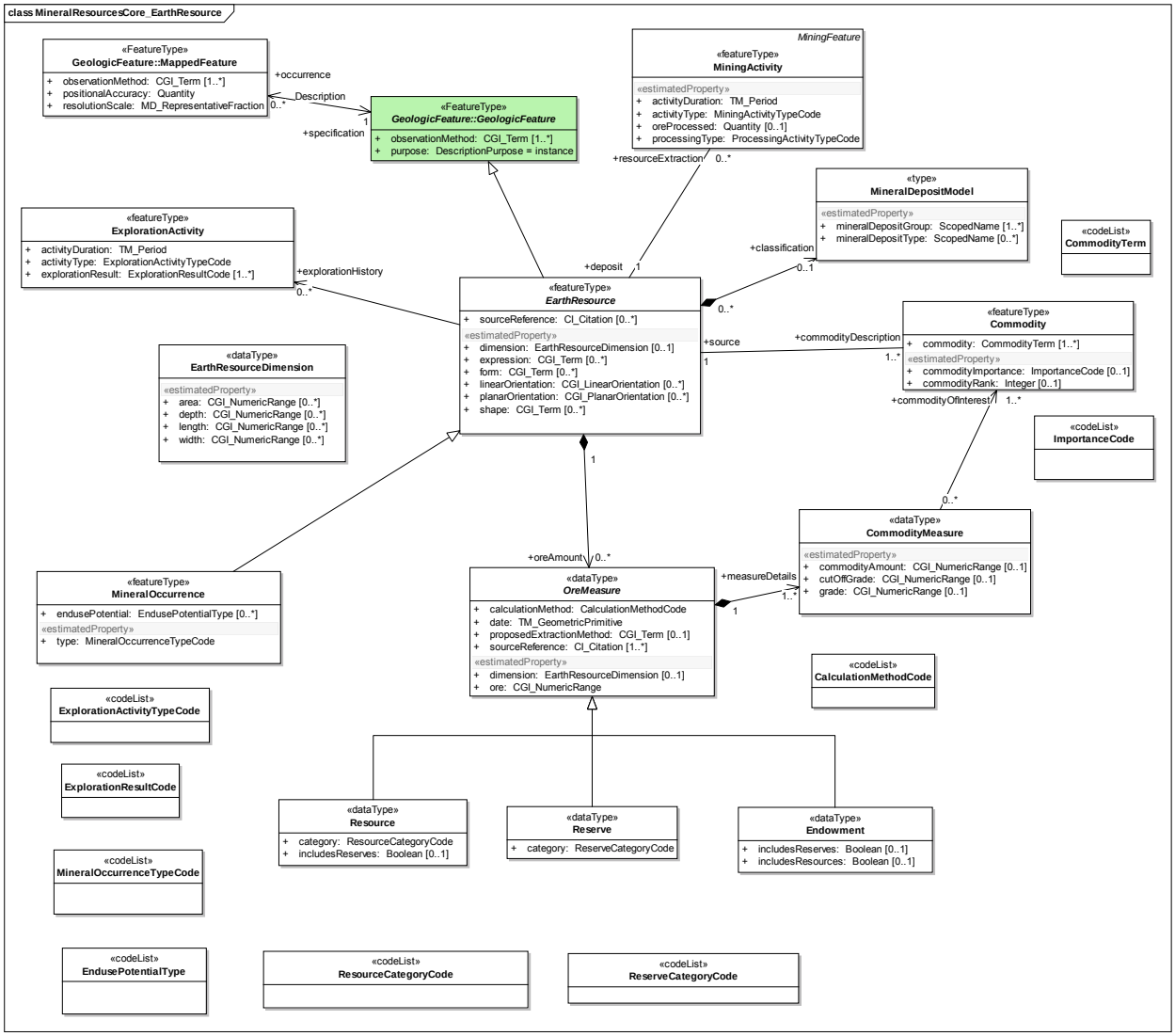


Figure 2: UML class diagram: MineralResourcesCore (Earth Resource)

The *commodityDescription* association from *EarthResource* to *Commodity* describes the material of economic interest in the Earth Resource. *Commodity* has three properties:

- The type of commodity (one or several) with the name (Cu, Au, …)
- The importance of the commodity to the earth resource. Five classes (from 'Occurrence' to 'Very Large Deposit') are defined for each commodity and are based on existing known deposits on the earth
- The commodity rank is based on the importance of this commodity compared to other commodities that are part of the earth resource

The *oreAmount* association from *EarthResource* to *OreMeasure* provides the estimate of the amount and dimension of the Earth Resource. *OreMeasure* has six properties:

- Ore: amount of ore
- Calculation method: which standard has been used for the calculation (JORC, UNESCO/World Bank, Canadian CIM, UNFC, Unspecified, etc).
- Date: date of calculated/estimated value (single date or range)
- Dimension defined by an area, a depth, a length, and a width
- References of sources

- Proposed extraction method: method proposed to extract the commodity (off-site methods, surface mining methods, underground mining methods, etc)

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). *CommodityMeasure* has three properties:

- Commodity Amount: The amount of the commodity
- Cut-off Grade: The cut-off grade used in the calculation of the commodity amount
- Grade: The grade of the commodity. Where the Ore Measure is a Reserve or Resource the grade must be provided

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). *MineralDepositModel* has two properties:

- Mineral deposit group: a grouping of mineral deposits defined by generic characteristics e.g. host rock, host structure, commodity, association with similar mineral processes e.g. porphyry. Regional, national and more universal lists can be used
- Mineral deposit type: style of mineral occurrence or deposit. Generally a local or regional term should be referenced for definitions and descriptions. Single deposit terms may be a member of a Mineral Deposit Group in local and regional schemas

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.

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 underground excavation for the extraction of mineral deposits, in contrast to surficial excavations such as quarries. The term is also applied to various types of open-pit workings.
- The *Mining Activity*, related to a Mine, describes the process of extracting metallic or non-metallic mineral deposits from the Earth.

The *occurrence* association from *MiningFeature* to *MiningFeatureOccurrence* allows the spatial representation of the Mining Feature to be described. *MiningFeatureOccurrence* has 3 properties:

- Observation Method: to specify the method used to identify the Mining Feature Occurrence (field observation, published map, etc)
- Positional Accuracy, either quantitative or non quantitative (accurate, approximate, 5 m, etc)
- Resolution Scale defined as a representative fraction

The *location* association from *MiningFeatureOccurrence* to *GM_Object* provides the geometry.

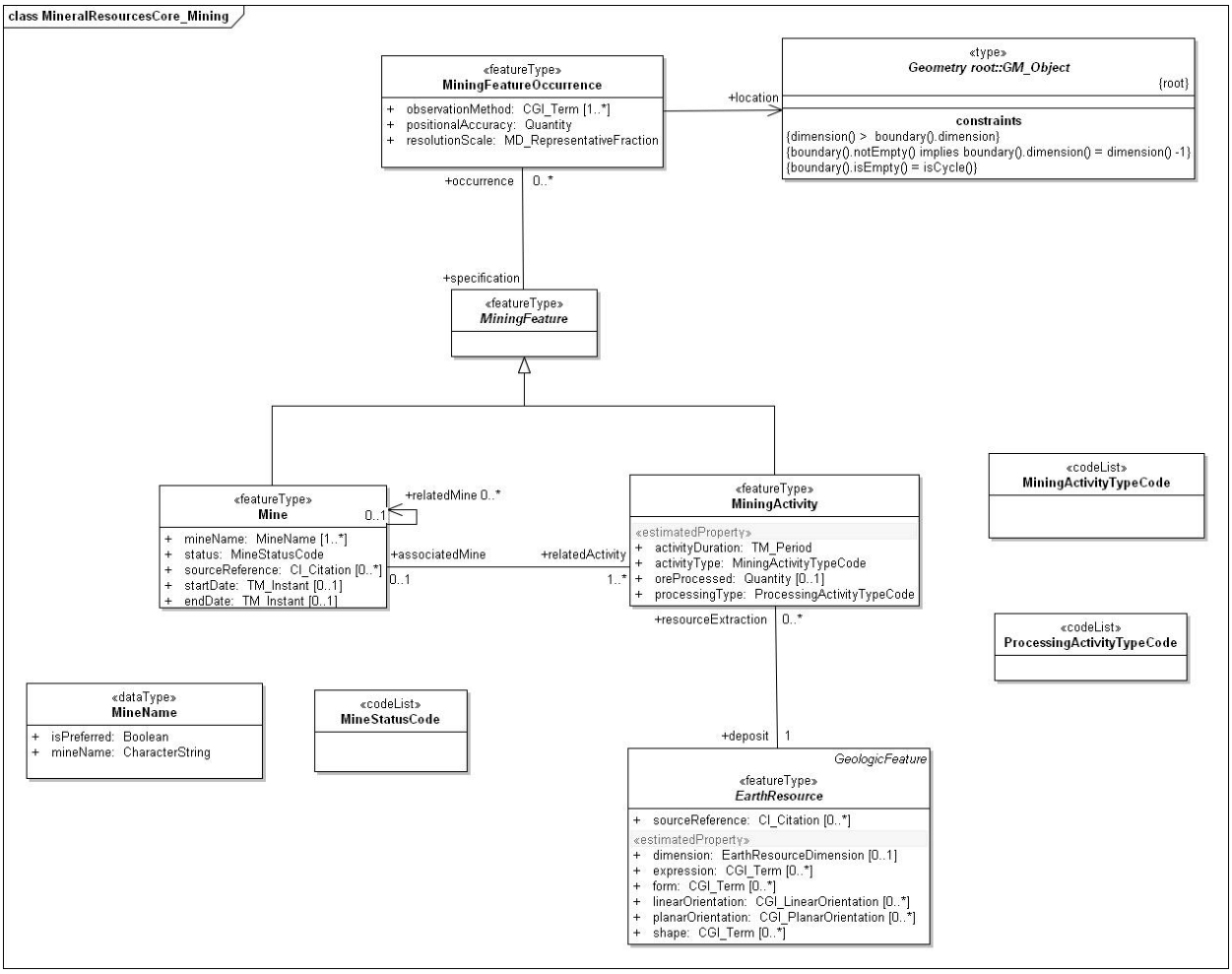


Figure 3: UML class diagram: MineralResourcesCore (Mining)

A *Mine* has five properties:

- Mine Name: the name(s) of the mine (one is preferred)
- a start and an end date of operation
- Status: operational status (pending approval, continuous activity, closed, abandoned, etc)
- Source Reference: for describing source information like mine plans etc

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. *MiningActivity* has four properties:

- Activity Duration: the time period of the Mining Activity
- Activity type: the type of Mining Activity (open cut mining, underground mining, etc)
- Ore Processed: the amount of ore processed by this activity
- Processing Type: the type of processing carried out during the mining activity

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

5.2.1.1. Consistency between spatial data sets

The observation location is specified by its coordinates

5.2.1.2. Identifier management

Issue: In mineral resources many feature-types are available and the structure of identifiers has not yet been defined (name space to identify the data source, and a local identifier assigned by the data provider).

5.2.2 Feature catalogue

Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue MineralResourcesCore
Scope	MineralResourcesCore
Version number	2.0
Version date	2011-06-13
Definition source	INSPIRE data specification MineralResourcesCore

Types defined in the feature catalogue

Type	Package	Stereotypes	Section
CalculationMethodCode	MineralResourcesCore	«codeList»	5.2.2.3.1
Commodity	MineralResourcesCore	«featureType»	5.2.2.1.1
CommodityMeasure	MineralResourcesCore	«dataType»	5.2.2.2.1
CommodityTerm	MineralResourcesCore	«codeList»	5.2.2.3.2
EarthResource	MineralResourcesCore	«featureType»	5.2.2.1.2
EarthResourceDimension	MineralResourcesCore	«dataType»	5.2.2.2.2
Endowment	MineralResourcesCore	«dataType»	5.2.2.2.3
EndusePotentialType	MineralResourcesCore	«codeList»	5.2.2.3.3
ExplorationActivity	MineralResourcesCore	«featureType»	5.2.2.1.3
ExplorationActivityTypeCode	MineralResourcesCore	«codeList»	5.2.2.3.4
ExplorationResultCode	MineralResourcesCore	«codeList»	5.2.2.3.5
ImportanceCode	MineralResourcesCore	«codeList»	5.2.2.3.6
Mine	MineralResourcesCore	«featureType»	5.2.2.1.4
MineName	MineralResourcesCore	«dataType»	5.2.2.2.4
MineStatusCode	MineralResourcesCore	«codeList»	5.2.2.3.7
MineralOccurrence	MineralResourcesCore	«featureType»	5.2.2.1.5
MineralOccurrenceTypeCode	MineralResourcesCore	«codeList»	5.2.2.3.8
MiningActivity	MineralResourcesCore	«featureType»	5.2.2.1.6
MiningActivityTypeCode	MineralResourcesCore	«codeList»	5.2.2.3.9
MiningFeature	MineralResourcesCore	«featureType»	5.2.2.1.7
MiningFeatureOccurrence	MineralResourcesCore	«featureType»	5.2.2.1.8
OreMeasure	MineralResourcesCore	«dataType»	5.2.2.2.5
ProcessingActivityTypeCode	MineralResourcesCore	«codeList»	5.2.2.3.10
Reserve	MineralResourcesCore	«dataType»	5.2.2.2.6
ReserveCategoryCode	MineralResourcesCore	«codeList»	5.2.2.3.11
Resource	MineralResourcesCore	«dataType»	5.2.2.2.7
ResourceCategoryCode	MineralResourcesCore	«codeList»	5.2.2.3.12

5.2.2.1. Spatial object types

5.2.2.1.1. Commodity

Commodity	
Definition:	The material of economic interest in the EarthResource
Status:	Proposed

Commodity	
Stereotypes:	«featureType»
Attribute: commodity	
Value type:	CommodityTerm
Definition:	The earth resource commodity (eg Cu, Au, Dimension Stone)
Multiplicity:	1..*
Attribute: commodityImportance	
Value type:	ImportanceCode
Definition:	The importance of the commodity to the earth resource. A subjective classification (eg minor, major)
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: commodityRank	
Value type:	Integer
Definition:	The rank the commodity has in the order of commodities that are part of the earth resource (eg 1, 2, 3)
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»

5.2.2.1.2. EarthResource

EarthResource (abstract)	
Subtype of:	GeologicFeature
Definition:	Identifes the kinds of observable or inferred phenomena required to classify economic and sub-economic earth resources
Status:	Proposed
Stereotypes:	«featureType»
Attribute: dimension	
Value type:	EarthResourceDimension
Definition:	Describes the size/volume of the earth resource
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: expression	
Value type:	CGI_Term
Definition:	Whether an EarthResource has a surface expression or has been detected under cover rocks.
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»
Attribute: form	
Value type:	CGI_Term
Definition:	The orebodies typical physical and structural relationship to wallrocks and associated rocks (e.g. strataform, stratabound, cross-cutting, vein, intrusive contact etc)
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»
Attribute: linearOrientation	
Value type:	CGI_LinearOrientation
Definition:	Captures linear orientation of the Earth Resource (Plunge etc)
Multiplicity:	0..*

EarthResource (abstract)

Stereotypes: «estimatedProperty»

Attribute: planarOrientation

Value type: CGI_PlanarOrientation
Definition: Captures planar orientation of the Earth Resource (Dip/Dip Direction etc)
Multiplicity: 0..*
Stereotypes: «estimatedProperty»

Attribute: shape

Value type: CGI_Term
Definition: The typical geometrical shape of the Earth Resource (e.g. lenticular, pipelike, irregular etc)
Multiplicity: 0..*
Stereotypes: «estimatedProperty»

Attribute: sourceReference

Value type: CI_Citation
Definition: The source or reference for the Earth Resource. CI_Citation can not be serialised in-line for GML3.1 but as an xlink reference.
Multiplicity: 0..*

Association role: classification

Value type: MineralDepositModel
Definition: Classifies the EarthResource Systematically arranged information describing the essential attributes of a class of mineral deposits. May be empirical (descriptive) or theoretical (genetic).
Multiplicity: 0..1

Association role: composition

Value type: EarthResourceMaterial
Definition: The material forming the EarthResource
Multiplicity: 0..*

Association role: explorationHistory

Value type: ExplorationActivity
Definition: 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: 0..*

Association role: geneticDescription

Value type: MineralSystem
Definition: Provides a description for how the EarthResource formed
Multiplicity: 0..1

Association role: oreAmount

Value type: OreMeasure
Definition: Gives an estimated or calculated amount of ore with the identification of the commodities contained and their grade.
Multiplicity: 0..*

Association role: supergeneModification

Value type: SupergeneProcesses

EarthResource (abstract)	
Definition:	A supergene process which would allow a metal enrichment produced by the chemical remobilisation of metals in an oxidised or transitional environment.
Multiplicity:	0..*

5.2.2.1.3. ExplorationActivity

ExplorationActivity	
Definition:	Chronological list of surveys undertaken to better define the potential of a mineral occurrence
Status:	Proposed
Stereotypes:	«featureType»
Attribute: activityDuration	
Value type:	TM_Period
Definition:	Period, or extent in time, of the mining activity. 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
Attribute: activityType	
Value type:	ExplorationActivityTypeCode
Definition:	The type of exploration activity (eg geological mapping, drilling, geophysical surveys, geochemical mapping, etc)
Multiplicity:	1
Attribute: explorationResult	
Value type:	ExplorationResultCode
Definition:	The result of the exploration activity
Multiplicity:	1..*

5.2.2.1.4. Mine

Mine	
Subtype of:	MiningFeature
Definition:	(A) An underground excavation for the extraction of mineral deposits, in contrast to surficial excavations such as quarries. The term is also applied to various types of open-pit workings. (B) The area or property of a mineral deposit that is being excavated; a mining claim.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: endDate	
Value type:	TM_Instant
Definition:	Date the mine ceased.
Multiplicity:	0..1
Attribute: mineName	
Value type:	MineName
Definition:	Data type to indicate whether the Mine Name is the preferred name
Multiplicity:	1..*
Attribute: sourceReference	
Value type:	CI_Citation
Definition:	Allows citing mine plans etc
Multiplicity:	0..*

Mine

Attribute: startDate

Value type: TM_Instant
Definition: Date the mine commenced.
Multiplicity: 0..1

Attribute: status

Value type: MineStatusCode
Definition: Operational status (eg Care & Maintenance, Pending Approval, operating continually)
Multiplicity: 1

Association role: relatedMine

Value type: Mine
Definition: A mine currently exploited may result from the resumption and the extension of a – or several – former or older (abandoned) mine(s).
Multiplicity: 0..*

5.2.2.1.5. MineralOccurrence

MineralOccurrence

Subtype of: EarthResource
Definition: A mineral occurrence. Examples are prospect, occurrence, mineral deposit, ore deposit, field, district, lode, mineralized zone etc
Status: Proposed
Stereotypes: «featureType»

Attribute: endusePotential

Value type: EndusePotentialType
Definition: The end-use potential of the mineral (eg for energy, fertilizer, building raw material etc)
Multiplicity: 0..*

Attribute: type

Value type: MineralOccurrenceTypeCode
Definition: Captures the type of mineral occurrence. Examples are prospect, occurrence, mineral deposit, ore deposit, field, district, lode, mineralized zone(?).
Multiplicity: 1
Stereotypes: «estimatedProperty»

5.2.2.1.6. MiningActivity

MiningActivity

Subtype of: MiningFeature
Definition: The process of extracting metallic or non-metallic mineral deposits from the Earth. The term may also include preliminary treatment eg. cleaning or sizing.
Status: Proposed
Stereotypes: «featureType»

Attribute: activityDuration

Value type: TM_Period
Definition: Period, or extent in time, of the mining activity. 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	
Stereotypes:	«estimatedProperty»
Attribute: activityType	
Value type:	MiningActivityTypeCode
Definition:	The type of mining activity (eg Open Cut, 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
Stereotypes:	«estimatedProperty»
Attribute: oreProcessed	
Value type:	Quantity
Definition:	The amount of ore processed by the activity
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: processingType	
Value type:	ProcessingActivityTypeCode
Definition:	The type of processing carried out during the mining activity
Multiplicity:	1
Stereotypes:	«estimatedProperty»
Association role: producedMaterial	
Value type:	Product
Definition:	Product(s) elaborated from mining activity, through a processing phase. Usually in the form of concentrates containing one or several commodities at various grades for metallic ores.
Multiplicity:	1..*
Association role: rawMaterial	
Value type:	MinedMaterial
Definition:	An ore is rarely extracted or mined alone. It is most of the time accompanied by a variable quantity of gangue, very slightly mineralized or completely barren, composed of non-metallic minerals (sometimes of interest) and/or altered host-rock(s).
Multiplicity:	0..*

5.2.2.1.7. MiningFeature

MiningFeature (abstract)	
Definition:	The abstract MiningFeature class represents a conceptual feature that exists coherently in the world. * this corresponds with a "Mine" or a "MiningActivity", locatable and identifiable features in time and/or space
Status:	Proposed
Stereotypes:	«featureType»

5.2.2.1.8. MiningFeatureOccurrence

MiningFeatureOccurrence	
Definition:	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 or location and the association with a Mining Feature provides specification of all the other descriptors
Status:	Proposed

MiningFeatureOccurrence	
Stereotypes:	«featureType»
Attribute: observationMethod	
Value type:	CGI_Term
Definition:	Specifies the method that was used to identify the MiningFeatureOccurrence. Examples: digitised, Global Positioning System, published map, fieldObservation, downhole survey, aerial photography, field survey. This corresponds (loosely) to ISO19115 Lineage.Statement
Multiplicity:	1..*
Attribute: positionalAccuracy	
Value type:	Quantity
Definition:	Examples: accurate, approximate, diagramatic, indefinite, unknown, 5 m. Corresponds to ISO19115 DQ_ThematicAccuracy (either quantitative or non quantitative).result.value
Multiplicity:	1
Attribute: resolutionScale	
Value type:	MD_RepresentativeFraction
Definition:	NOTE: this attribute type will be mapped to a temporary proxy for MD_RepresentativeFraction until support for GML3.2 is achieved. Reciprocal of equivalent scale of resolution for delineation of a feature's geometry. This is in contrast to positionAccuracy which is a measure of how well a feature is located relative to other features in the geographic reference system.
Multiplicity:	1
Association role: location	
Value type:	GM_Object
Definition:	Location of a MiningFeature. Can be very detailed depending on the resolution scale (e.g., an area (polygon), a 3D volume). However, in several databases it can be represented by a single point representing at the same time the mine and the deposit (i.e., the MiningFeatureOccurence and the MineralOccurrence).
Multiplicity:	

5.2.2.2. Data types

5.2.2.2.1. CommodityMeasure

CommodityMeasure	
Definition:	A measure of the amount of the commodity based on a Reserve, Resource or Endowment calculation.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: commodityAmount	
Value type:	CGI_NumericRange
Definition:	Amount of commodity
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: cutOffGrade	
Value type:	CGI_NumericRange
Definition:	Cut off grade used for calculation
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: grade	

CommodityMeasure	
Value type:	CGI_NumericRange
Definition:	grade of commodity Where OreMeasure is Resource or Reserve CommodityMeasure::grade is mandatory
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»

Association role: commodityOfInterest	
Value type:	Commodity
Definition:	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 necessitates a (statistical) comparison with a large set of deposits throughout the world to ensure that it is valid.
Multiplicity:	1..*

5.2.2.2.2. EarthResourceDimension

EarthResourceDimension	
Definition:	Describes the size/volume of the earth resource
Status:	Proposed
Stereotypes:	«dataType»

Attribute: area	
Value type:	CGI_NumericRange
Definition:	The area of the Earth Resource
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»

Attribute: depth	
Value type:	CGI_NumericRange
Definition:	The depth of the Earth Resource
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»

Attribute: length	
Value type:	CGI_NumericRange
Definition:	The length of the Earth Resource
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»

Attribute: width	
Value type:	CGI_NumericRange
Definition:	The width of the EArth Resource
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»

5.2.2.2.3. Endowment

Endowment	
Subtype of:	OreMeasure

Endowment	
Definition:	Endowment refers to that quantity of a mineral in accumulations (deposits) meeting specified physical characteristics such as quality, size and depth. 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.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: includesReserves	
Value type:	Boolean
Definition:	Does the estimate include the reserves value (Y/N)
Multiplicity:	0..1
Attribute: includesResources	
Value type:	Boolean
Definition:	Does the estimate include the resources value (Y/N)
Multiplicity:	0..1

5.2.2.2.4. MineName

MineName	
Definition:	Data type to indicate whether the Mine Name is the preferred name
Status:	Proposed
Stereotypes:	«dataType»
Attribute: isPreferred	
Value type:	Boolean
Definition:	A boolean operator to indicate if the value in mineName is the preferred name of the mine
Multiplicity:	1
Attribute: mineName	
Value type:	CharacterString
Definition:	The name of the mine
Multiplicity:	1

5.2.2.2.5. OreMeasure

OreMeasure (abstract)	
Definition:	The estimate of the Reserve, Resource or Endowment ore amount
Status:	Proposed
Stereotypes:	«dataType»
Attribute: calculationMethod	
Value type:	CalculationMethodCode
Definition:	Means of calculating the measurement. Examples include JORC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Multiplicity:	1
Attribute: date	
Value type:	TM_GeometricPrimitive
Definition:	Date of calculated/estimated value (single date or range)
Multiplicity:	1
Attribute: dimension	

OreMeasure (abstract)	
Value type:	EarthResourceDimension
Definition:	Size of the body used in the calculation
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: ore	
Value type:	CGI_NumericRange
Definition:	Amount of ore
Multiplicity:	1
Stereotypes:	«estimatedProperty»
Attribute: proposedExtractionMethod	
Value type:	CGI_Term
Definition:	The method proposed to extract the commodity
Multiplicity:	0..1
Attribute: sourceReference	
Value type:	CI_Citation
Definition:	reference for the values
Multiplicity:	1..*
Association role: measureDetails	
Value type:	CommodityMeasure
Definition:	A measure of the amount of each commodity, 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).
Multiplicity:	1..*

5.2.2.2.6. Reserve

Reserve	
Subtype of:	OreMeasure
Definition:	The economically mineable part of a Measured and/or Indicated Mineral Resource. 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
Status:	Proposed
Stereotypes:	«dataType»
Attribute: category	
Value type:	ReserveCategoryCode
Definition:	Defines the level of confidence of the estimate
Multiplicity:	1

5.2.2.2.7. Resource

Resource	
Subtype of:	OreMeasure

Resource	
Definition:	A concentration or occurrence 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 eventual economic extraction. Synonyms: Mineral Resource; Coal Resource (s); Diamond (Gemstone) Resource; Potentially Mineable Mineralisation
Status:	Proposed
Stereotypes:	«dataType»

Attribute: category	
Value type:	ResourceCategoryCode
Definition:	Indicates if the resource is measured, indicated, proved, probable, or inferred.
Multiplicity:	1

Attribute: includesReserves	
Value type:	Boolean
Definition:	Whether estimate of resources uses reserve values (Y/N)
Multiplicity:	0..1

5.2.2.3. Code lists

5.2.2.3.1. CalculationMethodCode

CalculationMethodCode	
Definition:	A code for the means used to calculate the ore measurement. Examples include JORC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.2. CommodityTerm

CommodityTerm	
Definition:	The earth resource commodity (eg Cu, Au, Dimension Stone)
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.3. EndusePotentialType

EndusePotentialType	
Definition:	There is no single classification for industrial minerals since different end-users divide them according to their own needs and disciplines. Industrial minerals have been classified according to their geological settings, chemistry or physical characteristics. Another classification, widely used, is based on their end-use (e.g., chemicals, fertilizers, ceramics, refractories, abrasives, etc.).
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.4. ExplorationActivityTypeCode

ExplorationActivityTypeCode	
Definition:	The type of exploration activity carried out
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.5. ExplorationResultCode

ExplorationResultCode

ExplorationResultCode	
Definition:	The result of the exploration activity
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.6. ImportanceCode

ImportanceCode	
Definition:	The importance of the commodity to the earth resource. A subjective classification.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.7. MineStatusCode

MineStatusCode	
Definition:	Operational status values
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.8. MineralOccurrenceTypeCode

MineralOccurrenceTypeCode	
Definition:	The type of mineral occurrence
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.9. MiningActivityTypeCode

MiningActivityTypeCode	
Definition:	The type of mining activity, processing activity, or production.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.10. ProcessingActivityTypeCode

ProcessingActivityTypeCode	
Definition:	The type of processing carried out during a mining activity
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.11. ReserveCategoryCode

ReserveCategoryCode	
Definition:	Defines the level of confidence of the estimate of the reserve
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.2.3.12. ResourceCategoryCode

ResourceCategoryCode	
Definition:	Indicates if the resource is measured, indicated, proved, probable, or inferred.
Status:	Proposed
Stereotypes:	«codeList»

ResourceCategoryCode	
Governance:	May be extended by Member States.

5.2.2.4. Imported types (informative)

This section lists definitions for feature types, data types and enumerations 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.

5.2.2.4.1. Boolean

Boolean	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103 Conceptual Schema Language::ISO 19103:2005 Schema Language::Basic Types::Primitive::Truth [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.2. CGI_LinearOrientation

CGI_LinearOrientation	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::CGI_Utilities::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.3. CGI_NumericRange

CGI_NumericRange	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::CGI_Utilities::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.4. CGI_PlanarOrientation

CGI_PlanarOrientation	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::CGI_Utilities::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.5. CGI_Term

CGI_Term	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::CGI_Utilities::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.6. CI_Citation

CI_Citation	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115-All Metadata::ISO 19115:2006 Metadata (Corrigendum)::Citation and responsible party information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.7. CharacterString

CharacterString

CharacterString	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103 Conceptual Schema Language::ISO 19103:2005 Schema Language::Basic Types::Primitive::Text [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.8. EarthResourceMaterial

EarthResourceMaterial	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesExtension [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Identifies the material found in the earth or produced from earth material that is of economic interest

5.2.2.4.9. GM_Object

GM_Object (abstract)	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19107 Spatial Schema::ISO 19107:2003 Spatial Schema:: Geometry::Geometry root [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.10. GeologicFeature

GeologicFeature (abstract)	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::GeoSciML-Core::GeologicFeature [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.11. Integer

Integer	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103 Conceptual Schema Language::ISO 19103:2005 Schema Language::Basic Types::Primitive::Numerics [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.12. MD_RepresentativeFraction

MD_RepresentativeFraction	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115-All Metadata::ISO 19115:2006 Metadata (Corrigendum)::Identification information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.13. MinedMaterial

MinedMaterial	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesExtension [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	A data type to describe the raw material of a mining activity

5.2.2.4.14. MineralSystem

MineralSystem

MineralSystem	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesExtension [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	All geological features that control the generation and preservation of mineral deposits.

5.2.2.4.15. Product

Product	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesExtension [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Identifes the type and amount of products associated with production

5.2.2.4.16. Quantity

Quantity	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19136 GML::valueObjects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.17. ScopedName

ScopedName	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19103 Conceptual Schema Language::ISO 19103:2005 Schema Language::Basic Types::Implementation::Names [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.18. SupergeneProcesses

SupergeneProcesses	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesExtension [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Metal enrichment produced by the chemical remobilisation of metals in an oxidised or transitional environment. Does a supergene process exist (Y/N)

5.2.2.4.19. TM_GeometricPrimitive

TM_GeometricPrimitive	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19108 Temporal schema::ISO 19108:2006 Temporal Schema::Temporal Objects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.20. TM_Instant

TM_Instant	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19108 Temporal schema::ISO 19108:2006 Temporal Schema::Temporal Objects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.21. TM_Period

TM_Period

TM_Period	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19108 Temporal schema::ISO 19108:2006 Temporal Schema::Temporal Objects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.3 Description of the MIneralResourcesExtension application schema

The full Earth Resource part of the data model is shown in Figure 4 (although Resource, Reserve and Endowment, which are unchanged in the extension, have been omitted so as not to over-complicate the diagram).

By comparison with Figure 2 it can be seen that that there are three additional Earth Resource classes in the extension schema: *MineralSystem, SupergeneProcesses,* and *EarthResourceMaterial.*

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. *MineralSystem* has one property:

- Association Type: a high level term describing the characteristics of a mineral system, indicative of the processes involved and resulting deposits

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

- Depth: The depth at which the supergene processes occurred
- Material: The description of the materials (rock, soil) that are the product of the supergene process
- Type: The type of supergene process. Examples are oxidation, leaching, enrichment etc

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. *EarthResourceMaterial* has three properties:

- Earth Resource Material Role: the role the Earth Material plays in the Earth Resource Description (eg host rock, alteration product, primary, secondary)
- Material: Uses *EarthMaterial* (Figure 6) to describe the material
- Proportion: The proportion that the Earth Resource Material is of the overall Earth Resource

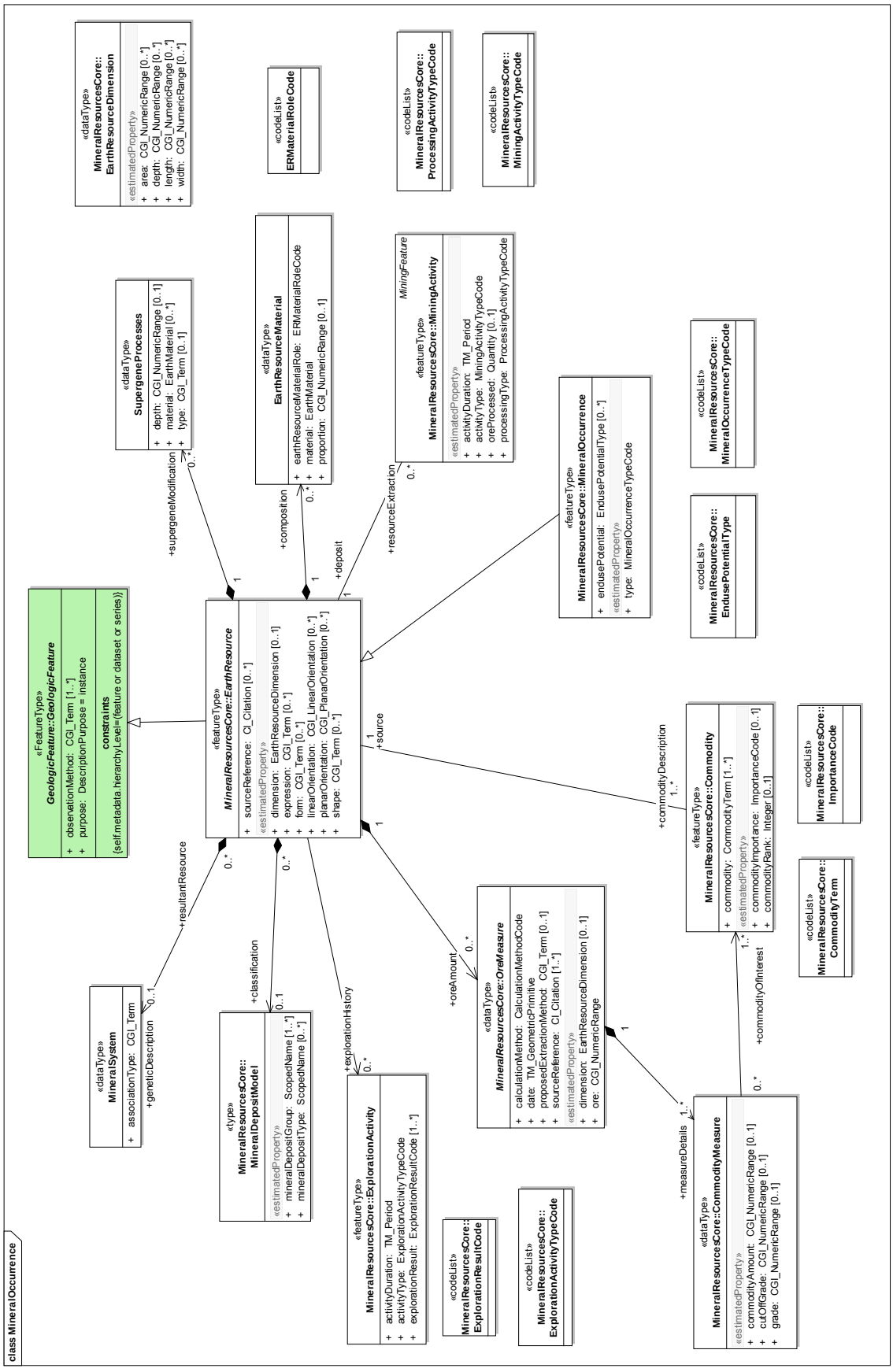


Figure 4: UML class diagram: MineralResourcesExtension (Earth Resource)

The full Mining part of the data model is shown in Figure 5. By comparison with Figure 3 it can be seen that that there are three additional classes in the extension schema: *MiningWaste, Product* and *MinedMaterial*.

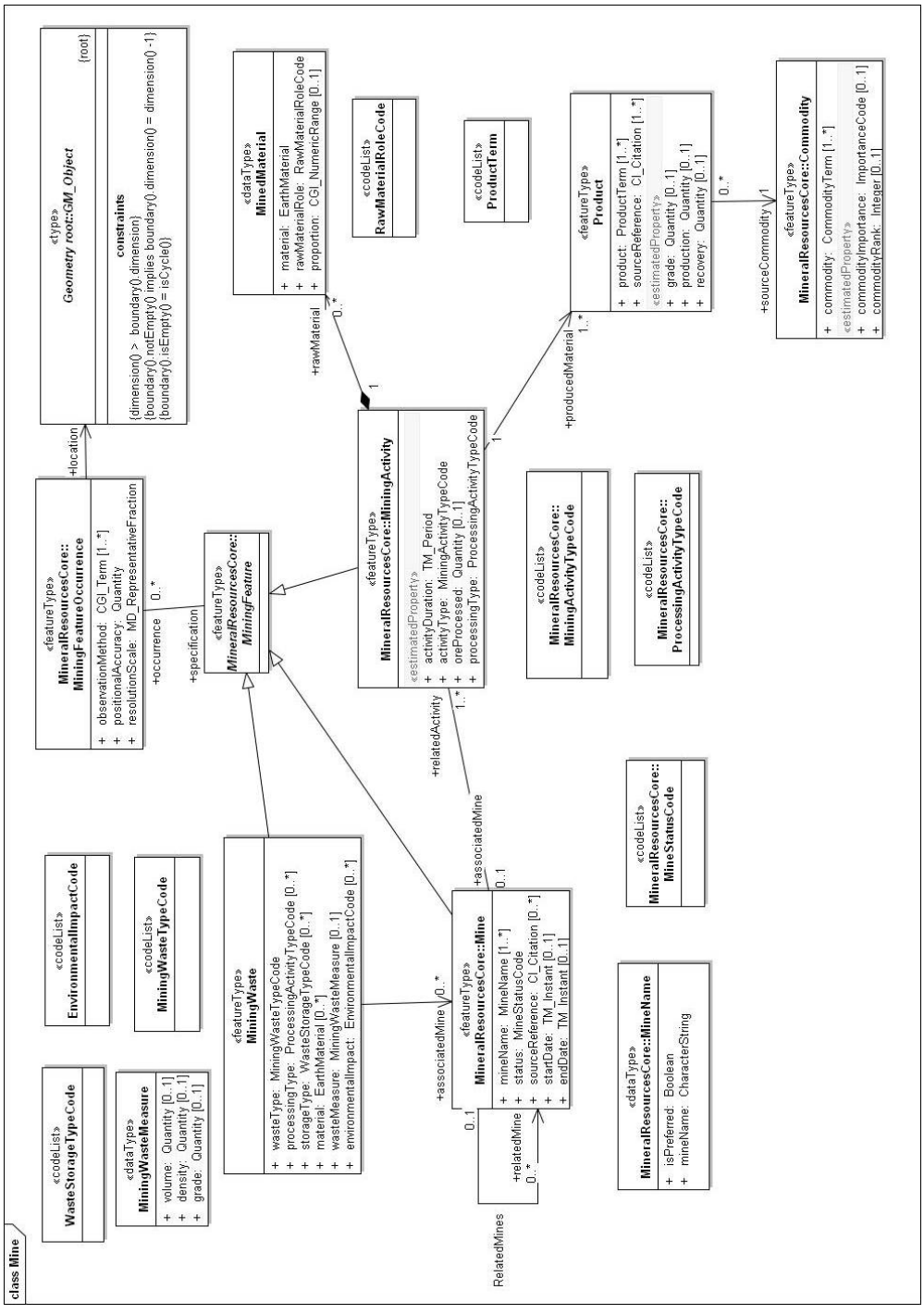


Figure 5: UML class diagram: MineralResourcesExtension (Mining)

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. *MiningWaste* has six properties:

- Waste Type: The type of mining waste
- Processing Type: The type of processing carried out on the mining waste

- Storage Type: The storage type of the waste (eg surface storage, tailings pond, waste dump, covered storage etc)
- Material: The material of which the mining waste is composed. This uses *EarthMaterial* (Figure 6) to describe the material
- Waste Measure: A measure of the amount of the Mining Waste in terms of its volume, density and grade
- Environmental Impact: The potential environmental impact of the mining waste

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

- Product: The value-added product that has been created from a commodity. In some cases the commodity and the product may be the same (e.g. gold).
- Source Reference: The reference(s) for the product information
- Grade: The relative quantity or percentage of ore mineral content in an orebody. (Could be Feed Grade, ore grade)
- Production: Quantity of the product produced during the Mining Activity
- Recovery: The percentage of valuable constituent derived from an ore, or of coal from a coal seam; a measure of mining or extraction efficiency. (Recovery rate is usually expressed as a percent)

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. *MinedMaterial* has three properties:

- Material: Uses *EarthMaterial* (Figure 6) to describe the raw material
- Raw Material Role: The role the Earth Material plays in the Mining Activity (eg gangue, ore)
- Proportion: The proportion that the Mined Material is of the overall Raw Material

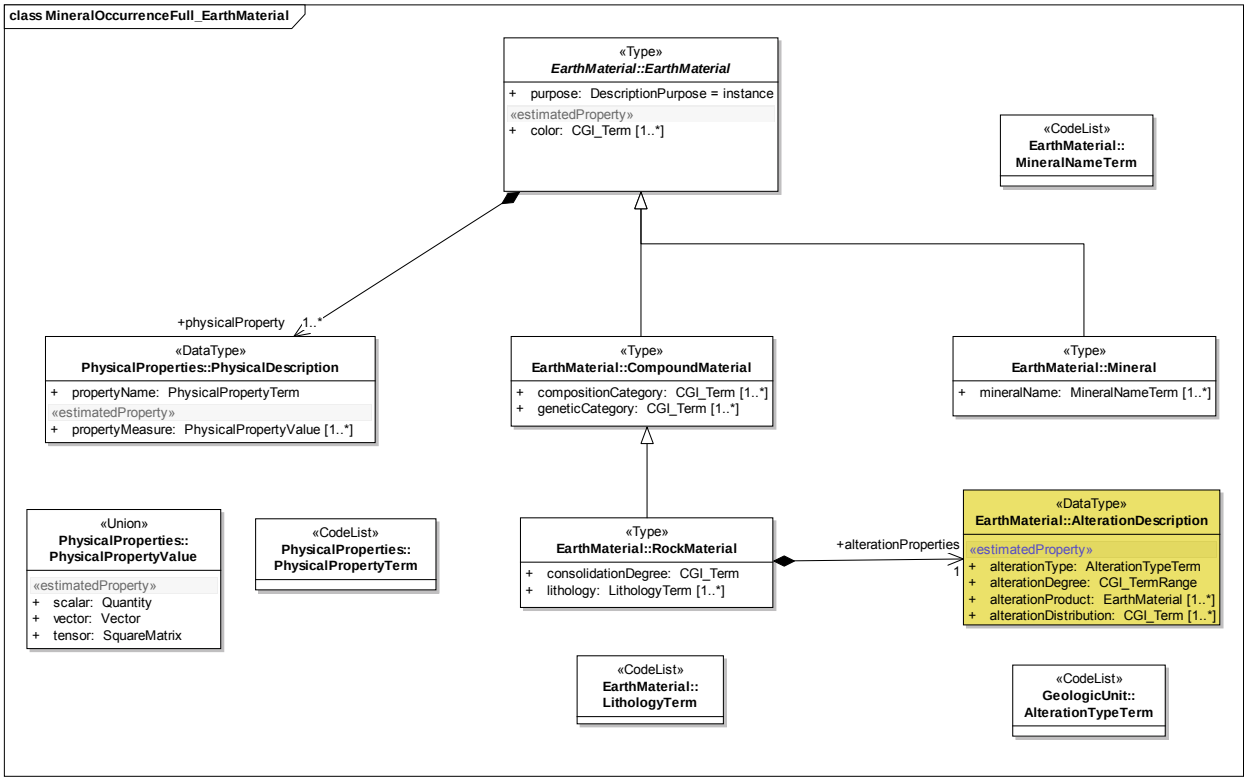


Figure 6: UML class diagram: MineralResourcesExtension (Earth Material)

The MineralResourcesExtension application schema uses *EarthMaterial* from GeoSciML to allow a full description of rock and mineral materials. Figure 6 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

5.2.3.1. Consistency between spatial data sets

The observation location is specified by its coordinates

5.2.3.2. Identifier management

Issue: In mineral resources many feature-types are available and the structure of identifiers has not yet been defined (name space to identify the data source, and a local identifier assigned by the data provider).

5.2.4 Feature catalogue

Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue MineralResourcesExtension
Scope	MineralResourcesExtension
Version number	2.0
Version date	2011-06-13
Definition source	INSPIRE data specification MineralResourcesExtension

Types defined in the feature catalogue

Type	Package	Stereotypes	Section
ERMaterialRoleCode	MineralResourcesExtension	«codeList»	5.2.2.3.1
EarthResourceMaterial	MineralResourcesExtension	«dataType»	5.2.2.2.1
EnvironmentalImpactCode	MineralResourcesExtension	«codeList»	5.2.2.3.2
MinedMaterial	MineralResourcesExtension	«dataType»	5.2.2.2.2
MineralSystem	MineralResourcesExtension	«dataType»	5.2.2.2.3
MiningWaste	MineralResourcesExtension	«featureType»	5.2.2.1.1
MiningWasteMeasure	MineralResourcesExtension	«dataType»	5.2.2.2.4
MiningWasteTypeCode	MineralResourcesExtension	«codeList»	5.2.2.3.3
Product	MineralResourcesExtension	«featureType»	5.2.2.1.2
ProductTerm	MineralResourcesExtension	«codeList»	5.2.2.3.4
RawMaterialRoleCode	MineralResourcesExtension	«codeList»	5.2.2.3.5
SupergeneProcesses	MineralResourcesExtension	«dataType»	5.2.2.2.5
WasteStorageTypeCode	MineralResourcesExtension	«codeList»	5.2.2.3.6

5.2.4.1. Spatial object types

5.2.4.1.1. MiningWaste

MiningWaste	
Subtype of:	MiningFeature
Definition:	Mining-selected waste (or simply 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.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: environmentalImpact	
Value type:	EnvironmentalImpactCode
Definition:	The potential environmental impact of the mining waste
Multiplicity:	0..*
Attribute: material	
Value type:	EarthMaterial
Definition:	The material of which the mining waste is composed
Multiplicity:	0..*
Attribute: processingType	
Value type:	ProcessingActivityTypeCode
Definition:	The type of processing carried out on the mining waste
Multiplicity:	0..*
Attribute: storageType	
Value type:	WasteStorageTypeCode
Definition:	The storage type of the waste eg surface storage, tailings pond, waste dump, covered storage etc
Multiplicity:	0..*
Attribute: wasteMeasure	
Value type:	MiningWasteMeasure
Definition:	The measure of mining waste
Multiplicity:	0..1
Attribute: wasteType	
Value type:	MiningWasteTypeCode
Definition:	The type of mining waste
Multiplicity:	1
Association role: associatedMine	
Value type:	Mine
Definition:	Mining wastes may be generated by a single mine. However, a processing plant may also be shared by several closely operating mines, thus generating wastes from different origins.
Multiplicity:	0..*

5.2.4.1.2. Product

Product	
Definition:	Identifes the type and amount of products associated with production
Status:	Proposed
Stereotypes:	«featureType»
Attribute: grade	

Product	
Value type:	Quantity
Definition:	The relative quantity or percentage of ore mineral content in an orebody. (Could be Feed Grade, ore grade)
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: product	
Value type:	ProductTerm
Definition:	Commodity that has been processed to create a value-added product. In some cases the commodity and the product may be the same (e.g. gold).
Multiplicity:	1..*
Attribute: production	
Value type:	Quantity
Definition:	Quantity of product produced during the activity
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: recovery	
Value type:	Quantity
Definition:	The percentage of valuable constituent derived from an ore, or of coal from a coal seam; a measure of mining or extraction efficency. (Recovery rate is usually expressed as a percent).
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»
Attribute: sourceReference	
Value type:	CI_Citation
Definition:	The reference(s) for the product information. CI_Citation data type cannot be serialised in GML 3.1, only as an xlink reference.
Multiplicity:	1..*
Association role: sourceCommodity	
Value type:	Commodity
Definition:	On which commodity(ies) contained in the ore, the elaborated product is based.
Multiplicity:	1

5.2.4.2. Data types

5.2.4.2.1. EarthResourceMaterial

EarthResourceMaterial	
Definition:	Identifies the material found in the earth or produced from earth material that is of economic interest
Status:	Proposed
Stereotypes:	«dataType»
Attribute: earthResourceMaterialRole	
Value type:	ERMaterialRoleCode
Definition:	The role the EarthMaterial plays in the EarthResourceDescription (eg host rock, alteration product, primary, secondary)
Multiplicity:	1
Attribute: material	
Value type:	EarthMaterial
Definition:	Uses EarthMaterial to describe the EarthResourceMaterial material

EarthResourceMaterial	
Multiplicity:	1
Attribute: proportion	
Value type:	CGI_NumericRange
Definition:	The proportion of the EarthRespourceMaterial in the EarthResourceDescription
Multiplicity:	0..1

5.2.4.2.2. MinedMaterial

MinedMaterial	
Definition:	A data type to describe the raw material of a mining activity
Status:	Proposed
Stereotypes:	«dataType»
Attribute: material	
Value type:	EarthMaterial
Definition:	Uses EarthMaterial to describe the RawMaterial material
Multiplicity:	1
Attribute: proportion	
Value type:	CGI_NumericRange
Definition:	Proportion of the RawMaterial playing the rawMaterialRole in the MiningActivity
Multiplicity:	0..1
Attribute: rawMaterialRole	
Value type:	RawMaterialRoleCode
Definition:	Role the EarthMaterial plays in the MiningActivity (eg gangue, ore)
Multiplicity:	1

5.2.4.2.3. MineralSystem

MineralSystem	
Definition:	All geological features that control the generation and preservation of mineral deposits.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: associationType	
Value type:	CGI_Term
Definition:	High level term describing the characteristics of a mineral system, indicative of the processes involved and resulting deposits
Multiplicity:	1

5.2.4.2.4. MiningWasteMeasure

MiningWasteMeasure	
Definition:	The evaluation of the potential of a mining waste in terms of base-, precious-, and strategic metals requires an estimation of the volume of the waste, its density, and the grade of remaining commodities, the tonnage figure being most of the time unknown. This calculation should be accompanied by a confidence index.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: density	
Value type:	Quantity
Definition:	The density of mining waste

MiningWasteMeasure	
Multiplicity:	0..1
Attribute: grade	
Value type:	Quantity
Definition:	The grade of mining waste
Multiplicity:	0..1
Attribute: volume	
Value type:	Quantity
Definition:	The volume of mining waste
Multiplicity:	0..1

5.2.4.2.5. SupergeneProcesses

SupergeneProcesses	
Definition:	Metal enrichment produced by the chemical remobilisation of metals in an oxidised or transitional environment. Does a supergene process exist (Y/N)
Status:	Proposed
Stereotypes:	«dataType»
Attribute: depth	
Value type:	CGI_NumericRange
Definition:	The depth at which the supergene processes occurred
Multiplicity:	0..1
Attribute: material	
Value type:	EarthMaterial
Definition:	The description of the material (rock, soil) that constitutes the supergene process
Multiplicity:	0..*
Attribute: type	
Value type:	CGI_Term
Definition:	Type of supergene process. Examples are oxidation, leaching, enrichment etc
Multiplicity:	0..1

5.2.4.3. Code lists

5.2.4.3.1. ERMaterialRoleCode

ERMaterialRoleCode	
Definition:	The role the EarthMaterial plays in the EarthResourceDescription
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.4.3.2. EnvironmentalImpactCode

EnvironmentalImpactCode	
Definition:	The potential environmental impact of the mining waste
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.4.3.3. MiningWasteTypeCode

MiningWasteTypeCode	
Definition:	The type of mining waste
Status:	Proposed

MiningWasteTypeCode	
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.4.3.4. ProductTerm

ProductTerm	
Definition:	A value-added product created from a commodity
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.4.3.5. RawMaterialRoleCode

RawMaterialRoleCode	
Definition:	Role the EarthMaterial plays in the MiningActivity (eg gangue, ore)
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.4.3.6. WasteStorageTypeCode

WasteStorageTypeCode	
Definition:	The type of mining waste storage
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.

5.2.4.4. Imported types (informative)

This section lists definitions for feature types, data types and enumerations 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.

5.2.4.4.1. CGI_NumericRange

CGI_NumericRange	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::CGI_Utilities::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.4.4.2. CGI_Term

CGI_Term	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::CGI_Utilities::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.4.4.3. CI_Citation

CI_Citation	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115-All Metadata::ISO 19115:2006 Metadata (Corrigendum)::Citation and responsible party information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.4.4.4. Commodity

Commodity

Commodity	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesCore [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	The material of economic interest in the EarthResource

5.2.4.4.5. EarthMaterial

EarthMaterial	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::GeoSciML::GeoSciML-Core [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.4.4.6. Mine

Mine	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesCore [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	(A) An underground excavation for the extraction of mineral deposits, in contrast to surficial excavations such as quarries. The term is also applied to various types of open-pit workings. (B) The area or property of a mineral deposit that is being excavated; a mining claim.

5.2.4.4.7. MiningFeature

MiningFeature (abstract)	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesCore [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	The abstract MiningFeature class represents a conceptual feature that exists coherently in the world. * this corresponds with a "Mine" or a "MiningActivity", locatable and identifiable features in time and/or space

5.2.4.4.8. ProcessingActivityTypeCode

ProcessingActivityTypeCode	
Package:	INSPIRE Consolidated UML Model::Themes::Annex III::MineralResources::MineralResourcesCore [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	The type of processing carried out during a mining activity

5.2.4.4.9. Quantity

Quantity	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19136 GML::valueObjects [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

6 Reference systems

6.1 Coordinate reference systems

6.1.1 Datum

IR Requirement 3 For the coordinate reference systems used for making available the INSPIRE spatial data sets, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, and 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 established and described relationship between both systems, according to EN ISO 19111.

6.1.2 Coordinate reference systems

IR Requirement 4 INSPIRE spatial data sets shall be made available using one of the three-dimensional, two-dimensional or compound coordinate reference systems specified in the list below.

Other coordinate reference systems than those listed below may only be used for regions outside of continental Europe. The geodetic codes and parameters for these coordinate reference systems shall be documented, and an identifier shall be created, according to EN ISO 19111 and ISO 19127.

1. Three-dimensional Coordinate Reference Systems
   - Three-dimensional Cartesian coordinates
   - Three-dimensional geodetic coordinates (latitude, longitude and ellipsoidal height), using the parameters of the GRS80 ellipsoid

2. Two-dimensional Coordinate Reference Systems
   - Two-dimensional geodetic coordinates, using the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Azimuthal Equal Area projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Lambert Conformal Conic projection and the parameters of the GRS80 ellipsoid
   - Plane coordinates using the Transverse Mercator projection and the parameters of the GRS80 ellipsoid

3. Compound Coordinate Reference Systems
   - For the horizontal component of the compound coordinate reference system, one of the two-dimensional coordinate reference systems specified above 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. The geodetic codes and parameters for these vertical reference systems shall be documented and an identifier shall be created, according to EN ISO 19111 and ISO 19127
   - For the vertical component measuring the depth of the sea floor, where there is an appreciable tidal range, the Lowest Astronomical Tide shall be used as reference surface. In marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200 m, the depth of the sea floor shall be referenced to the Mean Sea Level
   - For the vertical component measuring depths above the sea floor in the free ocean, barometric pressure shall be used
   - For the vertical component in the free atmosphere, barometric pressure, converted to height using ISO 2533:1975 International Standard Atmosphere shall be used

6.1.3 Display

IR Requirement 5 For the display of the INSPIRE spatial data sets with the View Service specified in D003152/02 Draft Commission Regulation implementing Directive 2007/2/EC of the European Parliament and of the Council as regards Network Services, at least the two dimensional geodetic coordinate system shall be made available.

6.1.4 Identifiers for coordinate reference systems

IR Requirement 6 For referring to the non-compound coordinate reference systems listed in this Section, the identifiers listed below shall be used.

For referring to a compound coordinate reference system, an identifier composed of the identifier of the horizontal component, followed by a slash (/), followed by the identifier of the vertical component, shall be used.

- ETRS89-XYZ for Cartesian coordinates in ETRS89
- ETRS89-GRS80h for three-dimensional geodetic coordinates in ETRS89 on the GRS80 ellipsoid
- ETRS89-GRS80 for two-dimensional geodetic coordinates in ETRS89 on the GRS80
- EVRS for height in EVRS
- LAT for depth of the sea floor, where there is an appreciable tidal range
- MSL for depth of the sea floor, in marine areas without an appreciable tidal range, in open oceans and effectively in waters that are deeper than 200m
- ISA for pressure coordinate in the free atmosphere
- PFO for Pressure coordinate in the free ocean
- ETRS89-LAEA for ETRS89 coordinates projected into plane coordinates by the Lambert Azimuthal Equal Area projection
- ETRS89-LCC for ETRS89 coordinates projected into plane coordinates by the Lambert Conformal Conic projection
- ETRS89-TMzn for ETRS89 coordinates projected into plane coordinates by the Transverse Mercator projection

6.2 Temporal reference system

IR Requirement 7 The Gregorian Calendar shall be used for as a reference system for date values, and the Universal Time Coordinated (UTC) or the local time including the time zone as an offset from UTC shall be used as a reference system for time values.

6.3 Theme-specific requirements and recommendations on reference systems

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

7 Data quality

This chapter includes a description of data quality elements and sub-elements as well as the associated data quality measures (section 7.1). The selected data quality measures should be used to evaluate quality of data sets for a specific data quality element / sub-element. The evaluation can be performed at the level of spatial object, spatial object type, dataset or dataset series.

The results of the evaluation are then reported at the spatial object type or dataset level in metadata utilising the same data quality elements and measures (see chapter 8).

NOTE The selection of appropriate data quality measures represents the first step towards the harmonisation of documenting data quality.

In addition, for some of the data quality elements described in section 7.1, minimum data quality requirements or recommendations may be defined. These are described in the section 1.2.

Recommendation 1 If data quality information is required at spatial object level then it should be modelled in the data model as an attribute of a relevant spatial object type.

7.1 Data quality elements and measures

Recommendation 2 To evaluate and report the data quality of data sets related to the spatial data theme **Mineral Resources**, the elements and measures listed in Table 2 should be used.

Table 2 – Data quality elements for evaluating and reporting the data quality of data sets related to the spatial data theme Mineral Resources

Section	Data quality element and sub-element
7.1.1	Completeness – Omission
7.1.2	Positional accuracy – Absolute or external accuracy

7.1.1 Completeness – Omission

Omission should be documented using the rate of missing items.

Name	**Rate of missing items**
Alternative name	–
Data quality element	Completeness
Data quality sub-element	Omission
Data quality basic measure	Error rate
Definition	Number of missing items in the dataset in relation to the number of items that should have been present.
Description	The date when resources and reserves of a commodity have been computed should be indicated.
Evaluation scope	spatial object type: OreMeasure
Reporting scope	spatial object type: OreMeasure data set
Parameter	–
Data quality value type	percentage
Data quality value structure	–
Source reference	–
Example	
Measure identifier	7 (ISO 19138)

7.1.2 Positional accuracy – Absolute or external accuracy

Absolute or external accuracy should be documented using Positional accuracy.

Name	**Positional accuracy**
Data quality element	Positional accuracy
Data quality sub-element	Absolute or external accuracy
Data quality basic measure	Two-dimensional random variable X and Y
Definition	Value of the positional uncertainty of a mine or a mineral occurrence location
Evaluation scope	spatial object type: Mine / MineralOccurrence
Reporting scope	spatial object type: Mine / MineralOccurrence
Description	
Parameter	
Data quality value type	Measure
Data quality value structure	
Source reference	
Example	
Measure identifier	28 (ISO 19138)

7.2 Minimum data quality requirements and recommendations

No minimum data quality requirements are defined.

Recommendation 3 For the data quality elements listed in Table 3, all data sets related to the spatial data theme **Mineral Resources** should meet the specified target results.

Table 3 – Data quality elements and measures for which minimum data quality recommendations are defined for the spatial data theme Mineral Resources

Section	Data quality element and sub-element	Measure name(s)	Target result(s)	Condition
7.1.1	Completeness – Omission		Max. 5%	
7.1.2	Positional accuracy – Absolute or external accuracy			

8 Dataset-level metadata

Metadata can be reported for each individual spatial object (spatial object-level metadata) or once for a complete dataset or dataset series (dataset-level metadata). Spatial object-level metadata is fully described in the application schema (section **5**). If data quality elements are used at spatial object level, the documentation shall refer to the appropriate definition in section 7. This section only specifies dataset-level metadata elements.

For some dataset-level metadata elements, in particular on 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. When using ISO 19115/19139 to encode the metadata, the following rules should be followed:

- The scope element (of type DQ_Scope) of the DQ_DataQuality subtype should be used to encode the 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 The value featureType is used to denote spatial object type.

Mandatory or conditional metadata elements are specified in Section 8.1. Optional metadata elements are specified in Section 8. The tables describing the metadata elements contain 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.
- The fourth column specifies the condition, under which the given element becomes mandatory (only for Table 4 and Table 5).

8.1 Common metadata elements

IR Requirement 8	The metadata describing a spatial data set or a spatial data set series related to the theme **Mineral Resources** shall comprise the metadata elements required by Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata) for spatial datasets and spatial dataset series (Table 4) as well as the metadata elements specified in Table 5.

Table 4 – Metadata for spatial datasets and spatial dataset series specified in Regulation 1205/2008/EC (implementing Directive 2007/2/EC of the European Parliament and of the Council as regards metadata)

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.
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	

Table 5 – Mandatory and conditional common metadata elements

INSPIRE Data Specification Mineral Resources **Section**	**Metadata element**	**Multiplicity**	**Condition**
8.1.1	Coordinate Reference System	1	

8.1.2	Temporal Reference System	0..*	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.
8.1.3	Encoding	1..*	
8.1.4	Character Encoding	0..*	Mandatory, if an encoding is used that is not based on UTF-8.
8.1.5	Data Quality – Logical Consistency – Topological Consistency	0..*	Mandatory, if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.

8.1.1 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
INSPIRE multiplicity	1
Data type(and ISO 19115 no.)	189. MD_CRS
Domain	Either the referenceSystemIdentifier (RS_Identifier) or the projection (RS_Identifier), ellipsoid (RS_Identifier) and datum (RS_Identifier) properties 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	
Comments	

8.1.2 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.
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. NOTEMore 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	
Comments	

8.1.3 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
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 9 shall be used to document the default and alternative encodings.
Implementing instructions	
Example	name: **Mineral Resources** GML application schema version: version **2.0**, GML, version 3.2.1 specification: D2.8.**II/III**.**21** Data Specification on **Mineral Resources** – Draft Guidelines
Example XML encoding	
Comments	

8.1.4 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	-
Example XML encoding	-
Comments	

8.1.5 Data Quality – Logical Consistency – Topological Consistency

Metadata element name	**Data Quality – Logical Consistency – Topological Consistency**
Definition	Correctness of the explicitly encoded topological characteristics of the dataset as described by the scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	Mandatory, if the data set includes types from the Generic Network Model and does not assure centreline topology (connectivity of centrelines) for the network.
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	115. DQ_TopologicalConsistency
Domain	Lines 100-107 from ISO 19115
Implementing instructions	This metadata should be filled, at least, with these elements: - valueUnit: UnitOfMeasure - value: Record
Example	
Example XML encoding	
Comments	See clauses on topological consistency in section 7 for detailed information. This metadata element is mandatory if connectivity is not assured for network centrelines in the dataset. In this case the *Connectivity tolerance* parameter – as described in section 7 – must be provided in order to ensure automatic and unambiguous creation of centreline topology in post-process.

8.2 Metadata elements for reporting data quality

Recommendation 4 For reporting the results of the data quality evaluation quantitatively, the data quality elements and measures defined in Chapter 7 should be used.

NOTE For reporting compliance with minimum data quality requirements and recommendations, see the Open issue 2 mentioned below the table.

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.

Recommendation 5 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 in the metadata using the 104. *evaluationMethodDescription* element.

Metadata element name	**See chapter 7**
Definition	<see chapter 7)
ISO 19115 number and name	80. report
ISO/TS 19139 path	dataQualityInfo/*/report
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*
Data type (and ISO 19115 no.)	Corresponding DQ_xxx element from ISO 19115, e.g. 109. DQ_CompletenessCommission

Domain	Lines 100-107 from ISO 19115 100. nameOfMeasure (O) 101. measureIdentification (O) 102. measureDescription (O) 103. evaluationMethodType (O) 104. evaluationMethodDescription (O) 105. evaluationProcedure (O) 106. dateTime (O) 107. result : DQ_Result (M)
Implementing instructions	Recommendation: For each DQ result included in the metadata, at least the following properties should be provided: 100, 103, 104, 106, 107 100 should be the name as defined in Chapter 7 103 should be selected from the DQ_EvaluationMethodTypeCode 104 should be used also for describing a method used for aggregation of the DQ results 106 should be data or range of dates on which the DQ measure was applied 107 should be of type DQ_QuantitativeResult.
Example	Add example
Example XML encoding	
Comments	See Chapter 7 for detailed information on the individual data quality elements and measures to be used.

Open issue 1: In the ongoing revision of ISO 19115 and development of new ISO 19157 standard (Geographic Information – Data quality) a new element is introduced (DQ_DescriptiveResult). This element enables to describe and report qualitative results of the data quality evaluation and can be used instead of DQ_QuantitativeResult. Once the standards are approved these guidelines should be updated if necessary.

Open issue 2: Documentation of conformance with target results specified in section 7.

Should be done using DQ_ConformanceResults. However, this issue is part of the larger discussion on the ATS and defining conformance classes for the data specification. This will be dealt with for v3.0.

8.3 Theme-specific metadata elements

Recommendation 6 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 6.

Table 6 – Optional theme-specific metadata elements for the theme Mineral Resources

INSPIRE Data Specification Mineral Resources **Section**	**Metadata element**	**Multiplicity**
8.3.1	Maintenance Information	0..1

	Completeness – Omission	0..1
	Positional accuracy – Absolute or external accuracy	0..1

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
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 Completeness – Omission

Metadata element name	**Data Quality – Completeness – Omission**
Definition	Data from the dataset with no date for OreMeasure, as described by the scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..1
Data type (and ISO 19115 no.)	110. DQ_CompletenessOmission
Domain	See section 7.1.1 of Data Quality.
Implementing instructions	
Example	
Example XML encoding	
Comments	

8.3.3 Positional accuracy – Absolute or external accuracy

Open issue: It is not yet defined how to aggregate information about positional accuracy at the dataset level (positional accuracy is described at the feature level).

Metadata element name	**Data Quality – Positional accuracy – Absolute or external accuracy**
Definition	closeness of reported coordinate values to values accepted as or being true
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..1
Data type (and ISO 19115 no.)	117. DQ_AbsoluteExternalPositionalAccuracy
Domain	See section 7.1.2 of Data Quality.
Implementing instructions	
Example	
Example XML encoding	
Comments	

8.4 Guidelines on using metadata elements defined in Regulation 1205/2008/EC

8.4.1 Conformity

The *Conformity* metadata element defined in Regulation 1205/2008/EC allows to report the conformance with the Implementing Rule for interoperability of spatial data sets and services or another specification. The degree of conformity of the dataset 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).

Recommendation 7 The Conformity metadata element should be used to report conceptual consistency with this INSPIRE data specification. The value of Conformant should be used for the Degree element only if the dataset passes all the requirements described in the abstract test suite presented in Annex A. The Specification element should be given as follows:
- title: “INSPIRE Data Specification on <Theme Name> – Draft Guidelines”
- date:
  - dateType: publication
  - date: 2011-06-10

Open issue 3: Conformance testing is still an open issue under discussion.

Instructions on conformance testing and a common abstract test suite (including detailed instructions on how to test specific requirements) will be added at a later stage.

This may also lead to an update of the recommendations on how to fill the conformity metadata element.

8.4.2 Lineage

Recommendation 8 Following the ISO 19113 Quality principles, if a data provider has a procedure for quality validation of their spatial data sets then the data quality elements listed in the Chapters 7 and 8 should be used. 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 specify that the statement sub-element of LI_Lineage (EN ISO 19115) should be used to implement the lineage metadata element.

Recommendation 9 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 This recommendation is based on the conclusions of the INSPIRE Data Quality Working Group to avoid overloading of the overall lineage statement element with information on the transformation steps and related source data.

NOTE 2 In order to improve the interoperability, domain templates and instructions for filling these free text elements (descriptions) may be specified in an Annex of this data specification.

Open issue 4: The suggested use of the LI_Lineage sub-elements needs to be discussed as part of the maintenance of the INSPIRE metadata Technical Guidelines.

8.4.3 Temporal reference

According to Regulation 1205/2008/EC, at least one of the following temporal reference metadata elements shall be provided: temporal extent, date of publication, date of last revision, date of creation. If feasible, the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata element.

9 Delivery

9.1 Delivery medium

DS Requirement 2 Data conformant to this INSPIRE data specification shall be made available through an INSPIRE network service.

DS Requirement 3	All information that is required by a calling application to be able to retrieve the data through the used network service shall be made available in accordance with the requirements defined in the Implementing Rules on Network Services.

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 proviced 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.

9.2 Encodings

9.2.1 Default Encoding(s)

DS Requirement 4	Data conformant to the application schema(s) defined in section 5 shall be encoded using the encoding(s) specified in this section.

9.2.1.1. Default encoding for application schema <application schema name>

Name: MineralResourcesCore GML Application Schema
Version: version 2.0, GML, version 3.2.1

- Specification: D2.8.**II/III**.**21** Data Specification on **Mineral Resources** – Draft Guidelines

Character set: UTF-8
Name: MineralResourcesExtension GML Application Schema
Version: version 2.0, GML, version 3.2.1

- Specification: D2.8.**II/III**.**21** Data Specification on **Mineral Resources** – Draft Guidelines

Character set: UTF-8

The GML Application Schema is distributed in a zip-file separately from the data specification document.

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.

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 on a specific topic.

Section 11.2 specifies the styles that shall be supported by INSPIRE view services for each of these layer types.

In section **Error! Reference source not found.**, 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.

Where XML fragments are used in these 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)

IR Requirement 9	If an INSPIRE view services supports the portrayal of data related to the theme **Mineral Resources**, it shall provide layers of the types specified in this section.

DS Requirement 5	If an INSPIRE view network service supports the portrayal of spatial data sets corresponding to the spatial data theme **Mineral Resources**, it shall support the styles specified in section 11.2. If no user-defined style is specified in a portrayal request for a specific layer to an INSPIRE view service, the default style specified in section 11.2 for that layer shall be used.

Recommendation 10	In addition to the styles defined in section 11.2, it is recommended that, where applicable, INSPIRE view services also support the styles defined in section **Error! Reference source not found.**.

11.1 Layers to be provided by INSPIRE view services

Layer Type	Layer Title	Spatial Object types
MR.CommodityBaseMetals	Base Metals	Commodity where CommodityName= see legend below
MR.CommodityPreciousMetals	Precious Metals	idem

MR.CommodityIronMetals	Iron and ferro-alloy metals	Idem
MR.CommodityRareMetals	Speciality and Rare metals	Idem
MR.CommodityEnergy	Energy Commodities	Idem
MR.CommodityPreciousStones	Precious and semi-precious stones	Idem
MR.CommodityChemicalUse	Mineral for chemical use	Idem
MR.CommodityCeramic	Ceramic and refractory minerals	Idem
MR.CommodityFertilizedMinerals	Fertilized minerals	Idem
MR.CommodityBuildingMaterials	Building raw materials, dimension stones	Idem
MR.CommodityIndustrialMinerals	Speciality and other industrial rocks and minerals	Idem

11.1.1 Layers organisation

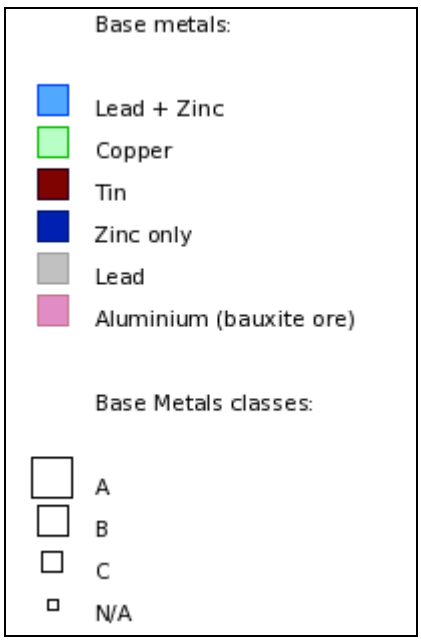
None.

11.2 Styles to be supported by INSPIRE view services

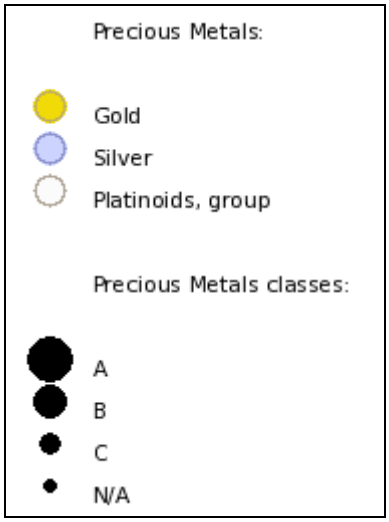
Open issue 5: The suggested styles are presented graphically. As there is no related standard but only some uses, the definition is still in discussion and required comments, suggestions from stakeholders. The template to provide detailed information about styles (Style Name, Default Style, Style Title, Style Abstract, Symbology, Minimum & maximum scales) will be used for the next version of this data specification.

The size of each symbol is related to the classification defined for each commodity (or group of commodities). The suggestion presented below is the result of the ProMine project. INSPIRE TWG-MR has completed this defining 6 classes : A, B, C, D, E and N/A for the deposit size and occurrence. (A: very large deposit, B: large deposit, C: medium size deposit, D: small deposit, E: occurrence, N/A: non information available)

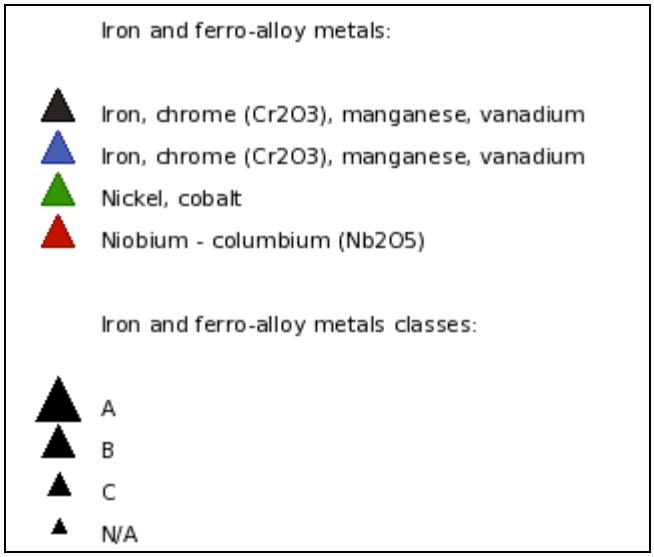
11.2.1 Styles for the layer Base metals



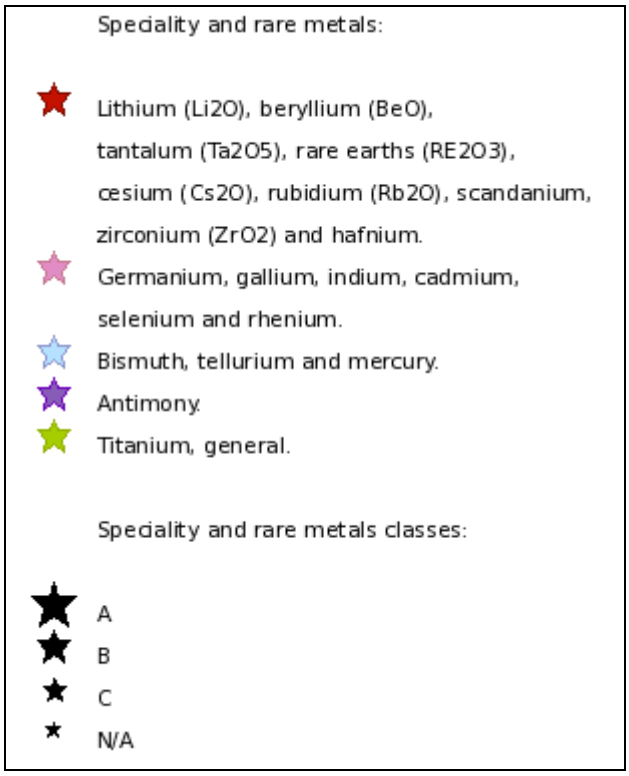
11.2.2 Styles for the layer Precious metals



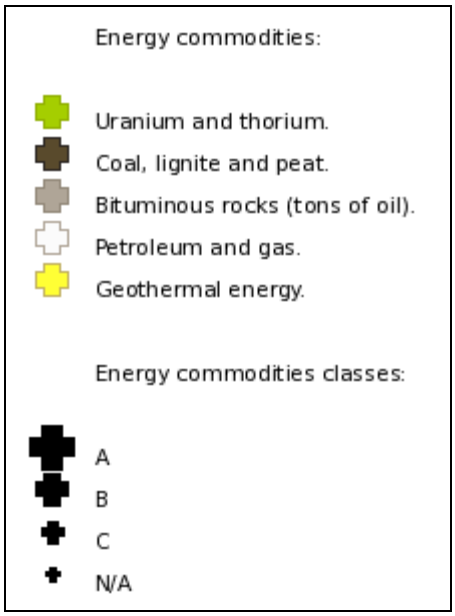
11.2.3 Styles for the layer Iron and ferro-alloy metals



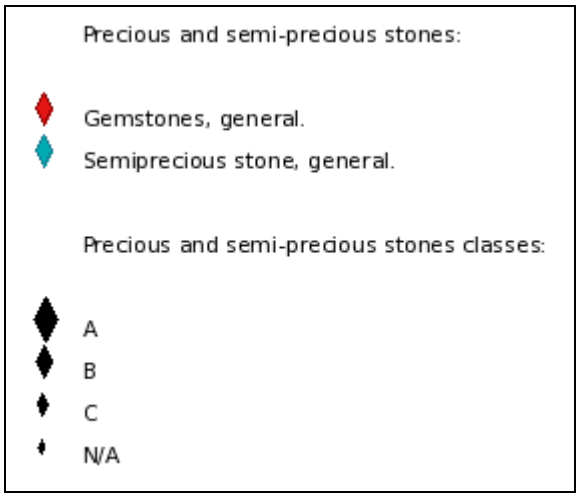
11.2.4 Styles for the layer Speciality and Rare metals



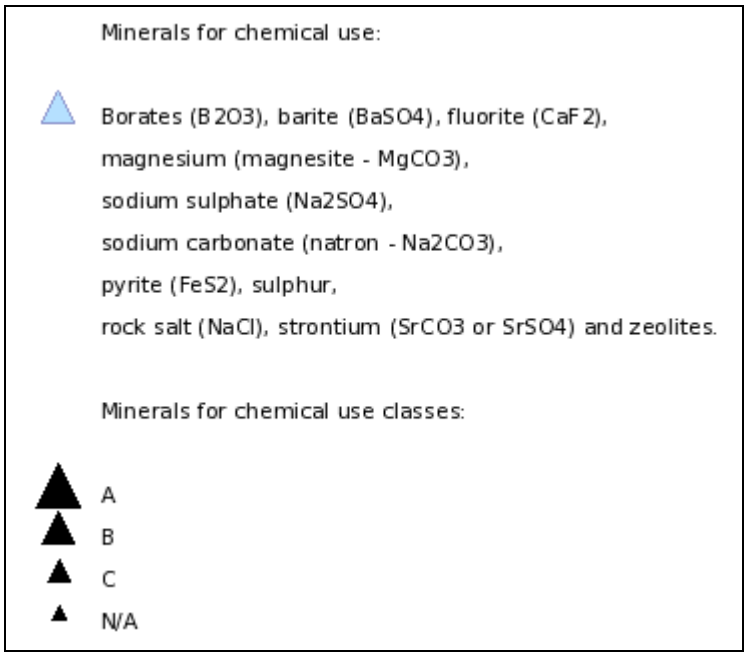
11.2.5 Styles for the layer Energy Commodities



11.2.6 Styles for the layer Precious and semi-precious stones



11.2.7 Styles for the layer Mineral for chemical use



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[ISO 19103] ISO/TS 19103:2005, Geographic information – Conceptual schema language

[ISO 19107] EN ISO 19107:2005, Geographic information – Spatial schema (ISO 19107:2003)

[ISO 19108] EN ISO 19108:2005 Geographic information - Temporal schema (ISO 19108:2002)

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

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

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

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

[OGC 06-103r3] Implementation Specification for Geographic Information - Simple feature access – Part 1: Common Architecture v1.2.0

Delete any of these references or add further references as applicable.

Annex A
(normative)

Abstract Test Suite

Any dataset conforming to this INSPIRE data specification shall meet all requirements specified in this document.

Open issue 6: Conformance testing is still an open issue under discussion.

Instructions on conformance testing and a common abstract test suite (including detailed instructions on how to test specific requirements) will be added at a later stage.

Annex B
(informative)
Use Cases for Mineral Resources

UC01: 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

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.

Detailed description

Use case description	
Name	What is the gold potential of Central and Southeastern Europe?
Priority	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 mineral deposits containing gold within the selected area. 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.
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 A+B, class A+B+C, 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 path	
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
Post-conditions	
Post-condition	The user has a listing and a map of selected deposits
Data source: *INSPIRE-conformant Mineral deposit data set provided by Member Sate*	
Description	Mineral deposit data from national sources.
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 (tbd)
Delivery	INSPIRE Mineral resources GML Application schema
Documentation	INSPIRE Mineral resources Data Specification

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.

UC02: 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).

Detailed description

Use case description	
Name	Ge in Europe: where to find it?
Priority	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 mineral deposits and mining wastes containing proven Ge at EU scale, and mineral deposits and wastes where Ge could be suspected. 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.
Flow of events – Basic path	
Step 1	Selection of the area (by adding countries, or graphically)
Step 2	Selection of the commodity (main / secondary)
Step 3	Selection of the class of deposit to visualize: class A (the largest) only, class A+B, class A+B+C, 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 path	
Post-conditions	
Post-condition	The user has a listing and a map of selected deposits/wastes
Data source: *INSPIRE-conformant Mineral deposit data set provided by Member Sate*	
Description	Mineral deposit and waste data from national sources.
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 (tbd)
Delivery	INSPIRE Mineral resources GML Application schema
Documentation	INSPIRE Mineral resources Data Specification

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.

UC03: 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 difference);
- Aspect ratio: 10 m^2/g;
- Abrasivity: 4 mg.

Detailed description

Use case description	
Name	A manufacturer looking for GCC
Priority	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).
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)
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 path	
Post-conditions	
Post-condition	The user has a listing and a map of selected deposits
Data source: *INSPIRE-conformant Mineral deposit data set provided by Member Sate*	
Description	Mineral deposit data from national sources.
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 (tbd)
Delivery	INSPIRE Mineral resources GML Application schema
Documentation	INSPIRE Mineral resources Data Specification

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.

UC04: Environmental uncertainties related to mining wastes

This use case is related to example of use:

- MR-04: Environmental impact assessment

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).

Detailed description

Use case description	
Name	Environmental uncertainties related to mining wastes
Priority	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.
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)
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 path	
Post-conditions	
Post-condition	The user has a listing and a map of selected deposits/wastes
Data source: *INSPIRE-conformant Mineral deposit data set provided by Member Sate*	
Description	Mineral deposit and waste data from national sources.
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 (tbd)
Delivery	INSPIRE Mineral resources GML Application schema
Documentation	INSPIRE Mineral resources Data Specification

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
(informative)
Analysis of related legislation

Two legal texts provide requirements for the data specification:
The raw materials initiative
The management of waste from extractive industries

The 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:

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:

- 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.
- 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 harmonised EU level data sets stands out

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

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;

The raw materials initiative

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:

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- 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 Beryllium Cobalt Fluorspar Gallium Germanium Graphite Indium Magnesium Niobium PGMs (Platinum Group Metals) Rare earths Tantalum 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 worldwide 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.

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:

- **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**;
- classification of the waste according to the relevant entry in Decision 2000/532/EC, with particular regard to its hazardous characteristics;
- description of the chemical substances to be used during treatment of the mineral resource and their stability;
- description of the method of deposition;
- waste transport system to be employed.

Consequences of the legislation on the data specification:

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 the same information about mineral resources than the assessment of the impact on environment.
So the TWG decided to provide two application schemas: one related to the common object types and common properties requested by all examples of use (the location of mineral resources, the main commodities, and the exploitation type), and another one to address more properties but optional.

Annex D
(informative)
Code lists for Mineral Resources

Code list
1_ImportanceCode
2_Commodity Term
3_Earth Resource expression
4_Earth Resource form
5_Earth Resource shape
6_ERMaterialRole
7_ExplorationActivityType
8_Exploration Activity result
9_MineStatus
10_RawMaterialRole
11_MineralOccurrenceType
12_mineralDepositGroup
13_Mineral Deposit Type
14_MiningActivity Type
15_Observation method
16_WasteStorageType
17_ProcessingActivityType
18_MiningWasteType
19_Environmental Impact
20_EndusePotentialType
22_Product name
23_ReserveCategory
24_ResourceCategory
25_Value Qualifier Mineral
26_Calculation Method
27_Mineral name

Name: ImportanceCode list

Code	INSPIRE DS_2.0	Definition	Def_ref
A	Very large deposit	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. This classification is based on the potential or endowment: reserves + resources.	ProMine
B	Large deposit	Ditto	ProMine
C	Medium sized deposit	Ditto	ProMine
D	Small deposit	Ditto	ProMine
E	Occurrence	Any ore or economic mineral in any concentration found in bedrock or as float; esp. a valuable mineral in sufficient concentration to suggest further exploration.	Glossary of Geology. 5th Edition, AGI - online
N/A	No information available		

Name: Commodity TermCode list

INSPIRE DS_2.0	CLASS_A	CLASS_B	CLASS_C	CLASS_D	UNIT
Abrasive minerals: garnet, staurolite (substance)	500000	100000	20000	5000	t (1000 kg)
Silver (metal)	10000	2500	500	100	t (1000 kg)
Aggregate (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Alluvial aggregate (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Chert, siliceous concretion (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Crushed aggregate (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Crushed aggregate from carbonate (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Crushed aggregate from magamtic rock (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Crushed aggregate from sandstone, quartzite (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Sand, sand and gravel (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Very fine sand (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Aquamarine (substance)	10	5	0.5	0.1	t (1000 kg)
Agata, chalcedony, jasper (substance)	1000	100	10	1	t (1000 kg)
Aluminium (Bauxite ore)	1000000000	100000000	10000000	1000000	t (1000 kg)
Alunite	5000000	1000000	200000	10000	t (1000 kg)
Amber	10	5	0.5	0.1	t (1000 kg)
Amethyst, quartz, citrine, aventurine (substance)	50	5	0.5	0.1	t (1000 kg)
Amazonite, gemstone (substance)	10	1	0.1	0.01	t (1000 kg)
Andalusite-kyanite group (substance)	5000000	2000000	500000	100000	t (1000 kg)
Andalusite (substance)	5000000	2000000	500000	100000	t (1000 kg)
Antophyllite (Asbestos) (substance)	10000000	1000000	100000	10000	t (1000 kg)
Apatite, gemstone ("cat's eye"), (substance)	10000000	1000000	100000	10000	ct
Arsenic (metal)	200000	20000	2000	200	t (1000 kg)
Asbestos (substance)	10000000	1000000	100000	10000	t (1000 kg)
Attapulgite, sepiolite (substance)	5000000	2000000	500000	100000	t (1000 kg)
Gold (metal)	500	100	10	1	t (1000 kg)
Beryllium (BeO)	20000	2000	200	50	t (1000 kg)
Bismuth (metal)	20000	2000	200	2	t (1000 kg)
Bituminous rocks (tons of oil)	1000000000	100000000	10000000	1000000	t (1000 kg)
Base metal (undifferenciated)	5000000	500000	50000	5000	t (1000 kg)
Bentonite (substance)	5000000	2000000	500000	100000	t (1000 kg)
Fossil wood	10	5	0.5	0.1	t (1000 kg)
Borates (B2O3)	25000000	2000000	100000	10000	t (1000 kg)
Bromine (substance)	1000000	100000	10000	1000	t (1000 kg)
Beryl, gemstone (substance)	10	1	0.1	0.01	t (1000 kg)
Barite (BaSO4)	5000000	1000000	200000	50000	t (1000 kg)
Calcium	0	0	0	0	
Calcite, filler for paper (CaCO3)	100000000	10000000	1000000	100000	t (1000 kg)

Calcite, optical use (CaCO3)	100	10	1	0.1	t (1000 kg)
Carbonates	0	0	0	0	
Chrysoberyl, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Carbonatite mineral markers	4	3	2	1	t (1000 kg)
Cadmium (metal)	10000	2000	500	100	t (1000 kg)
Cerium (Ce2O3)	250000	25000	2500	250	t (1000 kg)
Chrysotile (Asbestos) (substance)	10000000	1000000	100000	10000	t (1000 kg)
Chrysoprase, green opal (substance)	10	1	0.1	0.01	t (1000 kg)
Clays, unknown use	0	0	0	0	
Common clays for brick, tile (substance)	10000000	2000000	500000	100000	t (1000 kg)
Clays for cement works (substance)	10000000	2000000	500000	100000	t (1000 kg)
White-firing clays (refractory & ceramic) (subst.)	5000000	1000000	200000	50000	t (1000 kg)
Cobalt (metal)	500000	50000	2000	200	t (1000 kg)
Coal, lignite (substance)	10000000000	1000000000	100000000	5000000	t (1000 kg)
Iolite, gemstone (substance)	10000000	1000000	100000	10000	ct
Corundum, gemstone (substance)	10000000	1000000	100000	10000	ct
Chrome (Cr2O3)	25000000	5000000	1000000	200000	t (1000 kg)
Corundum (substance)	500000	100000	20000	5000	t (1000 kg)
Crocidolite (Asbestos) (substance)	10000000	1000000	100000	10000	t (1000 kg)
Cesium (Cs2O)	1000	100	10	1	t (1000 kg)
Copper (metal)	10000000	1000000	100000	10000	t (1000 kg)
Diamond, industrial and gemstone (substance)	100000000	10000000	1000000	100000	ct
Diamond mineral markers (pyrope, ilmenite, etc)	0	0	0	0	
Dioptase, gemstone (substance)	10000000	1000000	100000	10000	ct
Dolomite (substance)	500000000	50000000	5000000	500000	t (1000 kg)
Diatomite (kieselguhr) (substance)	10000000	1000000	100000	10000	t (1000 kg)
Dumortierite, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Emerald (substance)	10000000	1000000	100000	10000	ct
Diopside-enstatite, gemstone (substance)	10	1	0.1	0.01	t (1000 kg)
Euclase, gemstone (substance)	10000000	1000000	100000	10000	ct
Evaporites	0	0	0	0	
Iron (metal)	1000000000	100000000	10000000	1000000	t (1000 kg)
Feldspar, nepheline (substance)	100000000	10000000	1000000	100000	t (1000 kg)
Fluorite (CaF2)	5000000	1000000	200000	50000	t (1000 kg)
Gallium (metal)	100	50	10	1	t (1000 kg)
Gabbro, dolerite, etc., ornamental (substance)	100000000	20000000	5000000	1000000	t (1000 kg)
Gas (substance)	1000	250	50	10	km3
Germanium (metal)	500	100	20	5	t (1000 kg)
Gemstones, general (substance)	10000000	1000000	100000	10000	ct
Semiprecious stone, general (substance)	10	5	0.5	0.1	t (1000 kg)
Gypsum, anhydrite (substance)	500000000	50000000	5000000	500000	t (1000 kg)
Graphite (substance)	10000000	1000000	100000	10000	t (1000 kg)
Granite, syenite, etc., ornamental (substance)	100000000	20000000	5000000	1000000	t (1000 kg)
Sandstone, quartzite (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Garnet, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Geothermal energy	1000	100	10	1	Kwh
Hafnium (metal)	10000	1000	100	10	t (1000 kg)
Mercury (metal)	50000	5000	500	100	t (1000 kg)
Heavy minerals, general (substance)	10000000	1000000	100000	10000	t (1000 kg)

Iodine (substance)	10000	1000	100	10	t (1000 kg)
Indium (metal)	500	100	25	5	t (1000 kg)
Potassium	0	0	0	0	
Kimberlite mineral markers	4	3	2	1	ct
Kaolin (substance)	50000000	10000000	2000000	500000	t (1000 kg)
Kornerupine, gemstone (substance)	10000000	1000000	100000	10000	ct
Kyanite, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Kyanite (substance)	5000000	2000000	500000	100000	t (1000 kg)
Lithium (Li2O)	1000000	100000	50000	5000	t (1000 kg)
Limestone (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Cement limestone (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Chalk (substance)	250000000	50000000	10000000	2000000	t (1000 kg)
Limestone for lime (substance)	50000000	10000000	2000000	500000	t (1000 kg)
Lazulite, ornamental (substance)	500000	200000	50000	10000	t (1000 kg)
Malachite (substance)	5000	2000	500	100	t (1000 kg)
Magnesium, magnesite (MgCO3)	100000000	10000000	1000000	100000	t (1000 kg)
Magnesium, salts and brines (MgO)	100000000	20000000	5000000	500000	t (1000 kg)
Mica, sheet (substance)	100000	20000	5000	500	t (1000 kg)
Manganese (metal)	100000000	10000000	1000000	100000	t (1000 kg)
Monazite	0	0	0	0	
Molybdenum (metal)	500000	100000	5000	1000	t (1000 kg)
Moonstone (adularia), gemstone (substance)	10	1	0.1	0.01	t (1000 kg)
Marble (substance)	50000000	10000000	2000000	500000	t (1000 kg)
Commodity not available	0	0	0	0	t (1000 kg)
Sodium	0	0	0	0	
Sodium sulphate (Na2SO4)	1000000	100000	10000	1000	t (1000 kg)
Sodium carbonate (natron) (Na2CO3)	100000000	10000000	1000000	100000	t (1000 kg)
Niobium - columbium (Nb2O5)	1000000	100000	10000	2000	t (1000 kg)
Nickel (metal)	2000000	500000	20000	2000	t (1000 kg)
Nitrates (NO3)	100000000	10000000	1000000	100000	t (1000 kg)
Peridot, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Opal, gemstone (substance)	10000000	1000000	100000	10000	ct
Osmiridium (metal)	25	5	1	0.1	t (1000 kg)
Other ornamental stone, except Gabb-Gran (subst.)	100000000	20000000	5000000	1000000	t (1000 kg)
Alkaline plutonism mineral markers	4	3	2	1	t (1000 kg)
Lead (metal)	5000000	500000	50000	5000	t (1000 kg)
Lead + Zinc (metal)	10000000	1000000	100000	10000	t (1000 kg)
Palladium (metal)	1000	100	10	1	t (1000 kg)
Peat (substance)	500000000	50000000	5000000	500000	t (1000 kg)
Undifferentiated pegmatite	0	0	0	0	
Perlite (substance)	20000000	10000000	5000000	1000000	t (1000 kg)
Petroleum (substance)	1000000000	100000000	10000000	1000000	m3
Phenakite, gemstone (substance)	10000000	1000000	100000	10000	ct
Phosphate (P2O5)	200000000	20000000	2000000	200000	t (1000 kg)
Mineral pigment (substance)	1000000	100000	10000	1000	t (1000 kg)
Platinoids, group (metal)	1000	100	10	1	t (1000 kg)
Pumice, pozzolan (substance)	100000000	50000000	10000000	2000000	t (1000 kg)
Pyrophyllite (substance)	20000000	5000000	1000000	100000	t (1000 kg)
Platinum (metal)	1000	100	10	1	t (1000 kg)
Potash (sylvite, carnallite) (K20)	500000000	50000000	5000000	500000	t (1000 kg)

Pyrite (FeS2)	100000000	20000000	5000000	200000	t (1000 kg)
Massive quartz, blocks for ferrosilicon (SiO2)	10000000	1000000	100000	10000	t (1000 kg)
Quartz, optical &piezoelectrical use (SiO2)	100	10	1	0.1	t (1000 kg)
Rose quartz (gemstone)	100	10	1	0.1	t (1000 kg)
Rubidium (Rb2O)	1000	100	10	1	t (1000 kg)
Rhenium (metal)	5000	500	50	5	t (1000 kg)
Rare Earths (RE2O3)	1000000	100000	10000	1000	t (1000 kg)
Rhodium (metal)	25	5	1	0.1	t (1000 kg)
Rhodonite, gemstone (substance)	10000000	1000000	100000	10000	ct
Ruthenium	0	0	0	0	
Ruby (substance)	10000000	1000000	100000	10000	ct
Sulphur (substance)	20000000	2000000	200000	20000	t (1000 kg)
Rock salt (NaCl)	2000000000	200000000	20000000	2000000	t (1000 kg)
Sapphire (substance)	10000000	1000000	100000	10000	ct
Brine	0	0	0	0	
Antimony (metal)	100000	25000	2000	1000	t (1000 kg)
Scandium (metal)	1000	100	10	1	t (1000 kg)
Scapolite, gemstone (substance)	10000000	1000000	100000	10000	ct
Selenium (substance)	5000	1000	250	50	t (1000 kg)
Silica, silica sand (substance)	10000000	2500000	500000	100000	t (1000 kg)
Sillimanite (substance)	5000000	2000000	500000	100000	t (1000 kg)
Sinhalite, gemstone (substance)	10000000	1000000	100000	10000	ct
Slate (substance)	5000000	2000000	500000	100000	t (1000 kg)
Tin (metal)	200000	25000	1000	100	t (1000 kg)
Sodalite, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Spinel, gemstone (substance)	10000000	1000000	100000	10000	ct
Strontium (SrCO3 or SrSO4)	1000000	100000	10000	1000	t (1000 kg)
Sunstone, aventurine (Tiger's eye), gemstone	10	1	0.1	0.01	t (1000 kg)
Tantalum (Ta2O5)	25000	2000	1000	200	t (1000 kg)
Tanzanite, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Tellurium (metal)	500	100	20	5	t (1000 kg)
Thorium (metal)	100000	10000	1000	100	t (1000 kg)
Thermal springs	1	0.1	0.01	0.001	m3/s
Titanium, general (TiO2)	20000000	2000000	200000	20000	t (1000 kg)
Titanium, ilmenite (TiO2)	20000000	2000000	200000	20000	t (1000 kg)
Titanium, rutile (TiO2)	2000000	200000	20000	2000	t (1000 kg)
Thallium (metal)	5000	500	50	5	t (1000 kg)
Talc (substance)	20000000	2000000	200000	20000	t (1000 kg)
Tourmaline, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)
Topaz (substance)	10	5	0.5	0.1	t (1000 kg)
Travertine (substance)	10000000	1000000	100000	10000	t (1000 kg)
Tremolite-actinolite, gemstone (substance)	10000000	1000000	100000	10000	ct
Tsavorite (green grossular), gemstone (substance)	10000000	1000000	100000	10000	ct
Turquoise (substance)	10	5	0.5	0.1	t (1000 kg)
Uranium (metal)	100000	20000	5000	500	t (1000 kg)
Vanadium (metal)	2000000	200000	20000	2000	t (1000 kg)
Alkaline volcanism mineral markers	4	3	2	1	t (1000 kg)
Vesuvianite, gemstone (substance)	10000000	1000000	100000	10000	ct
Vermiculite (substance)	10000000	1000000	100000	10000	t (1000 kg)

Wolfram (WO3)	200000	50000	5000	500	t (1000 kg)
Wollastonite (substance)	5000000	500000	50000	5000	t (1000 kg)
Yttrium (Y2O3)	250000	25000	2500	250	t (1000 kg)
Zeolites (substance)	1000000	200000	50000	10000	t (1000 kg)
Zinc (metal)	10000000	1000000	100000	10000	t (1000 kg)
Zirconium (ZrO2)	1000000	100000	10000	1000	t (1000 kg)
Zircon, gemstone (substance)	10	5	0.5	0.1	t (1000 kg)

Name: Earth Resource_expressionCode list

INSPIRE DS_2.0	Definition	Def_ref
DIRECT (outcrop)	An EarthResource has a surface expression	CGI/ERML
INDIRECT (e.g. alteration)	An EarthResource has been detected indirectly (e.g. alteration zone)	CGI/ERML
TOTALLY CONCEALED	An EarthResource has been detected under cover rocks.	CGI/ERML
UNKNOWN		

Name: Earth Resource_formCode list

INSPIRE DS_2.0	Definition	Def_ref
Concordant to subconcordant primary orebody	The orebody typical physical and structural relationship to wallrocks and associated rocks. A concordant or nearly concordant orebody lies parallel or nearly parallel to wallrocks contacts or internal structures (bedding, foliation, etc.)	ERML + DC
Discordant primary orebody (vein, reef, mass, lens, pipe, column, etc.)	The orebody typical physical and structural relationship to wallrocks and associated rocks. A discordant orebody crosscuts wallrocks contacts or internal structures (bedding, foliation, etc.)	ERML + DC
Mixed (concordant to subconcordant and discordant) primary orebody	The orebody typical physical and structural relationship to wallrocks and associated rocks. A concordant to subconcordant and discordant orebody in some places lies parallel to- and in other places crosscuts wallrocks contacts or internal structures (bedding, foliation, etc.)	ERML + DC
Surficial orebody of secondary origin	An orebody formed on or close to the surface, resulting from the circulation of enriched meteoric fluids and the destruction or transformation of a primary mineralization through a supergene process (incuding transport and reconcentration).	DC
Orebodies of anthropogenic origin	An orebody (a heap, a pile, ...), resulting from human activity. Typical examples are mining dumps and waste heaps.	DC
Atypical, unspecified or ill-defined form		
UNKNOWN		

Name: Earth Resource_shapeCode list

INSPIRE DS_2.0	Definition	Def_ref
Bed	A mineral deposit that follows the bedding plane in a sedimentary rock. Also a layered replacement deposit.	Glossary of Geology. 4th Edition, AGI
Stratiform bed: single or multi-layered (syn-depositional with host rock)	Said of a special type of strata-bound deposit in which the desired rock or ore constitutes, or is strictly coextensive with, one or more sedimentary, metamorphic, or igneous layers (e.g. layers rich in chromite or platinum in a layered igneous complex).	Glossary of Geology. 4th Edition, AGI
Stratabound bed (single or multi-layered)	Said of a mineral deposit confined to a single stratigraphic unit. The term can refer to a stratiform deposit, to variously oriented orebodies contained within the unit, or to a deposit containing veinlets and alterationzones that may or may not be strictly conformable with bedding.	Glossary of Geology. 4th Edition, AGI
Concordant to subconcordant mass, lens or pod of massive to submassive ore	Lens: a deposit bounded by converging surfaces (at least one of which is curved), thick in the middle and thinning out toward the edges, ressembling a convex lens. Pod: term formely used to describe certain bodies that are long in one dimension and short in two dimensions and are enclosed in schist (or other rock type, e.g. chromite pods) with the long axis parallel to the schistosity.	Glossary of Geology. 4th Edition, AGI + DC
Stratiform mass or lens of massive to semimassive ore (syn-depositional with host rock)		
Subconcordant or stratabound mass or lens of massive to submassive ore		
Pod, pod-shaped body	Pod: term formely used to describe certain bodies that are long in one dimension and short in two dimensions and are enclosed in schist (or other rock type, e.g. chromite pods) with the long axis parallel to the schistosity.	Glossary of Geology. 4th Edition, AGI + DC
Concordant to subconcordant envelope of disseminated ore		
Stratiform envelope of disseminated ore		
Stratabound envelope of disseminated ore		
Dissiminated nodule and/or vugs, amygdaloids fillings	Nodule: a rounded fragment of a coarse-grained igneous rock (or of ore), apparently crystallized at depth, occurring as an inclusion in an extrusive rock; e.g. a chromite nodular ore. Vug: a small cavity in a vein or in a rock, usually lined with crystals of a different mineral composition from the enclosing rock. Amygdaloid: said of a rock having numerous amygdules: a gas cavity or vesicle in an igneous rock, which is filled with secondary minerals.	Glossary of Geology. 4th Edition, AGI

Subconcordant vein, bedded vein, intraformational sheet	Sheet: a term used in the Upper Mississipi lead-mining region of the U.S. for galena occurring in thin, continuous masses. Vein: an epigenetic mineral filling of a fault or other fracture in a host rock, in tabular or sheetlike form, often with associated replacement of the host rock; a mineral deposit of this form and origin.	Glossary of Geology. 4th Edition, AGI
Concordant to subconcordantstockwork (veinlets network) envelope	Stockwork: a mineral deposit consisting of a three-dimensional network of planar to irregular veinlets closely enough spaced that the whole mass can be mined.	Glossary of Geology. 4th Edition, AGI
Travertine and geyserite (sinter)	Sinter: a chemical sedimentary rock deposited as a hard incrustation on rocks or on the ground by precipitation from hot or cold mineral waters of springs, lakes, streams. Siliceous sinter and calcareous sinter (travertine). Geyserite: a syn. of siliceous sinter, used esp. for the compact, loose, concretionary, scaly, or filamentous inscrustation of opaline silica deposited by precipitation from the waters of a geyser.	Glossary of Geology. 4th Edition, AGI
Discordant mass or lens of massive to submassive ore		
Discordant envelope of disseminated ore		
Breccia-pipe, funnel, chimney, column, brecciated dyke	Breccia-pipe: a cylindrical chimney filled with breccia fragments of the country rock. Often found in mineralized epithermal systems and associated porphyry-type mineral deposits. Breccia vein/dyke: a fissure containing numeous wall-rock fragments, with mineral deposits in the interstices. Chimney: pipe. Funnel intrusion: an igneous intrusion with an inverted conical shape; typically layered, and mafic or ultramafic in composition.	Glossary of Geology. 4th Edition, AGI
Discordant mass (cylinder, sheet, cone, etc.) with filling commonly brecciated		
Column, chimney with possibly brecciated ore		
Discordant lode or vein (thickness > 50 cm), in clusters or isolated	Lode: a mineral deposit consisting of a zone of veins, veinlets, disseminations, or planar breccias.	Glossary of Geology. 4th Edition, AGI
Discordant isolated lode with different vein morphologies: tension-gash, bayonet-shaped ("jog"), en echelon, sigmoidal, saddle reef, etc.	Tension-gash: a short tension fracture along which the walls have been pulling apart. Tension gashes may be open or filled, and commonly have an en echelon pattern. They may occur diagonally in fault zones. Saddle reef: a mineral deposit associated with the crest of an anticlinal fold and following the bedding planes, usually found in vertical succession, esp. the gold-bearing quartz veins of Australia.	Glossary of Geology. 4th Edition, AGI
Field of discordant lodes (n*km2, n*ha)		
Mineralized dyke (orebody: magmatic rock)	Dyke (dike): A tabular igneous intrusion that cuts across the bedding or foliation of the country rock.	Glossary of Geology. 4th Edition, AGI

Stockwork (or network) of stringers or veinlets (thickness < 50 cm), discordant on the strata	Stringer: a mineral veinlet or filament, usually one of a number, occurring in a discontinuous subparallel pattern in host rock.	Glossary of Geology. 4th Edition, AGI
Mixed (concordant to subconcordant and discordant) primary orebody (synchronous to sub-synchronous emplacement)		
Synchronous to sub-synchronous lode (s) and bed (s)		
Varied synchronous to sub-synchronous primary orebodies		
Primary cavity- or fracture-filling orebody		
Stratoid or discordant ore body related to a major unconformity	Unconformity: a substantial break or gap in the geologic record where a rock unit is overlain by another that is not the next in stratigraphic succession, such as an interruption in the continuity of a depositional sequence of sedimentary rocks or a break between eroded igneous rocks and younger sedimentary strata. This desribes also the structural relationship between rock strata in contact, characterized by a lack of continuity in deposition, and corresponding to a period of nondeposition, weathering, or esp. erosion prior to the deposition of the younger beds, and often marked by the absence of parallelism between the strata; strictly, the relationship where the younger overlying stratum does not conform to the dip and strike of the underlying rocks, is shown specif. by an angular unconformity.	Glossary of Geology. 4th Edition, AGI
Tabular-shaped orebody of secondary origin		
Tabular-shaped mass or lens		
Cap, blanket, crust	Blanket deposit: a miner's term for a horizontal, tabular orebody. The term has no genetic connotation.	Glossary of Geology. 4th Edition, AGI
Secondary cavity- or fracture-filling orebody		
Pockets, "per descensum" lodes	Pocket: a small, discontinuous occurrence or patch of ore, e.g. a mineralized cavity or crevice. Can also be a localized enrichment of an ore deposit.	Glossary of Geology. 4th Edition, AGI
Present-day or recent placers	Placer: a surficial mineral deposit formed by mechanical concentration of mineral particles from weathered debris.The common types are beach placers and alluvial placers. The mineral concentrated is usually a heavy, durable mineral such as gold, cassiterite, or rutile.	Glossary of Geology. 4th Edition, AGI
Tailings, dumps, stockpiles	Tailings: those portions of washed or milled ore that are regarded as too poor to be treated further, as distinguished from the concentrates, or material of value. Dumps: stacked waste material; often cone-shaped when the latter is discharged from one point. Stockpiles: stacked material with a flat top.	Glossary of Geology. 4th Edition, AGI Dictionnairethématique des mines et carrières, SIM Editor
UNKNOWN		

Name: EarthMaterialRoleCode list

INSPIRE DS_2.0	Definition	Def_ref
alteration product	(a) Any change in the mineralogic composition of a rock brought about by physical or chemical means, esp. by the action of hydrothermal solutions; also, a secondary, i.e. supergene, change in a rock or mineral. (b) Changes in the chemical or mineralogical composition of a rock produced by weathering.	Glossary of Geology. 5th Edition, AGI - online
gangue	The valueless rock or mineral aggregates in an ore; that part of an ore that is not economically desirable but cannot be avoided in mining. It is separated from the ore minerals during concentration	Glossary of Geology. 5th Edition, AGI - online
host rock	A body of rock serving as a host for other rocks or for mineral deposits; e.g. a pluton containing xenoliths, or any rock in which ore deposits occur. It is a somewhat more specific term than country rock.	Glossary of Geology. 5th Edition, AGI - online
primary	(a) Rocks of which the constituents are newly formed particles that have never been constituents of previously formed rocks and that are not the products of alteration or replacement, esp. igneous rocks formed directly by solidification from a magma	Glossary of Geology. 5th Edition, AGI - online
secondary	(a) Rocks composed of particles derived from the erosion or weathering of pre-existing rocks, such as residual, chemical, or organic rocks formed of detrital, precipitated, or organically accumulated materials; specif. clastic sedimentary rocks.	Glossary of Geology. 5th Edition, AGI - online
unspecified		

Name: ExplorationActivityTypeCode list

INSPIRE DS_2.0	Definition	Def_ref
REGIONAL RECONNAISSANCE	Regional reconnaissance intends to reduce the initial surface of the selected region by identifying anomalies (geochemical, geophysical, mineralogic) and discovering occurrences.	DC
Hammer prospecting and geological reconnaissance	Drafting of a very preliminary geological map with the main formations and the main structures (e.g. faults), and with the location of discovered mineral showings.	DC
Regional geochemistry	The search for mineable mineral deposits by detection of abnormal concentrations of chemical elements in superficial water, soils or organisms, usually accomplished by instrumental, spot-test, or rapid techniques which are applicable in the field.	Dictionnaire thématique des mines et carrières, SIM Editor.
Airborne geophysics	Exploration technique based on the detection of anomalous physical characteristics of a ground: electric conductivity, spontaneous or induced polarization, electromagnetism, magnetic susceptibility, stray currents (magnetotelluric currents method), speed of transmission of shockwaves (seismic method), specific weight and gravity (gravimetric method), radioactivity, reflectance at various wave length (infrared, radar).	Dictionnaire thématique des mines et carrières, SIM Editor.
Heavy mineral sampling	Prospecting with a hand-held or mechanic washing tool, shaped like a plate or a flat cone, at the bottom of which the densest fractions of a soil, a stream sediment are collected. Heavy concentrates obtained with this technique may indicate the presence of a possible mineralization up to tens of km upriver or upstream.	DC + Dictionnaire thématique des mines et carrières, SIM Editor.
DETAILED SURFACE EXPLORATION	Detailed surface exploration aims at accurately delineate rocks, anomalies and describe occurrences in their refined geological context.	DC, JV
Geological mapping	Detailed geological mapping of the area(s) of interest.	DC
Detailed geochemistry	Detailed surveys (often on a grid) with the most appropriate method, in order to confirm and better delineate and characterize geochemical anomalies identified during the previous phase.	DC
Detailed geophysics	Detailed surveys (often on a grid) with the most appropriate method, in order to confirm and better delineate and characterize geophysical anomalies identified during the previous phase.	DC
SUBSURFACE EXPLORATION	Subsurface exploration is the first attempt, with low costs techniques (trenching, destructive drilling, etc.), of resources appraisal. The goal is the identification and ranking of 'possible' targets.	DC
Removal of overburden, trenching	Shallow ditch from which a sample can be taken and a geological observation made. Particularly useful when outcrops are rare.	DC
Auger, rotary, percussion drilling	Drilling of a cylindrical hole with an ad hoc tool in order to collect a rock sample, or to carry out a physical measurement or a geological observation. By extension, designates also the drill hole, whatever the latter's purpose. Boreholes may be drilled by coring or by destructive techniques (e.g. percussion drilling).	Dictionnaire thématique des mines et carrières, SIM Editor.

ASSESSMENT OF THE RESOURCE	The aim of this phase is the (still rough) delineation of the enveloppe of an orebody. Logging of cores, sampling of mineralized sections allow to better understand the distinctive features of the deposit, the physical properties of the ore, and finally lead to a first (still approximate) calculation of the resource.	DC
Core and/or percussion drilling (reconnaissance drilling)	Drilling of a cylindrical hole with an ad hoc tool in order to collect a rock sample, or to carry out a physical measurement or a geological observation. By extension, designates also the drill hole, whatever the latter's purpose. Boreholes may be drilled by coring or by destructive techniques.	Dictionnaire thématique des mines et carrières, SIM Editor.
Geological interpretation	Compilation and synthesis of all the available geological information in order to get an as precise as possible model of the deposit: genesis, type, geometry, internal structure, distribution of grades, relationships with host rocks, etc.	DC
Ore beneficiation tests	Technique designed to treat run of mine material. Its aim is to physically separate its constituents in order to produce a marketable product.	Dictionnaire thématique des mines et carrières, SIM Editor.
Approximate calculation of the resource	Rough evaluation of the tonnage and grade essentially based on drillholes information, by correlation and interpolation of crosscuted mineralized sections.	DC
EVALUATION OF THE ORE DEPOSIT	This the final phase of evaluation. Knowledge of the deposit must be as precise as possible, hence systematic core drilling and eventually reconnaissance mining workings. This phase should lead on to a Go/No Go decision (possibly revisable, depending on e.g. prevailing economicalcontitions) based on a feasibility study report.	DC
Core drilling (systematic reconnaissance)	Drilling of a cylindrical hole with an ad hoc tool in order to collect a rock sample, or to carry out a physical measurement or a geological observation. By extension, designates also the drill hole, whatever the latter's purpose. Boreholes may be drilled by coring or by destructive techniques.	Dictionnaire thématique des mines et carrières, SIM Editor.
Mining workings (reconnaissance drift, adit, shaft, etc.)	Reconnaissance workings aimed at getting a better understanding of the deposit, and allowing to get large ore samples for detailed beneficiation tests.	DC
Geostatistical estimates	Technique based on probability theory that is used to compute regionalized variables, the values of which depend on their position in space, such as the metal content or grade in a deposit.	Dictionnaire thématique des mines et carrières, SIM Editor.
Feasibility study and report	Technical economic study aimed at assessing the possibility to launching a mine venture. When data are insufficiently precise, the study is said to be a pre-feasibility study.	Dictionnaire thématique des mines et carrières, SIM Editor.
UNKNOWN		

Name: Exploration Activity resultCode list

INSPIRE DS_2.0	Definition	Def_ref
Anomalies	(c) A geological feature, esp. in the subsurface, which is different from the general surroundings and possibly of potential economic value; e.g., a magnetic anomaly. It may be distinguished by geological, geophysical, or geochemical means.	Glossary of Geology. 5th Edition, AGI - online
Occurrences	Any ore or economic mineral in any concentration found in bedrock or as float; esp. a valuable mineral in sufficient concentration to suggest further exploration.	Glossary of Geology. 5th Edition, AGI - online
Mineralisation indicated (after an identification and appraisal phase of the resource)		
Ore deposit indicated (resource estimate exists)		
Feasibility study report available		
Mining decision		

Name: MineStatusCode list

Code	INSPIRE DS_2.0	Definition	Def_ref
A	Operating		
A1	Operating continuously		
A2	Operating intermittently		
B	Not operating		
B1	Closed	A mine can be closed for several reasons, e.g. technical, economical or technico-economical. For example, it may be re-opened if the price of the exploited commodity increases.	DC
B2	Abandoned		
B3	Care and maintenance		
B4	Retention	A mine can be kept unexploited until the price of contained commodity(ies) makes it economical.	DC
B5	Historic	An 'old' mine which has been exploited before 1900, e.g. during Roman times, the Middle Ages, etc.	DC
C	Under development		
C1	Construction		
C2	Pending approval	Waiting for the exploitation authorization, generally given by government authorities.	DC+JV
C3	Feasibility	Technical economic study aimed at assessing the possibility to launching a mine venture.	Dictionnaire thématique des mines et carrières, SIM Editor.
D	No information available		
D1	Unknown		
D2	Unspecified		

Name: RawMaterialRoleCode list

INSPIRE DS_2.0	Definition	Def_ref
gangue	The valueless rock or mineral aggregates in an ore; that part of an ore that is not economically desirable but cannot be avoided in mining. It is separated from the ore minerals during concentration	Glossary of Geology. 5th Edition, AGI - online
ore	(a) The naturally occurring material from which a mineral or minerals of economic value can be extracted at a reasonable profit. Also, the mineral(s) thus extracted. The term is generally but not always used to refer to metalliferous material, and is often modified by the name of the valuable constituent, e.g., "iron ore".	Glossary of Geology. 5th Edition, AGI - online
waste	Any solid or liquid generated by human activity that has little or no economic value, usually the result of the manufacture, mining, or processing of a material to produce an economic product.	Glossary of Geology. 5th Edition, AGI - online

Name: MineralOccurrenceTypeCode list

INSPIRE DS_2.0	Definition	Def_ref
mineral deposit	A mass of naturally occurring mineral material, e.g. metal ores or nonmetallic minerals, usually of economic value, without regard to mode of origin. Accumulations of coal and petroleum may or may not be included; usage should be defined in context.	Glossary of Geology. 5th Edition, AGI - online
ore deposit	The naturally occurring material from which a mineral or minerals of economic value can be extracted at a reasonable profit. Also, the mineral(s) thus extracted. The term is generally but not always used to refer to metalliferous material, and is often modified by the name of the valuable constituent, e.g., "iron ore".	Glossary of Geology. 5th Edition, AGI - online
occurrence	Any ore or economic mineral in any concentration found in bedrock or as float; esp. a valuable mineral in sufficient concentration to suggest further exploration	Glossary of Geology. 5th Edition, AGI - online
prospect	(a) An area that is a potential site of mineral deposits, based on preliminary exploration. (b) Sometimes, an area that has been explored in a preliminary way but has not given evidence of economic value. (c) An area to be searched by some investigative technique, e.g. geophysical prospecting. (d) A geologic or geophysical anomaly, especially one recommended for additional exploration.	Glossary of Geology. 5th Edition, AGI - online

Name: Mineral Deposit group Codelist

INSPIRE DS_2.0	Definition	Def_ref
Epigenetic	Said of a mineral deposit of origin later than that of the enclosing rock	Glossary of Geology. 5th Edition, AGI - online
Syngenetic	Said of a mineral deposit formed contemporaneously with, and by essentially the same process as, the enclosing rocks	Glossary of Geology. 5th Edition, AGI - online
Unknown		

Name: Mineral Deposit Type Code list

Code	INSPIRE DS_2.0	Definition	Def_ref
1.1	Porphyry (Epigenetic):	Large, low grade deposits usually associated with a porphyritic intrusive body.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
A	Cu-Mo	Dominant economic metals	DC
B	Cu (-Au)	Dominant economic metals	DC
C	Mo (-W)	Dominant economic metals	DC
1.2	Skarn (Epigenetic):	Mineral deposits formed by replacement of limestone by ore and calc-silicate minerals, usually adjacent to a felsic or granitic intrusive body.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
A	W-Cu (-Zn, -Mo)	Dominant economic metals	DC
B	Zn-Pb-Ag (-Cu, -W)	Dominant economic metals	DC
C	Cu (-Fe, -Au, -Ag, - Mo)	Dominant economic metals	DC
D	Fe (-Cu, - Au)	Dominant economic metals	DC
E	Sn (-Cu, -W, -Zn)	Dominant economic metals	DC
F	Au (-As, -Cu)	Dominant economic metals	DC
1.3	Vein (Epigenetic):	Fracture filling deposits which often have great lateral and/or depth extent but which are usually very narrow.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
A	Hydrothermal - Cu (-Au)	Said of a hydrothermal mineral deposit formed at great depth and in the temperature range of 300-500°C	Glossary of Geology. 4th Edition, AGI
B	Mesothermal - Cu-Pb-Zn-Ag-Au	Said of a hydrothermal mineral deposit formed at considerable depth and in the temperature range of 200-300°C	Glossary of Geology. 4th Edition, AGI
C	Epithermal - Au-Ag (-Hg)	Said of a hydrothermal mineral deposit formed within about 1 kilometer of the Earth's surface and in the temperature range of 50°-200°C, occurring mainly as veins	Glossary of Geology. 4th Edition, AGI
1.4	Mississippi Valley (Epigenetic):	Named for the region where they were first described, these deposits formed within porous carbonate rocks (limestone reefs or caves). They are Pb-Zn deposits with low Ag values.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
2.1	Volcanic Massive Sulphide (VMS) (Syngenetic):	These deposits formed as massive (over 60% sulphide) lens-like accumulations on or near the sea floor in association with volcanic activity.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
A	Felsic volcanic hosted - Cu-Pb-Zn-Ag-Au	Felsic: a mnemonic adjective derived from feldspar + lenad (feldspathoid) + silica + c, and applied to an igneous rock having light-colored minerals in its mode; also applied to those minerals (quartz, feldspar, feldspathoid, muscovite) as a group. It is the complement of mafic.	Glossary of Geology. 4th Edition, AGI
B	Mafic volcanic hosted - Cu (-Zn, -Au)	Mafic: Said of an igneous rock composed chiefly of one or more ferromagnesian dark-clored minerals in its mode; also, said of those minerals. A mnemonic term derived from magnesium + ferric + ic. It is the complement of felsic.	Glossary of Geology. 4th Edition, AGI

C	Mixed volcanic/sedimentary - Cu-Zn (-Au)	Association of volcanic rocks (lavas, tuffs, etc.) interbedded with sedimentary rocks	DC
2.2	Sedimentary Massive Sulphide (Sedex) (Syngenetic):	These are formed by hydrothermal emanations on or near the sea floor in association with the deposition of sedimentary rocks.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
A	Pb-Zn-Ag	Dominant economic metals	DC
B	Ba	Dominant economic metals	DC
2.3	Magmatic- layered mafic intrusion (Syngenetic):	During the crystallization of a magma, usually mafic or ultramafic, heavy, metal-rich liquids settle and accumulate at specific sites, often at the base, within the intrusion.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
A	PGM (Platinum group metals)	Platinum: a very heavy, steel-gray to silvery-white , cubic mineral, the native element Pt, commonly containing palladium, iridium, iron, and nickel. It occurs as grains and nuggets in alluvial deposits, and disseminated in basic and ultrabasic rocks. PGM or PGE (Platinum Group Element): refers specifically to ruthenium, rhenium, palladium, osmium, iridium, and platinum.	Glossary of Geology. 4th Edition, AGI
B	Chromite	A brownish-black to iron-black cubic mineral of the spinel group: (Cr,Al)2[(Fe,Mg)O4]. It occurs in octahedral crystals as a primary accessory mineral in basic and ultrabasic igneous rocks; it also occurs massive, and it forms detrital deposits. Chromite is the most important ore of chromium.	Glossary of Geology. 4th Edition, AGI
C	Ni-Cu (-PGM)	Dominant economic metals	DC
2.4	Placer (Syngenetic):	Formed within sediments by the concentration of heavy resistant minerals (Au, diamond, cassiterite) by stream or wave action.	http://earthsci.org/mineral/mindep/depfile/clas_dep.htm
2.5	Unspecified		
2.6	Unknown		

Name: MiningActivity Type Code list

INSPIRE DS_2.0	Definition	Def_ref
Unkown		
Unworked		
Solution mining	(a) The in-place dissolution of water-soluble mineral components of an ore deposit by permitting a leaching solution, usually aqueous, to trickle downward through the fractured ore to collection galleries at depth	Glossary of Geology. 5th Edition, AGI - online
Surface mining	See - Underground mining	
Alluvial mining		
Dredging	A form of *open pit mining* in which the digging machinery and processing plant are situated on a floating barge or hull	Glossary of Geology. 5th Edition, AGI - online
Open pit	Type of surface mning	
Reworking		
Underground	An underground excavation for the extraction of mineral deposits, in contrast to surficial excavations	Glossary of Geology. 5th Edition, AGI - online
Surface mining and underground	See - Surface and underground mining	
Quarry	Open workings, usually for the extraction of stone	Glossary of Geology. 5th Edition, AGI - online
Unspecified		

Name: Observation method Code list

Name: WasteStorageTypeCode list

Code	INSPIRE DS_2.0	Definition	Def_ref
A	Surface storage		
A10	Covered		
A20	Uncovered		
B	Underground storage		
C	Unspecified		
D	Not analysed		

Name: ProcessingActivityTypeCodelist

INSPIRE DS_2.0	Definition	Def_ref
UNKNOWN TREATMENT (worked / processed site)		
PHYSICAL TREATMENT		
Optical methods (colour, shape, lustre)	Ore sorting refers to the process of separating an ore into separate constituent parts. Today, ore sorters are widely used in industrial mineral mines, diamond mines and base and precious metal mines. Ores are typically sorted to increase the efficiency of other refining processes, by reducing the amount of material to be processed while simultaneously increasing its purity. Modern, automated sorting applies optical sensors (visible spectrum, near infrared, X-ray, ultraviolet), that can be coupled with electrical conductivity and magnetic susceptibility sensors, to control the mechanical separation of ore into two or more categories.	http://en.wikipedia.org/wiki/Ore_sorting
Manual sorting (handpicking)	Sorting a coarse material into two or more classes on the basis of physical characteristics: appearance, colour, conductivity, fluorescence, etc. This process may be manual (hand picking) or mechanical.	Dictionnaire thématique des mines et carrières, SIM Editor.
Automatic sorting	Sorting a coarse material into two or more classes on the basis of physical characteristics: appearance, colour, conductivity, fluorescence, etc. This process may be manual (hand picking) or mechanical.	Dictionnaire thématique des mines et carrières, SIM Editor.
Gravimetric methods (density, shape)	Process in which the valuable particles are separated from the gangue by virtue of the difference between their specific volumes. This causes their settling rates within a medium - air or water - to be different. This process is therefore affected by particle size.	Dictionnaire thématique des mines et carrières, SIM Editor.
Stratification (jig)	Jig: Gravity separation concentrator in which the pulp is subjected to an alternating vertical motion that is imparted: (1) either by an alternating liquid stream moved by a piston, a diaphragm, or any other device, through a fixed perforated plate. There are two compartments: one housing the piston, the diaphragm, or the compressed air, and the other where the actual concentration takes place; (2) or by alterning vertical or inclined motion of the grate on which the feed is resting (e.g. Hancock jig).	Dictionnaire thématique des mines et carrières, SIM Editor.
Lamellar layering (sluice, cone, spiral)	Sluice: Gravity concentration units consisting of a slanting trough fitted with riffles or with moquette to trap the denser particles. Cone classifier: Hydraulic classifier consisting of pyramidal hopper with bottom apex. Spiral concentrator: Concentration device consisting of a spiral-shaped trough, along which the pulp flows. The finer and lighter particles are carried towards the outer edge, whereas the denser particles move towards the helix axis, where they are removed.	Dictionnaire thématique des mines et carrières, SIM Editor.
Shaking (table)	Gravity concentration consisting of an inclined desk fitted with riffles. Its shaking promotes the segregation of dense particles and keeps them moving across the deck down to the discharge end. A transverse water stream helps to separate the particles.	Dictionnaire thématique des mines et carrières, SIM Editor.

Centrifugal force (radial acceleration: Knelson, Falcon)	Classifying or thickening machine in which centrifugal force is of the essence: it presses the pulp against the sides of a bowl or basket.	Dictionnaire thématique des mines et carrières, SIM Editor.
Density separation (heavy medium)	Concentration process based on the ability of particles to float to the surface of a medium when the specific gravity of the latter is greater than that of tha particles. The medium may be a dense liquid, a solution, or a finely ground material in suspension in water (heavy media). The process may static. It takes place in a drum or a tank. It may be dynamic. It is then effected in a cyclone. The lighter product is sometimes referred to as float, the heavier as sink. This is a gravity separation process.	Dictionnaire thématique des mines et carrières, SIM Editor.
Methods based on electromagnetic susceptibility		
Magnetic separation (high or low intensity)	Separation process based on the difference in magnetic susceptibility between minerals. The intensity may be low, medium or high. Sometimes a high-gradient magnetic field is used. The magnetic field may be produced either by a series of permanent magnets or by electromagnets. The magnetic field is used either to deviate the magnetic particles from their course, or to lift the magnetic particles.	Dictionnaire thématique des mines et carrières, SIM Editor.
Electrostatic separation	Machine with positive and negative electric fields, used for separating minerals with different electrical properties.	Dictionnaire thématique des mines et carrières, SIM Editor.
Foucault currents	Eddy (or Foucault) currents: The principle is that an electric charge is induced into a conductor by changes in magnetic flux cutting through it. Such changes in magnetic flux can be achieved by rotating permanent magnets past an electrical conductor. The effect of such currents is to induce a secondary magnetic field around the non-ferrous particle. This field reacts with the magnetic field of the rotor, resulting in a combined driving and repelling force which literally ejects the conducted particle from the stream of mixed materials. This repulsion force in combination with the product belt speed and the optimization of the product splitter plate provides the means for an effective separation.	http://www.alunet.net/shownews.asp?ID=358&type=3
Liquid-solid separation	Includes: Thickening: Process in which a portion of the liquid of a pulp is removed to thicken the latter. Mostly achieved by decantation, but sometimes by filtration or cycloning. Decantation (clarification, dewatering): (1) Spontaneous separation by gravity of a solid phase in suspension within a liquid (settling), or of non-miscible liquids. (2) When solids are settling out they always retain some trapped liquid. But, as the settled phase has a higher solids percentage than the initial pulp, the end result is a thickening. Filtration: Process of separating solid particles in suspension in a fluid by forcing the latter to pass through some porous material (fabric, diatom layer, ...) that retains the solid particles.	Dictionnaire thématique des mines et carrières, SIM Editor.

Comminution (crushing-grinding-pulverising)	Breaking solid particles to reduce their sizes; general term encompassing crushing and grinding (there is no clearcut boundary between these processes). Synonymous with fragmentation.	Dictionnaire thématique des mines et carrières, SIM Editor.
Particle sizing (screening-sieving-cycloning)	Classification: separation of the pieces of a fragmented material into several classes, according to a particular criterion: size, density, equivalence, shape, etc. It is used more specifically with size separation. Screening/sieving: sizing by means of screens or sieves: particle with a size larger than the screen or sieve opening are said to form the oversize fraction, the others form the undersize fraction.	Dictionnaire thématique des mines et carrières, SIM Editor.
PHYSICO-CHEMICAL TREATMENT		
Flotation	Process in which particles are separated according to their tendency to adhere more or less to air bubbles to form a mineralized froth: this feature is linked to the natural or designed hydrophobic property of the particule surface.	Dictionnaire thématique des mines et carrières, SIM Editor.
Agglomeration or pelletization	Agglomeration: process designed to bind together finely ground particles. The result is an agglomerate or a sinter. Pelletization: process designed to produce spherical agglomerates of a few mm diameter, called pellets, through a rotating device (balling drum, balling disc) after the addition of some binding material (swelling clay, lime, cement, etc.) and water.	Dictionnaire thématique des mines et carrières, SIM Editor.
Coagulation	In a dispersed system, particles of all species can be aggregated into larger structures by several mechanisms. Aggregation, based on reducing inter-particle repulsion forces, is known as coagulation and the aggregates are called coagula. If coagulation is induced by a polymer-bridging action, the process is called flocculation and the aggregates are called flocs. When aggregation is achieved as a result of the action of an immersible bridging liquid, such as oil, the process is called agglomeration and the aggregates are referred to as agglomerates. The mechanisms include both those in coagulation (i.e. action of electrolytes) and bridging flocculation by either inorganic polymers or by precipitating metal hydroxides. The latter is known as sweep flocculation.	http://ktrungthuy.free.fr/SACH-BOOKS/Handbook%20of%20Flotation%20Reagents,%20Elsevier%20(2007),%200444530290.pdf
Flocculation	1. Natural or deliberate formation of minute particles into aggregations (flocs). The large amount of liquid that is trapped in a floc assists in the settlement of fine particles. 2. Adding reagents to promote flocculation.	Dictionnaire thématique des mines et carrières, SIM Editor.
CHEMICAL TREATMENT		
Hydrometallurgy	Hydrometallurgy is part of the field of extractive metallurgy involving the use of aqueous chemistry for the recovery of metals from ores, concentrates, and recycled or residual materials. Hydrometallurgy is typically divided into three general areas: leaching, solution concentration and purification, and metal recovery.	http://en.wikipedia.org/wiki/Hydrometallurgy

Leaching (bacterial, oxidative, reductive, complexation, gas scrubbing)	Action of chemical reagents on a material resulting in the dissolution of some of its elements.	Dictionnaire thématique des mines et carrières, SIM Editor.
Solvent extraction	Extraction with a solvent. This may be achieved on: (1) the soluble part of a solid matter (solid/liquid extraction), (2) the elements within a liquid phase (liquid/liquid extraction).	Dictionnaire thématique des mines et carrières, SIM Editor.
Cementation	Precipitation of a metal in solution, by the addition of another metal.	Dictionnaire thématique des mines et carrières, SIM Editor.
Electrolysis	Electrolysis: Electrowinning and electrorefining respectively involve the recovery and purification of metals using electrodeposition of metals at the cathode, and either metal dissolution or a competing oxidation reaction at the anode.	http://en.wikipedia.org/wiki/Hydrometallurgy
Adsorption	Taking up of ions, molecules or colloids on the surface of a material.	Dictionnaire thématique des mines et carrières, SIM Editor.
Distillation	Precious metals are recovered from the mercury by retorting the mercury. Retorting consists in distilling off the mercury from the amalgam and is done in a cast iron retort or steel retort , a vessel having a cover which can be fastened on so tightly that no fumes of mercury escape, except by the condenser, which leads from the cover to a vessel containing water, where the fumes of mercury are condensed to a metallic state. The condenser has a water jacket surrounding it, through which a small quantity of cold water is continuously passed during the operation. The open end of the vapor pipe must be lower than where it emerges from the discharge of the retort, and its open end is submerged in water during the distilling operation.	http://www.mine-engineer.com/mining/minproc/MercAmal.htm
Crystallization	Crystallization is the (natural or artificial) process of formation of solid crystals precipitating from a solution, melt or more rarely deposited directly from a gas. Crystallization is also a chemical solid-liquid separation technique, in which mass transfer of a solute from the liquid solution to a pure solid crystalline phase occurs. In chemical engineering crystallization occurs in a crystallizer. Crystallization is therefore an aspect of precipitation, obtained through a variation of the solubility conditions of the solute in the solvent, as compared to precipitation due to chemical reaction.	http://en.wikipedia.org/wiki/Crystallization
Precipitation	Precipitation in hydrometallurgy involves the chemical precipitation of either metals and their compounds or of the contaminants from aqueous solutions. Precipitation will proceed when, through reagent addition, evaporation, pH change or temperature manipulation, any given species exceeds its limit of solubility. In order to improve efficiency in downstream processes, seeding to initiate crystallization is often used.	http://en.wikipedia.org/wiki/Hydrometallurgy

Evaporation - drying	Drying is thermal removal of liquid moisture (not chemically bound) from a material. Drying is usually accomplished by contacting the moist solids with hot combustion gases generated by burning fossil fuels. In some cases, heat for drying can be provided by hot air or inert gas that has been indirectly heated. The amount of heat required for a given drying operation corresponds to the heat required to vaporize the liquid moisture, the heat required to raise the temperature of the products (dry solids and water vapor) to the final drying temperature, and heat required to offset radiant heat losses. Usually the drying temperature is set at a nominal value above the boiling point of water, often about 120°C. In special cases, such as in the drying of certain water-soluble salts, higher drying temperatures are required. In salt drying, the feed moisture is saturated with dissolved salts, which alters the boiling point and requires higher drying temperatures. Drying of moist solids is carried out in several types of industrial dryers, including rotary dryers, fluidized bed dryers, and flash dryers. Another type of drying, called spray drying, is carried out when the material to be dried is completely dissolved in aqueous solution. The solution is sprayed (usually through a specially designed nozzle) into a heated chamber and as the water is evaporated, solids crystallize. The water vapor is exhausted from the dryer, and dry solids are collected, usually in a conical section of the dryer. Solid material produced from a spray dryer often has special particle size and shape characteristics, which may be controlled by the concentration of dissolved material in the solution, and the design of the atomizing spray nozzle.	http://en.wikipedia.org/wiki/Pyrometallurgy
Pyrometallurgy	Pyrometallurgy is a branch of extractive metallurgy. It consists of the thermal treatment of minerals and metallurgical ores and concentrates to bring about physical and chemical transformations in the materials to enable recovery of valuable metals. Pyrometallurgical treatment may produce saleable products such as pure metals, or intermediate compounds or alloys, suitable as feed for further processing. Examples of elements extracted by pyrometallurgical processes include the oxides of less reactive elements like Fe, Cu, Zn, Chromium, Tin, Manganese.	http://en.wikipedia.org/wiki/Pyrometallurgy
Roasting (oxidizing, reducing, chlorizing, sulphating)	Action of gas on a solid material at high temperature. Roasting may be carried out in an environment that is either oxiding, chlorinizing, reducing (with CO), etc. The term is sometimes improperly used as synonymous with calcination.	Dictionnaire thématique des mines et carrières, SIM Editor.

Smelting	Smelting involves thermal reactions in which at least one product is a molten phase. Metal oxides can then be smelted by heating with coke or charcoal (forms of carbon), a reducing agent that liberates the oxygen as carbon dioxide leaving a refined mineral. Carbonate ores are also smelted with charcoal, but are sometimes need to be calcined first. Other materials may need to be added as flux, aiding the melting of the oxide ores and assisting in the formation of a slag, as the flux reacts with impurities, such as silicon compounds. Smelting usually takes place at a temperature above the melting point of the metal, but processes vary considerably according to the ore involved and other matters.	http://en.wikipedia.org/wiki/Pyrometallurgy#Smelting
Crystallization		
Burning	The utilization of coal-oil agglomerates in the recovery of gold is based on the natural hydrophobicity/oleophilicity of gold, a property which according to the consensus of most surface chemistry experts is brought about by the ease by which gold surface becomes contaminated, though is possible to recover gold by agglomerating them with oil, the amount of gold in the ore is usually small that there is insufficient gold particles to form agglomerates. Thus, the need to use other hydrophobic materials (e.g. coal) to either form agglomerates together with gold or act as a carrier of gold particles. Agglomerates are prepared in a previous step and then added to the ore pulp in a second step. The gold particles, being oilfilic, penetrate into the agglomerates. In a continuous operation the agglomerates would be maintained in contacting tanks until they reach a pre-determined gold content. The tailings are discarded by means of a screen situated at the upper part of the tanks. The recovery of gold from agglomerates is obtained in a later step by burning the agglomerates and then separating the gold from the ashes	http://www.e-goldprospecting.com/html/coal_gold_agglomeration__cga_.html
Calcining	Decomposition of a material at high temperature, e.g., removal of carbon dioxyde from limestones, carbonization of coal.	Dictionnaire thématique des mines et carrières, SIM Editor.
Incineration	A method used for drying and reducing sludge volume and weight. Since incineration requires auxiliary fuel to obtain and maintain high temperature and to evaporate the water contained in the incoming sludge, concentration techniques should be applied before incineration. Sludge incineration is a two-step process involving drying and combustion after a preceding dewatering process, such as filters, drying beds, or centrifuges.	http://www.eionet.europa.eu/gemet/concept?ns=1&cp=7738

Name: MiningWasteType Code list (from *http://scp.eionet.europa.eu/definitions/low*)

CODE	INSPIRE DS_2.0	Definition	Def_ref
01	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals	See: *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000D0532:20020101:EN:PDF*	
01 01	wastes from mineral excavation		
01 01 01	wastes from mineral metalliferous excavation		
01 01 02	wastes from mineral non-metalliferous excavation		
01 03	wastes from physical and chemical processingof metalliferous minerals		
01 03 04	acid-generating tailings from processing of sulphide ore		
01 03 05	other tailings containing dangerous substances		
01 03 06	tailings other than those mentioned in 01 03 04 and 01 03 05		
01 03 07	other wastes containing dangerous substances from physical and chemical processing of metalliferous minerals		
01 03 08	dusty and powdery wastes other than those mentioned in 01 03 07		
01 03 09	red mud from alumina production other than the wastes mentioned in 01 03 07		
01 03 99	wastes not otherwise specified		
01 04	wastes from physical and chemical processingof non-metalliferous minerals		
01 04 07	wastes containing dangerous substances from physical and chemical processing of non-metalliferous minerals		
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 04 07		
01 04 09	waste sand and clays		
01 04 10	dusty and powdery wastes other than those mentioned in 01 04 07		
01 04 11	wastes from potash and rock salt processing other than those mentioned in 01 04 07		

01 04 12	tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11		
01 04 13	wastes from stone cutting and sawing other than those mentioned in 01 04 07		
01 04 99	wastes not otherwise specified		
01 05	drillingmuds and other drilling wastes		
01 05 04	freshwater drilling muds and wastes		
01 05 05	oil-containing drilling muds and wastes		
01 05 06	drilling muds and other drilling wastes containing dangerous substances		
01 05 07	barite-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06		
01 05 08	chloride-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06		
01 05 99	wastes not otherwise specified		

Name: Environmental Impact Code list

INSPIRE DS_2.0	Definition	Def_ref
Emissions		
Dust		
Seepage water or effluents to groundwater		
AMD (Acid Mine Drainage)		
BMD (Basic Mine Drainage)		
NMD (Neutral Mine Drainage)		
Runoff water or effluents to surface water		
AMD (Acid Mine Drainage)		
BMD (Basic Mine Drainage)		
NMD (Neutral Mine Drainage)		
Gas		
Radiation		
Odour		
Noise		
Heat		
Physical impacts		
Erosion		
Stability		
Subsidence		
Flood		

Spillage		
Infiltration		
Dam failure		
Visual disturbance		
Transnational impacts		
N/A not analysed		

Name: EndusePotentialType Code list

INSPIRE DS_2.0	Definition	Def_ref
Abrasive material	Any natural or artificial substance suitable for grinding, polishing, cutting, or scouring. Natural abrasives include diamond, emery, garnet, silica sand, diatomite, and pumice; manufactured abrasives include esp. silicon carbide, fused alumina, and boron nitride.	Glossary of Geology. 5th Edition, AGI - online
Building raw material		
Ceramic and refractory use		
Chemical use		
Energy		
Fertilizer		
Speciality		
Recycled waste		
Other		
Undefined		
Not analysed		

Name: Product name Code list

Name: ReserveCategory Code list

INSPIRE DS_2.0	Definition	Def_ref
Proved ore reserves	A 'Proved Ore Reserve' is the economically mineable part of a Measured Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction could reasonably be justified	JORC 2004
Probable ore reserves	A 'Probable Ore Reserve' is the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. It includes diluting materials and allowances for losses which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors These assessments demonstrate at the time of reporting that extraction could reasonably be justified.	JORC 2004
Proved and probable ore reserves	Ditto	
Ore reserve documentation inaccessible or not found		

Name: ResourceCategory Code list

INSPIRE DS_2.0	Definition	Def_ref
Measured mineral resource	That part of a *mineral resource* for which tonnage, densities, shape, physical characteristics, *grade,* and mineral content can be estimated with a high level of confidence. It is measured using information from locations spaced closely enough to confirm geological and/or grade continuity (JORC, 1999).	JORC, 1999
Indicated mineral resource	That part of a *mineral resource* for which tonnage, densities, shape, physical characteristics, *grade,* and mineral content can be estimated with a reasonable level of confidence. It is indicated by information that is too widely or inappropriately spaced to confirm geological and/or grade continuity but is spaced closely enough for continuity to be assumed (JORC, 1999).	JORC, 1999
Inferred mineral resource	That part of a *mineral resource* for which tonnage, *grade,* and mineral content can be estimated with a low level of confidence. It is inferred from geological evidence and assumes, but does not verify, geological and/or grade continuity (JORC, 1999).	JORC, 1999
Measured and indicated mineral resource	Ditto	
Measured, indicated and inferred mineral resource	Ditto	
Poorly estimated mineral resource, poorly documented		

Name: Value Qualifier_Mineral Code list

Name: Calculation Method Code list

INSPIRE DS_2.0	Definition	Def_ref
JORC code	The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the 'JORC Code' or 'the Code')	http://www.jorc.org
NI 43-101	National Instrument 43-101 (the "NI 43-101" or the "NI") is a mineral resource classification scheme used for the public disclosure of information relating to mineral properties in Canada. The NI is a strict guideline for how public companies can disclose scientific and technical information about mineral projects on bourses supervised by the Canadian Securities Administrators	http://www.cim.org/splash/index.cfm
CIM standards	The CIM Definition Standards on Mineral Resources and Reserves (CIM Definition Standards) establish definitions and guidelines for the reporting of exploration information, mineral resources and mineral reserves in Canada	http://www.cim.org/splash/index.cfm
SAMREC code	The South African Code for Reporting of Exploration Results, Mineral Resources and Mineral Reserves.	www.samcode.co.za
IMM Reporting Code	The Code for Reporting of Mineral Resources and Mineral Reserves (the 'Reporting Code' or 'the Code') sets out minimum standards, recommendations and guidelines for Public Reporting of Mineral Exploration Results, Mineral Resources and Mineral Reserves in the United Kingdom, Ireland and Europe.	http://www.iom3.org/
SME Guide	A guide for reporting exploration information, mineral resources, and mineral reserves - USA	www.smenet.org
IIMCh Code	Certification Code for Exploration Prospects, Mineral Resources & Ore Reserves. This Code is the result of a Collaboration Agreement between the Institution of Mining Engineers of Chile (IIMCh) and the Ministry of Mining.	
Peruvian Code		www.bvl.com.pe
CRIRSCO Code	The International Reporting Template (IRT) is a document that draws on the best of the CRIRSCO-style reporting standards, the JORC Code (Australasia), SAMREC Code (South Africa), Reporting Code (UK / Western Europe), CIM Guidelines (Canada), SME Guide (USA) and Certification Code (Chile). These reporting standards are recognised and adopted world-wide for market-related reporting and financial investment	www.crirsco.com

UNFC Code	The United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 (UNFC-2009) is a universally applicable scheme for classifying/evaluating energy and mineral reserves and resources - it is the successor to UNFC-2004. Designed as an all-encompassing framework, it enables the incorporation and unification of existing national systems, while allowing their classification units and glossary to be retained. The principal objective of UNFC-2009 is to enhance international communication by providing a simple, user-friendly and uniform format for the reporting of energy reserves and resources, using market-based economic criteria. It has been developed to meet, to the extent possible, the needs of applications pertaining to international energy and mineral studies, government resource management functions, corporate business processes and financial reporting standards	http://www.unece.org/energy/se/reserves.html
SEC Guide	Description of Porperty by Issuers Engaged or to be Engaged in Significant Mining Operations. Developed by the United States Securities and Exchange Commission, this Guide contains the Commission's basic mining disclosure policy. It includes definitions and disclosure instructions that apply to all public mining entities and their public disclosure.	www.cim.org/standards/
PERC Code	The Pan European Reserves and Resources Reporting Committee (PERC) Code for Reporting of Exploration Results, Mineral Resources and Mineral Reserves (further referred to as 'the Code') sets out minimum standards, recommendations and guidelines for Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves in the United Kingdom, Ireland and Europe.	http://www.vmine.net/percreserves/
Russian Code	Currently effective in Russia is the Code approved by the Decree of the Ministry of Natural Resources, RF № 278 of 11 December, 2006. Full title of the Document: Classification of resources/reserves and prognostic resources of solid minerals.	
Code or standard not known		
Historic resource estimate	Term for resource estimation before "standard codes" (e.g. JORC etc.)	JV

Name: Mineral name Code list
see Full list of minerals - *http://pubsites.uws.edu.au/ima-cnmnc/imalist.htm* or *http://www.agiweb.org/georef/PDF/LISTLalpha.pdf*

INSPIRE DS_2.0	Definition	Def_ref
alloys (including carbides, nitrides, phosphides, silicides)	http://www.agiweb.org/georef/PDF/LISTLhier.pdf	
antimonates		
antimonides		
antimonites		
arsenates		
arsenides		
arsenites		
bismuthides		
borates		
bromides		
carbides		
carbonates		
chlorides		
chromates		
fluoborates		
fluorides		
fluosilicates		
germanates		
halides (includes bromides, chlorides, fluoborates, fluosilicates, iodides, and fluorides)		
hydrates		
iodates		
iodides		
molybdates		
native elements		
nitrates		
nitrides		
organic minerals		
oxalates		
oxides (including germanates)		
oxysulfides		
phosphates		
phosphides		
selenates		
selenides		
selenites		
silicates (use a narrower term below if dealing with specific mineral; otherwise larger group)		
aluminosilicates		
orthosilicates		
sorosilicates		
orthosilicates, axinite group		
orthosilicates, chevkinite group		
orthosilicates, epidote group		
orthosilicates, melilite group		

orthosilicates, pumpellyite group		
orthosilicates, thortveitite group		
nesosilicates		
orthosilicates, britholite group		
orthosilicates, datolite group		
orthosilicates, garnet group		
orthosilicates, olivine group		
orthosilicates, phenakite group		
orthosilicates, titanite group		
orthosilicates, zircon group		
ring silicates (cyclosilicates)		
ring silicates, milarite group		
ring silicates, tourmaline group		
chain silicates (inosilicates)		
chain silicates, aenigmatite group		
chain silicates, amphibole group		
chain silicates, alkalic amphibole		
chain silicates, clinoamphibole		
chain silicates, orthoamphibole		
chain silicates, pyroxene group		
chain silicates, alkalic pyroxene		
chain silicates, clinopyroxene		
chain silicates, orthopyroxene		
chain silicates, rhodonite group		
chain silicates, wollastonite group		
sheet silicates (phyllosilicates)		
sheet silicates, chlorite group		
sheet silicates, clay minerals		
sheet silicates. mica group		
sheet silicates, serpentine group		
framework silicates (tectosilicates)		
framework silicates, feldspar group		
framework silicates, alkali feldspar		
framework silicates, barium feldspar		
framework silicates, plagioclase		
framework silicates, nepheline group		
framework silicates, scapolite group		
framework silicates, silica minerals		
framework silicates, sodalite group		
framework silicates, zeolite group		
silicides		
sulfates		
sulfides (including antimonides, arsenides, bismuthides, oxysulfides, selenides, and tellurides)		
sulfosalts (including sulfantimonates, sulfantimonites, sulfarsenates, sulfarsenites, sulfobismuthites, sulfogermanates, sulfostannates, and sulfovanadates)		
tellurates		
tellurides		

tellurites		
tungstates		
vanadates		