INSPIRE
Infrastructure for Spatial Information in Europe

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

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Version	Changed Sections	Changes made
2.9	Executive Summary	Update some paragraphs
	Overview	Update some definitions
	Data content and structure	Move extension data model to Annex D
		Update Feature Catalogue for definitions
		Update tables for code lists

Foreword
How to read the document?

This document describes the “INSPIRE data specification on <Theme Name> - Guidelines” as developed by the Thematic Working Group *Mineral Resources* using both natural and a conceptual schema language. The data specification is based on a common template used for all data specifications and has been harmonised with the other Annex I data specifications by a joint editing team.

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 are attached in the annexes.

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

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

Interoperability of Spatial Data Sets and Services – General Executive Summary

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

INSPIRE 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 referenced, whenever possible.

To facilitate the implementation of INSPIRE, it is important that all stakeholders have the opportunity to participate its 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], expressed their views on the drafts of

[1] For Annex I data: 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 21/11/2008 was 276 and 162 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 I themes have been composed of experts from Belgium, Czech Republic, Denmark, France, Finland, Germany, Hungary, Italy Netherland, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, UK, the European Commission, and the European Environmental Agency

the technical documents of the data specification development framework[6] and are invited to comment the draft Implementing Rule on Interoperability of Spatial Data Sets and Services.

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 the data specification development framework, the Thematic Working Groups have created the INSPIRE data specification for each Annex I theme. The data specifications follow the structure of "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 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

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[6] Four documents describing common principles for data specifications across all spatial data themes. See further details in the text.

[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_v3.1.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_v3.0.pdf*

[11] UML – Unified Modelling Language

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

application areas targeted by the Directive. They are published as technical guidelines and provide the basis for the content of the Implementing Rule on Interoperability of Spatial Data Sets and Services for data themes included in Annex I of the Directive. The Implementing Rule 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 for 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.

A recent communication of the European Commission (COM(2011) 25 final) entitled 'TACKLING THE CHALLENGES IN COMMODITY MARKETS AND ON RAW MATERIALS' presents an overview of what has been achieved in each of these areas and of the steps which are planned to take the work

forward. This document sets out targeted measures to secure and improve access to raw materials for the EU, and also confirms that the needs expressed above are more than never of actuality.

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

From these examples, four use cases are detailed:

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

This overview shows the wide range of use with various sets of mineral resources properties according to the use: the management of resources and exploitation activities does not request 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 Earth Resources), 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).

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Table of contents

1 Scope

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

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

2 Overview

2.1 Name

INSPIRE data specification for the theme Mineral Resources.

2.2 Informal description

Definition:

Mineral resources including metal ores, industrial minerals, etc., where relevant including depth/height information on the extent of the resource

[Directive 2007/2/EC]

Description:

From the definition, we detail each word.

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

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

Metal ores:

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

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

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

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

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

Industrial minerals and rocks are minerals which are neither metallic nor used as fuels, but which are mined and processed for their economic use. A broader definition describes an industrial mineral as any rock, mineral, or naturally occurring substance of economic value, exclusive of metallic ores and mineral fuels, and gemstones. In essence, they are the raw materials used in many industrial, agricultural and construction products. However, **for convenience**, gemstones are frequently grouped together with industrial minerals under one umbrella.

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

2.2.1 The main object types of Mineral Resources data specification

The main object types are Mineral Occurrence, the Commodity, the Mine and the Product (mined material or concentrate), 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 excavation for the extraction of mineral deposits. 'True' mines are underground workings and open-pit workings (also called open-sky mines) generally for the extraction of metallic commodities. The Mine feature also includes open workings generally for the extraction of industrial minerals, commonly referred to as quarries.
- The **Mining Activity**, related to a Mine, describes the process of extracting metallic or non-metallic mineral deposits from the Earth.

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

- The **Mineral Occurrence** could be a prospect, an occurrence, a mineral deposit, an ore deposit, etc. (but not a lode, a field, a district, or a province)
- The **Commodity** describes the material of economic interest in the Earth Resource
- The **Ore Measure** is an estimated or calculated amount of ore and grade that exist within an Earth Resource, in terms of its resource, reserve and endowment

- The **Mineral Deposit Model** describes the essential attributes of a class of mineral deposits used to classify the Earth Resource
- An Earth Resource has an associated **Exploration Activity** to describe the process leading to the discovery and assessment of the resource.

The 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.

2.3 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

NOTE This 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*

2.4 Terms and definitions

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

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

2.6 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.

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

TG 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 X Recommendations are shown using this style.

2.7 Conformance

TG 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 Data content and structure

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.

This data specification defines the following application schemas:

- The MineralResourcesCore application schema 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 application schema 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.

Spatial data sets related to the theme Mineral Resources shall be made available using the spatial object types and data types specified in the following application schema(s): MineralResources_Core, These spatial object types and data types shall comply with the definitions and constraints and include the attributes and association roles defined in this section.

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 [DS-D2.5] for more details.

In addition to the application schemas listed in 0, additional application schemas have been defined for the theme *Mineral Resources*. These additional application schemas typically address requirements from specific (groups of) use cases and/or may be used to provide additional information. They are included in this specification in order to improve interoperability also for these additional aspects.

Recommendation 2	Additional and/or use case-specific information related to the theme *Mineral Resources* should be made available using the spatial object types and data types specified in the following application schema(s): MineralResources_Core These spatial object types and data types should comply with the definitions and constraints and include the attributes and association roles defined in this section.

4.1 Application schema MineralResourcesCore

4.1.1 Description

4.1.1.1. Narrative description and UML overview

An overview 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 following figures.
As can be seen the data model has two principal components: one, centred on *EarthResource*, describes the natural material of potential economic value (Figure 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.

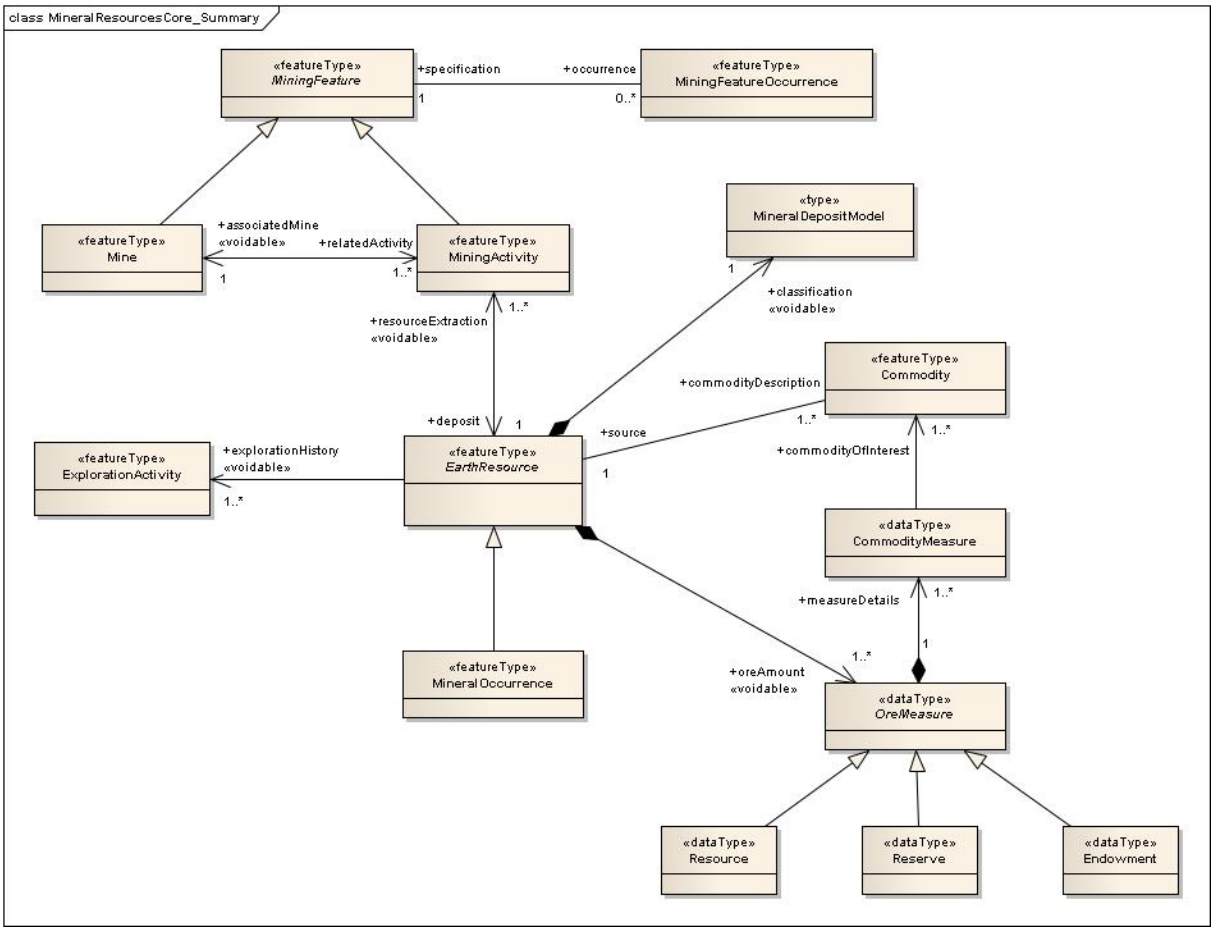


Figure 1 – UML class diagram: Overview of the MineralResourcesCore application schema

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

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

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)

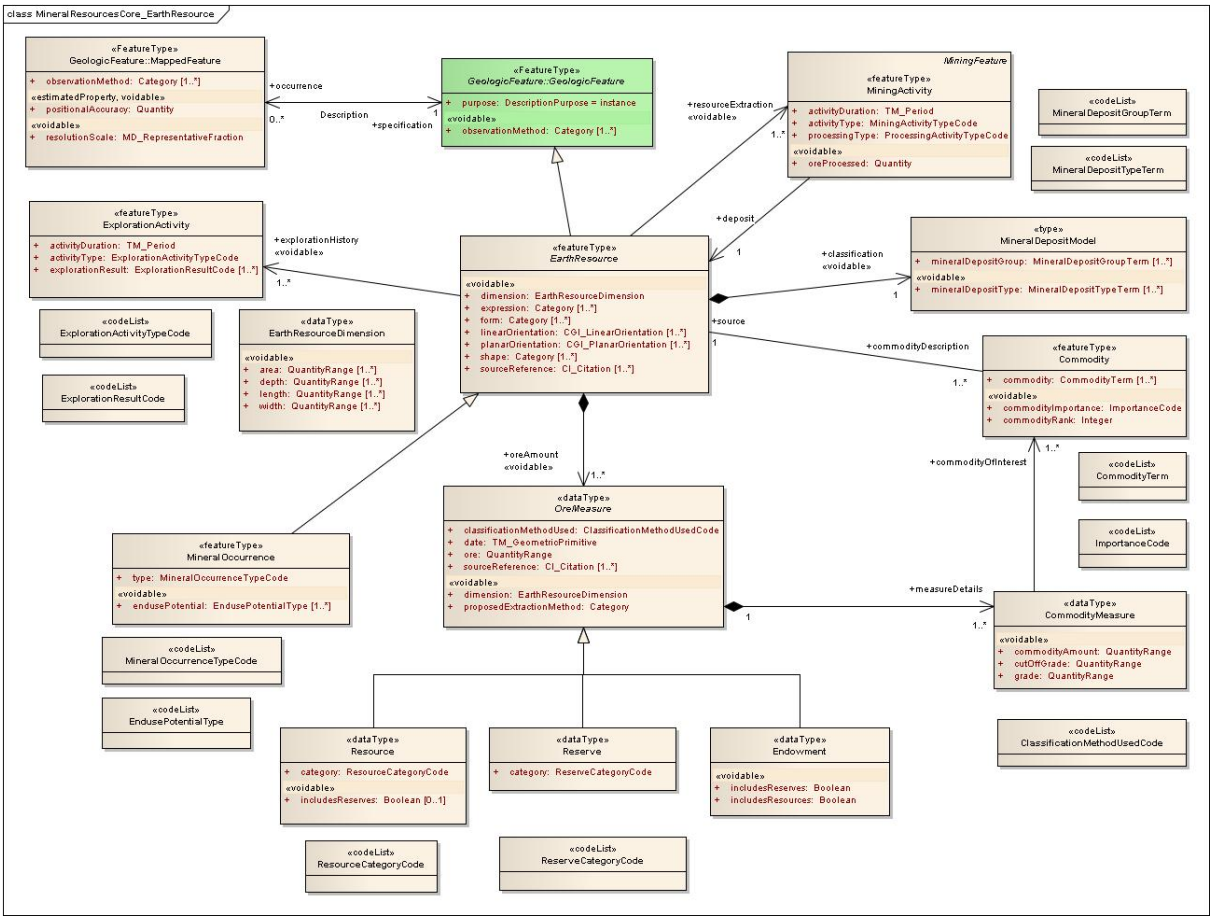


Figure 2 – UML class diagram: MineralResourcesCore (EarthResource)

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
- Classification method: which standard has been used for the classification (JORC, PERC, 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: the lowest concentration of a mineralized material that qualifies as ore in a given deposit (adapted from Neuendorf, 2005).
- 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 excavation for the extraction of mineral deposits. 'True' mines are underground workings and open-pit workings (also called open-sky mines) generally for the extraction of metallic commodities. The Mine feature also includes open workings generally for the extraction of industrial minerals, commonly referred to as quarries.
- The *Mining Activity*, related to a Mine, describes the process of extracting metallic or non-metallic mineral deposits from the Earth.

The *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.

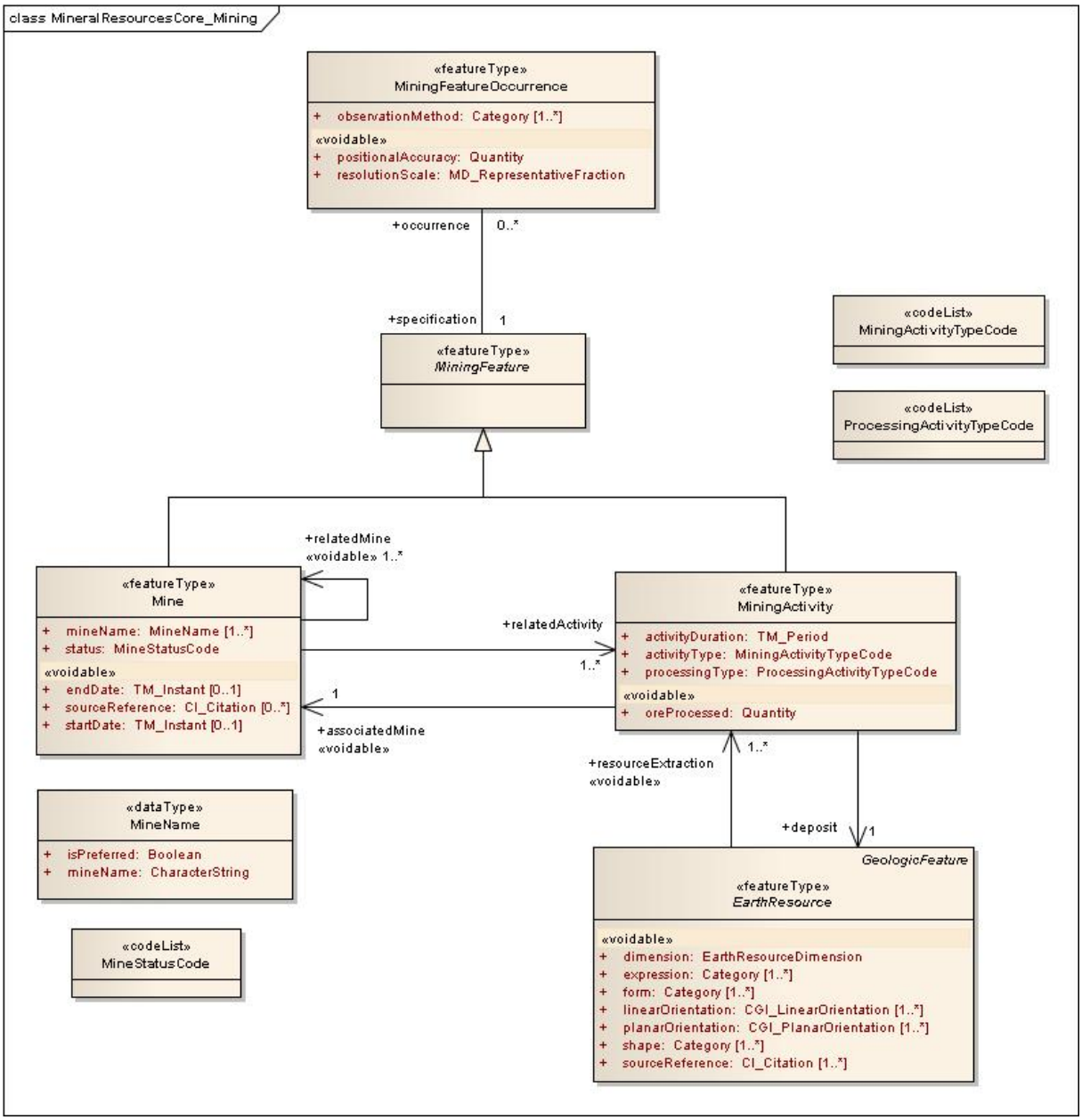


Figure 3 – UML class diagram: MineralResourcesCore (Mining)

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.

4.1.1.2. Consistency between spatial data sets

The observation location is specified by its coordinates.

4.1.1.3. Identifier management

4.1.1.4. Modelling of object references *(Optional)*

4.1.1.5. Geometry representation *(Optional)*

IR Requirement 1	The value domain of spatial properties used in this specification shall be restricted to the Simple Feature spatial schema as defined by EN ISO 19125-1.

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

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

4.1.1.6. Temporality representation *(Optional)*

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

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

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

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

Recommendation 3	If life-cycle information is not maintained as part of the spatial data set, all spatial objects belonging to this data set should provide a void value with a reason of "unpopulated".

4.1.2 Feature catalogue

Table 3 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue MineralResourcesCore
Scope	MineralResourcesCore
Version number	2.9
Version date	2012-02-24
Definition source	INSPIRE data specification MineralResourcesCore

Table 4 - Types defined in the feature catalogue

Type	Package	Stereotypes	Section
ClassificationMethodUsedCode	MineralResourcesCore	«codeList»	4.1.2.3.1
Commodity	MineralResourcesCore	«featureType»	4.1.2.1.1
CommodityMeasure	MineralResourcesCore	«dataType»	4.1.2.2.1
CommodityTerm	MineralResourcesCore	«codeList»	4.1.2.3.2
EarthResource	MineralResourcesCore	«featureType»	4.1.2.1.2
EarthResourceDimension	MineralResourcesCore	«dataType»	4.1.2.2.2
Endowment	MineralResourcesCore	«dataType»	4.1.2.2.3
EndusePotentialType	MineralResourcesCore	«codeList»	4.1.2.3.3
ExplorationActivity	MineralResourcesCore	«featureType»	4.1.2.1.3
ExplorationActivityTypeCode	MineralResourcesCore	«codeList»	4.1.2.3.4
ExplorationResultCode	MineralResourcesCore	«codeList»	4.1.2.3.5
ImportanceCode	MineralResourcesCore	«codeList»	4.1.2.3.6
Mine	MineralResourcesCore	«featureType»	4.1.2.1.4
MineName	MineralResourcesCore	«dataType»	4.1.2.2.4
MineStatusCode	MineralResourcesCore	«codeList»	4.1.2.3.7
MineralDepositGroupTerm	MineralResourcesCore	«codeList»	4.1.2.3.8

Type	Package	Stereotypes	Section
MineralDepositModel	MineralResourcesCore	«type»	4.1.2.2.5
MineralDepositTypeTerm	MineralResourcesCore	«codeList»	4.1.2.3.9
MineralOccurrence	MineralResourcesCore	«featureType»	4.1.2.1.5
MineralOccurrenceTypeCode	MineralResourcesCore	«codeList»	4.1.2.3.10
MiningActivity	MineralResourcesCore	«featureType»	4.1.2.1.6
MiningActivityTypeCode	MineralResourcesCore	«codeList»	4.1.2.3.11
MiningFeature	MineralResourcesCore	«featureType»	4.1.2.1.7
MiningFeatureOccurrence	MineralResourcesCore	«featureType»	4.1.2.1.8
OreMeasure	MineralResourcesCore	«dataType»	4.1.2.2.6
ProcessingActivityTypeCode	MineralResourcesCore	«codeList»	4.1.2.3.12
Reserve	MineralResourcesCore	«dataType»	4.1.2.2.7
ReserveCategoryCode	MineralResourcesCore	«codeList»	4.1.2.3.13
Resource	MineralResourcesCore	«dataType»	4.1.2.2.8
ResourceCategoryCode	MineralResourcesCore	«codeList»	4.1.2.3.14

4.1.2.1. Spatial object types

4.1.2.1.1. Commodity

Commodity

Name: Commodity
Definition: The material of economic interest in the EarthResource
Status: Proposed
Stereotypes: «featureType»
Identifier: null

Attribute: commodityImportance

Value type: ImportanceCode
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 is based on a statistical study of a large set of deposits throughout the world to ensure that it is valid. It is made using histograms allowing for each commodity to define class boundaries and what is a super large, a large, a medium-sized etc deposit for this commodity. This classification is based on the potential or endowment: reserves + resources.
Multiplicity: 1
Stereotypes: «voidable»
Obligation: Technical Guidance (recommendation)

Attribute: commodity

Value type: CommodityTerm
Definition: The earth resource commodity (eg Cu, Au, Dimension Stone)
Multiplicity: 1..*
Obligation: Technical Guidance (recommendation)

Attribute: commodityRank

Value type: Integer

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

4.1.2.1.2. EarthResource

EarthResource (abstract)	
Name:	Earth Resource
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»
Identifier:	null
Attribute: dimension	
Value type:	EarthResourceDimension
Definition:	Describes the size/volume of the earth resource
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: expression	
Value type:	Category
Definition:	Whether an EarthResource has a surface expression or has been detected under cover rocks.
Multiplicity:	1..*
Stereotypes:	«voidable»
Attribute: form	
Value type:	Category
Definition:	The orebodies typical physical and structural relationship to wallrocks and associated rocks (e.g. stratiform, stratabound, cross-cutting, vein, intrusive contact etc)
Multiplicity:	1..*
Stereotypes:	«voidable»
Attribute: linearOrientation	
Value type:	CGI_LinearOrientation
Definition:	Captures linear orientation of the Earth Resource (Plunge etc)
Multiplicity:	1..*
Stereotypes:	«voidable»
Attribute: planarOrientation	
Value type:	CGI_PlanarOrientation
Definition:	Captures planar orientation of the Earth Resource (Dip/Dip Direction etc)
Multiplicity:	1..*
Stereotypes:	«voidable»
Attribute: shape	

EarthResource (abstract)

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

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: 1..*
Stereotypes: «voidable»

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: 1..*
Stereotypes: «voidable»

Association role: geneticDescription

Value type: MineralSystem
Definition: Provides a description for how the EarthResource formed
Multiplicity: 1
Stereotypes: «voidable»

Association role: supergeneModification

Value type: SupergeneProcesses
Definition: A supergene process which would allow a metal enrichment produced by the chemical remobilisation of elements in an oxidised or transitional environment.
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: 1..*
Stereotypes: «voidable»

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: 1
Stereotypes: «voidable»

Association role: resourceExtraction

Value type: MiningActivity

EarthResource (abstract)	
Definition:	Infdicates if this resource is the subject of exploitation, and if so of which type. Depending on several factors (type of mineralization, size, grade, shape, depth, etc.) one or several (combined) methods may be used, including off site methods, surface mining (among which methods related to the exploitation of alluvial/elluvial deposits), underground mining. Knowledge about these methods is important as it may be strongly related to the quantity and type of wastes and environmental impacts generated by the extraction.
Multiplicity:	1..*
Stereotypes:	«voidable»
Association role: composition	
Value type:	EarthResourceMaterial
Definition:	The material forming the EarthResource
Multiplicity:	1..*
Stereotypes:	«voidable»

4.1.2.1.3. ExplorationActivity

ExplorationActivity	
Name:	Exploration Activity
Definition:	Chronological list of surveys undertaken to better define the potential of a mineral occurrence
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: activityDuration	
Value type:	TM_Period
Definition:	Period, or extent in time, of the exploration 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
Obligation:	Technical Guidance (recommendation)
Attribute: explorationResult	
Value type:	ExplorationResultCode
Definition:	The result of the exploration activity
Multiplicity:	1..*
Obligation:	Technical Guidance (recommendation)

4.1.2.1.4. Mine

Mine	
Name:	Mine
Subtype of:	MiningFeature

Mine	
Definition:	An excavation for the extraction of mineral deposits. 'True' mines are underground workings and open-pit workings (also called open-sky mines) generally for the extraction of metallic commodities. The Mine feature also includes open workings generally for the extraction of industrial minerals, commonly referred to as quarries.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null
Attribute: mineName	
Value type:	MineName
Definition:	Data type to indicate whether the Mine Name is the preferred name
Multiplicity:	1..*
Attribute: status	
Value type:	MineStatusCode
Definition:	Operational status value of the mine -- Example -- Care & Maintenance; Pending Approval; Operating continually
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: sourceReference	
Value type:	CI_Citation
Definition:	Allows citing mine plans etc
Multiplicity:	0..*
Stereotypes:	«voidable»
Attribute: startDate	
Value type:	TM_Instant
Definition:	Date the mine commenced.
Multiplicity:	0..1
Stereotypes:	«voidable»
Attribute: endDate	
Value type:	TM_Instant
Definition:	Date the mine ceased.
Multiplicity:	0..1
Stereotypes:	«voidable»
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:	1..*
Stereotypes:	«voidable»
Association role: relatedActivity	
Value type:	MiningActivity
Definition:	The MiningActivity associated with the Mine
Multiplicity:	1..*

4.1.2.1.5. MineralOccurrence

MineralOccurrence	
Name:	Mineral Occurrence

MineralOccurrence	
Subtype of:	EarthResource
Definition:	A mineral occurrence is a mineral accumulation in the lithosphere.
Description:	EXAMPLE Prospect, occurrence, mineral deposit, ore deposit, etc
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null

Attribute: type	
Value type:	MineralOccurrenceTypeCode
Definition:	Captures the type of mineral occurrence.
Description:	EXAMPLE prospect, occurrence, mineral deposit, ore deposit.
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)

Attribute: endusePotential	
Value type:	EndusePotentialType
Definition:	The end-use potential of the mineral (eg for energy, fertilizer, building raw material etc)
Multiplicity:	1..*
Stereotypes:	«voidable»
Obligation:	Technical Guidance (recommendation)

4.1.2.1.6. MiningActivity

MiningActivity	
Name:	Mining Activity
Subtype of:	MiningFeature
Definition:	The process of extracting metallic, non-metallic mineral, or industrial rock deposits from the Earth. The term may also include preliminary treatment eg. cleaning or sizing.
Status:	Proposed
Stereotypes:	«featureType»
Identifier:	null

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

Attribute: oreProcessed	
Value type:	Quantity

MiningActivity	
Definition:	The amount of ore processed by the activity
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: processingType	
Value type:	ProcessingActivityTypeCode
Definition:	The type of processing carried out during the mining activity
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Association role: producedMaterial	
Value type:	Product
Definition:	Product(s) are elaborated from mining activity through a processing phase which may be as simple as extraction. The product of a mine s.s. (excavation) is the mined ore or mined material. The product of a mine s.l. (excavation plus processing plant) is a concentrate containing one or several commodities at various grades for metallic ores. A product can also be dimension stone for ornamental rocks.
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:	1..*
Stereotypes:	«voidable»
Association role: deposit	
Value type:	EarthResource
Definition:	To which deposit a mining activity is associated.
Multiplicity:	1
Association role: associatedMine	
Value type:	Mine
Definition:	The mine that the MiningActivity occurred in
Multiplicity:	1
Stereotypes:	«voidable»
Association role: producedWaste	
Value type:	MiningWaste
Definition:	Waste products from a mining activity, through a processing phase.
Multiplicity:	1..*
Stereotypes:	«voidable»

4.1.2.1.7. MiningFeature

MiningFeature (abstract)	
Name:	Mining Feature
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»

MiningFeature (abstract)	
Identifier:	null

4.1.2.1.8. MiningFeatureOccurrence

MiningFeatureOccurrence	
Name:	Mining Feature Occurrence
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
Stereotypes:	«featureType»
Identifier:	null
Attribute: observationMethod	
Value type:	Category
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
Stereotypes:	«voidable»
Attribute: resolutionScale	
Value type:	MD_RepresentativeFraction
Definition:	Reciprocal of equivalent scale of resolution for delineation of a feature's geometry. This is in contrast to positionalAccuracy which is a measure of how well a feature is located relative to other features in the geographic reference system.
Multiplicity:	1
Stereotypes:	«voidable»
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:	1

4.1.2.2. Data types

4.1.2.2.1. CommodityMeasure

CommodityMeasure	
Name:	Commodity Measure
Definition:	A measure of the amount of the commodity based on a Reserve, Resource or Endowment calculation.
Status:	Proposed
Stereotypes:	«dataType»

CommodityMeasure	
Identifier:	null
Attribute: commodityAmount	
Value type:	QuantityRange
Definition:	Amount of commodity
Multiplicity:	1
Stereotypes:	«voidable»
Obligation:	null
Attribute: cutOffGrade	
Value type:	QuantityRange
Definition:	Cut off grade used for calculation: the lowest concentration of a mineralized material that qualifies as ore in a given deposit (adapted from Neuendorf, 2005).
Multiplicity:	1
Stereotypes:	«voidable»
Obligation:	null
Attribute: grade	
Value type:	QuantityRange
Definition:	grade of commodity Where OreMeasure is Resource or Reserve CommodityMeasure::grade is mandatory
Multiplicity:	1
Stereotypes:	«voidable»
Obligation:	null
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..*

4.1.2.2.2. EarthResourceDimension

EarthResourceDimension	
Name:	Earth Resource Dimension
Definition:	Describes the size/volume of the earth resource
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: area	
Value type:	QuantityRange
Definition:	The area of the Earth Resource
Multiplicity:	1..*
Stereotypes:	«voidable»
Obligation:	null
Attribute: depth	
Value type:	QuantityRange
Definition:	The depth of the Earth Resource
Multiplicity:	1..*
Stereotypes:	«voidable»

EarthResourceDimension	
Obligation:	null
Attribute: length	
Value type:	QuantityRange
Definition:	The length of the Earth Resource
Multiplicity:	1..*
Stereotypes:	«voidable»
Obligation:	null
Attribute: width	
Value type:	QuantityRange
Definition:	The width of the Earth Resource
Multiplicity:	1..*
Stereotypes:	«voidable»
Obligation:	null

4.1.2.2.3. Endowment

Endowment	
Name:	Endowment
Subtype of:	OreMeasure
Definition:	Endowment refers to that quantity of a mineral (or a group of minerals for industrial rocks) in accumulations (deposits) meeting specified physical characteristics such as quality, size and depth. 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»
Identifier:	null
Attribute: includesReserves	
Value type:	Boolean
Definition:	Does the estimate include the reserves value (Y/N)
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: includesResources	
Value type:	Boolean
Definition:	Does the estimate include the resources value (Y/N)
Multiplicity:	1
Stereotypes:	«voidable»

4.1.2.2.4. MineName

MineName	
Name:	Mine Name
Definition:	Data type to indicate whether the Mine Name is the preferred name
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: isPreferred	
Value type:	Boolean

MineName	
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

4.1.2.2.5. MineralDepositModel

MineralDepositModel	
Name:	Mineral Deposit Model
Definition:	Systematically arranged information describing the essential attributes of a class of mineral deposits. May be empirical (descriptive) or theoretical (genetic).
Status:	Proposed
Stereotypes:	«type»
Identifier:	null
Attribute: mineralDepositGroup	
Value type:	MineralDepositGroupTerm
Definition:	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 e.g. Cox and Singer 1986
Multiplicity:	1..*
Obligation:	Technical Guidance (recommendation)
Attribute: mineralDepositType	
Value type:	MineralDepositTypeTerm
Definition:	Style of mineral occurrence or deposit. Generally a local or regional term. Should be referenced for definitions and descriptions. Single deposit terms may form member of a Mineral Deposit Group in local and regional schemas.
Multiplicity:	1..*
Stereotypes:	«voidable»
Obligation:	Technical Guidance (recommendation)

4.1.2.2.6. OreMeasure

OreMeasure (abstract)	
Name:	Ore Measure
Definition:	The estimate of the Reserve, Resource or Endowment ore amount
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: classificationMethodUsed	
Value type:	ClassificationMethodUsedCode
Definition:	Means of calculating the measurement.
Description:	EXAMPLE JORC, PERC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: date	
Value type:	TM_GeometricPrimitive
Definition:	Date of calculated/estimated value (single date or range)

OreMeasure (abstract)	
Multiplicity:	1
Attribute: dimension	
Value type:	EarthResourceDimension
Definition:	Size of the body used in the calculation
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: ore	
Value type:	QuantityRange
Definition:	Amount of ore
Multiplicity:	1
Obligation:	null
Attribute: proposedExtractionMethod	
Value type:	Category
Definition:	The method proposed to extract the commodity
Multiplicity:	1
Stereotypes:	«voidable»
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..*

4.1.2.2.7. Reserve

Reserve	
Name:	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»
Identifier:	null
Attribute: category	
Value type:	ReserveCategoryCode
Definition:	Defines the level of confidence of the estimate
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)

4.1.2.2.8. Resource

Resource	
Name:	Resource
Subtype of:	OreMeasure
Definition:	An accumulation of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. Synonyms: Mineral Resource; Coal Resource (s); Diamond (Gemstone) Resource; Potentially Mineable Mineralisation
Status:	Proposed
Stereotypes:	«dataType»
Identifier:	null
Attribute: category	
Value type:	ResourceCategoryCode
Definition:	Indicates if the resource is measured, indicated, proved, probable, or inferred.
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: includesReserves	
Value type:	Boolean
Definition:	Whether estimate of resources uses reserve values (Y/N)
Multiplicity:	0..1
Stereotypes:	«voidable»

4.1.2.3. Code lists

4.1.2.3.1. ClassificationMethodUsedCode

ClassificationMethodUsedCode	
Name:	Classification Method Used Code
Definition:	A code for the means used to calculate the ore measurement.
Description:	EXAMPLE JORC, PERC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.2. CommodityTerm

CommodityTerm	
Name:	Commodity Term
Definition:	The earth resource commodity (eg Cu, Au, Dimension Stone)
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.3. EndusePotentialType

EndusePotentialType	
Name:	Enduse Potential Type
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

EndusePotentialType	
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.4. ExplorationActivityTypeCode

ExplorationActivityTypeCode	
Name:	Exploration Activity Type Code
Definition:	The type of exploration activity carried out
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.5. ExplorationResultCode

ExplorationResultCode	
Name:	Exploration Result Code
Definition:	The result of the exploration activity
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.6. ImportanceCode

ImportanceCode	
Name:	Importance Code
Definition:	Terms indicating the importance of the commodity to the earth resource. Such a ranking is based on a statistical study of a large set of deposits throughout the world to ensure that it is valid. It is made using histograms allowing for each commodity to define class boundaries and what is a very large, a large, a medium-sized etc deposit for this commodity.. This classification is based on the potential or endowment: reserves + resources.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.7. MineStatusCode

MineStatusCode	
Name:	Mine Status Code
Definition:	Operational status values of the mine
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.8. MineralDepositGroupTerm

MineralDepositGroupTerm	
Name:	Mineral Deposit Group Term
Definition:	Terms for the grouping of mineral deposits defined by generic characteristics e.g. host rock, host structure, commodity, association with similar mineral processes e.g. porphyry.
Status:	Proposed
Stereotypes:	«codeList»

MineralDepositGroupTerm	
Extensibility:	any
Identifier:	

4.1.2.3.9. MineralDepositTypeTerm

MineralDepositTypeTerm	
Name:	Mineral Deposit Type Term
Definition:	Terms for the atyle of mineral occurrence or deposit. Generally a local or regional term. Should be referenced for definitions and descriptions. Single deposit terms may form member of a Mineral Deposit Group in local and regional schemas.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.10. MineralOccurrenceTypeCode

MineralOccurrenceTypeCode	
Name:	Mineral Occurrence Type Code
Definition:	The type of mineral occurrence
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.11. MiningActivityTypeCode

MiningActivityTypeCode	
Name:	Mining Activity Type Code
Definition:	The type of mining activity, processing activity, or production.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.12. ProcessingActivityTypeCode

ProcessingActivityTypeCode	
Name:	Processing Activity Type Code
Definition:	The type of processing carried out during a mining activity
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.13. ReserveCategoryCode

ReserveCategoryCode	
Name:	Reserve Category Code
Definition:	Defines the level of confidence of the estimate of the reserve
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.3.14. ResourceCategoryCode

ResourceCategoryCode

ResourceCategoryCode	
Name:	Resource Category Code
Definition:	Indicates if the resource is measured, indicated, proved, probable, or inferred.
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

4.1.2.4. 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.

4.1.2.4.1. 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]

4.1.2.4.2. CGI_LinearOrientation

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

4.1.2.4.3. CGI_PlanarOrientation

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

4.1.2.4.4. 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]

4.1.2.4.5. Category

Category	
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]

4.1.2.4.6. 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]

4.1.2.4.7. 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

4.1.2.4.8. 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]

4.1.2.4.9. 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]

4.1.2.4.10. 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]

4.1.2.4.11. 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]

4.1.2.4.12. 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

4.1.2.4.13. 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.

4.1.2.4.14. MiningWaste

MiningWaste

MiningWaste	
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:	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.

4.1.2.4.15. 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:	Product(s) are elaborated from mining activity through a processing phase which may be as simple as extraction. The product of a mine s.s. (excavation) is the mined ore or mined material. The product of a mine s.l. (excavation plus processing plant) is a concentrate containing one or several commodities at various grades for metallic ores. A product can also be dimension stone for ornamental rocks.

4.1.2.4.16. 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]

4.1.2.4.17. 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 elements in an oxidised or transitional environment. Does a supergene process exist (Y/N)

4.1.2.4.18. 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]

4.1.2.4.19. 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]

4.1.2.4.20. 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]

4.1.3 INSPIRE-governed code lists

The INSPIRE-defined code lists included in this application schema include the values specified in the tables in this section.

All code lists for the Mineral Resources Core application schema are external code lists.

4.1.4 Externally governed code lists

The externally governed code lists included in this application schema are specified in the tables in this section.

4.1.4.1. Governance, availability and constraints

Code list	Governance	Version	Availability	Formats	Subset
ImportanceCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
CommodityTerm	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EarthResourceExpression	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EarthResourceForm	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EarthResourceShape	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ExplorationActivityTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ExplorationResultCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineStatusCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineralOccurrenceTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineralDepositGroup	IUGS/CGI	Latest available version	*http:// www.cgi-iugs.org/*	SKOS	
MineralDepositType	IUGS/CGI	Latest available version	*http:// www.cgi-iugs.org/*	SKOS	
MiningActivityTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	

ProcessingActivityTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EndusePotentialType	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ReserveCategoryCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ResourceCategoryCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ClassificationMethodUsedCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	

The values of selected external code lists are included in Annex E for information.

The values will be also available at this URL through a client application and a web service *[URL to be provided for DS 3.0]*

4.1.4.2. Rules for code list values

Code list	Identifiers	Identifier examples	Labels
ImportanceCode			
CommodityTerm			
EarthResourceExpression			
EarthResourceForm			
EarthResourceShape			
ExplorationActivityTypeCode			
ExplorationResultCode			
MineStatusCode			
MineralOccurrenceTypeCode			
MineralDepositGroup			
MiningActivityTypeCode			
ProcessingActivityTypeCode			
EndusePotentialType			
ReserveCategoryCode			
ResourceCategoryCode			
ClassificationMethodUsedCode			

To be completed

5 Reference systems

5.1 Coordinate reference systems

5.1.1 Datum

Requirement 1	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.

5.1.2 Coordinate reference systems

Requirement 2	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

5.1.3 Display

Requirement 3	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.

5.1.4 Identifiers for coordinate reference systems

Requirement 4 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

5.2 Temporal reference system

Requirement 5 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.

5.3 Theme-specific requirements and recommendations on reference systems

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

6 Data quality

This chapter includes a description of the data quality elements and sub-elements as well as the corresponding data quality measures that should be used to evaluate and document data quality for data sets related to the spatial data theme *Mineral Resources* (section 6.1).

It may also define requirements or recommendations about the targeted data quality results applicable for data sets related to the spatial data theme *Mineral Resources* (sections 6.2 and 6.3).

In particular, the data quality elements, sub-elements and measures specified in section 6.1 should be used for

- evaluating and documenting data quality properties and constraints of spatial objects, where such properties or constraints are defined as part of the application schema(s) (see section 5);
- evaluating and documenting data quality metadata elements of spatial data sets (see section 8); and/or
- specifying requirements or recommendations about the targeted data quality results applicable for data sets related to the spatial data theme *Mineral Resources* (see sections 6.2 and 6.3).

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

6.1 Data quality elements

Table 1 lists all data quality elements and sub-elements that are being used in this specification. Data quality information can be evaluated at level of spatial object, spatial object type, dataset or dataset series. The level at which the evaluation is performed is given in the "Evaluation Scope" column.

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

Table 1 – Data quality elements used in the spatial data theme *Mineral Resources*

Section	Data quality element	Data quality sub-element	Definition	Evaluation Scope
6.1.1	Completeness	Omission	data absent from the dataset, as described by the scope	dataset
6.1.2	Positional accuracy	Absolute or external accuracy	closeness of reported coordinate values to values accepted as or being true	spatial object

Recommendation 4 Where it is impossible to express the evaluation of a data quality element in a quantitative way, the evaluation of the element should be expressed with a textual statement as a data quality descriptive result.

6.1.1 Completeness – Omission

Recommendation 5 Omission should be evaluated and documented using <Name of the measure(s), from ISO/DIS 19157> as specified in the tables below.

Name	Completeness – Omission
Alternative name	
Data quality element	Completeness
Data quality sub-element	Omission
Data quality basic measure	Correct items count | Correct items rate
Definition	Completeness is defined as the presence and absence of features, their attributes and relationships. It shall be described by applicable

	data quality elements from the following list: commission – excess data present in a dataset; omission – data absent from a dataset.
Description	Dates related to OreMeasure (for reserves, resources, ..) should be defined. This element gives the number / percentage of data without this information.
Evaluation scope	data set
Reporting scope	data set
Parameter	
Data quality value type	
Data quality value structure	Single value
Source reference	ISO/DIS 19157 Geographic information – Data quality
Example	
Measure identifier	11

6.1.2 Positional accuracy – Absolute or external accuracy

Recommendation 6 Absolute or external accuracy should be evaluated and documented using <Name of the measure(s), from ISO/DIS 19157> as specified in the tables below.

Name	**Positional accuracy – Absolute or external accuracy**
Alternative name	
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.
Description	
Evaluation scope	spatial object type: Mine / MineralOccurrence
Reporting scope	spatial object type: Mine / MineralOccurrence
Parameter	
Data quality value type	
Data quality value structure	Single value
Source reference	ISO/DIS 19157 Geographic information – Data quality
Example	
Measure identifier	19

6.2 Minimum data quality requirements

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

6.3 Recommendation on data quality

No minimum data quality recommendations are defined.

Recommendation 8 For the data quality elements listed in **Erreur ! Source du renvoi introuvable.**, all data sets related to the spatial data theme *Mineral Resources* should meet the specified target results.

Table 2 – Recommended minimum data quality results for spatial data theme Mineral Resources

Section	Data quality element and sub-element	Measure name(s)	Target result(s)	Condition
7.1	Completeness - Omission	Rate of resources reserves defined		
7.2	Absolute or external accuracy			

7 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 **4**). 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.

NOTEThe value featureType is used to denote spatial object type.

Mandatory or conditional metadata elements are specified in Section 7.1. Optional metadata elements are specified in Section 7. 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 3 and Table 4).

7.1 Common metadata elements

Requirement 6	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 3) as well as the metadata elements specified in Table 4.

Table 3 – 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 4 – Mandatory and conditional common metadata elements

INSPIRE Data Specification Mineral Resources **Section**	**Metadata element**	**Multiplicity**	**Condition**
7.1.1	Coordinate Reference System	1	
7.1.2	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.
7.1.3	Encoding	1..*	
7.1.4	Character Encoding	0..*	Mandatory, if an encoding is used that is not based on UTF-8.
7.1.5	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.

7.1.1 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. *More specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute shall be provided by the TWG RS.*
Implementing instructions	<instructions on how the metadata can be obtained>
Example	referenceSystemIdentifier: code: ETRS_89 codeSpace: INSPIRE RS registry
Example XML encoding	
Comments	

7.1.2 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. *More specific instructions, in particular on pre-defined values for filling the referenceSystemIdentifier attribute shall be provided by DT/CT.*
Implementing instructions	<instructions on how the metadata can be obtained>
Example	referenceSystemIdentifier: code: GregorianCalendar codeSpace: INSPIRE RS registry
Example XML encoding	
Comments	

7.1.3 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 following property values shall be used for default and alternative encodings specified in section **Erreur ! Source du renvoi introuvable.**: Default Encoding – name: **Mineral Resources** GML application schema – version: version <version of this specification>; GML, version 3.2.1 – specification: D2.8.**III.21** Data Specification on **Mineral Resources** – Draft Guidelines Alternative Encoding *Include one paragraph for each alternative encoding defined in section **Erreur ! Source du renvoi introuvable.**.* – name: <Encoding name> – version: version <version of the encoding> – specification: <specification>
Implementing instructions	<instructions on how the metadata can be obtained>
Example	name: **Mineral Resources** GML application schema version: version 3.0, GML, version 3.2.1 specification: D2.8.**III.21** Data Specification on **Mineral Resources** – Draft Guidelines
Example XML encoding	
Comments	<comments>

7.1.4 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	

7.1.5 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.

7.2 Theme-specific metadata elements

No mandatory theme-specific metadata elements are defined for this theme.

IR Requirement 2	The metadata describing a spatial data set or a spatial data set series related to the theme *Mineral Resources* shall also comprise the theme-specific metadata elements specified in Table 5.

Table 5 – Mandatory and conditional theme-specific metadata elements for the theme *Mineral Resources*

Section	Metadata element	Multiplicity	Condition
Erreur ! Source du renvoi introuvable.	**Erreur ! Source du renvoi introuvable.**	<multiplicity> *at least 1 unless conditional*	*To be filled if the minimum cardinality is 0*

No optional theme-specific metadata elements are defined for this theme.

Recommendation 9 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*

Section	Metadata element	Multiplicity
7.2.1	Maintenance Information	0..1
Erreur ! Source du renvoi introuvable.	Completeness – Omission	0..1
Erreur ! Source du renvoi introuvable.	Positional accuracy – Absolute or external accuracy	0..1

7.2.1 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	

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 *(optional)*	
Example *(optional)*	
Example XML encoding *(optional)*	
Comments *(optional)*	

~~7.2.3~~7.2.2 Positional accuracy – Absolute or external accuracy

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 *(optional)*	
Example *(optional)*	
Example XML encoding *(optional)*	

Comments *(optional)*	

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

7.3.1 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 1 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: 2012-02-24

7.3.2 Lineage

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 Chapter 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”.

Recommendation 2 Apart from describing the process history, if feasible within a free text, the overall quality of the dataset (series) should be included in the *Lineage* metadata element. This statement should contain any quality information required for interoperability and/or valuable for use and evaluation of the data set (series).

7.3.3 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.

Recommendation 3 If feasible, the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata element.

8 Delivery

8.1 Encodings

8.1.1 Default Encoding(s)

TG Requirement 2	Data conformant to the application schema(s) defined in section 5 shall be encoded using the encoding(s) specified in this section.

8.1.1.1. Default encoding for application schema MineralResourcesCore

Name: MineralResourcesCore GML Application Schema
Version: version 3.0, GML, version 3.2.1
Specification: D2.8.**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.

8.1.1.1.1. Specific mappings from UML classes to GML/XML Schema types and elements

In addition to the mappings between conceptual UML classes and the associated GML object element, XML Schema type and GML property type provided in Table D.2 of ISO 19136 (GML), the mappings included in have been used to generate the GML application schema.

Table 7. Mappings between conceptual UML classes and the associated GML object elements, XML Schema types and GML property types

UML class	GML object element	GML type	GML property type

8.1.1.1.2. Implementation UML model used for generating the GML application schema

The GML application schema was not derived directly from the conceptual model described in section 5, but from an implementation model (for a schematic illustration of this process, see Figure 4).

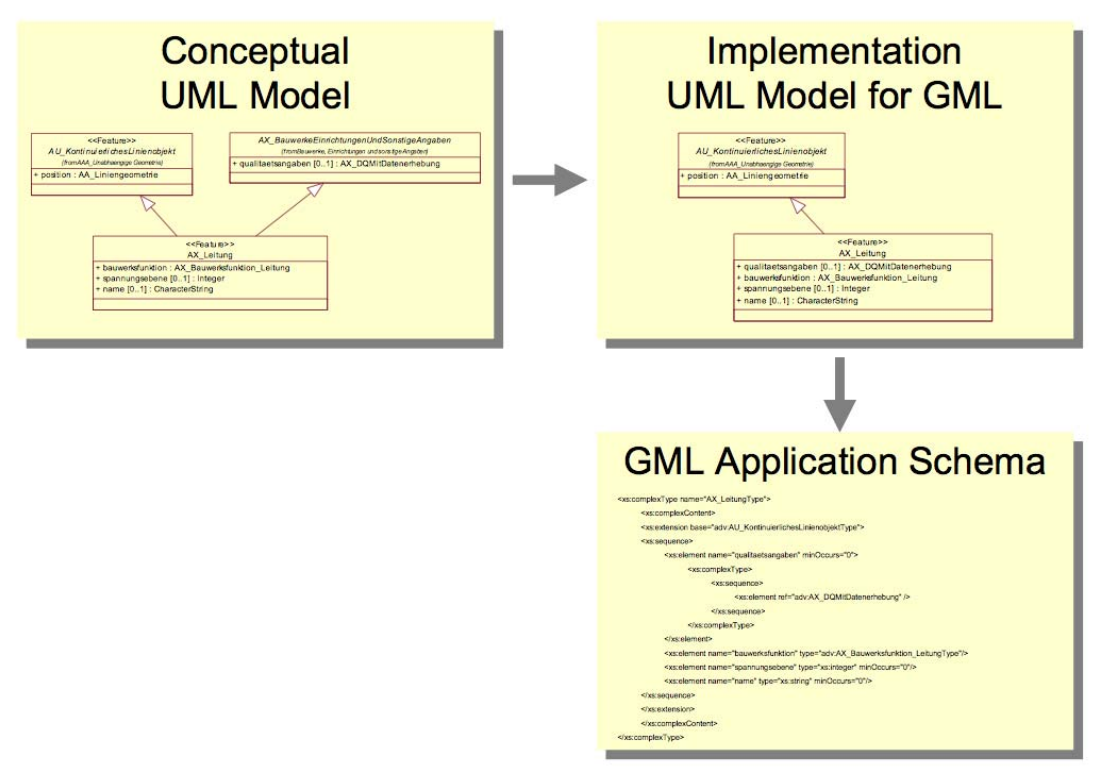


Figure 4 – Process of creating the GML application schema (from [DS-D2.7])

9 Data Capture

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

10 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 10, 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 10.2 specifies the default styles to be used for each of these layer types, while section **Erreur ! Source du renvoi introuvable.** specifies other well-defined styles.

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)

Requirement 7	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.

TG Requirement 3	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 default styles specified in the tables in this section. 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 this section for that layer shall be used.

TG Requirement 4	If an INSPIRE view service supports the portrayal of spatial data sets corresponding to the spatial data themes *Mineral Resources*, apart from the default styles specified in Section 10.2, it shall also support the well-defined styles specified in this section.

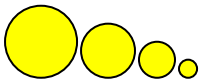
10.1 Layer types for the spatial data theme *Mineral Resources*

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.CommodityPreciousGemstones	Precious and semi-precious gemstones	Idem
MR.CommodityChemicalUse	Mineral for chemical use	Idem
MR.CommodityCeramic	Ceramic and refractory minerals	Idem
MR.CommodityFertilizerMinerals	Fertilizer minerals	Idem
MR.CommodityBuildingMaterials	Building raw materials, dimension stones	Idem
MR.CommodityIndustrialMinerals	Speciality and other industrial rocks and minerals	Idem

10.2 Default styles for the spatial data theme *Mineral Resources*

The size of each symbol is related to the classification defined for each commodity (or group of commodities). The classification (A, B, C, D, …) is defined with the commodities code-list (see Annex E).

1- Precious Metals

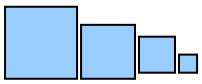


Gold A-B-C-N/A Class

Silver

PGE

2- Base Metals



Lead/Zinc

Copper

Copper

Zinc only

Lead only

Aluminium

3- Iron and ferro-alloys metals

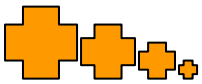
Fe, Cr, Mn, V

W, Mo

Nickel/Cobalt

Nb

4- Energetic metals or minerals



Uranium/Thorium

Coal, lignite, peat

Oil shale

5- Special and rare metals

Li, Be, Ta, REE, Cs, Rb, Sc, Zr, Hf

Ge, Ga, In, Cd, Se, Re

Bi, Te, Hg

Sb

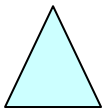
Ti

6- Precious and Semi-precious stones

Precious gemstones

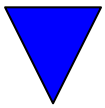
semi-precious gemstones

7- Minerals for chemical use

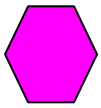


8- Ceramic and refractory minerals

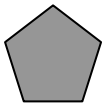
9- Fertilizer minerals



10- Building raw materials, dimension stones



11- Specialty and other industrial rocks and minerals



Include one table for each layer type defined in section 10.

Layer Name	**<Layer name>**
Style Name	<Name of the style> *The name should be composed as follows:* *<theme short name>.<layer name>.Default, e.g. CP.CadastralParcel.Default*
Style Title	<Title of the style>

	The title should be "<layer title> Default Style", e.g. "Cadastral Parcel Default Style". The title is referred to in the description templates below as $TITLE. If an external SLD file is provided, the title should be the same as specified here.
Style Abstract	<Abstract describing of the style in natural language> *If an external SLD file is provided, the abstract should be the same as specified here.*
Symbology	*Theme-specific symbology may be specified in two ways:* *1. The preferred representation is to specify the symbology using the OpenGIS Symbology Encoding Implementation Specification, version 1.1.0 (http://portal.opengeospatial.org/files/?artifact_id=16700), which is a language used for styling spatial data, and independent of any service interface specification. For defining the link between the styling defined by the Symbology Encoding and WMS layers, clause 11 (SLD Encoding) of the OpenGIS Styled Layer Descriptor (SLD) Profile of the Web Map Service Implementation Specification, version 1.1.0 (http://portal.opengeospatial.org/files/?artifact_id=22364) shall be used.* *If an agreed/standardised style exists for this spatial object type, this style should be specified here.* *In this case, add the following sentence:* The SLD specifying the symbology is distributed in a file separately from the data specification document. *If no such style exists, one of the XML fragments below can be used as a default layer description. The layer description templates use the following parameters:* • *$NAME=Name of the layer* • *$TITLE=Title of the style* • *$SPATIALOBJECTTYPE=Qualified name of the spatial object type in the GML application schema* • *$SPATIALPROPERTY=Qualified name of the spatial property of the spatial object type to be used in the default display* *The following XML fragment can be used as default layer description for a spatial object type with a **point** geometry* `<sld:NamedLayer>` `<se:Name>$NAME</se:Name>` `<sld:UserStyle>` `<se:Name>INSPIRE_Default</se:Name>` `<sld:IsDefault>1</sld:IsDefault>` `<se:FeatureTypeStyle version="1.1.0">` `<se:Description>` `<se:Title>$TITLE</se:Title>` `<se:Abstract>The geometry is rendered as a square with a size of 6 pixels, with a 50% grey (#808080) fill and a black outline.</se:Abstract>` `</se:Description>` `<se:FeatureTypeName>$SPATIALOBJECTTYPE</se:FeatureTypeName>` `<se:Rule>` `<se:PointSymbolizer>` `<se:Geometry>` `<ogc:PropertyName>$SPATIALPROPERTY</ogc:PropertyName>` `</se:Geometry>` `<se:Graphic/>` `</se:PointSymbolizer>` `</se:Rule>` `</se:FeatureTypeStyle>` `</sld:UserStyle>` `</sld:NamedLayer>`

	*The following XML fragment can be used as default layer description for a spatial object type with a **curve** geometry.* `<sld:NamedLayer>` `  <se:Name>$NAME</se:Name>` `  <sld:UserStyle>` `  <se:Name>INSPIRE_Default</se:Name>` `  <sld:IsDefault>1</sld:IsDefault>` `  <se:FeatureTypeStyle version="1.1.0">` `  <se:Description>` `  <se:Title>$TITLE</se:Title>` `  <se:Abstract>The geometry is rendered as a solid black line with a stroke width of 1 pixel.</se:Abstract>` `  </se:Description>` `  <se:FeatureTypeName>$SPATIALOBJECTTYPE</se:FeatureTypeName>` `  <se:Rule>` `  <se:LineSymbolizer>` `  <se:Geometry>` `  <ogc:PropertyName>$SPATIALPROPERTY</ogc:PropertyName>` `  </se:Geometry>` `  <se:Stroke/>` `  </se:LineSymbolizer>` `  </se:Rule>` `  </se:FeatureTypeStyle>` `  </sld:UserStyle>` `  </sld:NamedLayer>` *An example including labels is given in the example data specification in Appendix I.* *2. Alternatively, an existing portrayal specification used for the theme is referenced. This option is only feasible, if the parts of the source application schema that are referred to by the portrayal rules are also part of the INSPIRE application schema.* *In this case, add the following sentence:* The symbology is specified in <reference>.
Minimum & maximum scales	<min scale> - <max scale> *The range of scales for which it is appropriate to use this style. The default is no scale limits.* *Several default styles can be specified for one layer type – one for each scale range.*

10.3 Layers organisation

None.

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Annex B
(normative)

Abstract Test Suite

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

NOTEA common abstract test suite including detailed instructions on how to test each requirement 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 ratio);
- 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

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

C.1 The raw materials initiative (2008)

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

In this document, the Commission notices that there has been no integrated policy response at EU level up to now to ensure that it has sufficient access to raw materials at fair and undistorted prices. It is proposed that the EU should agree on an integrated raw materials strategy. Such a strategy should be based on the following 3 pillars:
(1) ensure **access to raw materials** from international markets under the same conditions as other industrial competitors;
(2) set the right **framework conditions** within the EU in order to foster sustainable supply of raw materials from European sources;
(3) boost overall resource efficiency and promote recycling to **reduce the EU's consumption of primary raw materials** and decrease the relative import dependence.

Two points are of particular interest for INSPIRE:

1 - The sustainable supply of raw materials based in the EU requires that **the knowledge base** of mineral deposits within the EU will be improved. In addition, the long term access to these deposits should be taken into account in land use planning. Therefore the Commission recommends that the national **geological surveys** become more actively involved in land use planning within the Member States.

2 - The Commission recommends better **networking between the national geological surveys** to facilitate the exchange of information and improve the interoperability of data and their dissemination, with particular attention to the needs of SMEs.

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

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

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

Although raw materials are essential for the EU economy, their availability is increasingly under pressure. Within the framework of the EU Raw Materials Initiative, it was decided to identify a list of critical raw materials at EU level, in close cooperation with Member States and stakeholders.

This report analyses a selection of 41 minerals and metals. In line with other studies, the report puts forward a **relative concept of criticality**. This means that raw material is labelled "critical" when the risks for supply shortage and their impacts on the economy are higher compared with most of the other raw materials. **Two types of risks** are considered: a) the **"supply risk"** taking into account the political-economic stability of the producing countries, the level of concentration of production, the potential for substitution and the recycling rate; and b) the **"environmental country risk"** assessing the risks that measures might be taken by countries with weak environmental performance in order to protect the environment and, in doing so, jeopardise the supply of raw materials to the EU. Building on existing approaches, this report sets out an innovative and pragmatic approach to determining criticality. In particular,
- It takes into **account the substitutability between materials**, i.e. the potential for substitution of a restricted raw material by another that does not face similar restrictions.
- It deals with **primary and secondary raw materials**, the latter being considered as similar to an indigenous European resource.
- It introduces a logical way to aggregate indicators and makes use of widely recognised indexes.
- It presents a transparent methodology.

Due to their high relative economic importance and to high relative supply risk, the Group has established a **list of 14 critical raw materials at EU level** (in alphabetical order):

Antimony	Indium
Beryllium	Magnesium
Cobalt	Niobium
Fluorspar	PGMs (Platinum Group Metals)
Gallium	Rare earths
Germanium	Tantalum
Graphite	Tungsten

Among the various recommendations made by the Group, one shall retain more particularly the following points:

- improving the availability of reliable, **consistent statistical information** in relation to raw materials;
- promoting the dissemination of this information, notably by preparing a **European Raw Materials Yearbook** with the involvement of national geological surveys and mining/processing industries. It should in particular aim at improving the knowledge on the availability of resources and on their flow into products through the value-added chains of the EU economies;
- establishing indicators of **competition to land** in the Member States.

The Group recommends **policy actions** to improve **access to primary resources** aiming at:

- supporting the findings and recommendations resulting from the work carried out by the ad hoc working group on "Best practices in the area of land use planning and permitting" with the view to **securing better access to land**, fair treatment of extraction with other competing land uses and more streamlined permitting processes;
- **promoting exploration**, and ensuring that exploration by companies is regarded as research activities;
- **promoting research on mineral processing**, extraction from old mine dumps, mineral extraction from deep deposits, and mineral exploration in general, notably under EU RTD Framework Programmes.

➔The raw materials initiative - Actions 6 & 7. Improving framework conditions for extracting minerals from the EU. Exchanging best practice on land use planning, permitting and geological knowledge sharing

The work detailed in this report has been undertaken with regards to actions 6 and 7 of the Raw Materials Initiative, linked to the second pillar of the Initiative (Set the right **framework conditions** within the EU in order to foster sustainable supply of raw materials from European sources). Action 6 involves identifying actions to promote the exchange of best practices in the area of land use planning and administrative conditions for exploration and extraction. Action 7 involves better networking between national Geological Surveys with the aim of increasing the EU's know ledge base, and looking into the need to develop a medium to long term strategy for integrating sub-surface components into land services of the GMES Land Monitoring Core Service.

Recommendations of the working group (text underlined in grey is of particular interest for INSPIRE)

The group recommends a **National Minerals Policy** to ensure that the mineral resources are provided to society in an economically viable way, harmonised with other national policies, based on sustainable developments principles and including a commitment to provide a legal and information framework.

The **Minerals Planning Policy** is seen as key component of the national minerals policy. It should describe in detail the ways that future minerals supply will be secured and demonstrate a strong link to broader land use planning policy and regulation.

A **Sustainable Minerals Policy** shall be based on the principles of sustainable development and incorporate economic, environmental and social requirements.

Any **land use policy for minerals** must utilise a robust digital geological knowledge base ensuring fair and equal consideration of all potential uses of land including the eventual extraction of raw materials. Alongside information on the resource of local importance, a method for estimating the long term demand for these materials, and a means by which this can be translated into a spatial plan while recognising the contribution of recycled materials a needed.

The most important elements of the minerals exploration and extraction application process are: **clarity, understanding** and **certainty** of what needs to be provided in order to get authorisation for minerals exploration or extraction.

This can take the shape of a standardised application form or could be set out in legislation or guidance.

Speeding up the authorisation processes may be achieved through integrating the different permits required so that they are issued by one competent authority (a one -stop-shop) and with only one environmental impact assessment or by parallel assessment.

Codes of practice are important instruments to achieve **technical, social and environmental excellence**. Use of codes of practice, guidelines or equivalent by industry helps to ensure protection of the environment from adverse impacts of mineral extraction.

To **improve the knowledge base** of mineral deposits in the EU the need harmonised EU level data sets stands out. **Better networking** between the national Geological Surveys of Member States is the basis for cooperation between relevant institutions and the Geological Survey and driven by the need to:

· achieve synergies between the Geological Surveys
· provide public data for policy making
· facilitate investment in exploration and extraction
· provide minerals intelligence.
· The networking must be structured, organised, long -term oriented and consensus based

Standardised and accurate statistical data on world wide minerals production, imports and exports, and publication of this data on an annual basis. This would serve to analyse trends and help decision makers to better understand and monitor the EU's supply and demand situation and related risks.

GMES will provide parts of the needed satellite data for e.g. ground stability monitoring which could be processed into directly useful information for RMI by national institutes or value-adding industry in the Member States. Alternatively, GMES could also potentially directly provide such services while requiring an assessment of whether respecting the principle of subsidiarity, of costs, benefits, political priorities etc.

Medium to long term projects should base on experience gained (e.g. ProMine project) to develop future '3D-Europe' projects while focussing at first on the areas with known mineral potential.

The development of a pan-European programme of deep scientific boreholes data acquisition, processing and modelling should be considered as an important component of Europe's scientific infrastructure.

C.2 The Mining Waste Directive

➔ DIRECTIVE 2006/21/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC

The document reminds of decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme that sets as the objective for wastes that are still generated that the level of their hazardousness should be reduced and that they should present as little risk as possible, **that preference should be given to recovery and especially to recycling**, that the quantity of waste for disposal should be minimised and should be safely disposed of, and that waste intended for disposal should be treated as closely as possible to the place of its generation … Decision No 1600/2002/EC also sets as a priority action the promotion of sustainable management of extractive industries with a view to reducing their environmental impact.

The document also gives a clear definition of wastes from the extractives industries: tailings (i.e. the waste solids or slurries that remain after the treatment of minerals by a number of techniques), waste rock and overburden (i.e. the material that extractive operations move during the process of accessing an ore or mineral body, including during the pre-production development stage), and topsoil (i.e. the upper layer of the ground) provided that they constitute waste as defined in Council Directive 75/442/EEC of 15 July 1975 on waste.

In article 5 "Waste management plan", it is clearly said that the objectives of the waste management plan shall be (among other) to encourage the recovery of extractive waste by means of recycling, reusing or reclaiming such waste, where this is environmentally sound in accordance with existing environmental standards at Community level and with the requirements of this Directive where relevant. **This point is particularly important because such wastes may contain *"high-tech / strategic metals"*. These wastes may represent under certain favourable conditions (volume, grade, …) not insignificant resources and thus might contribute to reduce the European deficit in these commodities.**

Annex II of the document deals with waste characterisation, and brings useful indications on how a "Mining waste" database should be structured:

The waste to be deposited in a facility shall be characterised in such a way as to guarantee the long‐term physical and chemical stability of the structure of the facility and to prevent major accidents. The waste characterisation shall include, where appropriate and in accordance with the category of the waste facility, the following aspects:

> (1) **description of expected physical and chemical characteristics of the waste to be deposited in the short and the long term**, with particular reference to its stability under surface atmospheric/meteorological conditions, **taking account of the type of mineral or minerals to be extracted and the nature of any overburden and/or gangue minerals that will be displaced in the course of the extractive operations**;
>
> (2) classification of the waste according to the relevant entry in Decision 2000/532/EC, with particular regard to its hazardous characteristics;
>
> (3) description of the chemical substances to be used during treatment of the mineral resource and their stability;
>
> (4) description of the method of deposition;
>
> (5) waste transport system to be employed.

Annex D
(informative)
Data model extension

Include additional information (e.g. use cases, examples) that helps the reader understand the data specification here.

Add/delete further annexes as required.
This annex describes the MineralResourcesExtension application schema.

The MineralResourcesExtension application schema 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.

D.1 MineralResourcesExtension application schema

D.1.1 Summary

The overview of the extension data model for Mineral Resources is shown the figure below.

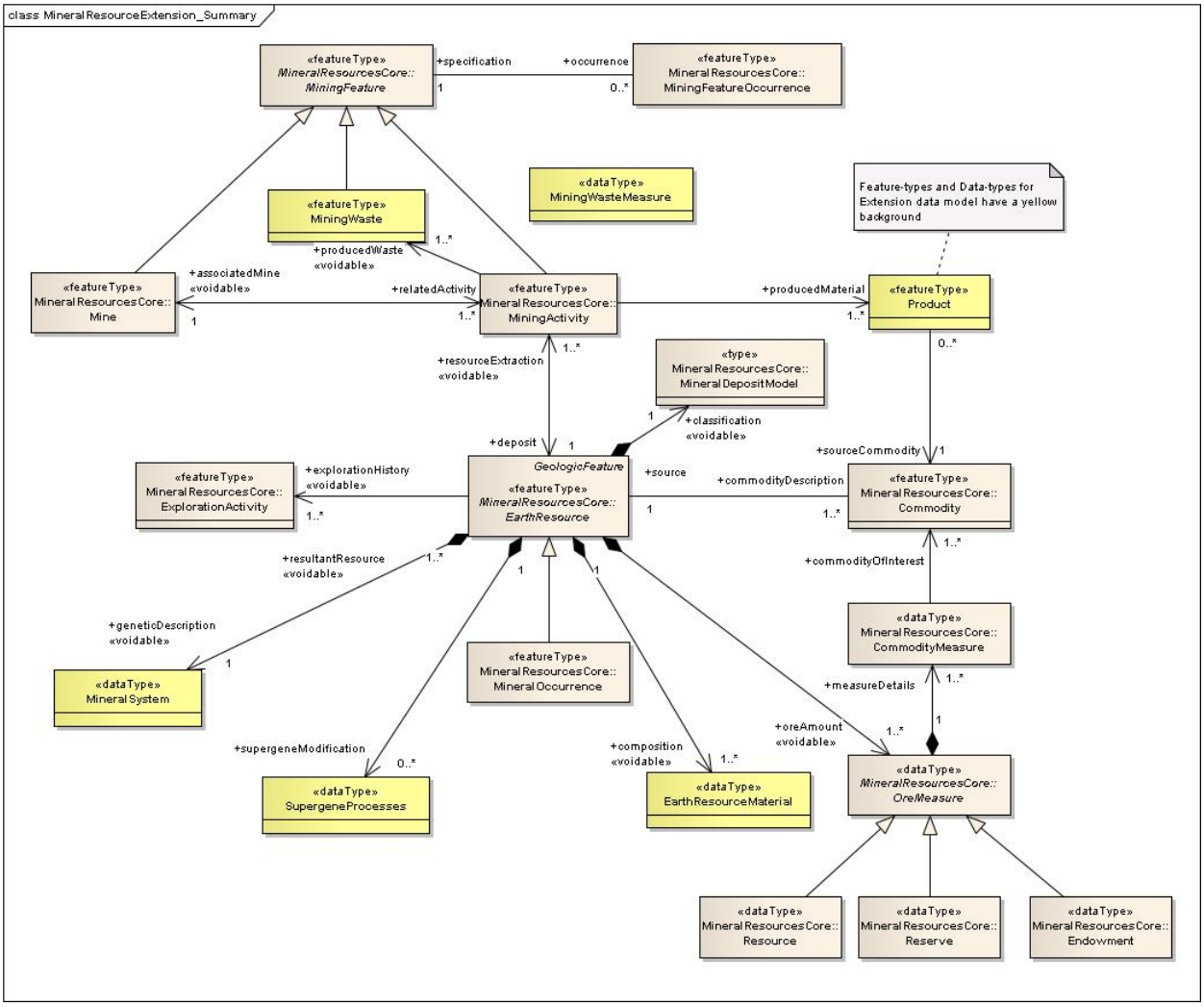

Figure 1 – UML class diagram: MineralResourcesExtension application schema Overview

By comparison with the core data model it can be seen that there are additional Earth Resource classes in the extension schema (yellow background): *MiningWaste and MiningWasteMeasure, MinedMaterial and Product,and MineralSystem, SupergeneProcesses,* and *EarthResourceMaterial.*

D.1.2 Mine Extension: Mining Waste, Product and Mined material

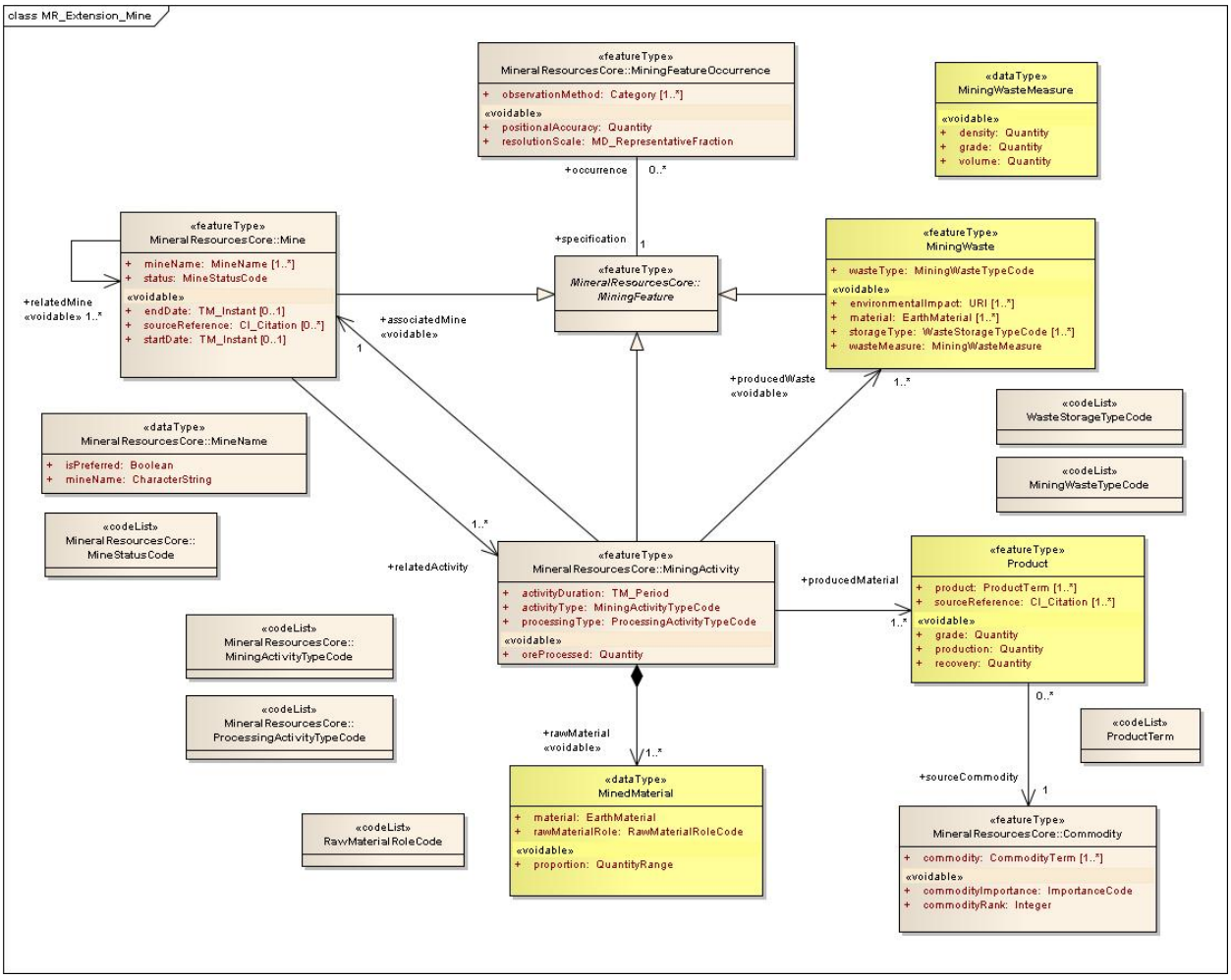

Figure 2 – UML class diagram: Mine Extension (Mining Waste, Product and Mined material)

MiningWaste is added as another type of *MiningFeature.* Mining waste can be defined as a part of the materials that result from the exploration, mining and processing of substances governed by legislation on mines and quarries. *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 X) 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: Product(s) are elaborated from mining activity through a processing phase which may be as simple as extraction. The product of a mine s.s. (excavation) is the mined ore or mined material. The product of a mine s.l. (excavation plus processing plant) is a concentrate containing one or several commodities at various grades for metallic ores. A product can also be dimension stone of ornamental rocks'.
- 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* 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

D.1.3 EarthResource material, mineral system, and supergene process

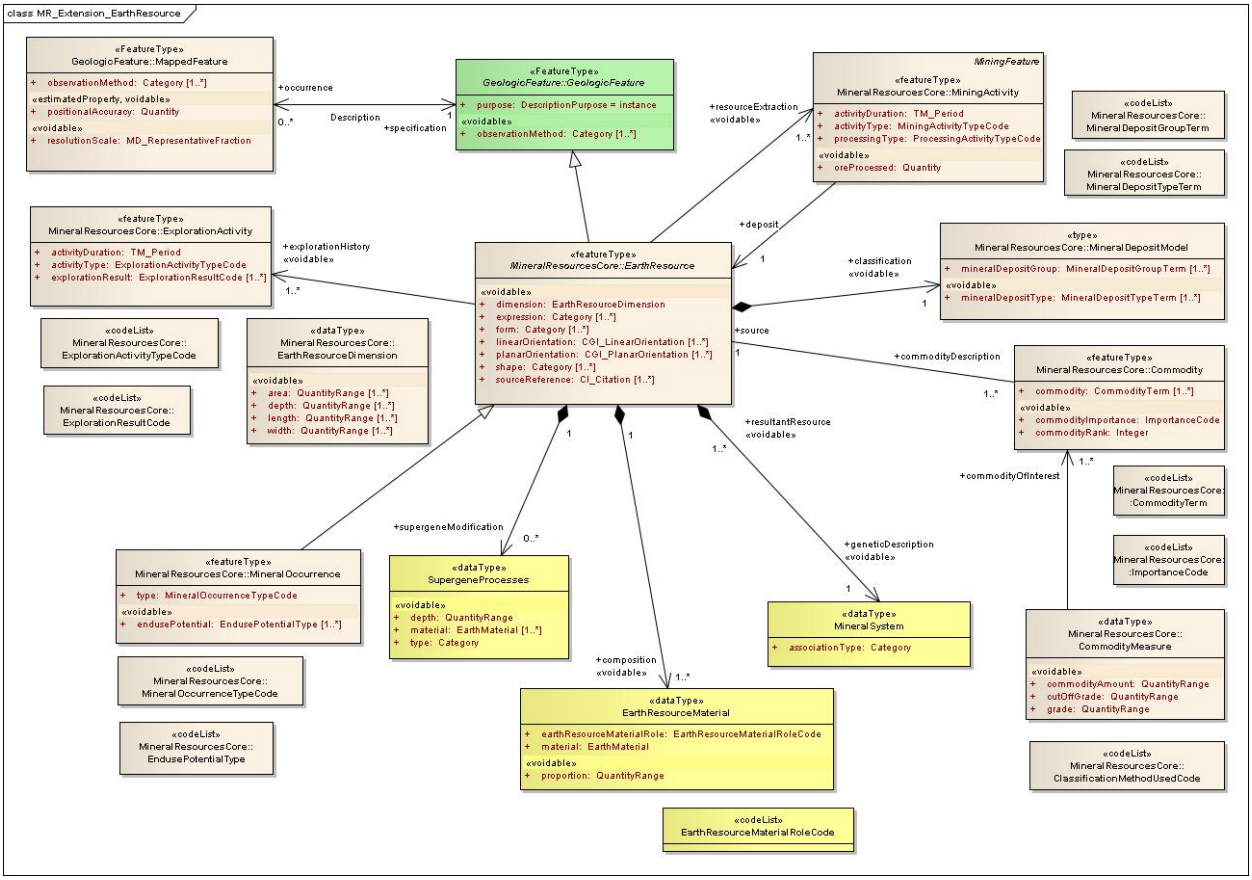

Figure 3 – UML class diagram: Earth Resource material

The *geneticDescription* association from *EarthResource* to *MineralSystem* allows all geological features that control the generation and preservation of the mineral deposits associated with the Earth Resource to be described. *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 elements 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* (see figure below) to describe the material
- Proportion: The proportion that the Earth Resource Material is of the overall Earth Resource

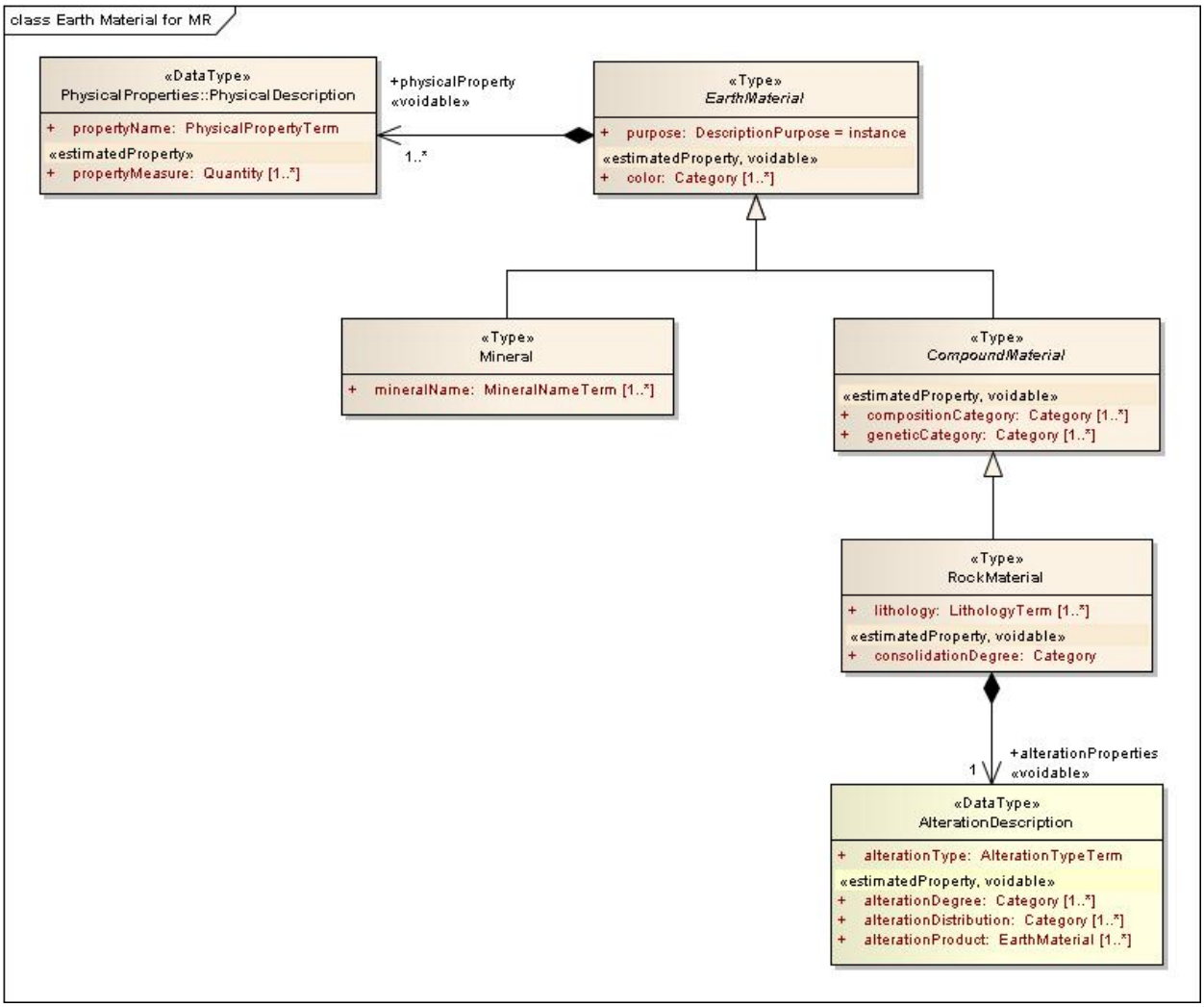

Figure 4 – UML class diagram: Earth Material

The MineralResourcesExtension application schema uses *EarthMaterial* from GeoSciML to allow a full description of rock and mineral materials. Figure 4 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

D.2 Feature catalogue related to the data model extension

Table 1 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue MineralResourcesExtension
Scope	MineralResourcesExtension
Version number	2.9
Version date	2012-02-24
Definition source	INSPIRE data specification MineralResourcesExtension

Table 2 - Types defined in the feature catalogue

Type	Package	Stereotypes
EarthResourceMaterial	MineralResourcesExtension	«dataType»
EarthResourceMaterialRoleCode	MineralResourcesExtension	«codeList»
MinedMaterial	MineralResourcesExtension	«dataType»
MineralSystem	MineralResourcesExtension	«dataType»
MiningWaste	MineralResourcesExtension	«featureType»
MiningWasteMeasure	MineralResourcesExtension	«dataType»
MiningWasteTypeCode	MineralResourcesExtension	«codeList»
Product	MineralResourcesExtension	«featureType»
ProductTerm	MineralResourcesExtension	«codeList»
RawMaterialRoleCode	MineralResourcesExtension	«codeList»
SupergeneProcesses	MineralResourcesExtension	«dataType»
WasteStorageTypeCode	MineralResourcesExtension	«codeList»

10.3.1.1. Spatial object types

10.3.1.1.1. MiningWaste

MiningWaste

Name: Mining Waste
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»
Identifier: null

Attribute: wasteType

Value type: MiningWasteTypeCode
Definition: The type of mining waste
Multiplicity: 1
Obligation: Technical Guidance (recommendation)

Attribute: storageType

Value type: WasteStorageTypeCode
Definition: The storage type of the waste eg surface storage, tailings pond, waste dump, covered storage etc

MiningWaste

Multiplicity: 1..*
Stereotypes: «voidable»
Obligation: Technical Guidance (recommendation)

Attribute: material

Value type: EarthMaterial
Definition: The material of which the mining waste is composed
Multiplicity: 1..*
Stereotypes: «voidable»

Attribute: wasteMeasure

Value type: MiningWasteMeasure
Definition: The measure of mining waste
Multiplicity: 1
Stereotypes: «voidable»

Attribute: environmentalImpact

Value type: URI
Definition: The potential environmental impact of the mining waste
Multiplicity: 1..*
Stereotypes: «voidable»

10.3.1.1.2. Product

Product

Name: Product
Definition: Product(s) are elaborated from mining activity through a processing phase which may be as simple as extraction. The product of a mine s.s. (excavation) is the mined ore or mined material. The product of a mine s.l. (excavation plus processing plant) is a concentrate containing one or several commodities at various grades for metallic ores. A product can also be dimension stone for ornamental rocks.
Status: Proposed
Stereotypes: «featureType»
Identifier: null

Attribute: grade

Value type: Quantity
Definition: The relative quantity or percentage of ore mineral content in an orebody. (Could be Feed Grade, ore grade)
Multiplicity: 1
Stereotypes: «voidable»

Attribute: production

Value type: Quantity
Definition: Quantity of product produced during the activity
Multiplicity: 1
Stereotypes: «voidable»

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..*
Obligation: Technical Guidance (recommendation)

Product
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: 1 Stereotypes: «voidable»
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

10.3.1.2. Data types

10.3.1.2.1. EarthResourceMaterial

EarthResourceMaterial
Name: Earth Resource Material Definition: Identifies the material found in the earth or produced from earth material that is of economic interest Status: Proposed Stereotypes: «dataType» Identifier: null
Attribute: earthResourceMaterialRole
Value type: EarthResourceMaterialRoleCode Definition: The role the EarthMaterial plays in the EarthResourceDescription (eg host rock, alteration product, primary, secondary) Multiplicity: 1 Obligation: Technical Guidance (recommendation)
Attribute: material
Value type: EarthMaterial Definition: Uses EarthMaterial to describe the EarthResourceMaterial material Multiplicity: 1
Attribute: proportion
Value type: QuantityRange Definition: The proportion of the EarthRespourceMaterial in the EarthResourceDescription Multiplicity: 1 Stereotypes: «voidable» Obligation: null

10.3.1.2.2. MinedMaterial

MinedMaterial
Name: Mined Material Definition: A data type to describe the raw material of a mining activity Status: Proposed

MinedMaterial	
Stereotypes:	«dataType»
Identifier:	null
Attribute: material	
Value type:	EarthMaterial
Definition:	Uses EarthMaterial to describe the RawMaterial material
Multiplicity:	1
Attribute: rawMaterialRole	
Value type:	RawMaterialRoleCode
Definition:	Role the EarthMaterial plays in the MiningActivity (eg gangue, ore)
Multiplicity:	1
Obligation:	Technical Guidance (recommendation)
Attribute: proportion	
Value type:	QuantityRange
Definition:	Proportion of the RawMaterial playing the rawMaterialRole in the MiningActivity
Multiplicity:	1
Stereotypes:	«voidable»
Obligation:	null

10.3.1.2.3. MineralSystem

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

10.3.1.2.4. MiningWasteMeasure

MiningWasteMeasure	
Name:	Mining Waste Measure
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»
Identifier:	null
Attribute: volume	
Value type:	Quantity
Definition:	The volume of mining waste
Multiplicity:	1
Stereotypes:	«voidable»

MiningWasteMeasure	
Attribute: density	
Value type:	Quantity
Definition:	The density of mining waste
Multiplicity:	1
Stereotypes:	«voidable»
Attribute: grade	
Value type:	Quantity
Definition:	The grade of mining waste
Multiplicity:	1
Stereotypes:	«voidable»

10.3.1.2.5. SupergeneProcesses

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

10.3.1.3. Code lists

10.3.1.3.1. EarthResourceMaterialRoleCode

EarthResourceMaterialRoleCode	
Name:	Earth Resource Material Role Code
Definition:	The role the EarthMaterial plays in the EarthResourceDescription
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

10.3.1.3.2. MiningWasteTypeCode

MiningWasteTypeCode

MiningWasteTypeCode	
Name:	Mining Waste Type Code
Definition:	The type of mining waste
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

10.3.1.3.3. ProductTerm

ProductTerm	
Name:	Product Term
Definition:	A value-added product created from a commodity
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

10.3.1.3.4. RawMaterialRoleCode

RawMaterialRoleCode	
Name:	Raw Material Role Code
Definition:	Role the EarthMaterial plays in the MiningActivity (eg gangue, ore)
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

10.3.1.3.5. WasteStorageTypeCode

WasteStorageTypeCode	
Name:	Waste Storage Type Code
Definition:	The type of mining waste storage
Status:	Proposed
Stereotypes:	«codeList»
Extensibility:	any
Identifier:	

10.3.1.4. 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.

10.3.1.4.1. 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]

10.3.1.4.2. Category

Category	
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]

10.3.1.4.3. 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

10.3.1.4.4. EarthMaterial

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

10.3.1.4.5. 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

10.3.1.4.6. 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]

10.3.1.4.7. URI

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

Annex E
(informative)
Code-lists values

E.1 Code lists for Mineral Resources - Core

Code list	Governance	Version	Availability	Formats	Subset
ImportanceCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
CommodityTerm	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EarthResourceExpressionCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EarthResourceFormCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EarthResourceShapeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ExplorationActivityTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ExplorationResultCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineStatusCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineralOccurrenceTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineralDepositGroup	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MineralDepositType	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MiningActivityTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ProcessingActivityTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EndusePotentialType	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	

ReserveCategoryCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ResourceCategoryCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
ClassificationMethodUsedCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	

Code list names to be harmonized

E.2 Code lists for Mineral Resources - extension

Code list	Governance	Version	Availability	Formats	Subset
EarthResourceMaterialRoleCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
RawMaterialRoleCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
WasteStorageTypeCode	IUGS/CGI	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
EnvironmentalImpactCode	IUGS/CGI?	Latest available version	http:// *www.cgi-iugs.org/*	SKOS	
MiningWasteTypeCode	EIONET	Latest available version	http://scp.eionet.europa.eu/definitions/low	PDF	
ProductTerm	Gensus.org	Latest available version	http://www.census.gov/prod/ec02/02numlist/212.pdf	PDF	
MineralNameTerm	IMA	Latest available version	http://pubsites.uws.edu.au/ima-cnmnc/imalist.htm	PDF	

E.3 Code lists values for Mineral Resources (core model)

Code list name: Importance Code

Value	Definition	Reference
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
Large deposit	Ditto	ProMine
Medium sized deposit	Ditto	ProMine
Small deposit	Ditto	ProMine
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
No information available		

Code list name: Commodity Term

ID	Value	Very large deposit	Large deposit	Medium sized deposit	Small deposit	PM_UNIT
Abr	Abrasive minerals: garnet, staurolite (substance)	500 000	100 000	20 000	5 000	t (1,000 kg)
Ag	Silver (metal)	10 000	2 500	500	100	t (1,000 kg)
Aggr	Aggregate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrA	Alluvial aggregate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrC	Chert, siliceous concretion (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrM	Crushed aggregate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrMLst	Crushed aggregate from carbonate (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrMMg	Crushed aggregate from magmatic rock (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrMSil	Crushed aggregate from sandstone, quartzite (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrSa	Sand, sand and gravel (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AggrSo	Very fine sand (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
AgM	Aquamarine (substance)	10	5	0,5	0,1	t (1,000 kg)
Agt	Agata, chalcedony, jasper (substance)	1 000	100	10	1	t (1,000 kg)
Al	Aluminium (Bauxite ore)	1 000 000 000	100 000 000	10 000 000	1 000 000	t (1,000 kg)
Alu	Alunite	5 000 000	1 000 000	200 000	10 000	t (1,000 kg)
Amb	Amber	10	5	0,5	0,1	t (1,000 kg)
Amt	Amethyst, quartz, citrine, aventurine (substance)	50	5	0,5	0,1	t (1,000 kg)
Amz	Amazonite, gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
And	Andalusite-kyanite group (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Anda	Andalusite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Ant	Antophyllite (Asbestos) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Apat	Apatite, gemstone ("cat's eye"), (substance)	10 000 000	1 000 000	100 000	10 000	ct
As	Arsenic (metal)	200 000	20 000	2 000	200	t (1,000 kg)
Asb	Asbestos (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Attp	Attapulgite, sepiolite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Au	Gold (metal)	500	100	10	1	t (1,000 kg)
Be	Beryllium (BeO)	20 000	2 000	200	50	t (1,000 kg)
Bi	Bismuth (metal)	20 000	2 000	200	2	t (1,000 kg)
Bitum	Bituminous rocks (tons of oil)	1 000 000 000	100 000 000	10 000 000	1 000 000	t (1,000 kg)
Bnt	Bentonite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Bor	Borates (B2O3)	25 000 000	2 000 000	100 000	10 000	t (1,000 kg)
Br	Bromine (substance)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Brl	Beryl, gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
Brt	Barite (BaSO4)	5 000 000	1 000 000	200 000	50 000	t (1,000 kg)
Cal	Calcite, filler for paper (CaCO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Caopt	Calcite, optical use (CaCO3)	100	10	1	0,1	t (1,000 kg)

CBrl	Chrysoberyl, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Cd	Cadmium (metal)	10 000	2 000	500	100	t (1,000 kg)
Ce	Cerium (Ce2O3)	250 000	25 000	2 500	250	t (1,000 kg)
Chr	Chrysotile (Asbestos) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Chrys	Chrysoprase, green opal (substance)	10	1	0,1	0,01	t (1,000 kg)
Cly	Clays, unknown use (substance)	10 000 000	2 000 000	500 000	100 000	t (1,000 kg)
ClyC	Common clays for brick, tile (substance)	10 000 000	2 000 000	500 000	100 000	t (1,000 kg)
ClyCim	Clays for cement works (substance)	10 000 000	2 000 000	500 000	100 000	t (1,000 kg)
ClyR	White-firing clays (refractory & ceramic) (subst.)	5 000 000	1 000 000	200 000	50 000	t (1,000 kg)
Co	Cobalt (metal)	500 000	50 000	2 000	200	t (1,000 kg)
Coal	Coal, lignite (substance)	10 000 000 000	1 000 000 000	100 000 000	5 000 000	t (1,000 kg)
Cord	Iolite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
CorG	Corundum, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Cr	Chrome (Cr2O3)	25 000 000	5 000 000	1 000 000	200 000	t (1,000 kg)
Crn	Corundum (substance)	500 000	100 000	20 000	5 000	t (1,000 kg)
Cro	Crocidolite (Asbestos) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Cs	Cesium (Cs2O)	1 000	100	10	1	t (1,000 kg)
Cu	Copper (metal)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Diam	Diamond, industrial and gemstone (substance)	100 000 000	10 000 000	1 000 000	100 000	ct
Diop	Dioptase, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Dol	Dolomite (substance)	500 000 000	50 000 000	5 000 000	500 000	t (1,000 kg)
Dtm	Diatomite (kieselguhr) (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Dum	Dumortierite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Em	Emerald (substance)	10 000 000	1 000 000	100 000	10 000	ct
Enst	Diopside-enstatite, gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
Eucl	Euclase, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Fe	Iron (metal)	1 000 000 000	100 000 000	10 000 000	1 000 000	t (1,000 kg)
Feld	Feldspar, nepheline (substance)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Fl	Fluorite or Fluospar (CaF2)	5 000 000	1 000 000	200 000	50 000	t (1,000 kg)
Ga	Gallium (metal)	100	50	10	1	t (1,000 kg)
Gabb	Gabbro, dolerite, etc., ornamental (substance)	100 000 000	20 000 000	5 000 000	1 000 000	t (1,000 kg)
Ge	Germanium (metal)	500	100	20	5	t (1,000 kg)
GemP	Gemstones, general (substance)	10 000 000	1 000 000	100 000	10 000	ct
GemS	Semiprecious stone, general (substance)	10	5	0,5	0,1	t (1,000 kg)
Gp	Gypsum, anhydrite (substance)	500 000 000	50 000 000	5 000 000	500 000	t (1,000 kg)
Gr	Graphite (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Gran	Granite, syenite, etc., ornamental (substance)	100 000 000	20 000 000	5 000 000	1 000 000	t (1,000 kg)
Gres	Sandstone, quartzite (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
Gt	Garnet, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Hf	Hafnium (metal)	10 000	1 000	100	10	t (1,000 kg)
Hg	Mercury (metal)	50 000	5 000	500	100	t (1,000 kg)

HM	Heavy minerals, general (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
I	Iodine (substance)	10 000	1 000	100	10	t (1,000 kg)
In	Indium (metal)	500	100	25	5	t (1,000 kg)
Kimb	Kimberlite mineral markers	4	3	2	1	ct
Kln	Kaolin (substance)	50 000 000	10 000 000	2 000 000	500 000	t (1,000 kg)
Korn	Kornerupine, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Ky	Kyanite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Kya	Kyanite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Li	Lithium (Li2O)	1 000 000	100 000	50 000	5 000	t (1,000 kg)
Lst	Limestone, ornemental (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
LstC	Cement limestone (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
LstCr	Chalk (substance)	250 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)
LstL	Limestone for lime (substance)	50 000 000	10 000 000	2 000 000	500 000	t (1,000 kg)
Lz	Lazulite, ornamental (substance)	500 000	200 000	50 000	10 000	t (1,000 kg)
Mal	Malachite (substance)	5 000	2 000	500	100	t (1,000 kg)
Mg	Magnesium, magnesite (MgCO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
MgCl	Magnesium, salts and brines (MgO)	100 000 000	20 000 000	5 000 000	500 000	t (1,000 kg)
Mica	Mica, sheet (substance)	100 000	20 000	5 000	500	t (1,000 kg)
Mn	Manganese (metal)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Mo	Molybdenum (metal)	500 000	100 000	5 000	1 000	t (1,000 kg)
Most	Moonstone (adularia), gemstone (substance)	10	1	0,1	0,01	t (1,000 kg)
Mrbl	Marble, ornemental (substance)	50 000 000	10 000 000	2 000 000	500 000	t (1,000 kg)
N/A	Commodity not available	0	0	0	0	t (1,000 kg)
Nasulf	Sodium sulphate (Na2SO4)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Natr	Sodium carbonate (natron) (Na2CO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Nb	Niobium - columbium (Nb2O5)	1 000 000	100 000	10 000	2 000	t (1,000 kg)
Ni	Nickel (metal)	2 000 000	500 000	20 000	2 000	t (1,000 kg)
Nitr	Nitrates (NO3)	100 000 000	10 000 000	1 000 000	100 000	t (1,000 kg)
Olv	Peridot, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Opal	Opal, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Osir	Osmiridium (metal)	25	5	1	0,1	t (1,000 kg)
Ost	Other ornamental stone, except Gabb-Gran (subst.)	100 000 000	20 000 000	5 000 000	1 000 000	t (1,000 kg)
Pb	Lead (metal)	5 000 000	500 000	50 000	5 000	t (1,000 kg)
PbZn	Lead + Zinc (metal)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Pd	Palladium (metal)	1000	100	10	1	t (1,000 kg)
Peat	Peat (substance)	500000000	50000000	5000000	500000	t (1000 kg)
Perl	Perlite (substance)	20 000 000	10 000 000	5 000 000	1 000 000	t (1,000 kg)
Phen	Phenakite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Phos	Phosphate (P2O5)	200 000 000	20 000 000	2 000 000	200 000	t (1,000 kg)
Pigmt	Mineral pigment (substance)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Pltd	Platinum group elements (PGE), group (metal)	1 000	100	10	1	t (1,000 kg)
Pozz	Pumice, pozzolan (substance)	100 000 000	50 000 000	10 000 000	2 000 000	t (1,000 kg)

Pphy	Pyrophyllite (substance)	20 000 000	5 000 000	1 000 000	100 000	t (1,000 kg)
Pt	Platinum (metal)	1 000	100	10	1	t (1,000 kg)
Ptsh	Potash (sylvite, carnallite) (K20)	500 000 000	50 000 000	5 000 000	500 000	t (1,000 kg)
Py	Pyrite (FeS2)	100 000 000	20 000 000	5 000 000	200 000	t (1,000 kg)
Qtz	Massive quartz, blocks for ferrosilicon (SiO2)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Qtzopt	Quartz, optical & piezoelectrical use (SiO2)	100	10	1	0,1	t (1,000 kg)
QtzPk	Rose quartz (gemstone)	100	10	1	0,1	t (1,000 kg)
Rb	Rubidium (Rb2O)	1 000	100	10	1	t (1,000 kg)
Re	Rhenium (metal)	5 000	500	50	5	t (1,000 kg)
REE	Rare Earths (RE2O3)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Rh	Rhodium (metal)	25	5	1	0,1	t (1,000 kg)
Rhod	Rhodonite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Rub	Ruby (substance)	10 000 000	1 000 000	100 000	10 000	ct
S	Sulphur (substance)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
Salt	Rock salt (NaCl)	2 000 000 000	200 000 000	20 000 000	2 000 000	t (1,000 kg)
Saph	Sapphire (substance)	10 000 000	1 000 000	100 000	10 000	ct
Sb	Antimony (metal)	100 000	25 000	2 000	1 000	t (1,000 kg)
Sc	Scandium (metal)	1 000	100	10	1	t (1,000 kg)
Scap	Scapolite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Se	Selenium (substance)	5 000	1 000	250	50	t (1,000 kg)
Silc	Silica, silica sand (substance)	10 000 000	2 500 000	500 000	100 000	t (1,000 kg)
Sill	Sillimanite (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Sinh	Sinhalite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Slt	Slate (substance)	5 000 000	2 000 000	500 000	100 000	t (1,000 kg)
Sn	Tin (metal)	200 000	25 000	1 000	100	t (1,000 kg)
Sod	Sodalite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Spl	Spinel, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Sr	Strontium (SrCO3 or SrSO4)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
Suns	Sunstone, aventurine (Tiger's eye), gemstone	10	1	0,1	0,01	t (1,000 kg)
Ta	Tantalum (Ta2O5)	25 000	2 000	1 000	200	t (1,000 kg)
Tanz	Tanzanite, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Te	Tellurium (metal)	500	100	20	5	t (1,000 kg)
Th	Thorium (metal)	100 000	10 000	1 000	100	t (1,000 kg)
Ti	Titanium, general (TiO2)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
TiIlm	Titanium, ilmenite (TiO2)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
TiRt	Titanium, rutile (TiO2)	2 000 000	200 000	20 000	2 000	t (1,000 kg)
Tl	Thallium (metal)	5 000	500	50	5	t (1,000 kg)
Tlc	Talc (substance)	20 000 000	2 000 000	200 000	20 000	t (1,000 kg)
To	Tourmaline, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)
Tpz	Topaz (substance)	10	5	0,5	0,1	t (1,000 kg)
Trav	Travertine (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Trem	Tremolite-actinolite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct

Tsav	Tsavorite (green grossular), gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Turq	Turquoise (substance)	10	5	0,5	0,1	t (1,000 kg)
U	Uranium (metal)	100 000	20 000	5 000	500	t (1,000 kg)
V	Vanadium (metal)	2 000 000	200 000	20 000	2 000	t (1,000 kg)
Vesu	Vesuvianite, gemstone (substance)	10 000 000	1 000 000	100 000	10 000	ct
Vrm	Vermiculite (substance)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
W	Wolfram (WO3)	200 000	50 000	5 000	500	t (1,000 kg)
Wol	Wollastonite (substance)	5 000 000	500 000	50 000	5 000	t (1,000 kg)
Y	Yttrium (Y2O3)	250 000	25 000	2 500	250	t (1,000 kg)
Zlt	Zeolites (substance)	1 000 000	200 000	50 000	10 000	t (1,000 kg)
Zn	Zinc (metal)	10 000 000	1 000 000	100 000	10 000	t (1,000 kg)
Zr	Zirconium (ZrO2)	1 000 000	100 000	10 000	1 000	t (1,000 kg)
ZrGm	Zircon, gemstone (substance)	10	5	0,5	0,1	t (1,000 kg)

Code list name: Earth Resource Expression Code

Value	Definition	Reference
Direct (outcrop)	An EarthResource has a surface expression	CGI/ERML 2.0
Indirect (e.g. alteration)	An EarthResource has been detected indirectly (e.g. alteration zone)	CGI/ERML 2.0
Totally concealed	An EarthResource has been detected under cover rocks.	CGI/ERML 2.0
Unknown		

Code list name: Earth Resource Form Code

Value	Definition	Reference
Concordant to subconcordant primary mineral deposit	The mineral deposit typical physical and structural relationship to wallrocks and associated rocks. A concordant or nearly concordant mineral deposit lies parallel or nearly parallel to wallrocks contacts or internal structures (bedding, foliation, etc.)	CGI/ERML 2.0
Discordant primary mineral deposit (vein, reef, mass, lens, pipe, column, etc.)	The mineral deposit typical physical and structural relationship to wallrocks and associated rocks. A discordant mineral deposit crosscuts wallrocks contacts or internal structures (bedding, foliation, etc.)	CGI/ERML 2.0
Mixed (subconcordant) primary mineral deposit	The mineral deposit typical physical and structural relationship to wallrocks and associated rocks. A subconcordant body in some places lies parallel to- and in other places crosscuts wallrocks contacts or internal structures (bedding, foliation, etc.)	CGI/ERML 2.0
Surficial mineral deposit of secondary origin	A mineral deposit 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 (including transport and reconcentration).	CGI/ERML 2.0
Atypical, unspecified or ill-defined form	Any form type not included on the list such as impregnated, disseminated, etc	CGI/ERML 2.0
UNKNOWN		

Code list name: Earth Resource Shape Code

Value	Definition	Reference
Bed	Said of a vein or other mineral deposit that follows the bedding plane in a sedimentary rock. Also said of a layered replacement deposit.	Glossary of Geology. 4th Edition, AGI
Stratiform bed: single or multi-layered	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 geologic 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 formerly 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. The mass, lens or pod of massive to submassive ore is mainly lying parallel to- and in a few other places is crosscuting wallrocks contacts or internal structures (bedding, foliation, etc.).	Glossary of Geology. 4th Edition, AGI + CGI/ERML 2.0
Stratiform mass or lens of massive to semimassive ore	Stratiform: as above. Stratiform mass or lens of massive to semi-massive ore, conformable (concordant) with host rock, i.e. lying parallel to wallrocks contacts or internal structures (bedding, foliation, etc.).	CGI/ERML 2.0
Subconcordant or stratabound mass or lens of massive to submassive ore	Mass or lens of massive to semi-massive ore, subconcordant with host rock, i.e. in some places lying parallel to- and in other places crosscutting wall rocks contacts or internal structures (bedding, foliation, etc.). If it is "stratabound", it is confined to a single stratigraphic unit.	CGI/ERML 2.0
Pod, podiform	Pod, pofiform: terms formerly 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 + CGI/ERML 2.0

Concordant to subconcordant envelope of disseminated ore	The ore is disseminated, but it is nevertheless possible to define a limit and to delineate an envelope. The envelope of disseminated ore is mainly lying parallel to- and in a few other places is crosscutting wallrocks contacts or internal structures (bedding, foliation, etc.).	CGI/ERML 2.0
Stratiform envelope of disseminated ore	As above, but the envelope of disseminated ore is conformable (concordant) with host rock, i.e. lying parallel to wallrocks contacts or internal structures (bedding, foliation, etc.).	CGI/ERML 2.0
Stratabound envelope of disseminated ore	Stratabound: as above. The stratabound envelope of disseminated ore is confined to a single stratigraphic unit and may or may not be strictly conformable with bedding.	CGI/ERML 2.0
Dissiminated nodule and/or vugs, amygdaloids fillings	Nodule [ign]; 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. [sed] (a) A small, irregularly rounded knot, mass, or lump of a mineral or mineral aggregate, normally having a warty or knobby surface and no internal structure, and usually exhibiting a contrasting composition from the enclosing sediment or rock matrix in which it is embedded; e.g. a nodule of pyrite in a coal bed, a chert nodule in limestone, or a phosphatic nodule in marine strata. Most nodules appear to be secondary structures: in sedimentary rocks they are primarily the result of postdepositional replacement of the host rock and are commonly elongated parallel to the bedding. Nodules can be separated as discrete masses from the host material. (b) One of the widely scattered concretionary lumps of manganese, cobalt, iron, and nickel found on the floors of the world's oceans. 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. 5th 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 subconcordant stockwork (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	A mass or lens of massive to submassive ore, discordant with host rock, i.e. crosscutting wallrocks contacts or internal structures (bedding, foliation, etc.).	CGI/ERML 2.0
Discordant envelope of disseminated ore	An envelope of disseminated ore (see above), discordant with host rock, i.e. crosscutting wallrocks contacts or internal structures (bedding, foliation, etc.).	CGI/ERML 2.0
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 numerous 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	A mass (cylinder, sheet, cone, etc. - see definition above) with filling commonly brecciated, discordant with host rock, i.e. crosscutting wallrocks contacts or internal structures (bedding, foliation, etc.).	CGI/ERML 2.0
Column, chimney with possibly brecciated ore	See definitions above.	CGI/ERML 2.0
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. The lode is discordant with host rock, and crosscut wallrocks contacts or internal structures (bedding, foliation, etc.).	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

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)	Composite primary orebody, with a mixture of forms (concordant, subconcordant, discordant) which were formed more or less at the same time.	CGI/ERML 2.0
Synchronous to sub-synchronous lode (s) and bed (s)	Association of lode(s) and bed(s) - see definitions above - which were formed more or less at the same time.	CGI/ERML 2.0
Varied synchronous to sub-synchronous primary orebodies	Association of varied orebodies which were formed more or less at the same time.	CGI/ERML 2.0
Primary cavity- or fracture-filling orebody	Some (epigenetic) deposits (e.g. hydrothermal deposits) show forms related to the geometry of the fluid channelways (e.g. veins or stockworks along fractures).	CGI/ERML 2.0
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 describes 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	The tabular shape is not primary. It can be acquired later, for example during a deformation phase by shearing, or during supergene processes.	CGI/ERML 2.0
Tabular-shaped mass or lens	Tabular-shaped mass or lens may be found in veins, which are tabular-shaped deposits of nonsedimentary origin, often dipping at high angles; they can also appear in the form of beds, or seams, which are tabular deposits conforming to the stratification of enclosing rocks.	CGI/ERML 2.0
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	Some deposits may form in collapse breccias and solution cavities related to a karstic network in association with supergene processes.	CGI/ERML 2.0

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	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.	Glossary of Geology. 4th Edition, AGI Dictionnaire thématique des mines et carrières, SIM Editor
UNKNOWN		

Code list name: Exploration Activity Type Code

ID	Value	Definition	Reference
A	REGIONAL RECONNAISSANCE	Regional reconnaissance intends to reduce the initial surface of the selected region by identifying anomalies (geochemical, geophysical, mineralogic) and discovering occurrences.	CGI/ERML 2.0
A10	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.	CGI/ERML 2.0
A20	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.
A30	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.
A40	Regional heavy mineral sampling	Prospecting with a hand-held washing tool, usually 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.	CGI/ERML 2.0 + Dictionnaire thématique des mines et carrières, SIM Editor.
B	DETAILED SURFACE EXPLORATION	Detailed surface exploration aims at accurately delineate anomalies and describe occurrences in their refined geological context.	CGI/ERML 2.0
B10	Geological mapping and sampling	Detailed geological mapping of the area(s) of interest. Sampling of outcrops, of alteration zones…	CGI/ERML 2.0
B20	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.	CGI/ERML 2.0
B30	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.	CGI/ERML 2.0

B40	Detailed heavy mineral sampling	As above, but at a more local scale.	CGI/ERML 2.0+ Dictionnaire thématique des mines et carrières, SIM Editor.
C	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.	CGI/ERML 2.0
C10	Removal of overburden, trenching, channel sampling	Shallow ditch from which a sample can be taken and a geological observation made. Particularly useful when outcrops are rare.	CGI/ERML 2.0
C20	Auger 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. In this case drilling is performed by means of an auger, i.e. with a helical screw which is driven into the ground with rotation.	CGI/ERML 2.0 + Dictionnaire thématique des mines et carrières, SIM Editor.
C30	Percussion drilling (subsurface)	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. In this case, drilling is performed with a percussion tool.	Dictionnaire thématique des mines et carrières, SIM Editor.
D	ASSESSMENT OF THE RESOURCE	The aim of this phase is the (still rough) delineation of the envelope 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.	CGI/ERML 2.0
D10	Percussion drilling (reconnaissance drilling)	As above, but at greater depths, and sometimes on a grid with a wide mesh.	CGI/ERML 2.0
D20	Core 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 are drilled by coring. This technique is used to collect undisturbed rock cylinders and allows to confirm/to precise results from percussion drilling.	Dictionnaire thématique des mines et carrières, SIM Editor.
D30	Geological interpretation	Compilation and synthesis of all the available geological information in order to get an as precise as possible model of the mineral resource: genesis, type, geometry, internal structure, distribution of grades, relationships with host rocks, etc.	CGI/ERML 2.0

D40	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. Can be performed on core samples.	Dictionnaire thématique des mines et carrières, SIM Editor + CGI/ERML 2.0
D50	Approximate calculation of the resource	Rough evaluation of the tonnage and grade essentially based on drill holes information, by correlation and interpolation of intersected mineralized sections.	CGI/ERML 2.0
E	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 economical conditions) based on a feasibility study report.	CGI/ERML 2.0
E10	Core drilling (systematic reconnaissance)	As above, with the aim to get very detailed information on the whole deposit and first quality samples.	CGI/ERML 2.0
E20	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.	CGI/ERML 2.0
E30	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.
E40	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.
F	Mining pilot	Intermediate phase between laboratory tests and actual plant. In French, may refer to a stope as well as to a plant.	Dictionnaire thématique des mines et carrières, SIM Editor.
N/A	UNKNOWN / UNSPECIFIED		

Code list name: Exploration Result Code

Value	Definition	Reference
Isolated mineralized stones, showings, occurrences, altered areas	Identification of possible markers of a mineralized area	CGI/ERML 2.0
Anomalies (possibly large)	Anomaly or anomalous area: area which properties are different from areas around and which might indicate the presence of a mineralizing process in the vicinity. Anomalies may be geophysical (e.g. radiometric, magnetic, electromagnetic, gravity…) or geochemical (mono- or multi-elements). Anomalies may be formed either at depth by igneous and metamorphic processes or at the earth's surface by agents of weathering, erosion, and surficial transportation.	CGI/ERML 2.0
Identification of key minerals	Identification of particular minerals which may indicate a possible mineralized area or accompany a mineralizing process	CGI/ERML 2.0
Detailed prospect map with location of mineralized areas (occurrences)	A detailed map with location of all the mineralized occurrences whatever their size and representation of their relationships with lithology, structures, alteration zones, anomalous areas, sampling analysis results….	CGI/ERML 2.0
Structured anomalies	As above, but with a more limited size due to the narrowing of the area under prospection, and a more detailed internal structure (measurements often made on fine-mesh grids)	CGI/ERML 2.0
Prospect boundaries refinement	The aim of prospecting is to progressively reduce the surface area until the discovery of a mineral deposit	CGI/ERML 2.0
Mineralization primary reconnaissance	The first attempts to see (removal of overburdens, trenching) or to intercept (auger, subsurface percussion drilling), and to sample primary mineralization	CGI/ERML 2.0
Mineralization indicated	The first attempts to roughly delineate the orebody, using reconnaissance drilling (percussion and then core drilling), to sample it in detail, and to approximately evaluate the resource using geological interpretation, beneficiation tests	CGI/ERML 2.0
Ore deposit indicated	The presence of an orebody has been demonstrated using systematic core drilling and sometimes some preliminary mining workings. The external geometry of the orebody and its internal structure (including ore grade distribution) start to be well-known	CGI/ERML 2.0
Ore deposit indicated and estimated	Refinement of previous knowledge using statistical tools allowing for example interpolations between drill holes, and definition of enriched areas	CGI/ERML 2.0

Feasibility study report available for mining decision	Technical economic study aimed at assessing the possibility to launching a mine venture. When the data are insufficiently precise, the study is said to be a pre-feasibility study	Dictionnaire thématique des mines et carrières, SIM Editor
Industrial test	Intermediate phase between laboratory tests and actual plant.	Dictionnaire thématique des mines et carrières, SIM Editor
Unknown/Unspecified		

Code list name: Mine Status Code

Value	Definition	Reference
Operating	A mine is operating	CGI/ERML 2.0
Operating continuously	A mine is operating continuously	CGI/ERML 2.0
Operating intermittently	A mine is operating intermittently	CGI/ERML 2.0
Not operating		CGI/ERML 2.0
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.	CGI/ERML 2.0
Abandoned	A mine is abandoned - one reason or another	CGI/ERML 2.0
Care and maintenance	A mine is under care and maintenance	
Retention	A mine can be kept unexploited until the price of contained commodity(ies) makes it economical.	CGI/ERML 2.0
Historic	An 'old' mine which has been exploited before 1900, e.g. during Roman times, the Middle Ages, etc.	CGI/ERML 2.0
Under development		
Construction		
Pending approval	Waiting for the exploitation authorization, generally given by a State Mining Engineering Department.	CGI/ERML 2.0
Feasibility	Technical economic study aimed at assessing the possibility to launching a mine venture.	Dictionnaire thématique des mines et carrières, SIM Editor.
No information available		
Unknown		
Unspecified		

Code list name: Mineral Occurrence Type Code

Value	Definition	Reference
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
Province	Geologic provinces by resources - Some studies classify provinces based upon mineral resources, such as mineral deposits.	http://en.wikipedia.org/wiki/Province_(geology)
District	Geologic districts by resources - Some studies classify districts based upon mineral resources, such as mineral deposits	CGI/ERML 2.0
Field	A region or area that possesses or is characterized by a particular mineral resource, e.g. gold field, coal field	Glossary of Geology. 5th Edition, AGI - online
Lode	A mineral deposit consisting of a zone of veins, veinlets, disseminations, or planar breccias; a mineral deposit in consolidated rock as opposed to placer deposits	Glossary of Geology. 5th Edition, AGI - online

Code list name: Mineral Deposit Group (not finalized)

Code list name: Mineral Deposit Type (not finalized)

Code list name: Mining Activity Type Code

Value	Definition	Reference
Adit	A horizontal passage from the surface into a mine	Glossary of Geology. 5th Edition, AGI - online
Alluvial	Said of a placer formed by the action of running water, as in a stream channel or alluvial fan; also, said of the valuable mineral, e.g. gold or diamond, associated with an alluvial placer	Glossary of Geology. 5th Edition, AGI - online
Decline	Passage or adit driven on a decline from the surface to provide access to a mine.	Glossary of Geology. 5th Edition, AGI - online
Diggings	A term applied in the western U.S. to diggings for gold or other precious minerals located on a bar or in the shallows of a stream, and worked when the water is low.	Glossary of Geology. 5th Edition, AGI - online
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
Multiple		
Open pit	An open-sky excavation (also sometimes called open-sky mine) for the extraction of metallic ores/commodities.	CGI/ERML 2.0
Open pit and underground	See open pit and underground	
Quarry	Open workings, usually for the extraction of stone (building materials and dimension stone).	Glossary of Geology. 5th Edition, AGI – online + CGI/ERML 2.0
Reworking		
Shaft	A vertical or inclined excavation through which a mine is worked	Glossary of Geology. 5th Edition, AGI – online
Sluicing	Concentrating heavy minerals, e.g., gold or cassiterite, by washing unconsolidated material through boxes (sluices) equipped with riffles that trap the heavier minerals on the floor of the box.	Glossary of Geology. 5th Edition, AGI - online
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. b) The mining of soluble rock material, esp. salt, from underground deposits by pumping water down wells into contact with the deposit and removing the artificial brine thus created.	Glossary of Geology. 5th Edition, AGI - online
Surface mining	See - Underground mining	
Surface mining and underground	See - Surface and underground mining	

Underground	An underground excavation for the extraction of mineral deposits, in contrast to surficial excavations	Glossary of Geology. 5th Edition, AGI - online
Unspecified		

Code list name: Processing Activity Type Code

Value	Definition	Reference
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 ore dressing and 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., manually.	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 take place automatically by machines.	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	Dictionnaire thématique des mines et carrières, SIM Editor.

	other where the actual concentration takes place; (2) or by altering vertical or inclined motion of the grate on which the feed is resting (e.g. Hancock jig).	
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 different dense particles and keeps them moving across the deck in different angles 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 causes the particles in the pulp movement 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 denser particles to float to the surface and lighter particles to sink to the bottom of a medium when the specific gravity of the medium is between those of the denser and lighter 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.

Magnetic /elecromagnetic 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	Separation process based on the difference in electrical conductivity between the various minerals.	B.A.Wills, T.J.Napier-Munn, Will's Mineral Processing Technology, Seventh edition, Elsevier 2006.
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	Dictionnaire thématique des mines et carrières, SIM Editor.

	retains the solid particles.	
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 particle 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	http://ktrungthuy.free.fr/SACH-BOOKS/Handbook%20of%20Flotation%20Reagents,%20Elsevier%20(2007),%200444530290.pdf

	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.	
Flocculation	Flocculation is the coagulation between particles induced by the bridging action of long-chain organic polymers.	B.A.Wills, T.J.Napier-Munn, Will's Mineral Processing Technology, Seventh edition, Elsevier 2006.
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	In metallurgy, cementation is a process in which ions are reduced to zero valence at a solid metallic interface	http://en.wikipedia.org/wiki/Cementation
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	Distillation is a method of separating mixtures based on differences in volatilities of components in a boiling liquid mixture. Distillation is a unit operation, or a physical separation process, and not a chemical	http://en.wikipedia.org/wiki/Distillation

	reaction.	
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/Distillation
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	http://en.wikipedia.org/wiki/Pyrometallurgy

	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.	
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)	Roasting is a step in the processing of certain ores. More specifically, roasting is a metallurgical process involving gas–solid reactions at elevated temperatures with the goal of purifying the metal component(s). Roasting consists of thermal gas–solid reactions, which can include oxidation, reduction, chlorination, sulfation, and pyrohydrolysis. In roasting, the ore or ore concentrate is treated with very hot air." http://en.wikipedia.org/wiki/Roasting_(me	http://en.wikipedia.org/wiki/Roasting_(metallurgy)

	tallurgy)	
Smelting	Smelting is a form of extractive metallurgy; its main use is to produce a metal from its ore. 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
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	http://www.e-goldprospecting.com/html/coal_gold_agglomeration__cga_.html

	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.	
Calcining	A more general definition is “Calcination (also referred to as calcining) is a thermal treatment process in presence of air applied to ores and other solid materials to bring about a thermal decomposition, phase transition, or removal of a volatile fraction. The calcination process normally takes place at temperatures below the melting point of the product materials. Calcination is to be distinguished from roasting, in which more complex gas–solid reactions take place between the furnace atmosphere and the solids.	http://en.wikipedia.org/wiki/Calcination
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

Code list name: End Use Potential Type

ID	Value	Definition	Reference
1	**Metallic minerals (wide range of end uses)**		
1.1	Precious metals	Silver; Gold; Platinoids general (Pt, Pd ..)	ProMine, EU FP7roject
1.2	Base metals (sl)	Aluminium; Copper; Lead; Lead + Zinc; Tin; Zinc	ProMine, EU FP7roject
1.3	Iron and ferro-alloy metals	Cobalt; Chromium; Iron; Manganese; Molybdenum; Niobium; Nickel; Vanadium; Tungsten	ProMine, EU FP7roject
1.4	Speciality and rare metals	Beryllium; Bismuth; Cadmium; Germanium, Gallium; Hafnium; Mercury; Indium; Lithium; Rubidium, Cesium; Rhenium; Rare Earths (undifferentiated); Antimony; Selenium; Tantalum; Tellurium; Titanium (ilmenite, rutile); Zirconium (zircon, baddeleyite)	ProMine, EU FP7roject
2	**Non-metallic minerals (with more dedicated end uses)**		ProMine, EU FP7roject
2.1	Building raw material	Aggregate; Dimension & ornamental stones (granite, gabbro, travertine,etc.); Gypsum, anhydrite; Cement limestone; Limestone for lime; Marble	ProMine, EU FP7roject
2.2	Ceramic and refractory	Common clays (brick, tile); White-firing clays (refractory and ceramic clays); Dolomite; Feldspar, nepheline; Kaolin; Andalusite group (andalusite, kyanite, sillimanite)	ProMine, EU FP7roject
2.3	Chemical	Borates; Barite; Fluorite; Magnesium (magnesite); Sodium sulphate; Sodium carbonate (trona); Pyrite; Sulphur; Rock salt; Strontium; Zeolites	ProMine, EU FP7roject
2.4	Energy	Bituminous sandstone/limestone, oil shale; Coal; Lignite; Peat; Thorium; Uranium	ProMine, EU FP7roject
2.5	Fertilizer	Phosphate; Potash (sylvite, carnalite)	ProMine, EU FP7roject
2.6	Precious and semi-precious stones (jewelry, abrasives…)	Diamond (industrial and gemstone); Emerald; Ruby, Sapphire, Corundum (gemstone); Beryls, quartz, tourmalines, garnets, topaz, peridot, zircon, etc. (gemstones)	ProMine, EU FP7roject
2.7	Speciality and other industrial rocks and minerals	Abrasives: garnet, staurolite, corundum; Asbestos (antophyllite, chrysotile, crocidolite); Attapulgite, sepiolite (clay); Bentonite (clay); Limestone, calcite (filler); Diatomite (kieselguhr); Graphite; Mica; Perlite; Quartz (massive / block for ferrosilicon); Quartz, optical & piezoelectrical use; Silica sand; Talc, pyrophyllite; Vermiculite; Wollastonite	ProMine, EU FP7roject
3	**Recycled waste**	Metals or minerals coming from mining wastes treatment	

4	**Other**		
5	**Undefined**		
6	**Not analyzed**		

Code list name: Reserve Category Code

Value	Definition	Reference
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		

Code list name: Resource Category Code

Value	Definition	Reference
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 based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are spaced closely enough to confirm geological and grade continuity.	JORC, 2004
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 based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes. The locations are too widely or inappropriately spaced to confirm geological and/or grade continuity but are spaced closely enough for continuity to be assumed.	JORC, 2004
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 assumed but not verified geological and/or grade continuity. It is based on information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes which may be limited or of uncertain quality and reliability.	JORC, 2004
Measured and indicated mineral resource	Ditto	
Measured, indicated and inferred mineral resource	Ditto	
Indicated and inferred mineral resource	Ditto	
Poorly estimated mineral resource, poorly documented		

Code list name: Classification Method Used Code

Value	Definition	Reference
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.	http://www.cim.org/standards/documents/Block470_Doc26.pdf

Peruvian Code	The Code for Reporting on Mineral Resources and Ore Reserves has the purpose to set out the minimum standards, recommendations and guidelines to be complied with the presentation of Public Reports which are the basis from which to have access to the Venture Capital Segment of the Lima Stock Exchange. These reports will sustain the results on mineral exploration, of Mineral Resources and Ore Reserves. This Code was prepared by a Joint Committee formed by members of the Lima Stock Exchange and by professionals dedicated to the exploration and evaluation of mineral resources. This Code is based on and follows the example of the 1999 JORC CODE of Australasia which was prepared to ensure compliance with its guidelines in every Public Report on mineral explorations and evaluation results, as well as with similar codes and translations in use such as Canada (CIMVal 2001), United States of America (US Bureau of Mines, USGS Circular 831, Principles of Resource and Reserve Classification for Minerals), South Africa (The SAMREC Code), England (The UKIMM), and Australia (The AusIMM The Valmin Code).	http://www.bvl.com.pe/scr/english/doc-reglamentos/Code%20for%20reporting%20of%20minerals.pdf
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 Property 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.	*http://www.imcinvest.com/pdf/Russian_reserves_8.pdf*
Historic resource estimate	Term for resource estimation before "standard codes" (e.g. JORC etc.)	CGI/ERML 2.0
Code or standard not known		

E.4 Code lists values for Mineral Resources (extension)

Code list name: Earth Resource Material Role Code

Value	Definition	Reference
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
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
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		

Code list name: Raw Material Role Code

Value	Definition	Reference
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

Code list name: Waste Storage Type Code

Value	Definition	Reference
Surface storage		
Covered		
Uncovered		
Underground storage		
Unspecified		
Not analysed		

Code list name: Mining Waste Type Code

ID	Value	Definition	Ref_def
01 01	**Wastes from mineral excavation**	Mine/quarry products and waste (unprocessed)	EU FP7 ProMine project
01 01 01	Waste from mineral metalliferous excavation	Run-of-mine ore, ore stockpiles unprocessed, mine waste dump, barren overburden	EU FP7 ProMine project
01 01 02	*Waste from mineral non-metalliferous excavation*	*As above, applied to non-metalliferous commodities*	(2000/532/EC)
01 02	**Wastes from mineral dressing**	Wastes resulting from mineral processing	EU FP7 ProMine project
01 02 01	Wastes from the dressing of metalliferous minerals	Wastes resulting from the treatment of run of mine material which aims to physically separate its constituents in order to produce a marketable product	Dictionnaire thématique des mines et carrières, SIM Editor.
01 02 01 01	Cobbing waste	Waste resulting from the sorting of a coarse material	Dictionnaire thématique des mines et carrières, SIM Editor.
01 02 01 02	Magnetic-separation tailings	Waste resulting from magnetic separation, a process based on the difference in magnetic susceptibility between minerals	Dictionnaire thématique des mines et carrières, SIM Editor.
01 02 01 03	Wash tailings	Waste resulting from washing which allow to upgrade a material through a wet process, usually gravimetry or flotation	Dictionnaire thématique des mines et carrières, SIM Editor.
01 02 01 04	Flotation tailings	Waste resulting from flotation, a process in which the 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 particle surface)	Dictionnaire thématique des mines et carrières, SIM Editor.
01 02 01 05	Leach residues	Waste resulting from the action of chemical reagents on a material resulting in the dissolution of some of its elements	Dictionnaire thématique des mines et carrières, SIM Editor.
01 02 01 06	Wastes not otherwise specified		(2000/532/EC)
01 02 02	*Wastes from the dressing on non-metalliferous minerals*	*As above, applied to non-metalliferous commodities*	(2000/532/EC)

01 03	**Wastes from further physical and chemical processing of metalliferous minerals**	Treatment waste (metallurgical residues & slags, etc.)	EU FP7 ProMine project
01 03 01	Tailings	- Smelter waste - (Smelting) Slag - Secondary refining residues - Roasting residues (pyrometallurgy) - Dephosphorization slag (Fe ores) Thomas' process slag - Matte (intermediate product)	EU FP7 ProMine project
01 03 02	Dusty and powdery waste	Flue dust electrochemical processes) - Combustion and incineration residue	EU FP7 ProMine project
01 03 03	Red mud from alumina production	"Red muds" from bauxite refining (Bayer)	EU FP7 ProMine project
01 03 04	Other sludges/muds/chemical liquid products than specified above	- Electrolytic sludge - Brine, liquor (e.g. Bayer liquor, H3PO4) - U leach tailings (sludge) - Lagooned ash	EU FP7 ProMine project
01 03 99	Wastes not otherwise specified		(2000/532/EC)
01 04	***Wastes from further physical and chemical processing on non-metalliferous minerals***		(2000/532/EC)
01 04 01	*Waste gravel and crushed rocks*		(2000/532/EC)
01 04 02	*Waste sand and clays*		(2000/532/EC)
01 04 03	*Dusty and powdery waste*		(2000/532/EC)
01 04 04	*Waste from potash and rock-salt processing*		(2000/532/EC)
01 04 05	*Waste from washing and cleaning of minerals*		(2000/532/EC)
01 04 06	*Waste from stone cutting and sawing*		(2000/532/EC)
01 04 99	*Waste not otherwise specified*		(2000/532/EC)
01 05	**Drilling muds and other drilling wastes**		(2000/532/EC)
01 05 01	Oil-containing drilling muds and wastes		(2000/532/EC)
01 05 02	Barite-containing drilling muds and wastes		(2000/532/EC)
01 05 03	Chloride-containing drilling muds and wastes		(2000/532/EC)
01 05 04	Fresh-water drilling muds and wastes		(2000/532/EC)
01 05 99	Wastes not otherwise specified		(2000/532/EC)

Code list name: Environmental Impact Code

Value	Definition	Reference
Emissions	*emission (EnDic):* Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or otherwise disposing of substances into the environment *(ESH)*.	**ESH** Environment, Safety and Health Thesaurus/Dictionary. U.S. Department of Energy. DOE/EH-0186, 1991. 510 p.
Dust	particulates	
Seepage water or effluents to groundwater	*seepage (EnDic)*: Slow movement of water in a porous medium (IGH) *effluent (EnDic)t*: Any liquid which is discharged as sewage, trade or industrial waste, untreated or treated *(ESD)*	**IGH** International Glossary of Hydrology. WMO - UNESCO, 1992. 413 p. ESD Gilpin, A. Dictionary of Environment and Sustainable Development. John Wiley and Sons. 1996. 247 p.
AMD (Acid Mine Drainage)	*AMD (BAT/BREF)*: Acid rock drainage (ARD). Acidic drainage stemming from open pit, underground mining operations, waste-rock or tailings facilities that contains free sulphuric acid and dissolved metals sulphate salts, resulting from the oxidation of contained sulphide minerals or additives to the process. The acid dissolves minerals in the rocks, further changing the quality of the drainage water	**BAT/BREF** of mining tailings and waste rock (European Commission 2004). http://eippcb.jrc.es/reference/BREF/mmr_adopted_0109.pdf
BMD (Basic Mine Drainage)	*BMD*: basic/saline (SD) mine drainage (GARD Guide)	GARD Guide 2012. http://www.gardguide.com/index.php/Main_Page
NMD (Neutral Mine Drainage)	*NMD*: neutral mine drainage (GARD Guide)	GARD Guide 2012. http://www.gardguide.com/index.php/Main_Page
Runoff water or effluents to surface water	*runoff (EnDic)*: That part of precipitation that flows towards the stream on the ground surface (surface runoff) or within the soil (subsurface runoff or interflow) *(IMV)*. Also the process of such flowing	**IMV** International Meteorological Vocabulary. WMO - No. 182, 1992. 784 p.
Gas		
Radiation	radioactive or energy radiation	
Odour	smell	
Noise		
Heat		
Physical impacts	*impact (EnDic)*: effect, influence	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened

Erosion	*erosion*: Wearing away and transport of the soil by running water, glaciers, wind or waves *(IGH)*	**IGH** International Glossary of Hydrology. WMO - UNESCO, 1992. 413 p.
Stability	steadiness; constancy, fastness, permanence; persistence, retentivity; soundness	
Subsidence	*subsidence (geol.)*, land subsidence, soil subsidence *(EnDic)*	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened
Flood	*flood (EnDic)*: Rise, usually brief, in the water level in a stream to a peak from which the water level recedes at a slower rate *(IGH)*.	**IGH** International Glossary of Hydrology. WMO - UNESCO, 1992. 413 p.
Spillage	*spill* (EnDic): overflow	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened
Infiltration	*infiltration (EnDic)*: Penetration of water through the soil surface into a porous medium.	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened
Dam failure	*dam failure* (EnDic): dam break (breach)	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened
Visual disturbance	*disturbance (EnDic)*: perturbation	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened
Transnational impacts	*transnational*: multinational, transboundary *transboundary (EnDic)*: transboundary transportation	**EnDic** Environmental Dictionary. http://mot.kielikone.fi/mot/endic/netmot.exe?UI=ened
N/A not analysed		

Code list name: Product Term

VALUE		
1 - BITUMINOUS COAL AND LIGNITE SURFACE MINING	1.1 - RUN-OF-MINE (RAW) BITUMINOUS COAL AND LIGNITE SHIPPED FROM SURFACE MINING OPERATIONS (without processing or for processing at other establishments)	
	1.2 - PROCESSED BITUMINOUS COAL AND LIGNITE SHIPPED FROM SURFACE OPERATIONS	1.2.1 - Processed bituminous coal and lignite shipped from surface operations, washed by wet-washing, pneumatic, or other methods
		1.2.2 - Processed bituminous coal, subbituminous coal, lignite coal shipped from surface operations (mechanically crushed, screened, or sized only)
2 - BITUMINOUS COAL UNDERGROUND MINING	2.1 - RUN-OF-MINE (RAW) BITUMINOUS COAL SHIPPED FROM UNDERGROUND MINING OPERATIONS (without processing or for processing at other establishments)	
	2.2 - PROCESSED BITUMINOUS COAL SHIPPED FROM UNDERGROUND MINING OPERATIONS	2.2.1 - Processed bituminous coal shipped from underground mining operations, washed by wet-washing, pneumatic, or other methods
		2.2.2 - Processed bituminous coal shipped from underground mining operations (mechanically crushed, screened, or sized only)
3 - ANTHRACITE MINING	3.1 - RUN-OF-MINE (RAW) ANTHRACITE (shipped for use without processing or for processing at other establishments)	
	3.2 - PROCESSED ANTHRACITE	3.2.1 - Processed anthracite, washed by wet-washing, pneumatic, or other methods
		3.2.2 - Processed anthracite (mechanically crushed, screened, or sized only)
4 - IRON ORE MINING	4.1 - CRUDE IRON ORE (for direct-shipping or for treatment, concentration, etc.)	
	4.2 - IRON ORE CONCENTRATES AND AGGLOMERATES	4.2.1 - Iron ore concentrates (including washed material) for consumption
		4.2.2 - Iron ore concentrates (including washed material) for agglomeration plants not at blast furnaces
		4.2.3 - Iron agglomerates (pellets, sinter, briquets, and other)

5 - GOLD ORE MINING	5.1 - CRUDE LODE GOLD ORES (gold ores mined, gold ore and residues shipped or transferred)	
	5.2 - GOLD CONCENTRATES	
	5.3 - GOLD MILL BULLION AND PLACER GOLD	5.3.1 - Gold mill bullion, dore, and precipitates
		5.3.2 - Placer gold
6 - SILVER ORE MINING	6.1 - CRUDE SILVER ORES (silver ores mined, silver ore and residues shipped or transferred)	
	6.2 - SILVER CONCENTRATES	
	6.3 - SILVER MILL BULLION AND PLACER SILVER	6.3.1 - Silver mill bullion, dore, and precipitates
		6.3.2 - Placer silver
7 - LEAD ORE AND ZINC ORE MINING	7.1 - CRUDE LEAD AND ZINC ORES (lead and zinc ores mined, lead and zinc ores and residues shipped or transferred)	
	7.2 - LEAD AND ZINC CONCENTRATES	
8 - COPPER ORE AND NICKEL ORE MINING	8.1 - CRUDE COPPER (NICKEL)-BEARING ORES (copper ores mined, copper ore and residues shipped or transferred)	
	8.2 - COPPER CONCENTRATES	
	8.3 - COPPER PRECIPITATES AND ELECTROWON COPPER RECOVERED FROM LEACHING OPERATIONS	
9 - URANIUM-RADIUM-VANADIUM ORE MINING	9.1 - CRUDE URANIUM-VANADIUM ORES	
	9.2 - URANIUM-VANADIUM CONCENTRATES	
10 - ALL OTHER METAL ORE MINING	10.1 - BAUXITE	
	10.2 - FERROALLOY ORES, EXCEPT VANADIUM	10.2.1 - Crude ferroalloy ores (except vanadium and nickel), including manganese and manganiferous ores, chromium, molybdenum, tungsten, etc.
		10.2.2 - Molybdenum concentrates
		10.2.3 - Other ferroalloy concentrates (except molybdenum, vanadium, and nickel), including chromium, manganese, tungsten, etc.

	10.3 - MISCELLANEOUS METAL ORES AND CONCENTRATES, INCLUDING ANTIMONY, BERYLLIUM, MERCURY, RARE-EARTH METALS, TIN, AND TITANIUM
11 - DIMENSION STONE MINING AND QUARRYING	11.1 - Rough dimension LIMESTONE
	11.2 - Rough dimension granite
	11.3 - Other rough dimension stone (slate, marble, trap rock, sandstone, and miscellaneous stone)
12 - CRUSHED AND BROKEN LIMESTONE (MINING AND QUARRYING)	
13 - CRUSHED AND BROKEN GRANITE (MINING AND QUARRYING)	
14 - BITUMINOUS LIMESTONE, BITUMINOUS SANDSTONE, AND OTHER CRUSHED AND BROKEN STONE (MINING AND QUARRYING)	
15 - CONSTRUCTION SAND AND GRAVEL MINING	15.1 - CONSTRUCTION SAND AND GRAVEL (RUN OF PIT OR BANK)
	15.2 - CONSTRUCTION SAND AND GRAVEL (WASHED, SCREENED, OR OTHERWISE TREATED)
16 - INDUSTRIAL SAND MINING	16.1 - INDUSTRIAL GLASS SAND
	16.2 - INDUSTRIAL MOLDING SAND
	16.3 - OTHER INDUSTRIAL SAND
17 - KAOLIN AND BALL CLAY (MINING)	
18 - CLAY AND CERAMIC AND REFRACTORY MINERALS MINING	18.1 - BENTONITE
	18.2 - FIRE CLAY
	18.3 - FULLER'S EARTH
	18.4 - OTHER CLAY, CERAMIC, AND REFRACTORY MINERALS INCLUDING MAGNESITE AND BRUCITE

	18.5 - FELDSPAR (CRUDE, CRUSHED, OR GROUND)	
	18.6 - COMMON (MISCELLANEOUS) CLAY AND SHALE	18.6.1 - Crude common (miscellaneous) clay and shale
		18.6.2 - Prepared common (miscellaneous) clay and shale
19 - POTASH, SODA, AND BORATE MINERAL MINING	19.1 - POTASSIUM SALTS AND BORON COMPOUNDS	
	19.2 - SODIUM CARBONATE AND SULFATE (natural)	
20 - PHOSPHATE ROCK MINING	20.1 - CRUDE PHOSPHATE ROCK (ORE OR MATRIX)	
	20.2 - PREPARED PHOSPHATE ROCK	20.2.1 - Washed and concentrated phosphate rock
		20.2.2 - Dried, calcined, sintered, or nodulized phosphate rock
21 - OTHER CHEMICAL AND FERTILIZER MINERAL MINING	21.1 - BARITE	
	21.2 - ROCK SALT	
	21.3 - NATIVE SULFUR	
	21.4 - OTHER CHEMICAL AND FERTILIZER MINERALS	
22 - ALL OTHER NONMETALLIC MINERAL MINING	22.1 - DIATOMITE, CRUDE AND PREPARED	
	22.2 - GYPSUM	
	22.3 - TALC, SOAPSTONE, AND PYROPHYLLITE	
	22.4 - OTHER NONMETALLIC MINERALS	22.4.1 - Mica
		22.4.2 - Native asphalt and bitumens (except bituminous limestone and bituminous sandstone)
		22.4.3 - Pumice and pumicite
		22.4.4 - Natural abrasives, except sand
		22.4.5 - Peat
		22.4.6 – Perlite
		22.4.7 - Shell, crushed or broken
		22.4.8 - All other nonmetallic minerals

Code list name: Mineral Name Term

See - http://pubsites.uws.edu.au/ima-cnmnc/imalist.htm