INSPIRE Infrastructure for Spatial Information in Europe

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

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Foreword
How to read the document?

This document describes the “INSPIRE data specification on <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 *Administrative units* 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 *Administrative units.*

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.

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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

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[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:

- the standard data model EarthResourceML for Mineral resources,
- the work currently done in the European project ProMine, which has to deliver a European database of mineral deposits and anthropogenic concentrations (often mining wastes)
- And two legal texts providing requirements for the data specification:
    - The raw materials initiative
    - The management of waste from extractive industries

The raw materials initiative (2008)
In this document, the Commission notices that there has been no integrated policy response at EU level up to now to ensure that it has sufficient access to raw materials at fair and undistorted prices. It is proposed that the EU should agree on an integrated raw materials strategy. Such a strategy should be based on the following 3 pillars:
(1) ensure **access to raw materials** from international markets under the same conditions as other industrial competitors;
(2) set the right **framework conditions** within the EU in order to foster sustainable supply of raw materials from European sources;
(3) boost overall resource efficiency and promote recycling to **reduce the EU’s consumption of primary raw materials** and decrease the relative import dependence.

Two points are of particular interest for INSPIRE:

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

Any **land use policy for minerals** must utilise a robust digital geological knowledge base ensuring fair and equal consideration of all potential uses of land including the eventual extraction of raw materials.
To **improve the knowledge base** of mineral deposits in the EU the need harmonised EU level data sets stands out

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

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

All this analysis has been completed by the description of the most relevant examples of use of mineral resources in various domains:

- Management of resources and exploitation activities: Providing information of invented and used peat resources, aggregate resources

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

From these examples, four use cases are detailed:

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

This overview shows the wide range of use with various sets of mineral resources properties according to the use: the management of resources and exploitation activities does not request the same information about mineral resources than the assessment of the impact on environment.
So the TWG decided to provide two application schemas: one related to the common object types and common properties requested by all examples of use (the location of mineral resources, the main commodities, and the exploitation type), and another one to address more properties, but optional, able to provide more attributes describing mineral resources, specially to meet requirements from the Raw Materials Initiative and the Mining Waste Directive.

Difficulties to provide this data specification version 1:
The TWG tried to address several difficulties with a first result which could be improved:

- Considering the wide range of uses of mineral resources (specially industrial minerals), it was difficult to find the compromise between a simple data model, with a few properties but useful only for a few use cases, and a more detailed model dealing with more properties to address exploration demands (from the Raw Material Initiative) but also to help solving environmental problems related to mines.
- Describing mining wastes (that could be considered sometimes as mineral resources) is quite new, and is not a part of the standard data model for mineral resources. The TWG has used the first results of the European project ProMine which is currently working on this topic.

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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.

This is something else in the scope.

2 Overview

2.1 Name and acronyms

INSPIRE data specification for the theme Mineral Resources

2.2 Informal description

Definition:

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

<definition> [Directive 2007/2/EC]

Description:

From the definition, we detail each word.

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

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

More precisely: an ore is an aggregate of economically important minerals that is sufficiently rich to separate for a profit. Although more than 3,500 mineral species are known, only about 100 are considered ore minerals. The term originally applied only to metallic minerals (see native element) but now includes such non-metallic substances as sulphur, calcium fluoride (fluorite), and barium sulfate (*barite*). Ore is always mixed with unwanted rocks and minerals, known collectively as gangue. The ore and the gangue are mined together and then separated. The desired element is then extracted from the ore. The metal may be still further refined (purified) or alloyed with other metals.

It looks thus that there is some 'overlapping' between the definitions of 'ore' and 'metal ore'.

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

Metal ores contain metals. Actually, this generic wording 'metals' covers 'true' metals (see Periodic Table of Elements) but also semi-metallic substances or metalloids such as As and Ge which are often intimately associated with metals.

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

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

To identify the most relevant object types and their properties, the TWG has analysed reference material and user requirements, and has provided a list of “Examples of use” of mineral resources:

- Management of resources and exploitation activities
- Environmental impact assessments
- Mineral exploration
- Promotion of private sector investment

(All these examples are described in detail in the TWG document “Examples of use” in circa)

2.2.1 Related legislation

A. The raw materials initiative

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

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

Two points are of particular interest for INSPIRE:

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

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

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

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

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

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

This report analyses a selection of 41 minerals and metals. In line with other studies, the report puts forward a relative concept of criticality. This means that raw material is labelled "critical" when the risks for supply shortage and their impacts on the economy are higher compared with most of the other raw materials. Two types of risks are considered: a) the "supply risk" taking into account the political-economic stability of the producing countries, the level of concentration of production, the potential for substitution and the recycling rate; and b) the "environmental country risk" assessing the risks that measures might be taken by countries with weak environmental performance in order to protect the environment and, in doing so, jeopardise the supply of raw materials to the EU. Building on existing approaches, this report sets out an innovative and pragmatic approach to determining criticality. In particular,

- It takes into account the substitutability between materials, i.e. the potential for substitution of a restricted raw material by another that does not face similar restrictions.
- It deals with primary and secondary raw materials, the latter being considered as similar to an indigenous European resource.
- It introduces a logical way to aggregate indicators and makes use of widely recognised indexes.
- It presents a transparent methodology.

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

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

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

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

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

- supporting the findings and recommendations resulting from the work carried out by the ad hoc working group on "Best practices in the area of land use planning and permitting" with the view to securing better access to land, fair treatment of extraction with other competing land uses and more streamlined permitting processes;

- promoting exploration, and ensuring that exploration by companies is regarded as research activities;
- promoting research on mineral processing, extraction from old mine dumps, mineral extraction from deep deposits, and mineral exploration in general, notably under EU RTD Framework Programmes.

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

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

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

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

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

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

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

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

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

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

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

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

- achieve synergies between the Geological Surveys

- provide public data for policy making
- facilitate investment in exploration and extraction
- provide minerals intelligence.

The networking must be structured, organised, long -term oriented and consensus based

Standardised and accurate statistical data on 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.

B. The "Mining Waste Directive"

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

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

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

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

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

The waste to be deposited in a facility shall be characterised in such a way as to guarantee the long- term physical and chemical stability of the structure of the facility and to prevent major

accidents. The waste characterisation shall include, where appropriate and in accordance with the category of the waste facility, the following aspects:

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

2.2.2 Consequences of the legislation on the data specification:

This overview shows the wide range of use with various sets of mineral resources properties according to the use: the management of resources and exploitation activities does not request the same information about mineral resources than the assessment of the impact on environment.
So the TWG decided to provide two application schemas: one related to the common object types and common properties requested by all examples of use (the location of mineral resources, the main commodities, and the exploitation type), and another one to address more properties but optional.

This specification identifies two application schemas of Mineral Resources:

- Simple: able to provide information about location and type of mineral resources, with a limited number of attributes,
- Full: able to provide the more attributes describing mineral resources, specially to meet requirements from the Raw Materials Initiative and the Mining Waste Directive.

2.2.3 The main object types of Mineral Resources data specification

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

And other useful information is 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.

2.2.4 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

Web sites describing the two data models standards:

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

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

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

2.4 Terms and definitions

Terms and definitions necessary for understanding this document are defined in the INSPIRE Glossary[13].

2.5 Symbols and abbreviations

No abbreviations are included in this version of the specification.

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.

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

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

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

Recommendation 1 Recommendations are shown using this style.

2.7 Conformance

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

3 Specification scopes

This data specification has only one scope, the general scope.

4 Identification information

Table 1 – Information identifying the INSPIRE data specification *Mineral Resources*

Title	INSPIRE data specification *Mineral Resources*
Abstract	Mineral Resources information describe mineral occurrences (deposit in the earth's crust of an organic or inorganic substance, such as energy fuels), metal ores (material that contains a metal in such quantities that it can be mined and worked commercially to extract that metal), industrial minerals (any rock, mineral, or naturally occurring substance of economic value, exclusive of metallic ores and mineral fuels, and gemstones) and construction minerals, but excluding water. Mining wastes are also included in this data specification.
Topic categories	geoscientificInformation
Geographic description	This INSPIRE data specification covers spatial data sets which relate to an area where a Member State has and/or exercises jurisdictional rights.
Purpose *(Optional)*	The purpose of this document is to specify a harmonised data specification for the spatial data theme *Mineral Resources* as defined in Annex III of the INSPIRE Directive.
Spatial representation type *(Optional)*	vector

Spatial resolution *(Optional)*	Not yet defined The European level The National level The Regional level The Local level
Supplemental information	

5 Data content and structure

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

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

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

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

5.1 Basic notions

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

5.1.1 Placeholder and candidate types

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

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

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

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

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

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

5.1.2 Voidable characteristics

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

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

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

- *Unpopulated*: The characteristic is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world. For example when the “elevation of the water body above the sea level” has not been included in a dataset containing lake spatial objects, then the reason for a void value of this property would be ‘Unpopulated’. The characteristic receives this value for all objects in the spatial data set.
- *Unknown*: The correct value for the specific spatial object is not known to, and not computable by the data provider. However, a correct value may exist. For example when the “elevation of the water body above the sea level” *of a certain lake* has not been measured, then the reason for a void value of this property would be ‘Unknown’. This value is applied on an object-by-object basis in a spatial data set.

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

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

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

In both cases, the «voidable» stereotype can be applied. A value (the real value or void) only needs to be made available for properties that have a minimum cardinality of 1.

5.1.3 Code lists and Enumerations

Style

All code lists and enumerations use the following modelling style:

- No initial value, but only the attribute name part, is used.

- The attribute name conforms to the rules for attributes names, i.e. is a lowerCamelCase name. Exceptions are words that consist of all uppercase letters (acronyms).

Governance

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

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

5.1.4 Stereotypes

In the application schemas in this sections several stereotypes are used that have been defined as part of a UML profile for use in INSPIRE [INSPIRE DS-D2.5]. These are explained in Table 2 below.

Table 2 – Stereotypes (adapted from [INSPIRE DS-D2.5])

Stereotype	Model element	Description
applicationSchema	Package	An INSPIRE application schema according to ISO 19109 and the Generic Conceptual Model.
featureType	Class	A spatial object type.
type	Class	A conceptual, abstract type that is not a spatial object type.
dataType	Class	A structured data type without identity.
union	Class	A structured data type without identity where exactly one of the properties of the type is present in any instance.
enumeration	Class	A fixed list of valid identifiers of named literal values. Attributes of an enumerated type may only take values from this list.
codeList	Class	A flexible enumeration that uses string values for expressing a list of potential values.
placeholder	Class	A placeholder class (see definition in section 5.1.1).
voidable	Attribute, association role	A voidable attribute or association role (see definition in section 5.1.2).
lifeCycleInfo	Attribute, association role	If in an application schema a property is considered to be part of the life-cycle information of a spatial object type, the property shall receive this stereotype.
version	Association role	If in an application schema an association role ends at a spatial object type, this stereotype denotes that the value of the property is meant to be a specific version of the spatial object, not the spatial object in general.

5.2 Application schema MR

5.2.1 Description

5.2.1.1. Narrative description and UML overview

The data specification for Mineral Resources 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 version 1 of the INSPIRE Mineral Resources model the relevant parts of EarthResourceML have been incorporated into the MineralResources package, but in subsequent versions it is intended to incorporate EarthResourceML into the INSPIRE foundation schema.

The data specification includes two related application schemas, one for Mineral Occurrences and one for Mines. It also includes a 'Mineral Resources Simple' UML diagram (Figure 1) illustrating that part of the overall data specification that it is considered should be the minimum requirement in the INSPIRE process.

Figure 1 shows MineralOccurrence as a type of EarthResource, which is in turn modelled as a type of GeologicFeature drawn from the Geology package and GeoSciML. An EarthResource has an associated ExplorationActivity to describe the process leading to the discovery and assessment of the resource, an assiociated Mining Activity to describe the process of resource extraction from the EarthResource, and a description of the commodity produced from the EarthResource. MiningActivity is associated with a particular Mine as is MiningWaste. Mine, MiningWaste and MiningActivity are all modelled as types of the abstract MiningFeature which has an association to MiningFeatureOccurrence. MiningFeatureOccurrence is directly analogous to a MappedFeature from the Geology package and provides a link between MiningFeature, which can be seen as a description package, and a particular spatial representation.

Figure 2 illustrates the Mine application schema in full. In addition to that included in the Figure 1 there is a MinedMaterial class to describe the raw material, as opposed to the final economic product, produced by a MiningActivity. The figure also shows that MiningFeatureOccurrence derives its geometry through an association with GM_Object.

In addition to that which is included in the simple model (Figure 1) the full Mineral Occurrence application schema (Figure 3) includes more detailed information describing the amount of ore that exists within an EarthResource, in terms of its resource, reserve and endowment. The full schema also provides more detailed geological information about the EarthResource including its composition in terms of EarthResourceMaterial, the SupergeneProcesses leading to the enrichment of the deposit, the MineralDepositModel whichdescribes the essential attributes of the class of mineral deposits used to classify the EarthResource, and a high level genetic description of the MineralSystem related to the EarthResource.

Figures 2 and 3 include all the defined code lists to be used in the Mineral Resources specification, both the simple and full versions.

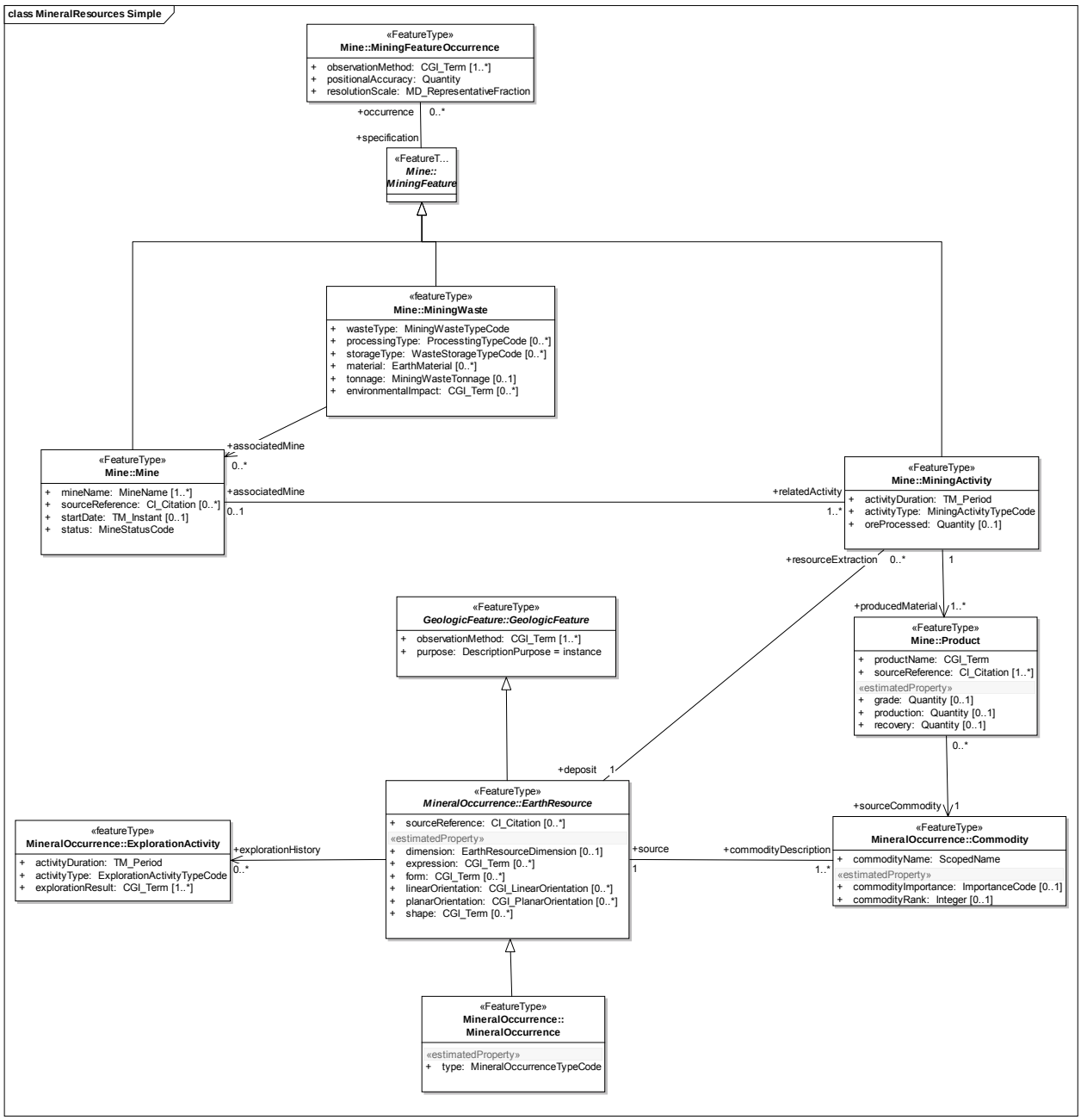

Figure 1 – UML class diagram: Overview of the MR application schema

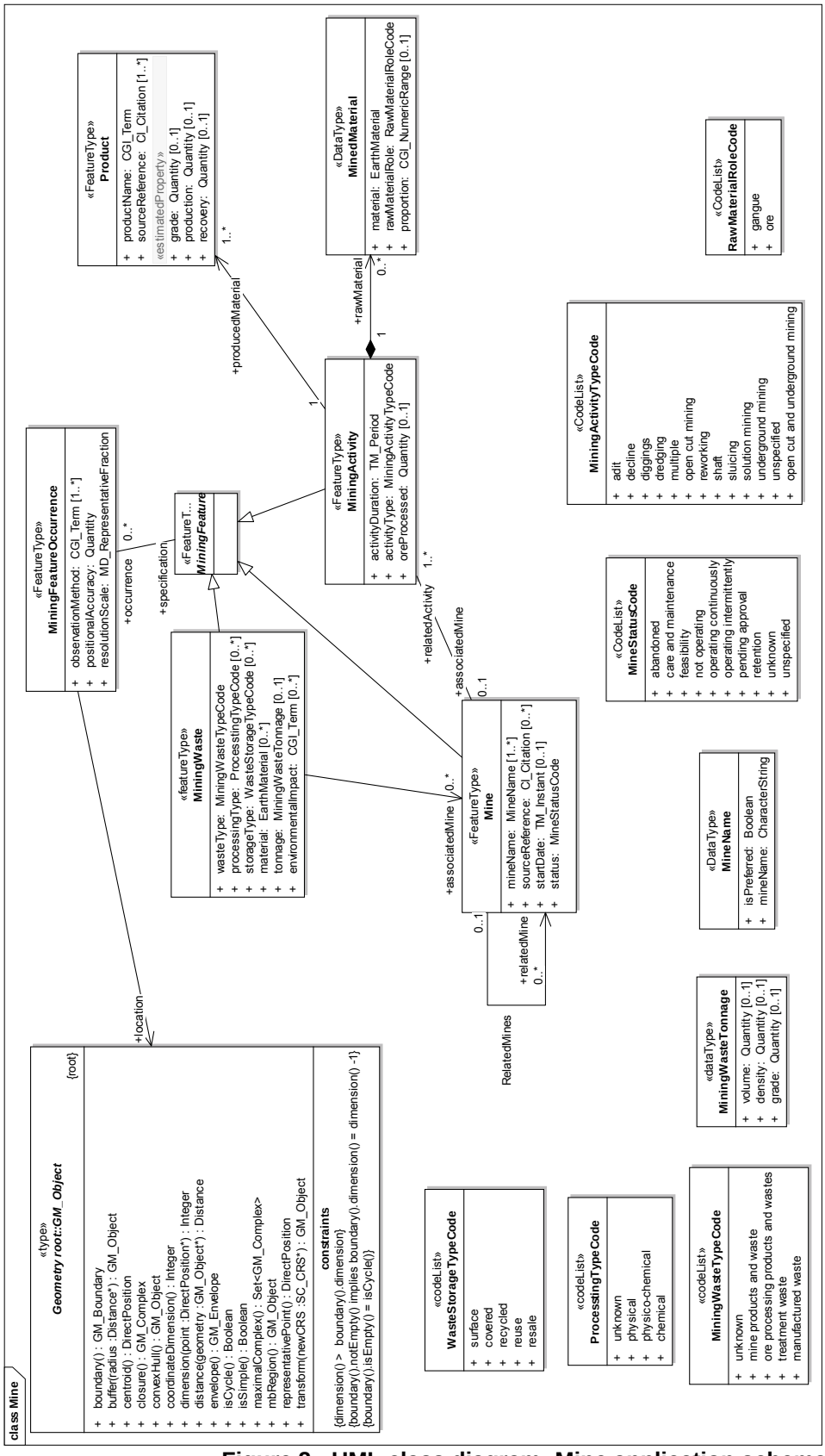

Figure 2 - UML class diagram: Mine application schema

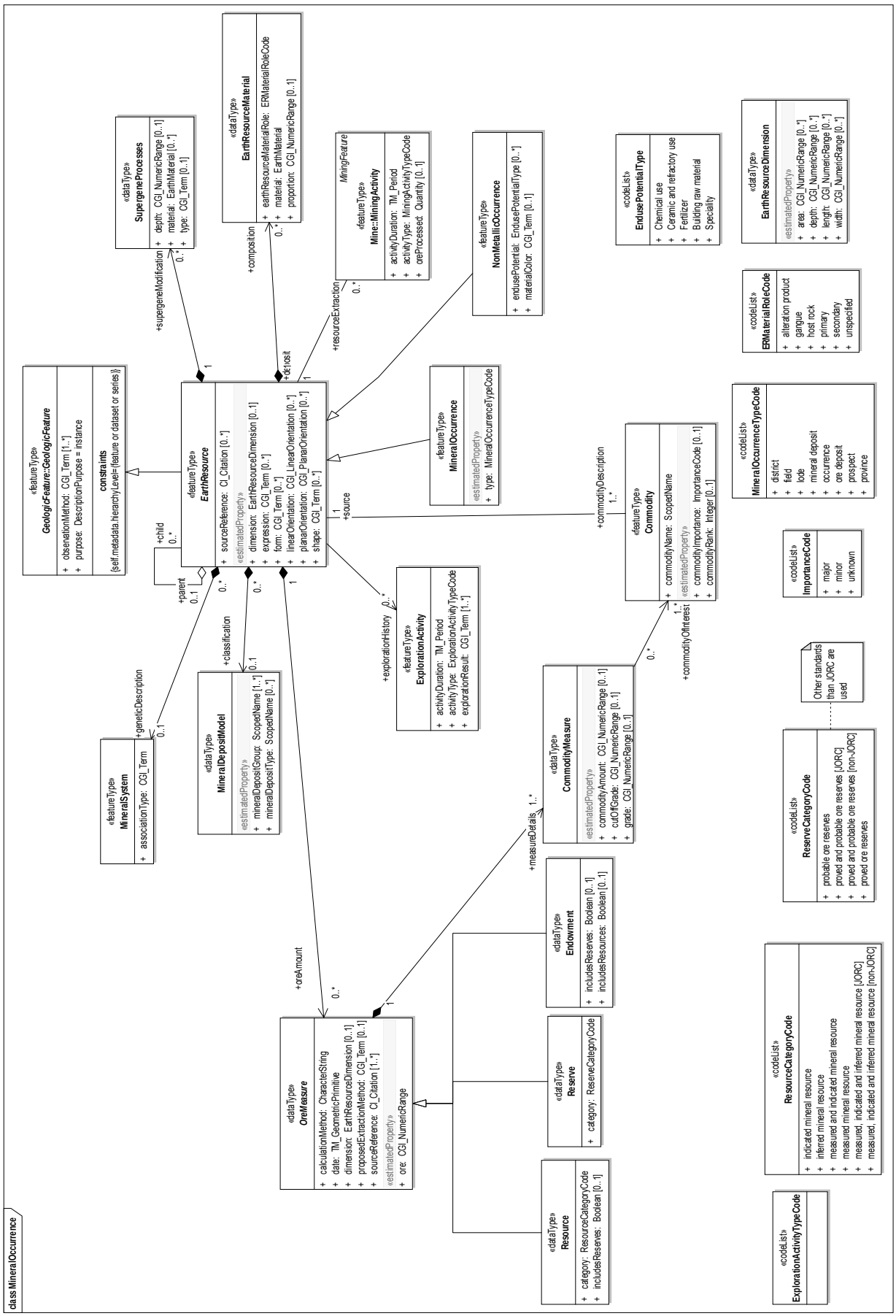

Figure 3 – UML class diagram: MineralOccurrence schema

5.2.1.2. Consistency between spatial data sets

The observation location is specified by its coordinates

5.2.2 Feature catalogue

Table 3 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue Mine
Scope	Mine
Version number	0.1
Version date	2010-10-27
Definition source	INSPIRE data specification Mine

Table 4 - Types defined in the feature catalogue

Type	Package	Stereotypes	Section
Mine	Mine	«featureType»	5.2.2.1.1
MineName	Mine	«dataType»	5.2.2.2.1
MineStatusCode	Mine	«codeList»	5.2.2.3.1
MinedMaterial	Mine	«dataType»	5.2.2.2.2
MiningActivity	Mine	«featureType»	5.2.2.1.2
MiningActivityTypeCode	Mine	«codeList»	5.2.2.3.2
MiningFeature	Mine	«featureType»	5.2.2.1.3
MiningFeatureOccurrence	Mine	«featureType»	5.2.2.1.4
MiningWaste	Mine	«featureType»	5.2.2.1.5
MiningWasteTonnage	Mine	«dataType»	5.2.2.2.3
MiningWasteTypeCode	Mine	«codeList»	5.2.2.3.3
ProcesstingTypeCode	Mine	«codeList»	5.2.2.3.4
Product	Mine	«featureType»	5.2.2.1.6
RawMaterialRoleCode	Mine	«codeList»	5.2.2.3.5
WasteStorageTypeCode	Mine	«codeList»	5.2.2.3.6

5.2.2.1. Spatial object types

5.2.2.1.1. Mine

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

Mine	
Definition:	Allows citing mine plans etc
Multiplicity:	0..*
Attribute: startDate	
Value type:	TM_Instant
Definition:	Date the mine commenced.
Multiplicity:	0..1
Attribute: status	
Value type:	MineStatusCode
Definition:	Operational status (eg Care & Maintenance, Pending Approval, operating continually)
Multiplicity:	1
Association role: relatedMine	
Value type:	Mine
Multiplicity:	0..*

5.2.2.1.2. MiningActivity

MiningActivity	
Subtype of:	MiningFeature
Definition:	The process of extracting metallic or non-metallic mineral deposits from the Earth. The term may also include preliminary treatment eg. cleaning or sizing.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: activityDuration	
Value type:	TM_Period
Definition:	Period, or extent in time, of the mining activity. The beginning of the activity links the TM_Period to the TM_Instant at which it starts. The ending links the TM_Period to the TM_Instant at which it ends. For a variety of reasons, the position of the TM_Instant designated by 'begin' or 'end' may be inderterminate.
Multiplicity:	1
Attribute: activityType	
Value type:	MiningActivityTypeCode
Definition:	The type of mining activity (eg Open Cut, Underground Mine, multiple, unspecified) or processing activity (eg Ore Processing) or production. Using activity to distinguish between the extraction, processing and production activities allows distinguishing between ore mined/grade/recovery, ore treated/grade/recovery and produced payable/plant recovery.
Multiplicity:	1
Attribute: oreProcessed	
Value type:	Quantity
Definition:	The amount of ore processed by the activity
Multiplicity:	0..1
Association role: producedMaterial	
Value type:	Product
Multiplicity:	1..*
Association role: rawMaterial	
Value type:	MinedMaterial

MiningActivity	
Multiplicity:	0..*

5.2.2.1.3. MiningFeature

MiningFeature (abstract)	
Definition:	The abstract MiningFeature class represents a conceptual feature that exists coherently in the world. * this corresponds with a "Mine" or a "MiningActivity", locatable and identifiable features in time and/or space
Status:	Proposed
Stereotypes:	«featureType»
Association role: metadata	
Value type:	MD_Metadata
Multiplicity:	0..1

5.2.2.1.4. MiningFeatureOccurrence

MiningFeatureOccurrence	
Definition:	A MiningFeatureOccurrence provides a link between a notional feature (description package) and one spatial representation of it, or part of it. The MiningFeatureOccurrence carries a geometry or location and the association with a Mining Feature provides specification of all the other descriptors
Status:	Proposed
Stereotypes:	«featureType»
Attribute: observationMethod	
Value type:	CGI_Term
Definition:	Specifies the method that was used to identify the MiningFeatureOccurrence. Examples: digitised, Global Positioning System, published map, fieldObservation, downhole survey, aerial photography, field survey. This corresponds (loosely) to ISO19115 Lineage.Statement
Multiplicity:	1..*
Attribute: positionalAccuracy	
Value type:	Quantity
Definition:	Examples: accurate, approximate, diagramatic, indefinite, unknown, 5 m. Corresponds to ISO19115 DQ_ThematicAccuracy (either quantitative or non quantitative).result.value
Multiplicity:	1
Attribute: resolutionScale	
Value type:	MD_RepresentativeFraction
Definition:	NOTE: this attribute type will be mapped to a temporary proxy for MD_RepresentativeFraction until support for GML3.2 is achieved. Reciprocal of equivalent scale of resolution for delineation of a feature's geometry. This is in contrast to positionAccuracy which is a measure of how well a feature is located relative to other features in the geographic reference system.
Multiplicity:	1
Association role: location	
Value type:	GM_Object
Multiplicity:	

5.2.2.1.5. MiningWaste

MiningWaste	
Subtype of:	MiningFeature

MiningWaste	
Definition:	Mining-selected waste (or simply mining waste) can be defined as a part of the materials that result from the exploration, mining and processing of substances governed by legislation on mines and quarries.
Status:	Proposed
Stereotypes:	«featureType»
Attribute: environmentalImpact	
Value type:	CGI_Term
Definition:	The potential environmental impact of the mining waste
Multiplicity:	0..*
Attribute: material	
Value type:	EarthMaterial
Definition:	The material of which the mining waste is composed
Multiplicity:	0..*
Attribute: processingType	
Value type:	ProcesstingTypeCode
Definition:	The type of processing carried out on the mining waste
Multiplicity:	0..*
Attribute: storageType	
Value type:	WasteStorageTypeCode
Definition:	The storage type of the waste eg surface storage, tailings pond, waste dump, covered storage etc
Multiplicity:	0..*
Attribute: tonnage	
Value type:	MiningWasteTonnage
Definition:	The tonnage of mining waste
Multiplicity:	0..1
Attribute: wasteType	
Value type:	MiningWasteTypeCode
Definition:	The type of mining waste
Multiplicity:	1
Association role: associatedMine	
Value type:	Mine
Multiplicity:	0..*

5.2.2.1.6. Product

Product	
Definition:	Identifes the type and amount of products associated with production
Status:	Proposed
Stereotypes:	«featureType»
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:	0..1
Stereotypes:	«estimatedProperty»
Attribute: productName	

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

5.2.2.2. Data types

5.2.2.2.1. MineName

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

5.2.2.2.2. MinedMaterial

MinedMaterial	
Definition:	A data type to describe the raw material of a mining activity
Status:	Proposed
Stereotypes:	«dataType»
Attribute: material	

MinedMaterial	
Value type:	EarthMaterial
Definition:	Uses EarthMaterial to describe the RawMaterial material
Multiplicity:	1
Attribute: proportion	
Value type:	CGI_NumericRange
Definition:	Proportion of the RawMaterial playing the rawMaterialRole in the MiningActivity
Multiplicity:	0..1
Attribute: rawMaterialRole	
Value type:	RawMaterialRoleCode
Definition:	Role the EarthMaterial plays in the MiningActivity (eg gangue, ore)
Multiplicity:	1

5.2.2.2.3. MiningWasteTonnage

MiningWasteTonnage	
Status:	Proposed
Stereotypes:	«dataType»
Attribute: density	
Value type:	Quantity
Definition:	The density of mining waste
Multiplicity:	0..1
Attribute: grade	
Value type:	Quantity
Definition:	The grade of mining waste
Multiplicity:	0..1
Attribute: volume	
Value type:	Quantity
Definition:	The volume of mining waste
Multiplicity:	0..1

5.2.2.3. Code lists

5.2.2.3.1. MineStatusCode

MineStatusCode	
Definition:	Operational status values
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: abandoned	
Value: care and maintenance	
Value: feasibility	
Value: not operating	
Value: operating continuously	
Value: operating intermittently	

MineStatusCode
Value: pending approval
Value: retention
Value: unknown
Value: unspecified

5.2.2.3.2. MiningActivityTypeCode

MiningActivityTypeCode
Definition: The type of mining activity, processing activity, or production. Status: Proposed Stereotypes: «codeList» Governance: May be extended by Member States.
Value: adit
Value: decline
Value: diggings
Value: dredging
Value: multiple
Value: open cut and underground mining
Value: open cut mining
Value: reworking
Value: shaft
Value: sluicing
Value: solution mining
Value: underground mining
Value: unspecified

5.2.2.3.3. MiningWasteTypeCode

MiningWasteTypeCode
Definition: The type of mining waste Status: Proposed Stereotypes: «codeList» Governance: May be extended by Member States.
Value: manufactured waste
Value: mine products and waste
Value: ore processing products and wastes

MiningWasteTypeCode
Value: treatment waste
Value: unknown

5.2.2.3.4. ProcesstingTypeCode

ProcesstingTypeCode	
Definition:	The type processing carried out on the mining waste
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: chemical	
Value: physical	
Value: physico-chemical	
Value: unknown	

5.2.2.3.5. RawMaterialRoleCode

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

5.2.2.3.6. WasteStorageTypeCode

WasteStorageTypeCode	
Definition:	The type of mining waste storage
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: covered	
Value: recycled	
Value: resale	
Value: reuse	
Value: surface	

5.2.2.4. Imported types (informative)

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

5.2.2.4.1. Boolean

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

5.2.2.4.2. CGI_NumericRange

CGI_NumericRange	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Allows specifying a range of numeric values (eg 443.7+-1.5 to 359+-2.5) and a single representative or estimated value. (eg: upper = 443.7+-1.5,lower = 359+-2.5, estimatedValue [mean] = 400) 1. Best practice for use with GeoSciML would be for Quantity:value, uom, and quality to be mandatory. 2. The UoMIdentifier type has been implemented in the SWE schema as gml:UnitDefinition (ie, not exactly as implied by the Quantity UML class) 3. Use Quantity "definition" attribute to indicate statistical type of esimatedValue/Quantity (eg; mean, median, mode). Possible example: <swe:Quantity definition="urn:cgi:classifier:CGI:Statistical_qualifier::mean"> 4. Where CGI_NumericRange is used to deliver a single numeric value, it should be repeated in both the upper and lower quantity values.

5.2.2.4.3. CGI_Term

CGI_Term	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	A value with a qualifier code. Many geological properties are recorded with some form of qualification.

5.2.2.4.4. 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]

5.2.2.4.5. CharacterString

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

5.2.2.4.6. Commodity

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

5.2.2.4.7. EarthMaterial

EarthMaterial (abstract)	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::EarthMaterial [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	The Earth Material class 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.

5.2.2.4.8. 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]

5.2.2.4.9. MD_Metadata

MD_Metadata	
Package:	INSPIRE Consolidated UML Model::Foundation Schemas::ISO TC211::ISO 19115-All Metadata::ISO 19115:2003 Metadata::Metadata entity set information [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

5.2.2.4.10. MD_RepresentativeFraction

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

5.2.2.4.11. Quantity

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

5.2.2.4.12. TM_Instant

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

5.2.2.4.13. TM_Period

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

5.2.3 Feature catalogue

Table 3 - Feature catalogue metadata

Feature catalogue name	INSPIRE feature catalogue MineralOccurrence
Scope	MineralOccurrence
Version number	0.1
Version date	2010-10-27
Definition source	INSPIRE data specification MineralOccurrence

Table 4 - Types defined in the feature catalogue

Type	Package	Stereotypes	Section
Commodity	MineralOccurrence	«featureType»	5.2.2.1.1
CommodityMeasure	MineralOccurrence	«dataType»	5.2.2.2.1
ERMaterialRoleCode	MineralOccurrence	«codeList»	5.2.2.3.1
EarthResource	MineralOccurrence	«featureType»	5.2.2.1.2
EarthResourceDimension	MineralOccurrence	«dataType»	5.2.2.2.2
EarthResourceMaterial	MineralOccurrence	«dataType»	5.2.2.2.3
Endowment	MineralOccurrence	«dataType»	5.2.2.2.4
EndusePotentialType	MineralOccurrence	«codeList»	5.2.2.3.2
ExplorationActivity	MineralOccurrence	«featureType»	5.2.2.1.3
ExplorationActivityTypeCode	MineralOccurrence	«codeList»	5.2.2.3.3
ImportanceCode	MineralOccurrence	«codeList»	5.2.2.3.4
MineralDepositModel	MineralOccurrence	«dataType»	5.2.2.2.5
MineralOccurrence	MineralOccurrence	«featureType»	5.2.2.1.4
MineralOccurrenceTypeCode	MineralOccurrence	«codeList»	5.2.2.3.5
MineralSystem	MineralOccurrence	«featureType»	5.2.2.1.5
NonMetallicOccurrence	MineralOccurrence	«featureType»	5.2.2.1.6
OreMeasure	MineralOccurrence	«dataType»	5.2.2.2.6
Reserve	MineralOccurrence	«dataType»	5.2.2.2.7
ReserveCategoryCode	MineralOccurrence	«codeList»	5.2.2.3.6
Resource	MineralOccurrence	«dataType»	5.2.2.2.8
ResourceCategoryCode	MineralOccurrence	«codeList»	5.2.2.3.7
SupergeneProcesses	MineralOccurrence	«dataType»	5.2.2.2.9

5.2.3.1. Spatial object types

5.2.3.1.1. Commodity

Commodity

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

Attribute: commodityImportance

Value type: ImportanceCode
Definition: The importance of the commodity to the earth resource. A subjective classification (eg minor, major)
Multiplicity: 0..1
Stereotypes: «estimatedProperty»

Attribute: commodityName

Value type: ScopedName
Definition: The earth resource commodity (eg Cu, Au, Dimension Stone)
Multiplicity: 1

Attribute: commodityRank

Commodity	
Value type:	Integer
Definition:	The rank the commodity has in the order of commodities that are part of the earth resource (eg 1, 2, 3)
Multiplicity:	0..1
Stereotypes:	«estimatedProperty»

5.2.3.1.2. EarthResource

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

EarthResource (abstract)
Attribute: sourceReference Value type: CI_Citation Definition: The source or reference for the Earth Resource. CI_Citation can not be serialised in-line for GML3.1 but as an xlink reference. Multiplicity: 0..*
Association role: classification Value type: MineralDepositModel Multiplicity: 0..1
Association role: composition Value type: EarthResourceMaterial Multiplicity: 0..*
Association role: explorationHistory Value type: ExplorationActivity Multiplicity: 0..*
Association role: geneticDescription Value type: MineralSystem Multiplicity: 0..1
Association role: oreAmount Value type: OreMeasure Multiplicity: 0..*
Association role: supergeneModification Value type: SupergeneProcesses Multiplicity: 0..*

5.2.3.1.3. ExplorationActivity

ExplorationActivity
Definition: Chronological list of surveys undertaken to better define the potential of a mineral occurrence Status: Proposed Stereotypes: «featureType»
Attribute: activityDuration Value type: TM_Period Definition: Period, or extent in time, of the mining activity. The beginning of the activity links the TM_Period to the TM_Instant at which it starts. The ending links the TM_Period to the TM_Instant at which it ends. For a variety of reasons, the position of the TM_Instant designated by 'begin' or 'end' may be inderterminate. Multiplicity: 1
Attribute: activityType Value type: ExplorationActivityTypeCode Definition: The type of exploration activity (eg geological mapping, drilling, geophysical surveys, geochemical mapping, etc) Multiplicity: 1
Attribute: explorationResult Value type: CGI_Term Definition: The result of the exploration activity

ExplorationActivity	
Multiplicity:	1..*

5.2.3.1.4. MineralOccurrence

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

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

5.2.3.1.5. MineralSystem

MineralSystem	
Definition:	All geological features that control the generation and preservation of mineral deposits.
Status:	Proposed
Stereotypes:	«featureType»

Attribute: associationType	
Value type:	CGI_Term
Definition:	High level term describing the characteristics of a mineral system, indicative of the processes involved and resulting deposits
Multiplicity:	1

5.2.3.1.6. NonMetallicOccurrence

NonMetallicOccurrence	
Subtype of:	EarthResource
Definition:	Any type of occurrence of minerals and rocks, which are neither metallic nor used as fuels, but which are mined and processed for their economic use. In essence they are the raw materials used in many industrial, agricultural and construction products. For convenience, gemstones are frequently grouped together with industrial minerals under one umbrella.
Status:	Proposed
Stereotypes:	«featureType»

Attribute: endusePotential	
Value type:	EndusePotentialType
Definition:	There is no single classification for industrial minerals since different end-users divide them according to their own needs and disciplines. Industrial minerals can be classified according to their geological setting, chemistry or physical characteristics and end-use. This latest criteria is particularly useful as in some instances, an industrial mineral or rock has several uses.
Multiplicity:	0..*

Attribute: materialColor	
Value type:	CGI_Term

NonMetallicOccurrence	
Definition:	Colour is an important parameter for several industrial minerals and rocks (precious and semi-precious stones, ornemental rocks, filler and pigment, etc.). Colour can be described using standardized charts or reference samples, or measured, like 'yellowness' (reflectance) for pulp and paper.
Multiplicity:	0..1

5.2.3.2. Data types

5.2.3.2.1. CommodityMeasure

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

5.2.3.2.2. EarthResourceDimension

EarthResourceDimension	
Definition:	Describes the size/volume of the earth resource
Status:	Proposed
Stereotypes:	«dataType»
Attribute: area	
Value type:	CGI_NumericRange
Definition:	The area of the Earth Resource
Multiplicity:	0..*
Stereotypes:	«estimatedProperty»
Attribute: depth	
Value type:	CGI_NumericRange
Definition:	The depth of the Earth Resource
Multiplicity:	0..*

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

5.2.3.2.3. EarthResourceMaterial

EarthResourceMaterial	
Definition:	Identifies the material found in the earth or produced from earth material that is of economic interest
Status:	Proposed
Stereotypes:	«dataType»
Attribute: earthResourceMaterialRole	
Value type:	ERMaterialRoleCode
Definition:	The role the EarthMaterial plays in the EarthResourceDescription (eg host rock, alteration product, primary, secondary)
Multiplicity:	1
Attribute: material	
Value type:	EarthMaterial
Definition:	Uses EarthMaterial to describe the EarthResourceMaterial material
Multiplicity:	1
Attribute: proportion	
Value type:	CGI_NumericRange
Definition:	The proportion of the EarthRespourceMaterial in the EarthResourceDescription
Multiplicity:	0..1

5.2.3.2.4. Endowment

Endowment	
Subtype of:	OreMeasure
Definition:	Endowment refers to that quantity of a mineral in accumulations (deposits) meeting specified physical characteristics such as quality, size and depth. Usually includes Resources, as unlike the latter, it does not have to have prospects for "eventual economic extraction". It often includes the total amount of a commodity originally introduced to a particular location during the deposit forming processes - and thus can include resources, reserves, past production and mining and metallurgical losses.
Status:	Proposed
Stereotypes:	«dataType»
Attribute: includesReserves	
Value type:	Boolean
Definition:	Does the estimate include the reserves value (Y/N)
Multiplicity:	0..1

Endowment

Attribute: includesResources

Value type: Boolean
Definition: Does the estimate include the resources value (Y/N)
Multiplicity: 0..1

5.2.3.2.5. MineralDepositModel

MineralDepositModel

Definition: Systematically arranged information describing the essential attributes of a class of mineral deposits. May be empirical (descriptive) or theoretical (genetic).
Status: Proposed
Stereotypes: «dataType»

Attribute: mineralDepositGroup

Value type: ScopedName
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 (modified by GA)
Multiplicity: 1..*
Stereotypes: «estimatedProperty»

Attribute: mineralDepositType

Value type: ScopedName
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: 0..*
Stereotypes: «estimatedProperty»

5.2.3.2.6. OreMeasure

OreMeasure (abstract)

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

Attribute: calculationMethod

Value type: CharacterString
Definition: Means of calculating the measurement. Examples include JORC, Unspecified, UNESCO/World Bank and the Canadian CIM.
Multiplicity: 1

Attribute: date

Value type: TM_GeometricPrimitive
Definition: Date of calculated/estimated value (single date or range)
Multiplicity: 1

Attribute: dimension

Value type: EarthResourceDimension
Definition: Size of the body used in the calculation
Multiplicity: 0..1

Attribute: ore

Value type: CGI_NumericRange

OreMeasure (abstract)	
Definition:	Amount of ore
Multiplicity:	1
Stereotypes:	«estimatedProperty»
Attribute: proposedExtractionMethod	
Value type:	CGI_Term
Definition:	The method proposed to extract the commodity
Multiplicity:	0..1
Attribute: sourceReference	
Value type:	CI_Citation
Definition:	reference for the values
Multiplicity:	1..*
Association role: measureDetails	
Value type:	CommodityMeasure
Multiplicity:	1..*

5.2.3.2.7. Reserve

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

5.2.3.2.8. Resource

Resource	
Subtype of:	OreMeasure
Definition:	A concentration or occurrence of material of intrinsic economic interest in or on the Earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. Synonyms: Mineral Resource; Coal Resource (s); Diamond (Gemstone) Resource; Potentially Mineable Mineralisation
Status:	Proposed
Stereotypes:	«dataType»
Attribute: category	
Value type:	ResourceCategoryCode
Definition:	Indicates if the resource is measured, indicated, proved, probable, or inferred.
Multiplicity:	1
Attribute: includesReserves	

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

5.2.3.2.9. SupergeneProcesses

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

5.2.3.3. Code lists

5.2.3.3.1. ERMaterialRoleCode

ERMaterialRoleCode	
Definition:	The role the EarthMaterial plays in the EarthResourceDescription
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: alteration product	
Value: gangue	
Value: host rock	
Value: primary	
Value: secondary	
Value: unspecified	

5.2.3.3.2. EndusePotentialType

EndusePotentialType	
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: Building raw material	

EndusePotentialType
Value: Ceramic and refractory use
Value: Chemical use
Value: Fertilizer
Value: Speciality

5.2.3.3.3. ExplorationActivityTypeCode

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

5.2.3.3.4. ImportanceCode

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

5.2.3.3.5. MineralOccurrenceTypeCode

MineralOccurrenceTypeCode	
Definition:	The type of mineral occurrence
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: district	
Value: field	
Value: lode	
Value: mineral deposit	
Value: occurrence	
Value: ore deposit	
Value: prospect	
Value: province	

5.2.3.3.6. ReserveCategoryCode

ReserveCategoryCode

ReserveCategoryCode	
Definition:	Defines the level of confidence of the estimate of the reserve
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: probable ore reserves	
Value: proved and probable ore reserves [JORC]	
Value: proved and probable ore reserves [non-JORC]	
Value: proved ore reserves	

5.2.3.3.7. ResourceCategoryCode

ResourceCategoryCode	
Definition:	Indicates if the resource is measured, indicated, proved, probable, or inferred.
Status:	Proposed
Stereotypes:	«codeList»
Governance:	May be extended by Member States.
Value: indicated mineral resource	
Value: inferred mineral resource	
Value: measured and indicated mineral resource	
Value: measured mineral resource	
Value: measured, indicated and inferred mineral resource [JORC]	
Value: measured, indicated and inferred mineral resource [non-JORC]	

5.2.3.4. Imported types (informative)

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

5.2.3.4.1. Boolean

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

5.2.3.4.2. CGI_LinearOrientation

CGI_LinearOrientation	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Description of the measured orientation of a line.

5.2.3.4.3. CGI_NumericRange

CGI_NumericRange	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Allows specifying a range of numeric values (eg 443.7+-1.5 to 359+-2.5) and a single representative or estimated value. (eg: upper = 443.7+-1.5,lower = 359+-2.5, estimatedValue [mean] = 400) 1. Best practice for use with GeoSciML would be for Quantity:value, uom, and quality to be mandatory. 2. The UoMIdentifier type has been implemented in the SWE schema as gml:UnitDefinition (ie, not exactly as implied by the Quantity UML class) 3. Use Quantity "definition" attribute to indicate statistical type of esimatedValue/Quantity (eg; mean, median, mode). Possible example: <swe:Quantity definition="urn:cgi:classifier:CGI:Statistical_qualifier::mean"> 4. Where CGI_NumericRange is used to deliver a single numeric value, it should be repeated in both the upper and lower quantity values.

5.2.3.4.4. CGI_PlanarOrientation

CGI_PlanarOrientation	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	Description of the geometry of a plane.

5.2.3.4.5. CGI_Term

CGI_Term	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::CGI_Value [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	A value with a qualifier code. Many geological properties are recorded with some form of qualification.

5.2.3.4.6. CI_Citation

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

5.2.3.4.7. CharacterString

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

5.2.3.4.8. EarthMaterial

EarthMaterial (abstract)	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::EarthMaterial [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]

EarthMaterial (abstract)	
Definition:	The Earth Material class 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.

5.2.3.4.9. GeologicFeature

GeologicFeature (abstract)	
Package:	INSPIRE Consolidated UML Model::Themes::Annex II::Geology::GeologyMain::Geology-Core::GeologicFeature [Include reference to the document that includes the package, e.g. INSPIRE data specification, ISO standard or the GCM]
Definition:	The abstract GeologicFeature class represents a conceptual feature that is hypothesized to exist coherently in the world. * this corresponds with a "legend item" from a traditional geologic map * while the bounding coordinates of a Geologic Feature may be described, its shape is not. The implemented Geologic Feature instance acts as the "description package" * the description package is classified according to its purpose as an Instance, TypicalNorm, or DefiningNorm.

5.2.3.4.10. 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]

5.2.3.4.11. ScopedName

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

5.2.3.4.12. TM_GeometricPrimitive

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

5.2.3.4.13. 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]

6 Reference systems

6.1 Coordinate reference systems

6.1.1 Datum

IR Requirement 3 For the coordinate reference systems used for making available the INSPIRE spatial data sets, the datum shall be the datum of the European Terrestrial Reference System 1989 (ETRS89) in areas within its geographical scope, and the datum of the International Terrestrial Reference System (ITRS) or other geodetic coordinate reference systems compliant with ITRS in areas that are outside the geographical scope of ETRS89. Compliant with the ITRS means that the system definition is based on the definition of the ITRS and there is a well established and described relationship between both systems, according to EN ISO 19111.

6.1.2 Coordinate reference systems

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

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

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

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

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

6.1.3 Display

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

6.1.4 Identifiers for coordinate reference systems

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

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

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

6.2 Temporal reference system

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

6.3 Theme-specific requirements and recommendations on reference systems

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

7 Data quality

This chapter includes a description of data quality elements and sub-elements as well as the associated basic data quality measures to be used to describe data related to the spatial data theme *Mineral* Resources (see Table 3). The data quality elements are described in section 7.1.

NOTEAdditional guidance documents on procedures and methods that can be used to implement the basic data quality measures introduced in this section will be provided at a later stage.

In addition, recommendations on minimum data quality are included for specific elements. These recommendations are included in section 7.2.

7.1 Data quality elements

Data quality information can be described at level of spatial object (feature), spatial object type (feature type), dataset or dataset series. Data quality information at spatial object level is modelled directly in the application schema (Chapter 5).

Recommendation 2 Aggregated data quality information should ideally be collected at the level of spatial object types and included in the dataset (series) metadata.

Chapter 8 describes the corresponding metadata elements to report about this data quality information.

Note: These are the preliminary DQ elements for MR theme – do yet discussed inside the GE- MR TWG!

Table 3 – List of **all data quality elements used in the spatial data theme** Mineral **Resources**

Section	**Data quality element and sub-elements** **Data quality sub-element**	**Scope(s)**
7.1.2	Completeness – Omission	dataset series
7.1.4	Positional accuracy – Absolute or external accuracy	dataset series

7.1.1 Completeness – Commission

Commission should be documented using the rate of excess items.

Name	**Rate of excess items**
Alternative name	–
Data quality element	Completeness
Data quality sub-element	Commission
Data quality basic measure	Error rate
Definition	Number of excess items in the dataset in relation to the number of items that should have been present.
Description	–
Parameter	–
Data quality value type	Real, percentage, ratio (example: 0,0189 ; 98,11% ; 11:582)
Data quality value structure	–
Source reference	–
Example	–
Measure identifier	3 (ISO 19138)

7.1.2 Completeness – Omission

Omission should be documented using the rate of missing items.

Name	**Rate of missing items**
Alternative name	–
Data quality element	Completeness
Data quality sub-element	Omission
Data quality basic measure	Error rate
Definition	Number of missing items in the dataset in relation to the number of items that should have been present.
Description	–
Parameter	–
Data quality value type	Real, percentage, ratio (example: 0,0189 ; 98,11% ; 11:582)
Data quality value structure	–
Source reference	–
Example	–
Measure identifier	7 (ISO 19138)

7.1.3 Logical Consistency – Topological consistency

Topological consistency should be documented using <Name of the measure>.

Specify the data quality measure (from ISO 19138, clause D2.4) using the template below.

Name	**<Name of the measure, from ISO 19138>**
Alternative name	*Other recognised name for the same data quality measure. It can either be a different commonly used name or an abbreviation or a short name. More than one alias may be provided.*
Data quality element	Logical consistency
Data quality sub-element	Topological consistency
Data quality basic measure	Error rate

Definition	*Statement of the fundamental concept of the data quality measure. If the data quality measure is derived from a data quality basic measure, the definition is based on the data quality basic measure definition and specialized for this data quality measure. The data quality measures are designed to test the topological consistency of geometric representations of features.*
Description	*Description of the data quality measure including method of calculation with all formulae and/or illustrations needed to establish the result of applying the measure. If the data quality measure uses the concept of errors, it shall be stated how an item shall be classified as incorrect.*
Parameter	*Auxiliary variable used by the data quality measure including name, definition and description. More than one parameter may be provided.*
Data quality value type	*Value type for reporting a data quality result. A data quality value type shall be provided for a data quality result. Examples include Boolean, Real, Integer, Ratio (numerator of type integer : denominator of type integer), Percentage, Measure(s) (value(s) + unit(s))*
Data quality value structure	*Structure for reporting a complex data quality result. A data quality result may consist of multiple values. In this case the data quality result shall be structured using one of the following data quality value structures: Bag, Set, Sequence, Table, Matrix, Coverage*
Source reference	*Citation of the source of the data quality measure. When a data quality measure for which additional information is provided in an external source is added to the list of standardized data quality measures, a reference to that source may be provided here.*
Example	*Example of applying the data quality measure or the result obtained for the data quality measure. More than one example may be provided.*
Measure identifier	*Integer number, uniquely identifying a data quality measure. Use the identifier number from ISO 19138, Annex D.*

7.1.4 Positional accuracy – Absolute or external accuracy

Absolute or external accuracy should be documented using <Name of the measure>.

Specify the data quality measure (from ISO 19138, clause D3.1) using the template below.

Name	**<Name of the measure, from ISO 19138>**
Alternative name	*Other recognised name for the same data quality measure. It can either be a different commonly used name or an abbreviation or a short name. More than one alias may be provided.*
Data quality element	Positional accuracy
Data quality sub-element	Absolute or external accuracy
Data quality basic measure	1) Counting-related data quality basic measures: Error indicator | Correctness indicator | Error count | Correct items count | Error rate | Correct items rate *(delete as appropriate)* *2)* Uncertainty-related data quality basic measures: One-dimensional random variable, Z | Two-dimensional random variable X and Y | Three-dimensional random variable X, Y, Z *(delete as appropriate: between 1) and 2) and between*

	options under 1) and 2) *See also ISO 19138, section 7.2.5 and Annex C*
Definition	*Statement of the fundamental concept of the data quality measure. If the data quality measure is derived from a data quality basic measure, the definition is based on the data quality basic measure definition and specialized for this data quality measure.*
Description	*Description of the data quality measure including method of calculation with all formulae and/or illustrations needed to establish the result of applying the measure. If the data quality measure uses the concept of errors, it shall be stated how an item shall be classified as incorrect.*
Parameter	*Auxiliary variable used by the data quality measure including name, definition and description. More than one parameter may be provided.*
Data quality value type	*Value type for reporting a data quality result. A data quality value type shall be provided for a data quality result. Examples include Boolean, Real, Integer, Ratio (numerator of type integer : denominator of type integer), Percentage, Measure(s) (value(s) + unit(s))*
Data quality value structure	*Structure for reporting a complex data quality result. A data quality result may consist of multiple values. In this case the data quality result shall be structured using one of the following data quality value structures: Bag, Set, Sequence, Table, Matrix, Coverage*
Source reference	*Citation of the source of the data quality measure. When a data quality measure for which additional information is provided in an external source is added to the list of standardized data quality measures, a reference to that source may be provided here.*
Example	*Example of applying the data quality measure or the result obtained for the data quality measure. More than one example may be provided.*
Measure identifier	*Integer number, uniquely identifying a data quality measure. Use the identifier number from ISO 19138, Annex D.*

7.2 Minimum data quality recommendations

No recommendations on minimum data quality are defined in this data specification.

8 Dataset-level metadata

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

For some dataset-level metadata elements, in particular on data quality and maintenance, a more specific scope can be specified. This allows the definition of metadata at sub-dataset level, e.g.

separately for each spatial object type. When using ISO 19115/19139 to encode the metadata, the following rules should be followed:

- The scope element (of type DQ_Scope) of the DQ_DataQuality subtype should be used to encode the scope.
- Only the following values should be used for the level element of DQ_Scope: Series, Dataset, featureType.
- If the level is featureType the levelDescription/MDScopeDescription/features element (of type Set< GF_FeatureType>) shall be used to list the feature type names.

NOTEThe value featureType is used to denote spatial object type.

Mandatory or conditional metadata elements are specified in Section 8.1. Optional metadata elements are specified in Section 8.2. The tables describing the metadata elements contain the following information:

- The first column provides a reference to a more detailed description.
- The second column specifies the name of the metadata element.
- The third column specifies the multiplicity.
- The fourth column specifies the condition, under which the given element becomes mandatory (only for Table 4 and Table 5).

8.1 Common metadata elements

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

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

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

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

Table 5 – Mandatory and conditional common metadata elements

INSPIRE Data Specification Mineral Resources **Section**	**Metadata element**	**Multiplicity**	**Condition**
8.1.1	Coordinate Reference System	1	
8.1.2	Temporal Reference System	0..*	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
8.1.3	Encoding	1..*	
8.1.4	Character Encoding	0..*	Mandatory, if an encoding is used that is not based on UTF-8.

8.1.1 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.
Implementing instructions	<instructions on how the metadata can be obtained>
Example	referenceSystemIdentifier: code: ETRS_89 codeSpace: INSPIRE RS registry
Example XML encoding	
Comments	

8.1.2 Temporal Reference System

Metadata element name	**Temporal Reference System**
Definition	Description of the temporal reference systems used in the dataset.
ISO 19115 number and name	13. referenceSystemInfo
ISO/TS 19139 path	referenceSystemInfo
INSPIRE obligation / condition	Mandatory, if the spatial data set or one of its feature types contains temporal information that does not refer to the Gregorian Calendar or the Coordinated Universal Time.
INSPIRE multiplicity	0..*
Data type(and ISO 19115 no.)	186. MD_ReferenceSystem
Domain	No specific type is defined in ISO 19115 for temporal reference systems. Thus, the generic MD_ReferenceSystem element and its reference SystemIdentifier (RS_Identifier) property shall be provided.
Implementing instructions	<instructions on how the metadata can be obtained>
Example	referenceSystemIdentifier: code: GregorianCalendar codeSpace: INSPIRE RS registry
Example XML encoding	
Comments	

8.1.3 Encoding

Metadata element name	**Encoding**
Definition	Description of the computer language construct that specifies the representation of data objects in a record, file, message, storage device or transmission channel
ISO 19115 number and name	271. distributionFormat
ISO/TS 19139 path	distributionInfo/MD_Distribution/distributionFormat
INSPIRE obligation / condition	mandatory
INSPIRE multiplicity	1
Data type (and ISO 19115 no.)	284. MD_Format

Domain	See B.2.10.4. The following property values shall be used for default and alternative encodings specified in section **Error! Reference source not found.**: 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. – 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>

8.1.4 Character Encoding

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

8.2 Theme-specific metadata elements

IR Requirement 9	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 6.
IR Requirement 10	
IR Requirement 11	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 7.
IR Requirement 12	
IR Requirement 13	
IR Requirement 14	It is important to provide the user with information about positional accuracy. This is partly a function of the quality of the topographic data used during the mapping and the mapping process. The attribute postionalAccuracy of the feature type MappedFeature is suitable for this **purpose.**

Recommendation 3	Another **important theme-specific element for Mineral Resources theme is** maintenance information **because gives a lot of information about the utility of data.**
Recommendation 4	
Recommendation 5	
Recommendation 6	Table 6 – Mandatory and conditional theme-specific metadata elements *for the theme* Mineral Resources
Recommendation 7	List all metadata elements here that **have a** multiplicity of 1 or 1..*. Delete the entries that are not applicable for this data specification.

INSPIRE Data Specification *Mineral Resources* Section	**Metadata element**	**Multiplicity**	**Condition**

Table 7 – Optional theme-specific metadata elements for the theme Mineral Resources

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

Delete any of the following subsections, if they are not applicable for this data specification.

8.2.1 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 **Error! Reference source not found.Error! Reference source not found.** and **Error! Reference source not found.** in **Error! Reference source not found.** in Chapter 7 related to missing connections due to undershoots and overshoots for detailed information. This metadata element is mandatory if connectivity is not assured for transport network centrelines in the dataset. In this case the *Connectivity tolerance* parameter – as described in **Error! Reference source not found.** and **Error! Reference source not found.** – must be provided in order to ensure automatic and unambiguous creation of centreline topology in post-process.

8.2.2 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	

Error! Not a valid filename.

8.2.3 Data Quality – Completeness – Omission

Metadata element name	**Data Quality – Completeness – Omission**
Definition	Data absent from the dataset, as described by the scope
ISO 19115 number and name	18. dataQualityInfo
ISO/TS 19139 path	dataQualityInfo
INSPIRE obligation / condition	optional
INSPIRE multiplicity	0..*

Data type (and ISO 19115 no.)	110. DQ_CompletenessOmission
Domain	Lines 100-107 from ISO 19115
Implementing instructions	
Example	
Example XML encoding	
Comments	See clause **7.1.2** in Chapter 7 for detailed information.

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

8.3.1 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 8 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: 2010-11-01

8.3.2 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 9 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).

8.3.3 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 10 If feasible, the date of the last revision of a spatial data set should be reported using the *Date of last revision* metadata element.

9 Delivery

9.1 Delivery medium

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

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

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

the list of spatial object types and/or predefined data sets that are offered by the download service (to be provided through the Get Download Service Metadata operation),

and the query capabilities section advertising the types of predicates that may be used to form a query expression (to be provided through the Get Download Service Metadata operation, where applicable),

a description of spatial object types offered by a download service instance (to be proviced through the Describe Spatial Object Types operation).

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

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

Source model (mandatory, if cannot be determined from the input data). The model in which the input data is provided.

Target model (mandatory). The model in which the results are expected.

Model mapping (mandatory, unless a default exists). Detailed description of how the transformation is to be carried out.

DS Requirement 4 Data conformant to the application schema(s) defined in section 5.2 shall be encoded using the encoding(s) specified in this section.

Recommendation 11 It is recommended that also the encodings specified in this section be provided for the relevant application schemas.

9.2 Encodings

9.2.1 Default Encoding(s)

9.2.1.1. Default encoding for application schema

Encoding information is not provided in this version of the standard.

10 Data Capture

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

11 Portrayal

This clause defines the rules for layers and styles to be used for portrayal of the spatial object types defined for this theme.

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

Section 11.2 specifies the default styles to be used for each of these layer types, while section 11.3 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)

IR Requirement 15	If an INSPIRE view services supports the portrayal of data related to the theme *Mineral Resources*, it shall provide layers of the types specified in this section.

DS Requirement 5	If an INSPIRE view network service supports the portrayal of spatial data sets corresponding to the spatial data theme *Mineral Resources*, it shall support the 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.

DS Requirement 6	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 11.2, it shall also support the well-defined styles specified in this section.

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

Layer Type	Layer Title	Spatial object type(s)	Keywords
Mineral Resources. Mineral Occurrence	Mineral Occurrence	Mineral Occurrence	mineral resources, mineral occurrence
Mineral Resources. Mine	Mine	Mine	mineral resources, mine
Mineral Resources. Commodity	Commodity	Commodity	mineral resources, commodity
Mineral Resources. Mining Waste	Mining Waste	Mining Waste	mineral resources. mining waste

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

Layer Name	Mineral Occurrence
Style Name	MR.MineralOccurrence.Default
Style Title	Mineral Occurrence Default Style.
Style Abstract	Captures the type of mineral occurrence. Examples are prospect, occurrence, mineral deposit, ore deposit, field, district, lode, mineralized zone etc (according to the EarthResourceML)
Symbology	The symbology is specified in later.
Minimum & maximum scales	No scale limits

Layer Name	Mine
Style Name	MR.Mine.Default
Style Title	Mine Default Style.
Style Abstract	(A) An underground excavation for the extraction of mineral deposits, in contrast to surficial excavations such as quarries. The term is also applied to various types of open-pit workings. (B) The area or property of a mineral deposit that is being excavated; a mining claim. (according to the EarthResourceML)
Symbology	The symbology is specified in later.

Minimum & maximum scales	No scale limits

Layer Name	Commodity
Style Name	MR.Commodity.Default
Style Title	Commodity Default Style.
Style Abstract	The material of economic interest in the Earth Resource (according to the EarthResourceML) – Earth Resource (metals, industrial minerals, energy, building raw materials, dimension stones etc.)
Symbology	The symbology is specified in later.
Minimum & maximum scales	No scale limits

Layer Name	Mining Waste
Style Name	MR.MiningWaste.Default
Style Title	Mining Waste Default Style.
Style Abstract	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.
Symbology	The symbology is specified in later.
Minimum & maximum scales	No scale limits

11.3 Layers organisation

Hierarchy of Mineral Resources layers (draft):

Mineral Occurrence and Mine
- Commodity
  - Base, precious, energy and high-tech metals
  - Industrial minerals
  - Building raw materials, dimension stones

Mine
- Mining Waste
  - Commodity

- Base, precious, energy and high-tech metals
- Industrial minerals
- Building raw materials, dimension stones

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Annex A
(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

B1 UC01: What is the gold potential of Central and Southeastern Europe?

This use case is related to example of use:

- MR-01: Mineral exploration.

B 1.1 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, …

B 1.2 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.

B 1.3 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

B 1.4 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

B 1.5 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.

B2 UC02: Ge in Europe: where to find it?

This use case is related to example of use:

- MR-01: Mineral exploration.

B2.1 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.

B2.2 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).

B2.3 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	TO BE CHECKED 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 (different pattern?)
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

B2.4 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)

B2.5 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.

B3 UC03: A manufacturer looking for GCC

This use case is related to example of use:

- MR-01: Mineral exploration.

B3.1 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.

B3.2 Narrative description

Ground Calcium Carbonate is used as filler mainly in the paper industry. More precisely, the user is looking for specific quality of GCC allowing elaborating coating. Geologically speaking, GCC correspond to white limestones. Such limestones have very distinct properties compared to all other limestones used in the industry (aggregates, lime, fertilizer, fluxing agent, etc.). Required physical properties are very precise:

- Whiteness: 88 to 96 %;
- Yellowness: 1.5 to 3 (no unit, it's a difference);
- Aspect ratio: 10 m^2/g;
- Abrasivity: 4 mg.

B3.3 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

B3.4 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.*

B3.5 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.

B4 UC04: Environmental uncertainties related to mining wastes

This use case is related to example of use:

- MR-04: Environmental impact assessment

B4.1 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.

B4.2 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).

B4.3 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

B4.4 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

B4.5 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