GeoSciML 3.2 Encoding Cookbook for INSPIRE WFS services

1. Introduction

The INSPIRE geology data specification (D2.8.II.4 Data Specification on Geology – Draft Technical Guidelines) describes the geological information that needs to be made available through INSPIRE conformant web services. GeoSciML is based on Geography Markup Language v3.2 (GML) (ISO 19136:2007) for representation of features and geometry and provides a framework for application-neutral encoding of geosciences information. GeoSciML was developed by the CGI (Commission for the Management and Application of Geoscience Information), a Commission of the International Union of Geological Sciences, and is an internationally agreed domain standard for geology. INSPIRE services can be encoded using GeoSciML v3.2 in order to achieve maximum global interoperability and to enable the INSPIRE geology data specification to be extended to include other geosciences information. The INSPIRE geology data specification provides a mapping between the specification and GeoSciML, and this is reproduced in Annex 1.

GeoSciML has a wide scope allowing the encoding of most information depicted on geological maps, as well as information about boreholes and laboratory analyses. This cookbook, however, concentrates on just that part of GeoSciML necessary for encoding the INSPIRE Geology application schema. Note that the INSPIRE Geology Data Specification also includes application schema for hydrogeology and geophysics which are not covered by this cookbook. The mapping from the INSPIRE geology data specification to GeoSciML is described, along with the encoding of all GeoSciML fields which are required for INSPIRE and other mandatory related GeoSciML fields. A GeoSciML service can deliver much more information using other parts of GeoSciML, but this won't be described in this cookbook.

To facilitate semantic interoperability vocabularies are included in the data specification and these are available from the INSPIRE registry (http://inspire.ec.europa.eu/registry/). These vocabularies use http URIs as concept identifiers and their use is mandatory for INSPIRE and will be described in the relevant section below. Many of these vocabularies are based closely on ones developed by the CGI for use with GeoSciML (http://resource.geosciml.org).

This cookbook is designed to assist users map their data to the GeoSciML data model. In most cases users with digital geoscience data will have their own formalised model of some type, although this will not always be the case. Where a formalised user data model exists then the process of mapping data to GeoSciML will largely involve mapping features/entities in the user model to their equivalents in the GeoSciML logical data model. Where no such user model exists then mapping must be carried out direct from the data.

To carry out the mapping, from either a model or direct from data, requires staff with geoscientific knowledge, familiarity with the user's own data and data model, and an understanding of the UML formalisation used in documenting GeoSciML. These staff are likely to be geoscientists, possibly those who were involved in developing the organisation's own data model, and it is these people who are seen as the main users of this cookbook.

Materials and documentation on GeoSciML have been produced by the CGI Interoperability Working Group (IWG) and are available "as is" for download from http://www.geosciml.org/. The supporting materials most relevant to this cookbook include:

- Full documentation of the GeoSciML model. This is generated automatically from the GeoSciML UML diagrams and draws on the scope notes in those diagrams. This full documentation, however, does not include any best practice guidance
- An Enterprise Architect version of the UML for the CGI packages
- GeoSciML examples

Although use of GeoSciML is open to the geoscience community, in order to ensure the integrity of the GeoSciML standard across the community the IWG requests that the following points be applied to any work involving GeoSciML:

1. full compliance with existing GeoSciML conformance criteria
2. the IWG and its GeoSciML products are not misrepresented or misused
3. the IWG retains full copyright to all IWG and GeoSciML names and products, including logos, text, images and technical materials
4. the GeoSciML name and associated namespaces, as well as the IWG name and associated task group names, are reserved strictly for IWG activities and products
5. the GeoSciML products developed by the IWG may be freely copied and used within third-party information systems, with acknowledgements as per (8) below
6. the GeoSciML products developed by the IWG are not to be modified by third-parties, except as part of the revision process within the IWG
7. extensions to GeoSciML by third-parties remain distinct from GeoSciML, exist in non-GeoSciML namespaces, and are not to be represented as IWG or GeoSciML products
8. acknowledgement of GeoSciML and the IWG is made in all communications and products related to work involving GeoSciML or the IWG, with appropriate citation
9. the IWG gives no warranty, expressed or implied, as to the quality or accuracy of the information supplied, or to the information's suitability for any use. The IWG

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2. *GeoSciML model and INSPIRE encoding*

There are fifteen packages in GeoSciML, nine of which are required for INSPIRE services: GeoSciML-Core; GeologicUnit; GeologicStructure; Geomorphology; GeologicAge; Borehole; Collection; EarthMaterial; and CGI_Utilities. This section will describe those parts of these packages which are the minimum requirement for conformance with the INSPIRE geology application schema. In order to show the context of the GeoSciML used in INSPIRE the complete UML diagram for the relevant packages are shown. The objects required by INSPIRE (see Annex 1) are enclosed by red rectangles, as are the required properties of those objects. The INSPIRE data specification UML is also included to show the relationship between INSPIRE and GeoSciML.

In GeoSciML most attributes have a cardinality of one or more, but are voidable. This is because these attributes must have a value, although it may not be available to the data provider. For example GeologicUnit has an attribute of unitThickness to describe the range in thickness of the unit. All units must have a range of thickness, but it may not be known. Note that data for all attributes in the INSPIRE data specification should be provided and a nil value used only where the data does not exist. 'Voidable' does not mean 'optional' in INSPIRE. GeoSciML properties not required by INSPIRE can however be given a nil value (Figure 1). Where no value is provided for a voidable attribute then a nilReason must be provided. One of the nilReasons defined in the INSPIRE VoidReasonValue codelist should be used:

- **unpopulated** – The characteristic is not part of the dataset maintained by the data provider. However, the characteristic may exist in the real world.
- **unknown** - the correct valuefor the specific spatial object is not known to, and not computable by, the data provider. However, a correct value may exist.
- **withheld** - the characteristic may exist, but it is confidential and nor divulged by the data provider.

An example of encoding nil values for GeologicUnit attributes is given in Figure 1.

```
<gsmlgu:bodyMorphology nilReason="unknown" xsi:nil="true" />
<gsmlgu:unitComposition nilReason="unknown" xsi:nil="true" />
 <gsmlgu:exposureColor nilReason="unpopulated" xsi:nil="true" />
 <gsmlgu:outcropCharacter nilReason="unpopulated" xsi:nil="true" />
```

Figure 1: Example of encoding of nil values

As GeoSciML is a GML schema all objects must have a value for the mandatory gml:id attribute. This provides an identifier for the XML element representing the object, and must be unique within the XML document. XML elements representing a particular object, for example a specific GeologicUnit, need only be described once in the document. Subsequent occurrences can reference the element using the gml:id. The gml:id attribute should not be used for the global identifier of the object, it is simply an identifier within the XML document.

Vocabulary concepts should be encoded by reference. This enables information about the concept, such as a full description, to be accessed from the relevant vocabulary service. The general pattern is that the href attribute provides the URI of the concept and the title attribute provides a human readable label for it.

An example of encoding the INSPIRE Geology application schema in GeoSciML is given in Annex 2. This example is structured as a GeologicCollection with one of each type of INSPIRE feature included. It is designed to illustrate GeoSciML encoding rather than illustrate what a real INSPIRE service might look like.

2.1 GeoSciML-Core – Mapped Feature and Geologic Feature

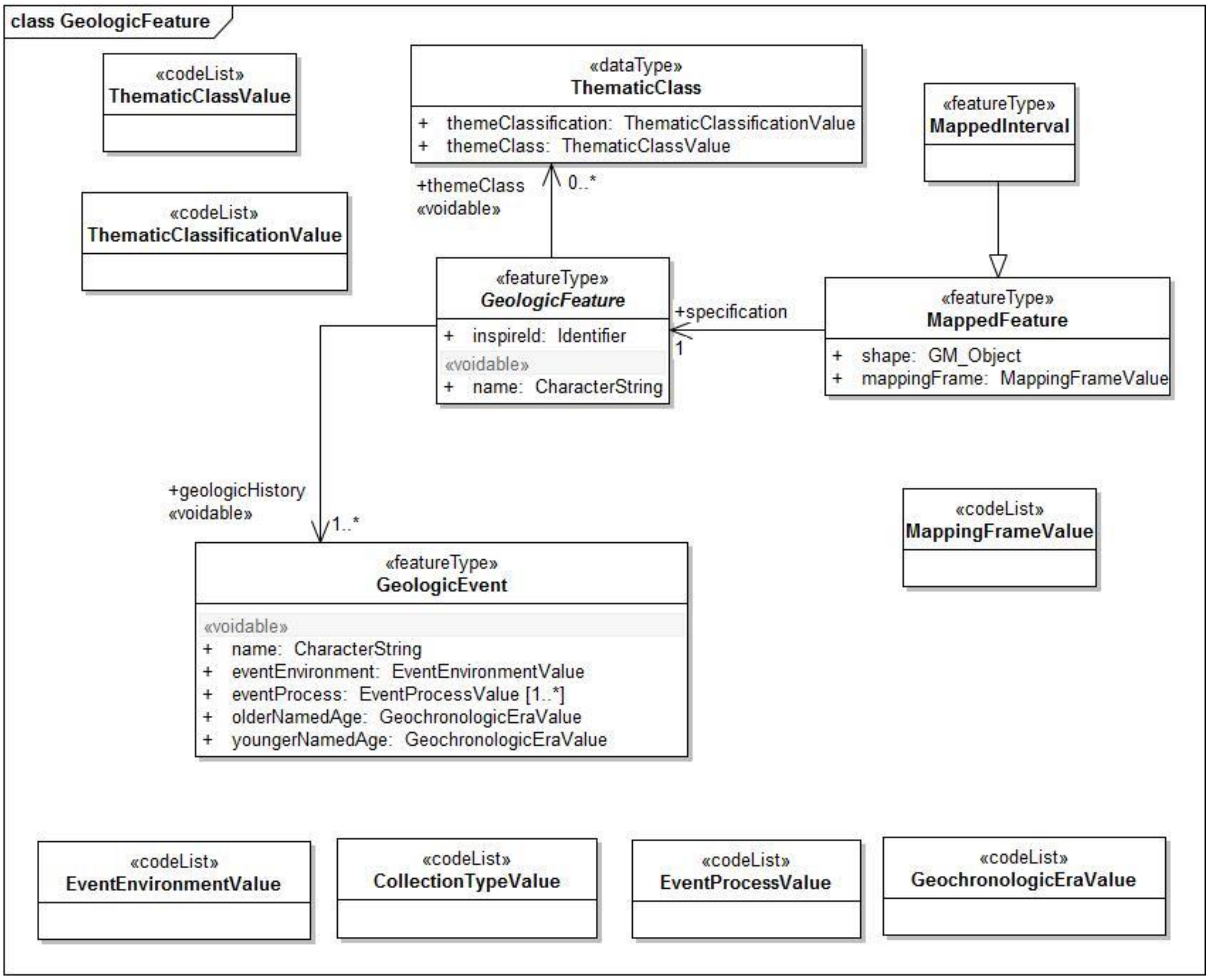

Figure 2: INSPIRE UML class diagram for GeologicFeature, MappedFeature, GeologicEvent and ThematicClass

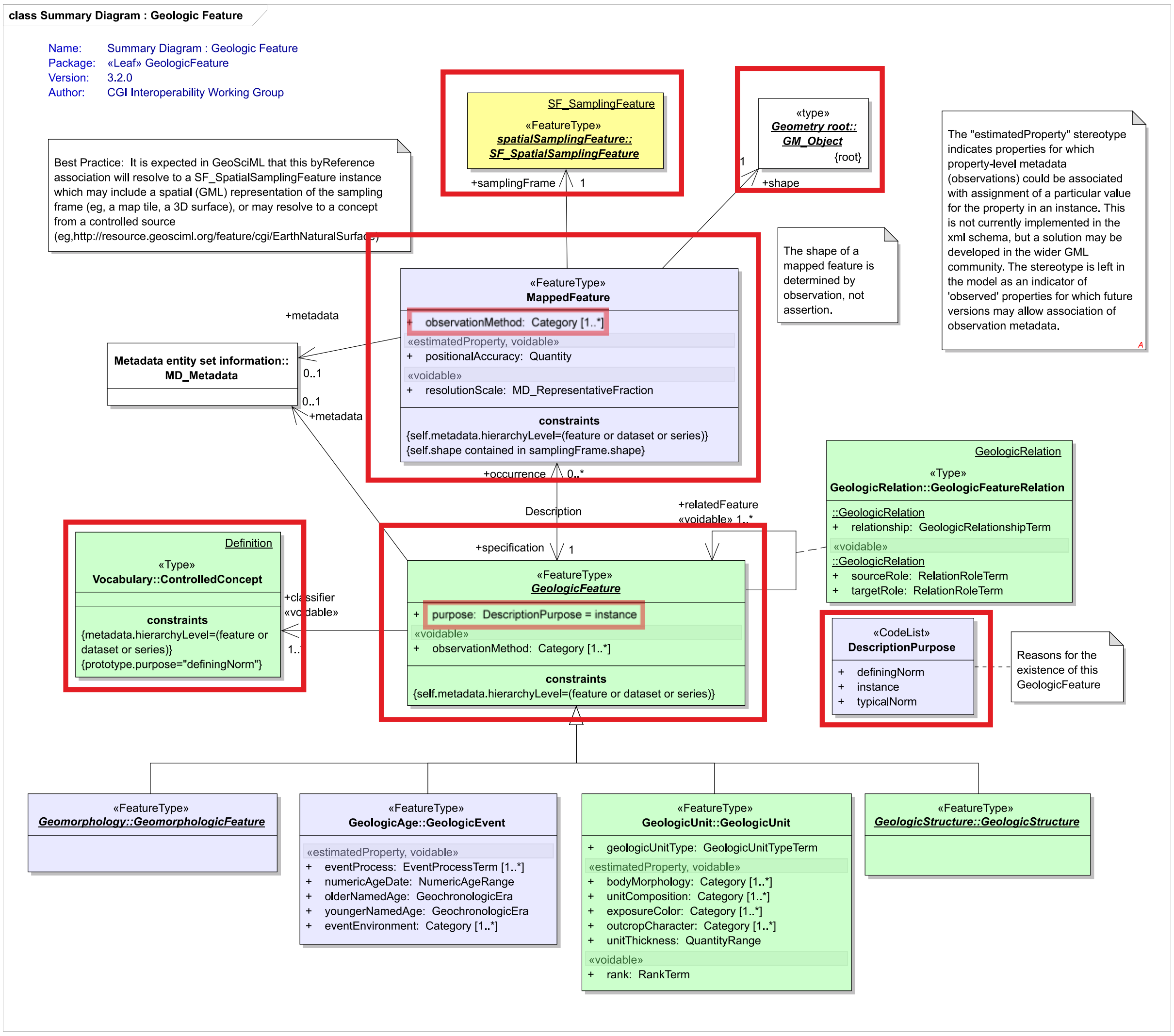

Figure 3: UML for the GeoSciML GeologicFeature package

The INSPIRE UML class diagram for GeologicFeature, MappedFeature, GeologicEvent and ThematicClass is shown in Figure 2 and the UML of the GeoSciML GeologicFeature package in Figure 3.

The MappedFeature and GeologicFeature objects are at the core of GeoSciML. A MappedFeature can be considered an occurrence, such as a polygon on a geologic map, of a real world GeologicFeature the full extent of which is unknown. It is independent of geometry, so the same GeologicFeature can have different MappedFeature instances, representing mapped polygons at different scales or a modelled volume for example. Each MappedFeature, however, can be specified by only one GeologicFeature. The specification association, from MappedFeature to GeologicFeature, is required by INSPIRE. An INSPIRE service provides a collection of MappedFeatures.

GeologicFeature is the abstract parent class for GeologicUnit, GeologicStructure, GeomorphologicFeature and GeologicEvent. This section will describe those properties which apply to all GeologicFeatures, but these will always be encoded as part of one of the specialist child classes. The INSPIRE GeologicFeature class has two associations, themeClass and geologicHistory. The themeClass association should be encoded using the GeoSciML classifier association, which will be explained in section 2.6, and geologicHistory should be encoded using the GeoSciML GeologicHistory relationship class between GeologicFeature and GeologicEvent, explained in section 2.2.

2.1.1 Mapped Feature - observation method

Although observationMethod is not required by INSPIRE it is a mandatory property in GeoSciML, and thus needs to be encoded by an INSPIRE service using GeoSciML. It enables the distinct methodologies for observing the MappedFeature to be recorded. For example a MappedFeature might be observed through field observation (mapping). The CGI vocabulary describing observationMethod is MappedFeatureObservationMethod (http://resource.geosciml.org/vocabulary/cgi/201211/MappedFeatureObservationMethod201211.rdf) and this should be used.

The observationMethod attribute is of type ‘Category’ which provides the resolvable URI for the vocabulary containing the observationMethod concepts in the codeSpace attribute, a definition of observationMethod in the definition property, the URI identifier for the observationMethod concept describing the MappedFeature in the value attribute, and a human readable version of the concept in the label attribute. The definition property can be populated with the URI of the vocabulary as this resolves to a page including the definition.

There is also a ‘Category extension’ which uses the same Category type and attributes to provide ‘qualification’ information on the data value being provided. For example where an observation method of ‘Compilation’ is provided the qualification information might be ‘always’ or ‘sometimes’. These qualification values are given in the ValueQualifier vocabulary (http://resource.geosciml.org/vocabulary/cgi/201211/ValueQualifier201211.rdf).

```
<gsml:observationMethod>
 <swe:Category
  definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
  <swe:extension>
   <swe:Category
    definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
    <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
    <swe:label>always</swe:label>
    <swe:codeSpace
     xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
    />
   </swe:Category>
  </swe:extension>
  <swe:identifier>http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/compilation</swe:identifier>
  <swe:label>Compilation</swe:label>
  <swe:codeSpace
   xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
  />
```

```xml
  </swe:Category>
</gsml:observationMethod>
```

Figure 4: Example of the encoding of observation method

2.1.2 Mapped Feature - sampling frame

The INSPIRE mappingFrame property is equivalent to the GeoSciML samplingFrame. Each MappedFeature has a samplingFrame association to SF_SpatialSamplingFeature that indicates the spatial reference frame within which the MappedFeatures have been observed, such as a surface of mapping. Values should be drawn from the MappingFrameValue vocabulary (http://inspire.ec.europa.eu/codelist/MappingFrameValue).

```xml
<gsml:samplingFrame xlink:href="http://inspire.ec.europa.eu/codelist/MappingFrameValue/topOfBedrock" xlink:title="top of bedrock"/>
```

Figure 5: Example of the encoding of sampling frame

2.1.3 Mapped Feature - geometry (shape)

The geometry of each MappedFeature is provided by the shape association to GM_Object. Figure 6 gives an example of encoding a polygon.

```xml
<gsml:shape>
   <gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326" gml:id="LOCAL_ID_0">
      <gml:exterior>
         <gml:LinearRing>
            <gml:posList srsDimension="2" count="8">55.0760921318516 -3.31719604609088 55.0833753209835 -3.31853455922777 55.0825574334633 -3.31921378657955 55.0801997429522 -3.31978309699423 55.0768616358466 -3.3194575613054 55.0741365291192 -3.31966903508197 55.0756843873373 -3.31747948721346 55.0760921318516 -3.31719604609088</gml:posList>
         </gml:LinearRing>
      </gml:exterior>
   </gml:Polygon>
 </gsml:shape>
```

Figure 6: Example of the encoding of MappedFeature geometry (shape)

2.1.4 Geologic Feature – inspireId

The INSPIRE inspireId property provides the persistent identifier used for the object by the data provider, for example the code from a stratigraphic lexicon in the case of a GeologicUnit. This should be encoded using gml:identifier which requires both the identifier value and the codespace identifying the data source (Figure 7).

2.1.5 Geologic Feature –name

The INSPIRE name property provides the name of the GeologicFeature, for example the expansion of the code provided by inspireId. It should be encoded using gml:name (Figure 7).

```xml
<gsmlgu:GeologicUnit gml:id="INV-SDSM">
      <gml:identifier codeSpace="http://data.bgs.ac.uk/id/Lexicon/NamedRockUnit/">INV</gml:identifier>
      <gml:name>INVERCLYDE GROUP</gml:name>
```

Figure 7: Example of the encoding of identifier and name for a GeologicUnit

2.1.6 *Geologic Feature - purpose*

GeologicFeature has only one mandatory attribute, purpose, describing the intention of the GeologicFeature. Although purpose is not required by INSPIRE as it is a mandatory property in GeoSciML it needs to be encoded by an INSPIRE service using GeoSciML.The purpose property must take one of the three values from the DescriptionPurpose codelist (Figure 3): an instance where the GeologicFeature description is of an individual occurrence; a definingNorm for the normative description of a type of GeologicFeature (eg a particular lithostratigraphic unit); or a typicalNorm for a description which includes information in addition to that which defines the GeologicFeature, and which is commonly derived from multiple instance descriptions. Most GeologicFeatures on a published geological map will be typicalNorms.

2.2 *Geologic Age*

In INSPIRE the geologicHistory association from GeologicFeature to GeologicEvent is the way in which geologic age is described (Figure 2). This applies to all types of GeologicFeature: GeologicUnit, GeologicStructure and GeomorphologicFeature. In GeoSciML age is modeled differently using the relatedFeature association from GeologicFeature to itself (Figure 8). This association is described by GeologicHistory, a specialisation of GeologicFeatureRelation, which constrains relatedFeature to associate a GeologicUnit, GeologicStructure or GeomorphologicUnit to a GeologicEvent. GeologicHistory allows the recording of a succession of GeologicEvents that affected the GeologicUnit, along with the period over which they occurred. In spite of the different modeling of age between INSPIRE and GeoSciML the concepts are the same and INSPIRE can be encoded using GeoSciML.

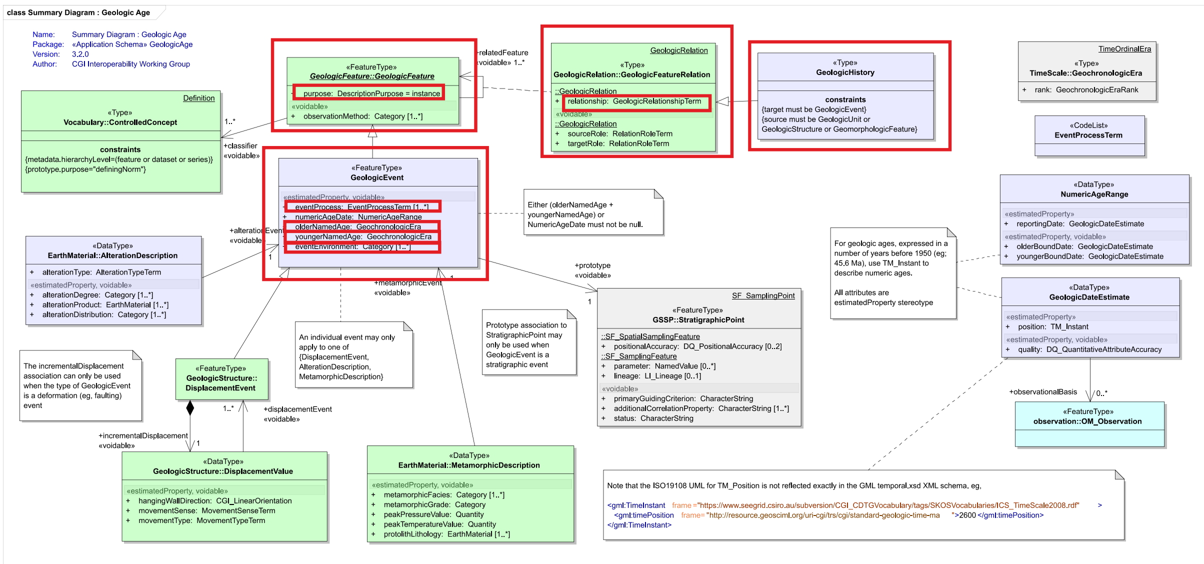

Figure 8: UML for the GeoSciML Geologic Age package

2.2.1 Geologic Feature Relation – relationship

Although it is not required by INSPIRE the relationship property of GeologicFeatureRelation is mandatory in GeoSciML. It describes the nature of the relationship between the GeologicUnit and the GeologicEvent. For example if the GeologicEvent that is being provided is that which was responsible for the creation of the GeologicUnit the relationship attribute will have a value something like 'Formation of the unit', however if the nature of the relationship isn't known then it can be encoded using the term 'geologicHistoryRelation'. These values should be drawn from a vocabulary, such as that at present under development by the CGI.

2.2.2 Geologic Event – name

The INSPIRE name property provides the name of the GeologicEvent, for example 'Hercynian Orogeny. Only major events such as orogenies are likely to have names and other events should be recorded as 'Unnamed event'. The field should be encoded using gml:name.

2.2.3 Geologic Event – purpose

GeologicEvent is a type of GeologicFeature from which it inherits the mandatory purpose attribute. The semantics are as described in section 2.1.6, and would commonly have a value of 'typicalNorm' for information from geological maps.

2.2.4 Geologic Event – youngerNamedAge and olderNamedAge

In INSPIRE it is necessary to provide geologic age expressed using a geochronologic era defined according to a geologic time scale. Geochronologic era names should be drawn from the GeochronologicEraValue vocabulary (http://inspire.ec.europa.eu/codelist/GeochronologicEraValue), which is based on the International Commission for Stratigraphy (ICS) international stratigraphic chart supplemented with a more detailed chronology for parts of the Precambrian and Quaternary. Both the olderNamedAge and the youngerNamedAge attributes should be populated, giving the age of the start and end of the GeologicEvent respectively. It may be that the GeologicEvent age is fully enclosed by a single geochronologic era, in which case the olderNamedAge and the youngerNamedAge attributes should both be populated with the same value.

2.2.5 Geologic Event - eventProcess

The eventProcess property describes one or more processes that took place during the event to modify the related GerologicFeature. It should be encoded using terms drawn from the EventProcessValue vocabulary (http://inspire.ec.europa.eu/codelist/EventProcessValue)

2.2.6 Geologic Event - eventEnvironment

The eventEnvironment property describes the environment within which the event took place and is of type Category. It should be encoded following the pattern described in section 2.1.1 using terms drawn from the EventEnvironmentValue vocabulary (http://inspire.ec.europa.eu/codelist/EventEnvironmentValue).

2.3 Geologic Unit and Earth Material

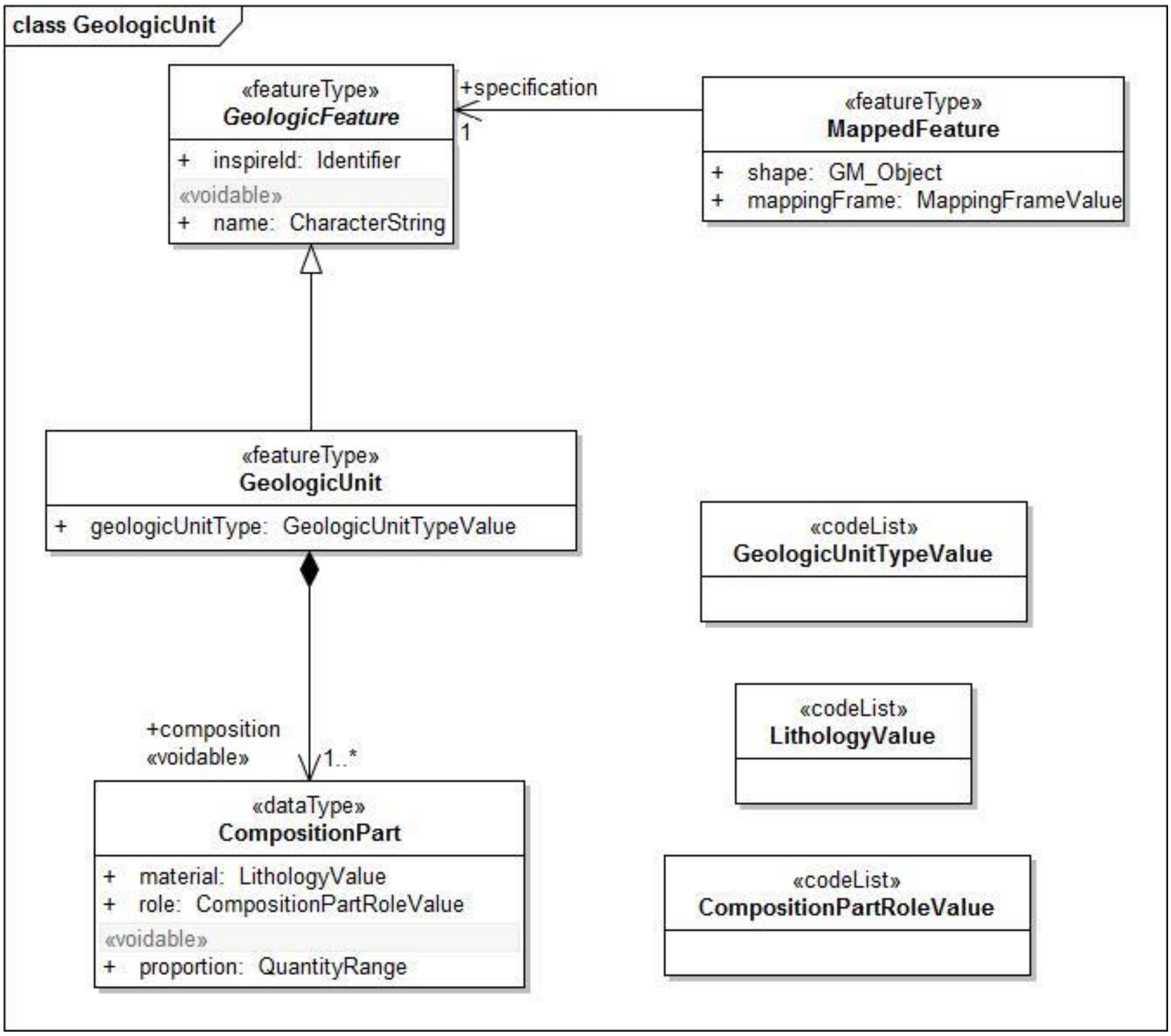

Figure 9: INSPIRE UML class diagram for GeologicUnit

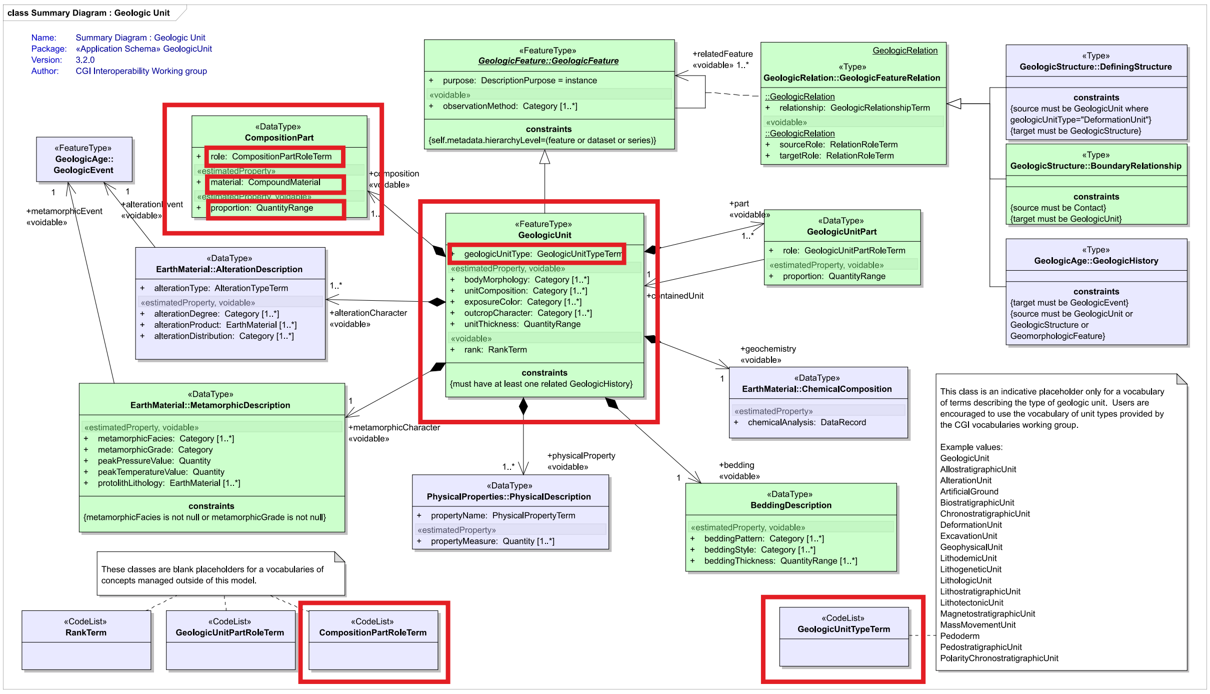

Figure 10: UML for the GeoSciML GeologicUnit package

The INSPIRE UML class diagram for GeologicUnit is shown in Figure 9 and the UML of the GeoSciML GeologicUnit package in Figure 10. GeologicUnit is a specialisation of GeologicFeature. In INSPIRE only the geologicUnitType property is required, along with the association to compositionPart, and as can be seen this is modelled in an identical way in GeoSciML.

2.3.1 *Geologic Unit – geologic unit type*

The only GeologicUnit attribute that is mandatory for INSPIRE is geologicUnitType. This indicates the type of the geologic unit, for example a lithostratigraphic unit or a lithologic unit. Values must be drawn from the GeologicUnitTypeValue vocabulary (http://inspire.ec.europa.eu/codelist/GeologicUnitTypeValue/).

2.3.2 *Geologic Unit – composition*

The composition association from GeologicUnit to CompositionPart provides the means for describing the lithology of the GeologicUnit. In INSPIRE a GeologicUnit must have at least one CompositionPart, but can have several where the GeologicUnit is composed of several different lithologies. For each CompositionPart values for three attributes must be provided: role, material and proportion.

2.3.3 *Composition Part - role*

Role defines the relationship of the compositionPart to the GeologicUnit as a whole, e.g. vein, interbedded constituent, layers, dominant constituent. Values should be drawn from the CompositionPartRoleValue vocabulary (http://inspire.ec.europa.eu/codelist/CompositionPartRoleValue).

2.3.4 Composition Part - proportion

The proportion attribute defines the proportion of the GeologicUnit as a whole that the CompositionPart comprises. It is of type GSML_QuantityRange and should be encoded as two percentage numbers giving the upper and lower limits of the range within which the CompositionPart proportion is considered to lie which are included both as a space separated tuple to be compatible with SWE and as separate lower and upper values to enable querying in a WFS (Figure 11).

```
<gsmlgu:proportion>
  <GSML_QuantityRange xmlns="http://xmlns.geosciml.org/Utilities/3.2">
    <swe:uom code="%" xlink:href="http://unitsofmeasure/ucum.html#para-29" xlink:title="percent"/>
    <swe:value>5.0 50.0</swe:value>
    <lowerValue>5.0</lowerValue>
    <upperValue>50.0</upperValue>
  </GSML_QuantityRange>
</gsmlgu:proportion>
```

Figure 11: Example of the encoding of proportion

2.3.5 Composition Part - material

The material attribute provides the lithology of the CompositionPart and is of type LithologyValue (a codelist) in INSPIRE (Figure 9) whereas in GeoSciML it is modelled as a CompoundMaterial (Figure 10). CompoundMaterial is a specialisation of EarthMaterial and the parent class of RockMaterial (Figure 12). The RockMaterial.lithology property is the equivalent of INSPIRE CompostionPart.material, but encoding in GeoSciML requires the additional mandatory EarthMaterial.purpose property.

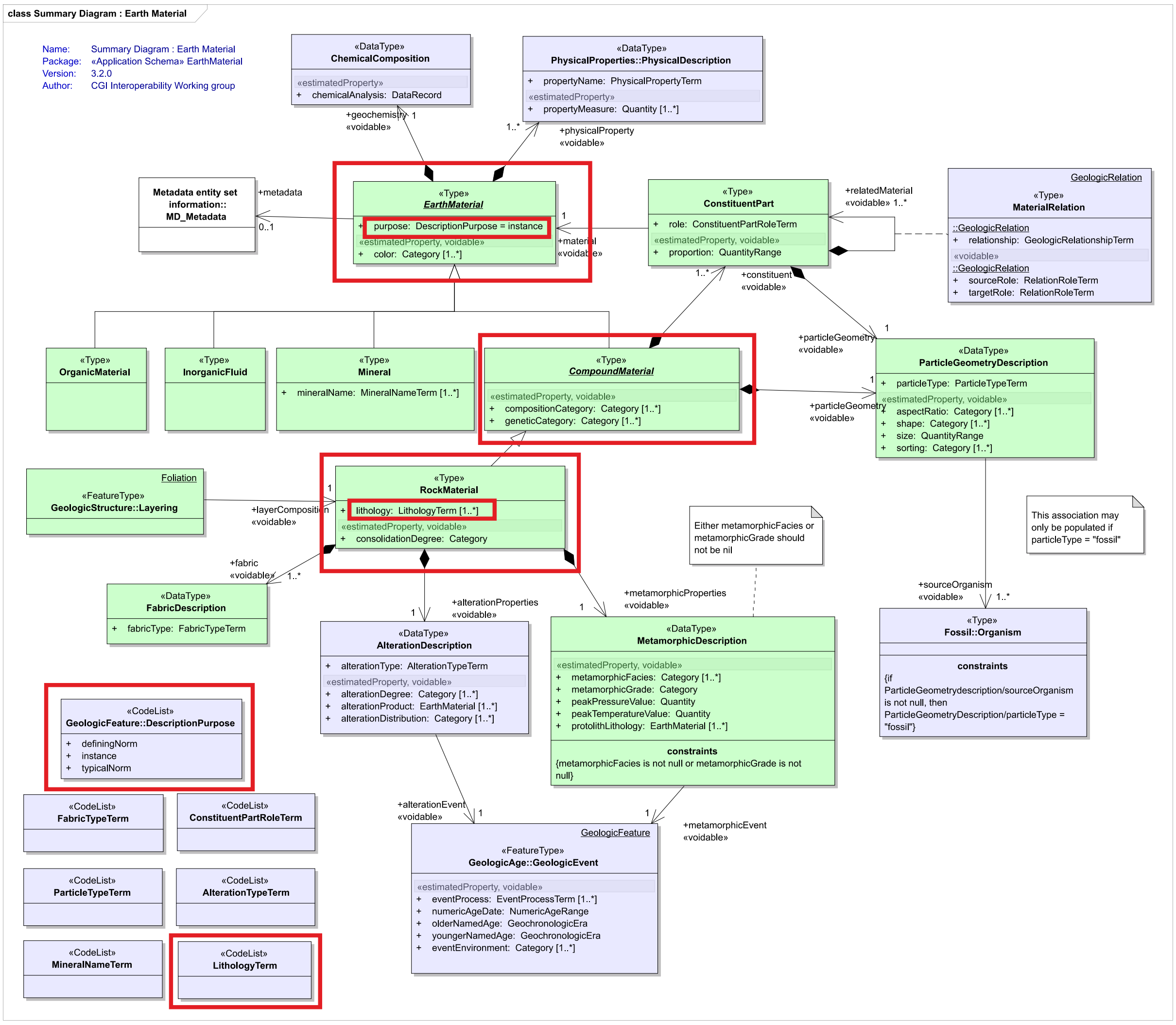

Figure 12: UML for the GeoSciML EarthMaterial package

2.3.6 Earth Material - purpose

The purpose attribute of EarthMaterial has identical semantics to the purpose attribute of GeologicFeature described in section 2.1.6.

2.3.7 Rock Material - lithology

The lithology attribute provides the lithology of the CompositionPart of the GeologicUnit. GeoSciML allows multiple lithologies for each CompositionPart, but in INSPIRE each CompositionPart should be restricted to a single lithology, although, as indicated in section 2.3.2, a GeologicUnit can have multiple CompositionParts. Values for lithology should be drawn from the LithologyValue vocabulary (http://inspire.ec.europa.eu/codelist/LithologyValue).

2.4 Geologic Structure

GeologicStructure is an abstract specialization of GeologicFeature and in INSPIRE only two types of GeologicStructure are required, ShearDisplacementStructure (faults) and Fold (Figure 13).

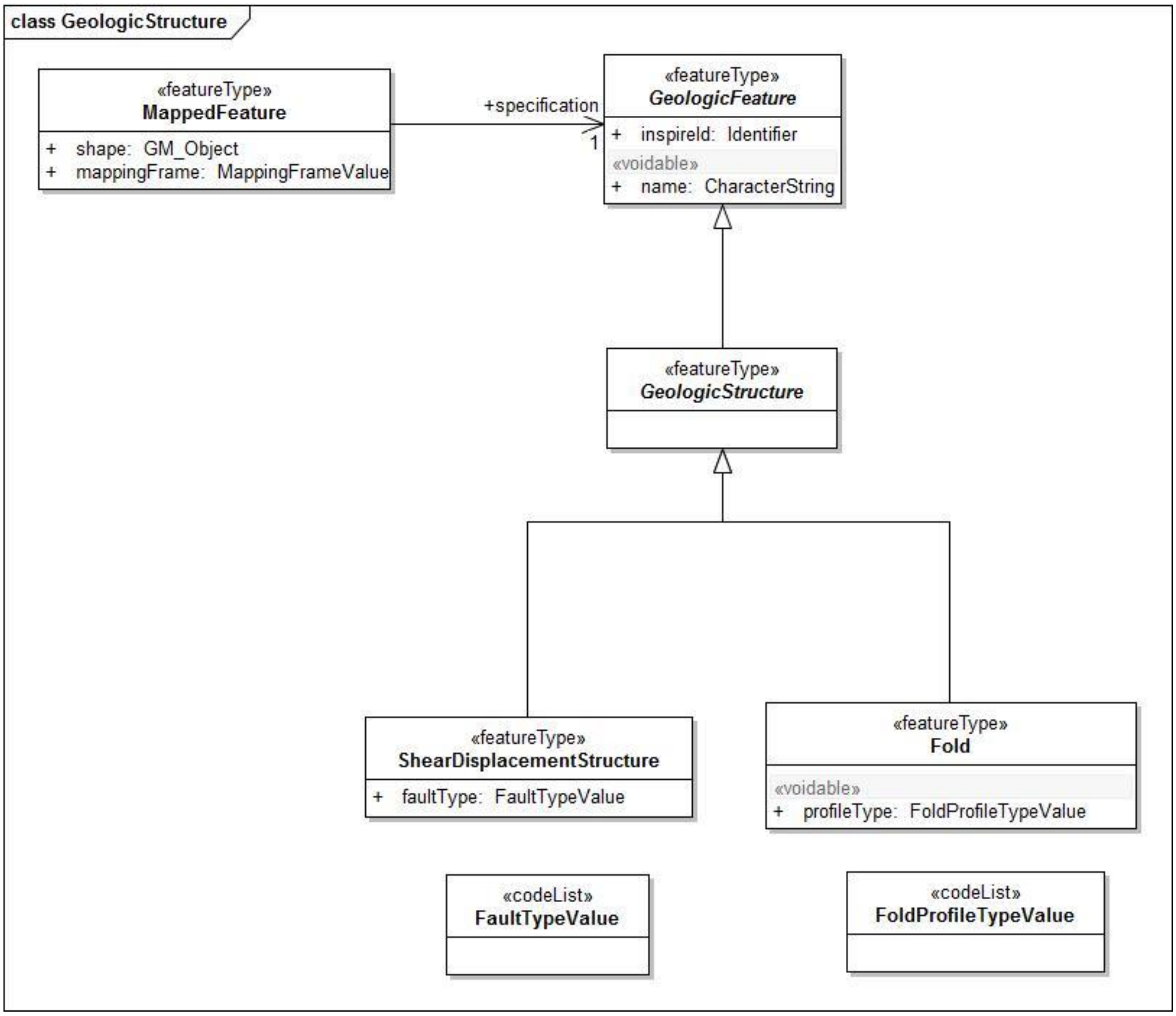

Figure 13: INSPIRE UML class diagram for GeologicStructure

The GeoSciML modelling of ShearDisplacementStructure is shown in Figure 14, and of Fold in Figure 15.

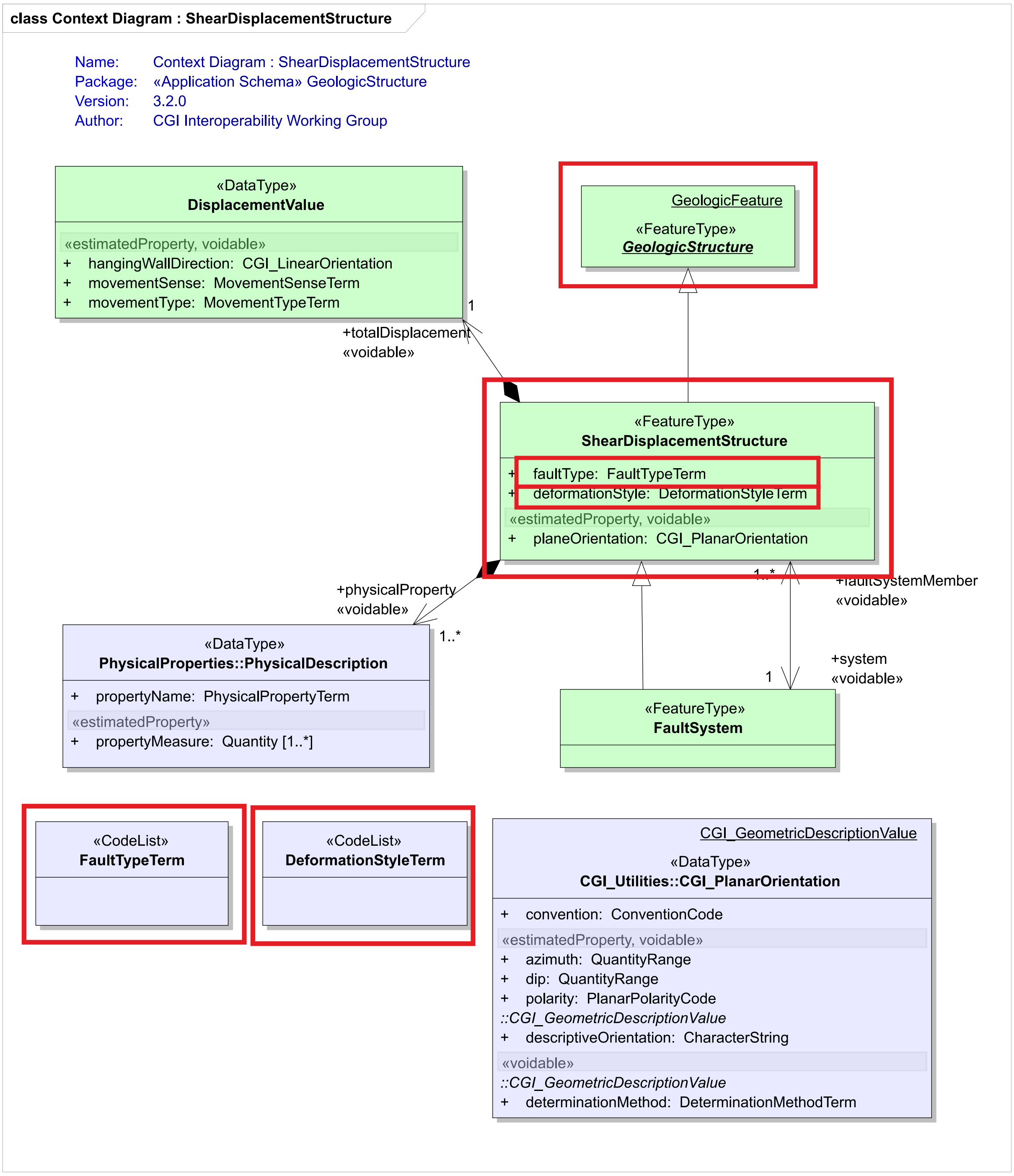

Figure 14: UML for the GeoSciML ShearDisplacementStructure

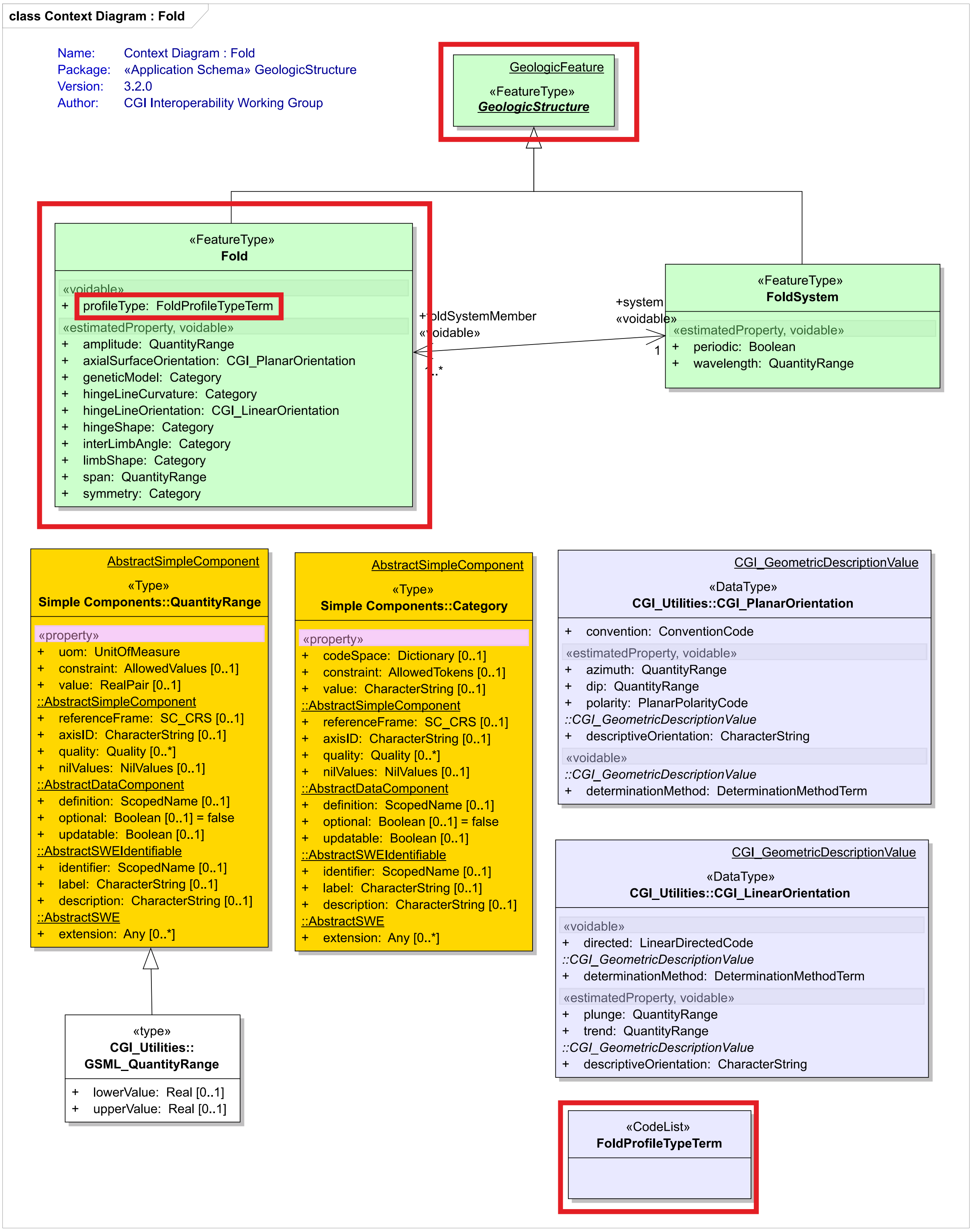

Figure 15: UML for the GeoSciML Fold

As can be seen in Figure 13, the only properties required by INSPIRE are faultType for ShearDisplacementStructure, and profileType for Fold. However, as shown in Figure 14, in GeoSciML the mandatory property deformationStyle is also required for ShearDisplacementStructure.

2.4.1 Shear Displacement Structure - faultType

The faultType property describes the type of ShearDispacementStructure and should be populated with a value drawn from the FaultTypeValue vocabulary (http://inspire.ec.europa.eu/codelist/FaultTypeValue).

2.4.2 Shear Displacement Structure - deformationStyle

The deformationStyle property is not required by INSPIRE but is mandatory in GeoSciML. It describes the style of deformation, such as brittle or ductile, of the ShearDisplacementStructure. This information should be encoded using one of the values in the CGI Deformation Style vocabulary (http://resource.geosciml.org/vocabulary/cgi/201211/DeformationStyle201211.rdf), which includes a value for ‘unknown’.

2.4.3 Fold - profileType

The profileType property describes the type of fold according to its geometry and the younging direction of the strata. It should be populated using values from the FoldProfileTypeValue vocabulary (http://inspire.ec.europa.eu/codelist/FoldProfileTypeValue).

2.5 Geomorphologic Feature

Figure 16 shows the INSPIRE UML class diagram for geomorphology, and Figure 17 the equivalent GeoSciML modeling. As can be seen these are modeled in an identical way. GeomorphologicFeature is an abstract specialization of GeologicFeature with two sub-types, AnthropogenicGeomorphologicFeature and NaturalGeomorphologicFeature.

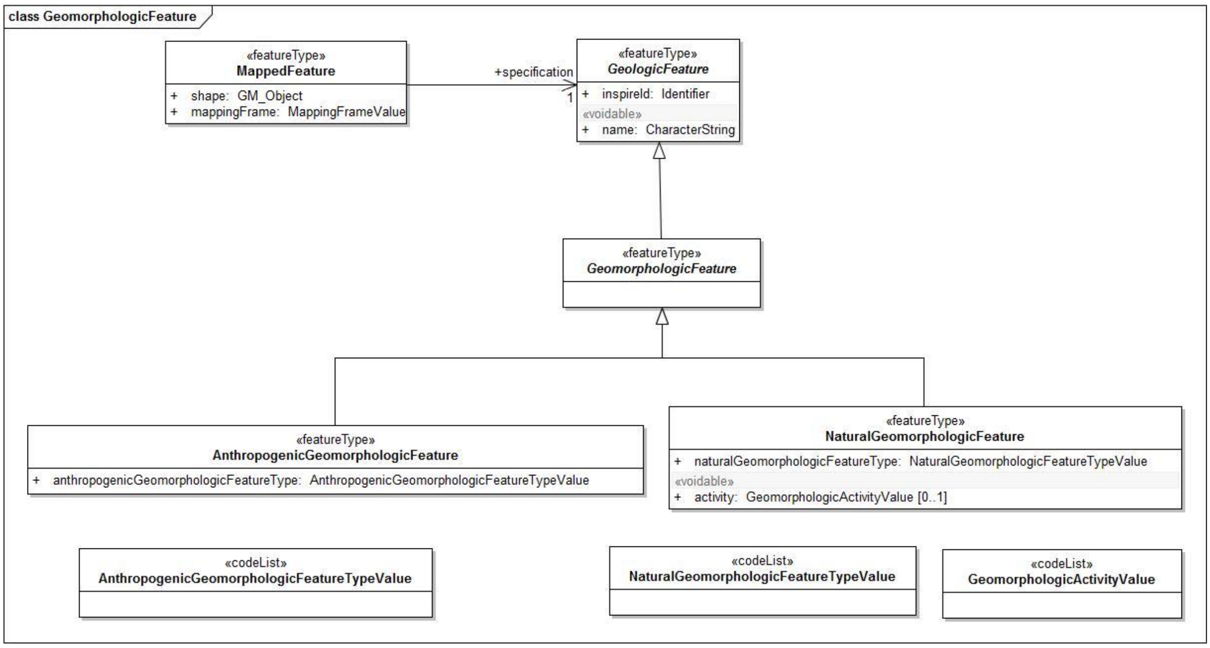

Figure 16: INSPIRE UML class diagram for GeomorphologicFeature

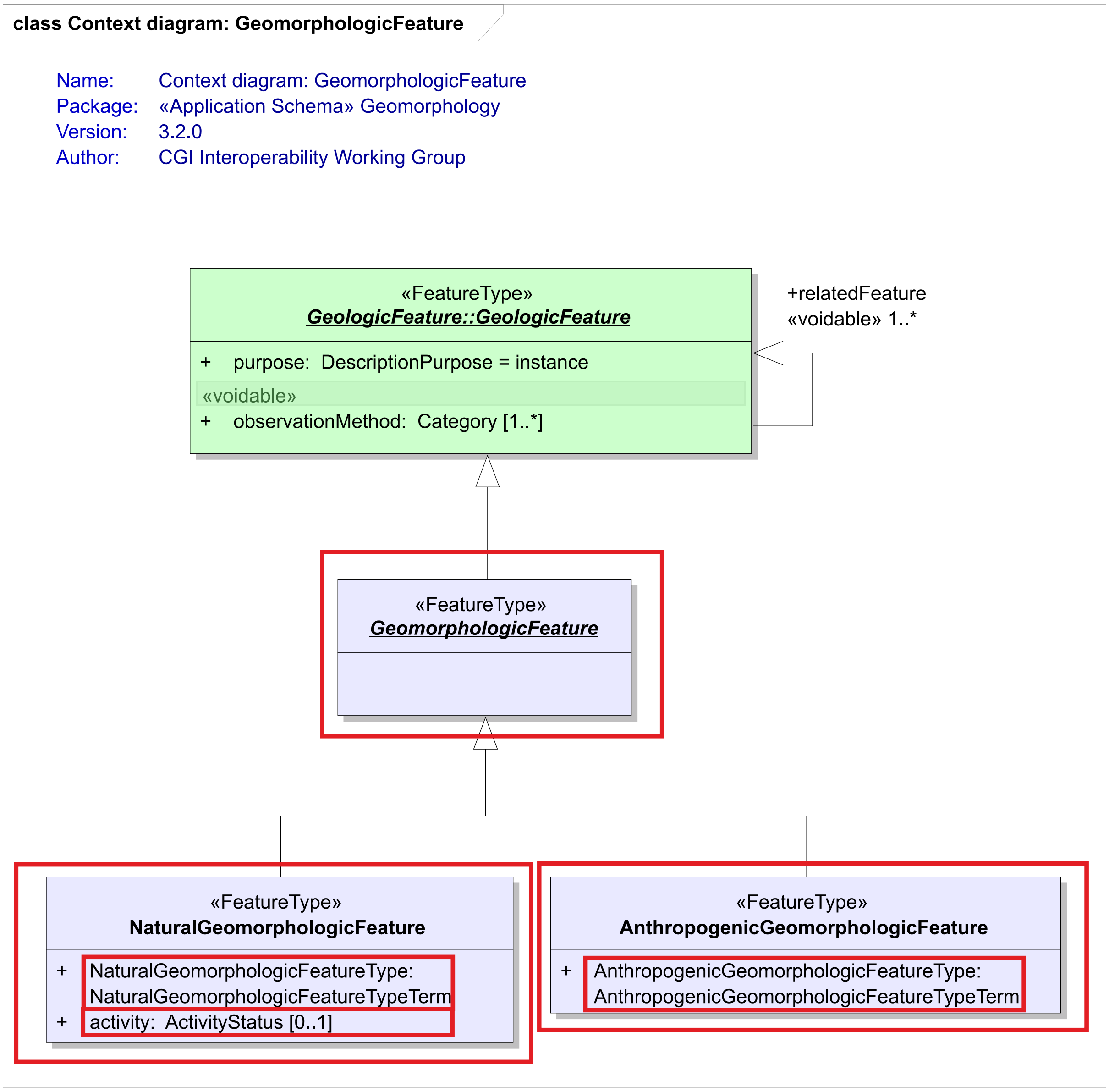

Figure 17: UML for the GeoSciML GeomorphologicFeature

2.5.1 Natural Geomorphologic Feature - NaturalGeomorphologicFeatureType

The NaturalGeomorphologicFeatureType property describes the type of NaturalGeomorphologicFeature and should be populated with a value drawn from the NaturalGeomorphologicFeatureTypeValue vocabulary (http://inspire.ec.europa.eu/codelist/NaturalGeomorphologicFeatureTypeValue).

2.5.2 Natural Geomorphologic Feature – activity

The activity property describes the level of activity of a NaturalGeomorphologicFeature and should be populated with a value from the GeomorphologicActivityValue vocabulary (http://inspire.ec.europa.eu/codelist/GeomorphologicActivityValue).

2.5.3 Anthropomorphic Geomorphologic Feature – AnthropogenicGeomorphologicFeatureType

The AnthopogenicGeomorphologicFeatureType property describes the type of AnthropogenicGeomorphologicFeature and should be populated with a value drawn from the AnthropogenicGeomorphologicFeatureTypeValue vocabulary (http://inspire.ec.europa.eu/codelist/AnthropogenicGeomorphologicFeatureTypeValue).

2.6 Thematic Class

The INSPIRE Thematic Class datatype (Figure 2) is designed to enable information on thematic maps to be delivered. Thematic maps commonly take a standard geological map and reclassify it using some vocabulary of concepts, for example a standard lithostratigraphic map might be reclassified into 'engineering geology units' based on various generalized physical properties of the lithostratigraphic units. This doesn't involve any new mapping, although it may lead to units being merged together.

There is no standard for thematic maps and therefore each data provider must provide their own vocabulary for classifying a particular map for a particular theme.

2.6.1 Geologic Feature – classifier

There is no direct equivalent of Thematic Class in GeoSciML but it can nevertheless be encoded in GeoSciML using the classifier association from GeologicFeature to ControlledConcept (Figure 3). This provides the URI of the relevant value in the thematic classification vocabulary being used (Figure 18).

```
          <gsmlgu:GeologicUnit gml:id="INV-SDSM">
            <gml:identifier codeSpace="http://data.bgs.ac.uk/id/Lexicon/NamedRockUnit">INV</gml:identifier>
            <gml:name>INVERCLYDE GROUP</gml:name>
            <gsml:observationMethod> [17 lines]
            <gsml:purpose>typicalNorm</gsml:purpose>
<!--  -->
<!-- The GeologicAge is provided by a relationship to a GeologicEvent -->
<!--  -->
            <gsml:relatedFeature> [46 lines]
<!--  -->
<!-- Example of a thematic classification of a GeologicUnit -->
<!--  -->
            <gsml:classifier
              xlink:href="http://data.bgs.ac.uk/ref/EngineeringGeologyTheme/strongSandstone"
              xlink:title="Engineering Geology theme: Strong Sandstone"/>
```

Figure 18: Example of encoding a GeologicUnit with a thematic classifier

2.7 Borehole

The INSPIRE UML class diagram for Borehole is shown in Figure 19 and the UML of the GeoSciML Borehole package in Figure 21. Although the modelling of boreholes in GeoSciML is more complex it includes everything required for INSPIRE which can therefore be encoded with GeoSciML. One of the main differences is that in

GeoSciML Borehole is modelled as a type of SamplingCurve, drawn from the OGC Observations & Measurements model.

The logElement association from Borehole to MappedInterval is the means by which the borehole log is encoded. MappedInterval is a type of MappedFeature and there should be one MappedInterval (logElement) for every discrete unit described down the borehole. A borehole encoded as a series of logElements can be seen as a 'vertical geological map' with each MappedInterval specified by a GeologicFeature in the same way as polygons on the map. It is also possible in GeoSciML to encode the borehole as a series of observations, using the OGC Observations & Measurements model, but as this isn't a requirement for INSPIRE it won't be described further here.

2.7.1 Borehole – inspireId

The INSPIRE inspireId property provides the persistent identifier used for the borehole by the data provider. This should be encoded using gml:identifier which requires both the identifier value and the codespace identifying the data source (Figure 7).

2.7.2 Borehole – sampledFeature

This property isn't required by INSPIRE but is mandatory for SamplingFeature and thus Borehole in GeoSciML. In a typical borehole being encoded the sampledFeatures will be the features, such as GeologicUnits, which the borehole penetrates and which specify the log elements (see section 2.7.7). There should be one sampledFeature encoded for each distinct feature in the log, and they can be referenced using the gml:id value of the feature. No extra information is therefore required to encode this property.

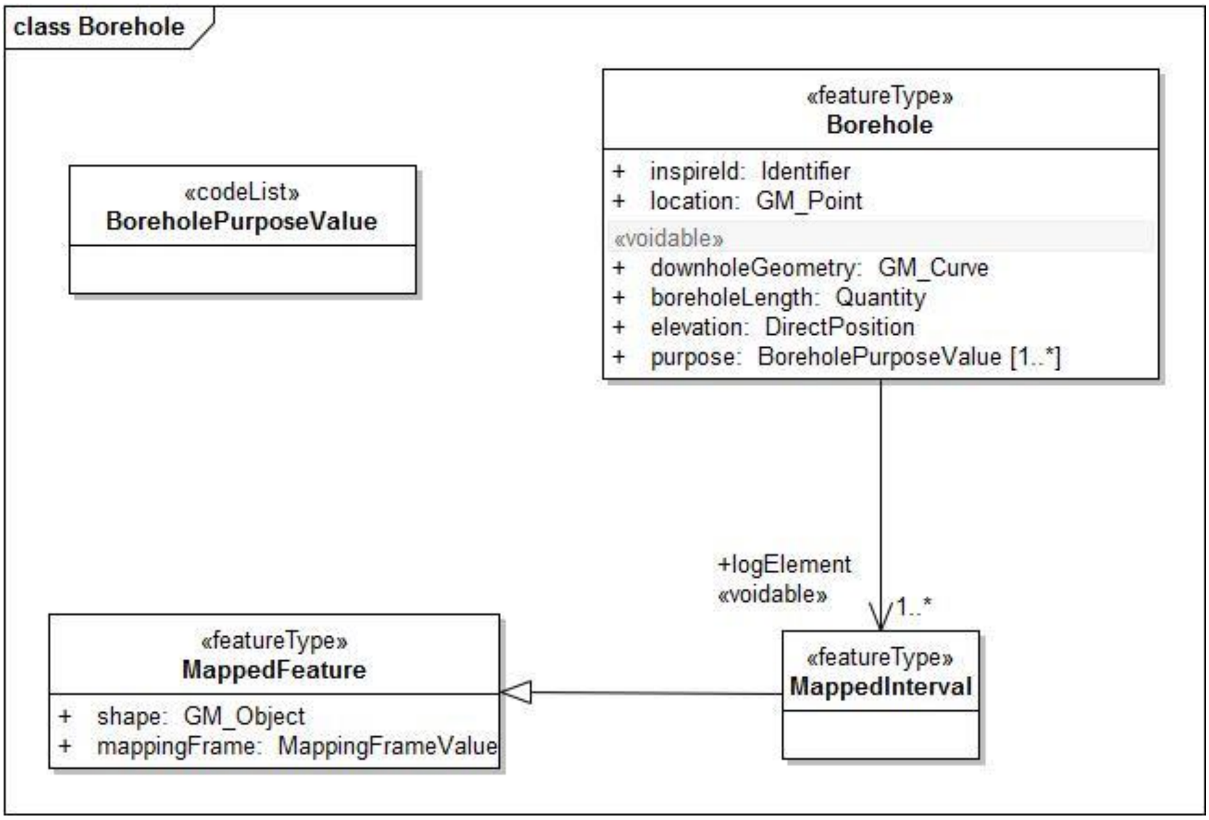

Figure 19: INSPIRE UML class diagram for Borehole

2.7.3 Borehole – downholeGeometry

This should be encoded using the SF_SpatialSamplingFeature shape association to GM_Object to provide a LineString with the 3D geometry of the borehole (Figure 20). Where the borehole is vertical the X and Y co-ordinates will be the same for all positions. The LineString should be given an identifier using gml:id for use in referencing the log elements (section 2.7.9)

```
<sams:shape>
 <gml:LineString gml:id="bh.ns94se5.shape" srsName="urn:ogc:def:crs:EPSG:6.15:7405">
  <gml:posList srsDimension="3" count="7">-30.7111 134.2059 321. -30.7112 134.2058 315.
   -30.7113 134.2057 303. -30.7114 134.2056 296.
   -30.7115 134.2055 272. -30.7116 134.2054 271.
   -30.7117 134.2053 270.</gml:posList>
 </gml:LineString>
</sams:shape>
```

Figure 20: Example of encoding the downhole geometry of a borehole

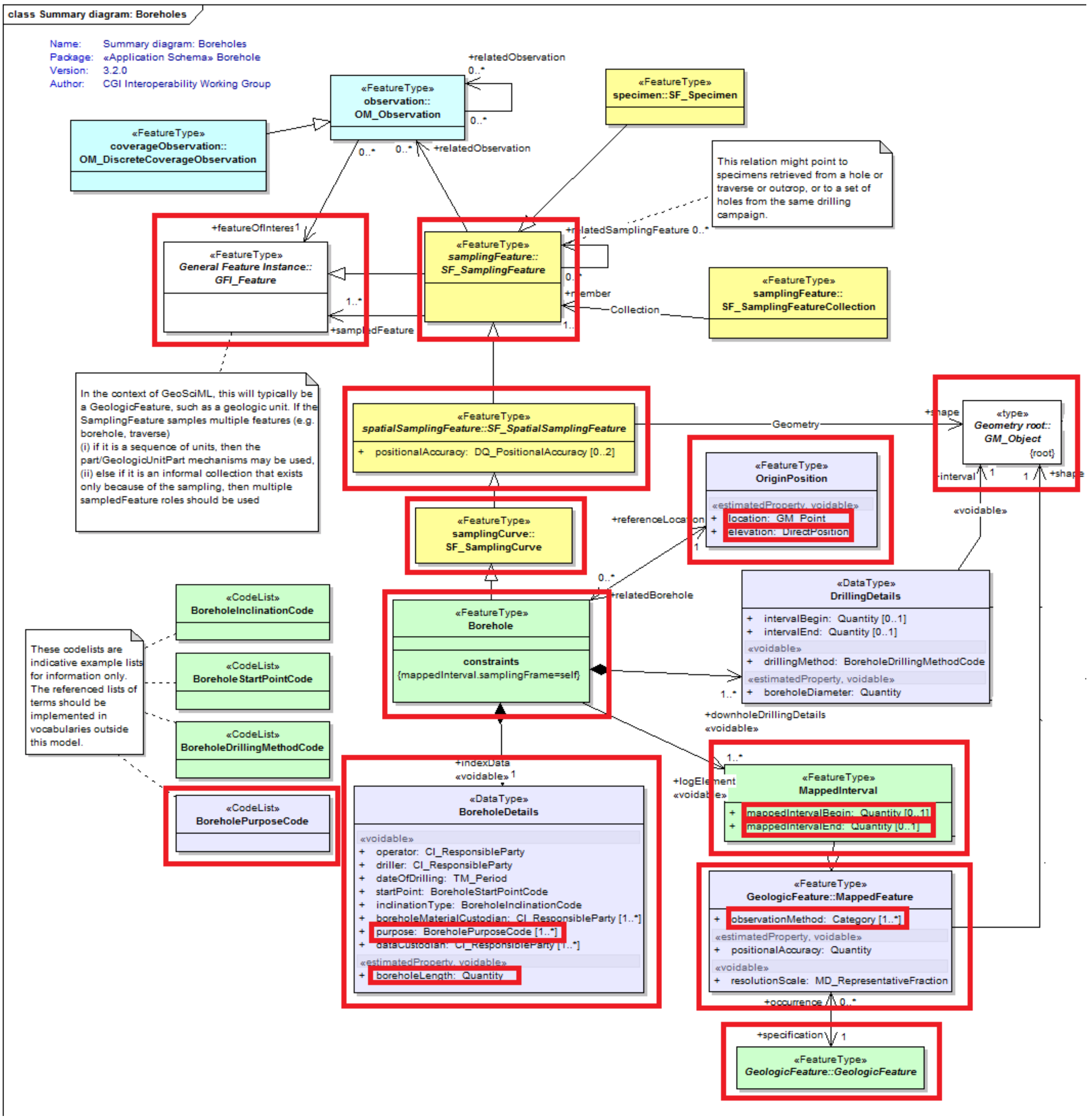

Figure 21: UML for the GeoSciML Borehole package

2.7.4 Borehole – location and elevation

The referenceLocation association from borehole to OriginPosition allows the encoding of both location and elevation. Location should be encoded as a two dimensional point and elevation as a one dimensional value (Figure 22).

```
<gsmlbh:referenceLocation>
 <gsmlbh:OriginPosition gml:id="op1">
  <gsmlbh:location>
   <gml:Point gml:id="pt1" srsName="urn:ogc:def:crs:EPSG:6.15:27700" srsDimension="2">
    <gml:pos>-30.7 134.2</gml:pos>
```

```xml
      </gml:Point>
    </gsmlbh:location>
    <gsmlbh:elevation srsName="urn:ogc:def:crs:EPSG:6.15:5701" srsDimension="1"
      >321.0</gsmlbh:elevation>
  </gsmlbh:OriginPosition>
</gsmlbh:referenceLocation>
```

Figure 22: Example of encoding the location and elevation of a borehole

2.7.5 Borehole – purpose

The purpose property describes the purpose for which the Borehole was drilled and should be populated with a value from the BoreholePurposeValue vocabulary (http://inspire.ec.europa.eu/codelist/BoreholePurposeValue).

2.7.6 Borehole – boreholeLength

The boreholeLength records the total length down the borehole and should be encoded as a Quantity value, which requires the units of measurement to be recorded along with the value (Figure 23). The unit of measure should reference the URI of an OGC definition.

```xml
<gsmlbh:boreholeLength>
  <swe:Quantity>
    <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
      xlink:title="metre"/>
    <swe:value>51.0</swe:value>
  </swe:Quantity>
</gsmlbh:boreholeLength>
```

Figure 23: Example of encoding the boreholeLength

2.7.7 Mapped Interval - observationMethod

This should be encoded as described for MappedFeature in section 2.1.1.

2.7.8 Mapped Interval - samplingframe

The samplingFrame of the MappedInterval is the borehole in which the MappedInterval is described. It should therefore be encoded by referencing the gml:id of the borehole, rather than a value from the MappingFrameValue vocabulary (Figure 24).

```xml
<gsml:samplingFrame xlink:href="#bh.ns94se5"/>
```

Figure 24: Example of encoding a MappedInterval samplingFrame

2.7.9 Mapped Interval – geometry (shape)

The geometry of the MappedInterval is the one dimensional linear segment down the borehole that the MappedInterval refers to. The reference system is the geometry of the borehole, which can be referenced using the gml:id of the borehole shape property (Figure 20). An example of encoding MappedInterval geometry is given in Figure 25.

```
<gsml:shape>
 <gml:LineString gml:id="ls1" srsName="#bh.ns94se5.shape">
  <gml:posList srsDimension="1" count="2">0.0 2.0</gml:posList>
 </gml:LineString>
</gsml:shape>
```

Figure 25: Example of encoding MappedInterval geometry

2.7.10 Mapped Interval – specification

A MappedInterval is specified by a GeologicFeature in exactly the same way as described in section 2.1 for MappedFeature. The encoding of a GeologicFeature specifying a MappedInterval is therefore identical to that described above for MappedFeatures and won't be repeated here.

2.7.11 Mapped Interval – mappedIntervalBegin & mappedIntervalEnd

The mappedIntervalBegin and mappedIntervalEnd properties hold the one dimensional co-ordinates of the start and end of the mappedInterval, as measured down the borehole, encoded as Quantity values (Figure 26). This information duplicates that held in the shape property, but queries such as 'find all MappedIntervals within 10m of the surface' are difficult to implement with current technology using the shape property and the mappedIntervalBegin and mappedIntervalEnd properties have been introduced to address this problem.

```
<gsmlbh:mappedIntervalBegin>
 <swe:Quantity>
  <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
   xlink:title="metre"/>
  <swe:value>0.0</swe:value>
 </swe:Quantity>
</gsmlbh:mappedIntervalBegin>
<gsmlbh:mappedIntervalEnd>
 <swe:Quantity>
  <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
   xlink:title="metre"/>
  <swe:value>2.0</swe:value>
 </swe:Quantity>
</gsmlbh:mappedIntervalEnd>
```

Figure 26: Example of encoding mappedIntervalBegin and mappedIntervalEnd

2.8 Geologic Collection

The GeologicCollection in INSPIRE is designed to enable features which comprise a higher level object, such as a geological map or a borehole exploration programme, to be grouped together. This enables information such as metadata to be provided for the collection of features as a whole. It is not necessary to use a GeologicCollection where features do not form part of such a higher level object. The INSPIRE UML class diagram for GeologicCollection is shown in Figure 27.

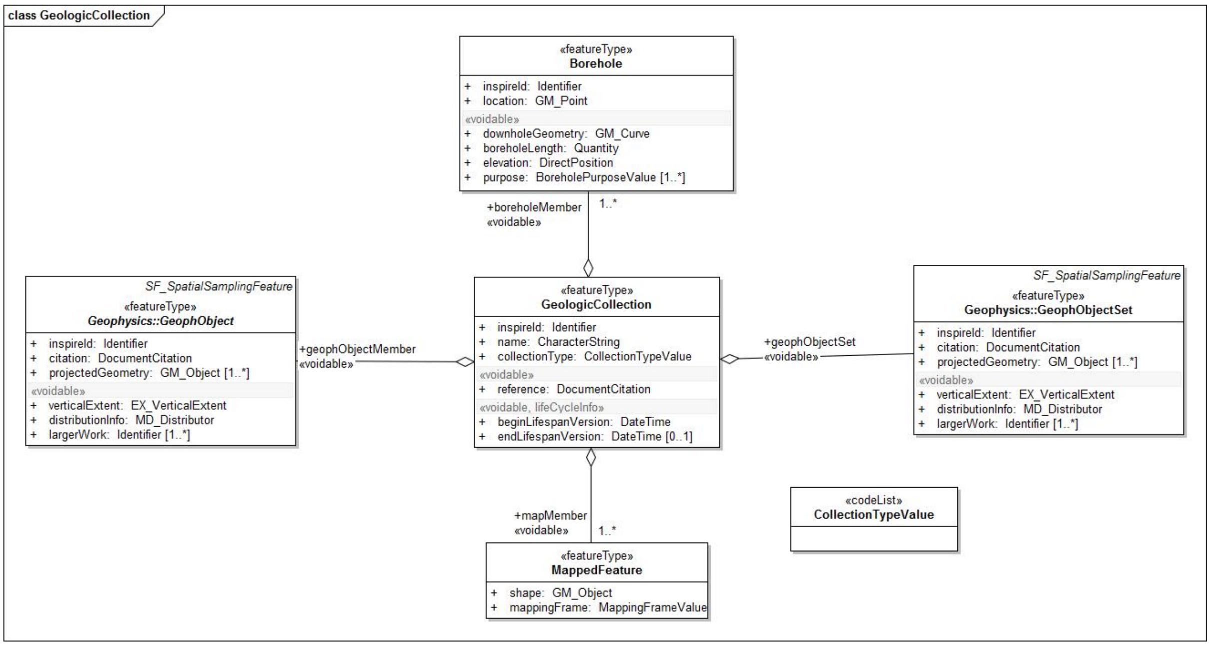

Figure 27: INSPIRE UML class diagram for GeologicCollection

In GeoSciML collections are modelled with the GSML feature (Figure 29).

Where features are not part of a GSML collection each individual feature is a member of a wfs:FeatureCollection. GSML is a GML feature so where a GSML collection is being delivered it is the GSML collection which is a member of the wfs:FeatureCollection and individual features are members of the GSML collection (Figure 28).

```
<wfs:member>
  <gsmlc:GSML gml:id="col1">
    <gml:identifier codeSpace="http://data.bgs.ac.uk/ref">625KGeologyMap</gml:identifier>
    <gml:name>BGS 1:625 000 Digital Geological Map</gml:name>
    <gsmlc:collectionType xlink:href="http://inspire.ec.europa.eu/codelist/CollectionTypeValue/geologicalMap"
     xlink:title="Geological Map"/>
     <gsmlc:member>
       <gsml:MappedFeature gml:id="mf.16">
     ....etc
```

Figure 28: Example of encoding a GSML collection as a member of a wfs:FeatureCollection and a MappedFeature as a member of the GSML collection

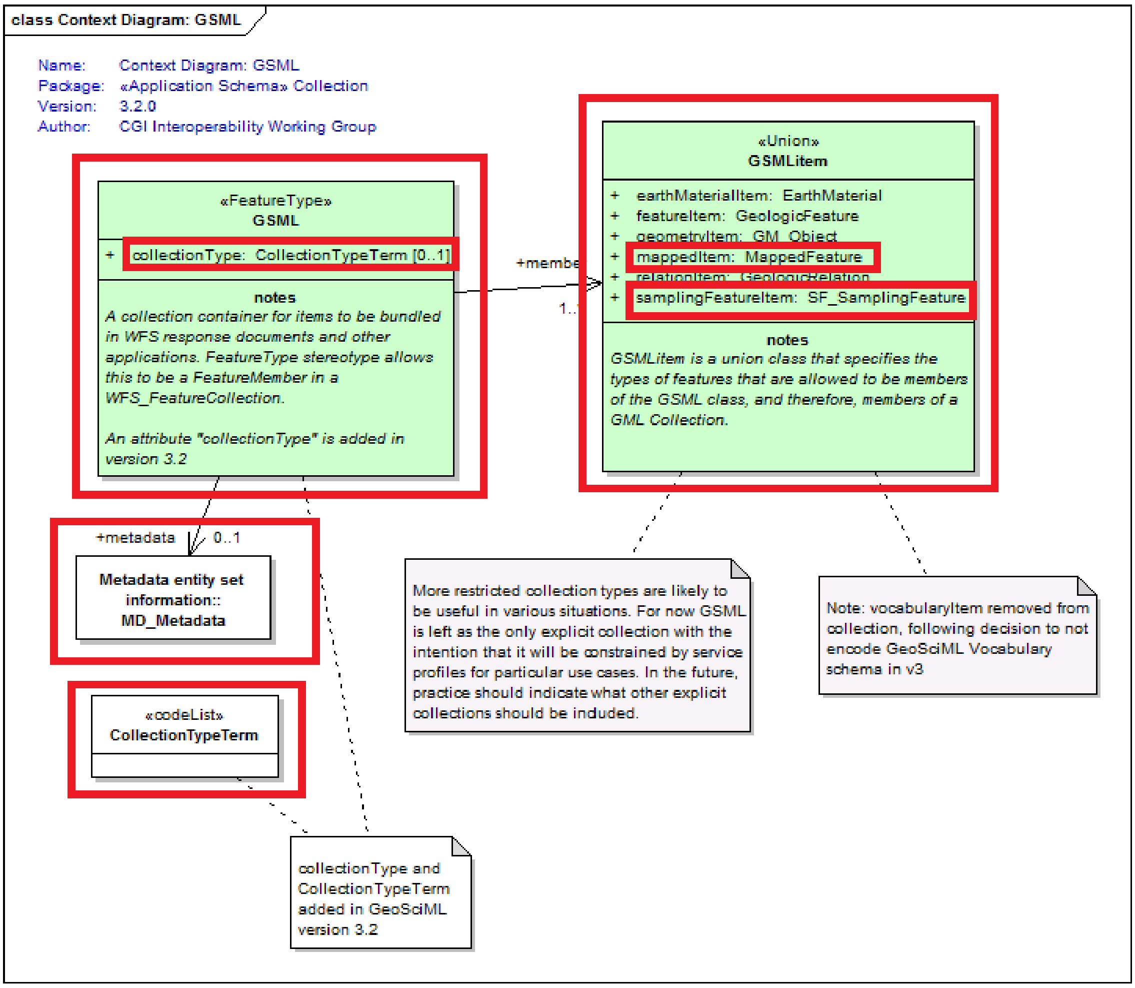

Figure 29: UML class diagram for GeoSciML Collection package

The INSPIRE reference, beginLifespanVersion and endLifespanVersion properties can all be implemented in GeoSciML using the metadata association from GSML to MD_Metadata (Figure 29). The use of MD_Metadata also requires certain other mandatory properties to be encoded which are not required by the INSPIRE data specification.

2.8.1 Geologic Collection – inspireId

The INSPIRE inspireId property provides the persistent identifier used for the GeologicCollection by the data provider. This should be encoded using gml:identifier which requires both the identifier value and the codespace identifying the data source (Figure 28).

2.8.2 Geologic Collection – name

The INSPIRE name property provides the name of the GeologicCollection. It should be encoded using gml:name (Figure 28).

2.8.3 Geologic Collection – collectionType

The collectionType property describes the type of collection and should be populated with a value from the CollectionTypeValue vocabulary (http://inspire.ec.europa.eu/codelist/CollectionTypeValue) (Figure 28).

2.8.4 Geologic Collection – member

In INSPIRE there are four types of feature which can be members of a GeologicCollection: MappedFeature; Borehole; GeophObject; and GeophObjectSet (Figure 27). In GeoSciML the member association from GSML to GSMLItem allows the members of a GSML collection to be any of the types in the GSMLItem union class. The types of member of an INSPIRE GeologicCollection can be mapped to these: MappedFeature maps to mappedItem; and Borehole, GeophObject and GeophObjectSet all map to samplingFeatureItem (Figure 29). Figure 28 shows the encoding of a MappedFeature as a member of a GSML collection.

2.8.5 MD_Metadata - contact

Although the MD_Metadata contact property is not required by INSPIRE it is mandatory for MD_Metadata. It identifies the organisation providing the metadata and its role with respect to the metadata. It is of type CI_ResponsibleParty which requires the encoding of the organisationName and role properties, the latter with values drawn from the CI_RoleCode vocabulary (http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode). Figure 30 gives an example of the encoding of contact.

```
<gmd:contact>
  <gmd:CI_ResponsibleParty>
    <gmd:organisationName>
      <gco:CharacterString>British Geological Survey (BGS)</gco:CharacterString>
    </gmd:organisationName>
    <gmd:role>
      <gmd:CI_RoleCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
          codeListValue="owner">owner</gmd:CI_RoleCode>
    </gmd:role>
  </gmd:CI_ResponsibleParty>
</gmd:contact>
```

Figure 30: Example of encoding MD_Metadata.contact

2.8.6 MD_Metadata - dateStamp

Although the MD_Metadata dateStamp property is not required by INSPIRE it is mandatory for MD_Metadata. It provides the date when the metadata was created and should follow the format defined in ISO8601. An example of encoding dateStamp is given in Figure 31.

```
<gmd:dateStamp>
  <gco:Date>2011-03-08</gco:Date>
</gmd:dateStamp>
```

Figure 31: Example of encoding MD_Metadata.dateStamp

2.8.7 Geologic Collection - reference

The reference property is of type DocumentCitation which requires the provision of a name, shortName, date and link (URL). The first three of these properties can be encoded using the MD_DataIdentification.citation property which is of type CI_Citation.

2.8.7.1 Document Citation – name

The DocumentCitation.name property can be encoded with CI_Citation.title (Figure 32). This property duplicates the information encoded in gml:name (section 2.8.2).

2.8.7.2 Document Citation – shortName

The DocumentCitation.shortName property can be encoded with CI_Citation.alternateTitle (Figure 32). This property is optional in INSPIRE and should be used where the GeologicCollection has a well recognised short name.

2.8.7.3 Document Citation – date

The DocumentCitation.date refers to the date cited in the reference, such as publication date or revision date. It can be encoded with CI_Citation.date (Figure 32) which is of type CI_Date requiring both the date and the dateType to be provided. The dateType property identifies what the date is referring to and should be encoded using a value drawn from the CI_DateTypeCode vocabulary (http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCod).

```
<gmd:CI_Citation>
 <gmd:title>
  <gco:CharacterString>BGS 1:625 000 Digital Geological Map</gco:CharacterString>
 </gmd:title>
 <gmd:alternateTitle>
  <gco:CharacterString>BGS 625k Map</gco:CharacterString>
 </gmd:alternateTitle>
 <gmd:date>
  <gmd:CI_Date>
   <gmd:date>
    <gco:Date>2012</gco:Date>
   </gmd:date>
   <gmd:dateType>
    <gmd:CI_DateTypeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
     codeListValue="revision">revision</gmd:CI_DateTypeCode>
   </gmd:dateType>
  </gmd:CI_Date>
 </gmd:date>
 <gmd:date>
</gmd:CI_Citation>
```

Figure 32: Example of encoding DocumentCitation using CI_Citation

2.8.7.4 Document Citation – link

The DocumentCitation.link property is defined as providing an online link to the document (not the citation of the document), and so should provide the URL of the GeologicCollection. This can be encoded using the MD_Metadata.dataSetURI property (Figure 33). However in the revised version of ISO19115 this property will be deprecated and a new property, MD_DigitalTransferOptions.online, should be used.

```
<gmd:dataSetURI>
  <gco:CharacterString>http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html</gco:CharacterString>
</gmd:dataSetURI>
```

Figure 33: Example of encoding DocumentCitation.link using MD_Metadata.dataSetURI

2.8.8 Geologic Collection – beginLifespanVersion & endLifespanVersion

The beginLifespanVersion and endLifespanVersion properties can both be encoded using the CI_Citation.date property (section 2.8.7.3), but with different values for the dateType property. The date should be encoded using the format defined in ISO8601. In the revised version of ISO19115 the CI_DateTypeCode vocabulary has been significantly extended and beginLifespanVersion should have a dateType code value of validityBegins and endLifespanVersion should have a dateType code value of validityEnds (Figure 34). The endLifespanVersion property should not be encoded if the GeologicCollection is still valid.

```
<gmd:date>
 <gmd:CI_Date>
  <gmd:date>
   <gco:Date>2008</gco:Date>
  </gmd:date>
  <gmd:dateType>
   <gmd:CI_DateTypeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="validityBegins">validityBegins</gmd:CI_DateTypeCode>
  </gmd:dateType>
 </gmd:CI_Date>
</gmd:date>
<gmd:date>
 <gmd:CI_Date>
  <gmd:date>
   <gco:Date>2013</gco:Date>
  </gmd:date>
  <gmd:dateType>
   <gmd:CI_DateTypeCode
codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="validityEnds">validityEnds</gmd:CI_DateTypeCode>
  </gmd:dateType>
 </gmd:CI_Date>
</gmd:date>
```

Figure 34: Example of encoding beginLifespanVersion and endLifespanVersion using CI_Citation.date

2.8.9 MD_DataIdentification - abstract

Although the MD_DataIdentification abstract property is not required by INSPIRE it is mandatory for MD_DataIdentification. It should be populated with a text description of the GeologicCollection (Figure 35).

2.8.10 MD_DataIdentification – language

Although the MD_DataIdentification language property is not required by INSPIRE it is mandatory for MD_DataIdentification. It identifies the language(s) used in the GeologicCollection and should be encoded using the language codes defined in ISO639-2 (Figure 35).

2.8.11 MD_DataIdentification – topicCategory

Although the MD_DataIdentification topicCategory property is not required by INSPIRE it is mandatory for MD_DataIdentification where the metadata is referring to a dataset. A GeologicCollection can be considered a dataset. MD_DataIdentification topicCategory should be populated with a value from the MD_TopicCategory_Code vocabulary (http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#MD_TopicCategoryCode) (Figure 35).

```xml
<gmd:abstract>
  <gco:CharacterString>The data shows polygonal and selected linear geological information, sourced
   from published BGS 1:625 000 scale maps of Great Britain. However, geological units are identified
   using the most up-to-date nomenclature that may differ from that on the printed maps. The maps are
   generally based on published material at 1:50 000 scale and compiled using techniques of selection,
   generalisation and exaggeration. The geology is fitted to a relevant topographic base at the time
   of production. Full UK coverage is available. The data is available in vector format. BGS licensing
   terms and conditions apply to external use of the data. The data can be used free of charge for
   non commercial use and is downloadable from the website.</gco:CharacterString>
</gmd:abstract>
<gmd:language>
  <gco:CharacterString>eng</gco:CharacterString>
</gmd:language>
<gmd:topicCategory>
  <gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
</gmd:topicCategory>
```

Figure 35: Example of encoding MD_Identification.abstract, MD_Identification.language and MD_Identification.topicCategory

Annex 1: Mapping of INSPIRE GE classes and properties to GeoSciML equivalents

INSPIRE GE class	INSPIRE GE property /association	GeoSciML class	GeoSciML property / association
AnthropogenicGeomorphologicFeature		AnthropogenicGeomorphologicFeature	
AnthropogenicGeomorphologicFeature	anthropogenic GeomorphologicFeatureType	AnthropogenicGeomorphologicFeature	anthropogenic GeomorphologicFeatureType
AnthropogenicGeomorphologicfeatureTypeValue		AnthropogenicGeomorphologicfeatureTypeTerm	
Borehole		Borehole	
Borehole	inspireId	Borehole	gml:identifier
Borehole	downholeGeometry	SF_SamplingCurve	shape
Borehole	location	OriginPosition	location
Borehole	boreholeLength	BoreholeDetails	boreholeLength
Borehole	elevation	OriginPosition	elevation
Borehole	purpose	BoreholeDetails	purpose
Borehole	logElement	Borehole	logElement
BoreholePurposeValue		BoreholePurposeCode	
CollectionTypeValue		CollectionTypeTerm	
CompositionPart		CompositionPart	
CompositionPart	material	RockMaterial	lithology
CompositionPart	role	CompositionPart	role
CompositionPart	proportion	CompositionPart	proportion
CompositionPartRoleValue		CompositionPartRoleTerm	
EventEnvironmentValue			
EventProcessValue		EventProcessTerm	
FaultTypeValue		FaultTypeTerm	
Fold		Fold	
Fold	profileType	Fold	profileType
FoldProfileTypeValue		FoldProfileTypeTerm	
GeochronologicEraValue		GeochronologicEra	
GeologicCollection		GSML	
GeologicCollection	inspireId	GSML	gml:identifier
GeologicCollection	name	GSML	gml:name
GeologicCollection	collectionType	GSML	collectionType

GeologicCollection	reference	GSML	metadata
GeologicCollection	beginLifespanVersion	GSML	metadata
GeologicCollection	endLifeSpanVersion	GSML	metadata
GeologicCollection	boreholeMember	GSML	member (where GSMLitem = samplingFeatureItem)
GeologicCollection	mapMember	GSML	member (where GSMLitem = mappedItem)
GeologicCollection	geophObjectMember	GSML	member (where GSMLitem = samplingFeatureItem)
GeologicCollection	geophObjectSet	GSML	member (where GSMLitem = samplingFeatureItem)
GeologicEvent		GeologicEvent	
GeologicEvent	name	GeologicFeature	gml:name
GeologicEvent	eventEnvironment	GeologicEvent	eventEnvironment
GeologicEvent	eventProcess	GeologicEvent	eventProcess
GeologicEvent	olderNamedAge	GeologicEvent	olderNamedAge
GeologicEvent	youngerNamedAge	GeologicEvent	youngerNamedAge
GeologicFeature		GeologicFeature	
GeologicFeature	inspireId	GeologicFeature	gml:identifier
GeologicFeature	name	GeologicFeature	gml:name
GeologicFeature	themeClass	GeologicFeature	classifier
GeologicFeature	geologicHistory	GeologicFeature	relatedFeature (where the relationship type is GeologicHistory)
GeologicStructure		GeologicStructure	
GeologicUnit		GeologicUnit	
GeologicUnit	geologicUnitType	GeologicUnit	geologicUnitType
GeologicUnit	composition	GeologicUnit	composition
GeologicUnitTypeValue		GeologicUnitTypeTerm	
GeomorphologicActivityValue		ActivityStatus	
GeomorphologicFeature		GeomorphologicFeature	
LithologyValue		LithologyTerm	
MappedFeature		MappedFeature	
MappedFeature	shape	MappedFeature	shape
MappedFeature	mappingFrame	MappedFeature	samplingFrame
MappedFeature	specification	MappedFeature	specification
MappedInterval		MappedInterval	
MappingFrameValue			
NaturalGeomorphologicFeature		NaturalGeomorphologicFeature	
NaturalGeomorphologicFeature	naturalGeomorphologicFeatureType	NaturalGeomorphologicFeature	naturalGeomorphologicFeatureType
NaturalGeomorphologicFeature	activity	NaturalGeomorphologicFeature	activity
NaturalGeomorphologicFeatureTypeValue		NaturalGeomorphologicFeatureTypeTerm	
ShearDispacementStructure		ShearDispacementStructure	

ShearDispacementStructure	faultTypeTerm	ShearDispacementStructure	faultTypeTerm
ThematicClass		GeologicFeature	
ThematicClass	themeClassification	GeologicFeature	classifier
ThematicClass	themeClass	GeologicFeature	classifier
ThemeClassValue			
ThemeClassificationValue			

Annex 2: Example of encoding the INSPIRE Geology application schema in GeoSciML


```xml
<?xml version="1.0" encoding="UTF-8"?>
<!--Created by GO Publisher WFS 2.1.2 Build 28125 from 2012-03-22 11:26-->
<!--Snowflake Software Ltd. (http://www.snowflakesoftware.com)-->
<wfs:FeatureCollection xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:xs="http://www.w3.org/2001/XMLSchema"
 xmlns:gsml="http://xmlns.geosciml.org/GeoSciML-Core/3.2"
 xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns:gco="http://www.isotc211.org/2005/gco"
 xmlns:gss="http://www.isotc211.org/2005/gss" xmlns:gts="http://www.isotc211.org/2005/gts"
 xmlns:gsr="http://www.isotc211.org/2005/gsr" xmlns:swe="http://www.opengis.net/swe/2.0"
 xmlns:sam="http://www.opengis.net/sampling/2.0" xmlns:om="http://www.opengis.net/om/2.0"
 xmlns:gsmlc="http://xmlns.geosciml.org/Collection/3.2"
 xmlns:gsmlgu="http://xmlns.geosciml.org/GeologicUnit/3.2"
 xmlns:gsmlst="http://xmlns.geosciml.org/GeologicStructure/3.2"
 xmlns:gsmlgm="http://xmlns.geosciml.org/Geomorphology/3.2"
 xmlns:gsmlem="http://xmlns.geosciml.org/EarthMaterial/3.2"
 xmlns:gsmlga="http://xmlns.geosciml.org/GeologicAge/3.2"
 xmlns:gsmlbh="http://xmlns.geosciml.org/Borehole/3.2"
 xmlns:gsmlgt="http://xmlns.geosciml.org/GeologicTime/3.0"
 xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
 xmlns:gsmltrs="http://xmlns.geosciml.org/TemporalReferenceSystem/3.2"
 xmlns:gsmlpp="http://xmlns.geosciml.org/PhysicalProperties/3.2"
 xmlns:wfs="http://www.opengis.net/wfs/2.0" xmlns:ows="http://www.opengis.net/ows/1.1"
 xmlns:fes="http://www.opengis.net/fes/2.0"
 xsi:schemaLocation="http://xmlns.geosciml.org/GeoSciML-Core/3.2 http://schemas.geosciml.org/geosciml-core/3.2/geosciml-core.xsd
 http://xmlns.geosciml.org/GeologicUnit/3.2 http://schemas.geosciml.org/geologicunit/3.2/geologicUnit.xsd
 http://xmlns.geosciml.org/GeologicStructure/3.2 http://schemas.geosciml.org/geologicstructure/3.2/geologicStructure.xsd
 http://xmlns.geosciml.org/Borehole/3.2 http://schemas.geosciml.org/borehole/3.2/borehole.xsd
 http://xmlns.geosciml.org/Collection/3.2 http://schemas.geosciml.org/collection/3.2/collection.xsd
 http://www.opengis.net/wfs/2.0 http://schemas.opengis.net/wfs/2.0/wfs.xsd
 http://xmlns.geosciml.org/Geomorphology/3.2 http://schemas.geosciml.org/geomorphology/3.2/geomorphology.xsd"
 numberMatched="1" numberReturned="1" timeStamp="2013-03-05T16:05:36">
 <!--  -->
```

```xml
<!-- All features have been included in a GSML collection as an example -->
<!--  -->
<wfs:member>
 <gsmlc:GSML gml:id="col1">
  <gml:identifier codeSpace="http://data.bgs.ac.uk/ref">625KGeologyMap</gml:identifier>
  <gml:name>BGS 1:625 000 Digital Geological Map</gml:name>
  <gsmlc:collectionType
   xlink:href="http://inspire.ec.europa.eu/codelist/CollectionTypeValue/geologicalMap"
   xlink:title="Geological Map"/>
  <!--  -->
  <!-- A Geologic Unit example -->
  <!--  -->
  <gsmlc:member>
   <gsml:MappedFeature gml:id="mf.16">
    <gsml:observationMethod>
     <swe:Category
      definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
      <swe:extension>
       <swe:Category
        definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
        <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
        <swe:label>always</swe:label>
        <swe:codeSpace
         xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
        />
       </swe:Category>
      </swe:extension>
      <swe:identifier>http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/compilation</swe:identifier>
      <swe:label>Compilation</swe:label>
      <swe:codeSpace
       xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
      />
     </swe:Category>
    </gsml:observationMethod>
    <gsml:positionalAccuracy nilReason="unpopulated" xsi:nil="true"/>
    <gsml:resolutionScale gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsml:samplingFrame
     xlink:href="http://inspire.ec.europa.eu/codelist/MappingFrameValue/topOfBedrock"
```

```
 xlink:title="top of bedrock"/>
<gsml:shape>
 <gml:Polygon srsName="urn:ogc:def:crs:EPSG::4326" gml:id="LOCAL_ID_0">
  <gml:exterior>
   <gml:LinearRing>
    <gml:posList srsDimension="2" count="8">55.0760921318516 -3.31719604609088
     55.0833753209835 -3.31853455922777 55.0825574334633 -3.31921378657955
     55.0801997429522 -3.31978309699423 55.0768616358466 -3.3194575613054
     55.0741365291192 -3.31966903508197 55.0756843873373 -3.31747948721346
     55.0760921318516 -3.31719604609088</gml:posList>
   </gml:LinearRing>
  </gml:exterior>
 </gml:Polygon>
</gsml:shape>
<!--  -->
<!-- The MappedFeature is specified by a GeologicUnit -->
<!--  -->
<gsml:specification>
 <gsmlgu:GeologicUnit gml:id="INV-SDSM">
  <gml:identifier codeSpace="http://data.bgs.ac.uk/id/Lexicon/NamedRockUnit">INV</gml:identifier>
  <gml:name>INVERCLYDE GROUP</gml:name>
  <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
  <gsml:purpose>typicalNorm</gsml:purpose>
  <!--  -->
  <!-- The GeologicAge is provided by a relationship to a GeologicEvent -->
  <!--  -->
  <gsml:relatedFeature>
   <gsmlga:GeologicHistory gml:id="HIST_1">
    <gsml:relationship
     xlink:href="http://resource.geosciml.org/classifier/cgi/featurerelation/geologicfeaturegeneticevent"/>
    <gsml:sourceRole nilReason="unpopulated" xsi:nil="true"/>
    <gsml:targetRole nilReason="unpopulated" xsi:nil="true"/>
    <gsml:relatedFeature>
     <gsmlga:GeologicEvent gml:id="EVENT_1">
      <gml:name>UNNAMED EVENT</gml:name>
      <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
      <gsml:purpose>instance</gsml:purpose>
      <gsml:relatedFeature nilReason="unpopulated" xsi:nil="true"/>
```

```xml
      <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
      <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
      <gsmlga:eventProcess
       xlink:href="http://inspire.ec.europa.eu/codelist/EventProcessValue/mechanicalDeposition"
       xlink:title="mechanical deposition"/>
      <gsmlga:numericAgeDate nilReason="unpopulated" xsi:nil="true"/>
      <gsmlga:olderNamedAge
       xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/tournaisian"
       xlink:title="Tournaisian"/>
      <gsmlga:youngerNamedAge
       xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/visean"
       xlink:title="Visean"/>
      <gsmlga:eventEnvironment>
       <swe:Category
        definition="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue">
        <swe:extension>
         <swe:Category
          definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
          <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
          <swe:label>always</swe:label>
          <swe:codeSpace
           xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
          />
         </swe:Category>
        </swe:extension>
        <swe:identifier>http://inspire.ec.europa.eu/codelist/EventEnvironmentValue/riverPlainSystemSetting</swe:identifier>
        <swe:label>River plain system setting</swe:label>
        <swe:codeSpace
         xlink:href="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue"
        />
       </swe:Category>
      </gsmlga:eventEnvironment>
      <gsmlga:prototype nilReason="unpopulated" xsi:nil="true"/>
     </gsmlga:GeologicEvent>
    </gsml:relatedFeature>
   </gsmlga:GeologicHistory>
  </gsml:relatedFeature>
  <!--  -->
```

```xml
<!-- Example of a thematic classification of a GeologicUnit -->
<!--  -->
<gsml:classifier
 xlink:href="http://data.bgs.ac.uk/ref/EngineeringGeologyTheme/strongSandstone"
 xlink:title="Engineering Geology theme: Strong Sandstone"/>
<!--  -->
<!--  -->
<!--  -->
<gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
<gsmlgu:geologicUnitType
 xlink:href="http://inspire.ec.europa.eu/codelist/GeologicUnitTypeValue/lithostratigraphicUnit/"
 xlink:title="Lithostratigraphic Unit"/>
<gsmlgu:bodyMorphology nilReason="unknown" xsi:nil="true"/>
<gsmlgu:unitComposition nilReason="unknown" xsi:nil="true"/>
<gsmlgu:exposureColor nilReason="unpopulated" xsi:nil="true"/>
<gsmlgu:outcropCharacter nilReason="unpopulated" xsi:nil="true"/>
<gsmlgu:rank nilReason="unpopulated" xsi:nil="true"/>
<gsmlgu:unitThickness nilReason="unpopulated" xsi:nil="true"/>
<!--  -->
<!-- The composition (lithology) of the GeologicUnit -->
<!-- There are three component lithologies in this example -->
<!--  -->
<gsmlgu:composition>
 <gsmlgu:CompositionPart>
  <gsmlgu:role xlink:title="Unspecified part role"
   xlink:href="http://inspire.ec.europa.eu/codelist/CompositionPartRoleValue/unspecifiedPartRole"/>
  <gsmlgu:material>
   <gsmlem:RockMaterial gml:id="LOCAL_ID_3">
    <gsmlem:color nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:purpose>typicalNorm</gsmlem:purpose>
    <gsmlem:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:geochemistry nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:compositionCategory nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:geneticCategory nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:constituent nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:particleGeometry nilReason="unpopulated" xsi:nil="true"/>
    <gsmlem:consolidationDegree nilReason="unpopulated" xsi:nil="true"/>
```

```xml
        <gsmlem:lithology
         xlink:href="http://inspire.ec.europa.eu/codelist/LithologyValue/mudstone"
         xlink:title="Mudstone"/>
        <gsmlem:metamorphicProperties nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:alterationProperties nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:fabric nilReason="unpopulated" xsi:nil="true"/>
       </gsmlem:RockMaterial>
      </gsmlgu:material>
      <gsmlgu:proportion>
       <GSML_QuantityRange xmlns="http://xmlns.geosciml.org/Utilities/3.2">
        <swe:uom code="%" xlink:href="http://unitsofmeasure/ucum.html#para-29" xlink:title="percent"/>
        <swe:value>5.0 50.0</swe:value>
        <lowerValue>5.0</lowerValue>
        <upperValue>50.0</upperValue>
       </GSML_QuantityRange>
      </gsmlgu:proportion>
     </gsmlgu:CompositionPart>
    </gsmlgu:composition>
    <gsmlgu:composition>
     <gsmlgu:CompositionPart>
      <gsmlgu:role xlink:title="Unspecified part role"
       xlink:href="http://inspire.ec.europa.eu/codelist/CompositionPartRoleValue/unspecifiedPartRole"/>
      <gsmlgu:material>
       <gsmlem:RockMaterial gml:id="LOCAL_ID_4">
        <gsmlem:color nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:purpose>typicalNorm</gsmlem:purpose>
        <gsmlem:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:geochemistry nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:compositionCategory nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:geneticCategory nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:constituent nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:particleGeometry nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:consolidationDegree nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:lithology
         xlink:href="http://inspire.ec.europa.eu/codelist/LithologyValue/sandstone"
         xlink:title="Sandstone"/>
        <gsmlem:metamorphicProperties nilReason="unpopulated" xsi:nil="true"/>
```

```xml
        <gsmlem:alterationProperties nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:fabric nilReason="unpopulated" xsi:nil="true"/>
      </gsmlem:RockMaterial>
    </gsmlgu:material>
    <gsmlgu:proportion>
      <GSML_QuantityRange xmlns="http://xmlns.geosciml.org/Utilities/3.2">
        <swe:uom code="%" xlink:href="http://unitsofmeasure/ucum.html#para-29" xlink:title="percent"/>
        <swe:value>50.0 95.0</swe:value>
        <lowerValue>50.0</lowerValue>
        <upperValue>95.0</upperValue>
      </GSML_QuantityRange>
    </gsmlgu:proportion>
  </gsmlgu:CompositionPart>
</gsmlgu:composition>
<gsmlgu:composition>
  <gsmlgu:CompositionPart>
    <gsmlgu:role xlink:title="Unspecified part role"
      xlink:href="http://inspire.ec.europa.eu/codelist/CompositionPartRoleValue/unspecifiedPartRole"/>
    <gsmlgu:material>
      <gsmlem:RockMaterial gml:id="LOCAL_ID_5">
        <gsmlem:color nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:purpose>typicalNorm</gsmlem:purpose>
        <gsmlem:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:geochemistry nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:compositionCategory nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:geneticCategory nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:constituent nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:particleGeometry nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:consolidationDegree nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:lithology
          xlink:href="http://inspire.ec.europa.eu/codelist/LithologyValue/siltstone"
          xlink:title="Siltstone"/>
        <gsmlem:metamorphicProperties nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:alterationProperties nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:fabric nilReason="unpopulated" xsi:nil="true"/>
      </gsmlem:RockMaterial>
    </gsmlgu:material>
```

```xml
          <gsmlgu:proportion>
            <GSML_QuantityRange xmlns="http://xmlns.geosciml.org/Utilities/3.2">
              <swe:uom code="%" xlink:href="http://unitsofmeasure/ucum.html#para-29" xlink:title="percent"/>
              <swe:value>5.0 50.0</swe:value>
              <lowerValue>5.0</lowerValue>
              <upperValue>50.0</upperValue>
            </GSML_QuantityRange>
          </gsmlgu:proportion>
        </gsmlgu:CompositionPart>
      </gsmlgu:composition>
      <gsmlgu:metamorphicCharacter nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:part nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:alterationCharacter nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:bedding nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:geochemistry nilReason="unpopulated" xsi:nil="true"/>
    </gsmlgu:GeologicUnit>
  </gsml:specification>
  <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
 </gsml:MappedFeature>
</gsmlc:member>
<!--  -->
<!-- A Fault example -->
<!--  -->
<gsmlc:member>
 <gsml:MappedFeature gml:id="mf.2">
  <gsml:observationMethod>
   <swe:Category
    definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
    <swe:extension>
     <swe:Category
      definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
      <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
      <swe:label>always</swe:label>
      <swe:codeSpace
       xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
      />
     </swe:Category>
```

```xml
    </swe:extension>
    <swe:identifier>http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/compilation</swe:identifier>
    <swe:label>Compilation</swe:label>
    <swe:codeSpace
      xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
    />
  </swe:Category>
</gsml:observationMethod>
<gsml:positionalAccuracy nilReason="unpopulated" xsi:nil="true"/>
<gsml:resolutionScale gco:nilReason="unpopulated" xsi:nil="true"/>
<gsml:samplingFrame
  xlink:href="http://inspire.ec.europa.eu/codelist/MappingFrameValue/topOfBedrock"
  xlink:title="top of bedrock"/>
<gsml:shape>
  <gml:LineString srsName="urn:ogc:def:crs:EPSG::4326" gml:id="LOCAL_ID_20">
    <gml:posList srsDimension="2" count="7">55.0760921318516 -3.31719604609088
      55.0833753209835 -3.31853455922777 55.0825574334633 -3.31921378657955
      55.0801997429522 -3.31978309699423 55.0768616358466 -3.3194575613054
      55.0741365291192 -3.31966903508197 55.0756843873373 -3.31747948721346</gml:posList>
  </gml:LineString>
</gsml:shape>
<!--  -->
<!-- The MappedFeature is specified by a ShearDisplacementStructure (Fault) -->
<!--  -->
<gsml:specification>
  <gsmlst:ShearDisplacementStructure gml:id="FAULT_ID_1">
    <gml:identifier codeSpace="http://data.bgs.ac.uk/ref/625KGeologyMap/Fault">bgsn_digmap20111213000010000_625k</gml:identifier>
    <gml:name>UNNAMED FAULT</gml:name>
    <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
    <gsml:purpose>typicalNorm</gsml:purpose>
    <!--  -->
    <!-- The GeologicAge is provided by a relationship to a GeologicEvent -->
    <!--  -->
    <gsml:relatedFeature>
      <gsmlga:GeologicHistory gml:id="HIST_2">
        <gsml:relationship
          xlink:href="http://resource.geosciml.org/classifier/cgi/featurerelation/geologicfeaturegeneticevent"/>
        <gsml:sourceRole nilReason="unpopulated" xsi:nil="true"/>
```

```xml
<gsml:targetRole nilReason="unpopulated" xsi:nil="true"/>
<gsml:relatedFeature>
 <gsmlga:GeologicEvent gml:id="EVENT_2">
  <gml:name>UNNAMED EVENT</gml:name>
  <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
  <gsml:purpose>instance</gsml:purpose>
  <gsml:relatedFeature nilReason="unpopulated" xsi:nil="true"/>
  <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
  <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
  <gsmlga:eventProcess
   xlink:href="http://inspire.ec.europa.eu/codelist/EventProcessValue/faulting"
   xlink:title="faulting"/>
  <gsmlga:numericAgeDate nilReason="unpopulated" xsi:nil="true"/>
  <gsmlga:olderNamedAge
   xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/tournaisian"
   xlink:title="Tournaisian"/>
  <gsmlga:youngerNamedAge
   xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/tournaisian"
   xlink:title="Tournaisian"/>
  <gsmlga:eventEnvironment>
   <swe:Category
    definition="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue">
    <swe:extension>
     <swe:Category
      definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
      <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
      <swe:label>always</swe:label>
      <swe:codeSpace
       xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
      />
     </swe:Category>
    </swe:extension>
    <swe:identifier>http://inspire.ec.europa.eu/codelist/EventEnvironmentValue/crustalSetting</swe:identifier>
    <swe:label>Crustal setting</swe:label>
    <swe:codeSpace
     xlink:href="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue"
    />
   </swe:Category>
```

```xml
            &lt;/gsmlga:eventEnvironment&gt;
            &lt;gsmlga:prototype nilReason="unpopulated" xsi:nil="true"/&gt;
          &lt;/gsmlga:GeologicEvent&gt;
        &lt;/gsml:relatedFeature&gt;
      &lt;/gsmlga:GeologicHistory&gt;
    &lt;/gsml:relatedFeature&gt;
    &lt;gsml:classifier nilReason="unpopulated" xsi:nil="true"/&gt;
    &lt;gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/&gt;
    <gsmlst:faultType
     xlink:href="http://inspire.ec.europa.eu/codelist/FaultTypeValue/normalFault"
     xlink:title="normal fault"/>
    <gsmlst:deformationStyle
     xlink:href="http://resource.geosciml.org/classifier/cgi/deformationstyle/brittle"
     xlink:title="brittle deformation"/>
    &lt;gsmlst:planeOrientation nilReason="unpopulated" xsi:nil="true"/&gt;
    &lt;gsmlst:totalDisplacement nilReason="unpopulated" xsi:nil="true"/&gt;
    &lt;gsmlst:physicalProperty nilReason="unpopulated" xsi:nil="true"/&gt;
   &lt;/gsmlst:ShearDisplacementStructure&gt;
  &lt;/gsml:specification&gt;
  &lt;gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/&gt;
 &lt;/gsml:MappedFeature&gt;
&lt;/gsmlc:member&gt;
&lt;!--  --&gt;
&lt;!-- A Fold example --&gt;
&lt;!--  --&gt;
&lt;gsmlc:member&gt;
 &lt;gsml:MappedFeature gml:id="mf.3"&gt;
  &lt;gsml:observationMethod&gt;
   <swe:Category
    definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
    &lt;swe:extension&gt;
     <swe:Category
      definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
      &lt;swe:identifier&gt;http://resource.geosciml.org/classifier/cgi/valuequalifier/always&lt;/swe:identifier&gt;
      &lt;swe:label&gt;always&lt;/swe:label&gt;
      <swe:codeSpace
       xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
```

```xml
        />
      </swe:Category>
    </swe:extension>
    <swe:identifier>http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/compilation</swe:identifier>
    <swe:label>Compilation</swe:label>
    <swe:codeSpace
      xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
    />
  </swe:Category>
</gsml:observationMethod>
<gsml:positionalAccuracy nilReason="unpopulated" xsi:nil="true"/>
<gsml:resolutionScale gco:nilReason="unpopulated" xsi:nil="true"/>
<gsml:samplingFrame
  xlink:href="http://inspire.ec.europa.eu/codelist/MappingFrameValue/topOfBedrock"
  xlink:title="top of bedrock"/>
<gsml:shape>
  <gml:LineString srsName="urn:ogc:def:crs:EPSG::4326" gml:id="LOCAL_ID_21">
    <gml:posList srsDimension="2" count="7">55.0760921318516 -3.31719604609088
      55.0833753209835 -3.31853455922777 55.0825574334633 -3.31921378657955
      55.0801997429522 -3.31978309699423 55.0768616358466 -3.3194575613054
      55.0741365291192 -3.31966903508197 55.0756843873373 -3.31747948721346</gml:posList>
  </gml:LineString>
</gsml:shape>
<!--  -->
<!-- The MappedFeature is specified by a Fold -->
<!--  -->
<gsml:specification>
  <gsmlst:Fold gml:id="FOLD_ID_1">
    <gml:identifier codeSpace="http://data.bgs.ac.uk/ref/625KGeologyMap/Fold">bgsn_digmap20111213000010000_625k</gml:identifier>
    <gml:name>UNNAMED FOLD</gml:name>
    <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
    <gsml:purpose>typicalNorm</gsml:purpose>
    <!--  -->
    <!-- The GeologicAge is provided by a relationship to a GeologicEvent -->
    <!--  -->
    <gsml:relatedFeature>
      <gsmlga:GeologicHistory gml:id="HIST_3">
        <gsml:relationship
```

```
 xlink:href="http://resource.geosciml.org/classifier/cgi/featurerelation/geologicfeaturegeneticevent"/>
&lt;gsml:sourceRole nilReason="unpopulated" xsi:nil="true"/&gt;
&lt;gsml:targetRole nilReason="unpopulated" xsi:nil="true"/&gt;
&lt;gsml:relatedFeature&gt;
 &lt;gsmlga:GeologicEvent gml:id="EVENT_3"&gt;
  &lt;gml:name&gt;HERCYNIAN OROGENY&lt;/gml:name&gt;
  &lt;gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/&gt;
  &lt;gsml:purpose&gt;instance&lt;/gsml:purpose&gt;
  &lt;gsml:relatedFeature nilReason="unpopulated" xsi:nil="true"/&gt;
  &lt;gsml:classifier nilReason="unpopulated" xsi:nil="true"/&gt;
  &lt;gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/&gt;
  <gsmlga:eventProcess
   xlink:href="http://inspire.ec.europa.eu/codelist/EventProcessValue/folding"
   xlink:title="folding"/>
  &lt;gsmlga:numericAgeDate nilReason="unpopulated" xsi:nil="true"/&gt;
  <gsmlga:olderNamedAge
   xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/tournaisian"
   xlink:title="Tournaisian"/>
  <gsmlga:youngerNamedAge
   xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/tournaisian"
   xlink:title="Tournaisian"/>
  &lt;gsmlga:eventEnvironment&gt;
   <swe:Category
    definition="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue">
    &lt;swe:extension&gt;
     <swe:Category
      definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
      &lt;swe:identifier&gt;http://resource.geosciml.org/classifier/cgi/valuequalifier/always&lt;/swe:identifier&gt;
      &lt;swe:label&gt;always&lt;/swe:label&gt;
      <swe:codeSpace
       xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
      />
     &lt;/swe:Category&gt;
    &lt;/swe:extension&gt;
    &lt;swe:identifier&gt;http://inspire.ec.europa.eu/codelist/EventEnvironmentValue/crustalSetting&lt;/swe:identifier&gt;
    &lt;swe:label&gt;Crustal setting&lt;/swe:label&gt;
    <swe:codeSpace
     xlink:href="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue"
```

```xml
                />
              </swe:Category>
            </gsmlga:eventEnvironment>
            <gsmlga:prototype nilReason="unpopulated" xsi:nil="true"/>
          </gsmlga:GeologicEvent>
        </gsml:relatedFeature>
      </gsmlga:GeologicHistory>
    </gsml:relatedFeature>
    <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
    <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:profileType
     xlink:href="http://inspire.ec.europa.eu/codelist/FoldProfileTypeValue/anticline"
     xlink:title="anticline"/>
    <gsmlst:amplitude nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:axialSurfaceOrientation nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:geneticModel nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:hingeLineCurvature nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:hingeLineOrientation nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:hingeShape nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:interLimbAngle nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:limbShape nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:span nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:symmetry nilReason="unpopulated" xsi:nil="true"/>
    <gsmlst:system nilReason="unpopulated" xsi:nil="true"/>
   </gsmlst:Fold>
  </gsml:specification>
  <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
 </gsml:MappedFeature>
</gsmlc:member>
<!--  -->
<!-- A Natural Geomorphologic Feature example -->
<!--  -->
<gsmlc:member>
 <gsml:MappedFeature gml:id="mf.4">
  <gsml:observationMethod>
   <swe:Category
    definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
    <swe:extension>
```

```xml
      <swe:Category
        definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
        <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
        <swe:label>always</swe:label>
        <swe:codeSpace
          xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
        />
      </swe:Category>
    </swe:extension>
    <swe:identifier>http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/compilation</swe:identifier>
    <swe:label>Compilation</swe:label>
    <swe:codeSpace
      xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
    />
  </swe:Category>
</gsml:observationMethod>
<gsml:positionalAccuracy nilReason="unpopulated" xsi:nil="true"/>
<gsml:resolutionScale gco:nilReason="unpopulated" xsi:nil="true"/>
<gsml:samplingFrame
  xlink:href="http://inspire.ec.europa.eu/codelist/MappingFrameValue/surfaceGeology"
  xlink:title="surface geology"/>
<gsml:shape>
  <gml:LineString srsName="urn:ogc:def:crs:EPSG::4326" gml:id="LOCAL_ID_22">
    <gml:posList srsDimension="2" count="7">55.0760921318516 -3.31719604609088
      55.0833753209835 -3.31853455922777 55.0825574334633 -3.31921378657955
      55.0801997429522 -3.31978309699423 55.0768616358466 -3.3194575613054
      55.0741365291192 -3.31966903508197 55.0756843873373 -3.31747948721346</gml:posList>
  </gml:LineString>
</gsml:shape>
<!--  -->
<!-- The MappedFeature is specified by a NaturalGeomorphologicFeature -->
<!--  -->
<gsml:specification>
  <gsmlgm:NaturalGeomorphologicFeature gml:id="GEOMORPH_1">
    <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
    <gsml:purpose>typicalNorm</gsml:purpose>
    <!--  -->
    <!-- The GeologicAge is provided by a relationship to a GeologicEvent -->
```

```xml
<!--  -->
<gsml:relatedFeature>
 <gsmlga:GeologicHistory gml:id="HIST_4">
  <gsml:relationship
   xlink:href="http://resource.geosciml.org/classifier/cgi/featurerelation/geologicfeaturegeneticevent"/>
  <gsml:sourceRole nilReason="unpopulated" xsi:nil="true"/>
  <gsml:targetRole nilReason="unpopulated" xsi:nil="true"/>
  <gsml:relatedFeature>
   <gsmlga:GeologicEvent gml:id="EVENT_4">
    <gml:name>LATE DEVENSIAN DEGLACIATION</gml:name>
    <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
    <gsml:purpose>instance</gsml:purpose>
    <gsml:relatedFeature nilReason="unpopulated" xsi:nil="true"/>
    <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
    <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlga:eventProcess
     xlink:href="http://inspire.ec.europa.eu/codelist/EventProcessValue/melting"
     xlink:title="melting"/>
    <gsmlga:numericAgeDate nilReason="unpopulated" xsi:nil="true"/>
    <gsmlga:olderNamedAge
     xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/latePleistocene"
     xlink:title="Late Pleistocene"/>
    <gsmlga:youngerNamedAge
     xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/latePleistocene"
     xlink:title="Late Pleistocene"/>
    <gsmlga:eventEnvironment>
     <swe:Category
      definition="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue">
      <swe:extension>
       <swe:Category
        definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
        <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
        <swe:label>always</swe:label>
        <swe:codeSpace
         xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
        />
       </swe:Category>
      </swe:extension>
```

```
          <swe:identifier>http://inspire.ec.europa.eu/codelist/EventEnvironmentValue/earthSurfaceSetting</swe:identifier>
          <swe:label>Earth Surface setting</swe:label>
          <swe:codeSpace
           xlink:href="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue"
          />
         </swe:Category>
        </gsmlga:eventEnvironment>
        <gsmlga:prototype nilReason="unpopulated" xsi:nil="true"/>
       </gsmlga:GeologicEvent>
      </gsml:relatedFeature>
     </gsmlga:GeologicHistory>
    </gsml:relatedFeature>
    <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
    <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlgm:NaturalGeomorphologicFeatureType
     xlink:href="http://inspire.ec.europa.eu/codelist/NaturalGeomorphologicFeatureTypeValue/glacial"
     xlink:title="glacial"/>
    <gsmlgm:activity
     xlink:href="http://inspire.ec.europa.eu/codelist/GeomorphologicActivityValue/inactive"
     xlink:title="inactive"/>
   </gsmlgm:NaturalGeomorphologicFeature>
  </gsml:specification>
  <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
 </gsml:MappedFeature>
</gsmlc:member>
<!--  -->
<!-- Borehole example -->
<!--  -->
<gsmlc:member>
 <gsmlbh:Borehole gml:id="bh.ns94se5">
  <gml:identifier codeSpace="http://data.bgs.ac.uk/id/Borehole">NS94SE5</gml:identifier>
  <sam:sampledFeature xlink:href="#PEAT"/>
  <sams:shape>
   <gml:LineString gml:id="bh.ns94se5.shape" srsName="urn:ogc:def:crs:EPSG:6.15:7405">
    <gml:posList srsDimension="3" count="7">-30.7111 134.2059 321. -30.7112 134.2058 315.
     -30.7113 134.2057 303. -30.7114 134.2056 296. -30.7115 134.2055 272. -30.7116
     134.2054 271. -30.7117 134.2053 270.</gml:posList>
   </gml:LineString>
```

```xml
</sams:shape>
<gsmlbh:referenceLocation>
 <gsmlbh:OriginPosition gml:id="op1">
  <gsmlbh:location>
   <gml:Point gml:id="pt1" srsName="urn:ogc:def:crs:EPSG:6.15:27700" srsDimension="2">
    <gml:pos>-30.7 134.2</gml:pos>
   </gml:Point>
  </gsmlbh:location>
  <gsmlbh:elevation srsName="urn:ogc:def:crs:EPSG:6.15:5701" srsDimension="1"
   >321.0</gsmlbh:elevation>
 </gsmlbh:OriginPosition>
</gsmlbh:referenceLocation>
<gsmlbh:indexData>
 <gsmlbh:BoreholeDetails>
  <gsmlbh:operator gco:nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:driller gco:nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:dateOfDrilling nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:startPoint nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:inclinationType nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:boreholeMaterialCustodian gco:nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:purpose
   xlink:href="http://inspire.ec.europa.eu/codelist/BoreholePurposeValue/geologicalSurvey"
   xlink:title="Geological Survey"/>
  <gsmlbh:dataCustodian gco:nilReason="unpopulated" xsi:nil="true"/>
  <gsmlbh:boreholeLength>
   <swe:Quantity>
    <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
     xlink:title="metre"/>
    <swe:value>51.0</swe:value>
   </swe:Quantity>
  </gsmlbh:boreholeLength>
 </gsmlbh:BoreholeDetails>
</gsmlbh:indexData>
<gsmlbh:downholeDrillingDetails nilReason="unpopulated" xsi:nil="true"/>
<!--  -->
<!-- The borehole log is given as a series of logElemants (MappedIntervals) -->
<!--  -->
<gsmlbh:logElement>
```

```xml
<gsmlbh:MappedInterval gml:id="mi1">
 <gsml:observationMethod>
  <swe:Category
   definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
   <swe:extension>
    <swe:Category
     definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
     <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
     <swe:label>always</swe:label>
     <swe:codeSpace
      xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
     />
    </swe:Category>
   </swe:extension>
   <swe:identifier>http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/observed_borehole_core</swe:identifier>
   <swe:label>Observed in borehole core</swe:label>
   <swe:codeSpace
    xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
   />
  </swe:Category>
 </gsml:observationMethod>
 <gsml:positionalAccuracy nilReason="unpopulated" xsi:nil="true"/>
 <gsml:resolutionScale gco:nilReason="unpopulated" xsi:nil="true"/>
 <gsml:samplingFrame xlink:href="#bh.ns94se5"/>
 <gsml:shape>
  <gml:LineString gml:id="ls1" srsName="#bh.ns94se5.shape">
   <gml:posList srsDimension="1" count="2">0.0 2.0</gml:posList>
  </gml:LineString>
 </gsml:shape>
 <!--  -->
 <!-- The MappedInterval is specified by a GeologicUnit -->
 <!--  -->
 <gsml:specification>
  <gsmlgu:GeologicUnit gml:id="PEAT">
   <gml:identifier codeSpace="http://data.bgs.ac.uk/id/Lexicon/NamedRockUnit">PEAT</gml:identifier>
   <gml:name>PEAT</gml:name>
   <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
   <gsml:purpose>typicalNorm</gsml:purpose>
```

```
<gsml:relatedFeature>
 <gsmlga:GeologicHistory gml:id="HIST_10">
  <gsml:relationship
   xlink:href="http://resource.geosciml.org/classifier/cgi/featurerelation/geologicfeaturegeneticevent"/>
  <gsml:sourceRole nilReason="unpopulated" xsi:nil="true"/>
  <gsml:targetRole nilReason="unpopulated" xsi:nil="true"/>
  <gsml:relatedFeature>
   <gsmlga:GeologicEvent gml:id="EVENT_10">
    <gml:name>UNNAMED EVENT</gml:name>
    <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
    <gsml:purpose>instance</gsml:purpose>
    <gsml:relatedFeature nilReason="unpopulated" xsi:nil="true"/>
    <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
    <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlga:eventProcess
     xlink:href="http://inspire.ec.europa.eu/codelist/EventProcessValue/inSituOrganismicGrowth"
     xlink:title="in-situ organismic growth"/>
    <gsmlga:numericAgeDate nilReason="unpopulated" xsi:nil="true"/>
    <gsmlga:olderNamedAge
     xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/holocene"
     xlink:title="Holocene"/>
    <gsmlga:youngerNamedAge
     xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/holocene"
     xlink:title="Holocene"/>
    <gsmlga:eventEnvironment>
     <swe:Category
      definition="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue">
      <swe:extension>
       <swe:Category
        definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
        <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
        <swe:label>always</swe:label>
        <swe:codeSpace
         xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
        />
       </swe:Category>
      </swe:extension>
      <swe:identifier>http://inspire.ec.europa.eu/codelist/EventEnvironmentValue/bogSetting</swe:identifier>
```

```xml
          <swe:label>Bog setting</swe:label>
          <swe:codeSpace
           xlink:href="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue"
          />
         </swe:Category>
        </gsmlga:eventEnvironment>
        <gsmlga:prototype nilReason="unpopulated" xsi:nil="true"/>
       </gsmlga:GeologicEvent>
      </gsml:relatedFeature>
     </gsmlga:GeologicHistory>
    </gsml:relatedFeature>
    <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
    <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlgu:geologicUnitType
     xlink:href="http://inspire.ec.europa.eu/codelist/GeologicUnitTypeValue/lithologicUnit/"
     xlink:title="Lithologic Unit"/>
    <gsmlgu:bodyMorphology nilReason="unknown" xsi:nil="true"/>
    <gsmlgu:unitComposition nilReason="unknown" xsi:nil="true"/>
    <gsmlgu:exposureColor nilReason="unpopulated" xsi:nil="true"/>
    <gsmlgu:outcropCharacter nilReason="unpopulated" xsi:nil="true"/>
    <gsmlgu:rank nilReason="unpopulated" xsi:nil="true"/>
    <gsmlgu:unitThickness nilReason="unpopulated" xsi:nil="true"/>
    <gsmlgu:composition>
     <gsmlgu:CompositionPart>
      <gsmlgu:role xlink:title="Unspecified part role"
       xlink:href="http://inspire.ec.europa.eu/codelist/CompositionPartRoleValue/unspecifiedPartRole"/>
      <gsmlgu:material>
       <gsmlem:RockMaterial gml:id="LOCAL_ID_30">
        <gsmlem:color nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:purpose>typicalNorm</gsmlem:purpose>
        <gsmlem:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:geochemistry nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:compositionCategory nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:geneticCategory nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:constituent nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:particleGeometry nilReason="unpopulated" xsi:nil="true"/>
        <gsmlem:consolidationDegree nilReason="unpopulated" xsi:nil="true"/>
```

```
          <gsmlem:lithology
           xlink:href="http://inspire.ec.europa.eu/codelist/LithologyValue/peat"
           xlink:title="Peat"/>
          &lt;gsmlem:metamorphicProperties nilReason="unpopulated" xsi:nil="true"/&gt;
          &lt;gsmlem:alterationProperties nilReason="unpopulated" xsi:nil="true"/&gt;
          &lt;gsmlem:fabric nilReason="unpopulated" xsi:nil="true"/&gt;
         &lt;/gsmlem:RockMaterial&gt;
        &lt;/gsmlgu:material&gt;
        &lt;gsmlgu:proportion&gt;
         &lt;GSML_QuantityRange xmlns="http://xmlns.geosciml.org/Utilities/3.2"&gt;
          &lt;swe:uom code="%" xlink:href="http://unitsofmeasure/ucum.html#para-29" xlink:title="percent"/&gt;
          &lt;swe:value&gt;100.0 100.0&lt;/swe:value&gt;
          &lt;lowerValue&gt;100.0&lt;/lowerValue&gt;
          &lt;upperValue&gt;100.0&lt;/upperValue&gt;
         &lt;/GSML_QuantityRange&gt;
        &lt;/gsmlgu:proportion&gt;
       &lt;/gsmlgu:CompositionPart&gt;
      &lt;/gsmlgu:composition&gt;
      &lt;gsmlgu:metamorphicCharacter nilReason="unpopulated" xsi:nil="true"/&gt;
      &lt;gsmlgu:part nilReason="unpopulated" xsi:nil="true"/&gt;
      &lt;gsmlgu:physicalProperty nilReason="unpopulated" xsi:nil="true"/&gt;
      &lt;gsmlgu:alterationCharacter nilReason="unpopulated" xsi:nil="true"/&gt;
      &lt;gsmlgu:bedding nilReason="unpopulated" xsi:nil="true"/&gt;
      &lt;gsmlgu:geochemistry nilReason="unpopulated" xsi:nil="true"/&gt;
     &lt;/gsmlgu:GeologicUnit&gt;
    &lt;/gsml:specification&gt;
    &lt;gsml:metadata/&gt;
    &lt;gsmlbh:mappedIntervalBegin&gt;
     &lt;swe:Quantity&gt;
      <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
       xlink:title="metre"/>
      &lt;swe:value&gt;0.0&lt;/swe:value&gt;
     &lt;/swe:Quantity&gt;
    &lt;/gsmlbh:mappedIntervalBegin&gt;
    &lt;gsmlbh:mappedIntervalEnd&gt;
     &lt;swe:Quantity&gt;
      <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
       xlink:title="metre"/>
```

```xml
        &lt;swe:value&gt;2.0&lt;/swe:value&gt;
      &lt;/swe:Quantity&gt;
    &lt;/gsmlbh:mappedIntervalEnd&gt;
  &lt;/gsmlbh:MappedInterval&gt;
&lt;/gsmlbh:logElement&gt;
&lt;gsmlbh:logElement&gt;
  &lt;gsmlbh:MappedInterval gml:id="mi2"&gt;
    &lt;gsml:observationMethod&gt;
      <swe:Category
        definition="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod">
        &lt;swe:extension&gt;
          <swe:Category
            definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
            &lt;swe:identifier&gt;http://resource.geosciml.org/classifier/cgi/valuequalifier/always&lt;/swe:identifier&gt;
            &lt;swe:label&gt;always&lt;/swe:label&gt;
            <swe:codeSpace
              xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
            />
          &lt;/swe:Category&gt;
        &lt;/swe:extension&gt;
        &lt;swe:identifier&gt;http://resource.geosciml.org/classifier/cgi/mappedfeatureobservationmethod/observed_borehole_core&lt;/swe:identifier&gt;
        &lt;swe:label&gt;Observed in borehole core&lt;/swe:label&gt;
        <swe:codeSpace
          xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/mappedfeatureobservationmethod"
        />
      &lt;/swe:Category&gt;
    &lt;/gsml:observationMethod&gt;
    &lt;gsml:positionalAccuracy nilReason="unpopulated" xsi:nil="true"/&gt;
    &lt;gsml:resolutionScale gco:nilReason="unpopulated" xsi:nil="true"/&gt;
    &lt;gsml:samplingFrame xlink:href="#bh.ns94se5"/&gt;
    &lt;gsml:shape&gt;
      &lt;gml:LineString gml:id="ls2" srsName="#bh.ns94se5.shape" srsDimension="1"&gt;
        &lt;gml:pos&gt;2.0&lt;/gml:pos&gt;
        &lt;gml:pos&gt;51.0&lt;/gml:pos&gt;
      &lt;/gml:LineString&gt;
    &lt;/gsml:shape&gt;
    &lt;gsml:specification&gt;
      &lt;gsmlgu:GeologicUnit gml:id="INV-MDST"&gt;
```

```xml
<gml:identifier codeSpace="http://data.bgs.ac.uk/id/Lexicon/NamedRockUnit">PEAT</gml:identifier>
<gml:name>PEAT</gml:name>
<gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
<gsml:purpose>typicalNorm</gsml:purpose>
<gsml:relatedFeature>
 <gsmlga:GeologicHistory gml:id="HIST_11">
  <gsml:relationship
   xlink:href="http://resource.geosciml.org/classifier/cgi/featurerelation/geologicfeaturegeneticevent"/>
  <gsml:sourceRole nilReason="unpopulated" xsi:nil="true"/>
  <gsml:targetRole nilReason="unpopulated" xsi:nil="true"/>
  <gsml:relatedFeature>
   <gsmlga:GeologicEvent gml:id="EVENT_11">
    <gml:name>UNNAMED EVENT</gml:name>
    <gsml:observationMethod nilReason="unpopulated" xsi:nil="true"/>
    <gsml:purpose>instance</gsml:purpose>
    <gsml:relatedFeature nilReason="unpopulated" xsi:nil="true"/>
    <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
    <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
    <gsmlga:eventProcess
     xlink:href="http://inspire.ec.europa.eu/codelist/EventProcessValue/mechanicalDeposition"
     xlink:title="mechanical deposition"/>
    <gsmlga:numericAgeDate nilReason="unpopulated" xsi:nil="true"/>
    <gsmlga:olderNamedAge
     xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/tournaisian"
     xlink:title="Tournaisian"/>
    <gsmlga:youngerNamedAge
     xlink:href="http://inspire.ec.europa.eu/codelist/GeochronologicEraValue/visean"
     xlink:title="Visean"/>
    <gsmlga:eventEnvironment>
     <swe:Category
      definition="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue">
      <swe:extension>
       <swe:Category
        definition="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier">
        <swe:identifier>http://resource.geosciml.org/classifier/cgi/valuequalifier/always</swe:identifier>
        <swe:label>always</swe:label>
        <swe:codeSpace
         xlink:href="http://resource.geosciml.org/classifierscheme/cgi/201211/valuequalifier"
```

```xml
          />
         </swe:Category>
        </swe:extension>
        <swe:identifier>http://inspire.ec.europa.eu/codelist/EventEnvironmentValue/riverPlainSystemSetting</swe:identifier>
        <swe:label>River plain system setting</swe:label>
        <swe:codeSpace
         xlink:href="http://inspire.ec.europa.eu/codelist/EventEnvironmentValue"
        />
       </swe:Category>
      </gsmlga:eventEnvironment>
      <gsmlga:prototype nilReason="unpopulated" xsi:nil="true"/>
     </gsmlga:GeologicEvent>
    </gsml:relatedFeature>
   </gsmlga:GeologicHistory>
  </gsml:relatedFeature>
  <gsml:classifier nilReason="unpopulated" xsi:nil="true"/>
  <gsml:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
  <gsmlgu:geologicUnitType
   xlink:href="http://inspire.ec.europa.eu/codelist/GeologicUnitTypeValue/lithostratigraphicUnit/"
   xlink:title="Lithostratigraphic Unit"/>
  <gsmlgu:bodyMorphology nilReason="unknown" xsi:nil="true"/>
  <gsmlgu:unitComposition nilReason="unknown" xsi:nil="true"/>
  <gsmlgu:exposureColor nilReason="unpopulated" xsi:nil="true"/>
  <gsmlgu:outcropCharacter nilReason="unpopulated" xsi:nil="true"/>
  <gsmlgu:rank nilReason="unpopulated" xsi:nil="true"/>
  <gsmlgu:unitThickness nilReason="unpopulated" xsi:nil="true"/>
  <gsmlgu:composition>
   <gsmlgu:CompositionPart>
    <gsmlgu:role xlink:title="Unspecified part role"
     xlink:href="http://inspire.ec.europa.eu/codelist/CompositionPartRoleValue/unspecifiedPartRole"/>
    <gsmlgu:material>
     <gsmlem:RockMaterial gml:id="LOCAL_ID_31">
      <gsmlem:color nilReason="unpopulated" xsi:nil="true"/>
      <gsmlem:purpose>typicalNorm</gsmlem:purpose>
      <gsmlem:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
      <gsmlem:geochemistry nilReason="unpopulated" xsi:nil="true"/>
      <gsmlem:metadata gco:nilReason="unpopulated" xsi:nil="true"/>
      <gsmlem:compositionCategory nilReason="unpopulated" xsi:nil="true"/>
```

```xml
          <gsmlem:geneticCategory nilReason="unpopulated" xsi:nil="true"/>
          <gsmlem:constituent nilReason="unpopulated" xsi:nil="true"/>
          <gsmlem:particleGeometry nilReason="unpopulated" xsi:nil="true"/>
          <gsmlem:consolidationDegree nilReason="unpopulated" xsi:nil="true"/>
          <gsmlem:lithology
           xlink:href="http://inspire.ec.europa.eu/codelist/LithologyValue/mudstone"
           xlink:title="Mudstone"/>
          <gsmlem:metamorphicProperties nilReason="unpopulated" xsi:nil="true"/>
          <gsmlem:alterationProperties nilReason="unpopulated" xsi:nil="true"/>
          <gsmlem:fabric nilReason="unpopulated" xsi:nil="true"/>
         </gsmlem:RockMaterial>
        </gsmlgu:material>
        <gsmlgu:proportion>
         <GSML_QuantityRange xmlns="http://xmlns.geosciml.org/Utilities/3.2">
          <swe:uom code="%" xlink:href="http://unitsofmeasure/ucum.html#para-29" xlink:title="percent"/>
          <swe:value>100.0 100.0</swe:value>
          <lowerValue>100.0</lowerValue>
          <upperValue>100.0</upperValue>
         </GSML_QuantityRange>
        </gsmlgu:proportion>
       </gsmlgu:CompositionPart>
      </gsmlgu:composition>
      <gsmlgu:metamorphicCharacter nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:part nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:physicalProperty nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:alterationCharacter nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:bedding nilReason="unpopulated" xsi:nil="true"/>
      <gsmlgu:geochemistry nilReason="unpopulated" xsi:nil="true"/>
     </gsmlgu:GeologicUnit>
    </gsml:specification>
    <gsml:metadata/>
    <gsmlbh:mappedIntervalBegin>
     <swe:Quantity>
      <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
       xlink:title="metre"/>
      <swe:value>2.0</swe:value>
     </swe:Quantity>
    </gsmlbh:mappedIntervalBegin>
```

```
        <gsmlbh:mappedIntervalEnd>
          <swe:Quantity>
            <swe:uom code="m" xlink:href="http://www.opengis.net/def/uom/OGC/1.0/metre"
              xlink:title="metre"/>
            <swe:value>51.0</swe:value>
          </swe:Quantity>
        </gsmlbh:mappedIntervalEnd>
      </gsmlbh:MappedInterval>
    </gsmlbh:logElement>
  </gsmlbh:Borehole>
</gsmlc:member>
<!--  -->
<!-- The metadata for the GSML collection -->
<!--  -->
<gsmlc:metadata>
  <gmd:MD_Metadata>
    <gmd:contact>
      <gmd:CI_ResponsibleParty>
        <gmd:organisationName>
          <gco:CharacterString>British Geological Survey (BGS)</gco:CharacterString>
        </gmd:organisationName>
        <gmd:role>
          <gmd:CI_RoleCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
            codeListValue="owner">owner</gmd:CI_RoleCode>
        </gmd:role>
      </gmd:CI_ResponsibleParty>
    </gmd:contact>
    <gmd:dateStamp>
      <gco:Date>2011-03-08</gco:Date>
    </gmd:dateStamp>
    <gmd:dataSetURI>
      <gco:CharacterString>http://www.bgs.ac.uk/products/digitalmaps/digmapgb_625.html</gco:CharacterString>
    </gmd:dataSetURI>
    <gmd:identificationInfo>
      <gmd:MD_DataIdentification>
        <gmd:citation>
          <gmd:CI_Citation>
            <gmd:title>
```

```xml
 <gco:CharacterString>BGS 1:625 000 Digital Geological Map</gco:CharacterString>
</gmd:title>
<gmd:alternateTitle>
 <gco:CharacterString>BGS 625k Map</gco:CharacterString>
</gmd:alternateTitle>
<gmd:date>
 <gmd:CI_Date>
  <gmd:date>
   <gco:Date>2012</gco:Date>
  </gmd:date>
  <gmd:dateType>
   <gmd:CI_DateTypeCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="revision">revision</gmd:CI_DateTypeCode>
  </gmd:dateType>
 </gmd:CI_Date>
</gmd:date>
<gmd:date>
 <gmd:CI_Date>
  <gmd:date>
   <gco:Date>2008</gco:Date>
  </gmd:date>
  <gmd:dateType>
   <gmd:CI_DateTypeCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="validityBegins">validityBegins</gmd:CI_DateTypeCode>
  </gmd:dateType>
 </gmd:CI_Date>
</gmd:date>
<gmd:date>
 <gmd:CI_Date>
  <gmd:date>
   <gco:Date>2013</gco:Date>
  </gmd:date>
  <gmd:dateType>
   <gmd:CI_DateTypeCode codeList="http://www.isotc211.org/2005/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
    codeListValue="validityEnds">validityEnds</gmd:CI_DateTypeCode>
  </gmd:dateType>
 </gmd:CI_Date>
</gmd:date>
```

```
            </gmd:CI_Citation>
          </gmd:citation>
          <gmd:abstract>
            <gco:CharacterString>The data shows polygonal and selected linear geological information, sourced
              from published BGS 1:625 000 scale maps of Great Britain. However, geological units are identified
              using the most up-to-date nomenclature that may differ from that on the printed maps. The maps are
              generally based on published material at 1:50 000 scale and compiled using techniques of selection,
              generalisation and exaggeration. The geology is fitted to a relevant topographic base at the time
              of production. Full UK coverage is available. The data is available in vector format. BGS licensing
              terms and conditions apply to external use of the data. The data can be used free of charge for
              non commercial use and is downloadable from the website.</gco:CharacterString>
          </gmd:abstract>
          <gmd:language>
            <gco:CharacterString>eng</gco:CharacterString>
          </gmd:language>
          <gmd:topicCategory>
            <gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
          </gmd:topicCategory>
        </gmd:MD_DataIdentification>
      </gmd:identificationInfo>
    </gmd:MD_Metadata>
   </gsmlc:metadata>
  </gsmlc:GSML>
 </wfs:member>
</wfs:FeatureCollection>
```