

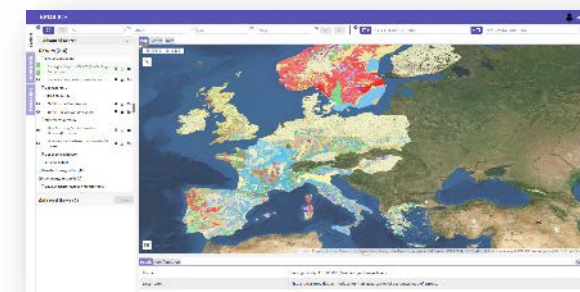
Open access to geological information and 3D modelling data sets in the European Plate Observing System platform (EPOS)

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Chat time: Monday, 4 May 2020, 08:30-10:15

Geological Information and Modelling (GIM) in EPOS

- EPOS: multi-disciplinary European Research Infrastructure for Solid Earth science
- Integrates a series of 10 domain-specific Thematic Core Services
- Discovery and access to Data, Data products, Software and Services
- GIM: 5 groups of services in operational conditions
 - Boreholes
 - Borehole Data Index
 - Borehole Data Index Discovery Service
 - Borehole Data Index View Service
 - Geologic Map
 - Geological Map 1:1,000,000 GeologicalFeature Index
 - GeologicalFeature Index Discovery Service
 - 3D/4D Models
 - 3D/4D Model Index Discovery Service
 - 3D/4D Model Index
 - 3D/4D Model Index View Service
 - Mineral Resources
 - Georesources (Mine Discovery Service and Mine View Service)
 - Data & Service cataloguing
 - TCS15 Catalogue service

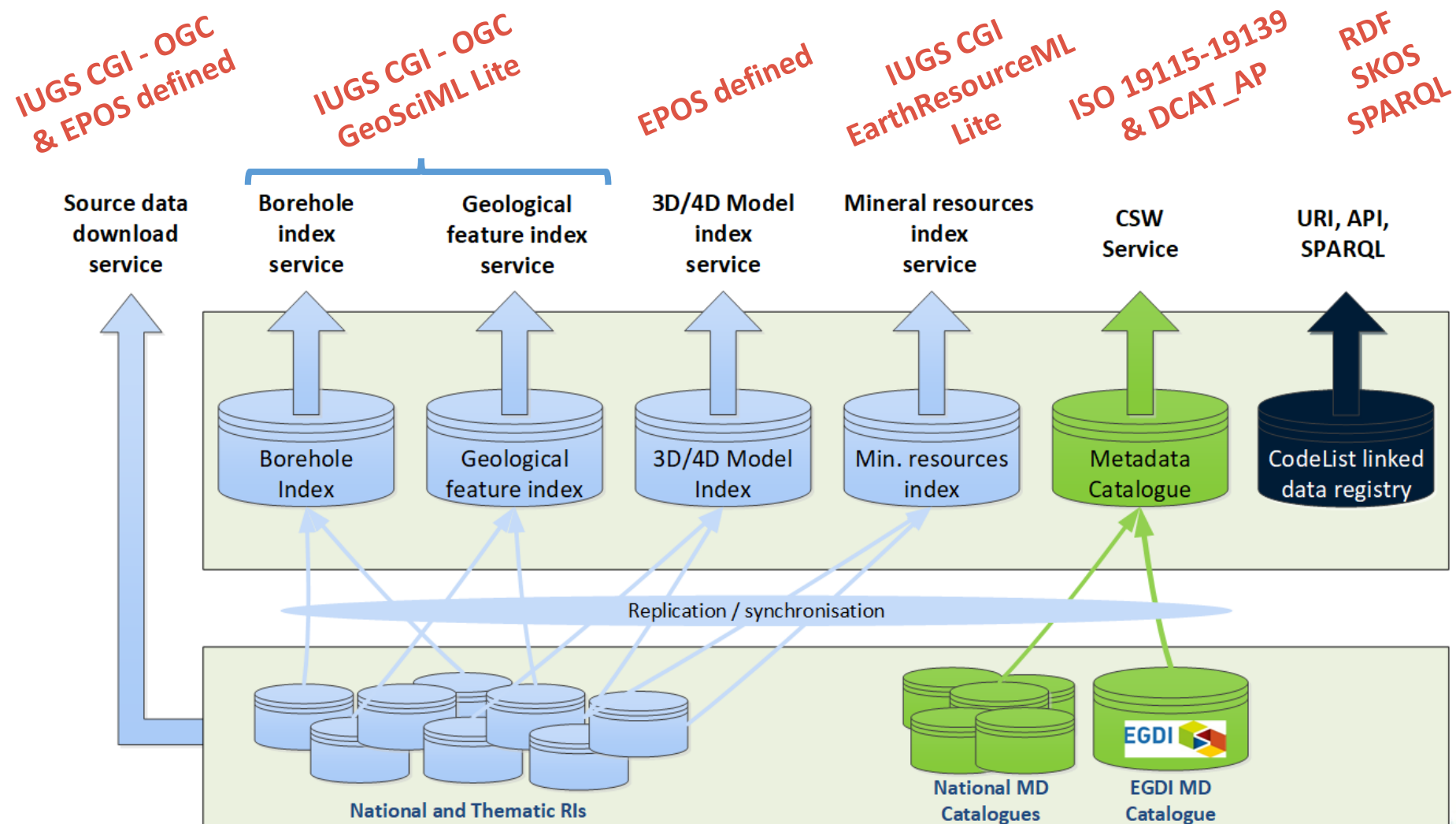


<https://ics-c.epos-ip.org/>

How to disseminate Geological Simple and Complex Features?

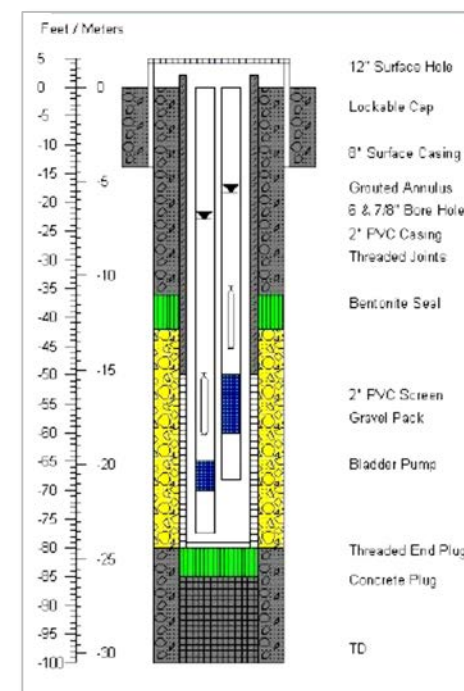
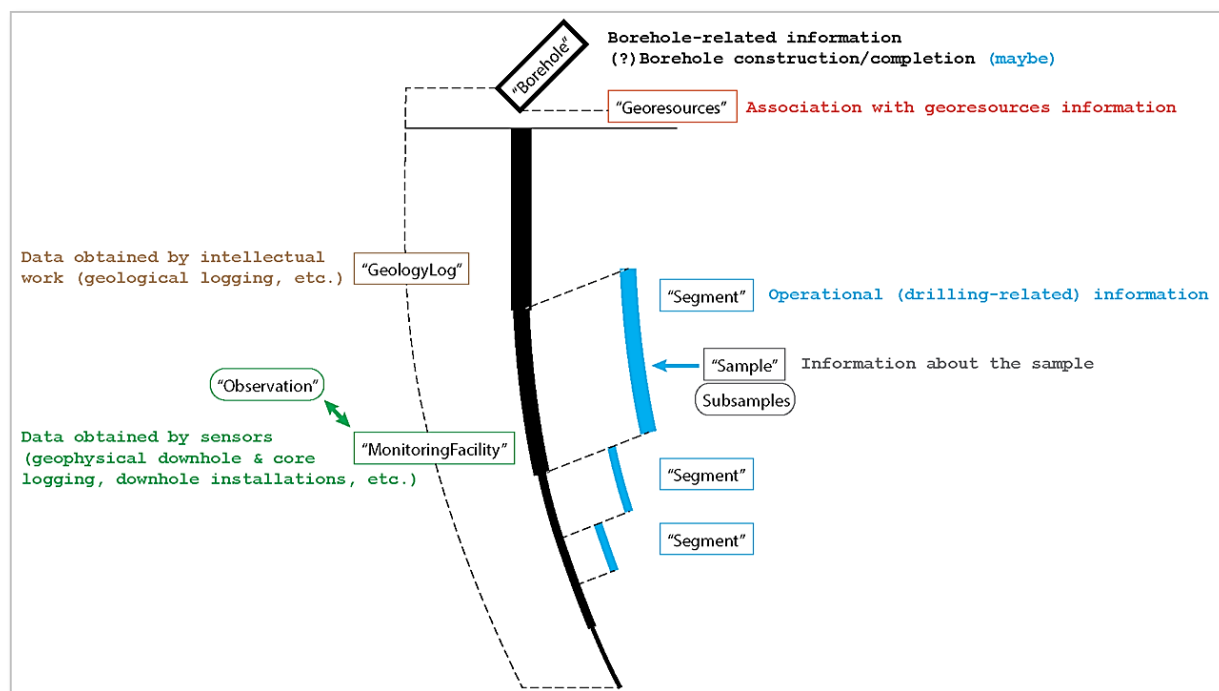
- Even though interoperability implementation frameworks are well described and used (ISO, OGC, IUGS/CGI, INSPIRE ...), it proved to be difficult for several data providers to deploy in the first place the required OGC services supporting the full semantic definition (OGC Complex Feature) to discover and view millions of geological entities
- Instead, data are collected and exposed using a simpler yet standardised description (GeoSciML Lite & EarthResourceML Lite). Subsequently, the more complex data flows are deployed with the corresponding semantics
- This approach was applied to design and implement the European Borehole Index and associated web services (View-WMS and Discovery-WFS) and extended to 3D Models
- TCS GIM exposes to the EPOS Central Integrated Core Services infrastructure a metadata catalogue service, a series of “index services”, a codeList registry and a Linked Data resolver

Discovery service architecture and semantics

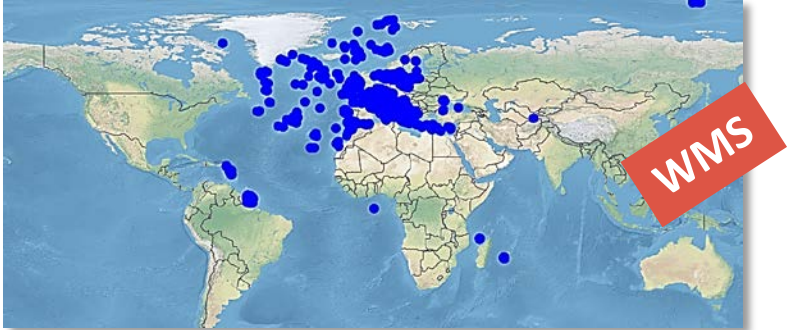


EPOS GIM Borehole Model

- Semantic reconciliation of several pre-existing 'Borehole' models
- Pushed to the OGC Borehole Interoperability Experiment
<https://github.com/opengeospatial/boreholeie/wiki>



EPOS GIM European Borehole Index



A Borehole Index entry is:

- a 'Borehole vCard'
- a summary information + HTTP URIs towards richer information flows

```
<wfs:FeatureCollection numberMatched="unknown" numberReturned="1" timeStamp="2017-09-05T07:42:27.003Z" xsi:schemaLocation="http://www.opengis.net/gml/3.2 http://schemas.opengis.net/gml/3.2.1/gml.xsd http://www.opengis.net/wfs/2.0 http://schemas.opengis.net/wfs/2.0/wfs.xsd https://forge.brgm.fr/svnrepository/epos/trunk/schemas https://forge.brgm.fr/svnrepository/epos/trunk/schemas/epos-lite.xsd">
```

```
<wfs:member>
  <gml:BoreholeView gml:id="BSS001REWV">
    <gml:description>Borehole description</gml:description>
    <gml:identifier>http://resource.brgm-rec.fr/data/BoreholeView/BSS001REWV</gml:identifier>
```

URI to each Borehole Index entry

```
    <gml:name>Forage BSS001REWV</gml:name>
    <gml:purpose>http://inspire.ec.europa.eu/codelist/BoreholePurposeValue/hydrogeologicalSurvey</gml:purpose>
    <gml:status>http://resource.europe-geology.eu/vocabs/BoreholeStatus/drillingCompleted</gml:status>
    <gml:drillingMethod>http://resource.europe-geology.eu/vocabs/DrillingMethod/hydraulic_rotary_drilling</gml:drillingMethod>
    <gml:driller>INTRAFOR-COFOR</gml:driller>
    <gml:drillEndDate>1974-11-30Z</gml:drillEndDate>
    <gml:startPoint>http://resource.europe-geology.eu/vocabs/BoreholeStartPoint/naturalLandSurface</gml:startPoint>
    <gml:inclinationType>http://resource.europe-geology.eu/vocabs/BoreholeInclinationType/vertical</gml:inclinationType>
    <gml:boreholeMaterialCustodian>unknown</gml:boreholeMaterialCustodian>
    <gml:boreholeLength_m uom="http://qudt.org/vocab/unit/M">23.0</gml:boreholeLength_m>
    <gml:elevation_m uom="http://qudt.org/vocab/unit/M">223.87</gml:elevation_m>
    <gml:elevation_srs>http://www.opengis.net/def/crs/EPSC/0/5720</gml:elevation_srs>
    <gml:source>http://ficheinfoterre.brgm.fr/InfoterreFicheBss.action?id=06512X0037/STREMY
    <gml:source>
      <gml:metadatas uri="http://www.geocatalogue.fr/Detail.do?fileIdentifier=BR_BSS_BAA"
      <gml:metadatas uri="http://www.geocatalogue.fr/Detail.do?fileIdentifier=BR_BSS_BAA"
      <gml:genericSymbolizer>Not provided</gml:genericSymbolizer>
      <gml:shape></gml:shape>
      <gml:cored>false</gml:cored>
      <gml:accessToPhysicalDrillCore>false</gml:accessToPhysicalDrillCore>
      <gml:boreholeUse>http://inspire.ec.europa.eu/codelist/BoreholePurposeValue/groundwaterLevelMonitoring</gml:boreholeUse>
      <gml:detailedDescription>http://www.opengis.net/def/nl/OGC/0/template</gml:detailedDescription>
      <gml:geophysicalLog>http://www.opengis.net/def/nl/OGC/0/unknown</gml:geophysicalLog>
      <gml:geologicalDescription>http://resource.brgm-rec.fr/data/RawGeologicalLog/BSS001REWV</gml:geologicalDescription>
      <gml:groundWaterLevel>http://resource.brgm-rec.fr/data/Piezometre/06512X0037/STREMY2</gml:groundWaterLevel>
      <gml:groundWaterChemistry>http://www.opengis.net/def/nl/OGC/0/unknown</gml:groundWaterChemistry>
      <gml:rockGeochemistry>http://www.opengis.net/def/nl/OGC/0/unknown</gml:rockGeochemistry>
      <gml:poreGasChemistry>http://www.opengis.net/def/nl/OGC/0/inapplicable</gml:poreGasChemistry>
      <gml:geoTechnicalInfo>http://www.opengis.net/def/nl/OGC/0/unknown</gml:geoTechnicalInfo>
    </gml:BoreholeView>
  </wfs:member>
</wfs:FeatureCollection>
```

URI to codeList entries (INSPIRE, TCS Geological Information and Modelling)

URI to a richer information resource

Sharing European geological data with the Linked Data approach

- Each instance is associated with a HTTP URI and points to other information resources also using HTTP URIs
- The Linked Data principles ensure the best semantic description (e.g. HTTP URIs to shared codeList registries entries) and also enrich an initial “information seed” (e.g. a set of Borehole entries matching a search) with more contents (e.g. HTTP URIs to more Features or a more complex description)
- As a result, this pattern including Simple Feature and Linked Data has a positive effect on the IT architecture: interoperable services are simpler and faster to deploy and there is no need to harvest a full OGC Complex Feature dataset
- This architecture is also more scalable and sustainable

Vocabulary registry

- Domain controlled geoscience vocabularies through the European Geoscience Registry <https://data.geoscience.earth/ncl/>
- Each register and register entity has its URI
- Accessible to humans and machines
- Part of the INSPIRE Register Federation

The screenshot shows the 'European Geoscience Registry' homepage. The main heading is 'Register: root', which is described as 'Register representing the root of the registry tree'. Below this, there are tabs for 'List', 'Table', 'Properties', and 'Metadata'. A section titled 'Sub-registers' lists several registers, each with a brief description and a status indicator (e.g., 'experimental'). The registers listed include:

- Register: [AmountEstimationMethod](#) - Amount Estimation Method
- Register: [BoreholeInclinationType](#) - Borehole Inclination Type
- Register: [BoreholeStatus](#) - Borehole Status
- Register: [CollarheadworkType](#) - Collar headwork type
- Register: [CompositionEstimationMethod](#) - Composition Estimation Method
- Register: [DrillingMethod](#) - Borehole Drilling Method

 Each register entry includes a short description of its purpose and a 'last changed' date.

This screenshot shows the 'Entity: core drilling' page. The URI is <https://data.geoscience.earth/ncl/DrillingMethod/coreDrilling>. The type is 'Concept'. The definition is: 'A core of sediment, soil, or rock is derived by an unspecified core drilling method.' The narrower terms are 'vibrocure', 'direct push', and 'diamond core'. The notation is '4'. The preferred label is 'core drilling'. The source is 'This vocabulary'. The top concept of 'drilling method' is 'Concept'. The page also includes a table for 'About the Item' with the following data:

About the Item	
accepted on	23 Jan 2019 11:20:30.856
submitted on	23 Jan 2019 11:20:10.666
submitted by	Abdel FELIACHI

This screenshot shows the 'Register: Borehole Drilling Method' page. The URI is <https://data.geoscience.earth/ncl/DrillingMethod>. The description states: 'This scheme specifies concepts used to describe methods used to drill a borehole, as defined by the IUGS Commission for Geoscience Information (CGI) Geoscience Terminology Working Group. By extension, it includes all concepts in this conceptScheme, as well as concepts in any previous versions of the scheme.' The page features a tree view of concepts, including:

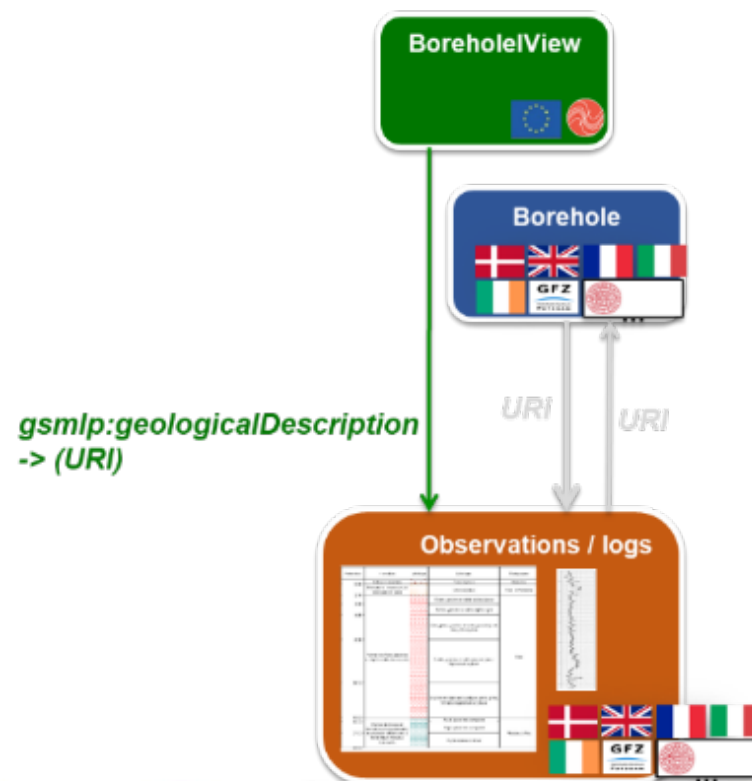
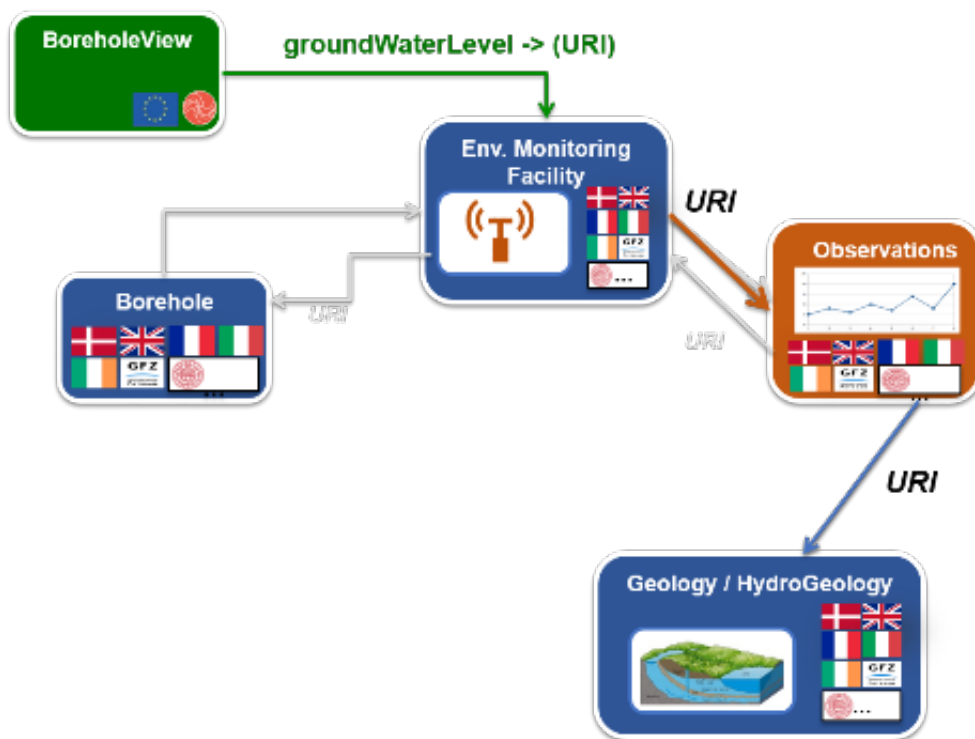
- auger
- percussion drilling
 - cable tool drilling
 - rotary air blast drilling
 - rotary hammer drilling
 - reverse circulation drilling
- hydraulic rotary drilling
- core drilling
 - diamond core
 - direct push
 - Extended Core Barrel (XCB)
 - vibrocure
- sonic
- air core
- box core
- sidewall core
- probe

 Each concept has a status indicator (e.g., 'experimental'). The page also includes a table for 'About the Register' with the following data:

About the Register	
owned by	1
last changed on	23 Jan 2019 11:25:52.383
submitted on	23 Jan 2019 11:20:10.641
submitted by	Abdel FELIACHI
accepted on	23 Jan 2019 11:20:26.356

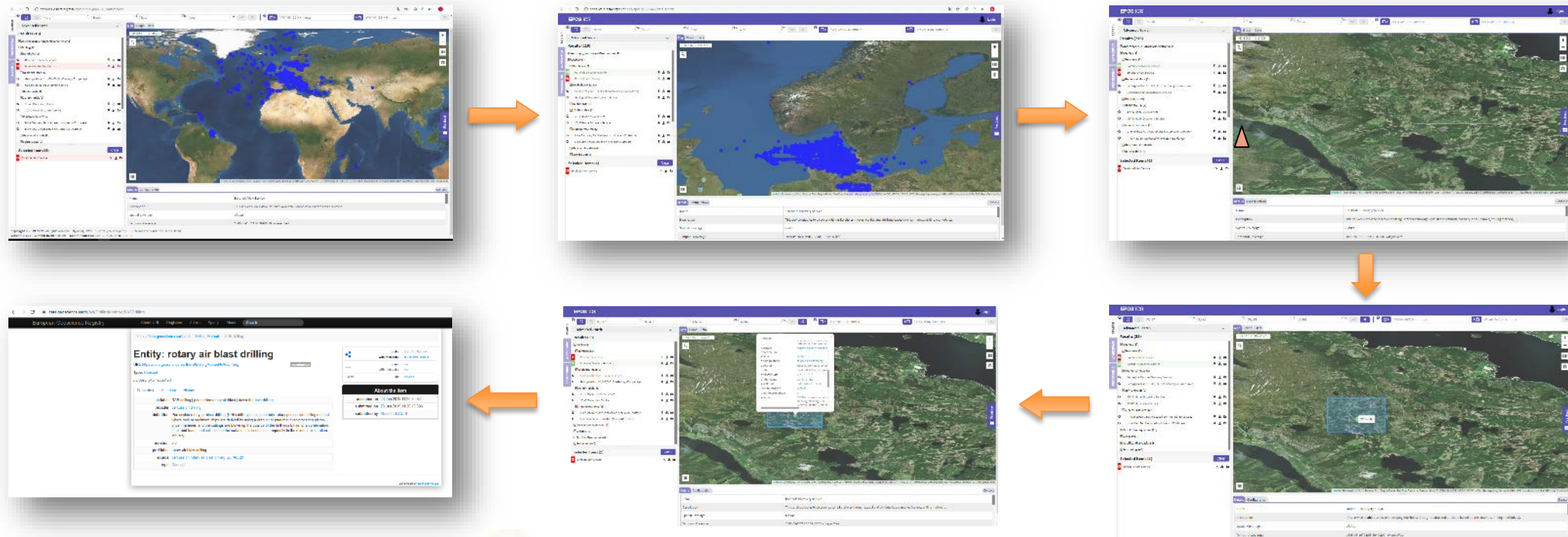
Accessing additional information through the data graph

From one entry point in the data graph (example: the BoreholeIndex entry point), it is possible to access richer information using URIs



Navigating through the data graph

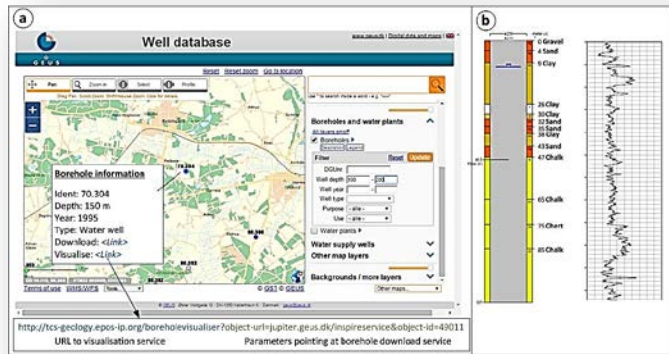
- From the BoreholeIndex entry point, navigate through all borehole-related features (ex.: logs) and display them using the borehole visualisation tool libraries
- This linked data mechanism is applied to all “Geological Information and Modelling” datasets



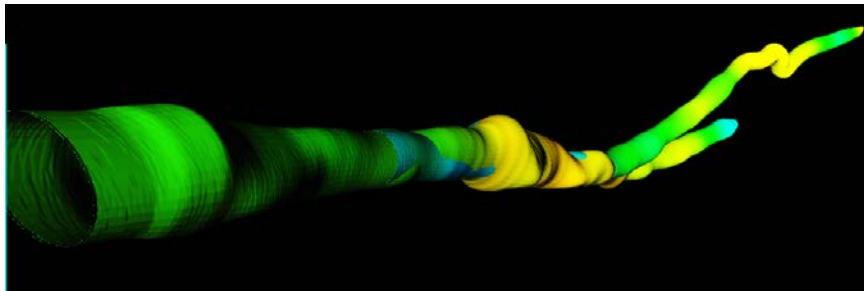
<https://data.geoscience.earth/ncl/DrillingMethod/RABDrilling>

Borehole visualisation services

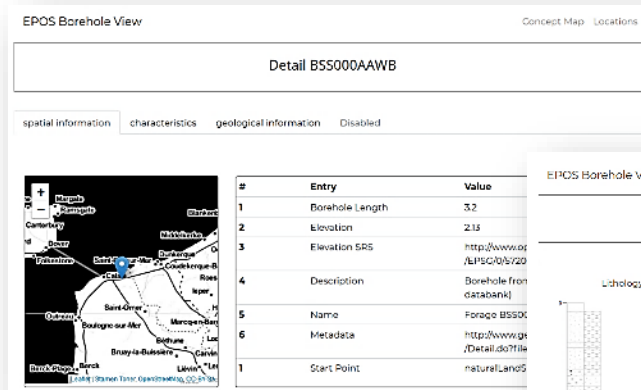
2D and 3D multi-parameter visualisation tools on top of EPOS GIM data and based on the previously mentioned Vocabularies e.g. Chronostratigraphy, Grain Size, Rock Names and many more



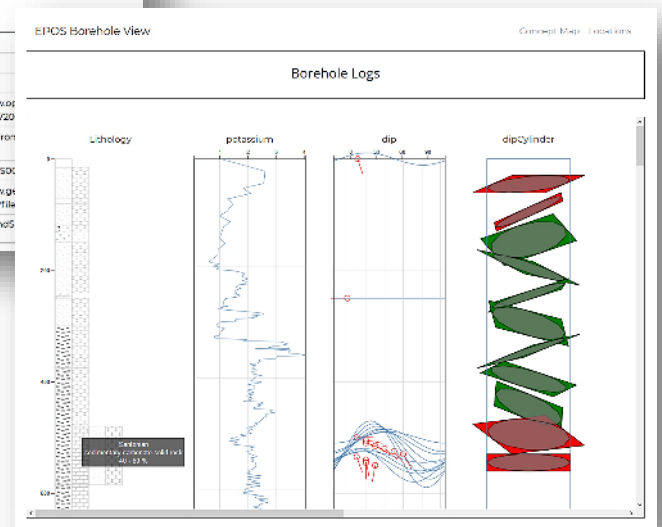
Borehole locations displayed on a map and borehole logs using multi-parameter visualisation tools (GEUS)



Generic consumption of the interoperable borehole trajectory description by the visualisation tool. The colours reflect the borehole diameter (GFZ)

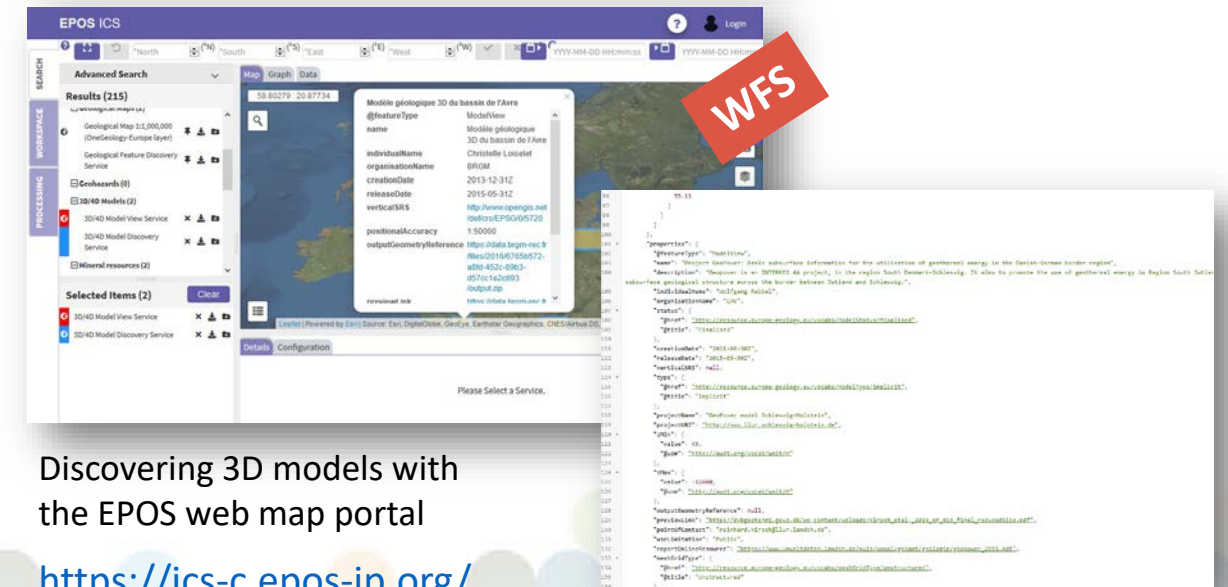
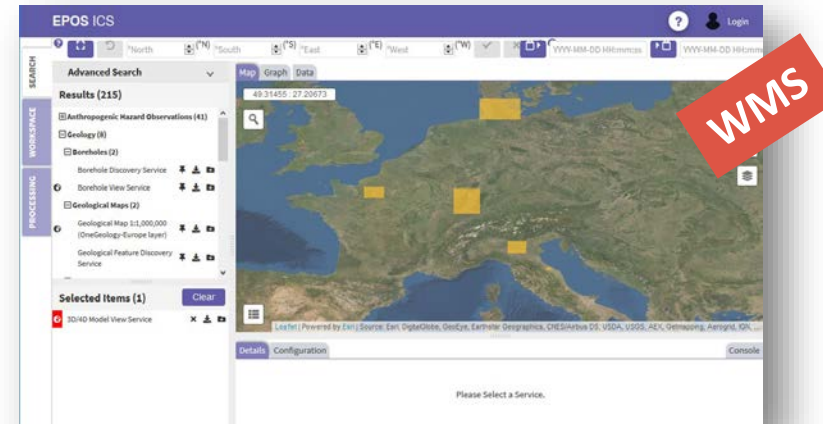


Borehole locations displayed on a map and borehole logs using multi-parameter visualisation tools (GFZ)



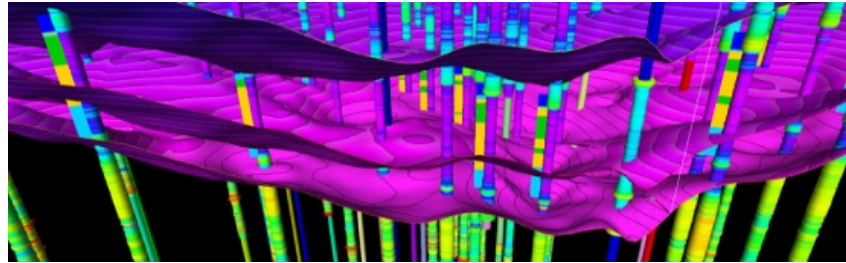
EPOS GIM European Model Index

- Basic information for describing & discovering subsurface models (3D, 4D, geophysical, etc.)
- Unlike the actual ISO19115 metadata catalogues, each entry is a feature based on a specific Feature model
- A Model Index entry is:
 - a 'Model vCard'
 - A summary information + HTTP URIs towards richer information flows (including download links)



Discovering 3D models with the EPOS web map portal

<https://ics-c.epos-ip.org/>



Merci pour votre attention

Thank you for your attention

Marc Urvois (m.urvois@brgm.fr)

BRGM – French Geological Survey

<https://www.epos-ip.org/tcs/geological-information-and-modeling/data-services/wp15-services-and-architecture>