What is EPOS “Geological Data and Modelling” Thematic Core Service (TCS) about?

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Geology describes the ground under our feet and tells us about the Earth’s history, but not only that! Geology also deals with the evolution and the future of our planet in a world that is rapidly changing and the growing population constantly requires more energy, more natural resources and also has to cope with climate changes and natural hazards.

Environmental issues like erosion, pollutions (water and soil contaminations, greenhouse gas emissions, waste...), access to ground and water resources, risk prevention and monitoring have an increasing impact on our lives. We have to tackle the economic and political challenges these factors are raising. Knowledge about geology and the understanding of earth phenomenon (seismic, landslides, floods...) are key and fast progressing. The development of new technologies now allows producing dynamic geological maps, Earth models, earthquake and other hazard simulations through the integration and processing of aggregated data combined into 3D and 4D products and services.

Scientists, decision makers at every scale (local to global) and the civil society can now benefit from huge amounts of valuable multidisciplinary data at hand. Sharing data from observations, experimentations and analysis from various disciplines (drilling, geophysics, geochemistry, chronostratigraphy...) are vectors to capitalize on, improve and disseminate geological knowledge, lower our grasp on environment and impact on climate. This is expected to enhance global coordination to face critical events, prepare for the future and elaborate on environmental policies.

This is what the EPOS (European Plate Observation System) is about. Within the EPOS initiative, the objective to make available data accessible to the scientific community is achieved though the creation of an efficient and comprehensive multidisciplinary research platform for the Earth Sciences in Europe.
This will provide future virtual research environments with means to facilitate the use of existing information to foster future applications (subsoil uses, transboundary exploration, environmental and socioeconomics issues). In addition, workflows will be established that allow the integration of other existing and new data and applications. Processing and the use of simulation and visualisation tools will subsequently support the integrated analysis and characterisation of complex subsurface structures and their inherent dynamic processes. This will in turn aid in the overall understanding of complex multi-scale geo-scientific questions.

The EPOS structure is made of several layers:

- **1st layer** is the National one, where the National Research Infrastructures provide available and collected information (the DDSS);
- **2nd layer**: the Thematic Core Services (TCS) is the (European) Community Layer where community standards are applied to DDSS that are relevant to the specific thematic area;
- **3rd (top) layer** represents the integration of the DDSS that come from the TCSs, where high level international standards are required.

The Geology TCS, on the 2nd layer level is an important brick of the EPOS system and will work alongside other EPOS TCSs to create the final research platform.

**“Geological Data and Modelling” Thematic Core Service (TCS) role**

A group of partners (BRGM, BGS, GEUS, ISPRA, UU-SE, and GFZ) is working within workpackage 15 (WP15) to carry on the various tasks they have been assigned in the project. The workpackage 15 is responsible for the Thematic Core Service (TCS) named “Geological Data and Modelling” and is working on 3 major axes:

- Develop, consolidate and take advantage of the synergy between the existing data infrastructure of the Geological Surveys and of the large amount of information produced by the research organisations and international communities.
- Provide two main data services:
  - Drilling data service (with data collected from borehole drilling)
  - Subsurface data service
- Create a catalogue of the various available models

After the WP15 kick-off in November 2015 in Copenhagen where existing standards were exposed and discussed, WP15 members subsequently met in Paris (Feb 2016) on boreholes, discussing and settling on a definition of the Use cases. Indeed, Geological data and Modelling TCS will be implemented on the basis of available databases throughout Europe in the fields of 1) stratigraphic boreholes and associated scientific drilling data, 2) multiscale geological maps, 3) 3D/4D geological models, 4) geohazard
databases and inventories.

For decades, European Geological Services and states have collected information in various domains related to geology (boreholes, geological maps, geohazards or more recently 3D/4D models...). Over the first year of the project, WP 15 launched a survey to explore the availability of the datasets and is now focusing on producing a common methodology to identify, share and exchange available data between the data-providers and EPOS end-users. Through the implementation of representative user cases (UCs), partners will be analysing the relevant exchange standards and associated services to facilitate the discovery of available identified information.

“Geological Data and Modelling” Thematic Core Service (TCS): a typical use case

The basic UC structure covers:

- Dataset discovery
- Simple feature view/download (where/which/what = basic metadata)
- Complex feature view/download (view /request/filter/download)

The specific UC developed on “Boreholes” is a good illustration of this approach. Borehole drilling provides huge amounts of information on the underground (lithography, depths, chemistry, groundwater...) which are essential resources for the research communities and the public or private sectors. The Borehole UC endeavours to create a European index of existing boreholes. It is not a device just designed to harvest data but a tool enabling users to get back to the data provider (country, Geological survey, mining company...) and access the borehole associated information (e.g. number of boreholes, range of depths, mapping scale, vertical extension of 3D model, type of geohazard, etc.) by means of a dedicated portal and methods specifically developed.

The same methodology will be applied to the other topics such as geological maps, geohazards or 3D/4D models. Once surveyed throughout Europe, indices will be implemented to capitalize information on availability, content, geographical coverage... for the elaboration of relevant catalogues.

The importance of normalisation and interoperability

Given the variety and heterogeneity of data sources, it is essential to achieve a high level of standardisation (from no or low standardisation to high-level data harmonization) interoperability of data is a prerequisite for their integration in catalogues based on international standards.

Providing a framework of rules, guidelines and standards as well as central indexes will facilitate collection and the introduction of value-added consultation services using thematic web services and
interfaces and is one of the major tasks of the TCSs.

Aware of the necessity to consider the community needs and requirements, existing standards, and to discuss about opportunities to develop joint initiatives with relevant end users, WP15 partners organized a “3D geoscience, borehole ad-hoc meeting” at the June 2016 Dublin OGC/Technical Committee. This led to the decision to launch the creation of a Domain Working Group (DWG) under OGC, to have an umbrella under which to discuss 3D, Boreholes and more topics, generate interoperability experiments and best practices. Further developments and actions will soon follow.

“Geological Data and Modelling” Thematic Core Service (TCS) and TCS harmonization

Each TCS declared a priority list of data, data products, services and software (DDSS) to be implemented in the EPOS Integrated Core Service (EPOS-ICS), a system made up of several, modular, interoperable building blocks (metadata catalogues, systems engine software, services and APIs...)

Within EPOS, WP15 Thematic Core Service (TCS) “Geological Data and Modelling” identified eight DDSS thematic areas: Borehole data, Geological maps, 3D/4D models, Geophysical data, Active Seismic, GeoHazards maps, Sample analysis data, Subsurface maps. A large list which evidences the close interconnections with other TCS (Technical Core Services) within the EPOS framework and the need for harmonisation groups to help with the overall understanding of complex multi-scale geo-scientific questions. The WP15 TCS will therefore work alongside other EPOS TCSs and is involved, as leader or partner, in 10 transverse domains such as boreholes, models, geophysical measures, rock sample properties, georesources (ores, mining index or sites), geohazards (landslides, floods, earthquakes,...). Cross TC harmonization will contribute the implementation of the TCS integration into the EPOS Integrated Core Service (EPOS-ICS).

WP15 prefigures EGS commitment in EPOS. The harmonization groups prepare the strong transverse dynamics, in particular in the geology data world. This will help lay the ground for the future organization. On the short term, the work started on the boreholes should give way to the first results, i.e. the centralized index and the borehole linked data sharing strategy, before the end of 2016.