WP 5.4: NETWORKING DEEP SEISMIC SOUNding DATA AND PRODUCTS

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WP OBJECTIVES

• Establish a networking activity to identify and gather the relevant institutions currently holding and/or collecting Deep Seismic Sounding (DSS) data and research infrastructures

• Map and establish a first comprehensive inventory of available and processed data, formats, metadata, products of various level obtained from the raw data, reports and technical documentation of past experiments

• Investigate access mechanisms and ownership issues where relevant

• Engage the broader user community to define a roadmap of key scientific questions which could be tackled by joining the active and passive seismology data collections

• Engage the technical community of the data owners and EPOS to discuss organizational objectives for allowing effective and seamless access to DSS data, with the aim of producing a roadmap and technical assessment to establish a service access ready to enter in pre-operational validation in the 4th year of EPOS-IP
The SERA working group has communicated with the DSS community in the discussion meetings at EGU meeting in Vienna in April 2018 and Seismix - International Symposium on Deep Seismic Profiling of the Continents and their Margins in Krakow in June 2018.

The group activities have contributed to informing the wide DSS community on the SERA objectives, as well as by including the DSS community in the discussion regarding finding the most appropriate model for including the DSS data into the EPOS framework. The DSS community we communicated with consists of international specialists from control source seismic exploration (DSS and Normal Incidence seismics).

These dialogues have significantly contributed to the current plans on how to proceed. However, engagement of the DSS community will be still needed for defining the most appropriate ways forward in the future.
To create a “project database” within the EPOS metadata system, WP5 has, as a first step, collated a list of DSS projects (such as ECORS, BIRPS, DEKORP, ESCI, FIRE, HIRE, URSEIS, EUROBRIDGE, TRANSALP, BABEL, EUGENO, etc.), with information regarding data-owning institutions, published data and results, etc.

With the help of the DSS community, the SERA working group will continue to refine the DSS project database, with a primary short-term aim of securing data which may be in danger of being lost.

The SERA working group has also listed examples of metadata that are already used in several existing DSS databases, such as OpenFIRE (Finland), CSIC (Spain), and BIRPS (UK), since it seems plausible that one or more of these can provide the technical basis for the design of a homogeneous European system suitable for EPOS.
These outcomes were further achieved through two public reports, “Deep seismic sounding data” and “Position Document on Future Deep Seismic Sounding (DSS) Data Accessibility”, as well as through the participation in other symposia, such as Lithosphere 2018, where we had a dialogue with the participants of OpenFire, a portal for browsing and downloading seismic reflection data and data products of the Finnish Reflection Experiment (FIRE).

The third report: “Scientific roadmap for the active and passive seismological community”, proposes a route towards developing an effective data access system for researchers working with European seismic data. The document also describes some of the issues related to this type of data, but also provides suggestions and recommendations on how to build and organize the system for handling them.

The fourth report presents “Feasibility assessment for the establishment of a DSS access service as part of the EPOS Framework, covering technical integration, organization, governance and financial aspects”.

www.sera-eu.org
Workshops & Dedicated Symposia

1) EGU (Viena, 2018, Austria)
2) Deep Seismix 2018 (Crakov, Poland)

DSS Control-source seismic data # natural source seismic data
Deep Seismic Sounding (DSS wide-angle + refraction)
Include the normal incidence data

› Academic data
› Industry data (Country dependent policies)
› On land
› Maine data (Existing public data repositories)

• Raw Data
• Processed Data
• Data products seismic velocity models

Directly attach to each Data-Set a project and an PI (research group)
Technical Approach Open Science

- Scientific research is producing a vast amount of scientific contributions published in different research journals. A significant amount of these contributions are based on experimental seismology which is mostly responsible of generating **Deep Seismic Sounding (DSS) data**.

- In order to consider the technical feasibility of data access and data products, access to these products is provided under the requirements of the EU mandates of open access.

- The FAIR principles: findable, accessible, interoperable and reusable.
Within the Open Research Data Pilot in H2020, the UE is also encouraging diffusion of scientific FAIR data by archiving data into research repositories and thus, supporting open access availability of them. It regards to:

- Develop a Data Management Plan
- Deposit of data in a repository
- Ensure third parties can freely access, exploit and disseminate data
- Provide related information to use the raw data.

https://www.openaire.eu/what-is-the-open-research-data-pilot
Up to now, earthquake engineering and seismology have not interfaced their data structures. However, there is a need to increase the interaction between them by integrating the most important databanks in Europe. An efficient use of resources, know-how data sharing and the added value of bringing together the data sources and data exchange services of the two communities, will be a step forward in the benefit of a wide range of users.

For that reason, EPOS (European Plate Observation System), formed by 53 partners from 25 countries, is working since 2002 to create a long-term plan to facilitate integrated use of data and data products.
EPOS functional architecture is based on 3 layers:

National Research Infrastructures and Data Centers (NRI): provide data

Thematic Core Services (TCS): e-infrastructures that provide and disseminate data and services to specific communities and international organisations

Integrated Core Services (ICS): ensure interoperability between the data and services provided by the TCSs
EPOS

- EPOS functional architecture is built on 10 Thematic Core Services (TCS).

- The Seismology TCS aims to build on existing (ORFEUS, EMSC, EFEHR) and new European infrastructures to provide services for waveform data, earthquake and hazard data and integrate this with the EPOS infrastructure.

- **DSS data:** The community recognizes that there are fundamental differences with conventional natural source seismic data. Link to a project, and research group or PI. Thus, access needs to be treated as close as possible as a regular publication.
• EPOS Graphical User Interface (GUI) is connected and integrated to the EPOS architecture scheme.

• EPOS ICS GUI allows for discovery data and services, workspace, visualization and processing/analysing.
The EPOS metadata reference model or baseline, aid the TCS in the collection and description of the metadata.

For each entity, a set of attributes is specified.
EPOS: Metadata reference model

• The baseline of EPOS metadata is a two-step process.

• First step: metadata is mapped from the TCS to the EPOS baseline. Convertors are written to transform metadata in the proprietary TCS format.

• Second step: metadata is converted to the CERIF (Common European Research Information Format) catalogue.
• Deep Seismic Sounding (DSS) data comprises long-range seismic refraction and wide-angle reflection data.

• DSS projects provide information of the whole crust and upper mantle.

• Acquisition: profile of recording stations (seismometers) and shot points (sources) at several points in the profile.

• Data processing: filter to enhance signal to noise ratio

• Data storage: seismic data are storage in a standard format defined by the Society of Exploration Geophysicists (SEG). These formats include information about the location of source and sensor, geometry and the time series (seismogram).
Technical aspects

- SEG-Y format was accepted in 1975.
- SEG-Y has evolved with the years adapting to the industry and research needs.
- Nowadays, SEG-Y is broadly spread in the seismic community.
## Technical aspects

Seismic data types for DSS which can be represented by SEG-Y format

<table>
<thead>
<tr>
<th>Data Type #</th>
<th>Data Category</th>
<th>Data Types</th>
<th>Data descriptions and comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raw DSS data (deep seismic sounding, long range refraction, wide-angle data)</td>
<td>Time series data for an individual sensor point. Associated location information, including altitude. Sensor type. Original recording equipment type and current form of storage. Station comments.</td>
<td>The time series ground motion data may be one component (usually the vertical), although three components are the most common. The coordinate system used should be clearly specified. For old data, where the location of the stations may be inaccurate, all available data should be included in the metadata file. When possible, it has to be included how the position was measured. Sensor type should include the sensor manufacturer and identification number, if possible, with a link to information regarding sensor performance. If old data was collected on f.m. tape, or other outdated recording mode. Timing accuracy may depend on the recording mode. Sensors may be deployed on different material (e.g. bedrock or sand) and the operator may have noted noise sources nearby.</td>
</tr>
<tr>
<td>2</td>
<td>Pre-process data DSS data sections</td>
<td>Commonly, reduced time sections after filtering. These may be digital time series, or as images.</td>
<td>Information about station position has been converted to source-receiver position. The reduction velocity and filter parameters are important and should be taken into account. For image files (old data), parameters such as the form of scaling of the traces, should be noted. Some sections may use more advanced processing techniques that may be relevant, e.g. including three component information.</td>
</tr>
<tr>
<td>3</td>
<td>Models derived from DSS data (Vp and Vs, in cases Vp/Vs or Poisson's ratio. Grids of physical properties</td>
<td>They primarily result in models of the arrival time of identified phases, producing a two-dimensional velocity model, of P- or S-waves velocities</td>
<td>Entities will be represented by the occurrences or mines, which could either be spatially represented by points or polygons. The data are already handled by Minerals4EU and it should be examined whether these services can simply be integrated “as is”.</td>
</tr>
</tbody>
</table>
CSIC aims to treat current dataset as published papers (DOI and handle).

IAM (Iberian Atlantic Margin) project comprise 3700 km of normal incidence deep seismic reflection data in the west Iberian margin.

Seismic lines are available to download together with a description of the dataset and related publications.
Metadata

• Seismic datasets should have a **permanent identifier** such as DOI or handle, thus helping the user to locate the document or dataset.
• DataCite Metadata schema → FAIR data
• Context, nature of the data, file format and legal aspects

Excel
Readme

Dataset
Prototype example

• Statistics of the access to the database.

• Number of visits and downloads by geographic location and time.
Prototype example

• Link to SHARE. Published material related to the dataset.

• Further options comprise a link to social networks (ResearchGate, LinkedIn...), Mendeley, Google Scholar...
Link to BASE, providing information about academic web resources.
• Deliverable “Validation of pre-operational access phase to selected DSS data and products” (Public report, Month 36)

• Milestones: M25: Complete preoperational validation for inclusion in EPOS operational phase (Means of verification: Approval by EPOS, Month 36)
  • M27: Successful final evaluation by Scientific Advisory Board (Means of verification: Report published, Month 36)