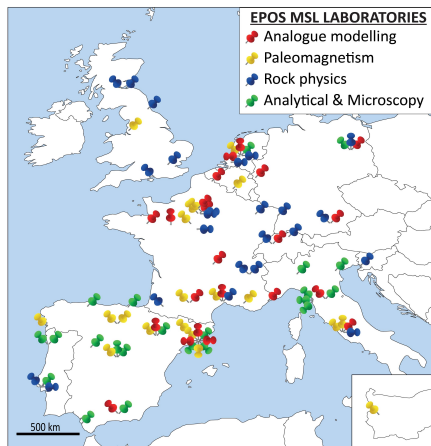


EPOS Multi-scale laboratories



❖ Consortium of 11 members from 8 countries



- ❖ 94 laboratories from 12 countries in MSL community
- ❖ 4 subdomains (Analogue Modeling, Analytical & Microscopy, Paleomagnetism, Rock Physics)



How to publish your data with the EPOS Multi-scale Laboratories

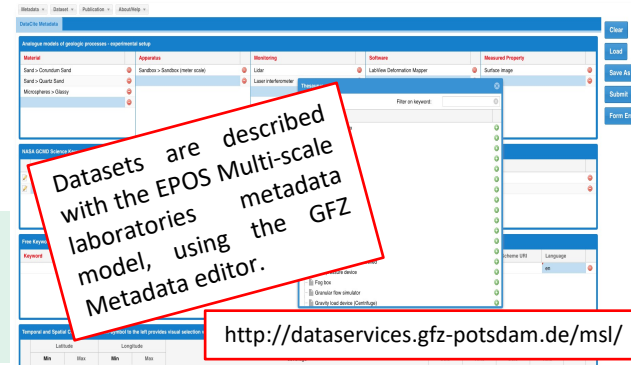
Geertje ter Maat & the EPOS TCS MSL team



Data publication chain

STEP 1

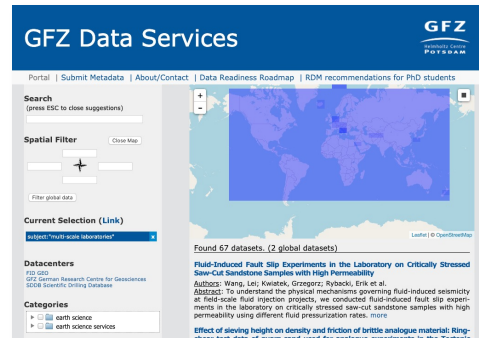
Data are produced in the labs and organised in datasets



<http://dataservices.gfz-potsdam.de/msl/>

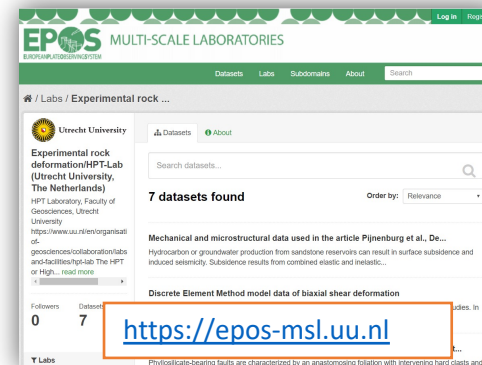
STEP 2

Dataset description with MSL metadata model



STEP 3

Datasets are published with a DOI in a MSL/Institutional repository



STEP 4

Datasets metadata are harvested in the TCS catalog

Why publish your research data through the EPOS Multi-scale labs?

- ✓ Make your research data **Findable**, **Accessible**, **Interoperable**, **Reusable** (**FAIR**) and citable for other scientist!
- ✓ Prevents you and your fellow scientists from re-inventing the wheel
- ✓ Stop a large part of your data ending up in the 'bottom-drawer', but getting used by colleagues instead

Other MSL activities

- ✓ Transnational Access
- ✓ Community meetings



@TCS_MSL

It is possible for laboratories/institutes to join the EPOS Multi-scale laboratory community!



multi-scale-labs@epos-ip.org



www.epos-ip.org/tcs/multi-scale-laboratories



The EPOS Multiscale Laboratories

Geertje ter Maat, Otto Lange, Martyn Drury & the EPOS Multi-scale laboratories Team

EGU 2021

Pan-European project with the goal:

Improving and facilitate the integration, access, use, and re-use of solid Earth science data, data products, services and facilities

Method:

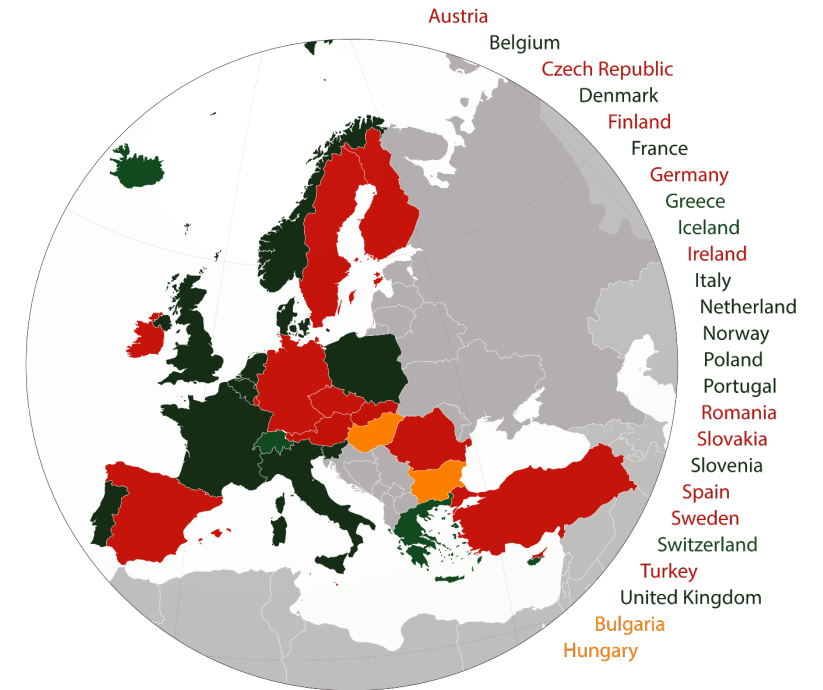
Harmonizing and integrating the mosaic of distributed but separated solid Earth sciences Research Infrastructures within Europe

- networks, observatories, data repositories, laboratories and modelling facilities, etc.

Deliverable:

A single sustainable, permanent and distributed infrastructure that integrates the diverse and advanced European Research Infrastructures for solid Earth science under a common framework

- Central data Portal

Legend EPOS ERIC countries:

Member, Observer country (Part of EPOS ERIC),
Prospective, Undecided (Not yet part of EPOS ERIC)

EPOS = Enabling science by integrating research infrastructures, thereby providing access to data, scientific products, and services

Community: Creating a coherent and well-organized network of solid Earth Science laboratories

- Consortium of 11 members from 8 countries
- 94 laboratories from 12 countries in MSL community
- 4 subdomains (Analogue Modeling, Analytical & Microscopy, Paleomagnetism, Rock Physics)

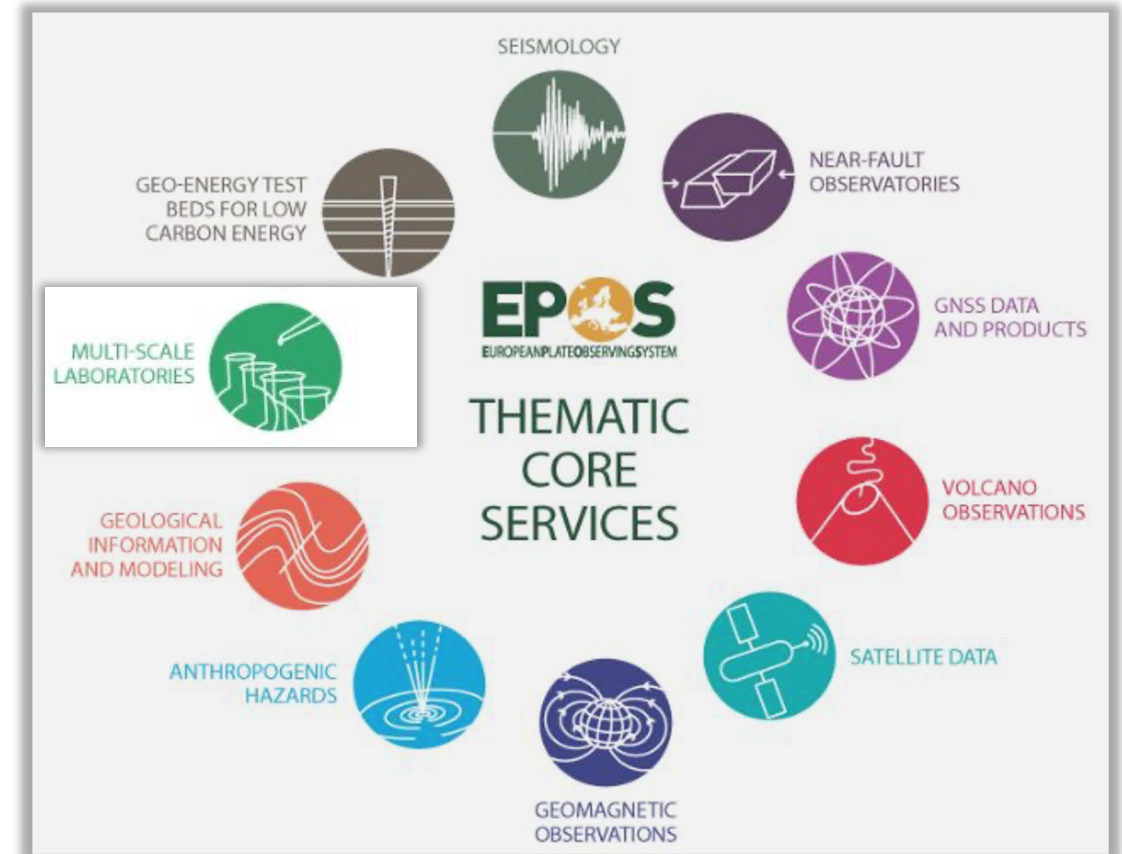
Facilities: Developing a Trans-national Access (TNA) program

- Providing access to research facilities

Data: Implementing dedicated data services

- Establishing data publication chain

EPOS consists of 10 Thematic Core Services (TCS)



1. The MSL community

EPOS (European Plate Observing System) is an ESFRI Landmark and European Research Infrastructure Consortium (ERIC). The EPOS Thematic Core Service Multi-scale laboratories (TCS MSL) represents a community of European solid Earth sciences laboratories including high temperature and pressure experimental facilities, electron microscopy, micro-beam analysis, analogue tectonic and geodynamic modelling, paleomagnetism, and analytical laboratories.

The mission of the EPOS TCS MSL is to create a unique point for collaboration and exchange by;

- 1) Creating a coherent and well-organized network of solid Earth Science laboratories;
- 2) Implementing dedicated Data Services and controlled vocabularies that will guarantee Findability, Accessibility, Interoperability, and Reusability (FAIR) of laboratory data with other solid Earth Science data;
- 3) Developing a Trans-national Access (TNA) program that will increase European state-of-the-art solid Earth science laboratories attractiveness for researchers and contribute to increased researchers mobility, cooperation and exchange.



In addition, the TCS MSL collects facility information from affiliated laboratories that is displayed in the EPOS Infrastructure Portal, thereby providing an overview of the Solid Earth Sciences laboratory landscape in Europe.

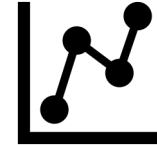
2. Data Services

The TCS Multi-scale laboratories Data Services aim at the dissemination of scientific results in the form of datasets coming from experimental research, uniquely identifiable through publication with a DOI: citable, trackable, persistent and with metadata and data description for re-use and discovery.

Datasets are described with the EPOS Multi-scale laboratories metadata model, which includes standard vocabularies (ISO19115/INSPIRE, GCMD, DataCite) and new controlled vocabulaires specific for: Analogue models of geologic processes, Paleomagnetic and magnetic data, Rock and melt physical properties, Geochemical and Microscopy data. Metadata includes licensing information.

Datasets can be published in generic, institutional repositories or in dedicated EPOS Multi-scale laboratories repositories.

➤ The next slide shows the TCS MSL laboratory data publication process



3. Data publication chain

5. ICS-C Data Portal

4. MSL catalogue

GFZ Data Services

3. GFZ Data Services (repository)

2. GFZ metadata editor

1. Example dataset

Wide variety of data types and sizes!

STEP 5

Datasets metadata are harvested into EPOS ICS Portal

STEP 4

Datasets metadata are harvested in the TCS catalogue

STEP 3

Datasets are published with a DOI in a TCS MSL/Institutional repository

STEP 2

Datasets are described with TCS MSL metadata model

STEP 1

Data are produced in the labs and organised in datasets

4. Metadata editor

MetadataDatasetPublicationAbout/Help

DataCite Metadata

Analogue models of geologic processes - experimental setup

Material	Apparatus	Monitoring	Software	Measured Property
Sand > Corundum Sand	Sandbox > Sandbox (meter scale)	Lidar	LabView Deformation Mapper	Surface image
Sand > Quartz Sand		Laser interferometer		
Microspheres > Glassy				

NASA GCMD Science Keywords

Keyword
EARTH SCIENCE > SOLID EARTH > TECTONICS > PLATE TECTONICS > STRAIN

Free Keywords (Supply as many keywords as you want)

Keyword

Thesaurus

Filter on keyword:

Name
2D Convection box
3D Convection box
Glass/Plexiglas box
Cooler device
Densimeter
Dynamometer
Earthquake simulator
Electric engine (mm/hr)
Electronic microscope
Extension box
Fault simulator
Flow channel
Fluid injector
Fluid injector termally controlled
Fluid pressure device
Fog box
Granular flow simulator
Gravity load device (Centrifuge)

Temporal and Spatial Coverage (The EDIT-symbol to the left provides visual selection via Google Maps.)

Latitude		Longitude		Description of spatial and temporal coverage	Date/Time Start		Date/Time End		Time zone
Min	Max	Min	Max		Date	Time	Date	Time	

Clear

Load

Save As

Submit

Form Errors

Datasets are described with the EPOS Multi-scale laboratories metadata model, using the GFZ Metadata editor.

5. Discovering lab data

Multi-scale laboratories datasets will be discoverable through the EPOS ICS Portal.

Datasets can also be discovered by directly accessing the TCS Multi-scale laboratories catalog. Here, datasets can be searched using filters such as domain specific keywords or research infrastructure. The TCS MSL catalog provides also a short description of each contributing laboratory.

TCS Catalog website:
<https://epos-msl.uu.nl>

The screenshot shows the EPOS Multi-scale Laboratories website. The header features the EPOS logo (European Plate Observing System) and navigation links: Datasets, Labs, Subdomains, and About. A search bar is located in the top right corner. The main content area is divided into two columns. The left column contains a 'Search data' section with a search input field (placeholder: 'E.g. environment') and a search button. Below this is a 'Popular keywords' section with buttons for 'multi-scale laborat...', 'TECTONICS', and 'EARTH SCIENCE SERVICES'. The right column features a large EPOS logo and a text block that reads: 'Click <https://epos-no.uib.no/epos-tna/facilities> to go to the EPOS TNA-/Infrastructure portal for an overview of labs currently involved within the MSL network.' Below this is another text block: 'This is the central data catalog of the EPOS Multi-scale laboratories community. Here you can find openly published data coming from a wide range of world-class experimental laboratory infrastructures: from high pressure-temperature rock and fault mechanics and rock physics facilities, to electron microscopy, micro-beam analysis, analogue modelling and paleomagnetic laboratories. More information about the Multi-scale laboratories community is to be found at <https://epos-ip.org/tcs/multi-scale-laboratories>.' At the bottom of the left column, there is a section titled 'EPOS - Multi-scale laboratories data catalog statistics' showing three statistics: 63 datasets, 82 labs, and 4 groups.

EPOS MULTI-SCALE LABORATORIES
EUROPEAN PLATE OBSERVING SYSTEM

Datasets Labs Subdomains About Search

Search data

E.g. environment

Popular keywords multi-scale laborat... TECTONICS EARTH SCIENCE SERVICES

EPOS - Multi-scale laboratories data catalog statistics

63 datasets **82** labs **4** groups

EPOS EUROPEAN PLATE OBSERVING SYSTEM

Click <https://epos-no.uib.no/epos-tna/facilities> to go to the EPOS TNA-/Infrastructure portal for an overview of labs currently involved within the MSL network.

This is the central data catalog of the EPOS Multi-scale laboratories community. Here you can find openly published data coming from a wide range of world-class experimental laboratory infrastructures: from high pressure-temperature rock and fault mechanics and rock physics facilities, to electron microscopy, micro-beam analysis, analogue modelling and paleomagnetic laboratories. More information about the Multi-scale laboratories community is to be found at <https://epos-ip.org/tcs/multi-scale-laboratories>.

6. Facility information

EPOS TNA Home Infrastructures Open calls Past projects Contact Login/Register

Filter Search

Filter

☒ Asset type

- ☐ Access to mobile instruments
- ☐ Access to Volcano Observatories and Volcano
- ☒ laboratory
- ☐ Provision of Rock Samples

☐ Domain

- ☐ Analogue modelling
- ☐ Analytical and microscopy
- ☐ Paleomagnetism
- ☐ Rock physics
- ☐ Volcanological Research

☐ Institution

☐ Country

☐ Equipment

☐ Measurement

☐ TNA



Facility information from affiliated TCS MSL laboratories is displayed in the EPOS Infrastructure Portal, thereby providing an overview of the Solid Earth Sciences laboratory landscape in Europe.

Type	Research field	Facility Name	Location
+ laboratory	Paleomagnetism	Paleomagnetic Laboratory	Roma TRE
+ laboratory	Paleomagnetism	Paléomagnétisme Géosciences Rennes	CNRS

7. Equipment information

We also collect information about the available instruments and types of measurements that you can conduct at these facilities!

EPoS TNA Home Infrastructures Open data Best projects Contact Login/Register

Filter Search

Filter

Asset type

- ☐ Access to mobile instruments
- ☐ Access to Volcano Observatories and Volcano
- ☒ laboratory
- ☐ Provision of Rock Samples

Domain

- ☐ Institution
- ☐ Country

Latitude: 46.951311

Longitude: 7.428887

Website: [Link](#)

Services

Equipments

(13) -

- ▶ DIC/PIV - Matlab code
- ▶ Digital volume correlation techniques
- ▶ MeshLab
- ▶ Move (Midland Valley)
- ▶ Osirix
- ▶ Petrel (Schlumberger)
- ▶ SLR camera
- ▶ Sandbox - meter scale
- ▶ Sandbox - meter scale
- ▶ SfM - Photogram (Agisoft)
- ▶ The Kingdom of SMT
- ▶ Time lapse camera
- ▶ X-ray computed tomographic scanner (CT-scan)

Measurements

(12) +

+ laboratory Analogue modelling TecMOD - GEOAZURmodel

+ laboratory Analogue modelling TecMOD - LMVmodel

TCS MSL Catalog

EPoS MULTI-SCALE LABORATORIES

Log in

Datasets Labs Subdomains About Search

/ Labs / Tectonic Modelling Laboratory ...

u^b

UNIVERSITÄT BERN

Tectonic Modelling Laboratory at the Institute for Geological Sciences (TecLab Bern, Switzerland)

Analogue modelling is a well-established technique to investigate the evolution of tectonic structures in the Earth's crust and lithosphere. Scaled analogue models offer the... [read more](#)

Followers: 0 Datasets: 7

T Labs

Tectonic Modelling ... (7)

Search datasets...

7 datasets found

Order by: Relevance

4D X-Ray CT data and surface view videos of a systematic comparison of experi...

This data set includes 40 videos (+ 1 image) depicting the surface evolution of 39 experiments on crustal extension, as well as 4D CT imagery (figures and videos) of 6 of these...

GeoMod2008 materials benchmark: The axial test dataset

This dataset provides compaction data from axial testing on natural and artificial granular materials used for experimental simulation by the analogue geodynamic modelling...

GeoMod2008 materials benchmark: The SEM image dataset

This dataset provides images from scanning electron microscope (SEM) photography of natural and artificial granular materials used for experimental simulation by the analogue...

GeoMod2008 materials benchmark: The sieve dataset

This dataset provides sieve data (grain size distributions) on natural and artificial granular materials used for experimental simulation by the analogue geodynamic modelling...

GeoMod2008 materials benchmark: The ring shear test dataset

Equipment specifics

Sandbox - meter scale

Type : Apparatus

Group : Modeling_device

Name : Sandbox - meter scale

Brand : Prototype (developed and constructed by HSR Rapperswil)

Quantity : 1.0

Website :

Specifics & comments : (oblique) shortening, (oblique) extension, strike-slip

Info

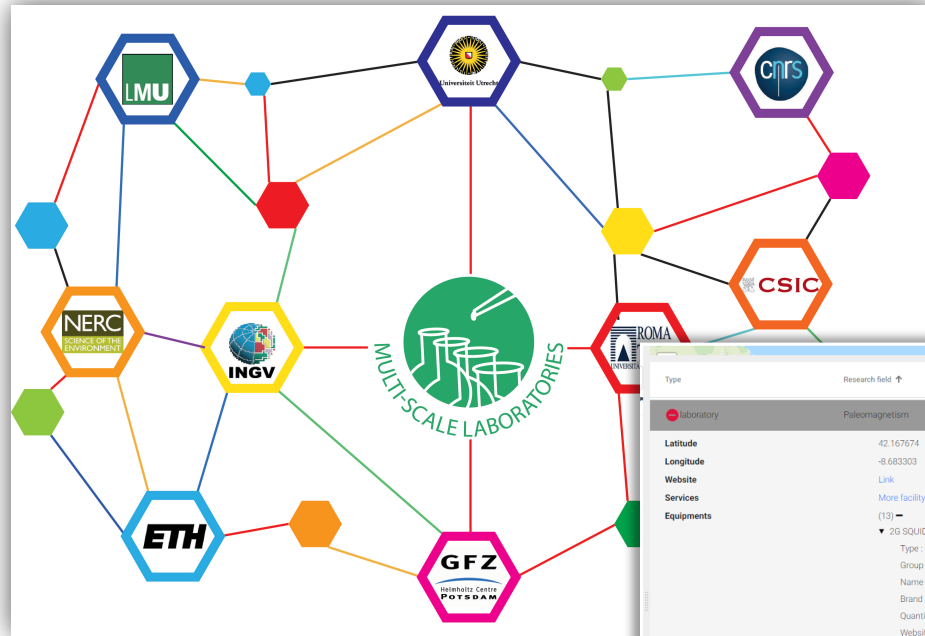
URLs

<https://epos-no.uib.no/epos-tna/facilities>

What's in it for laboratories?

Visibility within the community

Become part of the EPOS MSL network



EPOS MULTI-SCALE LABORATORIES
EUROPEAN PLATE OBSERVING SYSTEM

Datasets Labs Subdomains About Search

/ Labs / Fragmentation Lab ...

MSL portal

Fragmentation Lab (Ludwig-Maximilians-University Munich, Germany)

Fragmentation Lab (Ludwig-Maximilians-University Munich, Germany)

Explosive volcanic eruptions and their eruptive products impact humans, the environment and infrastructures on local, regional and global scales. For the wide-reaching hazard they pose to our global society, the focus of volcanology is to determine the process controlling the eruptive dynamics of volcanoes and their impact on the Earth system. Modern volcanology is founded on three main methodological pillars: 1) field observations and measurements, 2) laboratory experiments, 3) numerical modelling. The combination of those techniques is paramount to untangle the highly complex nature of processes controlling volcanic eruptions and to provide a reliable and quantitative estimate of the hazard they pose. In particular laboratory research is pivotal in the way it provides quantitative fundamental input parameters to constrain both field observation and numerical models. The experimental volcanology facilities at LMU University of Munich is equipped with world-class unique experimental setups and bench instruments which enable the characterization of materials and simulation of processes at conditions relevant to volcanic eruptions.

Information on the equipment operating at the experimental facilities can be found at www.mineralogie.geowissenschaften.uni-muenchen.de/facilities/frag/index.html

Facility info

Type: laboratory Research field: Paleomagnetism Facility Name: Laboratory of Paleomagnetism RI Name: University of Vigo Country: Spain

Latitude: 42.167674 Longitude: -8.683303 Website: [Link](#) More facility information

Services: (13) Equipments:

- 2G SQUID magnetometer
 - Type: Rock_Magnetometer
 - Group: Cryogenic
 - Name: 2G SQUID magnetometer
 - Brand: 2G Enterprises
 - Quantity: 1.0
 - Website:
 - Specifics & comments:
 - AGICO AF demagnetizer LDA-3A
 - AGICO Kappabridge KLY3
 - AGICO spinner magnetometer JR-5
 - Bartington Mag-01H single axis fluxgate
 - Bartington magnetic susceptibility meter
 - MMTD80 thermal demagnetizer
 - Magnetic Measurements low field cage
 - Magnetic Measurements pulse magnetizer
 - Marcorist DDM3-230 diamond core drill
 - Molepini Minispin
 - Portable rock drill MMPRD
 - Quantum Design PPMS



82 laboratories & growing!

Showcase facility information (672 instruments)

What's in it for laboratories?

Open your lab for foreign researchers (TNA)

Share your research output

The screenshot shows the EPOS MSL portal interface. At the top, there's a navigation bar with 'Datasets', 'Labs', 'Subdomains', and 'About'. A search bar is also present. Below the navigation bar, the page title is 'Labs / Experimental rock ...'. On the left, there's a sidebar for 'Utrecht University' with a logo and text: 'Experimental rock deformation/HPT-Lab (Utrecht University, The Netherlands)', 'HPT Laboratory, Faculty of Geosciences, Utrecht University', and a link to 'https://www.uu.nl/en/organisati...'. Below this, it says 'Followers 0' and 'Datasets 7'. The main content area shows '7 datasets found' and a search bar. Below the search bar, there are three dataset entries: 'Mechanical and microstructural data used in the article Pijenburg et al., De...', 'Discrete Element Method model data of biaxial shear deformation', and 'Velocity-dependent slip weakening by the combined operation of pressure solut...'. Each entry has a brief description.

<https://epos-msl.uu.nl>

Equipment

3rd TNA Call: 38 labs

The list of equipments available at the selected lab can be found here

Analogue labs

• https://www.epos-ip.org/sites/default/files/repository/3rd_TNA_Call_Suppliers_Info_Analog_modelling.pdf

Analytical labs

• https://www.epos-ip.org/sites/default/files/repository/3rd_TNA_Call_Suppliers_Info_Analytical%26Microscopy.pdf

Paleomagnetism labs

• https://www.epos-ip.org/sites/default/files/repository/3rd_TNA_Call_Suppliers_Info_Paleomagnetism.pdf

Rock/melt experimental labs

• https://www.epos-ip.org/sites/default/files/repository/3rd_TNA_Call_Suppliers_Info_RockMelt.pdf

Analogue modeling:

Analytical & Microscopy:

Paleomagnetism:

Rock/melt physics:

RI/TNA Supplier (Country Code)	Facility	Contact	Apparatus
GFZ- Potsdam (DE)	Potsdam Imaging and Spectral Analysis (PISA) Facility	Liane G. Benning	FIB, Focused ion beam
			TEM, Transmission electron microscope
			SEM-CL, Scanning electron microscope-cathodoluminescence
			SEM-EBSD, Scanning electron microscope-electron backscatter diffraction
			SEM-EDX, Scanning electron microscope-energy dispersive X-ray spectrometry
IACT Instituto Andaluz de Ciencias de la Tierra (CSIC), Granada (ES)	ANDALCHRON	Carlos Garrido	LA-ICP-MS, Laser ablation inductively coupled plasma mass spectrometer
			SEM-EBSD, Scanning electron microscope-electron backscatter diffraction
			SEM-EBSD, Scanning electron microscope-electron backscatter diffraction
IGG Istituto di Geoscienze e Georisorse, CNR, Pavia (IT)	Laboratory of Geochemical Microanalysis	Alberto Zanetti	ICP-MS, Inductively coupled plasma mass spectrometer
			ICP-MS, Inductively coupled plasma mass spectrometer
			HR-ICP-MS, High-resolution inductively coupled plasma mass spectrometer
			LA, Laser ablation system
			LA, Laser ablation system
			SIMS, Secondary ion mass spectrometer

Why publish your research data through the EPOS Multi-scale labs?

- ✓ Make your research data **F**indable, **A**ccessible, **I**nteroperable, **R**eusable (**FAIR**) and citable for other scientist!
- ✓ Prevents you and your fellow scientists from re-inventing the wheel
- ✓ Stop a large part of your data ending up in the 'bottom-drawer', but getting used by colleagues instead

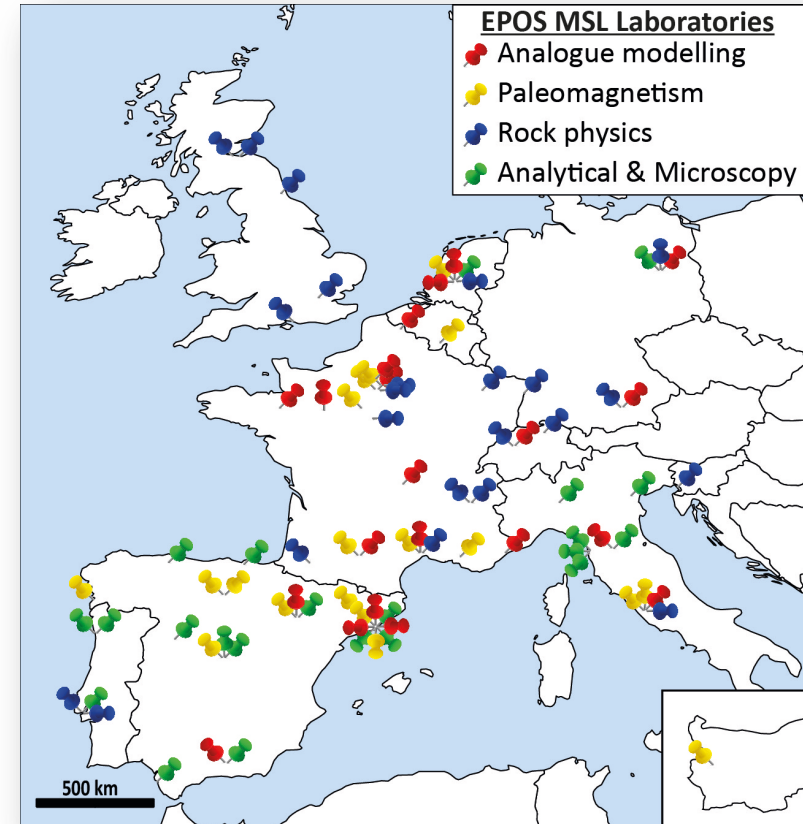
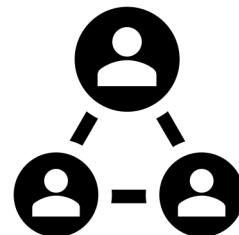
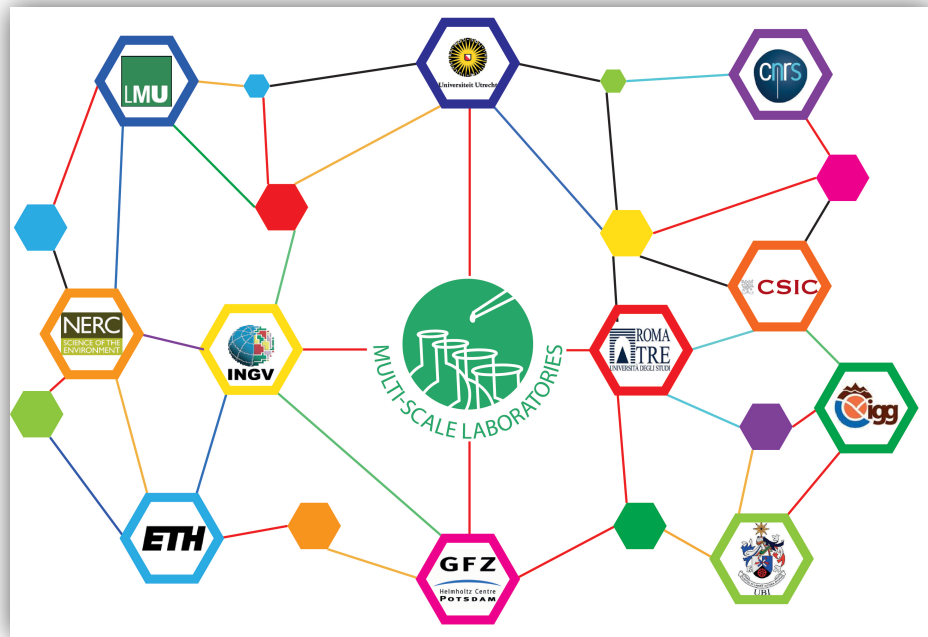


❖ Because the funder requires you to present a Data Management Plan and/or (the journal) requires you to publish your data in a FAIR manner...



What's in it for researchers?

Collaborations with other labs/researchers (TNA)



What's in it for researchers?

Citation index



- Journals (such as Elsevier) add links to the datasets (DOI) to already published papers!

Discovery of your research data

Experimental rock deformation/HPT-Lab (Utrecht University, The Netherlands)

HPT Laboratory, Faculty of Geosciences, Utrecht University
<https://www.uu.nl/en/organisatie/geosciences/collaboration/labs-and-facilities/hpt-lab> The HPT or High... [read more](#)

License

CC BY 4.0

MSL portal

controlled by the kinetics of pressure solution. Since compaction is known to operate in faults, this mechanism for frictional instabilities directly relates to natural seismicity.

The zip-file contains a Python script (render_figures.py) that is used to generate the data figures as reported by Van den Ende & Niemeijer (2018), auxiliary script files in the scripts directory, and the original model data in ASCII and HDF format in the data directory. The main Python script file render_figures.py will read and process the original model data and generate the interactive data figures. These figures are automatically saved in PDF format. More information is given in Van den Ende & Niemeijer (2018) to which these data and scripts are supplementary material to.

[Biaxial shear defor...](#)
[Discrete Element Me...](#)
[EARTHQUAKES](#)
[European Plate Obse...](#)
[Stick-slip mechanics](#)
[TECTONICS](#)
[deformation](#)
[multi-scale laborat...](#)
[shearing](#)

Additional Info

Field	Value
Source	http://doi.org/doi:10.5880/fidgeo.2018.008
Author	van den Ende, Martijn (Utrecht University)
Provided by	GFZ Potsdam
Created at repository	2018-02
Dataset contact	van den Ende, Martijn (Utrecht University PhD candidate martijnende@gmail.com https://www.uu.nl/staff/MPAvandenEnde)
Is supplement to	1) Van den Ende, M., & Niemeijer, A. (2018). Time-dependent compaction as a mechanism for regular stick-slips. <i>Geophysical Research Letters</i> .
Publication date	2018-02
Publisher	http://www.gfz-potsdam.de/

<https://epos-msl.uu.nl>

Multi-scale laboratories: recap

- Mission: Create a coherent and well-organized network of solid Earth Science laboratories
- Organized in a Consortium of 11 members; contains 94 laboratories from 12 countries – and growing
- Fully operational Data Publication Chain: data – metadata – curation – storage – DOI – discovery
- Provides Trans-national Access (TNA) through affiliated laboratories
- **It is possible for laboratories/institutes to join the EPOS Multi-scale laboratory community!**

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Marco Bonini, National Research Council (CNR), Italy, ORCID: 0000-0003-4818-8076,
Chiara Boschi, Institute of Geosciences and Earth Resources - CNR, Italy, ORCID: 0000-0001-8972-4432,
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Corrado Cimarelli, Ludwig-Maximilians-Universität München, Germany, ORCID: 0000-0002-5707-5930,
Fabio Corbi, Istituto di Geologia Ambientale e Geoingegneria – CNR C/o Dipartimento Scienze della Terra Sapienza Università di Roma, Rome, Italy, ORCID: 0000-0003-2662-3065,
Matilde Horta Costa e Silva, CERENA, Técnico Universidade de Lisboa, Portugal, ORCID: 0000-0002-1354-8636,
Elisabetta Del Bello, Istituto Nazionale di Geofisica e Vulcanologia Italy, Italy, ORCID: 0000-0001-8043-7410, Stephane Dominguez, Université de Montpellier. Géosciences Montpellier, CNRS, F34095, Montpellier, France, ORCID: 0000-0001-8218-7144,
Kirsten Elger, GFZ German Research Centre for Geosciences, Potsdam, Germany , ORCID: 0000-0001-5140-8602,
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Francesca Funicello, Dip. Scienze Univ. Roma Tre, Rome , Italy , ORCID: 0000-0001-7900-8272, Olga García-Moreno, Dpto. Geología. Universidad de Oviedo, Asturias, Spain, ORCID: 0000-0001-7815-0242,
Carlos J. Garrido, CSIC-IACT, Granada, Spain, ORCID: 0000-0003-4357-3637,
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Benjamin Guillaume, Univ Rennes, CNRS, Géosciences Rennes - UMR 6118, Rennes, France, ORCID: 0000-0002-4260-3155,

Diana Jordanova, (National Institute of Geophysics, Geodesy and Geography, Bulgarian academy of Sciences, Sofia, Bulgaria, ORCID: 0000-0003-0595-3153,
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Audrey Ougier-Simonin, British Geological Survey, UK, ORCID: 0000-0001-9778-4910,
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Guido Schreurs, University of Bern, Switzerland, ORCID: 0000-0002-4544-7514,
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