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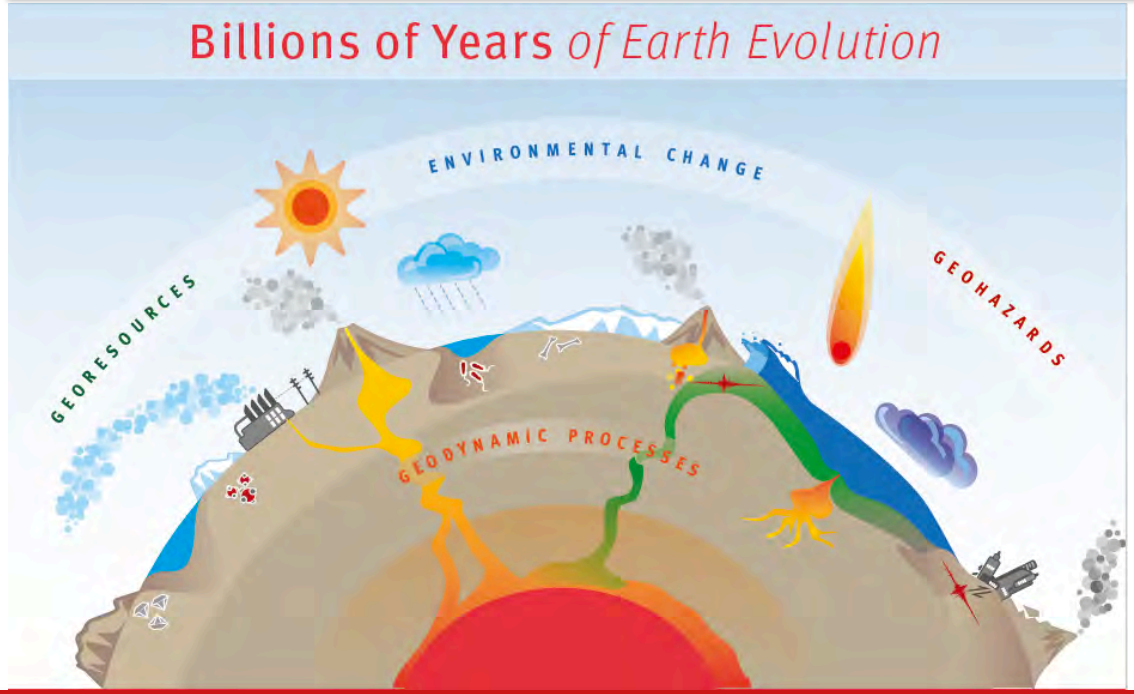

ICDP Running and Upcoming Projects

Uli Harms | ICDP Operational Support Group | GFZ, Potsdam, Germany

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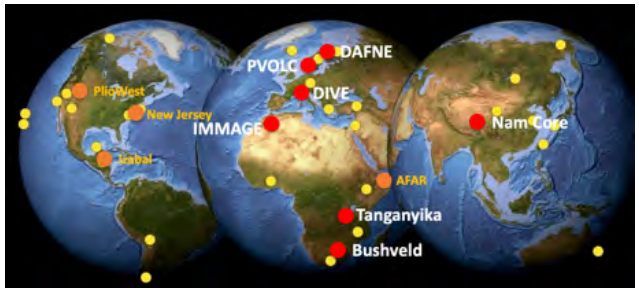
Status of ICDP Projects: Oversight

The Science Plan 2020 to 2030 – The framework of ICDPs projects

Global oversight per year



Projects along the Scientific Themes

Key technical developments

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ICDP Science Plan 2020-2030

icdp mission:

We aim at generating the most exact, fundamental and globally significant knowledge on the structure, composition and processes of the Earth's crust, through the unique capabilities of continental scientific drilling.

Societal challenges

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ICDP Science Plan 2020-2030

THEME 01: geodynamic processes

1) How and when did plate tectonics initiate and how has the Earth's crust and mantle evolved through time?

2) What controlled the development of Earth's hydro-sphere-atmosphere-biosphere system, and how are the associated chemical elements recycled through time?

3) How did life on Earth originate and how did it influence the evolution of environmental conditions through time?

THEME 02: geohazards

Understanding the full chain from hazard to risk

1) What are the drivers initiating and controlling earth-quakes, volcanic eruptions and mass movements such as landslides?

2) How do we distinguish faults, volcanoes and potential landslides that present an immediate threat from those with low hazard?

3) How do we build a better quantitative understanding of physical processes, allowing us to provide advanced warn-ing time to mitigate the risks associated with geohazards?

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THEME 03: georesources

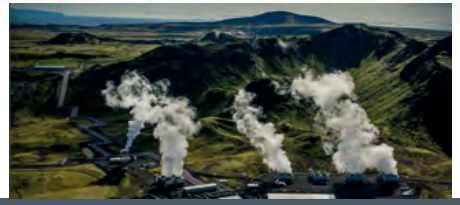
Improved understanding of the subsurface

1.) How can we improve our understanding of and gain access to low-carbon energy sources, particularly for geothermal energy?

2.) What is the most reliable way to remove CO2 from smokestack emissions and – more challenging – from air, and store it permanently underground, either as supercritical fluid in pore space or as solid carbonate minerals?

3.) What is needed to understand the processes that concentrate raw materials that are essential for low-carbon technology, especially mineral and metal resources such as lithium and cobalt that are used to make batteries?

4.) How to identify future water resources?



THEME 04: environmental change

1.) What can we learn from past 'greenhouse' conditions in Earth's climate to better anticipate future changes in the hydrological cycle?

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4.) How do Archean rocks archive deep-time earth-surface processes and their interactions with an early atmosphere?

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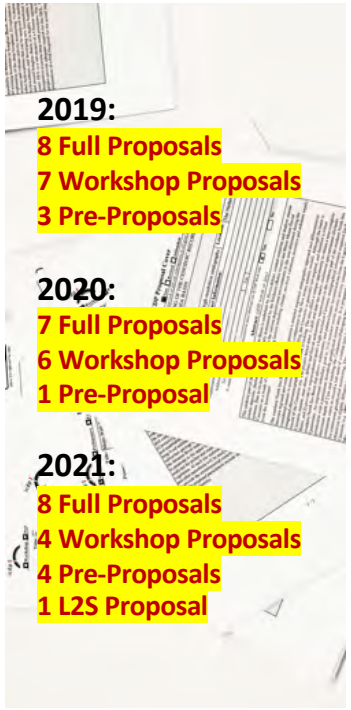
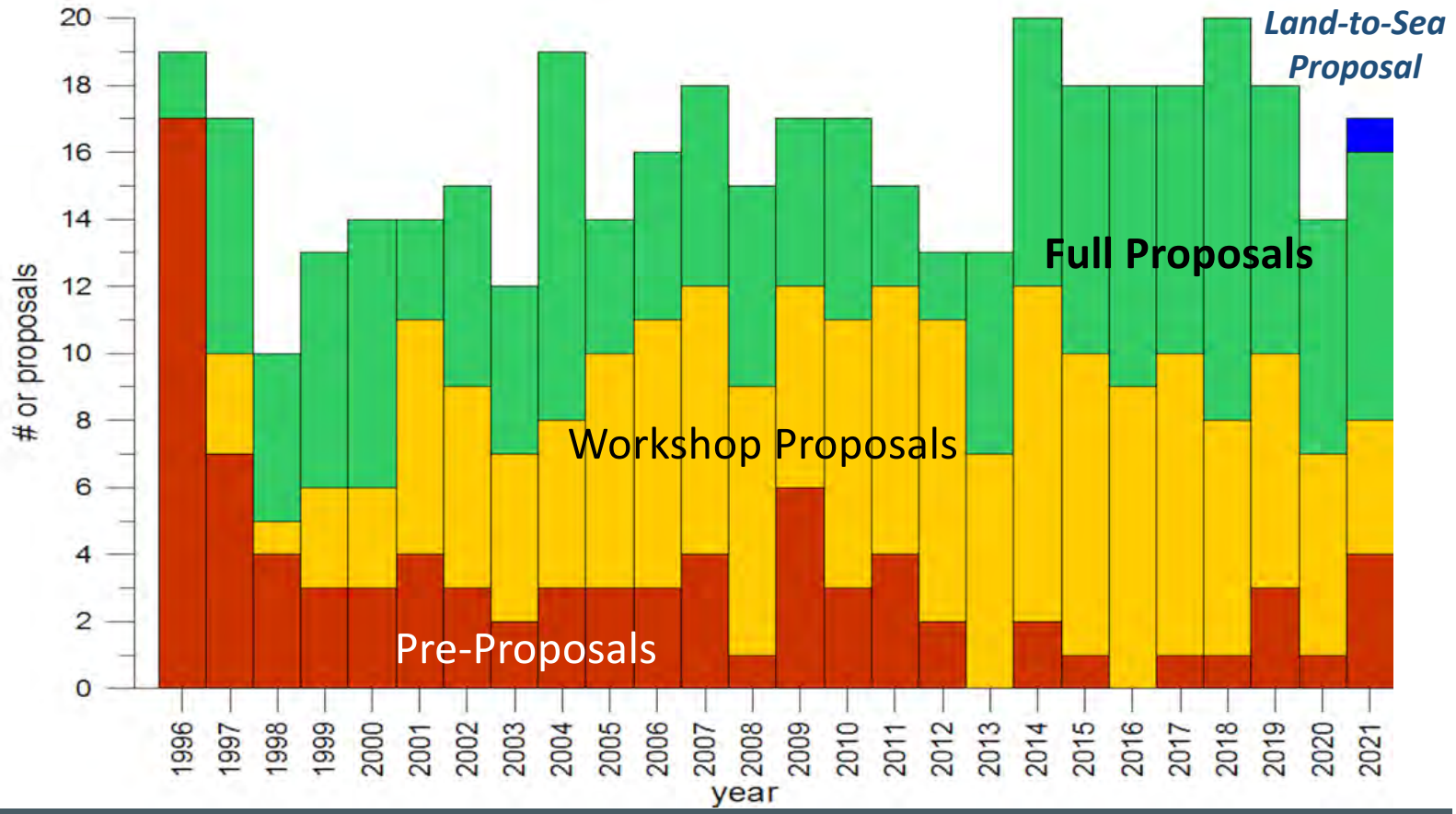
Number of Proposals per year



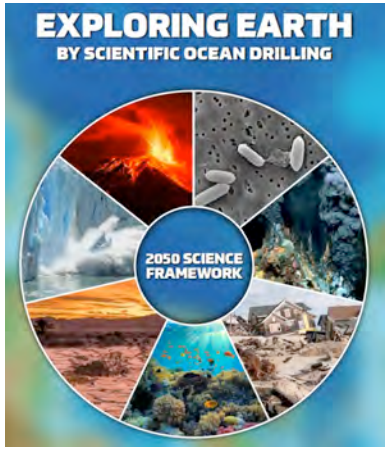
2019:
8 Full Proposals
7 Workshop Proposals
3 Pre-Proposals

2020:
7 Full Proposals
6 Workshop Proposals
1 Pre-Proposal

2021:
8 Full Proposals
4 Workshop Proposals
4 Pre-Proposals
1 L2S Proposal



Partnering with IODP



- Joint new proposal-project scheme: Land-to-Sea projects
- Joint outreach: Scientific Drilling, Town Hall meetings
- Cooperation in data management, core repositories, software

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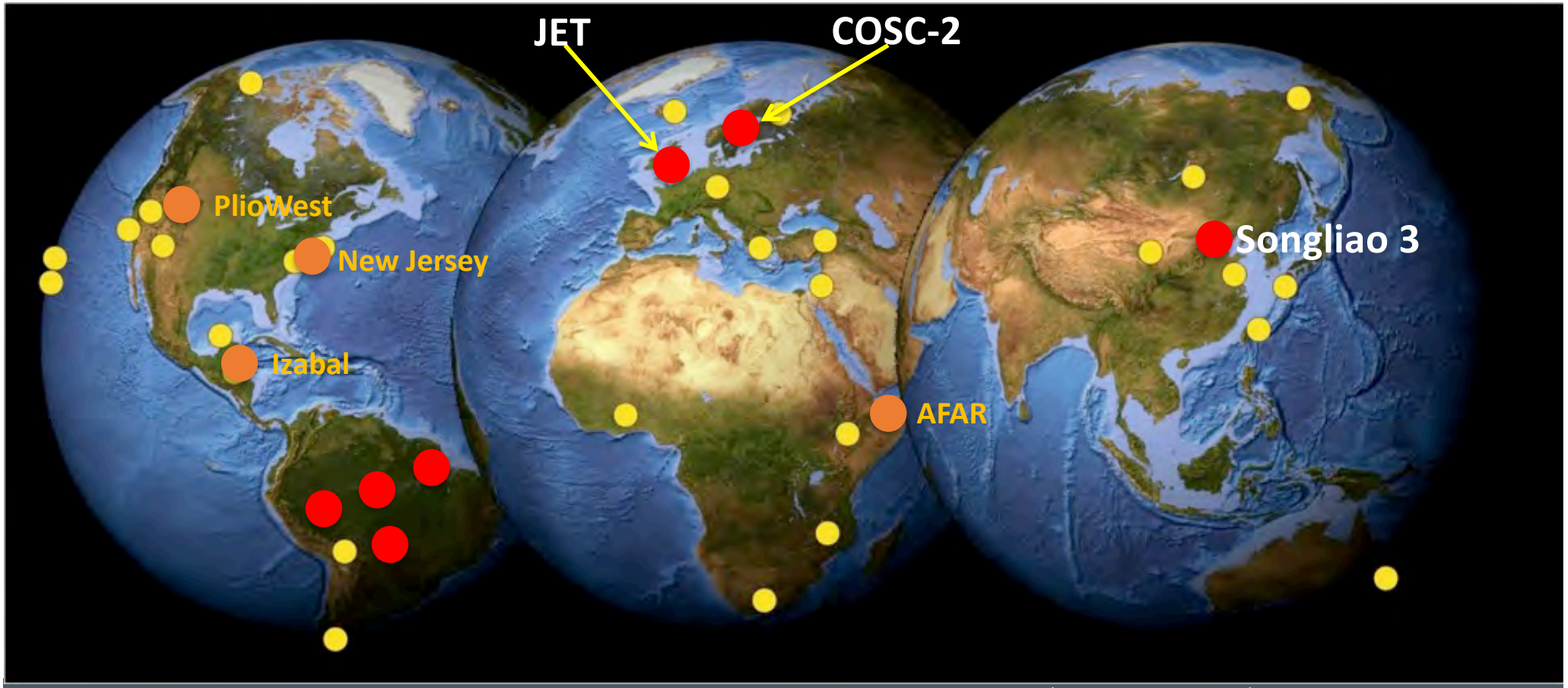
ICDP Operations in 2020



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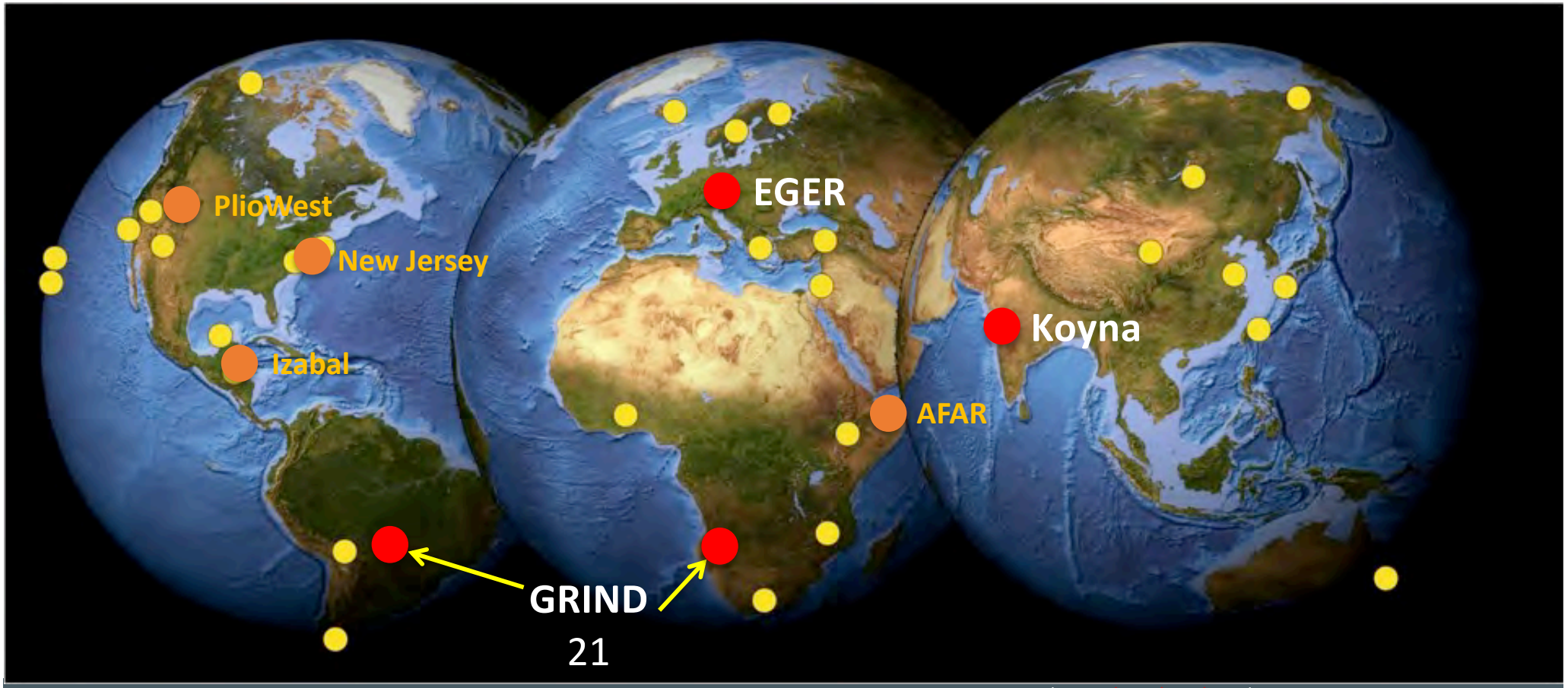
ICDP Operations to be continued in 2021



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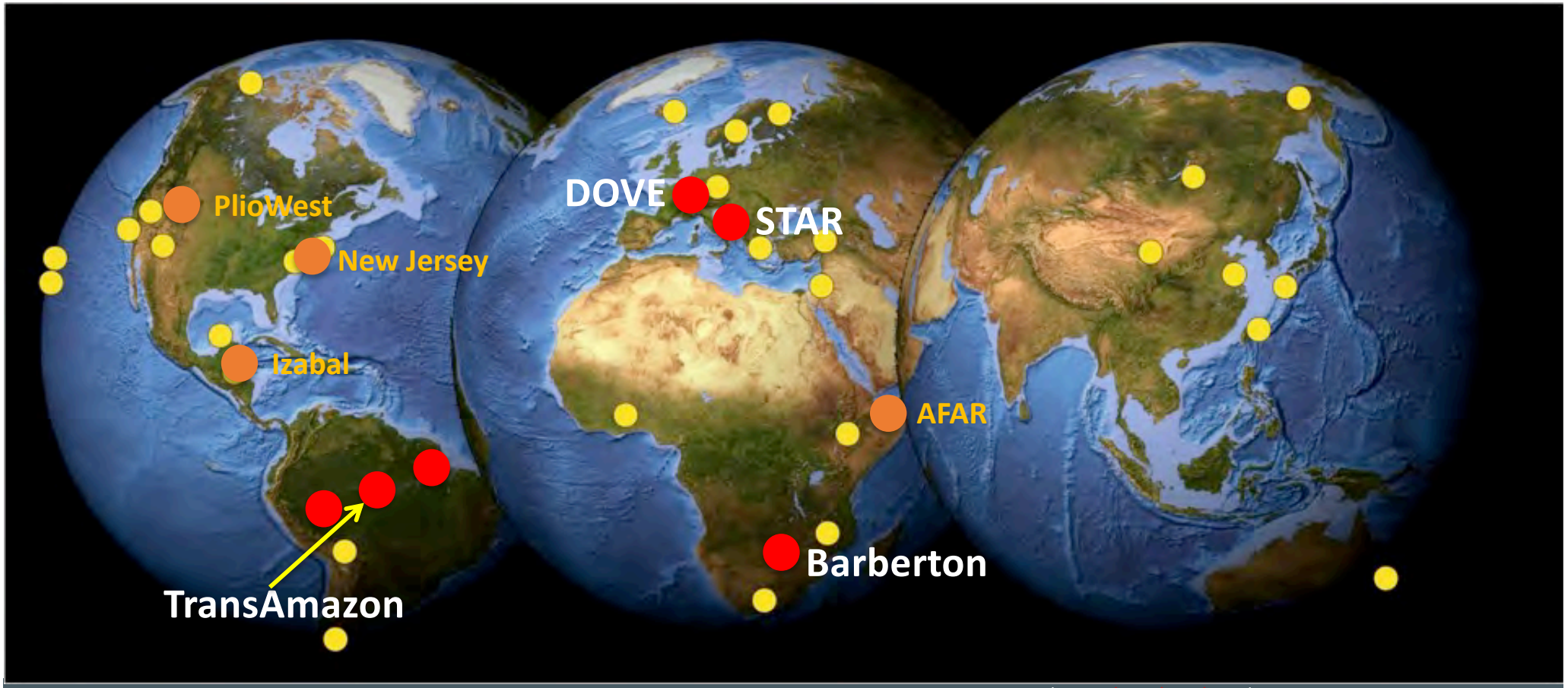
ICDP Operations to start in 2021



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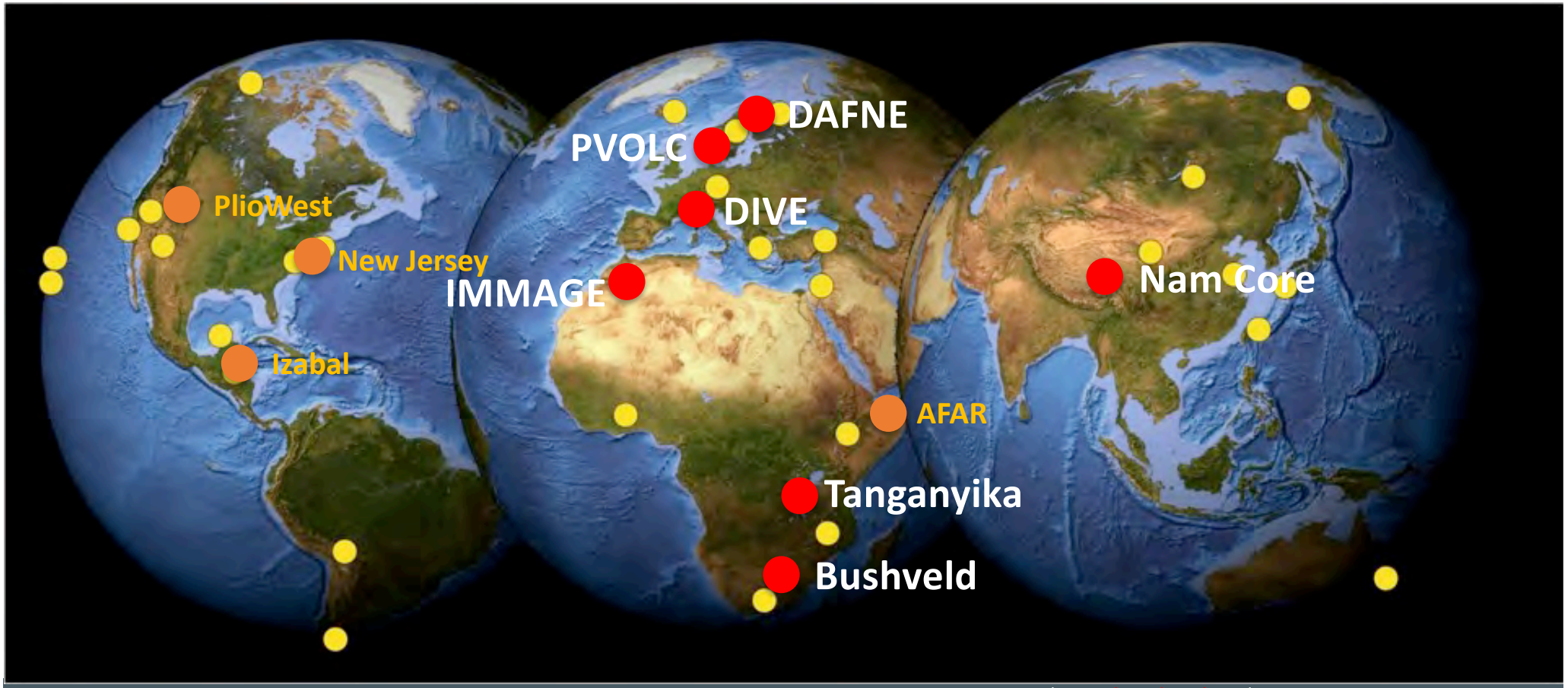
ICDP Operations to begin in 2022 or beyond



Uli Harms | OSG | GFZ | Potsdam, Germany

ICDP Science Plan 2020-2030

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JET: Integrated understanding of the early Jurassic

Earth system and Timescale of the Early Jurassic

Project objectives for Prees-2:

Construct a fully integrated stratigraphy* for the marine Early Jurassic and use it to gain insights into Earth System processes and solar system history.

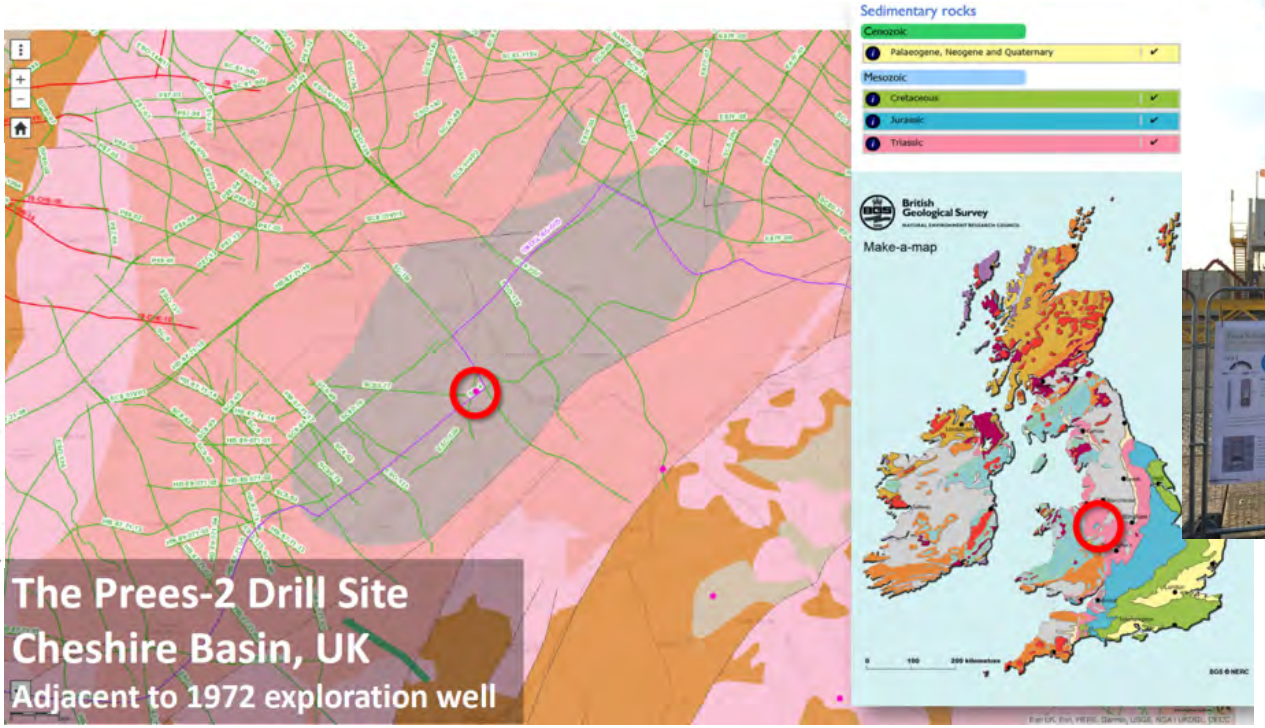
Crucial to core Hettangian–Sinemurian interval to link:

upwards to Llanbedr (Mochras Farm) borehole records

downwards to Newark-Hartford Basin and Colorado Plateau Coring Project (CPCP) records

Link to nearby base Sinemurian and base Pliensbachian Global Stratotype Sections and Points (GSSPs)

*Astro-, bio-, magneto-, chemo-, etc.



PI: Stephen Hesselbo

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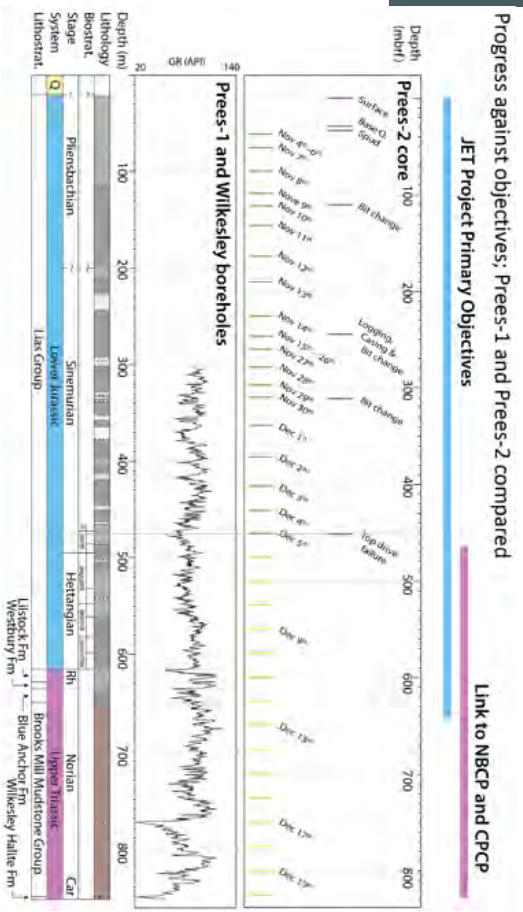
INTERNATIONAL CONTINENTAL SCIENTIFIC DRILLING PROGRAM

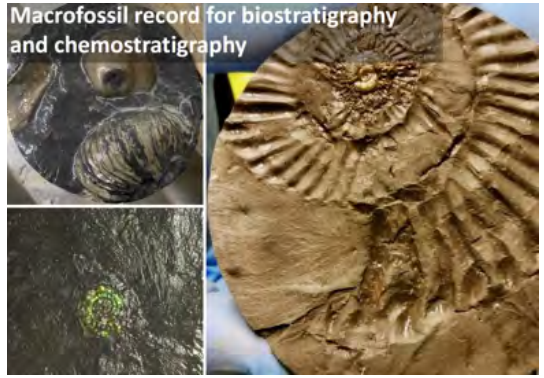
JET: Integrated understanding of the early Jurassic



Earth system and Timescale of the Early Jurassic

Achievements

- Excellent core recovery throughout section to 656 m depth, 114 cores
- Pliensbachian, Sinnemurian, Hettangian, Rhaetian, Norian cored
- Complete lower Jurassic sequence and Upper Permian strata recovered
- Mostly uniform fossiliferous mudstone lithology showing m-scale cyclicity promising for astrochronology, biostratigraphy, chemostratigraphy
- Key objectives met
- Link to Colodaro Plateau Project
- Downhole logs acquired
- Core scanning ongoing
- Sampling Party delayed



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SONGLIAO SK-3 well completed

The 3. phase of scientific drilling in the Songliao Basin comprised the borehole SK-3 in Nong'an County (Jilin Province, China)

Depth:	3600 m
Cored length:	1607 m and
Recovery:	1592 m core (99%)
Completion:	January 30, 2021

The SK project comprises four drill holes. Cores covering over 8,200 m of terrestrial sediments from Late Jurassic to Early Paleogene

Scientific drilling in the Songliao Basin aims at providing a high-precision, comprehensive chronostratigraphic framework to reconstruct the paleoclimate evolution of the northern mid-latitudes on multiple time scales and explore the coupling relationship between the formation of continental petroleum deposits and paleoclimate and paleoenvironmental change.

SK-3 is funded and supported by:
- Ministry of Science and Technology
- Jilin Oilfield Company
- ICDP

Cores are accessible to the international geoscience community for collaborative research.

PI: Chengshan Wang

Geological Research through Integrated Neoproterozoic Drilling

Aims

Understand the drivers of the Neoproterozoic Earth system revolution, including Snowball Earth events, rise of atmospheric oxygen, and Cambrian Revolution, by drilling in Namibia,Brazil, and China

Achievements

Drilling in Namibia between 09/09-11/09 retrieved 1862 m drill core from 7 sites.

Next Steps

- Drill final well in Nambia - 2021
- 1. Sampling Party in Berlin - 2021
- Drilling in Brazil in 2021
- Successive drilling in China

GRIND
Geological Research Integrated through Neoproterozoic Drilling

GRIND drilling and core description at Tierkloof - Namibia in fall 2019

PIs: Catherine Rose and Tony Prave

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Drilling Overdeepened Alpine Valleys

DOVE

Goals

Sample fluvio-glacial sediments from glacially carved valleys around Alps

German site Tannwald:

- Two flush drillings for geophysics in progress
- Core drilling in May/June 2021

Swiss Site Basadingen:

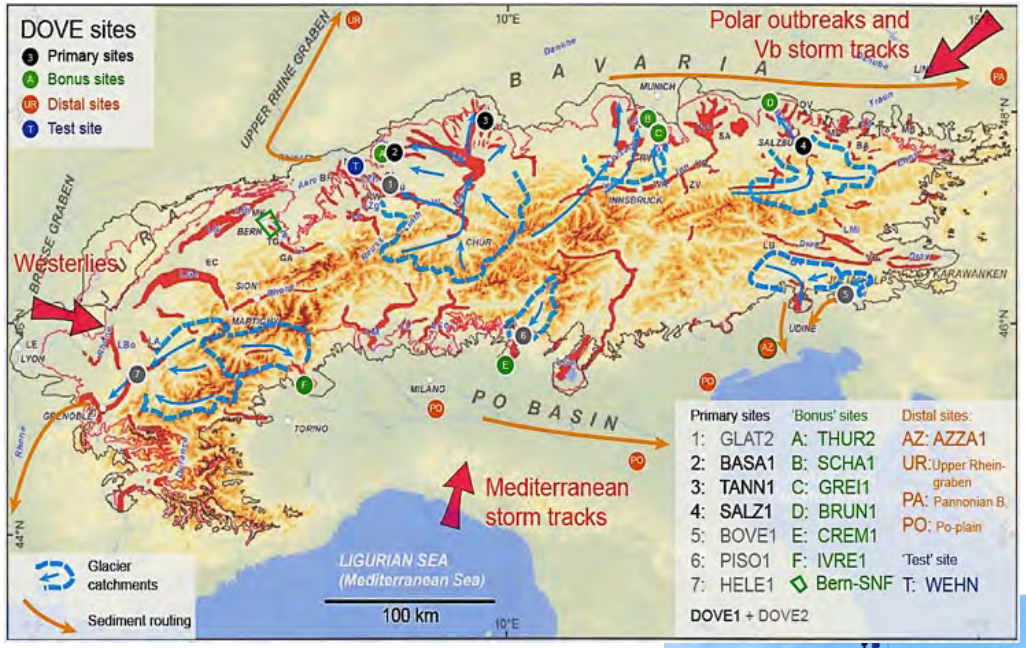
- Core drilling in May 2021

Austrian Site Lienz:

- Replaces Salzach, which according to new geophysical data, turned out to have less scientific potential (Pomper, et al., 2017).

Bonus Sites:

- Some of the sites are already completed in Bavaria and Lower Aare Valley (CH)



PIs: Flavio Anselmetti and Gerald Gabriel

Trans Amazon Drilling Project

TRANS AMAZON DRILLING PROJECT

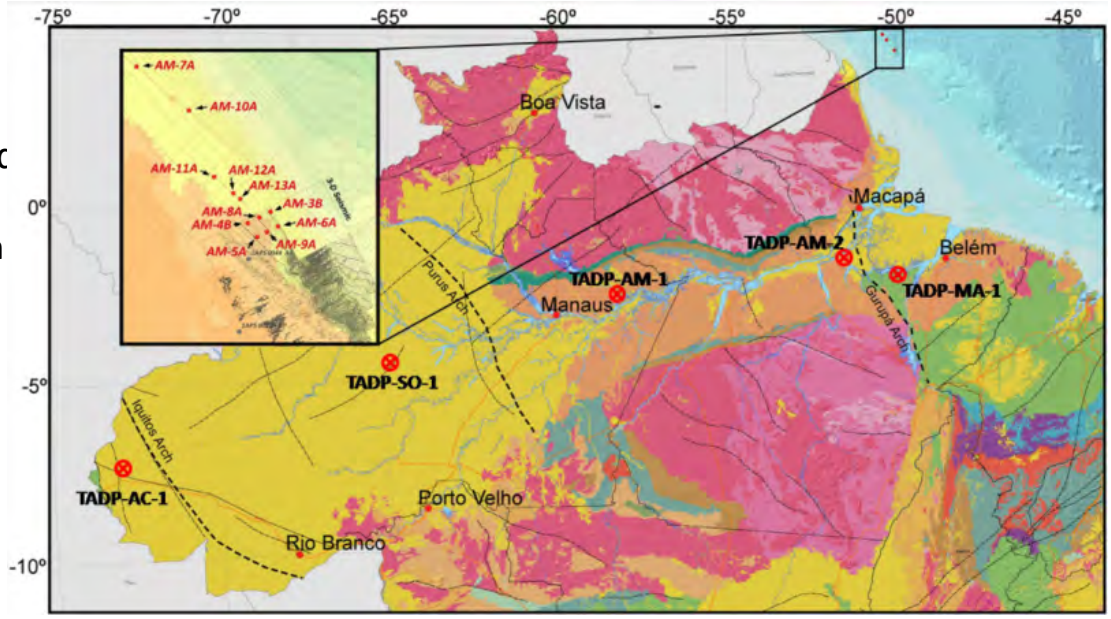
Goals

Trans-Amazon will address fundamental questions about the Cenozoic climate and geologic history and biotic evolution of the Amazon - including

- Uplift of the Andes and development of the Amazon fluvial system
- The link to the evolution of the rainforest and it's unique biodiversity
- The origin of the one of Earth's largest intrusive complexes

Offshore, Cenozoic terrigenous sediments will be recovered from the upper continental slope of the Atlantic in an IODP-funded drilling leg. On land, an ICDP drilling project will sample the ancient sedimentary basins aligned along the modern Amazon River. The ICDP/IODP transect will span 40°W to 73°W, nearly 10% of the Earth's equatorial circumference.

PIs: Sheri Fritz and Paul Baker



- IODP drilling offshore Marajo is delayed
- Planning and permitting ICDP wells is underway
- Spud in of the first Amazonian well is planned for fall 2021 if Corona permits

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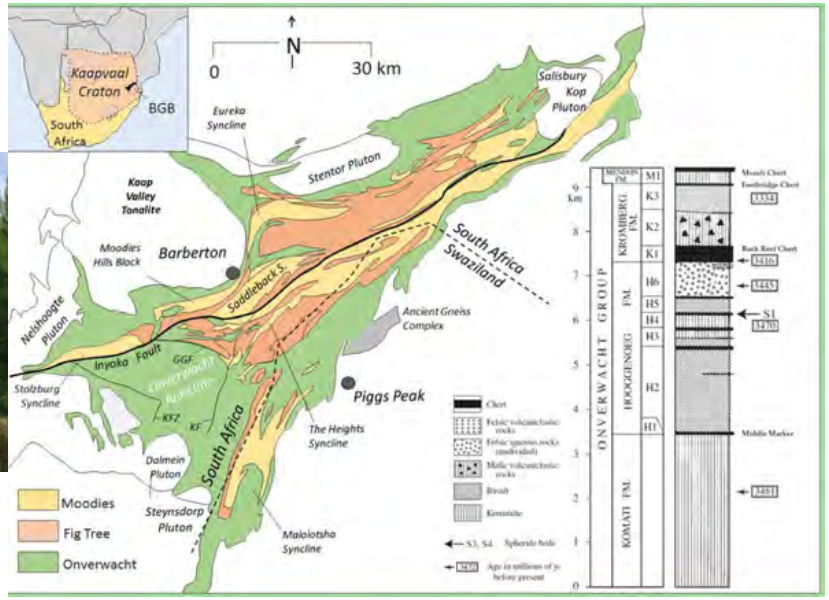
BASE: Barberton Archean Surface Environments

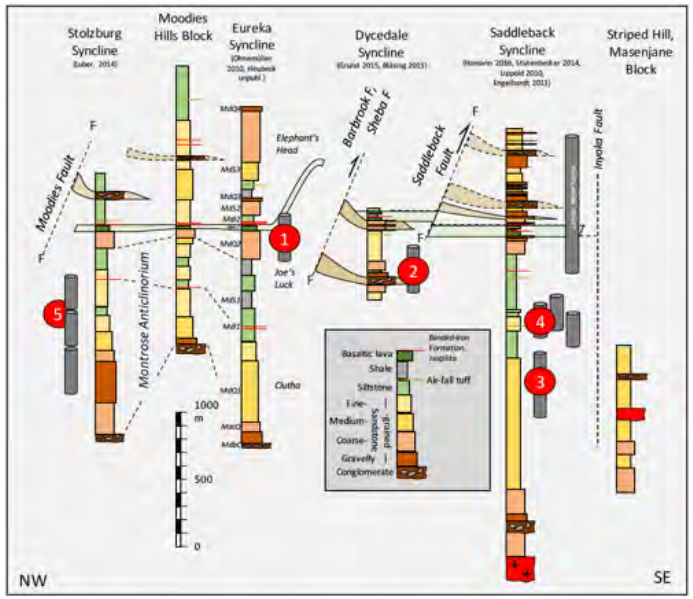
BARBERTON

Goals:

Drilling the Moodies fluvial-to-prodeltaic silici-clastics of 3.7 km thickness covering a time of 1-11 Ma to understand **early oxygenation and surface processes**

Site inspection in April 2021





PIs: Nic Beukes and Chris Heubeck

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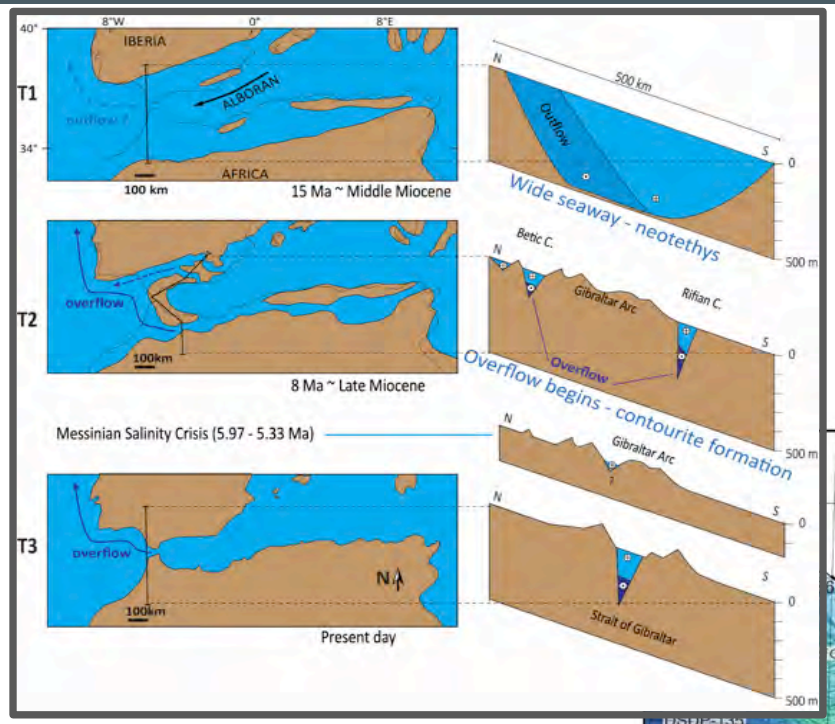
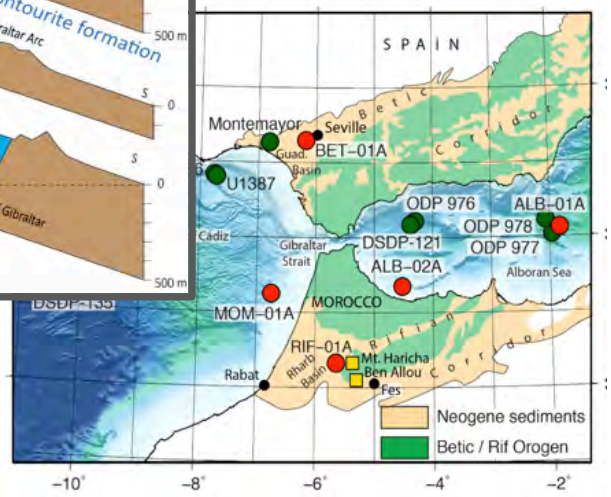
IMMAGE on- and offshore project with IODP

Goals

Timing of Mediterranean overflow into Atlantic and record of the Messinian Salinity Crisis

- ICDP funding approved conditionally
- IODP safety panel approved 6 of 9 offshore sites
- Decision on IODP scheduling in June
- Contractor search for land drilling in Morocco is ongoing
- COST action proposals underway
- Progress on how to manage tension between climate imperative and hydrocarbon industry





PI: Rachel Flecker

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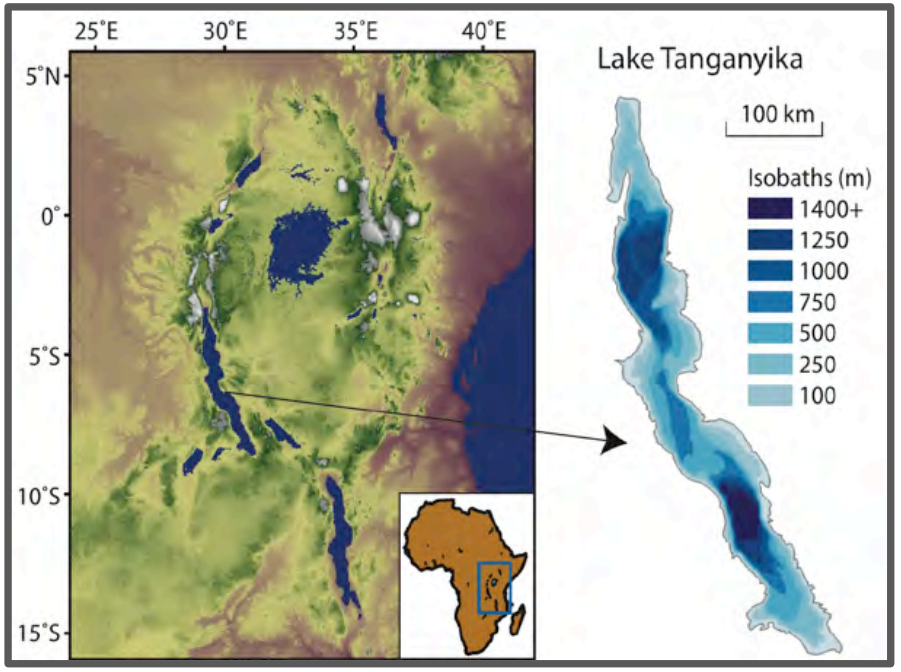
Lake Tanganyika Drilling Project

Addressing world-class scientific questions in paleoclimatiology - tectonics - and evolutionary ecology in Africa‘a oldest lake

- Full proposal accepted 2020
- 3rd party funding acquisiton
- Large infrastructure pre-proposal to US NSF submitted to acquire suitable barge and drilling system
- Results available by the end of 2021
- Drilling not before 2022



PI: James Russell

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ICDP Science Plan 2020-2030

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Improved understanding of the subsurface

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4.) How to identify future water resources?

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Bushveld Drilling Project

PIs

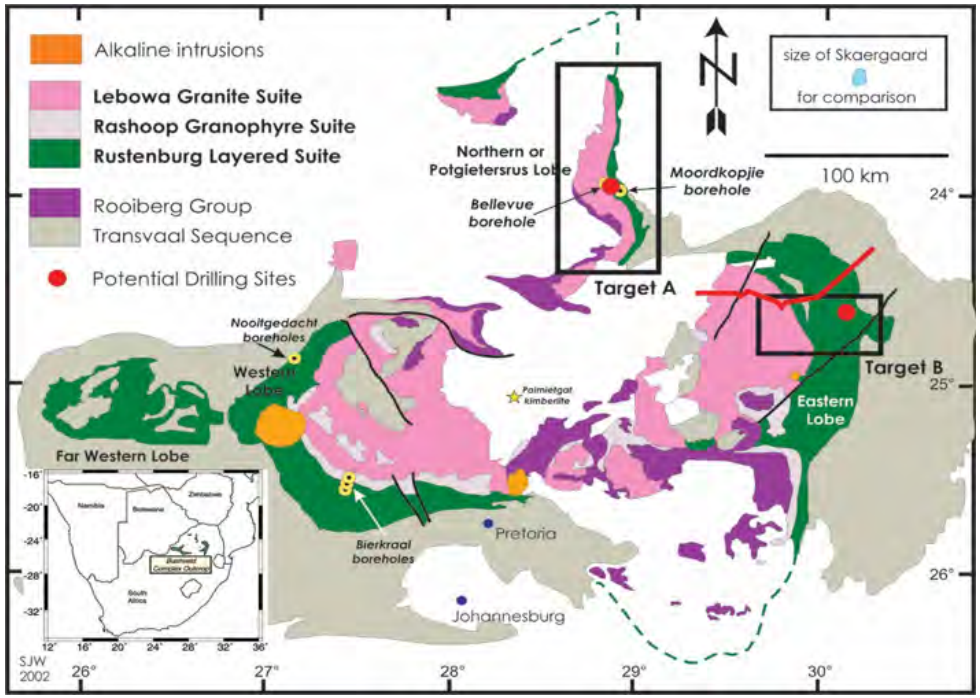
- R. Trumbull, L. Ashval

Goals

- Complete suite of cores covering this plutonic complex to unravel petrogenesis and mineral resource formation

Status

- Additional 6 km core donated by industry
- National Core Library acts as responsible custodian for core handling
  2. CGS Project "Bushveld" established - managed by Executive Manager and staffed by 2 senior scientist, 1 scientist of National Core Library, 2 junior scientists
- Funding acquisition ongoing
- Drilling to start 2022



PI: Robert Trumbull and Lew Ashval

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Understanding the full chain from hazard to risk

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Drilling the Eger Rift in the Czech Republic and Germany

Aims

Study swarmquakes - crustal and mantle-derived fluid flow and degassing - and processes of the deep biosphere

Achievements

S1 well drilled 400 m in crystalline basement, 2019
S2 well to 490 m, 2017, in kind contribution
S3 well to 400 m in phyllites in 2018, STC station
F1, F2 wells (30, 108 m) , in kind contribution
F3 well to 270 m drilled in 2019
Geochemical and geophysical monitoring

Next steps

- S4 well coring in a maar lake in spring/summer 2021
- Installations of seismic chains and monitoring strings in boreholes once fluid monitoring is finalized

PI: Tomas Fischer


Drilling the F3 borehole at Hartoušov - CZE

EGER

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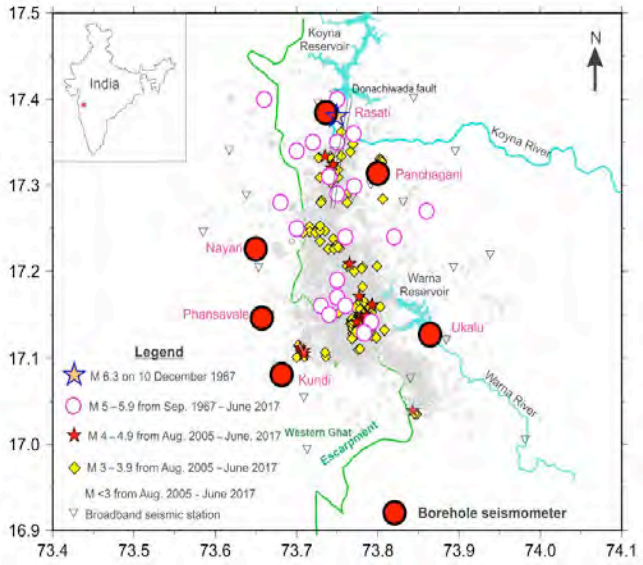
Koyna: Probing Reservoir Triggered Earthquakes



Goals

Study reservoir-triggered earthquakes

Accomplishments

1. Pilot Borehole (3 km) completed
2. Geophysical Well Logging
3. WL Hydrofrac testing (to 2.4 km)
4. Geomicrobiology
5. Post-Operations Workshop

Tasks remaining

1. Zero-offset VSP survey
2. Installation of seismometer array

Expected: Late 2020

PI: Sukanta Roy and Harsh Gupta

- Water-reservoir triggered earthquakes since onset of lake filling in 1962 incl. a M6.3, 20 M5 etc
- ICDP project since 2011: 2 WS held in 2011 & 2014
- Implementation of borehole seismometer network
- 6 km deep well in planning

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Strainmeter Array Along the Alto Tiberina Fault System - STAR

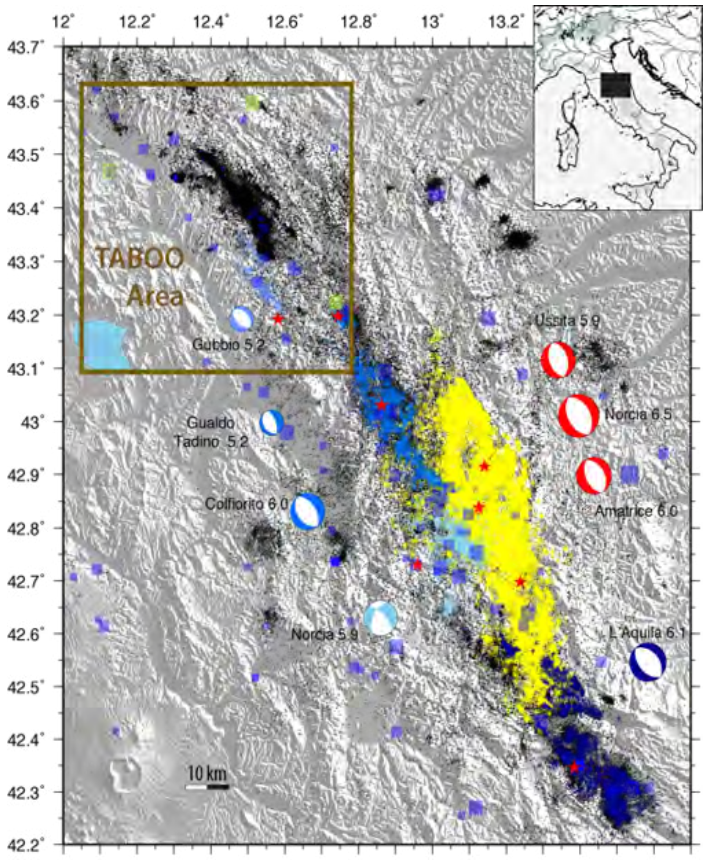
STAR
STRAIN METER ARRAY
ALTO TIBERINA

Goals of the project:

- Monitor slow (aseismic) deformation at the low-angle normal Alto Tiberina fault (ATF) in the Northern Apennines
- Address questions about the relationship between creep - slow slip - dynamic earthquake rupture - tectonic faulting and degassing

Drilling plan and schedule:

- STAR will consist of six 80-160 m deep vertical boreholes to be instrumented with strainmeters, downhole seismometers and pressure transducers
- Each site will be also equipped with surface GPS and a meteorological station
- **Kick-off meeting planned for May 2021**
- **Drilling and instrument installation to start soon after**



PI: Lauro Chiaraluce (INGV) et al.

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Drilling Active Faults in Northern Europe (DAFNE)

Aims

The project DAFNE aims at scientific drilling in the intraplate Pärvie fault system in northern Sweden. It is the longest known postglacial fault in the world - and a key site for improving understanding of intraplate earthquakes. It is 155 km long with a maximum surface offset of 25 m.

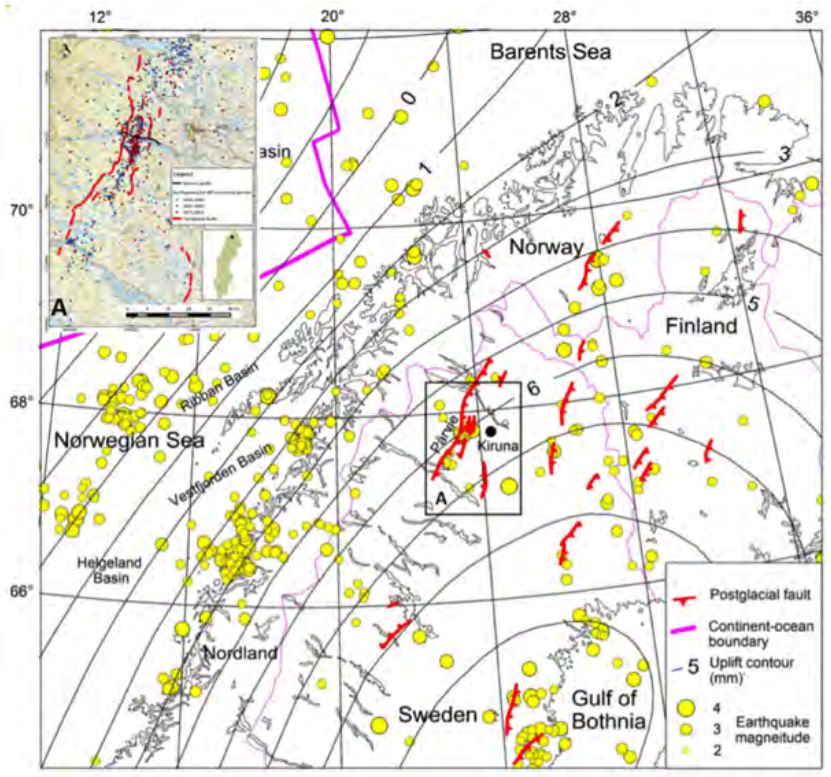
Status

ICDP approved projects
Awaiting co-funding approval

Next steps

Drilling to commence 2022

PI: Maria Ask



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ICDP Science Plan 2020-2030

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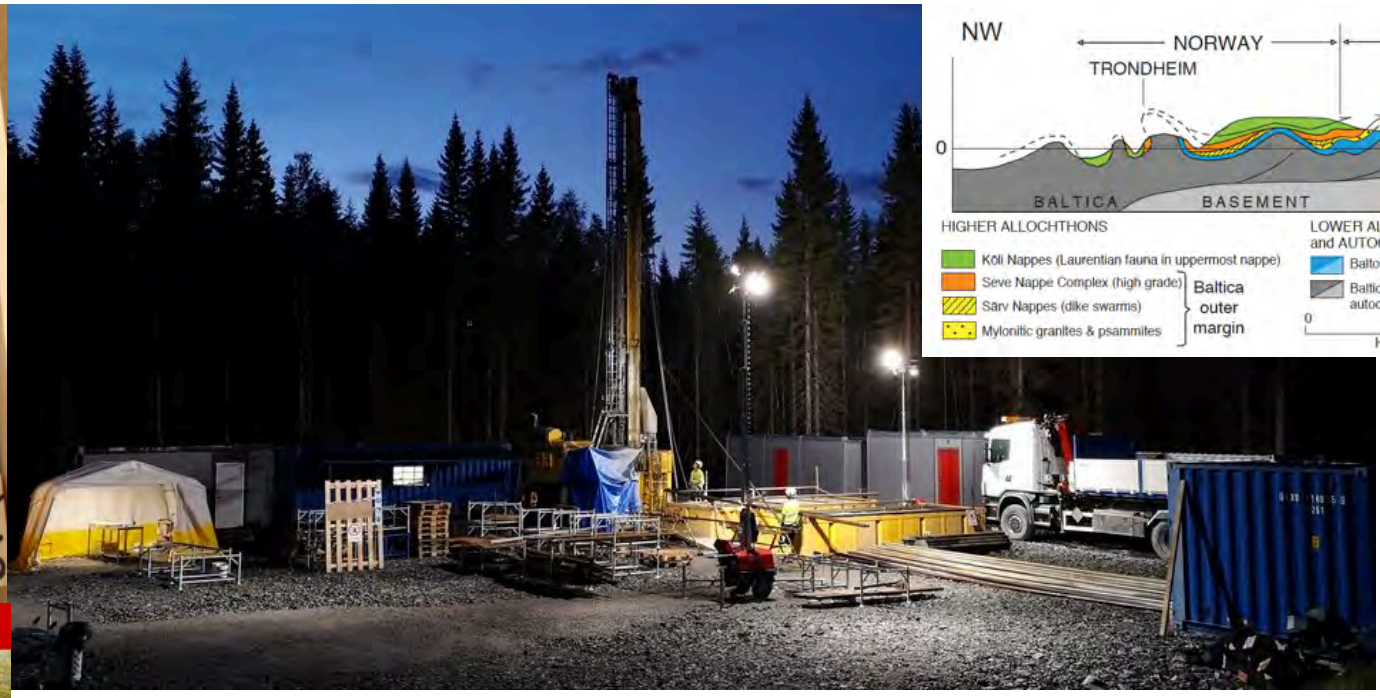
COSC-2: Collisional Orogeny in the Scandinavian Caledonides

Drilling the main Caledonian Décollement and the Basement of the Fennoscandics



COSC-2 drilled 2276 m deep and cored almost 100% from April 17 to August 13, 2020
Downhole logging and testing was performed by ICDP OSG in September 2020
Detailed core description will be done at the Berlin-Spandau core repository in Spring 2021

PI: Chris Juhlin and Henning Lorenz

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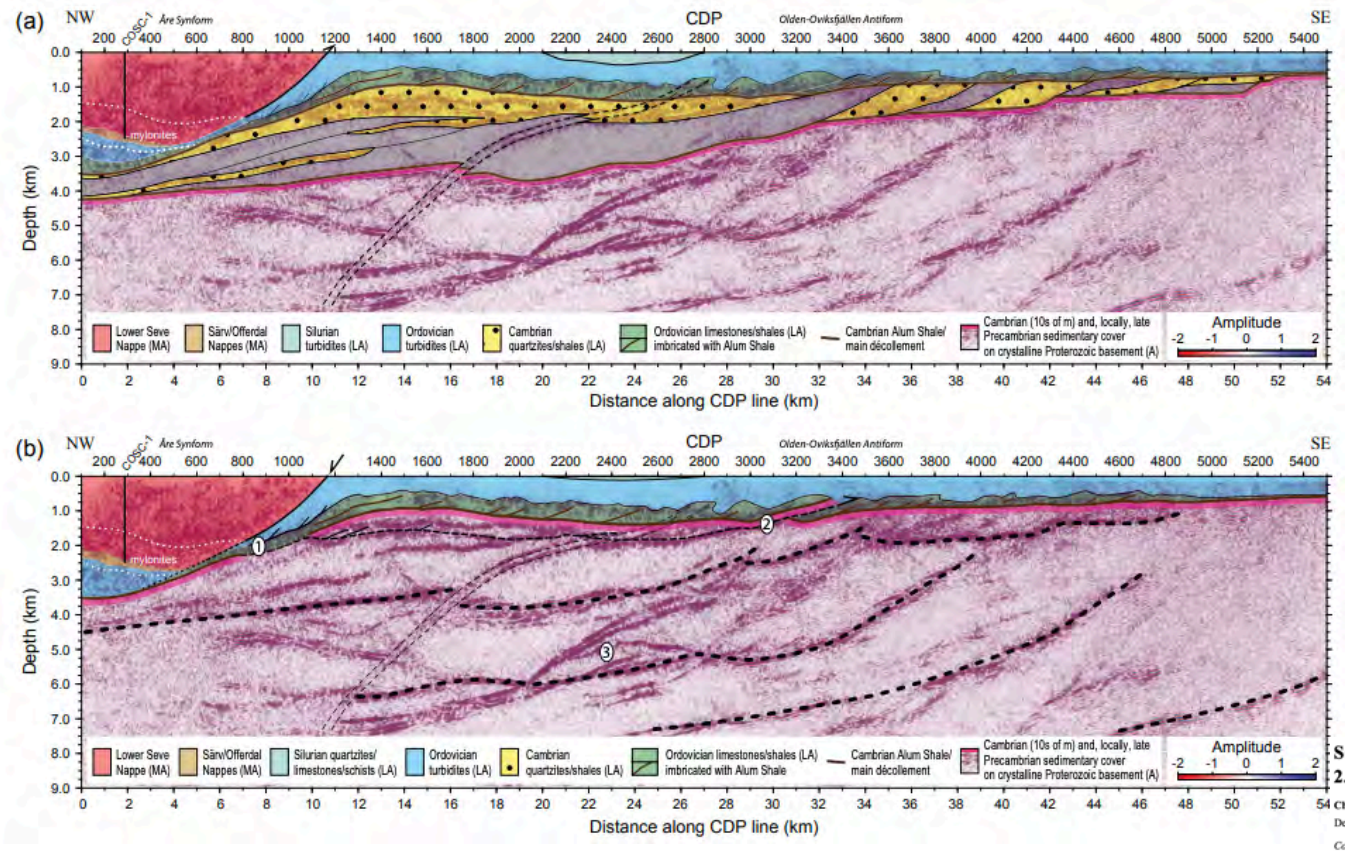
COSC-2: Models versus Reality



Seismic imaging in the eastern Scandinavian Caledonides: siting the 2.5 km deep COSC-2 borehole, central Sweden

Christopher Juhlin, Peter Hedin, David G. Gee, Henning Lorenz, Thomas Kalscheuer, and Ping Yan

Department of Earth Sciences, Uppsala University, Uppsala, Sweden

Correspondence to: Peter Hedin (peter.hedin@geo.uu.se)

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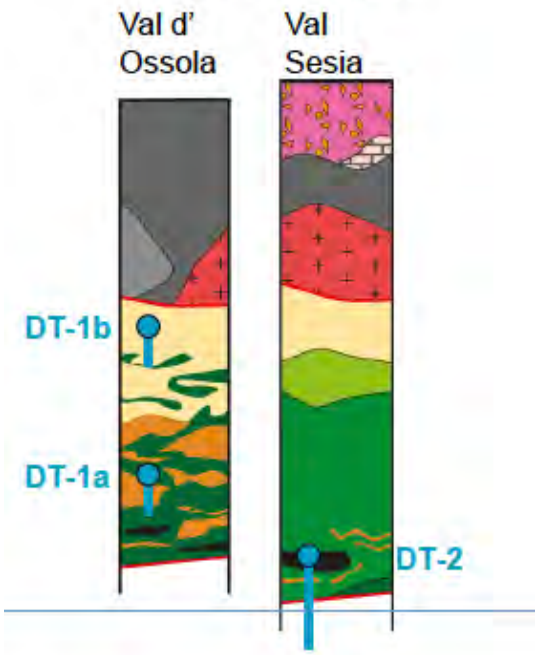
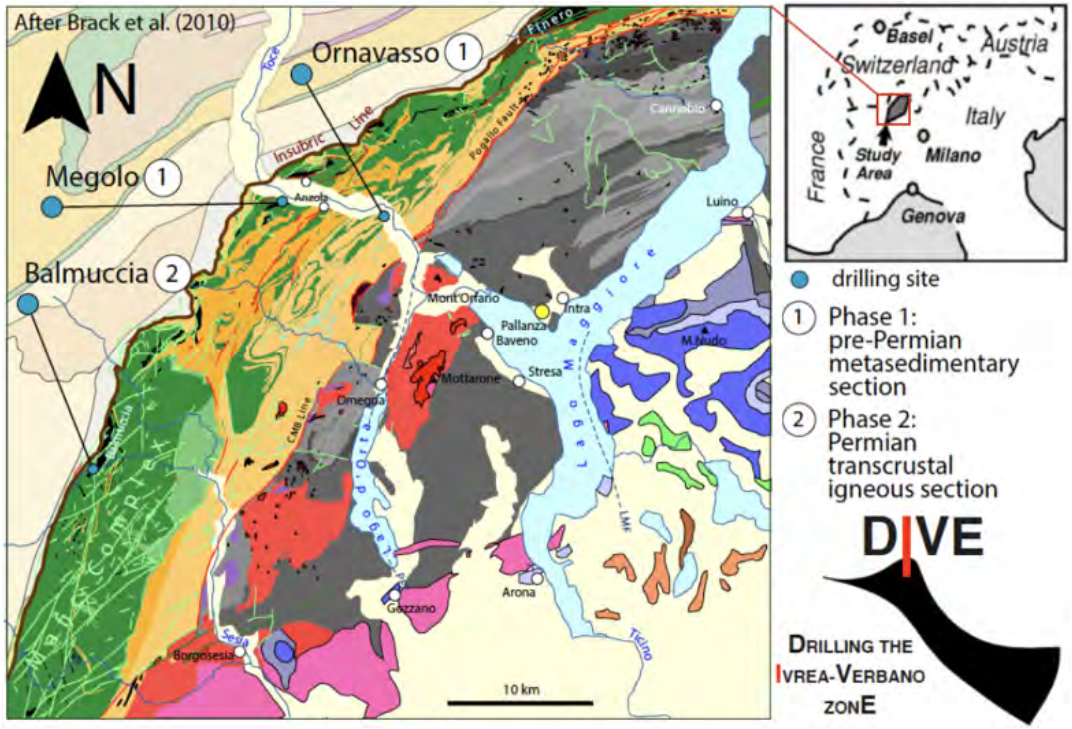
Drilling the Ivrea Verbano Zone: DIVE

DIVE samples the Pre-Permian and Permian lower crust mantle transition zone at high resolution



Drilling planned for 2022, co-funding acquisition and permitting is ongoing



PI: Othmar Müntener

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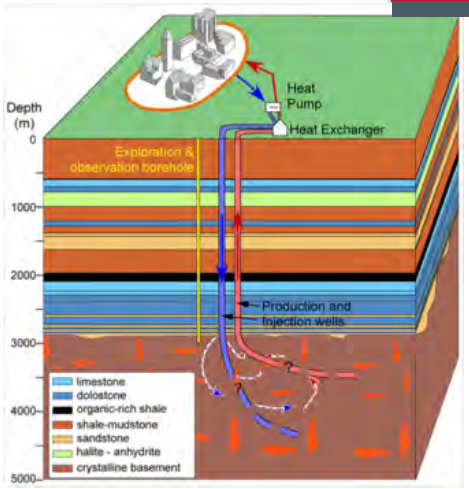
ICDP workshops 2020



Cornell Deep Geothermal Test Borehole

Ithaca - NY - January 2020 – 65 participants from 6 countries

Planned Workshops 2020:

Afar Dallol Drilling –	July 2021
Lake Izabal Basin –	Aug. 2021
Pliocene Lakes W' US –	Sep. 2021

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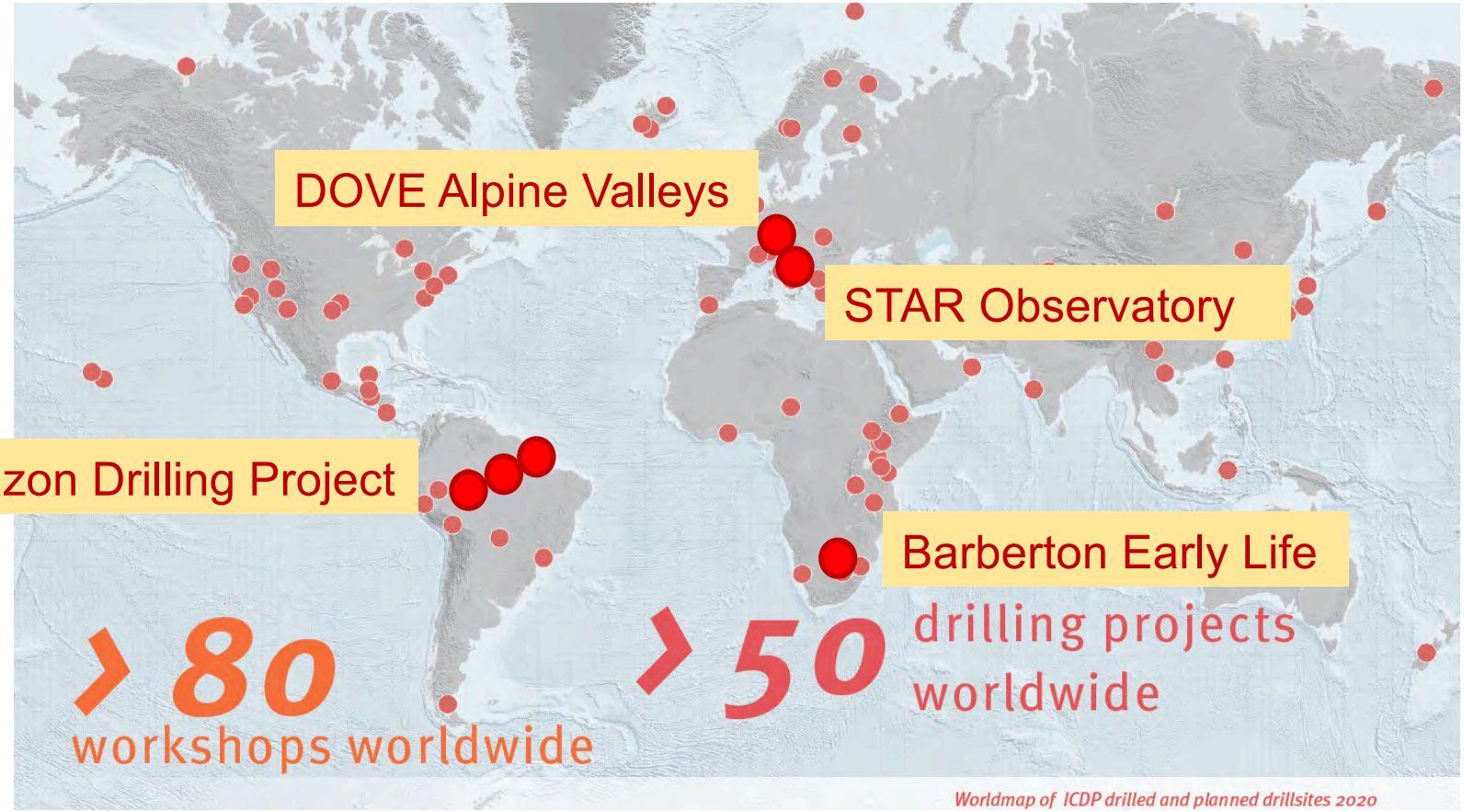
Worldmap of ICDP projects and planned drill sites

Upcoming highlights



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OSG duties and ICDP Equipment Pool

- Program Management
- Engineering & Drilling Management
- Sample & Data Management
- Dowhnhole Logging
- Education & Outreach
- Instrument Pool

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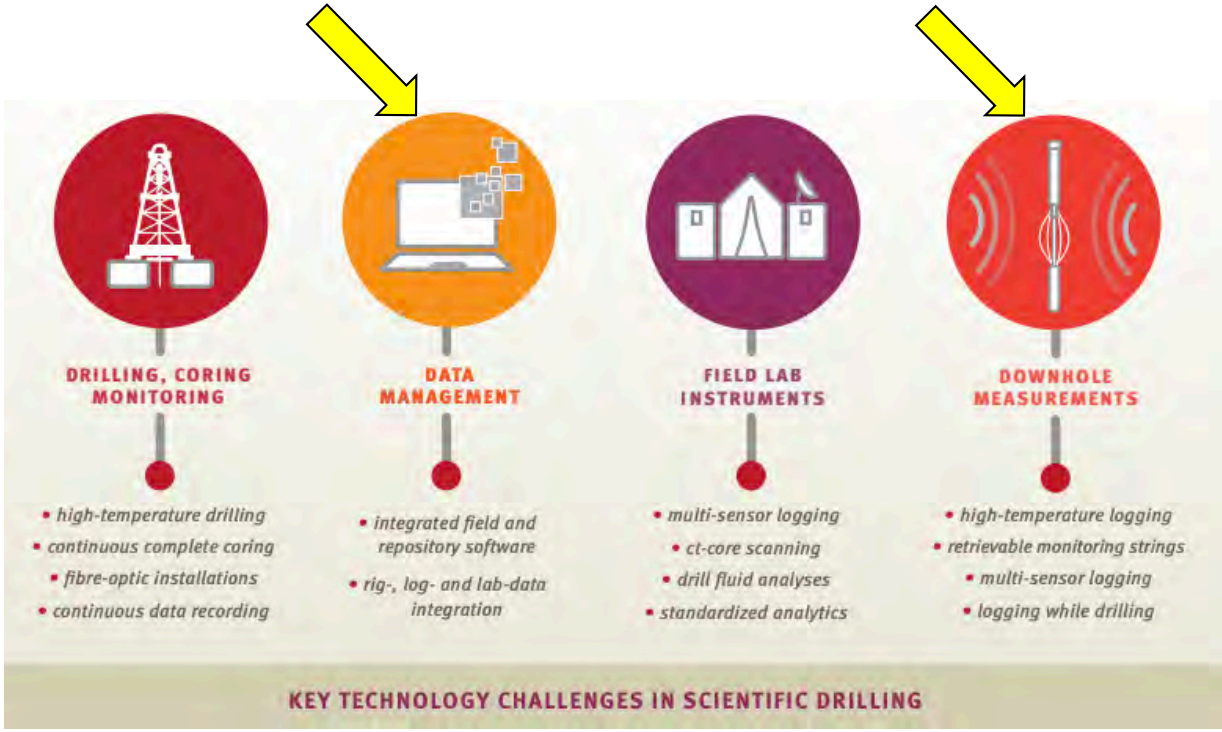
OSG instrument and software developments

Downhole instrument developments and utilization – memory logging while tripping, XRF-borehole wall geochemistry, seismic prediction while drilling, logging container

mDIS, mobile Drilling Information System – a new platform independent data management system for registration and distribution of initial science data during drilling



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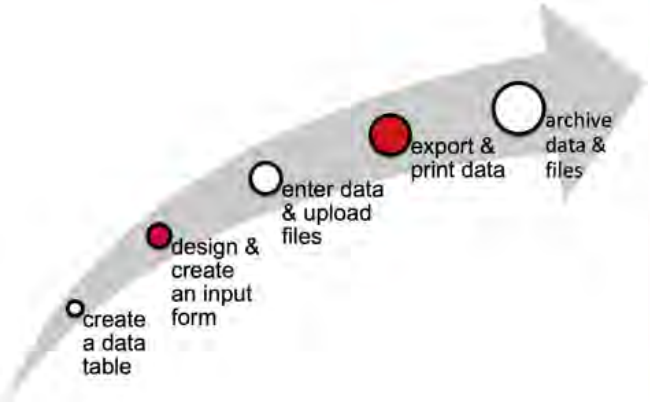
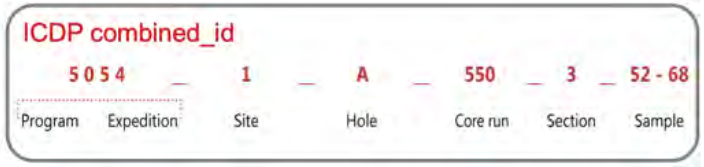
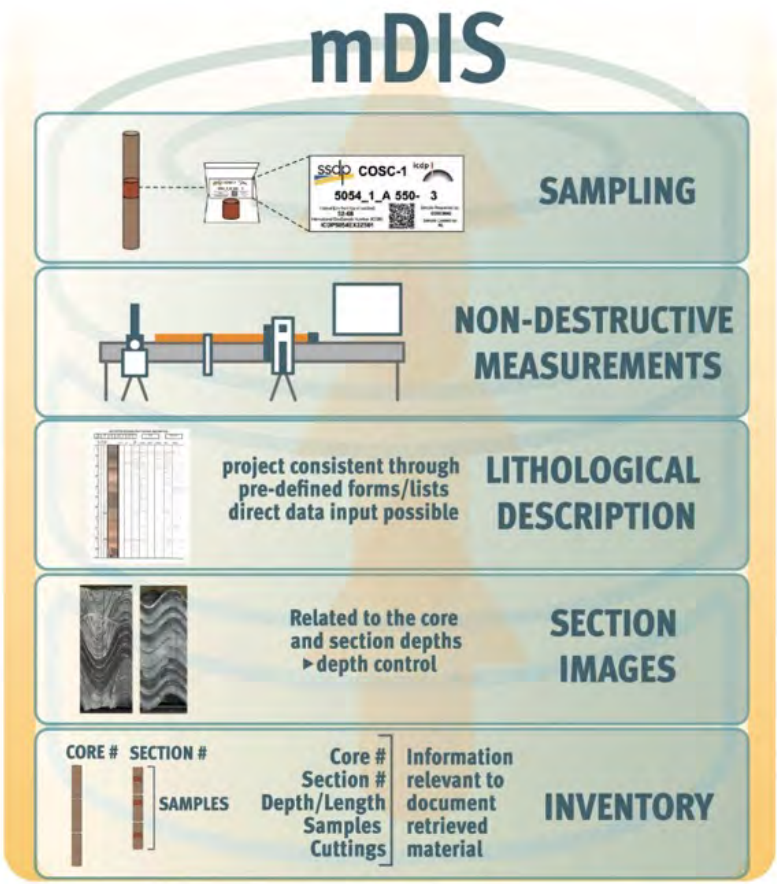
New mobile Drilling Information System, ICDP mDIS

Database management system for hierarchical data

- management, long-term archiving, and web distribution of all basic scientific drilling data, images, files
- Relational database
- Hierarchical data structure naming conventions
- Uses Unique Identifiers: combined_id & IGSN
- Exports for IGSN and Corely
- Current versions: expedition mDIS; curation mDIS
- **OPEN SOURCE**







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Compatibility through..open source, responsive design

mDIS Server

Host system: Win(>8.1)/Mac/ Linux

backend

Apache
MySQL
PHP

Virtual Box ca. 10 - 40 GB
Docker Container

REST API

cores,...

mDIS Client

Platform independent

frontend/
application

standard web
browser (HTML 5)

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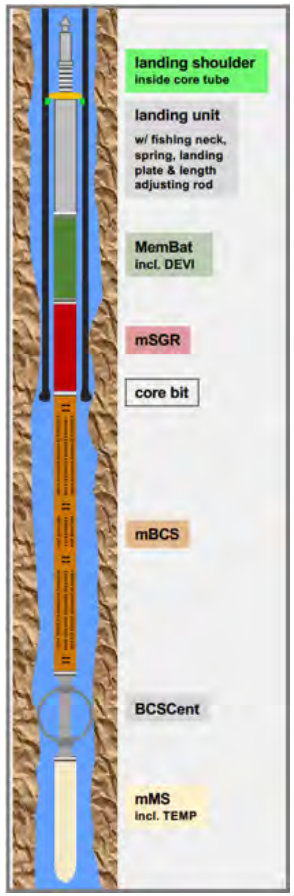
Memory Downhole Logging Instruments



Set of basic geophysical borehole parameters: SGR, MSUS, Sonic, DIL resistivity

Logging under difficult borehole conditions: e.g. lakes, inclined wells

Requirement: wireline coring drill string (HQ)

Bonus: sondes can also be run in wireline mode

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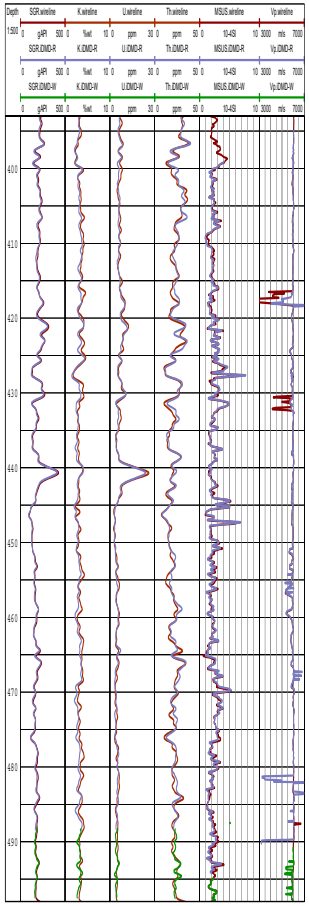
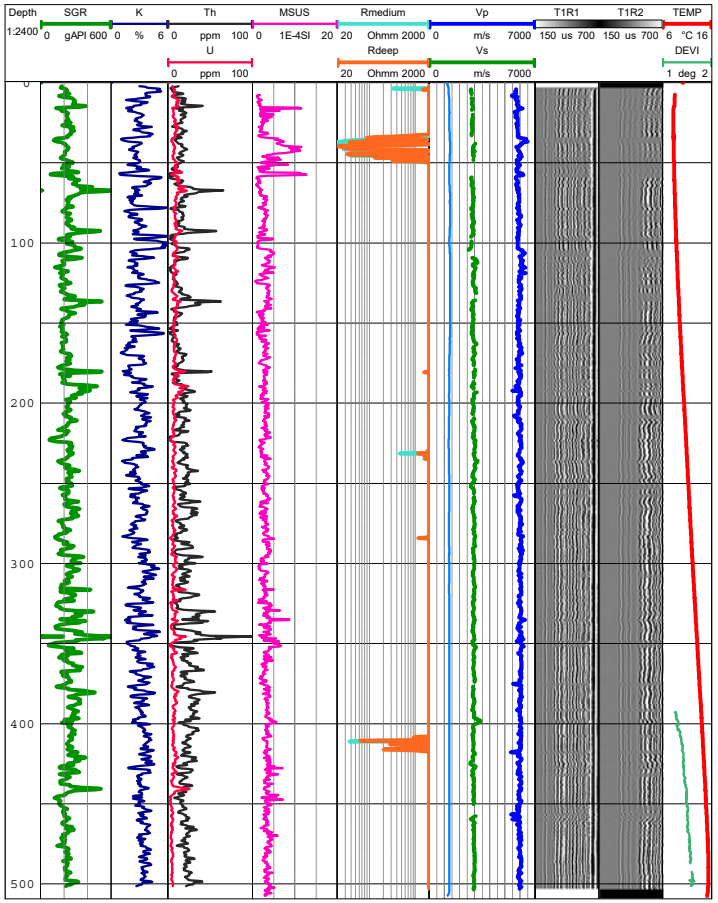
Memory Downhole Logging Instruments

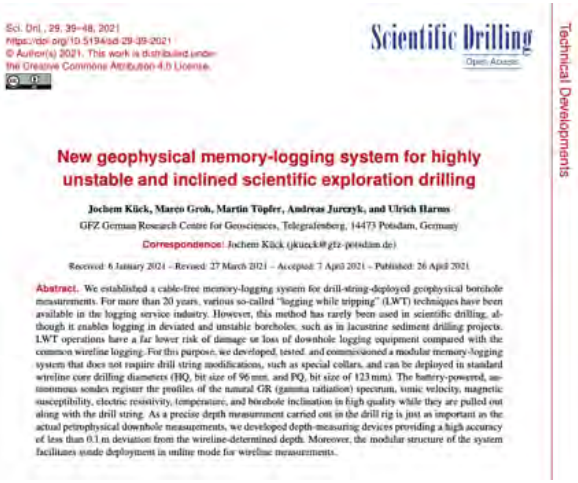
Comparison of results of conventional and memory logs

Memory logging data and depth Measurements match very well (blue vs red lines)





Paper published today:



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Scientific Drilling
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Technical Developments

New geophysical memory-logging system for highly unstable and inclined scientific exploration drilling

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Abstract. We established a cable-free memory-logging system for drill-string-deployed geophysical borehole measurements. For more than 20 years, various so-called "logging while tripping" (LWT) techniques have been available in the logging service industry. However, this method has rarely been used in scientific drilling, although it enables logging in deviated and unstable boreholes, such as in lacustrine sediment drilling projects. LWT operations have a far lower risk of damage or loss of downhole logging equipment compared with the common wireline logging. For this purpose, we developed, tested, and commissioned a modular memory-logging system that does not require drill string modifications, such as special collars, and can be deployed in standard wireline core drilling diameters (HQ, bit size of 96 mm, and PQ, bit size of 123 mm). The battery-powered, autonomous sondes register the profiles of the natural GR (gamma radiation) spectrum, sonic velocity, magnetic susceptibility, electric resistivity, temperature, and borehole inclination in high quality while they are pulled out along with the drill string. As a precise depth measurement carried out in the drill rig is just as important as the actual petrophysical downhole measurements, we developed depth-measuring devices providing a high accuracy of less than 0.1 m deviation from the wireline-determined depth. Moreover, the modular structure of the system facilitates sonde deployment in online mode for wireline measurements.

Thank you


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