SMARTIES

Supercritical fluids and MAgma Reconnaissance for Transformative Iceland Energy Solutions

Workshop
GFZ Potsdam
27-29 April 2022

Philippe Jousset
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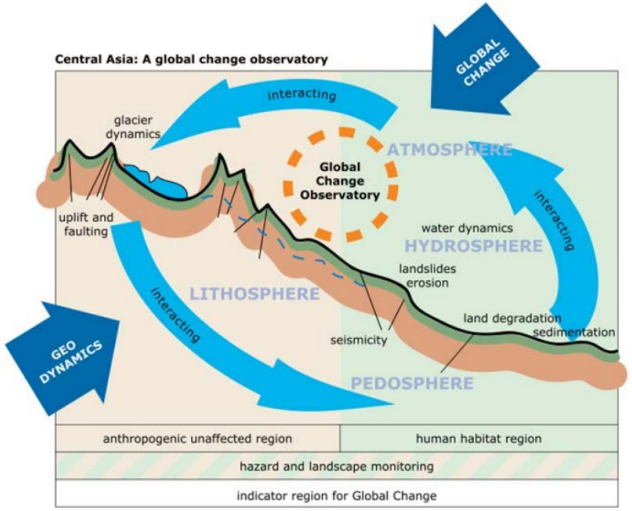
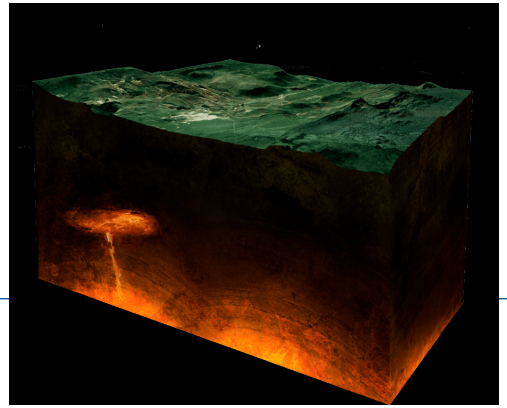
POF - Focus Sites

- Global Change Observatory Central Asia
  - How does Climate Change affect the human-habitat in a tectonically active intra-plate setting?
  - Broadband seismometers, strong motion, cave & lake monitoring, tide gauges, ROMPS, GNSS, river discharges, snow monitoring
- Taroko (Taiwan)
  - Monitoring of Earth surface processes, solute, gaseous and matter fluxes in a tectonically highly active mountain landscape with high precipitation, and erosion rates
  - 8(+20 planned) multiparameter stations (broadband, meteo) 3(+2 planned) river hydrometric stations
- Mt Etna (MhNES)
  - Hazard cascade processes (volcanic, earthquake, mass movements – flank instability
  - DAS monitoring on submarine and land fibres (temp); GeoSEA marine geodesy for strain (GEOMAR!); remote sensing
- Iceland (SMARTIES)
  - Understand supercritical and superhot thermal reservoirs under natural and human forcing; dynamics of magmatic and hydrothermal systems to assess volcanic hazars and quantify geotherm potential; linked to Krafla Magma Testbed
  - superconducting gravity meters; seismic + GNSS; magmatic flux monitoring; Planned: Borehole ICDP (KMT);





SMARTIES - Objectives

- Observe and model the structure and dynamics of magmatic/hydrothermal systems and their transition zone to assess potential volcanic hazards and quantify the geothermal energy potential?
- Characterize and model processes of mass and energy transfer within supercritical and “superhot” hydrothermal reservoirs under natural and anthropogenic forcing?

SMARTIES - Activities

Activities, examples

- Superconducting gravity meters Mass, basic science (instruments)

  Schäffer et al., GJI, 2020; Erbas et al., WGC, 2021; Forster et al., 2021;
  Portier et al., PAG, 2022; Hinderer et al., 2022

- Magmatic volatile flux monitoring

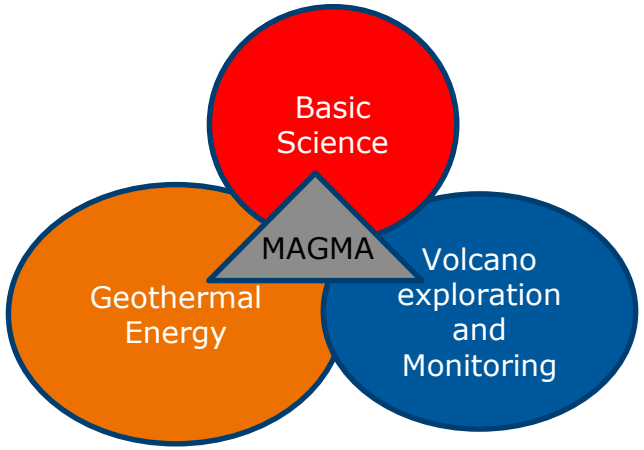
- Seismic + GNSS Strain, Stress

  Toledo et al., JVGR, accepted

Planned:

- Borehole ICDP (KMT)
- Ambition to contribute to KMT phase 0,+

SMARTIES
link with GFZ Program (POF) and European Projects



Collaborations since 2017:

ISOR, University of Iceland, Landsvirkjun, EOST (France);

EU Projects:

IMPROVE (ITN), EU proposals submitted.

Icelandic GFZ study sites: Krafla, Reykjanes, Hengill, other volcanoes

Iceland could be "Lighthouse project" for POF

T8 (Energy) & T3 (Hazard)

Examples of suggested activities for SMARTIES

Thermal characterisation of rocks and sites – laboratory (Svenn)
Heat and Mass numerical modelling (Phillip)
Soil gas analytics (Egbert)
Gravitymeters for energy and hazard (Philippe)
Current EU projects (Torsten)
New solutions for ground deformation modelling (Eleonora)
Drilling observations - fibre optics (Johannes, Martin, Lotte)
Data management and outreach (Tobias, Christian, Egbert)

SMARTIES - Perspectives

Linked to Krafla Magma Testbed

Planned: Borehole ICDP (KMT)

Many other ideas @GFZ, unexpressed and unexploited…

Section	Name(s) – if known	Contribution / Activity
1.1	Benjamin Männel Markus Ramachi	• GPS data series analysis • GPS instrumentation
1.2	Tilo Schöne Nico Stolarczuk	• ROMPS systems
1.4	Mahdi Motagh	• Radar and optical remote sensing for geohazards
2.1	Torsten Dahm Sebastian Hainzl Magdalena Vassileva Sebastian Heimann Marius Isken Thomas Walter Eleonora Rivalta Claus Milkereit	• Activities include structural analysis with drones, induced and triggered seismicity, and large-scale deformation analysis using InSAR, as well as artificial intelligence and data science
2.2	Philippe Jousset Charlotte Krawczyk NN PhD student (ITN IMPROVE) Christian Haberland	• Gravity meters as key instruments to monitor mass changes associated to reservoir exploitation and future magma forcing with KMT borehole (when drilled) • Contribution to fibre optic data acquisition, processing and interpretation • Seismology • Active seismics
2.5	Sascha Brune Bernhard Steinberger	• Understand large-scale geodynamic processes of the Iceland plume, such as mantle dynamics, magma migration, faulting/fracturing across scales, degassing
3.1	Egbert Jolie Philipp Weis	• Mobile soil gas lab for monitoring in the context of georesources and geohazards • Numerical modelling of superhot geothermal systems (mineral deposition in hydrothermal systems)
4.2	Thomas Wiersberg Jochem Kück Carolin Boese Marco Groh (technician) Martin Töpfer (technician)	• Link to ICDP KMT • Feasibility, planning and implementation of a non-digital temperature sonde for Ultra-High Temperatures and a pressure preserving downhole fluid sampler tool to be applied at KMT borehole • Application of UHT piezoelectric sensors for KMT downhole seismic monitoring • Near-surface seismic monitoring • KMT Borehole gas and fluid geochemical logging and monitoring
4.4	Andreas Güntner, Stephan Schröder	• Gravity meters as key instruments to monitor mass changes – modelling subsurface hydrological gravity contributions • Hydrology parameters
4.5	Judith Bott	• Integrate the detected distribution of fault and fracture activity with 3D models of the physical state of the lithosphere to differentiate between anthropogenic, magmatic-hydrothermal and tectonic driving forces of the system
4.8	Jan Henninges Tanja Ballerstedt Simona Regenspurg Juliane Kummerow Hannes Hofmann?	• DTS and DAS monitoring in borehole • Gravity meters technical issues • Geochemical properties of Icelandic fluids • Monitoring reactive flow in high-enthalpy geothermal settings • Modelling aspects of hydrothermal systems

Funding!

- SMARTIES: recurrent funding (GFZ)
- Since 2022 15 k€/year, every year ☺

- Part of this funding used for this workshop

- Call for ideas for this year and for future!

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