

NAtural Seismicity as a Prospecting and MONitoring tool for geothermal energy extraction

Annual meeting 2021

Josef Horálek

Reykjavík 8th September 2021

Outline

- 1 Project summary
- 2 Team
- 3 Work Packages
- 4 Timeline
- 5 Results
- 6 TACR monitoring
- 7 Data Management Plan
- 8 Partnership agreement

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Objectives

- reveal the physical processes that cause earthquakes with special emphasis on the role of fluids, geothermal operations and tectonic plate movements
- apply the results to develop guidelines for underground operations in seismically active areas
- test and develop seismic methods as a prospecting tool in geothermal exploration

The target area in Iceland has intensive seismicity due to variety of geodynamic processes and human activities, such as plate movements in rift segments, volcanoes, active hydrothermal areas with production/reinjection. The results are expected to be transformable to other areas with potential geothermal sources and micro-earthquake activity.

The main tasks

- analyze seismicity recorded by REYKJANET
- test and develop automatic seismic data processing procedures
- characterize of source mechanisms and stress field
- derive 1D and 3D velocity models of the Earth's crust
- make an integrated analyses of geophysical and geological data to detect fluid paths and their accumulation
- the use of local seismicity as a prospecting tool in geothermal exploration for energy production

The project will enhance understanding of subsurface structures and processes related to geothermal reservoirs. Such results are of high importance for geothermal development and are applicable to other seismic regions where the fluid balance is

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Institutions

- Institute of Geophysics (IG), CAS - main applicant, project promoter
- Iceland Geosurvey (ÍSOR) - project partner
- Institute of Rock Structure and Mechanics (IRSM), CAS - project partner
- Faculty of Science, CU - project partner



INSTITUTE OF GEOPHYSICS
OF THE CZECH ACADEMY OF SCIENCES



ÍSOR
ICELAND GEOSURVEY



FACULTY OF SCIENCE
Charles University

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WP's and teams I. - institutions involved and leaders

- WP1: Project management (IG) - **Josef**
- WP2: Data acquisition and data archiving (ÍSOR, IG) - **Egill**
- WP3: Automatic data processing: detection and location of earthquakes (ÍSOR, IG, CU) - **Tobba**
- WP4: Seismic activity: Time and space analysis (IG, ÍSOR, CU) - **Jana**

WP's and teams II. - institutions involved and leaders

- WP5: Earthquake source mechanisms and stress analysis (IG, ÍSOR) - Josef
- WP6: Upper crustal seismic models (IG, IRSM, ÍSOR) - Slávek
- WP7: Ground motion model: Input for hazard assessment (IRSM, ÍSOR) - Jiří
- WP8: Multi disciplinary interpretation (ÍSOR, IG, IRSM, CU) - Gylfi

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2021

Years		2021											
Months		1	2	3	4	5	6	7	8	9	10	11	12
WP1	Project management				M1								
WP2	Data acquisition and data archiving		M1		M2								
WP3	Automatic data processing		M1	M2	M3			M4		M5		D1	
WP4	Seismic activity: Time and space analysis												
WP5	Earthquake Source Mechanisms and stress analysis												
WP6	Upper crustal seismic models												D1
WP7	Ground Motion Model												
WP8	Multi-disciplinary interpretation												

M1	Kick-off meeting in Prague during the 1st quarter of 2021
M1	Seismic data archive and structure complete by March 2021
M2	REYKJANET data stations streaming in real time by April 2021.

2021

Years		2021											
Months		1	2	3	4	5	6	7	8	9	10	11	12
WP1	Project management				M1								
WP2	Data acquisition and data archiving		M1		M2								
WP3	Automatic data processing		M1	M2	M3			M4		M5		D1	
WP4	Seismic activity: Time and space analysis												
WP5	Earthquake Source Mechanisms and stress analysis												
WP6	Upper crustal seismic models												D1
WP7	Ground Motion Model												
WP8	Multi-disciplinary interpretation												

M3	Tune Seiscomp for REYKJANET by April 2021
M4	Tuning of detection algorithms (Seiscomp, SLRNN, QuakeMigrate, comparison of their performance by July 2021
M5	Implementation of the formula for routine local-magnitude estimation of by September 2021
D1	Deliver phase picks from all earthquakes in WP2 of $M_L > 1.25$ by October 2021

2022

Years		2022											
Months		13	14	15	16	17	18	19	20	21	22	23	24
WP1	Project management										M2		
WP2	Data acquisition and data archiving												
WP3	Automatic data processing	D2					M6						
WP4	Seismic activity: Time and space analysis				D1								D2
WP5	Earthquake Source Mechanisms and stress analysis				D1								D2
WP6	Upper crustal seismic models				D2								D3
WP7	Ground Motion Model												
WP8	Multi-disciplinary interpretation												

M2 | Project work shop in Prague

D2 | Deliver earthquake locations from QM and Seicomp, NLLC and hypoDD and their comparison with earthquake locations

based on manual arrival-time readings by November 2021



2022

Years		2022											
Months		13	14	15	16	17	18	19	20	21	22	23	24
WP1	Project management										M2		
WP2	Data acquisition and data archiving												
WP3	Automatic data processing	D2					M6						
WP4	Seismic activity: Time and space analysis				D1								D2
WP5	Earthquake Source Mechanisms and stress analysis				D1								D2
WP6	Upper crustal seismic models				D2								D3
WP7	Ground Motion Model												
WP8	Multi-disciplinary interpretation												

D1	Presentations poster/oral at EGU
D2	Deliver primary map of the brittle-ductile boundary

D1	Presentations poster/oral at EGU
D2	Deliver primary catalog of source mechanisms

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Data

- Maps of earthquake hypocentres on the Reykjanes Peninsula (4/24)
- Maps of the seismic velocities (6/23)
- Open access database of earthquake parameters (4/24)

Software

- Updated ground motion model for Reykjanes Peninsula (11/23)
- Automatic data processing (4/24)

Technical upgrade

- Improvement of routine seismic monitoring (11/22)
- Upgrade of the REYKJANET network to on-line, real time data transfer (9/21)

Scientific papers

- Time and space distribution of hypocentres, imaging of faults (6/22)
- Source mechanisms and local stress analyses (6/23)
- Interpretation of seismic and other geophysical data (4/24)

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Project monitoring

- regular monitoring visits from TACR agency
- first was held online 06/21, no issues found
- next one will be at IG Prague 10/21

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Required by TACR

- available at the project website
- must respect FAIR principles (Findability, Accessibility, Interoperability, Reusability)
- can be changed during the project
- defines data embargo (24 months after the project has ended), storing, backup and description of the data (both measured and produced)
- all publications **MUST** be in OpenAccess journals

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Partnership agreement highlights

- PA is signed between the promoter (IG) and partner (participating institutions: ISOR, CU, IRSM)
- each publication must be sent to the partners at least 45 calendar days before publishing
- each party shall ensure open access to all peer-reviewed scientific publications relating to its Results