

Advanced 3D Geophysical Imaging Technologies for Geothermal Resource Characterization

Cooperation under the IPGT:

- LBNL (Gregory A. Newman)
- MIT (Michael Fehler)
- UR (Ólafur Guðmundsson)
- ISOR (Knútur Árnason)

Supported by:

Doe, **GEORG**, UR and ISOR

PhD student: Guðni Karl Rosenkjær

The goal

Develop joint geophysical imaging methodologies for geothermal site characterization

Focusing on EM, passive seismic and gravity data

Using existing data and new seismic data from The Reykjanes peninsula.

Data to be used

Krafla. Existing gravity EM (TEM/MT) and seismic data and possibly new CSEM data.

Hengill-Reykjanes peninsula. Existing gravity and EM and new seismic data

The Coso field in California. Existing gravity, EM and seismic data

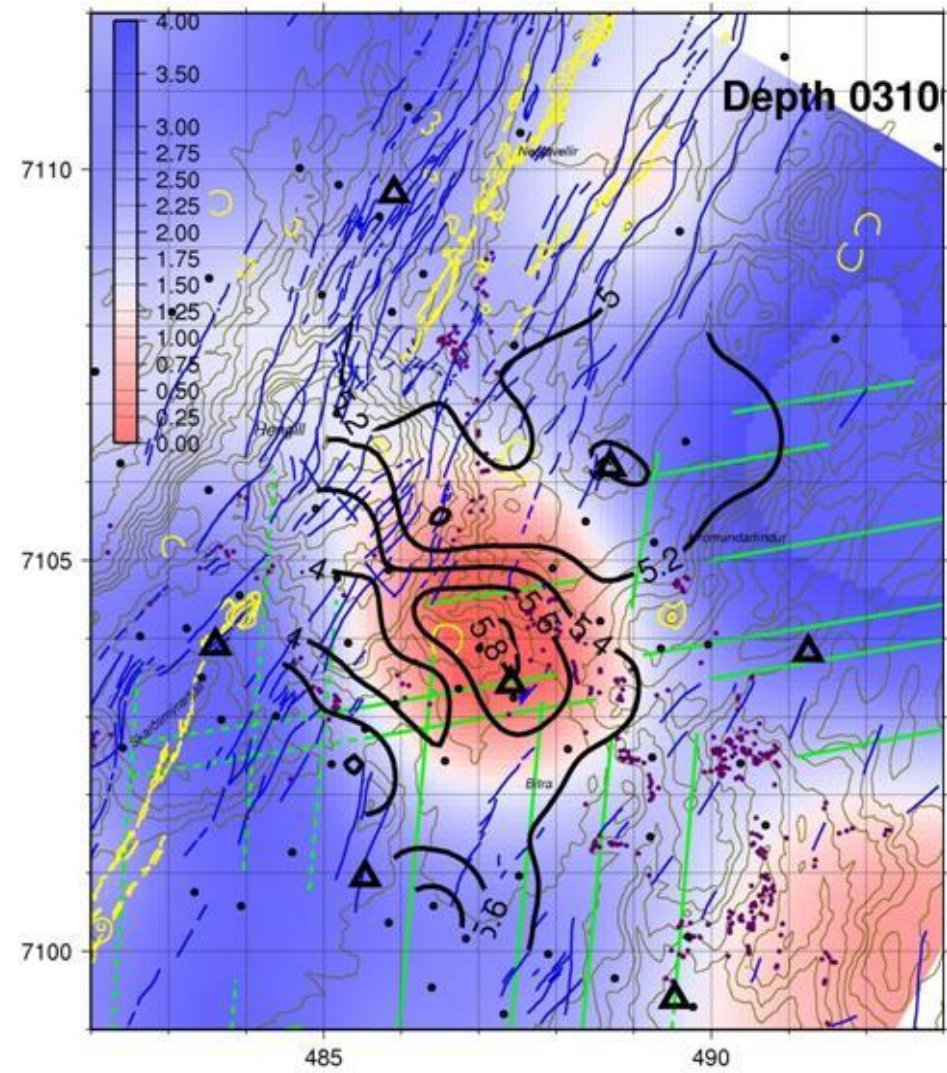
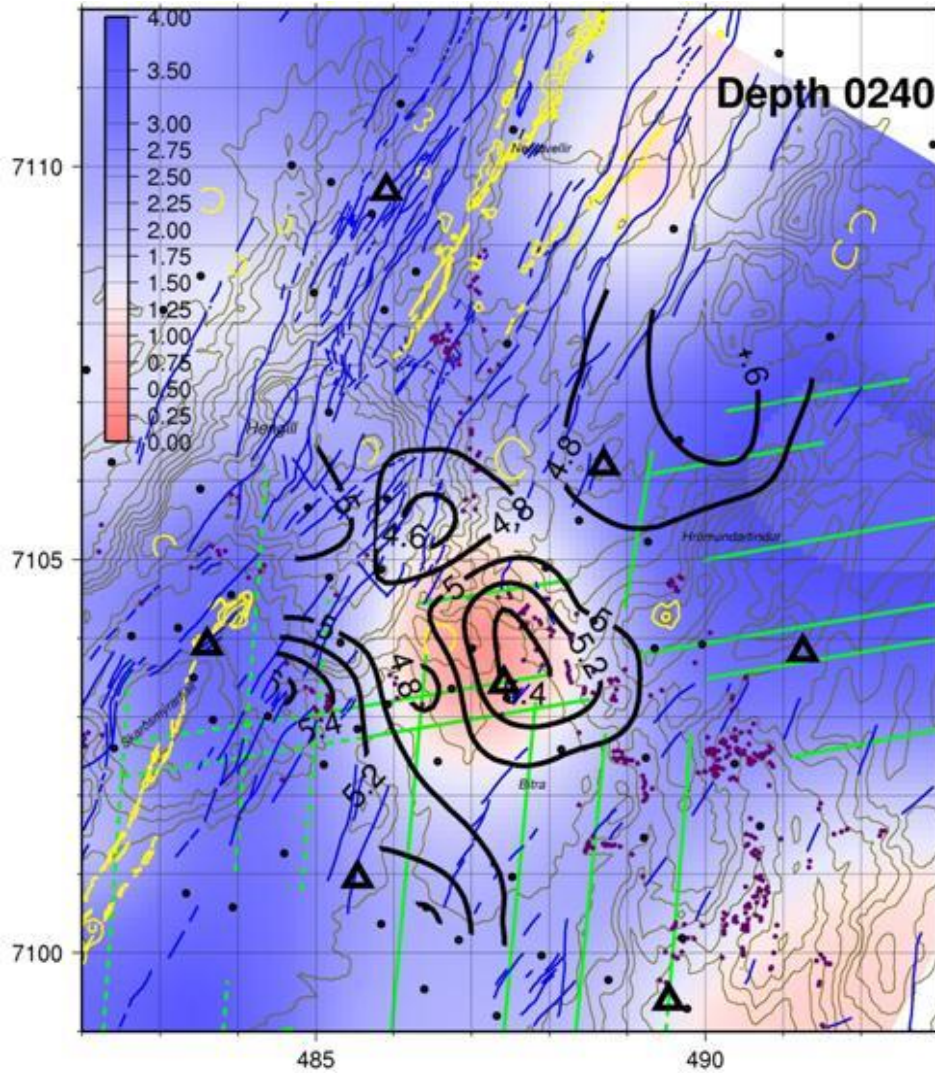
The joint imaging scheme

Joint inversion based on parametric relations between physical attributes has not proven to be successful.

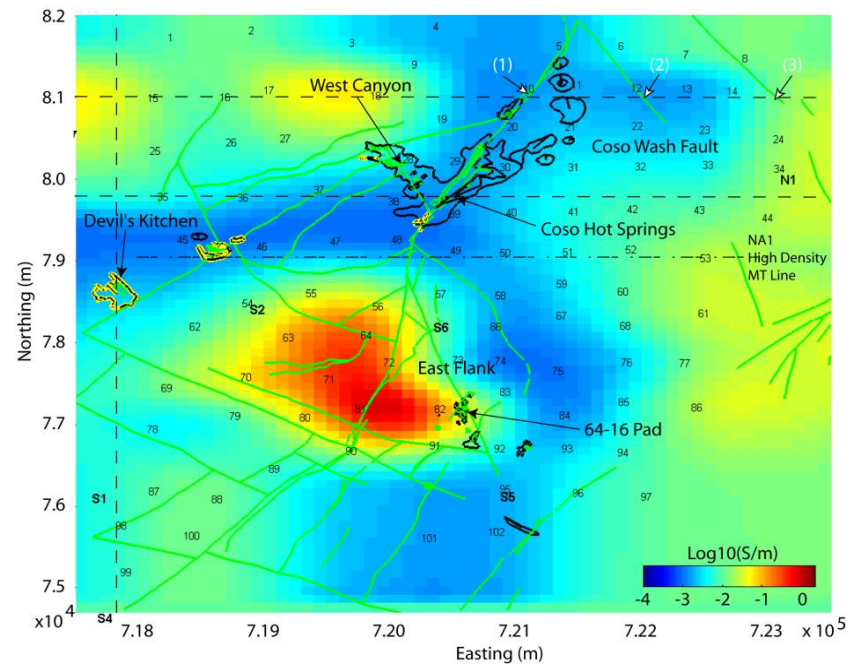
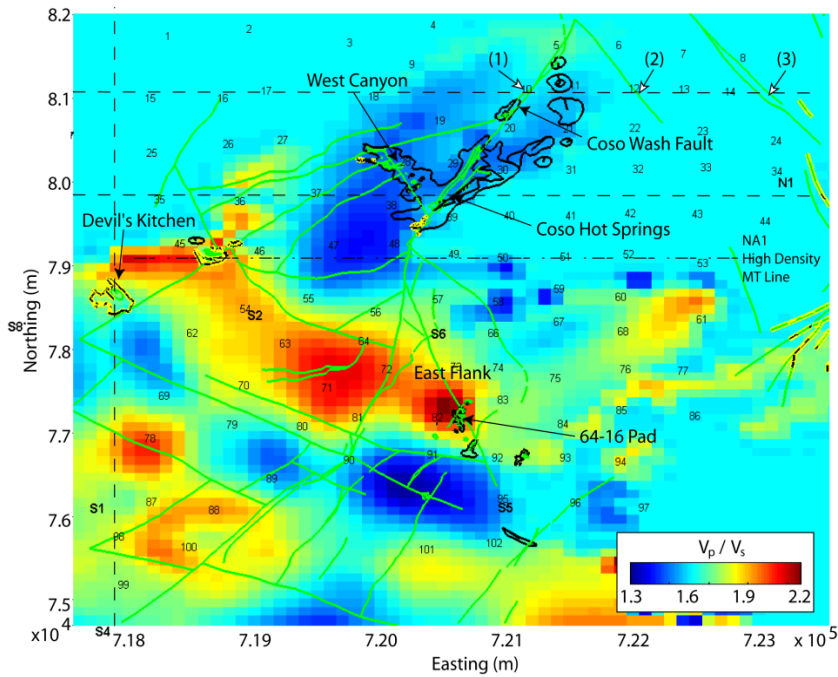
NEW APPROACH:

Make a sort of “geometric” inversion looking for coincident anomalies (minimize cross-products of gradients in physical parameters). Seismic data have better spatial resolution than EM data.

Hengill, comparison of P-wave velocity and resistivity



Coso



7295

415

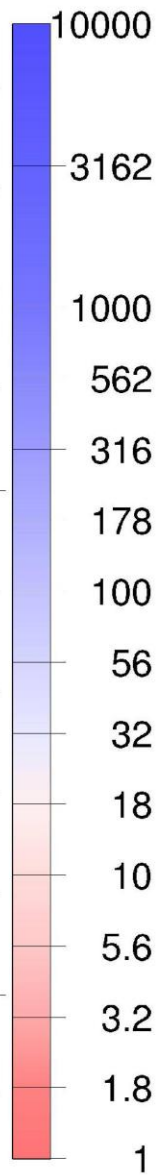
420

425

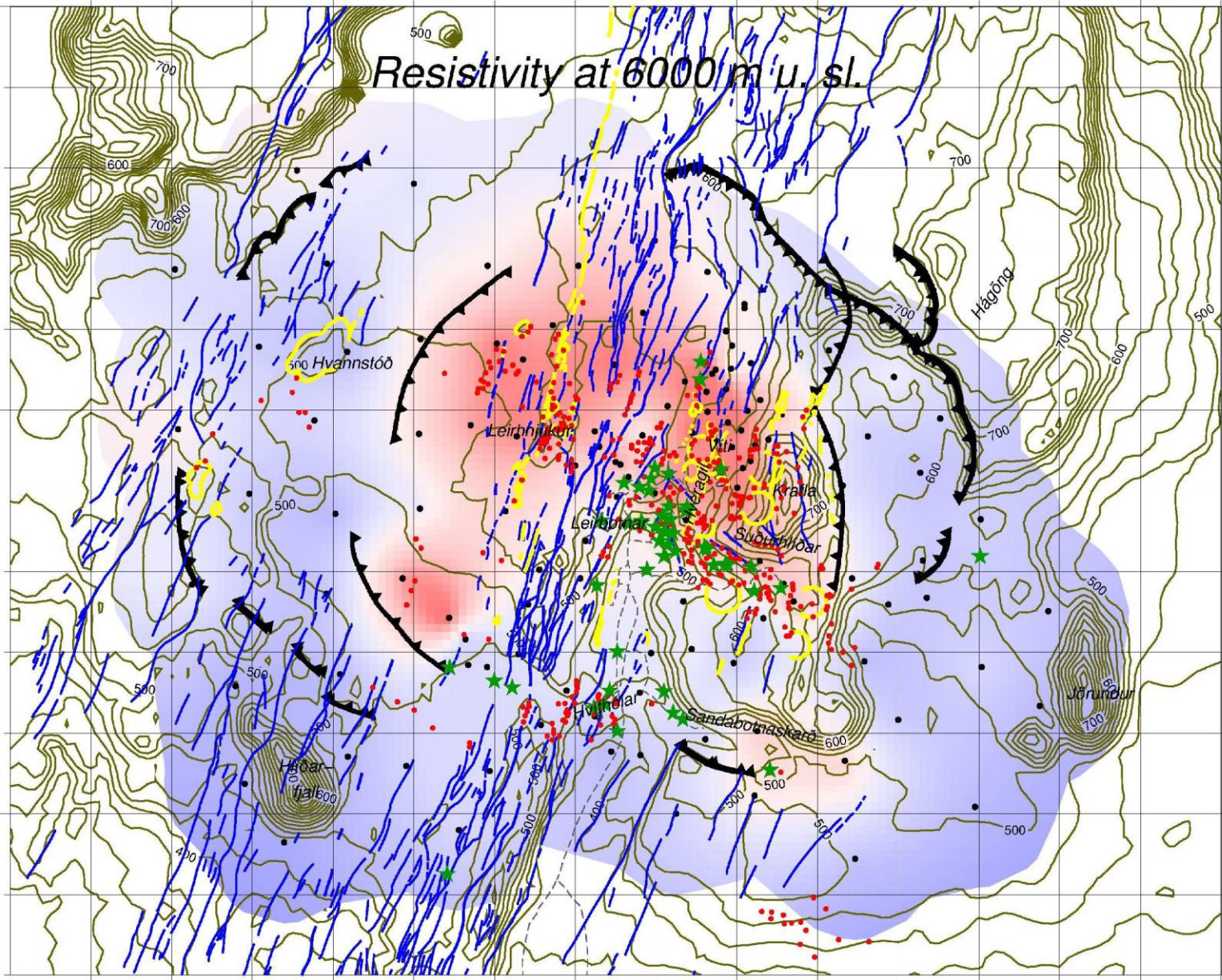
Resistivity at 6000 m u. sl.

7290

7285



Resistivity (Ωm)



415

420

425

Merging of codes

The joint inversion will be achieved by merging existing 3D inversion codes:

EMGEO, 3D EM data inversion code (LBNL)

TOMODD, 3D seismic tomography inversion (MIT)

Stepwise approach

1. Analysis of seismic, and MT, CSEM, TEM and gravity data independently using existing techniques.
2. Joint inversion of EM and MEQ data using existing techniques that are coupled in a leap-frog fashion.
3. Fully-coupled inversion of seismic and EM data using an acoustic formulation for seismic data .
4. Fully-coupled inversion of seismic and EM data using an elastic formulation for seismic data in the Laplace Transform domain.

TASKS	Year 1												Year 2												Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
<i>Year 1 Data Acquisition, Imaging Tools & Analysis</i>																																				
1.1	Gather existing data at the three test sites																																			
1.2	Acquire seismic data - Reykjanes Peninsula																																			
1.3	Imaging of geophysical data types - Step 1																																			
1.3	Analysis/correlate geophysical attributes																																			
1.4	Develop Joint Imaging algorithms - Step 2																																			
1.5	Present Results at Technical Meetings																																			
<i>Year 2 Data Acquisition, Imaging Tools & Analysis</i>																																				
2.1	Acquire seismic data - Reykjanes Peninsula																																			
2.2	Collect & Process CSEM data at Krafla																																			
2.3	Develop Joint Imaging tools - Steps 2 & 3																																			
2.4	Joint Image Geophysical Data Types																																			
2.5	Quantify & Appraise Joint Image Uncertainty																																			
2.6	Present Results at Technical Meetings																																			
2.7	Prepare Technical Publications from Year 1																																			
<i>Year 3 Data Acquisition, Imaging Tools & Analysis</i>																																				
3.1	Image select Reykjanes Peninsula Geothermal fids																																			
3.2	Collect and process more CSEM data at Krafla																																			
3.3	Complete Joint Imaging Tools - Step 3 & 4																																			
3.4	Jointly Image Geophysical Data Types																																			
3.5	Quantify & Appraise Joint Image Uncertainty																																			
3.6	Present Results at Technical Meetings																																			
3.7	Prepare Final Project Report																																			