

High Temperature Instrumentation for Supercritical Geothermal Reservoir Characterization and Exploitation



Project building – the case of HiTI

- The HiTI project is a spin-off from another scientific and industrial effort, the so-called IDDP or Iceland Deep Drilling Project.
- The need for new methods in supercritical geothermal utilization became clear in the early noughties.
- The situation was discussed within the geothermal community for some time.
- In 2004, a FP6 call dedicated to technology improvement in high temperature geothermal utilization was opened.
- The HiTI partnership was formed later that year and application submitted in December 2004



- The application was well received (26/30 points) but was not supported in 2005.
- In July 2006, an invitation to negotiations was received.
- A renewed partner list and Description of Work was submitted and project could start on January 1st 2007. A three year STREP project.
- The project has now come to an end, with most deliverables complete despite the main target geothermal source did not reach supercritical geothermal conditions.
- The geothermal community is now much better prepared for supercritical geothermal resources.



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Why supercritical instrument tolerance?

- Supercritical geothermal fluids contain greater energy density, believed to allow 5-10 fold increase in electrical production and improved economy.
- Researchers are limited by available instrumentation, almost entirely designed for the oil & gas industry, where temperatures rarely exceed 250°C.
- To answer both scientific and feasibility questions, a number of instruments and methods have been built and applied in Icelandic high temperature areas, supported in the 6th European framework program (FP6).



HiTI Deliverables

Deliverable no.	Deliverable name	Responsible partner
1	MultiSensor, PLT400, 400°C	CalEng
2	High temperature wireline T sensor	BRGM
3	Dual Laterolog (DLL), 300 °C	CalEng
4	Gamma ray (GR) detector, 300 °C	ALT
6	Televiwer with casing thickness and cement evaluation to 300°C	ALT
7	Distributed temperature sensing	GFZ
8	HPHT rig 600°C laboratory	CNRS
9	Na-Li temperature evaluation to 500°C	BRGM
10	Organic tracers to 350°C	BRGM
11	Patents	CalEng/ALT
12	Internet web pages	CRES
13	Publications	ISOR
14	Market study	CRES
15	HITI brochure	CRES
16	Project workshop	CRES
17	New concept for development of DTS cable	GFZ
18	Dedicated session at HITEN conference	Oxatec

Assessment

- The IDDP well was drilled into magma at 2 km. Temperature at bottom high but unknown.
- Casing rupture at 600 m prevents logging tools from going deeper
- HiTI tools and methods could however be demonstrated in the high temperature geothermal fields.
- Geothermometric methods were developed and tracer testing performed
- Temperature, pressure, televiewer, gamma radiation and fluid flow measurements were demonstrated to either rated or existing *in situ* conditions.
- Laboratory measurements took place with available cores.
- Some proposed methods have reached maturity during the project.

Future concepts

- Continue high temperature tool development.
- Continue laboratory testing.
- Additional physical parameters at high temperature, including seismic, sonic and resistivity microimaging.
- Pressure and temperature sensing in the 400-600°C range.
- Seismic while drilling methods.
- TEM and MT at higher resolution.
- Fluid sampling.
- High temperature electronics.