THE ICELAND DEEP DRILLING PROJECT (IDDP)

Drilling for Supercritical Fluid

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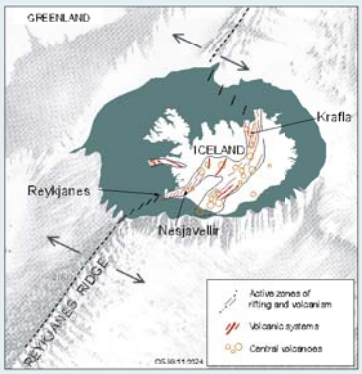
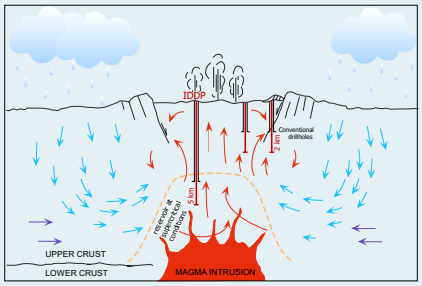
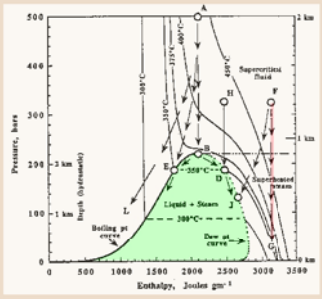


In Iceland conventional geothermal systems supply about 18% of the installed electrical capacity and district heating for about 90% of the population of the country. However studies suggest that wells drilled into natural supercritical geothermal systems could have a power output an order of magnitude greater than that produced from conventional 2.5 km deep geothermal wells. A consortium of Icelandic energy companies (Hitaveita Sudurnesja, Landsvirkjun and Orkuveita Reykjavikur) is preparing to drill a series of 4-5 km deep wells to produce 400-600°C supercritical hydrous fluids from three high-temperature hydrothermal systems, Reykjanes, Nesjavellir and Krafla. The first well in the series is planned for 2005. The high temperature geothermal system at the Reykjanes peninsula, a direct landward continuation of the Reykjanes Ridge, has been chosen as the first drillsite. Plans call for coring to be carried out below 2.5 km depth and flow tests to be performed at 2.7, 3.7 and 5 km depths. The consortium is now seeking the participation of international partners and scientists in this study of an unconventional geothermal energy resource from an active high-temperature, saline, hydrothermal system located in an ophiolite-like environment that is actively forming today.



Simplified Model of a geothermal system



Pressure enthalpy diagram for pure water with selected isotherms. The conditions under which steam and water coexist is shown by the shaded area, bounded by the boiling point curve to the left and the dew point curve to the right. The arrows show various different possible cooling paths (Fournier 1999: Economic Geology, 94 (8): 1193-1211).

The Iceland Deep Drilling Project aims to produce supercritical fluid to the surface in such a way that it transforms directly to superheated steam along a path like F-G in the diagram above, resulting in a much greater power output than from a typical geothermal well.

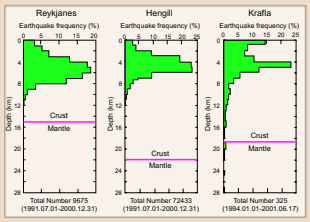
FLUIDS

Fluid compositions at Reykjanes are similar to seawater whereas the inland systems in Iceland are characterized by very dilute fluids. The table shows concentrations in ppm (mg/kg)

	Seawater	Reykjanes	Nesjavellir and Krafla
Na	10,800	9,380	~ 200
Ca	411	1,600	2-5
K	392	1,370	0.2-0.3
Cl	19,400	18,400	~ 100
TDS	35,000	33,140	800

PERMEABILITY

The frequent occurrence of earthquakes of 0-5 on the Richter scale beneath the three target geothermal fields suggest that permeability exists at at depths of 4-8 km.

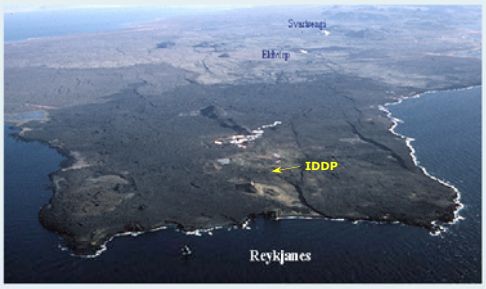


The composition of supercritical fluid is not known in detail, but concentrated brines may develop beneath selfsealing zones. However, their existence may be short lived because of the frequent earthquakes create permeability within the Icelandic crust, thereby allowing mixing. The IDDP boreholes are designed to resolve such questions concerning fluid composition and permeability.

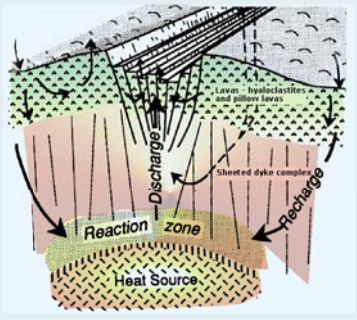
BENEFITS:

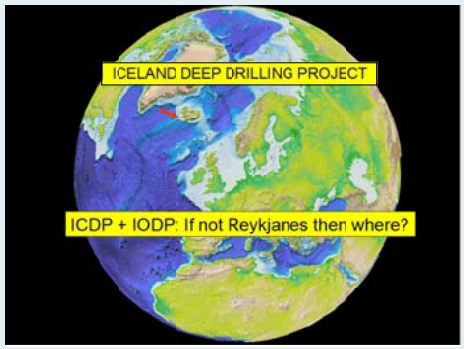
1. Increased power output per well (5-10 fold)
2. Production of a higher value steam (higher P-T)
3. Extending the resource base and lifetime of existing fields
4. Knowledge of reservoir characteristics at greater depths
5. Advancing techniques of UGR (Unconventional Geothermal Resources)
6. Development of an environmentally benign resource
7. Development of high-temp. instruments and drilling technology
8. Application to high-temp. geothermal systems world wide
9. Increased knowledge of mid-ocean rift systems
10. Educational, industrial and economic spin offs

The Reykjanes drillsite



***REYKJANES** is the landward extension of the Mid-Atlantic Ridge. The geothermal water is of hosted in an active ophiolite-like environment, shown schematically in the picture to the right.*





INTERNATIONAL ASPECTS :

The IDDP has participation by an international team of scientist from more than a dozen countries and has received support from the International Continental Scientific Drilling Program (ICDP) to hold two planning workshops. However a preliminary drilling proposal submitted to Integrated Ocean Drilling Program (IODP) in March 2004 was rejected. We proposed that the Reykjanes drillsite should be considered as a **Mission Specific Platform** by the **IODP**. The IDDP offers the unparalleled opportunity to core drill the mid-ocean ridge crest at 2.5-5.0 km depth within an active geothermal system comparable to a black smoker. The grounds for the rejection by the IODP was that the proposed drillsite is now above sea level. However the upper crust at Reykjanes is an actively forming submarine ophiolite complex. We are disappointed by the inflexible attitude of the IODP as it should maintain a focus on achieving scientific goals as efficiently as possible, and do this by a wise choice of drill sites. The IDDP is an unparalled opportunity for collaboration between the **IODP** and the **ICDP** to study mid-ocean ridge hydrothermal systems and their coupling with magmatic heat sources. Rotary drilling of the first 2.7 km at the selected drillsite will begin **JANUARY 2005**. The amount of coring and fluid sampling from 2.5 to 4.0 km depth for scientific studies will depend on how successful we are in attracting international funding.

Further information: www.iddp.is

Acknowledgment: Thanks are due to Hitaveita Sudurnesja, Landsvirkjun, Orkuveita Reykjavikur and Orkustofnun for financing and supporting our activities in advocating for international cooperation and to ICDP for supporting the workshops to discuss and organize the science structure of IDDP.