

The Hydrothermal Laboratory comes of age

21 years of experimentation at high temperatures and pressures

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The Hydrothermal Laboratory studies chemical reactions between fluids and rocks under conditions found in the top few kilometres of the Earth's crust. In its 21 years it has been at the centre of numerous investigations, and early in 2000 its one thousandth experiment will be started. It is timely therefore, to look back at the major contributions the Hydrothermal Laboratory has made to the geosciences.

Historical perspective

The laboratory was initiated by Neil Chapman (now at QuantiSci Ltd) and David Savage (now at Quintessa Ltd) at Harwell in 1979. At that time, the UK high-level radioactive waste programme needed a better understanding of reactions between hot, vitrified waste and groundwater. Early experiments were aimed at this issue, with the first started on August 14th 1979. However, in 1983 the laboratory was dismantled and became the first to be built at the then expanding BGS main site at Keyworth.

Changes in government policy resulted in the decline of the high-level waste programme in 1981. However, at about the same time a need for laboratory experiments for the hot dry rock (HDR) geothermal programme in Cornwall was identified, and the laboratory became one of the major sources of information on how granite reacted with injected water. Knowledge gained from this allowed lab-

oratory staff to study reactions in a 'real' geothermal system in Costa Rica (1985–87), and those associated with submarine 'black smokers' as part of the British mid-ocean ridge (BRIDGE) initiative (1994–95).

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The demise of the UK HDR programme in 1989 led to another shift in emphasis to research associated with the use of cement-based materials as engineered barriers for the disposal of radioactive wastes. Since 1989, the laboratory has been a major source of information on the way in which alkaline cement porewaters react with rocks.

International concern about the effect of carbon dioxide (CO₂) on global temperatures provided another avenue of study. In 1992 the BGS led an international team investigating the potential for the deep underground storage of CO₂ as a way to prevent its release to the atmosphere. Within this programme the laboratory studied the reactions between CO₂, groundwaters and various rock types, and similar work continues.

Academic links

Most of the work described above has been supported by government agencies and industrial organisations. However, the laboratory has also been host to several university researchers. A diverse range of projects has covered areas such as: porosity generation within oil reservoirs, reactions within geothermal systems, heavy metal release from incinerator ash, degradation of medieval stained glass, and numerous studies on mineral reaction rates.

Capabilities

During its lifetime the laboratory has developed numerous pieces of equipment. Batch and flow-through equipment is available, with volumes of less than one millilitre to over ten litres. Many pieces of equipment can withstand high temperatures and pressures, with current limits being about 400° C and 250 MPa respectively.

Future directions

The diverse range of past programmes is likely to be repeated in the future, and it will be important that the laboratory remains adaptable to the changing needs of geoscience. However, problems associated with the disposal of waste and those associated with the extractive industries are likely to remain important. The laboratory is well placed to continue to input valuable data to these, and other areas, well into the next millennium.



Part of the Hydrothermal Laboratory with large flow-through autoclave in the foreground, and pressure indicators and blast-resistant cubicles in the background.