



Hydrogeochemical response to seismic activity in the Tjörnes Fracture Zone, North of Iceland

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Geochemical monitoring of groundwater, sampled from a 1.5 km deep geothermal borehole (HU-01) in northern Iceland has been conducted since July 2002 with the aim of identifying chemical and/or isotopical changes related to seismic activity. On September 16 2002, an M_w 5.8 earthquake occurred ~ 90 km from HU-01. The earthquake was preceded by short-lived, but statistically-significant increases in the concentration of Cu, Zn, Mn, Fe and Cr in the groundwater samples. There is some indication that these changes were accompanied by a linear increase of the Na/Ca ratio (Claesson, et al., 2004). The Cu, Zn, Mn, Fe and Cr anomalies arrived to the monitoring site (HU-01) 1, 2, 5 and ≥ 10 weeks before the earthquake. Claesson et al. (2004) proposed that these changes were due to influx of groundwater which had interacted with the host rock at higher temperatures. Fluid flow could have been enabled by a stress-induced modification of the rock permeability. Shortly after the earthquake, rapid increases (12-19%) in a group of dissolved elements were detected. These changes were accompanied by negative shifts of $\delta^{18}\text{O}$ and δD . Isotopic values for both groundwater reservoirs suggest an ice age origin (Claesson, et al., 2004). Geochemical analyses have been conducted using an ICP-AES (Varian Vista Pro Ax) (cations), an ion chromatographic system (Dionex DX-300) (anions) and a Finnigan Delta Plus mass spectrometer (stable isotopes). While successful, this approach is time-consuming, expensive and, because samples must be shipped to and analysed at a laboratory, cannot be undertaken “real time”. Here, we discuss implementation of two novel approaches, both of which are in the developmental phase and both of which could permit continuous (1 sample every 15 minutes) off-laboratory monitoring of hydrogeochemical changes, such as those seen at HU-01. Both methods can detect low concentrations ($\mu\text{g/l}$) of metals, such as Cu, Zn, Mn, Fe and Cr. The first uses voltammetry and is de-

scribed by Mikkelsen et al. (2004). The latter uses an atmospheric microwave plasma and is tailored for detection of metal contaminants in gases (Woskov et al., 1999), but modification for application to liquids is under investigation.

References

Claesson *et al.* (2004), *Geol.* 32, 641-644.

Mikkelsen *et al.* (2004). 10thESEAC, Galway, Ireland.

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