Oceanic basalts provide a biased view of mantle composition

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Chemical and isotopic variations in oceanic basalts are commonly used to infer the chemical structure and evolution of the Earth's mantle. The mantle source of intraplate oceanic basalts is thought to be more 'enriched' than that which melts beneath spreading ridges, due to a greater contribution from recycled oceanic crust or sediment, which can be identified using incompatible trace element and isotope ratios. This approach assumes that mantle melts inherit the incompatible trace element and isotope ratios of their mantle source, an assumption which is also inherent in many geochemical models for melting at spreading ridges and ocean islands.

We will present geochemical data for lavas erupted during slowdown and after the end of active spreading on the fossil Galapagos Rise spreading centre, which show that many oceanic basalts probably do not faithfully record the average composition of the volume of mantle that is melted. Galapagos Rise lavas were generated by variable degrees of melting from 'normal' depleted upper mantle, yet display an enormous range of compositions. At 9.2 Ma, before spreading ceased, incompatible element depleted NMORB (0.75 ppm Nb, Nb/Zr 0.011, $^{87}Sr/^{86}Sr$ 0.70251) were erupted. Younger post spreading lavas, dated at between 7.5 and 5.7 Ma, were produced by smaller degrees of melting and are increasingly enriched. The youngest basalts are trace element enriched EMORB with 77.9 ppm Nb, Nb/Zr 0.256, $^{87}Sr/^{86}Sr$ 0.70311.

The correlated trace element and isotope variations in Galapagos Rise lavas are inconsistent with simple mixing of endmember melt compositions, and also cannot be explained by melting of variably heterogeneous mantle in which enriched and depleted materials contribute equally to melting. Instead, our data can be explained by variable degrees of melting of heterogeneous mantle, within which incompatible element enriched lithologies melt to a greater extent than the more depleted 'matrix'. Our results have implications for the way in which oceanic basalts can be used to infer mantle melting processes and source compositions. For example, the 'garnet signatures' inferred from rare earth element and Nd isotope compositions in MORB may be more sensitive to variations in mantle composition, than to the average depth of melting. Melts of heterogeneous mantle will be biased towards the compositions of more fertile, enriched lithologies, so that the mantle may be significantly more depleted than is often assumed.

Monitoring fluid properties in a geothermal plant

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Measuring chemical properties of geothermal fluids, processed in a geothermal plant is challenging due to high temperatures, salinities and change of conditions resulting in chemical reactions such as corrosion or scaling (=mineral precipitation). At the geothermal *in situ* research laboratory Groß Schönebeck (Germany) chemical reactions of a fluid produced from a Permian sandstone at ~ 4300 m depth, are investigated by a newly developed, fluid-chemical monitoring unit. The apparatus can be connected to different locations at the above ground installations. At these adapters, part of the fluid from the main pipe, would flow through a bypass containing a small heat exchanger. On both sites of the heat exchanger a sampling unit as well as probes to measure pH value and redox potential are installed which can be operated at 150 and 70°C, respectively. Besides high temperatures, the sensors need to be corrosion resistent due to the high chloride concentration typically found in geothermal brines (up to 5 M).

The device simulates processes occuring at heat exchangers which are typically installed in geothermal plants to transfer the heat of the fluid for electric energy production. The chemical informations obtained from this monitoring unit describe not only the compositional variability of the produced fluid over time, but also chemical processes and their kinetics potentially occurring within the plant due to temperature decrease, which could result in corrosion or clogging of the pipes and components. In Groß Schönebeck, chemical equilibrium caculations indicated oversaturation of sulfate-, silicate-, iron- and lead minerals due to temperature drop. The monitoring validates modeled reactions and thus gives evidence on these reactions and might finally predict plant failures.