Fluid evolution of Krafla Geothermal Field, Iceland, as traced by noble gas and stable isotopes

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This project aims to provide new insights into the fluid origin and circulation, as well as to assess how main physical processes, such as boiling, steam separation and re-injection, affect the gas geochemistry in Krafla geothermal field, Iceland. Noble gas and stable isotope data were obtained for ten geothermal boreholes and two gas discharging pools in the Krafla geothermal field.

According to tectonic settings in Iceland, CO_2 in the gas phase derived from geothermal water is considered to be magmatic in origin, with $\delta^{13}C(CO_2)$ ranging between -3.86 and -7.99‰. Gas samples collected from boreholes have relatively constant mantle-dominated $^3He/^4He$ ratios, giving an average value of 9.47 Ra. Two higher ratios (11.1Ra, 13.8Ra) are found in mudpot bubbling gas samples. The high $^3He/^4He$ ratios suggest that the geothermal water reservoir receives deep-seated volatiles and heat from an active magmatic system at depth. Ne, Ar, Kr and Xe isotopic ratios are mainly Air-like. Solubility driven elemental fractionations (Ne/Ar, Kr/Ar, Xe/Ar) reveal that the processes of boiling and steam separation have occurred during the circulation of geothermal fluids in the shallow crust in the Krafla field. However, some samples show elemental ratios which cannot be explained by modelled boiling curves for residual liquid after steam separation. This can be explained by the addition of air, possibly introduced by re-injected geothermal fluids, which have a significant effect on the geochemical signatures of Krafla geothermal fluid.