$^{87}Sr/^{86}Sr$ systematics and Li of shallow groundwaters and springs at the western main fault of the northern Upper Rhine Graben

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Combined strontium isotope ratios, Sr and Li concentrations of the dissolved load of near surface groundwater and springs are important tracers of hydrological processes such as groundwater mixing in the vicinity of active faults. The $^{87}Sr/^{86}Sr$ ratios of shallow groundwater and springs at the western main fault of the northern upper Rhine Graben range from 0.708766 to 0.710614. $^{87}Sr/^{86}Sr$ ratios, Sr and Li contents generally decline in near surface groundwater with distance to the investigated western main border fault. Strontium isotope data suggest mixing of (1) deep-sourced ascending fluids with radiogenic Sr and Li and (2) brines derived from dissolution of Tertiary evaporates migrating at the western main border fault plus (3) dilution by recharge components of the alluvial aquifers and river bank filtration of the River Rhine having low $^{87}Sr/^{86}Sr$ ratios and contents in solutes. The contribution of deep-sourced fluids to the shallow aquifer is calculated to be around 1.5 wt% of a hydrothermal fluid end member with high Sr concentrations and radiogenic Sr of the actively discharging thermal springs along the Taunus border fault zone at Wiesbaden and Bad Nauheim [1]. Geothermometric calculations give a minimum aquifer temperature for the Li-Mg thermometers of around 38 °C. - Assuming a geothermal gradient of 3°C per 100 m corresponds to an minimum aquifer depth of 1.3 km. The aquifer temperature is strongly underestimated due to the occurrences of dilution and mixing processes.

Our results demonstrate that the western main fault of the upper Rhine Graben is hydraulically active and a preferential pathway to shallow aquifers for (1) ascending NaCl-dominated mineralized waters derived from Miocene saliferous sediments, (2) deep-sourced fluids from the upper crustal crystalline basement and/or basement debris represented by Permian clastic sediments of the Saar-Nahe basin (similar $^{87}Sr/^{86}Sr$ ratios), and (3) mantle-derived He [2].

[1] Loges et al. (2012) *Appl. Geochem.* **27**, 1153-1169. [2] Freundt et al. (2013) Goldschmidt2013, Conf. Abs., 1111.