Radiologic disequilibria in sandstone reservoir rocks at a geothermal facility in the North German Basin

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Radionuclides of the ^{238}U and ^{232}Th natural decay series are ubiquitary spread in rocks and sediments. On a geological time scale, the daughters should have grown in a closed system into radiological (secular) equilibrium with their parents and the activity ratios of the parents and all daughters have become unity. At the geothermal research facility in Groß Schönebeck (North German Basin) we determined the radionuclide concentrations in samples from reservoir rocks, scalings, filter residues and fluids using gamma-ray spectrometry. Main results concerning elevated radionuclide content of $^{226,\ 228}$Ra and ^{210}Pb in filter residues (some 10 Bq/g) and brines (some 10 Bq/l) are published elsewhere [1] [2].

The high radionuclide content in brine and in precipitated filter residues obviously stems from the host rock. The specific activity of less than 60 Bq/kg for radionuclides of the ^{238}U and ^{232}Th series in reservoir rock is in line with the mean concentration in the upper earth crust and far from being extraordinary. Calculating the ratios of ^{238}U, ^{226}Ra and ^{210}Pb, they differ in some samples significantly from unity, surprisingly. We find a deficiency of ^{226}Ra and ^{210}Pb compared to their parent ^{238}U. Due to radiophysical properties of the members of the ^{232}Th decay series similar considerations using data from gamma ray spectrometry are inappropriate. We determined the isotopes ^{232}Th and ^{228}Th via alpha spectrometry using a micro wave extraction with aqua regia as solvent. The ratio in some samples differ as well significantly from unity. This can be explained by a different geochemical behaviour of Th compared to ^{228}Ra, which is arranged between ^{232}Th and ^{228}Th in the decay series. However, the ratio is in some samples below and in others above unity A coherent explanation for these findings is still missing.

[1] Regenspurg *et al*. (2014) *Environmental Earth Science* **72**, 4131-4140. [2] Dilling *et al*. (2014) Proceedings II EU-NORM Symposium, Prague.