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$^{87}Sr/^{86}Sr$, ^{18}O, ^{2}H and ^{3}H as tracers for genesis and saturation history of infiltrating groundwater in evaporitic deposits of the German Zechstein Basin

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Salt mines in evaporitic deposits of the Permian Zechstein Basin might be subject to flooding if formation water seeps into the mine openings through for instance tectonically induced fractures. We apply several isotopic tracers to localize the sources of intrusions and to reconstruct the genesis and evolution of such brines.

The evolution from formation water to brine comprises several starting points for isotopic tracers. Once the water infiltrates the salt deposits, it starts to solute and concentrate various constituents and extractives of the drained deposits, and later on precipitations could occur. This non-linear solution and partly undersaturation poses a problem to the regular tracing methods. The element content might provide only limited indications on the source, which can be an aquifer outside or a large brine occurrence within the deposits. An aggravating factor is that such inclusions must not be of Permian age. The draining fractures can be closed in direction of the aquifer while enclosing liquids in different sized caverns or jointed rocks. However, these confined volumes of fluids pose only a limited risk for flooding.

A combination of isotopic tracers, which provide indications on meteoric water, mixed water, connate water and a mixture of all, has to be contemplated:

The cosmogenic radionuclide Tritium ^{3}H (τ = 12.35 yrs.) indicates -if present- a direct connection to the earth's surface. The stable isotopes ^{18}O and ^{2}H can give clues to the type of water when related to older data (e.g. Schmiedel et al. 1982, Müller & Papendieck 1975). We have applied $^{87}Sr/^{86}Sr$ isotopes as an additional tool to further

define the source. Recent $^{87}Sr/^{86}Sr$ analyses of one brine inflow in a potash mine in the upper Permian Zechstein series suggest that the Sr isotope composition is rather affected by salt clay detritus than by halite or anhydrite. Other data show variations according to several isotopic seawater curves of Permian age.

A combination of different isotopic tools may help to further delimit the source regions of infiltrating formation water in salt mines.

References:

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