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Assessment of the hydrochemical integrity of deep geothermal aquifers - Lessons from bottled water producers

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Geothermal resources for heat and power generation are an integral part of the transition from fossil fuels to clean and sustainable energy and have been successfully developed in the North Alpine Foreland Basin since the 2000s. The timeframe since the first exploration activities is rather short and data on induced changes in the aquifer is scarce. It might be a good idea to take a look at the development classical groundwater resources for comparison, even more so, if the geothermal facility also includes a net withdrawal for eg. medical or wellness applications.

Most deep groundwater aquifers are of vital importance but strongly limited as resources for drinking water. Depletion of these aquifers is easy to assess and usually handled well in the legislative procedure. The development of the hydrochemical state and the possible occurrence of mobile persistent trace pollutants, on the other hand, is hard to predict. Here, the current assessment framework which is based on the protection of the aquifer by impermeable layers falls short: together with groundwater renewal the age structure of the aquifer has to change. Old groundwater is replaced by more recent groundwater. Substances with a similar transport behaviour as water itself will sooner or later show up in these deep groundwater resources. Examples from bottled water producers show that the development from a state without any traces of anthropogenic substances to a the first occurrence is sharp and irreversible.

Future development concepts for deep groundwater aquifers have to take the age structure of the aquifer into account when defining acceptable withdrawal rates, groundwater protection zones and technical operations which influence the integrity of the protecting layers.

We present a conceptual assessment and monitoring concept for deep groundwater aquifers which includes the risks posed by unconventional uses of the impermeable layers (foundations, corroded wells, geothermal, ...).