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Petrothermal heat extraction using a single deviated well (Horstberg, revisited)

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The single-well tracer test conducted (Behrens et al. 2006) in conjunction with waterfrac experiments at Horstberg is re-examined with a view at four basic issues: why single-well? why fracturing? why tracers? does this only work at Horstberg, or can it work almost anywhere else in the Northern-German sedimentary basin?

Heat and tracer transport within a composite reservoir (impermeable matrix + waterfrac + permeable layer), as accessed by a single deviated well, turn out to fit into a surprisingly simple description, as the plain (arithmetic) sum of certain petrothermal-type and aquifer-type contributions, whose weighting relative to each other can vary from site to site, depending upon stratigraphy and upon wellbore geometry. At Horstberg, within the particular formations tested ('Volpriehausen', 'Detfurth', 'Solling', comprising mainly claystone and sandstone layers), thermal lifetime results to be petrothermally-dominated, while tracer residence times prove to be 'aquifer'-dominated. Despite this disparity, the reservoir's thermal lifetime can reliably be predicted from tracer test results. What cannot be determined from waterfrac flow-path tracing is the very waterfrac's aperture. Aperture uncertainty, however, does not impede upon thermal lifetime predictability.

The results of the semi-analytical approach are confirmed by numerical simulations using a FE model that includes more details of hydrogeological heterogeneity for the Horstberg site. They are complemented by a parameter sensitivity analysis.

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