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Insights into Upscaling of Modeling of Thermal Dispersion in Geothermal Doublets

Wednesday, 1 June 2022 09:20 (1h 10m)

Representing the fine-scale heterogeneities of geological formations is computationally expensive in the modeling of geothermal processes. Upscaling is necessary for efficient modeling, using coarser grids and average rock and fluid properties. In modelling geothermal doublets, the breakthrough time of injected cold water at the production well is critical to project viability. Breakthrough time in turn depends on thermal dispersion in the reservoir, which arises largely from reservoir heterogeneity.
Tang and Rossen (2021) present an improved upscaling method for thermal dispersivity in modeling heterogeneous reservoirs and demonstrate its accuracy in representing thermal dispersion when layers are combined in reservoir modeling. Here we illustrate this approach through application to a geothermal doublet using the reservoir well log and a 2D layer-cake model. We show the relative roles of numerical dispersion, effects of thermal conduction between upscaled layers and effects of overburden and underburden in determining the breakthrough time. We report the grid resolution needed to keep numerical dispersion from dominating physical dispersion, based on the study of Lantz (1971) for 1D flow. The results show that it may be necessary to upscale thermal diffusivity in the transverse direction as well. The importance of overburden and underburden layers is crucial in relatively thin reservoirs where heat conduction from the overburden and underburden is dominant. It is possible that accurate thermo-physical properties are not crucial when reservoir is relatively thin. In that case, heat conduction from the overburden and underburden dominates thermal dispersion in the reservoir and thus cold-water breakthrough time.

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References

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Lantz, R. B. (1971). Quantitative evaluation of numerical diffusion (truncation error). Society of Petroleum Engineers Journal, 11(03), 315-320.
Tang, J., & Rossen, W. R. (2021). Application of thermal Taylor dispersion to upscaling of geothermal processes in heterogeneous formations. In EGU General Assembly Conference Abstracts (pp. EGU21-10564).

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

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