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Hydrodynamic and heat transport 3D modelling of the Pannonian Basin, HU-SRB-RO - pilot area of the DARLINGe project

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The main aim of the DARLINGe project is to establish a strategy and make tangible recommendations for enhanced and efficient utilisation of geothermal energy at the southern part of the Danube Region. Various elements of a tool-box aiming sustainable management of transboundary geothermal energy resources (risk mitigation; benchmarking and a decision-tree) are tested by modelling in real environment in three cross-border pilot areas. One of the pilot areas is situated in the territory of South-east-Hungary – Western-Romania – North-Serbia (HU-SRB-RO) focusing on clastic (intergranular) geothermal aquifers of the sedimentary basin fill widely used by all 3 countries in the region, cca. 20 000 km2. The city of Szeged has been facing a huge boom on geothermal usage, which means more than 10 production-reinjection doublets will be/ is being installed nowadays into the deep porous geothermal reservoir. The aim of the ongoing work is to model the hydrodynamic and thermal regime of this part of the Pannonian Basin and geothermal/exploitation scenarios in the deep aquifer of the Neogene sediments - lower parts of the intergranular Upper Pannonian sequences. Based on harmonised geological data a conceptual structural model has already been set up. The refined structural model of Szeged visualises the 3D configuration of the subsurface including an improved representation of the basement's depth and the thickness of the thermal aquifer in the basin fill. Although the magnitude of the geothermal parameters is known from open-source databases, scientific publications, model scenes – based on the jointly collected data from the three countries – produced different thermal conductivity and heat flow values. Further modelling is being carried out to refine these values, whereas these scenarios provide information for various risk mitigation procedures and for the prediction of future adverse processes e.g. overproduction, thermal breakthrough, or cooling effects of competing usages.

The hydrodynamic and heat transport model-series have been carried out by finite-element FEFLOW software, using different scientific approach of density-coupling (low/high degree of coupling, viscosity effect etc.) The modelling process and its logistic with the proposed methodology based on harmonised data can raise the attention on present and/or future conflicts and can reveal significant data shortages, as well as highlighting areas comprising untapped geothermal potential. This type of modelling approach of the diverse subsurface usages (e.g. geothermal, CH, CCS storage etc.) can establish the scientific basis for an integrated subsurface management.

These achievements - although based on the outcomes of the pilot area studies - will have a high potential of replicability to other areas within (and outside) the Danube Region, as they represent very common geological and geothermal settings with standard thermal water utilisation schemes.

Primary author(s) : KUN, Éva; Dr ZILAHI-SEBESS, László (Mining and Geological Survey of Hungary); Dr SZANYI, János (InnoGeo Ltd); CSANÁDI, Attila (InnoGeo Ltd); ÉZSIÁS, Tamás (InnoGeo Ltd); Dr GÁL, Nóra (Mining and Geological Survey of Hungary); FĂRNOAGĂ, Radu (Geological Institute of Romania); OLÁH, István (TERRATECHNIK SRL); VRANJES, Ana (University of Belgrade, Faculty of Mining and Geology); VUKICEVIC, Milan (University of Belgrade, Faculty of Mining and Geology)

Presenter(s) : KUN, Éva

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