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Microstructure and fluid state in an Icelandic geothermal reservoir from inversion of tomography data

Mathilde Adelinet (1), Mickaele Le Ravalec (1), Catherine Dorbath (2), Jérôme Fortin (3), and Yves Guéguen (3)

(1) IFP Energies nouvelles, Geophysics, RUEIL-MALMAISON, France (mathilde.adelinet@ifpenergiesnouvelles.fr), (2) EOST-IRD, UMR 7516, Strasbourg, France, (3) Laboratoire de géologie, UMR 8538, ENS, Paris, France

The inversion 3 of seismic data to infer rock microstructural properties and fluid flow patterns in the crust is a challenging issue. In this paper, we develop an effective medium model for estimating velocities in porous media including both pores and cracks and use it to derive the distribution of crack density beneath the Reykjanes Peninsula from accurate tomography data. Outside the active hydrothermal areas, crack density is shown to decrease with depth. There are two main reasons for this: the closure of cracks be cause of the increasing overburden and the secondary filling of cracks because of hydrothermal flows. However, crack density may locally increase with depth beneath the southwestern part of the Kleifarvatn lake. This is consistent with the presence of a deep reservoir with supercritical fluids under pressure, which may activate hydrofracturing processes. We recognize that capturing the link between seismic data and the physical properties of crust is very difficult. This study shows that a combination of mechanical concepts and effective medium theory contributes to improve our understanding of the phenomena occurring within the Icelandic crust.