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Predictive Mechanical model for fracture stimulation in an enhanced geothermal system (EGS) context

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ABSTRACT

Controlling fracture stimulation is fundamental for enhancement of geothermal production.

The development of an EGS is one of the goals of the GEMex project, an international collaboration of two consortia, one from Europe and one from Mexico. The research is based on exploration, characterization and assessment of two geothermal systems located in the Trans-Mexican volcanic belt, Los Humeros and Acoculco. Los Humeros has been a producing field for several years, but Acoculco is yet to be developed. Thanks to surface manifestations of hydrothermal activities (Canet, et al., 2015), the existence of a geothermal system is evident. However, two wells reached very high temperatures, but did not find any fluids. For that reason, the Acoculco Caldera is foreseen as EGS development site, hoping to connect existing wells to a productive zone (Pulido, et al., 2010).

In this study, we develop a workflow from fracture characterization at the outcrop all the way to a predictive mechanical model for fracture stimulation from the well borehole. For practical reasons, the Acoculco site has been used as a case study to illustrate the method. This approach includes the fracture identification and description using the scanline survey method (ISRM, 1979) and a method for processing the collected data to generate a geological discrete fracture network (DFN). With the DFN generated this way we used the finite element method to build a mechanical model, discretized and populated with properties determined _experimentally in the rock physics laboratory. Finally, we calculated the fracture propagation using the non-local damage approach, combined with a cohesive-zone model.

This workflow is based on easily accessible data from the field, and gives an accurate mechanical model of the fracture propagation and the pressure distribution for well borehole stimulation. Thanks to its simplicity, this approach can be applied in most EGS case studies, as for example, in the ultra-deep geothermal systems planned to be accessed in the Netherlands.

REFERENCES

ISRM, 1979. Suggested methods for the quantitative description of discontinuities in rock masses. International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts, volume 16, p 22. DOI 10.1016/0148-9062(79)91476-1

Canet C., Hernández-Cruz B., Jiménez-Franco A., Pi T., Peláez B., Villanueva-Estrada R. E., Alfonso P., González-Partida E., Salinas S., 2015. Combining ammonium mapping and short-wave infrared (SWIR) reflectance spectroscopy to constrain a model of hydrothermal alteration for the Acoculco geothermal zone, Eastern Mexico. Geothermics, volume 53, p 154-165. DOI10.1016/j.geothermics.2014.05.012

Pulido L. C., Armenta F. M., Silva R. G., 2010. Characterization of the Acoculco Geothermal Zone as a HDR System. Geothermal Resources Council Transactions, volume 34. Geothermal Resources Council, p 369-372.