Reducing the efforts to access deep geo-resources by thermally assisting the drilling process

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In order to meet the increasing worldwide energy demand in the next decades, access to deep geothermal, oil or gas reservoirs will be key in the future global energy supply. Construction of deep wells, especially for deep geothermal energy, require major costs, mainly related to the involved drilling operations. Indeed, drilling costs are found to increase exponentially with depth and, furthermore, they occur in an early, considerably high-risk phase of the project. Drilling of deep wells into hard rocks represents a major challenge for conventional rotary drilling systems, featuring high rates of drill bit wear with consequent bit replacement and high non-productive time (NPT), low rates of penetration (ROP) and poor process efficiency. Thus, advances are needed to decrease the overall costs of drilling and therefore improving the project economics, by enhancing the overall drilling performance, specifically in hard granite rocks, commonly found formations in deep geothermal projects.

We propose to combine a thermal assistance, e.g., by flame jets, to conventional rotary drilling methods. We term this method combined thermo-mechanical drilling (CTMD). In this manner, the hard rock material is weakened thermally, prior to the mechanical removal by conventional cutters. This concept is expected to increase the removal performance and thereby intensify the drilling process in hard rock materials, enhance the overall bit lifetime, thus reducing the cost of drilling. In this work, we show laboratory evidence that the CTMD can effectively enhance the drilling process in hard granite rock. Further, the CTMD technology is field-tested under relevant process conditions. We provide conclusions on its advantages, technical feasibility and integration potential of this technology into conventional drilling systems. Finally, we also compare the removal characteristics of this approach against conventional mechanical drilling methods to discuss on the performance improvements to drill deep wells in hard rocks.

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