Multi-Scale Numerical-Experimental Approach for Cost Effective Deep Hard Rock Drilling

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ABSTRACT

A radical increase in the ROP in hard rock drilling for the oil & gas sector and renewable geothermal energy sector requires development of specialized drilling and control systems. Among the drilling related issues, the rock breaking is probably the most important part of the drilling process chain when drilling in hard rock. Low penetration rates, rapid wear of equipment and drill bit wear/failure are challenges frequently associated with hard rock drilling. The research activities presented here are defined as part of the research-based innovation project INNO-Drill aiming to reduce the hard rock drilling cost by improved rate of penetration, reduced tool wear, and through innovative drilling solutions. The main objective is to create numerical/experimental technology platform to evaluate and optimize the performance of hard rock drilling system. The methodology is based on an approach involving numerical models and experimental tests at different scales going from material microstructure to field tests. In this approach experimental tests were developed and designed to characterize the material wear resistance for different drilling technologies (rotary drilling and percussive impact drilling). The evaluation of wear resistance was supplemented by the characterization of the microstructure of the drilling tool materials. The relationship between wear resistance and material microstructure is studied to guide the improvement of material processing and to better predict material degradation during the drilling process in presence of hard rock.