Novel Drilling Technology Combining Hydro-jet and Percussion for ROP Improvement in Deep Geothermal Drilling

ORCHYD

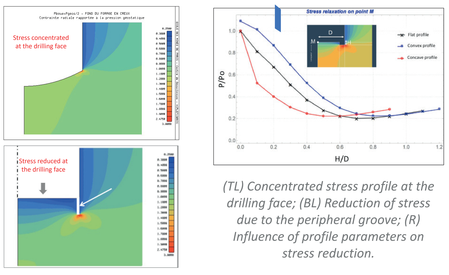
ARMINES · MINES ParisTech · PSL · Imperial College London · SINTEF · UNIVERSITY OF PIRAEUS RESEARCH CENTER · DRILLSTAR INDUSTRIES · CHINA UNIVERSITY OF PETROLEUM 1953

Challenge: Low drilling speed of conventional rotary systems in deep hard rocks (> 4 km) encountered in deep geothermal projects lead to huge drilling costs

Objective: To increase the hard rock drilling rates from the current range of 1-2m/h to up to 4-10 m/h

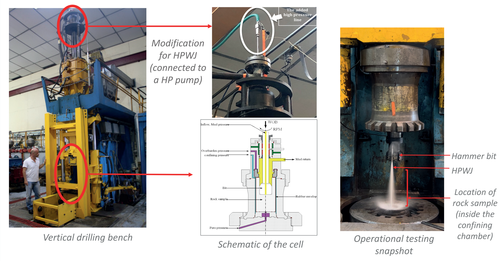
Self-Relief Drilling (SRD)

Reduce the stress-field of the rock surface around the drillbit. A peripheral groove contributes to increased drilling rate due to reduced rock stress and wave reflections on the free surface.



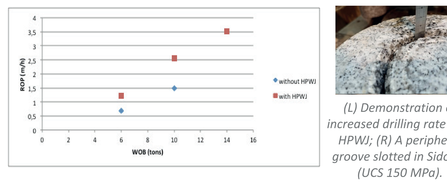
(TL) Concentrated stress profile at the drilling face; (BL) Reduction of stress due to the peripheral groove; (R) Influence of profile parameters on stress reduction.

Experimental demonstration



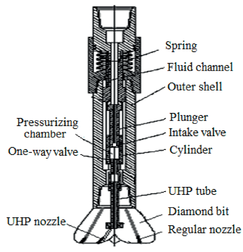
Vertical drilling bench · *Schematic of the cell* · *Operational testing snapshot*

The laboratory facilities of ARMINES at Pau, France are utilized to study the influence of different drilling parameters like weight on bit, bottom hole pressure, fluid jet pressure, etc. on the drilling rate. The design modication of the drilling bench presented here was used to create the grooves on Sidobre and demonstrate an increase of 80% in ROP while using the high pressure water jet.

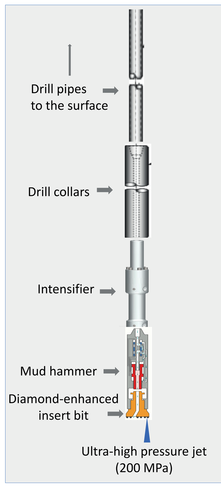


(L) Demonstration of increased drilling rate with HPWJ; (R) A peripheral groove slotted in Sidobre (UCS 150 MPa).

Innovative combined drilling tool



Intensifier that generates high pressure water jet in the downhole conditions.

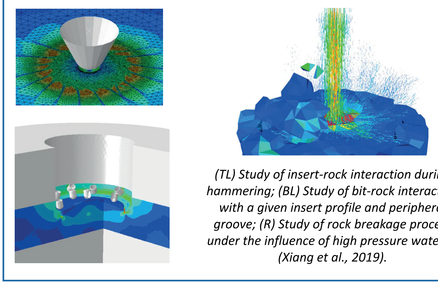


Combined with a fully fluid-driven **mud hammer.** It brings high-power and high-frequency percussion to the specifically designed hammer bit.

A fully fluid-driven **prototype** to be tested.

Numerical simulations

A range of numerical capabilities is achieved during this project. At the given stage, there are two streams of numerical efforts persued: to study the jetting action on the rock breakge process and to study the hammering effect at the scale of insert-rock and bit-rock ineractions.



(TL) Study of insert-rock interaction during hammering; (BL) Study of bit-rock interaction with a given insert profile and peripheral groove; (R) Study of rock breakage process under the influence of high pressure waterjet (Xiang et al., 2019).

Environmental and social sustainability

Environmental and social impact assessment
Energy security & geopolitical perspective

Risk analysis · Life cycle analysis · Carbon footprint · Ecological footprint

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