

A comprehensive study on drilling performance of first prototype from ORCHYD: Design, fabrication and experimental tests

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**Imperial College
London**



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006752

ORCHYD

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

ORCHYD



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ORCHYD

Problem statement

Challenge

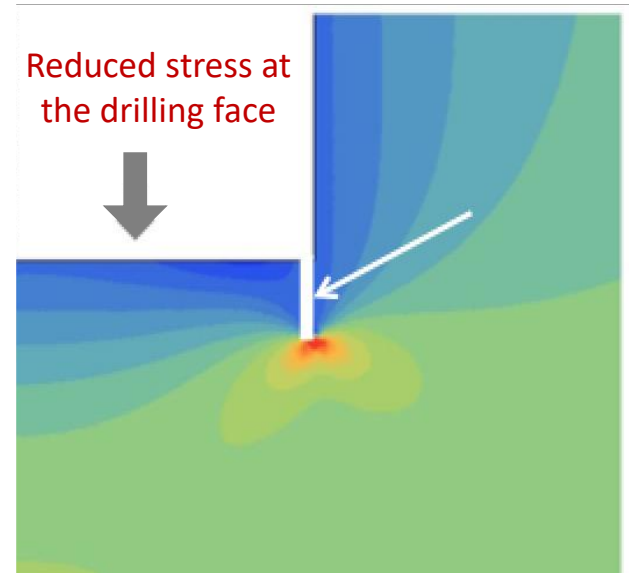
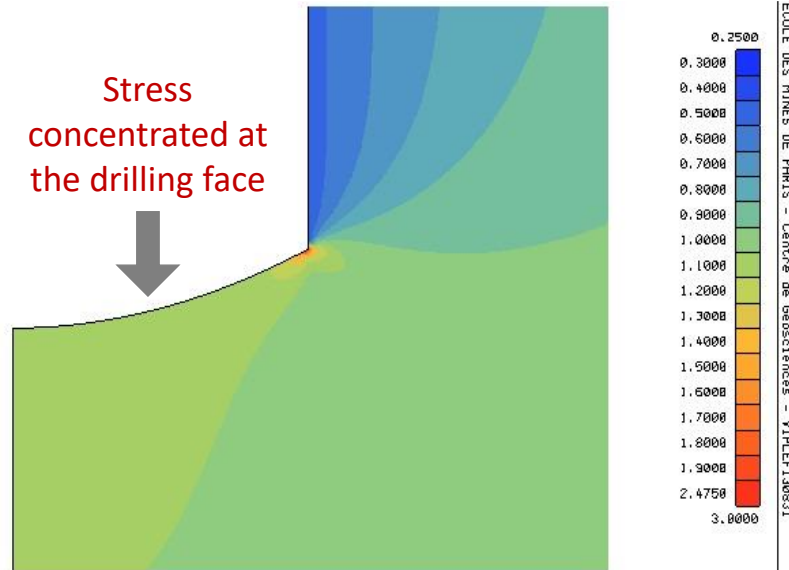
Low drilling speed of conventional rotary systems in deep hard rocks (> 4 km) encountered in deep geothermal projects lead to huge drilling costs

Objective

To increase the hard rock drilling rates by **4X** as compared to conventional rotatory techniques



ORCHYD approach: Self Relief Drilling



Stress release

+

Wave reflection on free surface

ORCHYD: Goal

Percussion drilling

+

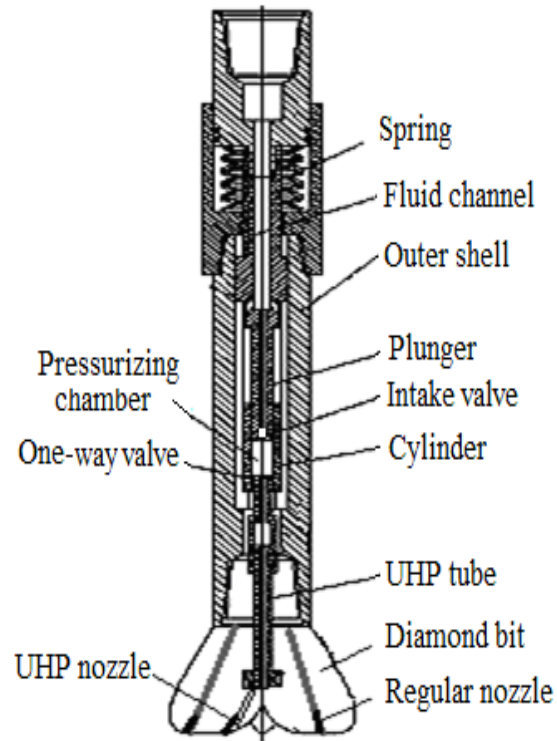
High pressure water jetting (~200 MPa)

=

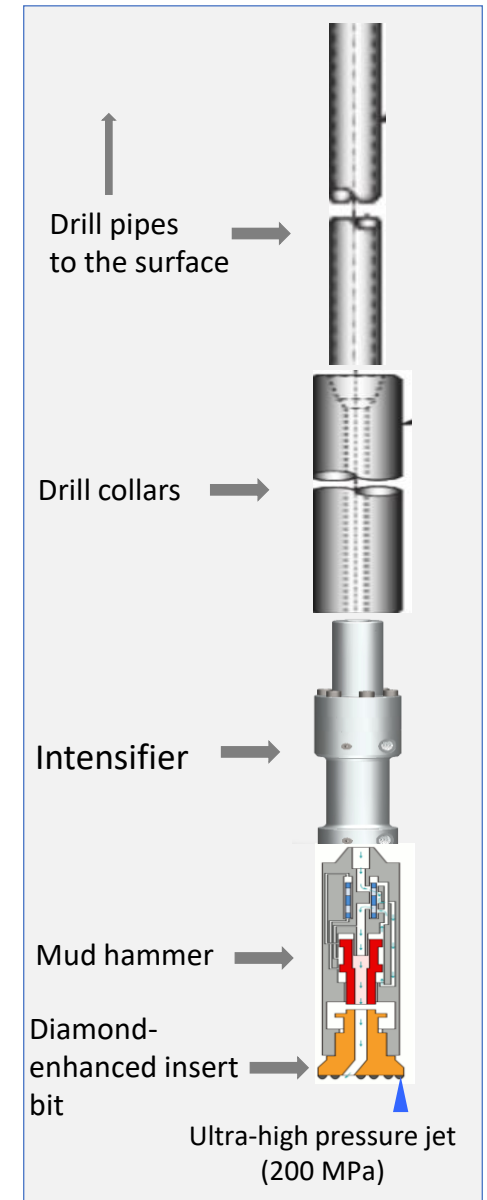
Fully fluid-driven ORCHYD system



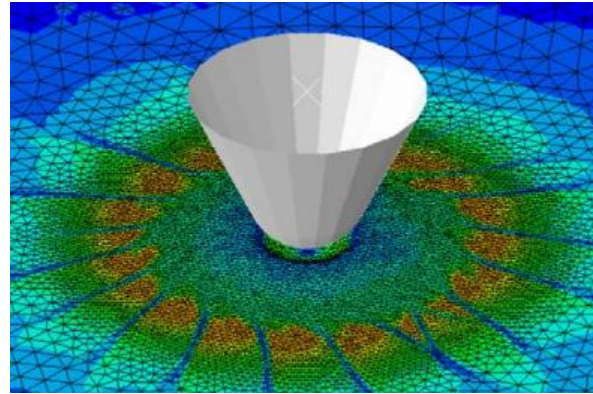
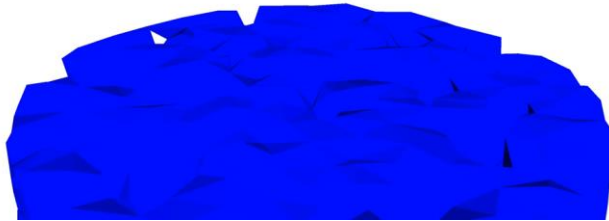
MUDHammer



Intensifier



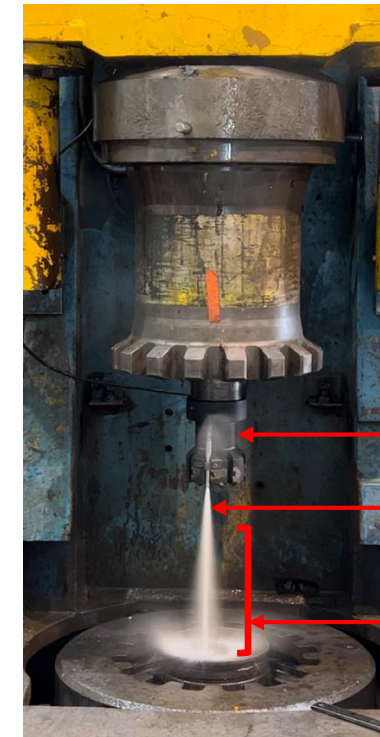
ORCHYD: Methodology



Jetting

+

Percussion



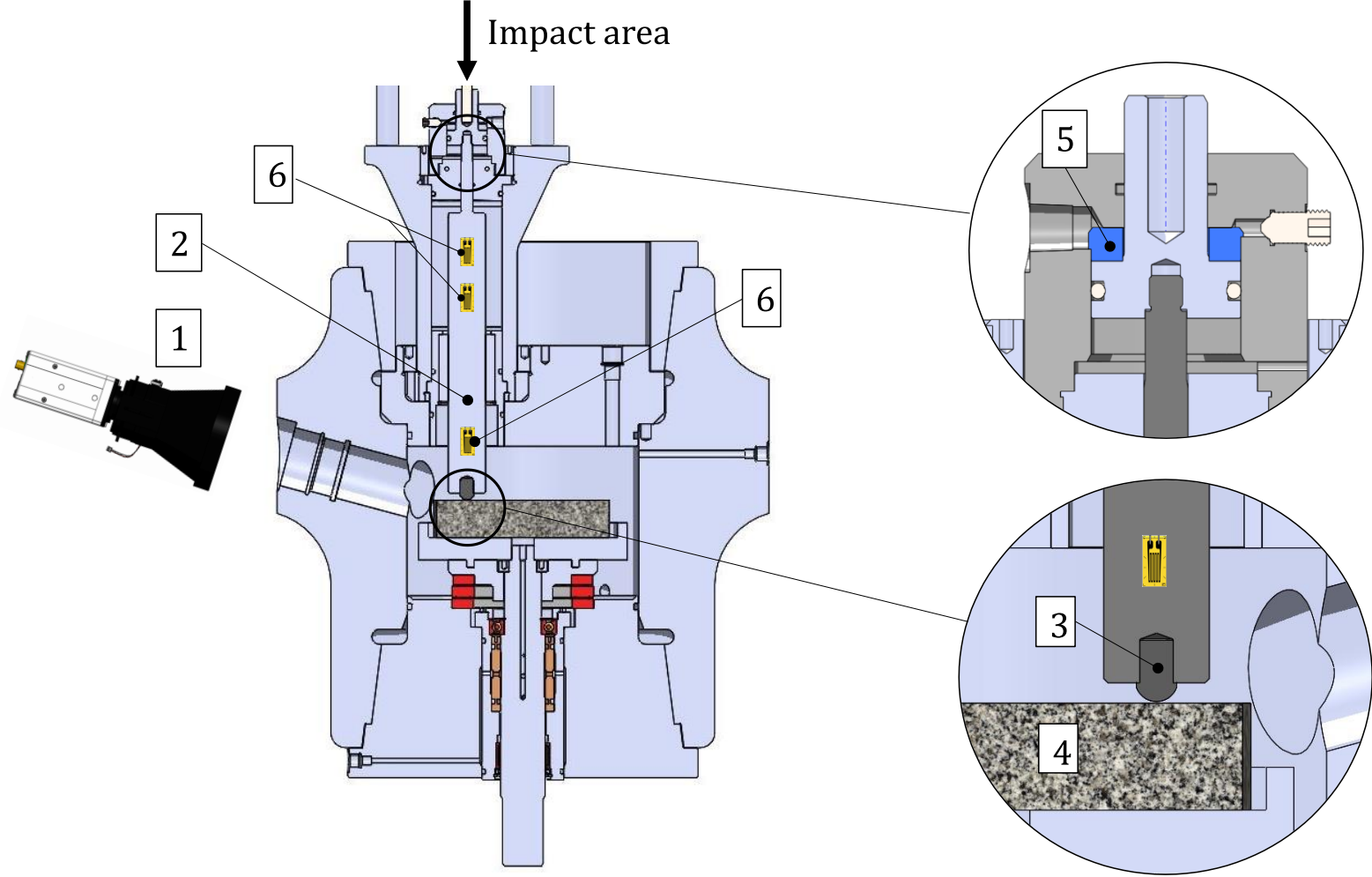
Hammer bit

HPWJ

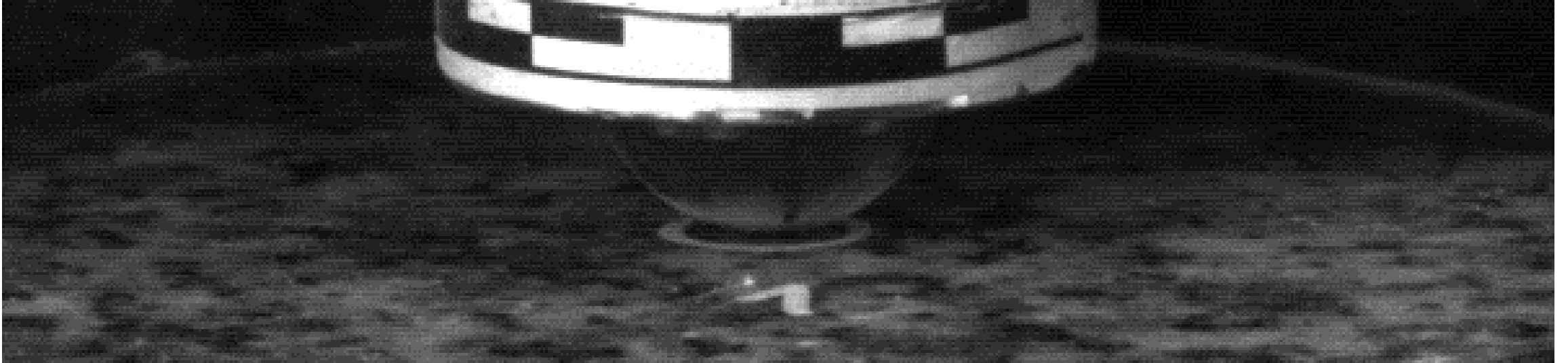
Location of rock sample (inside the confining chamber)

Operational testing snapshot

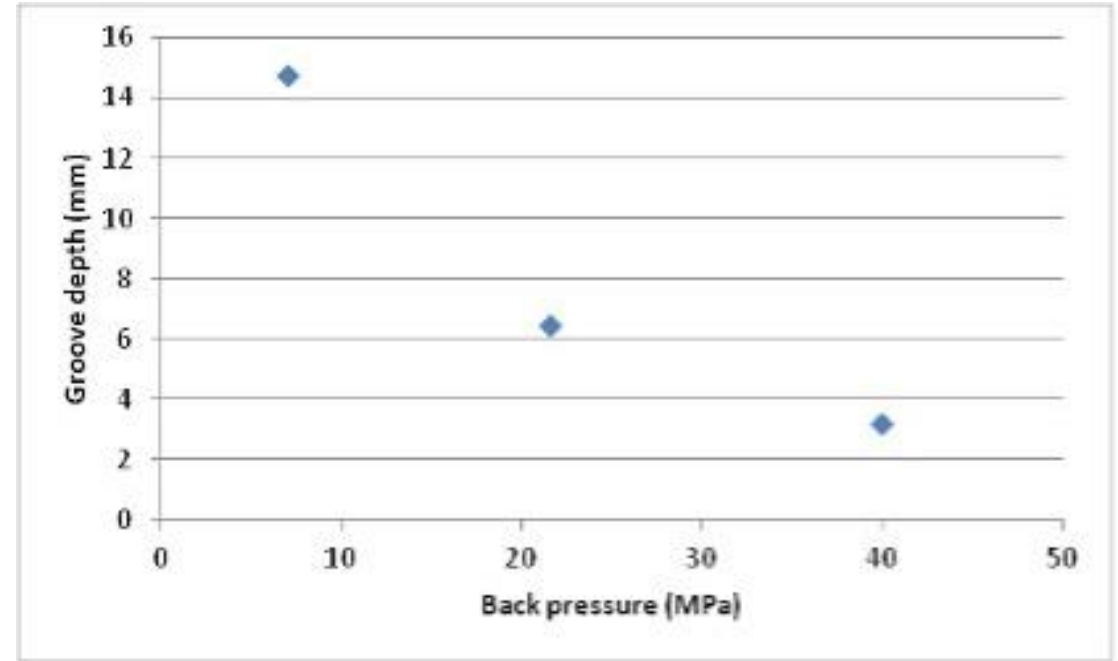
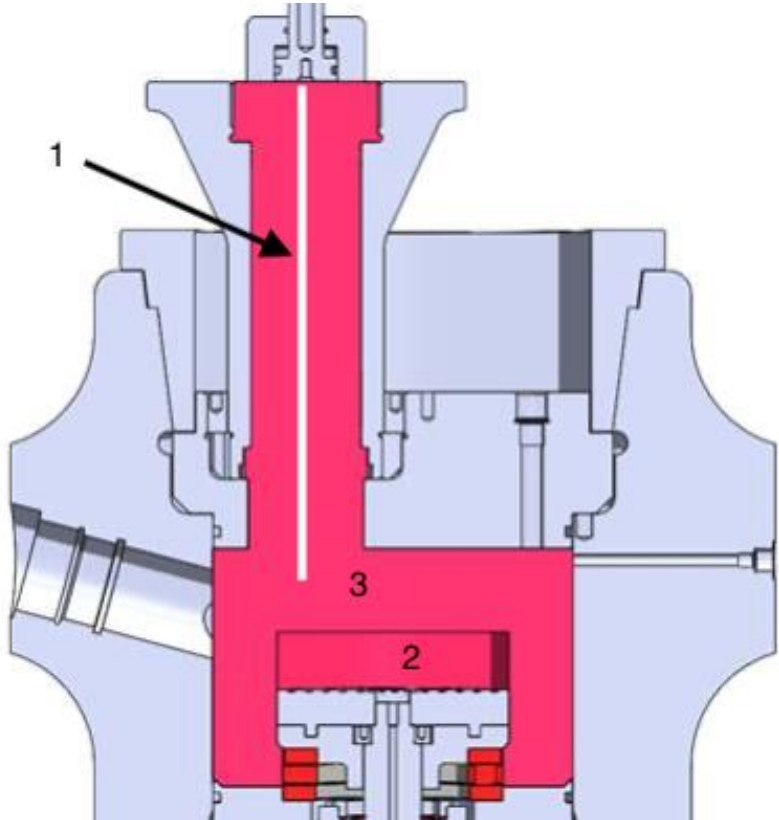
Insert rock interactions: experimental setup



Single insert rock interactions: experiments

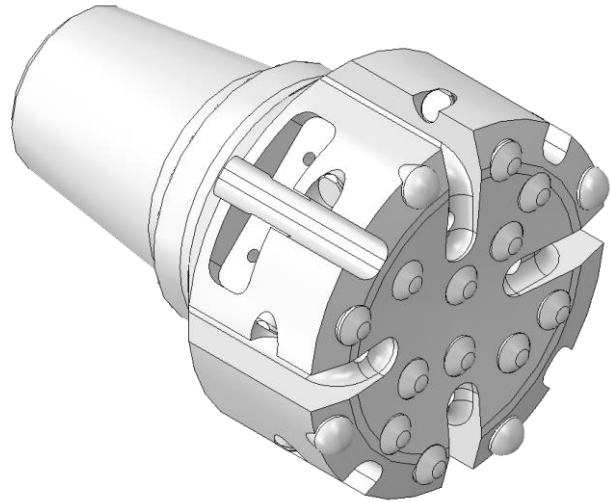


High Pressure Water Jetting (HPWJ): Experimental setup



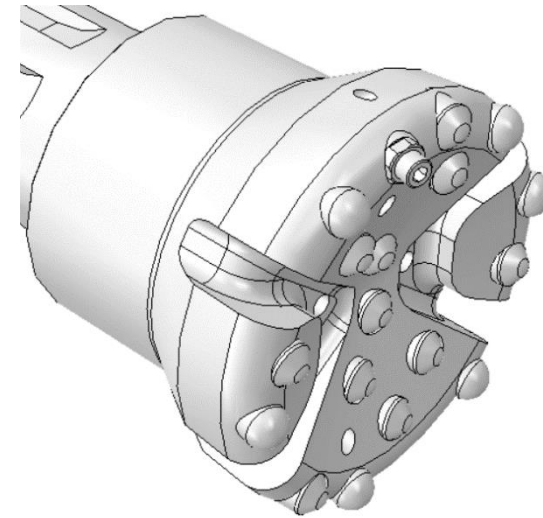
More info: Velmurugan, N., Gerbaud, L., Chambres, C., Naderi, S., Xiang, J., & Latham, J. P. (2023, June). Influencing Factors in Rock Cutting Using High Pressure Water Jets Under Submerged Downhole Conditions. In *ARMA US Rock Mechanics/Geomechanics Symposium* (pp. ARMA-2023). ARMA.

Improvement in bit design



Initial design

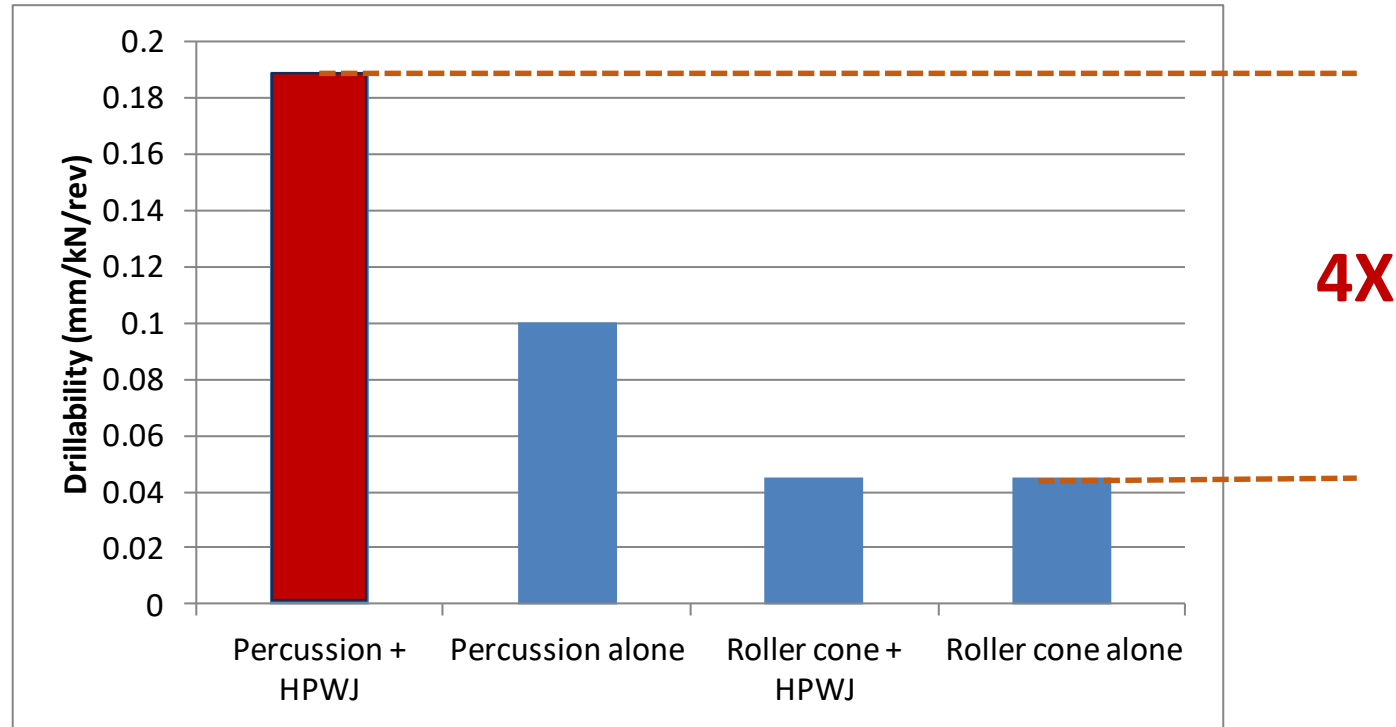
Early 2022



Optimised prototype

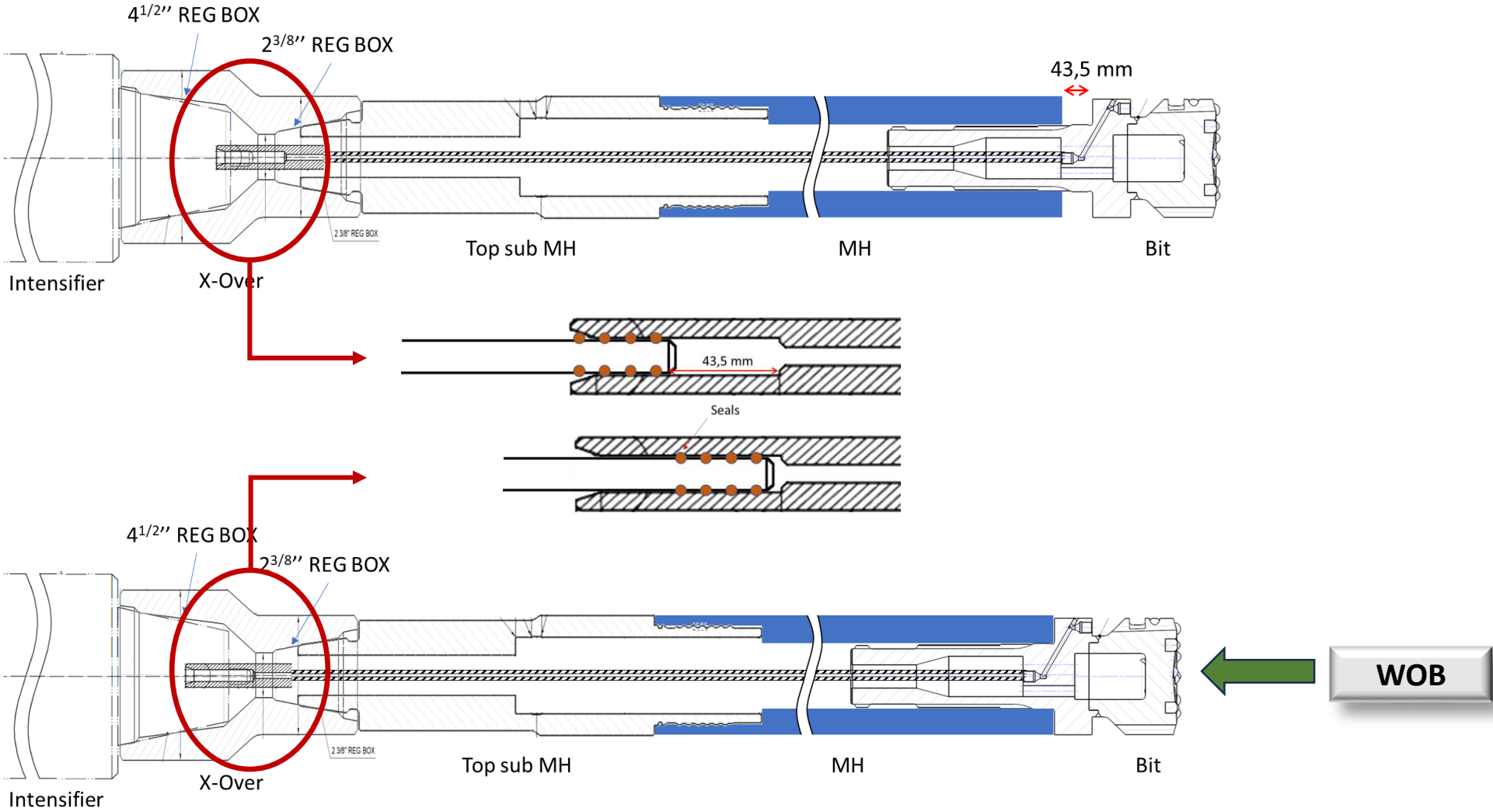
Current

Performance of ORCHYD concept

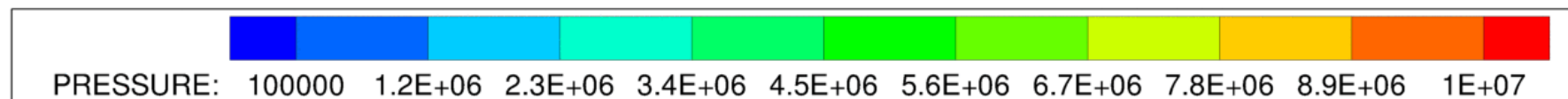
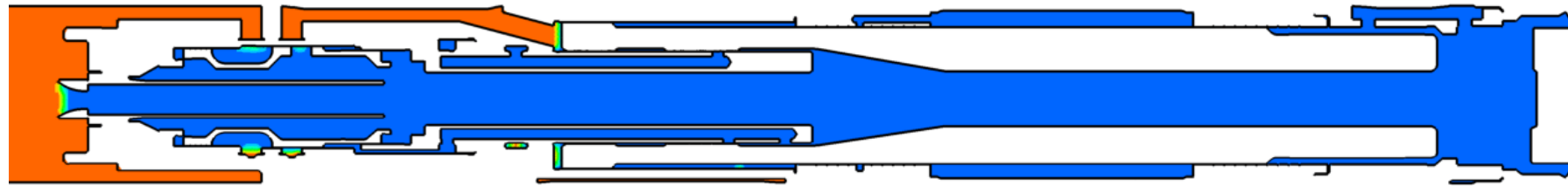


More info: Gerbaud, L., Jahangir, E., Velmurugan, N., Sellami, H., & Cazenave, F. (2023, June). Enhancing drilling performance of mud hammers by combining high pressure water jets slotting. In *ARMA US Rock Mechanics/Geomechanics Symposium* (pp. ARMA-2023). ARMA.

Mud hammer: Flushing & Hammering



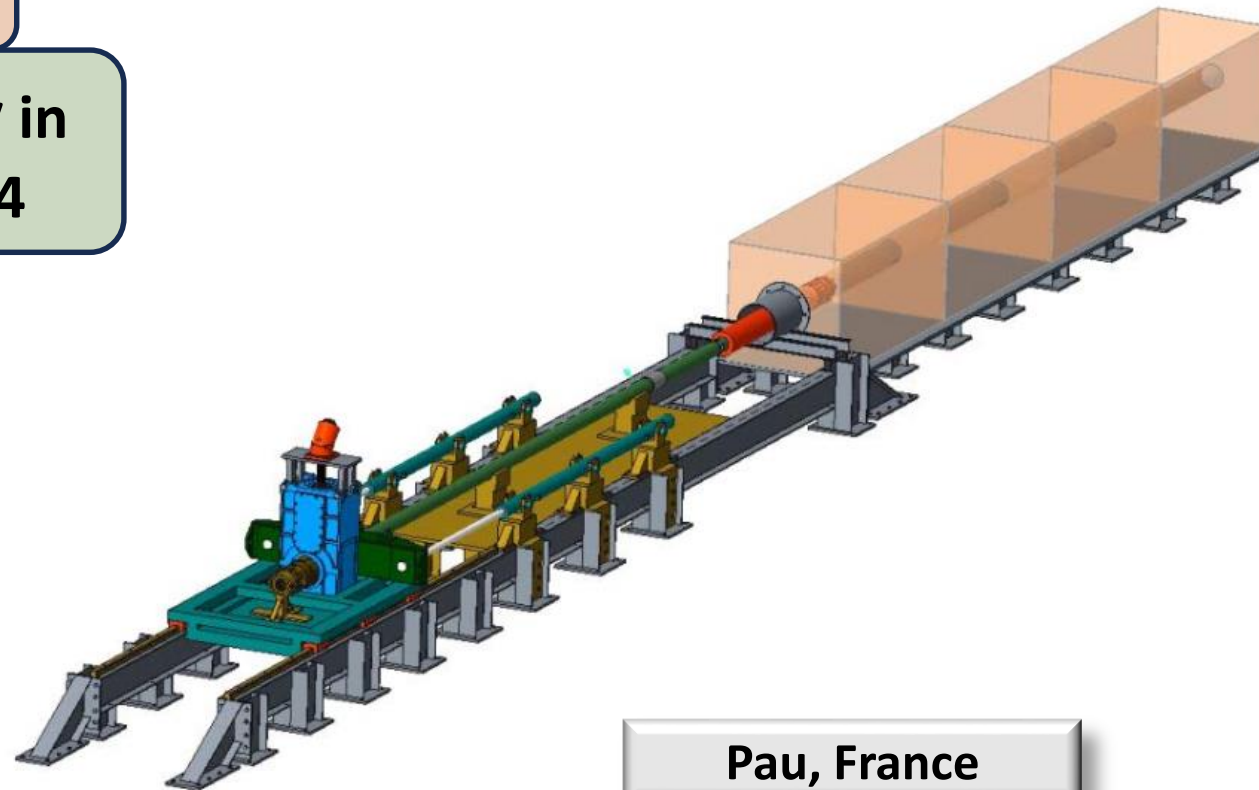
Hammering action



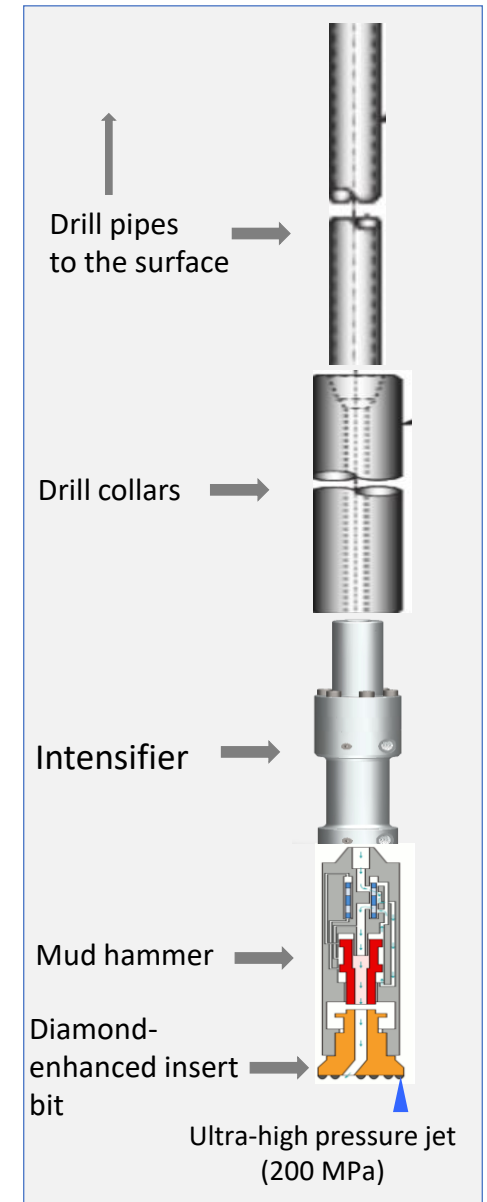
Final deliverable of ORCHYD

Intensifier + Mud Hammer testing

Prototype ready in September 2024



Pau, France



Thank you!

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