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Geological, petrophysical, geotechnical and hydromechanical assessment of the Lusatian Granodiorite for the construction of the Einstein Telescope

The Einstein Telescope (ET) is a proposed next-generation underground gravitational-wave detector in Europe, anticipated to enhance sensitivity by an order of magnitude compared to existing detectors while extending the observation band down to frequencies as low as 2 Hz. A thorough site characterization is critical for ET, considering geological, hydrogeological, and geotechnical conditions. Geological evaluations must address the identification of frequently vaguely known structures like faults and fractures that could compromise tunnel stability and environmental integrity. Hydrogeological assessments focus on rock permeability to design effective drainage systems and mitigate groundwater hazards. Additionally, a comprehensive geotechnical characterization of the underground environment is essential for ensuring safe construction and operational practices.

To facilitate this, the DZA-01/2022 borehole was drilled into the Lusatian granodiorite to a depth of 250 meters, penetrating sedimentary overburden. The borehole and core samples were characterized geologically, geotechnically, hydrogeologically and petrophysically, revealing key insights into rock quality, strength, density, porosity, and permeability. Despite passing through an old seismic fault zone, findings indicate high rock strength and low permeability below the altered paleosurface, suggesting favorable tunneling conditions with minimal water ingress. Overall, this geotechnical assessment demonstrates that the rock mass is suitable for tunnel construction at this depth, supporting the viability of the proposed underground facilities for the Einstein Telescope.

Primary author: ACHTZIGER-ZUPANCIC, Peter (Fraunhofer IEG)

Co-authors: Dr AHRENS, Benedikt; Dr GAUS, Garri; Ms STEINGROBE, Janina; Ms OSTERMEIER, Runa; Dr WEBER, Sebastian (Deutsch)

Presenter: ACHTZIGER-ZUPANCIC, Peter (Fraunhofer IEG)

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