中国科学院武汉岩土力学研究所
Institute of Rock and Soil Mechanics,Chinese Academy of Sciences

岩土力学与工程前沿讲坛

Forum on Geomechanics and Geo-engineering

No.SKL2026-05

应岩土力学与工程安全全国重点实验室邀请，德国卡尔斯鲁厄理工大学，应用地球研究所程超杰博士来实验室进行学术交流并讲学，报告信息安排如下：

报告人 Lecturer	**程超杰 博士**
报告题目 Theme	**Abiotic and biotic reactions during underground hydrogen storage in porous media**
报告时间 Time	**2026 年 4 月 16 日（周四） 下午 16:00**
报告地点 Spot	**武汉岩土所研发大楼 11 楼学术交流室**
邀请人 Inv. by	**李琦 研究员 （地质碳储与工程安全研究中心）**

岩土力学与工程安全全国重点实验室
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报告简介

Underground hydrogen storage (UHS) in porous rocks is a promising solution for large-scale energy buffering, but hydrogen's strong reactivity with minerals and microorganisms introduces uncertainties for reservoir performance and safety. This seminar highlights recent experimental advances that clarify both abiotic geochemical and biotic microbial processes relevant to UHS. High-pressure, high-temperature batch experiments on reservoir rocks (>100 bar H_2, 100 °C, >4 weeks) were designed to distinguish hydrogen-induced effects from natural fluid-rock interactions. While hematite showed no measurable reduction, observed petrophysical changes in Buntsandstein were mainly driven by anhydrite dissolution unrelated to hydrogen. In contrast, pyrite-bearing Greensand exhibited clear hydrogen reactivity, supported by microstructural changes, Raman spectroscopy, gas analyses, and magnetic susceptibility, though no crystalline pyrrhotite formed. Overall, hydrogen exposure did not degrade permeability or porosity. This study also addresses microbial hydrogen consumption, a major barrier to UHS. We introduce real-rock micromodels that capture natural mineralogy and grain-surface features, enabling pore-scale visualization of microbial colonization and biofilm impacts on flow. Early results show strong links between mineral surfaces, microbial distribution, and gas consumption. Within the ongoing EU HyDRA project, these approaches are expanded to reservoir microbial communities to improve risk assessments and mitigation strategies for safe UHS deployment.

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报告人介绍

Chaojie Cheng is a senior researcher and group leader in the Structural Geology Department at the Institute of Applied Geosciences, Karlsruhe Institute of Technology (KIT). His research focuses on fluid flow in fractured porous media, fluid-microbe-rock interactions, and experimental rock mechanics, with applications in underground hydrogen/CO_2 storage, geothermal energy, and sustainable subsurface engineering. He leads the Coupled THMC-B Research Group, combining microfluidics, core-scale experiments, and reactive-transport analyses to better understand long-term reservoir behavior. Dr. Cheng earned his Dr. rer. nat. in Hydrogeology from the GFZ Helmholtz Center for Geosciences and the University of Potsdam in 2021, and holds an MSc in Geotechnical Engineering and a BSc in Engineering Geology from the China University of Geosciences. His professional career includes positions at KIT and GFZ, where he contributed to or led major EU and national projects on underground hydrogen storage (EU HyDRA), CO_2 sequestration (CO_2 cycle), and geothermal exploitation (EU MEET). He has published scientific papers in journals such as *JGR-SE*, *GRL*, *Solid Earth*, *RMRE*, *and IJHE,* and has served as a reviewer for multiple scientific journals and as a convenor for InterPore, CouFrac, and DGGV (The German Geological Society) annual conferences.

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