Hydraulic fracturing by supercritical fluids considering rock microstructure

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Prof. Keita Yoshioka is a Professor of Geo-Energy Production Engineering at the Technical University of Leoben in Austria. His presentation will be at 9:00 a.m. Central Time on Thursday, April 16, 2026. The topic is **"Hydraulic fracturing by supercritical fluids considering rock microstructure."**

Abstract

Supercritical fluid injection is known to generate numerous small, isolated (remote) fractures, which may be beneficial for more effective reservoir stimulation. Despite this potential, however, the mechanisms and conditions that govern the formation of such fracture patterns are poorly understood. Through poroelastic analyses, this study identifies two key factors that control nucleation of remote hydraulic fractures: (1) prolonged pressure diffusion facilitated by the low viscosity of the fluid, and (2) heterogeneity in Biot's coefficient. To validate these findings, hydraulic fracturing experiments were performed on two types of marble: fine-grain marble, representing a homogeneous sample, and coarse-grain marble, representing a heterogeneous sample. Both water and supercritical CO_2 were used as injection fluids. The results demonstrate that remote fractures only form in heterogeneous rocks when supercritical CO_2 is used as an injection fluid. These findings suggest the potential to develop a safe and innovative reservoir stimulation technique that effectively stimulates large surface areas by strategically alternating the viscosity of the injection fluid while maintaining low injection pressures.

Biography

Dr. Yoshioka received his Bachelor of Science in Resources and Environmental Engineering from Waseda University, Japan, and his PhD in Petroleum Engineering from Texas A&M University. From 2007 to 2017, he worked as a research scientist in the geomechanics team at Chevron in Houston, including a short-term assignment in the geothermal business unit in Jakarta. In 2017, he moved to Germany and began working on an open-source code development project at the Helmholtz Centre for Environmental Research in Leipzig, focusing on computational fracture mechanics. Since 2022, he has been a Professor of Geo-Energy Production Engineering at the Technical University of Leoben in Austria.