ARMA Future Leader Webinar Series

Every Two Weeks on Fridays 9-10 am MT (11 am – 12 pm ET)

The Effect of Microstructure on the Cracking Mechanisms and Acoustic Emission Features of Rocks

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https://stonybrook.zoom.us/j/9539339965?omn=96069259795

Abstract

Understanding the cracking behavior of rocks is pivotal for subsurface rock engineering, such as Enhanced Geothermal Systems (EGS). In EGS, a key step is to enhance the permeability of tight crystalline geothermal reservoirs by creating open, well-connected fracture networks through hydraulic fracturing. In the field, one can rarely directly observe the cracking processes and must rely on indirect information such as micro-seismicity induced by the cracking processes. However, it is often challenging to infer the cracking behavior from micro-seismic data given the complex conditions (e.g. in-situ stress, lithology) that may affect their relations. Experimentalists make use of well-controlled rock fracturing laboratory tests to correlate the cracking behavior with the lab-scale seismicity (i.e. acoustic emission, AE). Previous studies typically consider the effect of loading conditions, often overlooking the role of the microstructure of rocks. The lithology and microstructures of host rocks vary across rock engineering projects and in cases like EGS, rock-fluid interactions may alter the microstructure. My research focuses on the effects of microstructure on the cracking mechanisms and AE signatures of rocks. This presentation will cover three topics: First, the effects of the microstructures (e.g. grain size and thermal microcracks) of granite on its cracking behavior and AE features; second, a comparative study of AE features and cracking mechanisms of three rocks with different microstructures (granite, marble, and sandstone); lastly, my recent work on a deep-learning P-wave arrival picker for laboratory AEs which is different but relevant to the AE data analysis part in the previous two topics. This research provides a foundation for a better understanding of microseismicity and the associated cracking behavior of rocks in engineering applications.

Biography

Dr Tianyang Guo is a postdoctoral scholar at the Doerr School of Sustainability at Stanford University. He holds a Ph.D. from the University of Hong Kong where he focused on rock fracture mechanics. He earned his bachelor's and master's degrees in Geotechnical Engineering from Wuhan University, China. Before joining Staford he was a Postdoctoral Fellow at the Hong Kong Polytechnic University (PolyU) under the PolyU Distinguished Postdoctoral Fellowship Scheme 2021. Dr. Guo is an experimentalist and data scientist specializing in rock mechanics and engineering geology. He has an interdisciplinary background and is skilled in integrating methods from rock mechanics, geophysics, geology, and artificial intelligence (AI). He applies these techniques to tackle scientific challenges in rock engineering, particularly those relevant to Net Zero initiatives, such as enhanced geothermal systems, nuclear waste geological disposal, and CO_2 geological storage. Dr. Guo has been an active contributor to the rock mechanics and rock physics community, serving as the session chair for both the 58th and 59th U.S. Rock Mechanics/Geomechanics Symposia (ARMA) and as a convener for the American Geophysical Union (AGU) Fall Meeting in 2024.