**Geomechanical modelling and evaluation of induced seismicity in subsurface engineering operations**

**Abstract:** Anthropogenic earthquakes have long been a major challenge faced by a range of underground industrial engineering operations, involving both rock mass excavation and fluid injection/withdrawal. Understanding causal mechanisms for induced seismicity is of vital importance to the development of regulation methods to mitigate against seismic risk during project operations. Induced seismicity is predominantly caused by the activation of underlying fractures or fault structures, governed by the Mohr-Coulomb fracture slippage criterion. Plausible causal mechanisms include fluid pressure change, poroelastic stress, thermoelastic stress, and rock excavation and fault slippage-induced stress transfer. Multiple causal mechanisms might be simultaneously at play at the same field site, which adds to the difficulty in understanding and controlling induced seismicity. This talk will introduce work on geomechanical evaluation of the potential for seismicity for several seismically active field sites from different subsurface engineering industries, such as underground mining, shale gas exploitation, geothermal systems, and geological carbon storage. Three-dimensional geomechanical modelling, in combination with interpretation of field monitored seismicity, engineering operation records and hydrological observations, has been performed to examine the physical plausibility of possible causal mechanisms and to isolate the relative contribution from each individual mechanism. Two geomechanics-based yet data-driven seismic risk forecasting methodologies, one applicable for rock mass excavation and the other for fluid injection/withdrawal, will be further presented.

**Short bio:** Wenzhuo Cao is a Research Associate at Imperial College London with expertise and experience in geomechanics, rock physics, engineering seismology and resource evaluation in geo-energy deployment and mineral resources exploitation. He holds a PhD degree from Imperial College London. His main research interests are in the areas of mining rock mechanics and reservoir geomechanics, with emphasis on coupled multiphysics and induced seismicity applied to a range of engineering applications such as geological carbon storage, deep geothermal systems, aquifer thermal energy storage, hard rock/coal mining, and shale gas exploitation. He is the recipient of Rocha Medal Runner-up Award from International Society for Rock Mechanics and Rock Engineering (ISRM) and NGW Cook PhD Dissertation Award from American Rock Mechanics Association (ARMA). He serves as the founding member of the Underground Storage and Utilization Technical Committee of ARMA, and the Product Lead for Thermal Energy and Nuclear Waste Storage.