

# THE STRESS STATE OF MAJOR FAULTS AND ITS IMPLICATIONS FOR THE ONSET OF SEISMOGENESIS AND MUD VOLCANIC ACTIVITY IN GEODINAMIC SETTING

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The peculiar nature of mud volcanoes and diapirs has been a subject to scientific investigation for almost two centuries. Their abundance seems to correlate with thick, rapidly deposited, clay-bearing sediments in compressional tectonic settings. In these scenarios fluids are often generated by mineral dehydration and hydrocarbon formation processes, so that the bulk density of the clayey strata decreases and mud ascent is favored. Fluid pressure variations in conjunction with earthquake activity have long been known to correspond with mud extrusion and gas seepage.

Basic physical properties measurements in the laboratory help to understand extrusion dynamics and to estimate the depth of mud mobilization. They also shed light on the strength and frictional response of clay-rich geomaterials, which are often found in fault zones at convergent margins. One main objective in laboratory geotechnical testing is hence to separate the pore fluid pressure transients from the mineralogical control on friction when it comes to faulting, seismicity, and mud and fluid mobilization. Such experiments can include ring and direct shear tests, permeability and pore pressure measurement, and viscosity testing. They can further be related to *in situ* data from logging-while-drilling, seafloor probe deployments or instrumented holes. The interrelationship of a few basic physical parameters like fluid pressure (as a function of convergence rate and permeability) and sediment strength suggests that the weakness of clay minerals is the major player in processes like mud mobilization, diapiric as well as vigorous ascent, landslides, but also seismic slip along major faults such as subduction zone décollements. The linkage of them makes mud domes a valuable earthquake precursor since relatively small changes in regional stress and pore pressure trigger fluid emission and other activity. Presently, cost-intensive scientific research projects (e.g., IODP, NSF *SEIZE & Margins*, EarthScope [SAFOD, PBO, USArray] and numerous others elsewhere) focus on the understanding of convergent margins, and namely fluid-related faulting, seismogenesis, and the subduction factory with the various devolatilization processes. Given the involvement of hydrocarbons, there is also great potential for cooperation with industry to understand those complex geosystems.