Seismic Geomechanics of Mud Volcanoes

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Abstract

Hydrocarbon occurrences in many Cenozoic deltas is characterized by rapid accumulation of great thicknesses of unconsolidated sediments leading to overpressures, which in turn may be associated with mud volcanism. Mud volcanoes provide important windows into the subsurface structure, stratigraphy and fluid plumbing system as they bring sediment-fluid mixtures to the sediment-water interface where they can be readily sampled. However, mud volcanoes and their related fluid flow phenomena also pose significant level of hazards, with particular reference to field development. These include deformation and fracturing of surrounding sediments, perturbation of local stresses causing shallow earthquakes, presence of methane gas and other anomalous fluids and overpressures in and around mud volcano systems.

This study utilizes 2D seismic velocity data to examine mud volcano systems offshore Azerbaijan in order to characterize the mud volcano systems and to construct geo-mechanical models for the surrounding strata which are the focus for oil and gas developments. Although mud volcanoes and their habitats in these areas have been extensively studied and documented with particular respect to tectono-stratigraphical evolution, geochemical characterization and to a lesser extent from a geomechanical perspective, there are many open questions regarding their spatial and temporal evolution and mechanics of formation, which causes significant risk to development drilling. This study addresses these open questions and risks by integrating a detailed research into the geomechanical significance of mud volcanoes and associated geologic features through 2D seismic dataset.

Construction of 2D geomechanical models of mud volcanoes and their habitats are carried out by employing seismically derived properties. Furthermore quantitative model was validated through published data wherever available, to maintain an internally consistent model, with a view to optimize development drilling performance in areas affected by mud volcanism. The presentation will showcase how the geomechanical models allow well planning in and around mud volcano edifices by risking the geomechanical properties of the mud volcanoes and their encasing strata.