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Evolutive models for the Absheron mud volcanoes: insight from 3D seismic data, well data and sediment analysis.

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Mud volcanoes, described since the 19th century, have been extensively studied for decades, although past research has mainly focused on surface morphology. However, most of research in this field are presently dedicated to increasing the understanding of their underground structure and the mud generation mechanisms.

The South Caspian Basin (SCB) and the Lower Kura Basin, onshore Azerbaijan, have the densest known distribution of MV in the world. Three-dimensional (3D) seismic data acquired by oil and gas companies in the offshore domain offer the opportunity to understand possible mechanisms of mud generation and MV systems formation.

An offshore 3-D seismic survey of the Absheron anticline shows two MVs with different morphologies. The larger volcano, currently active, is located on the crest of the anticline; its underground structure is poorly imaged due to the presence of gas. Seafloor bathymetry shows a 4.5 km-diameter mud shield with 5 mud pies, 300 m to 1 km in diameter, distributed at its surface. The mud shield is surrounded by a moat and ridge; the latter has been breached at various points and a 10 km-long mud flow emanated from the western breach. On seismic sections, older mud flows can be observed, as well as compressional wedges radiating from the volcano. The second structure is a fossil mud volcano, 500 m in diameter, buried 5 Km below seabed at the North of the main edifice. The thickness of the volcano itself is close to seismic resolution, but its root system is well imaged and shows a direct link with the regional source rock, i.e. the Maykop Formation. The emplacement of this MV is controlled by a deep thrust.

Based on seismic interpretation, we propose a conceptual evolutive model for the emplacement of the deeply-rooted small mud volcano system: (1) overpressure buildup in the anticline crest in relation to thrust formation, (2) hydro-fracturing of under-compacted and overpressured sediments which are driven upwards repetitively, leading to (3) mud extrusion at the seabed. Understanding the functioning of this small structure provides guidelines for interpreting the deep structure and mode of development for the large mud volcano. Combining this model with well data, sediment analysis and other studied structures of the SCB, we propose a formation model for the larger edifice.