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Use of Electrical Resistivity Tomography to characterize fluid pathways on the Saribokha mud volcano, Azerbaijan

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Mud volcanism is a global phenomenon that can be found in hydrocarbon-bearing sedimentary basins that have undergone high sedimentation rates and subsidence in the past, and subsequently underwent to compressive tectonics. Due to increasing pressure at depth, Mud Volcano (MV) manifests by migration through hydrofractures, and eruption to the surface, of mix-composed fluids. Thus, they represent serious geohazards for people and infrastructures and the study of the mechanism responsible for the formation and activation of MVs is very important to assess this risk.

Some models have been derived to define their deep structure and dynamics at depth and closer to the surface based on local and regional processes. Such models explain mud flow pathways from deep mud chambers to shallow structures and link them to surface features and morphologies. To create such models, the results of various geophysical methods can be used. One of these is Electrical Resistivity Tomography (ERT) which has been used successfully to image fluid flow pathways in mud volcanoes.

In this work, we introduce a 2D ERT survey to investigate and image mud flow pathways on Saribokha MV (Azerbaijan). It is located on an anticline and presents a conical shape morphology characterized by active vents and multiple surface structures. The survey consisted of two ERT lines crossing each other at a 45° angle. For both lines, the 2D imaging shows a very low resistive layer (less than 2 W.m) in between two higher resistive mediums (between 2 to 5 W.m) down to 40 m depth. We interpret it as extruded mud spreading through the subsurface between the two impermeable layers of mud breccia. The impermeable surface layer acts as a kind of “rind” which prevents mudflow discharge to the surface except through mud volcanic features (gryphons, vents, and salsa lakes). The bottom impermeable layer seems to constrain transports of mud up from a deeper source only through two vertical pipes. Inside the mud flow discharge layer, we find more resistive blocks that we interpret either as artefacts due to data and inversion uncertainties or floating blocks of mud breccia between mud flow pathways that are not well resolved.

To validate these underground features and identify clearly whether two pipes feed the mud volcano, we created a synthetic model of the first profile with mud flow resistivity of 1.5 W.m and mud breccia resistivity of 3.5 W.m. Inverted synthetic result shows similar behavior to the real case and define the more resistive blocks in the mud flow discharge layer as artefacts due to inversion process. However, it does not allow to confirm the existence of two feeding pipes due to ERT

limitation in high conductive areas.

These results allow us to correlate mud flow pathways and surface structures. Although, they put forth the need to improve imaging at mid-depth to determine if the driving process of Saribokha MV creation is the result of fracture appearance around the anticline axis and their following transformation into mud pipes.