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Mud volcano formation within the Western slope of the Nile Cone sourced from pre-salt layers

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Mud volcanos are prevalent in a variety of settings, particularly in those where rapid sedimentation, thrust loading or horizontal tectonic stresses are observed. Here we describe from a three-dimensional (3D) seismic survey located on the Western slope of the Nile Cone, a suite of mud volcanoes emplaced throughout the post-salt Pliocene-Recent succession. These mud volcanoes are highly variable in scale, some among the largest ever described. Extrusive volumes range from <1 km^3 to >100 km^3. Evaporites are widely considered a world class seal which has given rise to the discovery of numerous pre-salt hydrocarbon accumulations. Pre-salt depletion features, contrasts in p-wave velocity and salt welding due to mud remobilisation, are all indicative of a pre-Messinian (sub-salt) primary mud source, predominantly Tortonian in age. This implies large scale mud remobilisation through the thick Messinian evaporite succession.

It is our interpretation that the formation of mud volcanoes within this region is intimately related to the basinal hydrodynamics, which include undercompaction and subsequent fluid retention, local sea level variation and overpressure generation. These mechanisms are controlled by key events in the geological history of the basin such as the Messinian Salinity Crisis (MSC) and the Zanclean flood. We argue that the formation of these mud volcanoes is a direct response to overpressure generated primarily through rapid loading of pre-salt sediments during the MSC and catastrophic re-flooding during its immediate aftermath. Ultimately the location at which they form is associated with deeper features such as underlying faults and potential hydrocarbon plays. It is feasible that similar basin-scale remobilisation and overpressure could be expected for other salt basins world-wide that have undergone similar priming processes.