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Seismic characterization of deep-water pipe structures in the Levant Basin, SE Mediterranean

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Analysis of a new deep-water (1100 m – 1500 m) high resolution 3D seismic dataset covering part of the central Levant Basin, offshore Israel reveals previously undocumented evidences for subsurface fluid flow in the post-Messinian overburden manifested as pipe structures. Interestingly, these pipe structures are genetically and spatially contextualized east and west of the study area, all emanating from the Messinian evaporite substratum. Pipes in the western group accounts for 83% of the pipe population, are crudely cylindrical, oval to elliptical in planform, with diameter and height ranging ca. 350 m - 2000 m and 320 m - 420 m, respectively. Internal configuration within this group varies from chaotic to concave upward reflections diagnostic of fluid induced collapse. Pipes in the eastern group are seepage pipes appearing conical in shape, with height of ∼350 m - 510 m and diameter of 320 m - 420 m. The western group indicates an episode of fluid flow till the mid-Pliocene, compared to late Pliocene in the eastern group where successive mass wasting events during the late Pliocene plugged piping. A conceptual model for the pipes in the western group is proposed to have occurred from subjacent dissolution of the Messinian evaporite under deep-water marine conditions during the Pliocene by vertically focused fluid flow from intra-Messinian realm dissolving the top evaporites and inducing systematic collapse in the overburden. The onset of which may have been triggered by seismicity. Conversely, pipes in the eastern group are proposed to develop from breaching the top evaporite by pressurized fluids that developed from lateral pressure transfer due to differential loading of the overburden and salt tectonics. Most likely, these fluids are biogenic gas since the major gas fields in deep-waters offshore Israel and close to the study area are of this composition. The pipe structures identified in the study area extend the current understanding of fluid flow subsequent to the Messinian salinity crisis event (∼5.96 – 5.33 Ma) that affected the entire Mediterranean realm. The spatio-temporal manifestations of these pipe structures may be of potential hazard during deep-water exploration campaigns, field development and possible future sequestration projects in the Levant Basin. Our result may be used as an analogue in other basins to understand subsurface fluid flow dynamics, and also has wider implications for the hydrodynamics of many basins where thick salt layers are widely developed.