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Subsurface Fluid Escape at the Palmachim Disturbance in the Levant Basin, SE Mediterranean Sea

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Submarine fluid escape is a pervasive phenomenon occurring along continental margins and is usually deciphered by the presence of geomorphic structures such as pockmarks, mud volcanoes and mounds. In the present study we have analyzed a new high-resolution three-dimensional seismic reflection dataset covering the compressive domain of the Palmachim disturbance. The Palmachim disturbance is a 20 x 10 km salient slump body offshore southern Israel, which detach above the Messinian evaporites and extend upwards to the present day seafloor. In this contribution we present a new set of pockmarks having diameters and depths of up to 400 and 35 m, respectively. Interestingly, the majority of these pockmarks are localized on the crest and flanks of seafloor ridges associated with the evolution of the Palmachim disturbance. We show that significant populations of these pockmarks are coupled with subsurface fluid flow conduits above fault system detaching onto the Messinian evaporites, within a complex region of their withdrawal. Other pockmarks are related to regions characterized by channel-levee complex in the supra-evaporites stratigraphy. We propose a dual fluid source driving subsurface fluid plumbing within the vicinity of the Palmachim disturbance: (1) shallow fluid source derived from the channel-levee complex and likewise the possibility of sapropels within the supra-evaporites stratigraphy; and (2) a deeper-source of fluids emanating from Pre-Messinian reservoirs and possible intra-Messinian clastic sequence. Structural deformations associated with the Palmachim disturbance may as well act as seal-by-pass systems whereby fluids from the Messinian realm can be channeled to shallower levels through trust faults. The presence of mass transport deposits and channel-levee complexes in Pliocene overburden may serve as transient reservoirs for redistributing and focusing fluids toward the seafloor for expulsion. The findings from this study are relevant for better understanding subsurface fluid plumbing systems in hydrocarbon-rich evaporites basins as well as for geohazard mitigation in deep-water subsalt exploration.