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Deformation-driven fluid escape in the Levant Basin, offshore southern Israel

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Submarine fluid emissions are global phenomena, which can be inferred from the presence of seafloor morphologies (e.g. pockmarks, mud volcanoes) occurring in various geological settings. However, despite the Levant Basin been a prolific hydrocarbon province, only a paucity of fluid escape morphologies have been identified on the present-day seafloor. In this study, we present a detailed analysis of a newly available high-resolution 3D seismic reflection dataset from offshore southern Israel. Evidences of subsurface fluid plumbing and escape are manifested here as present-day seafloor pockmarks, paleo-pockmarks, pipe structures and enhanced reflectivity patterns. Interestingly, these pockmarks are situated on and around bathymetric highs, which are ridges related to the Palmachim Disturbance. Our initial results show the fluid flow structures are spatially localized above a region of complex evaporites evacuation at depth, and likewise proximal to a shallower region characterized by high amplitude reflectors. The latter may be evidences for a shallow gas system. Our initial hypothesis proposes a dual shallow-source driven focused fluid flow system. Yet, we favour a deeper Messinian plumbing system driving fluid flow across the overburden in the study area. Corroborating this are fault systems characterized near the pipes feeding the seafloor pockmarks and paleo-pockmark, detaching in the upper Messinian evaporite. We further suggest that a combined supra-salt deformation system arising from the evacuation of the Messinian evaporites coupled with gravitational tectonics are in charge of modulating focused fluid flow. Under this scenario the emplaced mass transport complex acts as a transient reservoir for fluid flow, dewatering under deformation and channelling fluids towards the seafloor for expulsion. However, the contributions from microbially-generated methane in the shallow Quaternary overburden associated with the channel-levee complex cannot be neglected.