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Geohazard assessment of submarine salt-related thin-skinned faults: Levant Basin, offshore Israel

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The Israeli continental slope is dissected by numerous thin-skinned normal faults, deforming the Pliocene-Quaternary section. This extensional faulting is caused by subsurface deformation of the Messinian salt underlying Pliocene rocks. It began in the early Gelasian, at 2.6 Ma, and it is still active today, as indicated by the ruptured seabed. High-resolution bathymetric data reveal shore-parallel seabed steps reaching heights of a few tens of meters. Considering that since the beginning of faulting the average sedimentation rate (100-400 m/My) exceeds the displacement rate (50-100 m/My), the presence of numerous unburied fault scarps indicates seismic ruptures rather than slow creep. For example, considering recent sedimentation rates as measured in seabed cores (5 cm/ka = 50 m/My), if an earthquake produces a 5-m-high fault scarp, it would take about 100 ky to bury it. These preliminary considerations highlight the importance of hazard assessment for seabed infrastructures.

The recent development of gas fields offshore Israel, as well as the increasing number of planned infrastructures on the seafloor requires a risk assessment, geohazard management, and particularly accurate mapping of faults. Unlike onshore geohazard management, there is no statutory fault map for offshore Israel. Moreover, 'active' and 'potentially active' faults in the offshore area are still not defined. The purpose of this study is to prepare a fault map and discuss criteria for defining the level of fault activity in the marine environment. To accomplish this goal, we use high-resolution bathymetric data and 3D seismic surveys, allowing 3D mapping of faults much better than usually possible onshore.

For bathymetry, we developed an algorithm, which automatically calculates the height of fault scars along predefined segments. Results indicate higher faults scarps in the north, consistent with extension measurement and steepness of the continental slope that also increases northward. A 3D mapping of fault planes shows that (1) many small faults at the seabed are actually segments of a major fault. This allows reducing the total number of faults to a few large ones. (2) A significant fault can be hidden below the surface with no bathymetric expression. (3) The structure of a seismic reflector dated to 350 ka emphasizes areas with greater recent activity much better than the best available bathymetric data. This allows a quick way to focus on hazardous areas. The next stage of the research will be to measure the area of fault planes and calculate potential earthquake magnitudes. Altogether, we point out the advantage of 3D seismic mapping for

geohazard assessment.