Natural oil seeps external forcings: case studies in the Eastern Mediterranean, Aegean and Black seas

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Résumé

Satellite imagery is a suitable tool for monitoring liquid hydrocarbon seepage at the sea surface and studying temporal modifications of fluid outflows. The hundreds of kilometers wide swath provide large scales observations. We carried out comparative studies between the Black, Aegean, and Mediterranean Seas. A consistent temporal series of Radar Sentinel-1 satellite data was analyzed for the years 2017 to 2022.
In the Black Sea, the integration of optical imagery over oil seep sites detected with Sentinel-1 data provides new insights into the volume estimations by comparing colorimetric properties with the slick thickness. We assessed oil slicks volumes and showed that the volume expelled can vary over very short time intervals, typically of the order of a month.

In the Aegean Sea, the natural oil seep sites detected in the north are mostly distributed along the North Anatolian Fault. The strike-slip regime progressively transitions eastward into a transtensional regime, generating zones of subsidence and creating a series of pull-apart basins. The subsidence of the pull-apart triggers the development of a 30 km wide gravity slide showing signs of active deformation and smaller-scale mass transport deposits (MTDs). The tectonic environment associated with these natural expulsion zones thus combines strike-slip faulting and gravity deformation systems associated with the growth of a pull-apart basin. Oil slicks are also detected further south, close to the Skyros-Edremit basin. The presence of hydrocarbon expulsions in both the northern (North Anatolian Fault) and the southern (Skyros-Edremit Fault) questions about a common source rock that would involve a southern extension of the Oligocene-Eocene productive series of the Thrace Basin.
On the eastern Mediterranean side, the study of satellite images in the vicinity of the large earthquakes that struck Turkey on February 6, 2023 (Mag. Max: 7.8) shows repercussions on

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the activity of fluid expulsions at the same period. Indeed, the activation of a fluid expulsion site located along the East Anatolian fault and Cyprus Arc temporally coincides with the occurrence of seismic activity in the region. This is the first spatial observation of the effect of earthquakes on fluid expulsions in the marine domain.

Mots-Clés: oil, satellite, hydrocarbon, strike, slip, quantification, earthquake