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Impact of Fluid circulation in old oceanic Lithosphere on the seismicity of transfOrm-type plate boundaries: The FLOWS project (EU-COST ES1301)

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The recent occurrence of large earthquakes and the discovery of deep fluid seepage calls for a revision of the postulated hydrogeological inactivity and low seismic activity of old oceanic transform-type plate boundaries. Both processes are intrinsically associated. The COST Action FLOWS seeks to merge the expertise of a large number of research groups and supports the development of multidisciplinary knowledge on how seep fluid (bio)chemistry relates to seismicity. It aims to identify (bio)geochemical proxies for the detection of precursory seismic signals and to develop innovative physico-chemical sensors for deep-ocean seismogenic faults. At present, study areas include the Azores-Gibraltar Fracture Zone and the North Anatolian Fault which have generated some of the most devastating earthquakes in Europe.

Here we present the latest results from recently-discovered deep-sea mud volcanoes (MVs) located at the rim of the Horseshoe Abyssal Plain, western Gulf of Cadiz (NE Atlantic Ocean). An analysis of the molecular and isotopic composition of hydrocarbon and noble gases is performed on fluids collected at the newly-discovered seeps and in MVs located across the active sedimentary wedge of the Gulf of Cadiz. The tectonic and seismic environments involved vary. However, all active seeps are located along crustal strike-slip faults, which clearly control the seepage of the deep-sourced fluids.

Our results yield insights into the effects of the interplay of petroleum migration/trapping, deep sediment dewatering and gas hydrate formation on the geochemical signature of natural gas in deep marine sediments.

The cross-disciplinary approach fostered by the FLOWS project yields first indications on the relations between tectonics and seismicity and the secondary processes that shape the geochemical compositions of the fluids transported from deeply buried sediments to the seafloor. It highlights the role of strike-slip faults as the locus of deep fluid transport to the surface.