

## Pockmarks and fluid migration in the Estremadura Spur, Western Iberian Margin

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**Summary:** A field with more than 70 pockmarks in the Estremadura Spur outer shelf on the Western Iberia margin is the main focus of research of the PES project. High-resolution seismic reflection profiles and multibeam bathymetry allowed the characterization of the seismic sequence of a Pliocene-Quaternary basin as well as the pockmark field therein. The Pliocene-Quaternary basin developed on top of a folded, most probably, Miocene sequence. The pockmarks are found either sealed within the Pliocene-Quaternary sedimentary sequence or as depressions at the seafloor. Besides the pockmarks, several other seismic evidences of fluid migration and shallow gas accumulations are identified on the seismic dataset. No evidences of pockmarks were found below the Pliocene-Quaternary sequence. The seafloor observations with a ROV on three of those pockmarks show that, although several episodes of fluid migration and escape affected this region at present seepage seems to be mainly inactive.

**Key words:** pockmarks, fluids migration, W Iberia Margin.

**Palavras-chave:** pockmarks, migração de fluidos, Margem W Ibérica.

Pockmarks are negative topographic features (depressions) found at the seabed, with a of round to oval shape, steep flanks and a relatively flat bottom; they are seabed culminations of fluids (mainly gas) migration through the sedimentary column (Judd & Hovland, 2007). A field of pockmarks (Fig. 1) was discovered in the Estremadura Spur outer shelf on the Western Iberia margin during the PACEMAKER survey (Kim & the cruise 64PE332 shipboard scientific party, 2011). This field of pockmarks (Fig 1) was further surveyed in the scope of the PES project (Magalhães, 2017) and more than 70 pockmarks were identified on the high resolution bathymetry dataset. This pockmarks field is the first evidence of fluid seepage related structures identified in the Western Portuguese margin.

This pockmarks field is the focus of the PES project, a process-oriented and multidisciplinary project. In order to achieve the aims of the project and provide important insights into the stratigraphic and structural control of fluid generation, migration and escape, the project relies upon close collaboration between researchers from a broad range of fields. It includes biologists, geophysicists, sedimentologists, organic and inorganic geochemists, structural geologists, and seismo-stratigraphy experts.

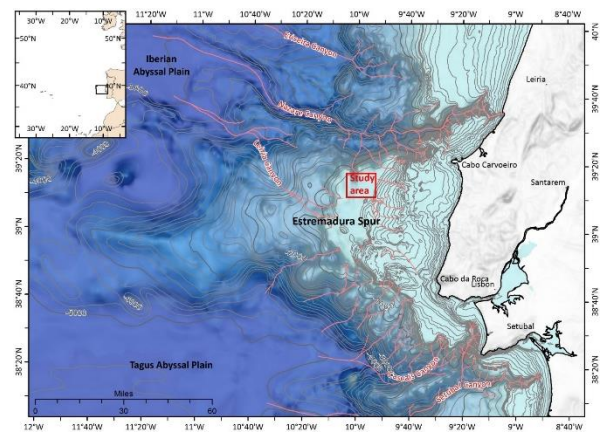


Fig. 1. Map of the Estremadura Spur showing the location of the Lourinha Monocline pockmarks field.

Fluid flow associated with pockmarks, schematically illustrated in Fig. 2, can often be recognized on seismic data and evidences of the presence of gas and fluid flow can be inferred by the observation of geophysical indicators (Judd & Hovland, 2007; Duarte et al., 2007). Based on the single and multichannel reflection seismics dataset and on the swath multibeam dataset acquired and processed within the PES project, the

following characteristics of this pockmark field can be summarized:

- More than 70 individual pockmarks were identified between 220 and 350 m water depth, with diameters between few meters to over 400 m and depths between < 1 m up to 20 m;
- The pockmarks are located within sedimentary basins, such as the Lourinhã Monocline Basin, established and filled with up to 40 meters of Pliocene and Quaternary sediments (Badagola et al., 2006). These basins are representative of Late-Miocene NE-SW extensional tectonics (Duarte et al., 2017);
- The acoustic evidences of gas accumulation and seepage in the seismic dataset are expressed by: pockmarks located at the seabed or buried at different depths, acoustic blanking, acoustic turbidity, and migration pathways;

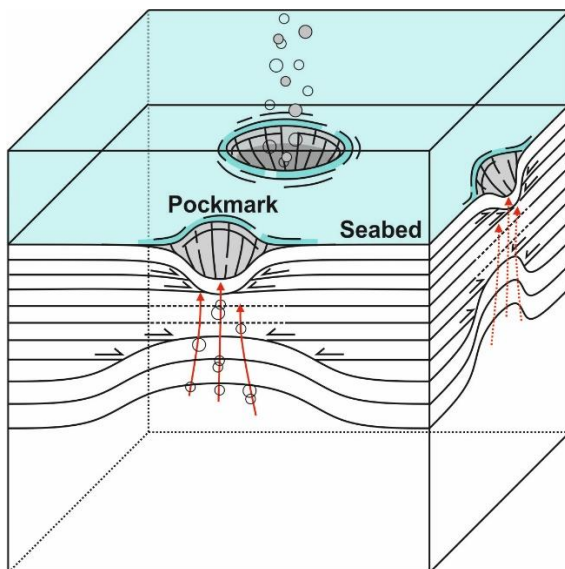


Fig. 2. Schematic representation of the Estremadura Spur seepage and pockmarks.

- Many of the fluids migration pathways begin or end at disturbed subsurface reflectors. These zones were interpreted as acoustic turbidity. Vertical zones of acoustic anomalies that cross cut the seismic sequence were also observed, ending near to the seabed and characterized by a loss of lateral coherency and low amplitude of the reflectors - these were interpreted as acoustic blanking zones;
- In the basin depocenter most of the pockmarks are buried, indicating that they are inactive;
- In the region where the Pliocene-Quaternary sedimentary package is thinner, the pockmarks occur at the seafloor with a morphological expression, indicating that fluid expulsion occurs at present or has occurred recently;

- The existence of buried pockmarks along the seismic sequence also indicate that the migration of fluids is intermittent and repeated periodically, probably caused by the cyclical sea-level changes or by seismologically driven periodical overpressure variations.

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