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High-Resolution Marine Magnetic Mapping of the Portuguese Nearshore: Unraveling Geological Domains, Faults and Magmatic Structures

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Abstract Text:

The SW Portuguese margin has been intensively studied, particularly for rifting, tectonic inversion and tectonic reactivation of the Atlantic passive margin. In this work we bring new data on the continental shelf, usually not acquired by the heavier geophysical methods (e.g. airborne or low resolution deep seismic-magnetic surveys). These new data allow casting a clear light bridging between the geological structures onshore and offshore. The geology of this margin went through the Variscan orogeny of Paleozoic age, the North Atlantic rifting, the Late Cretaceous alkaline magmatism (intrusive and extrusive), the Alpine tectonic inversion and the Quaternary reactivation of the passive margin.

We present results from the compilation of a series of marine magnetic surveys conducted along the Portuguese nearshore from 2014 to 2019. Magnetic data were acquired with 1 nautic mile line separation, resulting in near full coverage of the nearshore along a 120 km long margin segment, from Sintra to Odeceixe. For a large part of the surveyed area, ultra-high resolution seismics and multibeam bathymetry were simultaneously acquired.

Magnetic data were processed to produce high resolution mapping of magnetic anomalies, and also to enhance both shallow and deep structures, using several derivative and filtering techniques.

We combine the interpretation of high-resolution magnetic mapping with the interpretation of ultra-high resolution and vintage deep penetration seismic data to infer the local and regional expression of tectonic structures and magmatic bodies. Our results allow: identifying the offshore extension of important faults, e.g. the Grândola, Pinhal Novo and Messejana faults; resolving previously blurry-imaged magmatic structures, e.g. Sines and Cabo Raso anomalies; identifying faults recycled from the Paleozoic through Present; constraining the relation between magmatic intrusions and faults; and bringing constraints to the discussion of magmatic emplacement.

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