Connecting onshore-offshore Pelotas Basin structures using magnetic data

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Abstract

Crustal faults are crucial elements in attempting to understand the structure and sedimentary basin evolution. In particular, the continental shelf of Pelotas Basin is a structurally complex area containing features of different ages, styles, and trends. Tectono-structural studies along the Brazilian margin showed a high variability of structures, which seem to be related to the different stages of the South Atlantic rift through time, besides differential quantities of magma addition. Airborne and marine magnetic data for the Pelotas Basin (Brazil and Uruguay) were used to map regional-scale faults and, particularly, to delineate the main geophysical features. We reprocessed and merged four magnetic surveys and applied techniques that allowed the detection of edges and ridges used to interpret several lineations. Due to the low latitudes, we applied Reduction to Pole (RTP) to transform an observed total magnetic intensity (TMI) anomaly into an anomaly that would be measured at the north magnetic pole. Thus, avoiding changes in anomaly shapes, amplitude reduction, and changes in map textures caused by the dependence on magnetic inclination. Also, the vertical derivative (DZ) and tilt derivative technique (TDR) were applied to enhance linear trends and extract new geological information. The power spectrum was used to estimate the depth of the magnetic interface and the upward continuation at these distinct depths provided deeper views of the crustal magnetic anomalies. The deep sources helped to understand the magnetic domains intrinsic to the regional geologic framework of the basin. The result points to the onshore-offshore links of large-scale structural elements, especially in the proximal offshore area, where there is a fewer stretched crust. The Pelotas Basin exhibits distinctive magnetic features, where high-amplitude and short-wavelength anomalies in the onshore region reveal magmatic sources near the surface. At the same time, higher intensities with longer wavelengths in the offshore area were associated with wider and deeper magmatic sources. The magnetic anomaly pattern observed onshore shows continuation towards offshore, with continental magnetic lineaments connecting with offshore anomalies. The short-wavelength NE-SW anomalies onshore likely reflect the upper crust structures are associated with sub-surface structures related to the initial rifting of the Gondwana at this portion of the southeastern Brazilian Atlantic Margin. This event also reactivated the SE-NW deep structures formed during the Brasilian Tectonic Cycle. The regional character of the magnetic responses allowed the division of the framework of the Pelotas Basin into three domains: i) north is characterized by high-frequency anomalies, almost parallel to the coastline associated with pre-rift volcanism; ii) central is characterized by a smooth regional magnetic relief overlapped by EW elongated high-frequency anomalies associated with episodes of continental drift; iii) south is characterized by a more disturbing regional magnetic relief in relation to the Central domain, evidencing the presence of relatively deeper magnetic sources. An elongated anomaly parallel to the coastline inflects towards the E-W direction, and expressive E-W lineaments are probably associated below. The connecting onshore-offshore Pelotas Basin structures bring a positive understanding of the structure and evolution of sedimentary basins.