Structural Characterisation of the Ribeirão Grande Shear Zone, Southern Brazil

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The Ribeirão Grande Shear Zone (RGSZ) is a major tectonic structure within the Apiaí Domain, southern Brazil, separating the Votuverava Formation and Perau Formation of the Açungui Group. The Votuverava Formation consists of sericite schists, phyllites, slates, metarenites, rare carbonate rocks, and metabasalts, reflecting a marine to transitional depositional environment. The Perau Formation features slates, phyllites, metarenites, metaconglomerates, carbonate rocks, and metavolcanic rocks, and is associated with lead and zinc mineralisation due to its carbonate-rich lithology and tectonic setting. This study examines the structural and tectonic significance of the RGSZ and its role in controlling Pb, Zn, and Cu mineralisation. A multidisciplinary approach integrates Digital Elevation Model (DEM) interpretation, field mapping, and microtectonic analysis. DEM interpretation reveals anastomosing lineaments with stepped geometries, indicating shear-related patterns. Field mapping identifies ductile deformation near the shear zone core and transitional ductile-brittle structures in distal areas. Microtectonic analysis highlights multiple deformation phases, with alternating dextral and sinistral shear movements, confirming the polyphase nature of the RGSZ. Stress inversion analysis defines principal axes: σ_1 trending NE-SW (compressional), σ_2 vertical, and σ_3 trending WNW-ESE (extensional). The RGSZ exhibits ductile deformation followed by a ductile-brittle transition, displacing three blocks: western and eastern blocks moving northeastward, and the central block shifting southwestward. These findings enhance understanding of tectonic controls on mineralisation within the Perau Formation, particularly in carbonate-rich lithologies. By analysing fault network geometry, strike-slip systems, and kinematic segmentation, the study provides a framework for predictive exploration models. Structural controls and fluid flow pathways identified in the RGSZ guide exploration strategies, optimising the discovery of economically viable Pb, Zn, and Cu deposits across the Apiaí Domain.