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Magma Emplacement during active rifting in the upper crust: kinematics and petrology of diabase and host rocks

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During active rifting, whenever magmatism is present, magma emplacement on the upper crust is usually controlled by brittle structures reactivating an inherited tectonic fabric. In the southeastern Brazilian margin, a Cretaceous NE-SW tholeiitic dyke swarm follows the trend of the Neoproterozoic Ribeira Belt. However, in the coastal area of Rio de Janeiro, it crosscuts orthogonally the Paleoproterozoic orthogneisses of the Cabo Frio Tectonic Domain. In order to investigate how these South Atlantic rift structures formed orthogonally to the inherited host fabric, detailed structural analysis on two key areas was performed, using geological mapping with high-resolution drone images, analyzing the relation of brittle structures, diabase dykes and host rocks. The main set of faults and fractures is oriented parallel to the NE-SW diabase dykes. Dykes bifurcate or change direction abruptly following faults and fractures. Three paleostresses regimes were characterized: (1) a strike-slip transtension with NNE-SSW and NE-SW strike-slip faults; (2) an extensional transtension with oblique NNE-SSW and ENE-WSW faults; and (3) a pure extension with NNE-SSW and ENE-WSW normal faults. The tholeiitic dykes were emplaced during phases 2 and 3 continuously. Syn-kinematic secondary minerals formed on the cataclasites and the host rocks by fluid interaction. Calcite, epidote, chlorite and iron oxide compose a low-grade metamorphism of Ca-, Fe- and Mg- assemblage. These minerals also registered different phases of deformation during paleostresses regimes, with crystallization/precipitation facilitated by thermal injection of the tholeiitic magmas. Increase in permeability of the host rocks by formation of faults and fractures also contributes for the fluid migration, thus contributing with hydrothermal alteration on the upper crust. These mineral reactions also corroborated with the weakening of the continental crust, allied with the increase of dilatant slip surfaces. The combination of these tectonic and hydrothermal processes enabled the emplacement of the NE-SW Serra do Mar Dyke Swarm into the Cabo Frio Tectonic Domain, disregarding the NW-SE inherited tectonic fabric.