MAGNETOTELLURICS, GRAVITY AND GEOID IN SOUTH SAO FRANCISCO CRATON, BRAZIL: GEOPHYSICAL INDICATORS OF CRATONIC LITHOSPHERE REJUVENATION AND CRUSTAL UNDERPLATING

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The south Sao Francisco craton is characterized by a positive, circular shaped, 8 m amplitude geoid anomaly which coincides with the outcropping terrain of an Archean-Paleoproterozoic basement. An integrated study of broadband and long period magnetotelluric (MT) soundings, gravity field and geoid provides the basis for a proposal that this cratonic lithosphere underwent compositional rejuvenation in the mantle and crustal underplating. Broadband MT data inversions of two radial profiles from the center of the circular geoid anomaly resulted in geoelectrical crustal sections whereby a region in the lower crust is locally more conductive (~10 to 100 ohm.m) in spatial coincidence with a denser lower crust (~50 kg/m^3) modeled by the gravity data. This anomalous lower crust may have resulted from magmatic underplating, probably associated with at least three main episodes of tholeiitic dike intrusion in this segment of the craton. Long-period MT soundings reveal a low electrical resistivity mantle (~10 to 500 ohm.m) from depths beyond 100 km at the region immediately below the cryptic underplated crust, but elsewhere surrounded by a more resistive mantle (~500 to 2,000 ohm.m). Forward geoid modeling using as constraint the enclosing volume that defines the low electrical resistivity region within the lithospheric mantle requires a density increase of 30 to 50 kg/m^3. Percolated carbonatite melts (0.005%) within olivine and other mineral phases of the peridotitic mantle is claimed to explain this electrically less resistive upper mantle. We propose that metasomatic processes in the sub-continental lithospheric mantle fostered the conditions for the low degree of melting which produced the melts with variable CO_2 and Fe content. Even though the precise age of this metasomatism is unknown, it is here suggested to be older than Early Cretaceous. During the onset of the lithosphere extension and break-up of the western Gondwana, leading to the South Atlantic formation, a high degree of melting of a shallower lithospheric mantle already impregnated with carbonatites produced Early Cretaceous tholeiitic dike intrusions. The proxies are the NE Parana and Espinhaco (130 Ma, Ar/Ar ages) dikes which contain traces of carbonatites in their composition. Also, positive geoid anomaly (+10 m) and pre-tholeiites (age larger than 138 Ma) alkalines, carbonatites and kimberlites along the west Africa continental margin (Angola and Namibia) reinforces the age of the former Sao Francisco-Congo craton rejuvenation to be older than the South America and Africa final separation.

Integrated geophysical studies, crustal underplating, cratonic lithosphere deformation

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