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Semi-pelite anatexis: generation of tonalite-trondhjemite melts in metamorphic system

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Semi-pelite, or wacke, is an important component in continental crust, which under amphibolite facies metamorphism originates biotite schist with variable amounts of plagioclase and aluminum-rich minerals, as garnet, staurolite and Al_2SiO_5 polymorphs. The Santo Antônio unit is part of the Andrelândia *Nappe* System, Southern Brasília Orogen, MG, Brazil, and it groups a transition from kyanite-garnet-muscovite-biotite-plagioclase schist to metatexite with incipient to moderate partial melting. The investigation of its metamorphism and anatexis is accomplished using field data, mineral chemistry and calculating pseudosections with THERMOCALC. The metatexite presents leucosome veins mainly composed of quartz and plagioclase, with some mica, rare garnet and almost no high-stability phases, as zircon, rutile, ilmenite and monazite, and, although deformed, igneous textures, as euhedral plagioclase with concentric zoning and thin quartz films trapped in intergranular boundaries, are recognized. New biotite occurs either as melanosome, the main peritectic phase formed during incongruent partial melt reaction of muscovite, or as schlieren. Despite its origin as the main residual phase, it is difficult to distinguish whether biotite is peritectic or retrometamorphic, as most neosome remains unsegregated, even in the outcrops with higher leucosome content, up to 30% in volume in the unit structural top. From schist to metatexite a compositional banding is developed due to different amounts of leucosome lenses that are parallel or locally discordant to main foliation in matrix (palaeosome + unsegregated neosome). Pseudosection modeling in NCKFMASHTO system was calculated for two textural homogeneous samples from each main example, schist and metatexite, showing wide tri- to pentavariant and small uni-, di-, hexa-, or heptavariant fields. In both examples, metamorphic peak assemblage is quartz, biotite, plagioclase, garnet, ilmenite, rutile and melt, formed at expenses of Na-rich muscovite, plagioclase and kyanite; no K-feldspar is observed. The compositional variations observed in mica ($Na_{0.07-0.15}$, $Fe_{0.10-0.12}$ apfu), plagioclase (An_{16-40} matrix, An_{12-35} leucosome, An_{16-48} garnet inclusions) and garnet ($X_{Mg0.09-0.28}$, variable core-rim zoning) are in accordance with calculated compositional isopleths and combined indicate heating at high-pressure, reaching metamorphic peak at ~ 750 ºC above 10 kbar, followed by cooling-decompression stage, in agreement with optimized thermobarometry and Zr-in-rutile temperatures. Modeling indicates melt composition is sodium and silica-rich that is in consonance with leucosome composition, rich in quartz and Na-rich plagioclase: moderate temperature and high-pressure partial melting via plagioclase-muscovite breakdown will produce tonalite-trondhjemite melt before addition of K-feldspar in the system, which occurs only in high *P-T* conditions, above 10 kbar and 850 °C. The increase in leucosome volume toward the unit structural top is also compatible with calculated higher *P-T* conditions, and implies an inverted metamorphic gradient for the area. The characterization of this process highlights the importance of Na-rich muscovite and plagioclase in the generation of tonalite-trondhjemite melts over granite ones, from semi-pelite protoliths, when proper *P-T* are achieved.