Mesozoic alkaline magmatism as a window to interpret geotectonic evolution of the Central Andes

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The alkaline petrographic province from Southern Peru to Northwestern Argentina is represented by small stocks intruding the basement of the Eastern Andes. Spatial distribution of those magmatic complexes seems to be related to thermal anomalies and deep crustal fractures produced during extensional tectonic processes. The petrology is characterized by felsic alkaline rocks SiO_2-saturated (nordmarkitic trend) and SiO_2-undersaturated (pulaskitic trend).

The magmatic association is characterized by high HFS/ LIL element ratios, suggesting a source of asthenospheric basic rocks, enriched in incompatible elements comparable to those erupted in actual rift systems, showing no evidences on influence of subduction processes in the generation of these magmatic rocks. Oxygen and carbon isotopes in carbonate phases of different magmatic rocks show truly primary, magmatic values shifting isotopic composition as result of hydrothermal activity and temperature decrease.

For these petrogenetic process should have been interacted an oblique subduction of an asysmic oceanic ridge vs. hotspot migration beneath the continent. This situation generated pull apart basins and asthenospheric mantle upwelling with the subsequent alkaline magmatism. Cenozoic Andean tectonic inverted partially the Mesozoic extensional structures.

Cretaceous Gross Spitzkoppe stock in Namibia: genuine A-type granites related to continental rifting

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Anorogenic Damaraland igneous province in western Namibia comprises mafic, silicic and alkalic volcanic and plutonic rocks that were emplaced at 124-137 Ma into the Neoproterozoic Damara orogenic belt between the Congo and Kalahari cratons. The magmatism was related to the Tristan mantle plume and continental rifting that led to separation of South America from Africa. Silicic plutonic rocks include hornblende biotite granite and minor peralkalic granites (Brandberg), peraluminous granodiorite and tourmaline-bearing biotite granite (Erongo) and topaz granites (Gross Spitzkoppe, Kleine Spitzkoppe). The plutons are associated with mafic and silicic dikes, as well as some lamprophyre dikes.

The Gross Spitzkoppe stock consists of topaz-bearing biotite (siderophyllite-annite) granites (Frindt et al., 2004a and b; Frindt and Haapala, 2004). Bimodal association is indicated by synplutonic mafic dikes and magmatic mafic enclaves. The stock contact is marked by marginal pegmatite and layered aplite. Miarolitic cavities and pegmatite pockets contain gem-quality topaz and beryl, and hydrothermal alteration has locally produced wolframite-bearing greisen. Texturally different granite types show only little variation in chemical composition: SiO_2 74.4-76.9, TiO_2 0.03-0.15, Al_2O_3 11.8-12.9, Fe_2O_3 1.0-2.2, FeO 0.4-1.2, MgO 0.0-0.1, CaO 0.2-1.0, Na_2O 2.8-3.9, K_2O 4.6-5.6, P_2O_5 0.00-0.16, and F 0.2-0.7 wt.%. High contents of incompatible elements (Rb 446-831, Nb 60-176, Ta 3-15, Ga 24-42 ppm) and low Sr (5-48 ppm), Ba (0-164 ppm), and Eu/Eu* (0.0-0.23) suggest high fractionation. The granites can be classified as ferroan alkali-calcic rocks, and they show the chemical and mineralogical characteristics of aluminous A-type and within-plate granites. Isotope studies (Nd, Sr) suggest dominant crustal source with significant mantle component (Frindt et al., 2004b). The preferred genetic model is magmatic underplating.

References

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