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Nepheline syenites to granitic rocks from the Itatiaia Alkaline Massif, southern Brazil: new geological and petrological insights

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The Itatiaia Alkaline Massif is one of the biggest alkaline Mezo-Cenozoic occurrences of Brazil (~220 km²; 22°18'/22°28' S; 44°34'/44°49' W). It has an elongated NW-SE shape with a ~10 km diameter ring structure at the central region. Recent geological mapping has shown a much more complex geological and lithological context, than previously described. Over twenty petrographic facies were identified, which could represent different magmatic pulses or stages of magmatic evolution. The geomorphology (with elevations ranging from 540 to 2792 m) heavily emphasizes the relations between these facies and suggests different intrusions divided in three areas with distinct characteristics: SE, Central and NW.

The SE area does not show remarkable structural features and is composed exclusively by miaskitic to agpaitic nepheline syenites. The most silica-undersaturated facies is on the edge, in contact with basement, and is locality peraluminous with modal hercynite and corundum. There are dykes of aphyric, porphyritic (some of them with pseudoleucite) and brecciod phonolites, besides a nephelinite.

The Central area is shaped as a ring structure that intrudes partially the SE area. It shows an external C-shape ring made up by miaskitic to agpaitic nepheline syenites and phonolites. The moon-shaped inner facies migrates to NW, suggesting successive intrusions. They are composed by different units of pulaskites, nordmarkites and quartz alkali feldspar syenites, which trends to increase the silica saturations to the center. A small intrusive body of alaskite occurs next to the center. Dykes of phonolite occurs in the outer regions, whereas in the inner part dykes of trachyte and rhyolite occur. The transition to the NW area occurs by a 'neck' formed by quartz syenite glomeroporphyritic with anti-rapakivi, enclaves and others textures that attest instability. There are also irregular bodies of brecciod to porphyritic trachyte with aphanitic matrix and the fragments are almost entirely angular with fine to aphanitic granulation. The NW area also shows some moon-shaped structures where nepheline syenites predominate with nordmarkites on the northern boundary. Locality, cumulitic melagabro and biotite monzonite occur. In the center of the area there is a volcanic neck formed by porphyritic to brecciod trachyte that stands out in the landscape.

Besides these structural and petrographic differences, the three areas also differ in geochemical behavior. The SE area shows different or opposite trace-elements patterns with other two areas, displaying little or no relation to the evolution of the rest of the massif. The Central area shows well-defined trends with silica enrichment, while the NW area shows a little spread trend, however mostly agreeing with the Central area. Zircon SHRIMP U-Pb ages also agree with these differences. The SE area shows an age of 71 Ma, the Central area varies around 69 Ma and NW area show an age of 67.5 Ma. These ages may represent three magmatic events to form the massif over at least 4 million years.

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