symo = 0768560

PETROGENESIS OF THE MONZONITIC-MONZODIORITIC PIRACAIA MASSIF, STATE OF SÃO PAULO, SOUTHERN BRAZIL

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Financed by FAPESP, CNPq and FINEP-PADCT

The Piracaia massif, located in the NE part of the State of São Paulo, crops out over 32 km^2. Rock types cover a wide compositional range (diorites to alkali-feldspar quartz syenites), similar to the "alkaline" granitoid tendency of Lameyre and Bowden, but monzodiorites and monzonites are by far predominant. Most rocks show, at least in part, tectonic foliation and metamorphic recrystallization.

The massif was emplaced in the area of contact between the Upper Proterozoic Socorro orthogneisses and migmatized older supracrustal units of the Piracaia Metamorphic Complex. Locally, late granitoid veins intruded the massif, but the contact and structural relations of the massif with nearby anatectic granites of Brasiliano age are unknown. Foliation within the massif is attibuted to the regional F_{n+2} phase of deformation.

Detailed observations identified 29 macroscopically recognizable facies (in part, transformed by metamorphism), usually of restricted outcrop size; for mapping purposes, these rocks were grouped into mappable "facies associations". Geologic observations showed an overall intrusion pattern, with older ("earlier") more mafic and less differentiated monzodiorites and monzonites (with some diorites) followed by younger ("later") more felsic and differentiated syenites, quartz syenites, quartz monzonites and alkali-feldspar quartz syenites, quartz monzonites and alkali-feldspar quartz syenites.

The "earlier" monzodiorites and monzonites predominate and are found mainly within the core of the massif. Main varieties are dark grey heterogeneous monzodiorites (Mdf and Mdm facies associations, up to 40% of the outcrop area), grey monzonites (Mfc association, invading Mdf and Mdm facies, 20% of the outcrop area), and violet-grey coarse-grained monzodiorites (Mdr association, cutting Mdf; 5% of the outcrop area). The "later" facies invaded mainly the borders of the massif, apparently forcefully, and are divided into light-grey syenites (Scm association) and light, coarse-grained quartz monzonites (Qml), quartz syenites (Qsl) and alkali-feldspar quartz syenites (Aqs).

The principal primary minerals observed in preserved igneous textures are plagioclase, alkali feldspar, biotite and augite; Fe-hypersthene is found in some monzonites, and quartz in late differentiates. Main accessory minerals are apatite, magnetite and ilmenite.

Crystallization usually began with plagioclase and biotite, followed by augite and alkali feldspar. Resorption of plagioclase was probably important in many monzonites and monzodiorites, alkali feldspar occasionally being seen as mantles around this mineral.

Earlier facies frequently are strongly permeated by lighter quartz monzonite and quartz syenite veins and sheets, locally giving a migmatitic aspect to the outcrop. Some of these structures were probably generated before the intrusion of the larger felsic masses ("later" facies).

The earliest rock types (diorites to leuco-monzonites) show petrographic and chemical relations compatible with differentiation by crystal fractionation possibly controlled by crystal extraction from a predominantly liquid mush of monzodioritic composition. More felsic varieties apparently started as small segregations ocelli and veim, separated from largely crystalline mushes of manjodioritic-monzonitic compositions, these segregations eventually collected as larger masses, subject to further differentiation up to quartz-rich final products.

Initial metamorphism within the massif is considered "synplutonic", related to the beginning of segregation Primary felsic and mafic minerals recrystallized in response to diminishing (but still high) temperatures and an increase in a_{H2O}. Later metamorphism at lower temperatures generated brown biotite and hornblende (mainly from pyroxenes), which, in turn, were replaced by lower-grade assemblages with greenish biotite and epidote as

International Symposium on Granites and Associated Mineralizations, 1987, Salvador. Abstracts.

the main mafic minerals. Up to 75% of the massif shows both lower-grade mineralogy and tectonic gneissic foliation; H_2O influx, which favoured both deformation and recrystallization, was probably most significant along the marginal parts of the massif.

A Rb-Sr whole-rock reference isochron of 582±13 Ma was obtained for the metamorphosed late facies. This value is interpreted as a metamorphic homogenization age, more or less contemporaneous with the F_{n+2} regional phase of deformation.