New geochemical constraints on I-type granites of Macao: petrogenesis and geodynamic implications

P. QUELHAS[1;2], J. MATA[2], U.T. LOU[1], R. BORGES[1], M.L. RIBEIRO[3] AND Á. A. DIAS[1;2]

[1]ISE, University of Saint Joseph, Macau
[2]IDL, Faculdade de Ciências, Universidade de Lisboa, Portugal
[3]LNEG, Laboratório Nacional de Engenharia e Geologia, Portugal

Around 30 km^2 of Jurassic to Cretaceous granitic rocks crop out in Macao (Southeast China). They are mostly calc-alkaline metaluminous to weakly peraluminous (A/CNK = 0.96-1.13) I-type biotite granites, representing variable degrees of magma evolution. Two distinct groups of granites can be recognized in Macao: porphyritic granites with La_N/Yb_N = 2.05 – 11.83 and zircon saturation temperatures T_{Zr} = 727 – 835ºC and non-porphyritic garnet-bearing granites with La_N/Yb_N = 0.12-1.2 and T_{Zr} = 697 - 735ºC. Modeling shows that part of the variation of major and trace element contents is due to fractionation of feldspar, biotite, Ti-Fe oxides, sphene and hornblende. Variation of Rare Earth Elements (REE) seems to be mainly controlled by fractionation of allanite, monazite and apatite, while the presence of accessory garnet in the more differentiated granites explains the relatively high contents in heavy REE and Y. Small tetrad effects in the more evolved REE patterns suggests late-stage interaction between a highly evolved melt and a co-existing aqueous fluid, which might have contributed to some of the observed trace element depletions. Overall, geochemical variation is consistent with fractionation of Macao granitoids from quartz monzodiorite, through monzogranite, syenogranite to alkali feldspar granite.

The high T_{Zr} determined for the less fractionated granites are consistent with T_{Zr} determined for similar granites in adjacent areas, suggesting involvement of mantle-derived magmas that acted as a heat source for the regional magmatism. Contribution of mafic magmas is also supported by abundant microgranular mafic enclaves within some of the studied granitic facies. Trace element composition suggests a tectonic setting at the time of granite generation transitional from syn-collisional to within-plate extensional. This agrees with the regional geodynamic model for the Late Jurassic to Early Cretaceous stage of the Yanshanian Orogeny, marked by subduction of the Paleo-Pacific plate under Eurasian Plate followed by collision, later evolving to an extensional regime consequence of the slab break-up and foundering, allowing asthenospheric upwelling and increase of the geothermal gradient.