CRYSTALLIZATION CONDITIONS OF THE A–TYPE MANDIRA PLUTON, GRACIOSA PROVINCE, SE BRAZIL.

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ABSTRACT: The Mandira pluton is one among several A–type intrusions in the Neoproterozoic (ca. 580 Ma) Graciosa province **Error! Reference source not found.**formed in post-collisional, extensional tectonic regime in southern Brazil. This pluton includes two petrographic alkaline and aluminous associations, which are divided into peralkaline alkali–feldspar granites and syenites (Mandira And Acaraú units) and subalkaline biotite–hornblende syenogranites (Mandira1 unit) respectively. The hypersolvus peralkaline granites from the alkaline association contain perthitic alkali feldspars ($Or_{64-98}Ab_{36-2}An_0$); sodic–calcic amphiboles (ferric–ferro–winchite with mg# [=Mg/(Mg+Fe^{2+})] ca. 0.02), sodic amphiboles (arfvedsonite and riebeckite; mg# ≤ 0.005) and biotites (Fe–rich–annite with fe# [=Fe/(Fe^{2+}+Mg)] close to 1.0 and Al^{VI} ≤ 0.2 cpfu) are the main mafic minerals. Typical accessories are zircon, fluorite, magnetite, ilmenite, apatite and some astrophyllite. Syenogranites in the aluminous association comprise both plagioclase ($Or_0Ab_{85-98}An_{15-2}$) and perthitic alkali feldspar crystals; calcic amphibole (ferric–ferro–hornblende and hastingsite with 0.08 ≤ mg# ≤ 0.3) and biotite (Al–annite; fe# ca. 0.8 and Al^{VI} varying from 0.2 to 0.5 cpfu) as the main mafic minerals, and zircon, allanite, fluorite, magnetite and apatite, as accessory minerals. Whole–rock geochemical compositions and mineral chemistry of amphiboles and biotite were used to constrain the crystallization conditions (P–T) during the emplacement of the magmas that build the Mandira pluton. Zircon and apatite saturation thermometry (T_{Zr} and T_{Ap}) gives values within the interval 753–865°C and 663–696°C for the alkaline association and 749–827°C and 789–853°C for the aluminous association, respectively; these results are interpreted as close–to–liquidus temperatures. Hornblende–plagioclase thermobarometers point to pressure and close–to–solidus temperature ranges from 130 to 170 (±60) MPa and 723–750 (±35)°C, respectively. These pressures are in agreement with whole-rock normative data, which suggest also average low pressures (ca. 130 MPa for the alkaline association and ca. 186 Mpa for the aluminous one). The Fe/[Fe+Mg] ratios of calcic–amphiboles from the aluminous association suggest relatively low oxygen fugacity (fO_2) conditions, compatible with the high fe# ratios in biotite from magnetite-bearing granite varieties, which indicate reducing conditions (–1 ≤ ∆QFM ≤ 0, QFM = Quartz–Fayalite–Magnetite buffer). Of note, fe# ratios in bioite in (magnetite-bearing) varieties from the alkaline association point to somewhat more reduced conditions (∆QFM≤ –1). Estimated intensive crystallization parameters suggest that magmas were emplaced at shallow crustal levels at depths between ca. 2.2 and 2.7 km, compatible with field evidences, textural features, and mineral assemblages.

KEYWORDS: MINERAL CHEMISTRY, GEOTHERMOBAROMETERS, AMPHIBOLES AND BIOTITE.