The Congonhas Pluton: a new occurrence of orbicular granodiorite

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The new occurrence comes from a series of outcrops of the pluton scattered inside the historical artistic baroque city of Congonhas, Minas Gerais state, southeastern Brazil. The Congonhas Pluton contains distinctive swarms of 1 to 5 cm sized, round to lens or amoeboid shaped and concentrically arranged biotite-rich orbicules. The mineralogy of the orbicules comprises up to ~80 vol.% biotite as well as igneous muscovite, quartz, plagioclase (oligoclase/albite), and accessory ilmenite, titanite, apatite, zircon and rare allanite and/or monazite. The pluton varies from a muscovite biotite granodiorite facies to an albite-bearing trondhjemitic facies, containing from 69 to 73 wt.% SiO_2. The least fractionated member is granodioritic and peraluminous (1.4–3.2 wt.% of CIPW-normative corundum). The trace element content of the host granitoids is characterized by the relatively high Sr (>400 ppm) and the low to very low heavy Rare Earth Elements (REE, Y<4 ppm and Yb<0.3 ppm), producing high to very high chondrite-normalized light/heavy REE and Sr/Y ratios (>35 and 128, respectively). The orbicules are enriched in a number of elements compared to the host granitoids, including large-ion-lithophile (LIL) such as K, Rb and Ba, as well as REE and high-field-strength elements (HFSE, Y, Zr, Nb and Th). The sympathetic correlation between the biotite composition, and the whole rock compositions in a plot of cationic K content against the maficity index (measured as mol Mg + Fe), coupled with Rayleigh fractional crystallization trace element modelling allow to suggest that the orbicules crystallized as magmatic segregations in the parental granodioritic and peraluminous facies, and causing the shift of the residual liquid composition to the trondhjemitic and slightly metaluminous facies. Archaean T_{DM} Nd model age (ca. 3.0 Ga) and negative $\varepsilon Nd(t)$ of −8 to −6 (for inferred ca. 2.1 to 2.2 Ga crystallization age) indicate crustal recycled components to the most probable metasedimentary source rock of the Congonhas Pluton.