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Enclaves of diverse origin in Punugodu granite pluton, Prakasam District, Andhra Pradesh, India: Implications for source rock composition and crustal contamination

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The A-type Punugodu granite pluton (PGP), covering an area of about 7 sq. km occurs to the east of Kanigiri town, near Punugodu village, Prakasam district, Andhra Pradesh, India, is a massive equigranular, coarse grained, meta-aluminous and has hypersolvus nature. The PGP has a spatial association with granitic, gabbroic, gneissic, acid volcanic, calk-silicate and hornfelsic rocks. It also hosts for abundant and different types of enclaves. Based on the field and petrographical evidences, the enclaves can be seen as xenoliths, mafic magmatic enclaves (MME), felsic magmatic enclaves (FME) and basic microgranular enclaves (BME). The aim of present study is to understand the magmatic processes involved in the genesis of various types of enclaves in felsic igneous system.

Most xenoliths are felsic, angular and show sharp contacts with host granite. They are mostly rhyodacites consist of quartz, feldspars and perthite as essential minerals and hornblende, zircon, biotite and other opaques as accessories. Broadly they are less deformed exhibiting recrystallized quartz, plagioclase with bent lamellae, coronas and granophyric textures. Mafic xenoliths, however less in abundance, are coarse grained composed of altered plagioclase, clinopyroxene, fluorite, calcite, epidote and chlorite. FME and MME are appears to be coeval magmatic blebs exhibit ellipsoidal, lenticular, spherical, and linear shapes. They possess fine grained crystals with igneous micro texture, usually hosts for quartz and perthitic mantled xenocrysts. MME are composed with hornblende, alkali amphibole, augite, plagioclase, quartz and opaques. FME have similar mineralogical composition to those of host rock, consists of perthite, quartz, K-feldspar (microcline), highly pleochroic biotite. Blueish green alkali amphibole occurs as rims and blebs replaces augite at places. BME are basaltic, fairly dark, consist of fine grained crystals of plagioclase and pyroxene dispersed in glassy matrix. Most BME are with recrystallized light coloured child margins composed of fine grained quartz, perthite and biotite with sharp, crenulated to cuspate contact.

The MME, BME, FME and xenoliths are subalkaline tholetiic to alkaline and magnesian to ferroan in nature. TiO_2 contents are high in BMEs (1.48-1.83 wt%) in contrast to xenoliths, FME, and MME. The BME are tholeitic to alkaline, Nb enriched in the range of 20-79 ppm with low total alkali contents of 3.7-5.2 wt%, when compare to MME, FME and xenoliths (7.3-9.4 wt%), high Zr (144-466 ppm) and Ti/Y, Nb/Y and Zr/Y ratios 9.0-16.3, 0.7-0.9 and 3.6-4.3 respectively. Chondrite normalized REE patterns of MME, FME and xenoliths show highly fractionated, LREE enrichment and HREE depletion with negative Eu anomaly. BME patterns show slightly less fractionated without Eu-anomaly, which are transitional to tholetiic-alkaline basalts, and akin to oceanic - continental tectonic settings. The low Zr/Nb ratios (4.4-5.2) and high Nb/Yb (7.6-12.1) and Zr/Y (3.6-4.3) ratios relative to N-MORB are indicative of partial melting of enriched mantle source. Hence we speculate BME of OIB signatures which are early formed

and assimilated into granitic melts or late stage chemical exchange/equilibration of coeval melts at high temperature might have given such BME.

Field, petrographic and geochemical studies reveal that the enclaves hosted by A-type PGP show high Zr/Ti ratios indicating that they could have been derived from single magma source more likely to be a high Ti-basaltic parentage with an involvement of magma chamber process (phenocrystic BME). Mineral replacement phenomenon observed in the MME and FME, indicates mixing and mingling processes due to their coeval generation. Rhyodacitic xenoliths are the obvious products of assimilation process by the late stage granitic plutonism. The presence of fluorite in host granite as well as enclaves clearly reflects low degree of partial melting of the mantle at a high temparature which subsequently intruded into crust. The attenuation of barium in granites and in the enclaves indicate the genetic nature of the melts.