SHORT COMMUNICATION

SINGLE-SHELLED ORBICULAR GRANITOIDS OF POSSIBLE ARCHAEOAN AGE FROM BUNDELKHAND GRANITOID COMPLEX (BUGC)

Jayanta Kumar Pati
Department of Earth and Planetary Sciences Nehru Science Centre, University of Allahabad, Allahabad 211 002
Email: jkpatt@yahoo.co.in

Single-shelled orbicular granitoids from the Manpur area, Karwi district, Uttar Pradesh are being reported for the first time. However, this is the second report of orbicular granitoid from the Bundelkhand Granitoid Complex and dissimilar to the earlier report (Pati and Mamgain, 1996) from the Raui Kalyanpur area, Banda district (now in Karwi district) in terms of their modal composition, host rock and structure.

Location and Geological Setting

These orbicular granitoids occur about 600 m SSW of Manpur (25°8'18", 80°42'54") village, Karwi district in U P (Fig 1) and located (25°07'55 1", 80°42'45 7") at the base of a hill within deformed tonalite-trondhjemite-granodiorite (TTG) gneiss of possible Archaean age The exposed outcrop (Fig 2) size is about 54 sq m However, its true dimensions could not be deciphered due to the alluvial cover on the northeastern and northern sides of the outcrop.

The host rock is a gneiss having leucosome, melanosome and mesosome components. They are compositionally and mineralogically distinct. There are enclaves of amphibolite, hornblendite and banded amphibolite within this gneiss. The gneiss is intruded by late felsic intrusives similar to the earlier reports (~2.5 to 2.2 Ga) from different parts of the BUGC (Sarkar et al. 1984, Sarkar et al. 1994). The dolerite dykes of tholeiitic affinity (~1.8 to 1.6 Ga) at places cut across the felsic intrusives. The gneissic rock is extensively deformed, and sub-vertical to steeply inclined refolded folds (F2) with nearly E-W gneissosity (S2) are very well developed. The F1 folds are tight to isoclinal with thick hinge and attenuated limbs. The orbicules are deformed and show pancake shape.

Mineralogy of the Orbicules

The size of the orbicules shows wide range and most of them are oval to elliptical. The long axes measure between 3.5 and 17 cm and the short axes range between 1.7 and 8 cm. Some of the orbicules (Fig 3) have possibly been distorted due to their physical interaction in the plastic stage.

There is only one two shell in these orbicules excluding the core. The core is composed dominantly of biotite + chlorite + olivine + plagioclase + quartz + magnebite + apatite + zircon + sphene. The outer shell comprises plagioclase + quartz + trace amount of biotite + chlorite + apatite ± epidote ± magnetite ± zircon ± sphene ± calcite. Deformed twin lamellae are observed in plagioclase. The plagioclase composition does not seem to vary from core to outer shell. Except for the relative biotite abundance in the core, the overall assemblage in the core as well as outer shell remains the same. The matrix is dominantly defined by biotite and other phases remain in small amount. The modal analyses of the orbicular granitoids plot in the tonalite field and the host rock is TTG gneiss (Pati, in preparation). Orbicular tonalites and trondhjemites are also well known in India and elsewhere (Srikanta et al. 1994, Pati, in preparation, Van Diver, 1970).

Discussion

It is well known that orbicular granitoids are rare (Leveson, 1966), small in size (Elliston, 1984, Srikanta et al. 1994, Prakash, 1996, Decitre et al 2002), found in pluton margins (Sederholm, 1928, Moore and Lockwood, 1973, Elliston, 1984, Meyer, 1997), varied in composition (Leveson, 1966, Symes et al. 1987, Srinivasan et al. 1995), magmatic to metamorphic in origin and possibly forms in a superheated condition (Barrière, 1972, Vernon, 1985). Orbicular granitoids in the vicinity of a "cauldron structure" have also been reported from SSW of Kutawalt village, Shivpuri district, M P (Srivastava et al. 2002). Magma mixing is also considered responsible for the formation of the orbicular rocks (Pati and Mamgain, 1996, Decitre et al. 2002, Durant and Fowler, 2002). However, the genesis of orbicular granitoid is still unclear and every orbicular rock is different from the other requiring a special set of conditions for its formation. The detailed study of every orbicular occurrence becomes significant to solve the enigma in totality.

The orbicular tonalites from Manpur area occurring as...
Fig. 2. Orbicular granitoid outcrop occurs as a vein within the banded gneiss. The gneissic rock is intricately folded and intruded by late felsic intrusives.

Fig. 3. Close-up view of the orbicular granitoid outcrop shows the distortion of orbs in the plastic stage and varied shape of orbicules with contrasting core and shell compositions.
a narrow vein type body within the gneisses contain lots of biotite indicating relatively high $P_{H_2O}$ in the magma. The distortion of orbicules indicates that they are deformed in the plastic stage in an igneous environment. Their original shape must have been spherical following the phenomenon of surface tension. Experimental studies have shown that near the liquidus every melt would try to attain minimum surface area approaching that of a sphere (Murase and McBirney, 1973, Pati, 1985). The rapid undercooling of a superheated magma leads to the formation of orbicules due to diffusion controlled growth. It is also believed that despite the high $P_{H_2O}$ of the magma, the orbs are formed in a non-turbulent environment possibly due to the high viscosity of the dominant quartzo-feldspathic component. The relative low viscosity of biotite-rich melt must have helped in faster growth and, as a result, they occupy the core and rimmed by more viscous quartzo-feldspathic fraction. The country rock possibly provided water to the system for supercooling. The inter-orb spaces are filled by biotite-rich fraction, likely to be of another generation.

These two orbicular granite outcrops occurring in close proximity and of varied composition, mineralogy and structure suggest that it indeed represents superheating situation and margin of the Bundelkhand granit in the northeast. Detailed study of these rocks is currently in progress.

References

BARRÈRE, M (1972) Le gabbro orbiculaire des Alhérasses (massif de Néouvielle, Pyrénées françaises) Bull Soc Fr Minéral Cristallogr. v 95, pp 495-506

DECIRE, S, GASQUET, D et MARKOUNC, C (2002) Genesis of orbicular granite rocks from the Ploumanac'h Plutonic Complex (Brittany, France) petrographical, mineralogical and geochemical constraints Eur Jour Mineral, v 14 pp 715-731


LEVeson, D J (1966) Orbicular rocks A review Geol Soc Amer Bull v 77, pp 409-426


MOorc, J G and LOCKWOOD, J P (1973) Origin of comb-layering and orbicular structures, Sierra Nevada Batholith, California Geol Soc Amer Bull v 84, pp 1-20

Murase, T and McBirney, A R (1973) Properties of some common igneous rocks and their melts at high temperatures Geol Soc Amer Bull , v 84, pp 3563-3592


Pati, J K (1997) Specialized thematic studies of Bundelkhand Granitoids for appraisal of the mode of occurrence of molybdenum and associated mineralization Rauli Kalyanpur area, Banda districts, U P, Geol Surv India Rec v 129, pp 144-146

Prakash, H S M (1996) Orbicular structures from Lingsugur Area, Raichur District, Karnataka Jour Geol Soc India, v 47 pp 525-534


Sederholm VaI, J J (1928) On orbicular granites Bull Comm Geol Finland, v 83, 105p

Srikanta, S V, BHAT, PG K and SUBRAMAni, N (1994) Orbicular rocks from Closepet granite near Hoskote, Tumkur district, Karnataka Jour Geol Soc India, v 43 pp 267-279

Srinivasan, K N and Roop KUMAR, D (1995) Orbicular structures from a diorite body within the granite complex of Nellore Schist Belt Jour Geol Soc India, v 45 pp 277-283


Vernon, R H (1985) Possible role of superheated magma in the formation of orbicular granitoids Geology v 13 pp 843 845

(Received 15 December 2003 Revised form accepted 6 April 2004)}