SHORT COMMUNICATION

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

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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 Rauli 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, too 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 (F_2) with nearly E-W gneissosity (S_2) are very well developed The F_1 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 + oligoclase + quartz + magnetite + apatite + zircon + sphene The outer shell comprises oligoclase + 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 (Srikantia 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, Srikantia 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 Kutawali 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

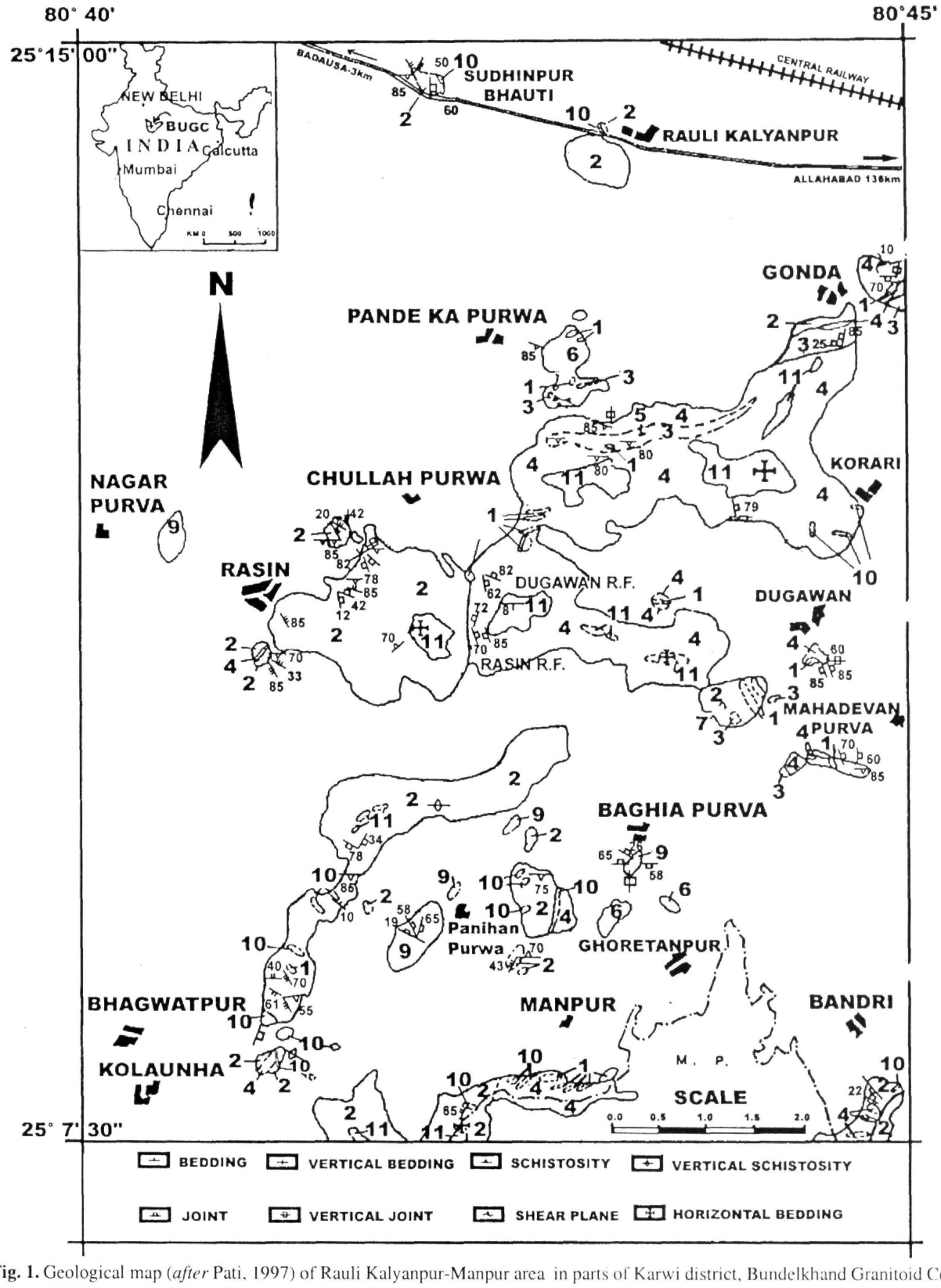

Fig. 1. Geological map (*after* Pati, 1997) of Rauli Kalyanpur-Manpur area in parts of Karwi district, Bundelkhand Granitoid Complex (BUGC). **1.** Enclave rocks (gneisses, amphibolite, banded amphibolite, hornblendite), **2.** Porphyritic granitoid suite, **3.** Foliated grey granitoid, **4.** Foliated greyish pink granitoid, **5.** Pegmatite-1, **6.** Foliated pink granitoid, **7.** Leucogranite, **8.** Pegmatite-2, **9.** Giant quartz vein, **10.** Dolerite dykes and **11.** Vindhyan Supergroup of rocks.

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.

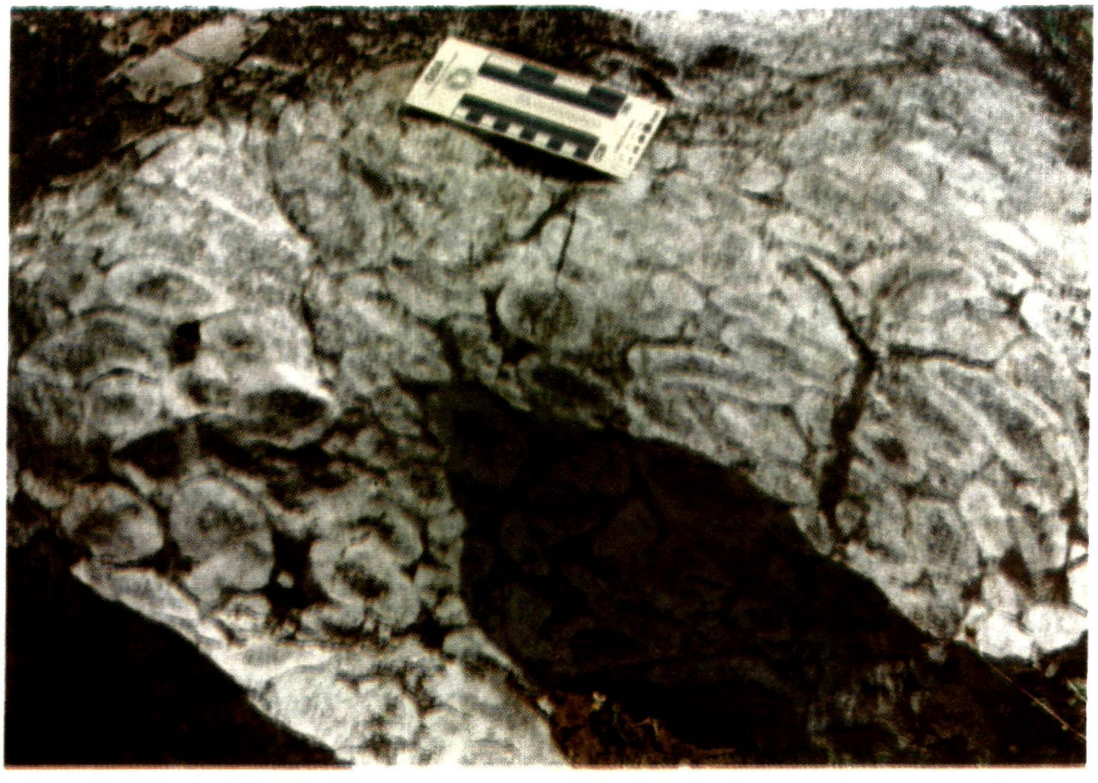

Fig. 3. Close-up view of the orbicular granitoid outcrop shows the distortion of orbs in the plastic stage and varied shape of orbicules with contrasting core and shell compositions.

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 to 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_{H2O} 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 granitoid outcrops occurring in close proximity and of varied composition, mineralogy and structure suggest that it indeed represents superheating situation and margin of the Bundelkhand craton in the northeast Detailed study of these rocks is currently in progress

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