Petrogenesis and tectonic implications of orbicular granodiorite from Yangtze cratonic nucleus

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Orbicular granodiorite outcropped in the Yangtze cratonic nucleus (Huangling Dome), where at least six Precambrian (3.4-0.8 Ga) tectonic events have been recorded. Hence, Huangling Orbicluar Granodiorite (HOG) could help us to investigate both petrogenesis and tectonic implications.

The HOG exposed in the northern margin of Neoproterozoic (~0.8 Ga) Huangling batholith, merely 30 meters long and 5 meters wide. They are composed of obicules (5-12 centimeters in diameter) and matrix. The obicules have different structure as no shell, one-layer shell and multiple-layer shells. In detail, one-layer shell are formed by dark color minerals such as amphibole and biotite; multiple-layer shells are made up of dark layers (dominated by amphibole) and light layers (dominated by plagioclase) at random intervals (0.2-4.3 millimeters). Their inner parts (core) are major plagioclase with minor amphiboles.

Mineral chemistry data are obtained by Electron Probe Micro Analyzer (EPMA) from two profiles crossing obicules. The An (An=100 Ca/(Ca+Na+K)) of plagioclase in matrix, shell and core from one-layer obicule are 26-30, 30-35 and 35-40, indicating the crystallization sequence is from core to shell and then matrix. The An of plagioclase in matrix, shell and core from multiple-layer obicule are more complicate, as 33, 36-46 and 42-45. The data suggest that the obicule crystallized before matrix, without distinct sequence between core and shells.

P-T conditions are calculated by Hb-Pl thermobarometry (Holland and Blundy, 1994; Bhadra and Bhattacharya, 2007). 0.63 GPa and 728℃ are obtained from core of one-layer obicule, while 0.49 GPa and 706℃ are gained from core of multiple-layer obicule. Moreover, P-T condition of multiple-layer shells vary from 0.50-0.80 Gpa and 669-713 ℃, showing pressure decrease towards core with few sharp increasing. The average P-T condition of shells are 0.60 Gpa and 700 ℃, whose pressure is higher than the core. As a result, the multiple-layer obicules may form during decompression. Besides, the sharp increase of An and P-T condition suggest that more basic (Ca-rich) composition may be added into shells during formation.

Chemical distribution patterns of shells and *in-situ* zircon structure have been examined by field emission scanning electron microscopy (FESEM). Energy-dispersive X-ray spectrometers (EDS) mapping shows that no obvious chemical differentiation have been observed in the rhythm shells. Core-mantle-rim structure zircons have been found in the matrix near the shells of obicules. Short columnar zircons with oscillatory bands have been found in amphiboles, while long columnar zircons with wide bands and overgrowth rims/patches have been found in plagioclase.

Zircons with Core-mantle-rim structure present concordant U-Pb ages as 1.95 Ga, 1.85 Ga and 0.88 Ga, with corresponding Epsilon Hf(t) values of -17.2 to -4.6, -10.8 to 0.36 and -23.6 to -21.5. Both short and long columnar zircons present concordant U-Pb ages of 0.88 Ga with Epsilon Hf(t) values of -23.7 to -19.85.

Based on new data and geological background, a model for generation of the HOG has been proposed as:

1) sediments metamorphosed at 1.95 Ga during continent-continent collision (Yin et al., 2013); 2) A-type granitic magma intruded the metasediments at 1.85 Ga (Xiong et al., 2009); 3) dioritic magma intruded the metasediments via the A-type granitic channel at 0.88 Ga; 4) water-rich superheating caused by dehydration of metasediments; 5) rapid crystallzation caused by undercooling while pressure decreasing.

Keywords: Huangling Orbicluar Granodiorite, Cratonic nucleus, Petrogenesis, Tectonic implications