

## **Back reaction of peritectic garnet for origin of mafic enclaves in S-type granite**

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The origin of mafic enclaves in granites is an important topic in igneous petrology. By studying different types of enclaves, one can acquire valuable petrogenetic information about the source nature and magmatic processes, which are not readily available from granites themselves. For instance, residual enclaves represent refractory restites from the source, whereas mixing enclaves register magma-mixing process in open-systems. However, many mafic enclaves in S-type granites are rich in biotite, but their origin has been not resolved yet.

We carried out a combined study of petrology and geochemistry for biotite-rich enclaves and their host S-type granites from the Jiuling batholith in South China. The enclaves are fine-grained, and contain more biotites and less K-feldspars than the host granites. Garnet debris occurs in some biotite aggregates. Petrographic observations show the occurrence of biotite rims on garnet fragments and the embayment of biotite and quartz into the garnet, suggesting that some biotites are produced by consumption of garnets. These metasomatic biotites are characterized by higher Mg# values, lower K<sub>2</sub>O and TiO<sub>2</sub> concentrations, lower (La/Yb)<sub>N</sub> and (Gd/Yb)<sub>N</sub> values and distinct negative Eu anomalies. Some biotites in the enclaves exhibit similar geochemical characteristics to those metasomatic ones. The biotites in the enclaves contain no K-feldspar inclusions and more plagioclase inclusions than those in the host granites. Furthermore, these enclaves have indistinguishable whole-rock Sr-Nd-Hf-O isotopes and consistent zircon U-Pb ages, similar zircon Hf-O isotopes to the host granites. Therefore, the biotite-rich enclaves were produced by back reaction of peritectic garnet aggregates with granitic melts at an increased water fugacity in the granitic magma. Thermodynamic modeling indicates that the quantity of directly crystallized biotites is low (< 5%). It is inferred that most of the biotites in the S-type granites are produced by the back reaction of peritectic garnet entrained from the source during magma emplacement.