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Residual, magmatic and replacement origins of biotite in the Wuluma Granite

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The Wuluma Granite (ca.17 km^2) is hosted by Palaeoproterozoic, granulite facies metasedimentary and metaigneous rocks. It is believed to have formed by partial melting of quartzo-feldspathic gneisses and segregation of the anatectic melt at 1728$\pm$3 Ma.

Wuluma granite is anomalously rich in biotite. We have investigated these biotites and find that there are several different groups. These vary in mode, form, microtexture, and composition. A first group occurs in granulites and migmatites at Wuluma, and enclave of this plus schlieren in the Wuluma granite. These biotites are coarse-grain, idioblastic to subidioblastic and oriented. They can be interstitial or corroded. Biotites of this group in granulite, enclave and migmatite, have higher Mg number than those in schlieren. Biotites in the migmatites also have lower Ti and Al contents than all other biotites found. The second group comprises the biotites in the matrix of the Wuluma granite, and are fine to coarse grained, anhedral to subhedral and generally oriented. They have low Mg number, except the medium grained ones have systematically slightly higher Mg number. There is a variation in Al^{IV}/Al^{VI} which correlates with the grainsize of the groundmass. In general these biotites have compositions similar to those in the schlieren. The third group are biotites occuring as inclusions or as a replacement of other ferromagnesian minerals in the granulites, or in the granite. The phase most commonly replaced is garnet, and the phase most commonly with inclusions of biotite is orthopyroxene. These biotites are anhedral to subhedral in orthopyroxene and are not oriented (they are not rounded, red-coloured biotite commonly regarded as relics of prograde biotite). Chemically they are much richer in Fe compared to all the other biotites in the rocks.

These different groups of biotite represent different phases of biotite growth. The first group represents growth during high-temperature prograde metamorphic reaction in the granulites, migmatites, enclaves and schleiren. In contrast, the second group represents growth of biotite from granitic magma. The third group is replacement of ferromagnesian phases garnet, cordierite and orthopyroxene that were either residual (peritectic) or of liquidus origin in the granite. Replacement began as a late stage magmatic reaction between pre-existing anhydrous ferromagnesian minerals and the residual anatectic melt. Subsequently post-solidus reaction between the remaining garnet, cordierite or othopyroxene and high temperature aqueous fluid resulted in further replacement by biotite.