Solving three metamorphic mysteries by apprehending the culprit: the biotite solution model

F. GERVAIS[1]

[1]Polytechnique Montreal, Montreal, QC, H3T1J4, Canada (*correspondence: felix.gervais@polymtl.ca)

Pelitic schists in amphibolite to granulite facies metamorphic terrains often present features that had no theoretical explanation until this contribution. Indeed, phase equilibria modeling cannot account for textures commonly observed in most pelitic schists that followed a prograde path, such as the following three examples:1) biotite often presents textural evidence of growth along a prograde path; 2) garnet grains in subsolidus schist are generally inclusion-rich, whereas inclusion-poor grains or rims around inclusion-rich cores are prevalent in suprasolidus schist. The paucity of the former in migmatitic terrains implies an important dissolution phase before growth of the latter; 3) some studies have linked zircon trace element patterns to prograde metamorphic reactions suggesting prograde zircon growth.

Phase equilibria modeling using the biotite solution model of Tajčmanová et al. (2009) reveals that, with sufficient Ti in the bulk composition, garnet and rutile become reactants in the muscovite-dehydration melting reaction and biotite becomes a product. The Zr budget of a pelitic schist from the Canadian Cordillera was calculated from T-dependent equations for the Zr content in garnet, rutile and melt and results predict zircon growth along a prograde path as previously documented from zircon trace elements patterns of this sample. These results indicate that zircon and biotite should grow, whereas garnet and rutile should breakdown during the muscovite-dehydration melting of a typical pelitic schists following orogenic, prograde P-T paths, thus resolving three longstanding mysteries of metamorphic petrology.

Tajčmanová et al. J. metamorphic Geol., 2009, 27, 153-165.