American Mineralogist, Volume 86, pages 1414–1422, 2001

Instability of Al_2SiO_5 "triple-point" assemblages in muscovite+biotite+quartz-bearing metapelites, with implications

DAVID R.M. PATTISON*

Department of Geology and Geophysics, University of Calgary, Calgary, AB, T2N 1N4, Canada

ABSTRACT

This paper uses constraints from experiments, thermodynamic modeling, and natural mineral assemblages to argue that Al_2SiO_5 "triple-point" assemblages, in which all three Al_2SiO_5 minerals are in stable equilibrium, are not possible in common muscovite(Ms)+biotite(Bt)+quartz(Qtz)-bearing metapelitic rocks because the reactions that first introduce an Al_2SiO_5 mineral to these bulk compositions occur at higher temperature than the triple point. Less-common, highly aluminous bulk compositions may develop Al_2SiO_5 minerals at temperatures below the triple point such that stable triple-point assemblages are theoretically possible. The "invisibility" of the triple-point to common Ms+Bt+Qtz-bearing metapelites calls into question most metapelitic triple-point localities reported in the literature, and carries implications for the topology of the metapelitic petrogenetic grid, the bathozone/bathograd scheme of Carmichael (1978), and the possibility of prograde kyanite $\rightarrow$ andalusite $\rightarrow$ sillimanite sequences. Re-examination of reported triple-point localities suggests that in most if not all cases, the Al_2SiO_5 minerals grew at different times in the metamorphic history of the rock.