

Limits on the precision of geobarometry at low grossular and anorthite content

CLIFFORD S. TODD*

Department of Geology and Geophysics, SOEST, University of Hawaii, Honolulu, Hawaii 96822, U.S.A.

ABSTRACT

In many cases the grossular content of garnet and/or the anorthite content of the plagioclase used in thermobarometry are very low, leading to a large pressure uncertainty. The dependence of this uncertainty on mole fractions of grossular and anorthite is evaluated by propagating uncertainties in composition and activity terms into the GASP geobarometer for a series of hypothetical rocks equilibrated at 550 °C and 6 kbar. Results are ± 0.65 kbar (1 standard deviation) at high mole fractions ($X_{\text{grs}} = 0.15$, $X_{\text{an}} = 0.98$), increasing to ± 1.55 kbar at low mole fractions ($X_{\text{grs}} = 0.03$, $X_{\text{an}} = 0.133$). Specific results vary depending on errors chosen, P - T conditions, thermodynamic database, and activity models used, but an overall trend of increasing uncertainty with decreasing mole fraction is robust. These theoretical conclusions are supported by a data set of 42 amphibolite facies metapelitic samples for which pressure and temperature were determined with and without grossular-anorthite-bearing equilibria. If grossular and anorthite mole fractions are large the difference in P determination is low (<0.5 kbar), but if these mole fractions are <0.10 and 0.30 , respectively, the difference in P determination is variable and can be high (>3 kbar). A general guideline is that if the product of grossular and anorthite mole fraction is <0.05 , then grossular-anorthite-bearing equilibria should be used only with great caution.