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

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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_{grs} = 0.15, X_{an} = 0.98), increasing to ± 1.55 kbar at low mole fractions (X_{grs} = 0.03, X_{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.