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A Note on the Significance of the Assemblage Calcite-Quartz-Plagioclase-Paragonite-Graphite

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Abstract. The biotite zone assemblage: calcite-quartz-plagioclase (An_{25})-phengite-paragonite-chlorite-graphite, is developed at the contact between a carbonate and a pelite from British Columbia. Thermochemical data for the equilibrium paragonite+calcite+2 quartz=albite+anorthite+CO_2+H_2O yields:

$$\log f_{H_2O}+\log f_{CO_2}=5.76+0.117\times10^{-3}\,(P-1)$$

for a temperature of 700° K and a plagioclase composition of An_{25}. By combining this equation with equations describing equilibria between graphite and gas species in the system C-H-O, the following partial pressures: $P_{H_2O}=2572$ b, $P_{CO_2}=3162$ b, $P_{H_2}=2.5$ b, $P_{CH_4}=52.5$ b, $P_{CO}=11.0$ b are obtained for $f_{O_2}=10^{-26}$. If total pressure equals fluid pressure, then the total pressure during metamorphism was approximately 6 kb. The total fluid pressure calculated is extremely sensitive to the value of f_{O_2} chosen.

Among the micas, paragonite is not uncommon in metamorphosed pelitic rocks; however, it has rarely been reported as a member of a carbonate-bearing assemblage. In this note we report the occurrence of a calcite-quartz-plagioclase-phengite-paragonite-chlorite-graphite assemblage in the biotite zone rocks of the Horsethief Creek Formation, Esplanade Range, Selkirk Mountains, British Columbia (51°35′N, 117°35′W). Pelitic rocks of this Proterozoic unit locally contain chloritoid and paragonite whereas biotite is generally more abundant in the metasandstones. Thin interbeds of metacarbonate, up to 10 feet thick, contain calcite-mica-quartz (± dolomite) assemblages. At contacts between pelitic and carbonate beds more diverse assemblages are developed, including the assemblage calcite-quartz-plagioclase-phengite-paragonite-chlorite-graphite.

In recent years hydroxl-bearing silicate and silicate-carbonate assemblages have been studied to obtain estimates of fluid pressures during metamorphism (e.g. Wones and Eugster, 1965; Greenwood, 1967). In this note thermochemical and experimental data are used in an attempt to assess the significance of the assemblage calcite-quartz-plagioclase-paragonite-graphite as a fluid pressure indicator during metamorphism.

Partial analyses with the electron microprobe indicate about 3.3 mole percent $MgCO_3$ solid solution in calcite from this assemblage. This value, in light of recent experimental data (Goldsmith and Newton, 1969) and an estimated load pressure of 3—6 kilobars indicates a minimum temperature of approximately 700° K (427° C). This temperature is consistent with results obtained from the partition of Mg between calcite and dolomite in adjacent rocks.