32nd International Geological Congress, Florence, August 20-28, 2004, Abstract Volume, part 1, p. 296.

Session 59-8 Oral

VERY LOW-GRADE METAMORPHISM OF MANGANIFEROUS METAPELITES IN THE BELGIAN ARDENNES: SIGNIFICANCE OF THE GARNET + SUDOITE ASSEMBLAGE

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Keywords: sudoite; spessartine; manganiferous; low-grade; thermobarometry

In general, mineral parageneses in pelitic sediments do not sensitively reflect very low-grade/low-grade metamorphic conditions. In contrast, manganiferous pelitic rocks and associated hydrothermal veins may show a variety of specific assemblages that include silicate minerals such as ottrelite (cld), carpholite (cph), spessartine (grt), davreuxite, clinochlore (chl), and sudoite (sud). Mineral assemblages containing these minerals are suitable candidates for geothermobarometric approaches. We studied Silurian metasediments from the Lienne valley in the Venn-Stavelot Massif of the Belgian Ardennes that were metamorphosed at about 300°C, 1-2 kbar. The country rock is mainly a fine-grained red shale containing hematite. Occasionally, mm-sized whitish layers ("mini-coticule") are intercalated that are characterized by the assemblage: grt + sud + chl + muscovite + paragonite + quartz. No carbonate minerals are present. Neglecting micas, the observed assemblage can closely be modelled in the system MnO-MgO-Al2O3-SiO2-H2O (MnMASH). The stability field of grt + sud in MnMASH can be calculated using published thermodynamic data for MASH phases as well as Mn-Mg partition coefficients derived in the present study. Accordingly, the sud + grt paragenesis is stable in a narrow T range of about 300°C to 380°C, at P up to 6 kbar. The calculated low-T limit of grt + sud is defined by the univariant reaction cph + chl = grt + sud. To higher T, grt + sud decompose to chl + andalusite at $P < 2$ kbar and to chl + pyrophyllite at higher P. The univariant MASH equilibrium sud + chl = grt is mainly T dependent. Although the calculations are tentative because of very low activities of the pyrope and clinochlore components, the derived P-T stability of sud + grt fits well with previously estimated metamorphic conditions. A further sophistication is achieved additionally considering the white K-mica components (muscovite, celadonite) and a further chl component (amesite). We conclude that mineral assemblages in manganiferous metapelites may be well suited to characterize very low-grade P-T conditions.