Peak-pressure determination in retrogressed eclogite and the "bulk-rock composition effect" on omphacite composition

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In this study, three new localities of strongly retrogressed eclogite from the Dunhuang Orogenic Belt, northwestern China are described. A detailed investigation was carried out to understand if similar or contrasted peak pressure conditions are recorded by these metabasite bodies. Omphacite in these samples has broken down to symplectites of clinopyroxene + oligoclase ± quartz ± amphibole. Quantitative compositional maps of symplectites have been used to reintegrate original omphacite compositions through the integration of pixel composition using the built-in density corrected algorithm available in XMapTools (Lanari *et al.*, 2014). The values of X_{Jd} (= Na - Fe^{3+}) among the retrogressed eclogites range from 0.26 to 0.40. Gibbs Energy minimization was conducted for each sample using the bulk-rock composition at the pressure-peak pressure–temperature (*P*–*T*) condition of 2.1 GPa and 700 °C, determined in a fresh eclogite sample found in this belt (Wang et al., 2017). The modeling predicts that different samples have slightly different mineral assemblages, typically consisting of Grt + Omp + Ru + Qz ± Amp ± Mica ± Bt, and is able to reproduce the range of observed X_{Jd} values within uncertainty. This result indicates that different X_{Jd} values can reflect identical *P*–*T* conditions.

Pressure, temperature, and bulk-rock composition are the three main factors controlling the mineral assemblage, mineral modes, and mineral compositions in metamorphic rocks. In the present case, it can be ruled out that *P* and *T* are the controlling factors for the observed differences in X_{Jd} values in different samples. We find that the X_{Jd} values are correlated with bulk Na_2O contents in our samples, highlighting a "bulk-rock composition effect". A database for eclogite containing bulk-rock compositions, mineral assemblages, mineral compositions, and peak metamorphic *P*–*T* conditions has been compiled from the literature to assess the extent of this effect in other eclogites. The X_{Jd} of clinopyroxene versus Na_2O contents in bulk-rock and the Na/(Na+Ca) of clinopyroxene versus Na/(Na+Ca) of bulk-rock scatter diagrams show that the main factor controlling X_{Jd} at similar pressure (and temperature) conditions is bulk composition. In the Na/(Na+Ca) of clinopyroxene versus Na/(Na+Ca) of bulk-rock scatter diagram, most data points deviate upward from the 1:1 line, perhaps reflecting the contents of garnet, zoisite, amphibole, lawsonite, and other calcium-containing minerals in different samples.

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