Geophysical Research Abstracts, Vol. 8, 03144, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03144


# Compositional and phase relations in “dry” eclogite at diamond-related pressures.

V.G. Butvina, Yu.A. Litvin, A.A. Marakushev, O.G. Safonov.
Institute of Experimental Mineralogy, Chernogolovka, Moscow district, Russia, butvina@iem.ac.ru

Introduction

Pseudo-ternary eclogite system omphacite-pyrope(+grossular)-almandine(+grossular) is a perfect approximation for modeling of phase equilibria of natural mantle eclogites. It includes several pseudo-binary joins, such as omphacite-pyrope, omphacite-almandine, pyrope-almandine, as well internal join in omphacite-garnet. Some of these joins are experimentally studied at pressures 3-4 GPa (Davis, 1963; O’Hara, 1963; Litvin, 1991). However, most of mantle eclogites were formed at pressures far above these values. No data on “dry” eclogite phase relations at diamond-related pressures ($>$ 5.0 GPa) are available so far. We experimentally constructed some of these joins at pressures 4.0 - 7.0 GPa. Compositions of starting phases were chosen in accordance with prototypes from natural rutile-bearing eclogites.

Experimental results

(1) The phase diagrams of *the join pyrope-almandine* are experimentally constructed at 4.0 and 6.5 GPa (Butvina et al., 2001). At both pressures, the join shows a complete solubility of end-members. In the ternary pyrope-grossular-almandine join we found corundum, that agrees with the experimental data on the pyrope-grossular system at lower pressures (Maaloe & Wyllie, 1979; Malinovskii et al., 1982). Kyanite appears in the grossular-almandine part of the system, as well.

(2) Phase relations in the pseudobinary system clinopyroxene (omphacite)-garnet were studied at 7.0 GPa. Garnet and omphacite are only liquidus phases. No incongruent melting of garnet is observed in the system. The solidus is composed of an assemblage Cpx+Grt exclusively. Concentration of the Ca-Tschemack molecule in clinopy-

roxene is negligible. Nevertheless, clinopyroxene shows some excess of alumina with respect to the jadeite, which is related to the Ca-Eskola end-member. It is found that lnKd(Mg/Fe) between garnet and clinopyroxene shows a strong negative dependence on the Ca-Eskola content in clinopyroxene. This implies that Ca-Eskola must be taken into account in derivation of Grt-Cpx geothermometer for ultrahigh pressure conditions.

## Discussion and conclusion

The above features are major differences of the eclogite system at 7 GPa from similar Na-free fluid-absent eclogite systems at pressures 3.0 – 4.0 GPa (Davis, 1963; O'Hara, 1963; Litvin, 1991). However, these data closely describe compositional relations of garnets and omphacites in natural mantle eclogites. For example, the absence of the Cpx solid solution field perfectly agrees with natural data, which show that Ca-Tschemack content of is not characteristic for jadeite-rich omphacites. On the CFM diagram, high-temperature Grt-Cpx pairs form shorter tie-lines with respect to low-temperature assemblages. "Dry" solidus of the studied eclogite is located at about $1450^{0}$Ñ. This value is significantly higher than temperatures of eclogites formation deduced from mineral thermometry. High temperature of the solidus for the "dry" eclogites implies fluid-rich (probably, aqueous) environment for natural eclogite formation.

## References

Butvina V.G., Bobrov A.V., Litvin Yu.A. Experimental study of the system pyrope – grossular – almandine at 6,5 GPa and 1500-1900 Ñ. 2001. Dokaldy Akademii Nauk, V. 379, no. 5. P. 655-658.

Davis B.T.C. The system diopside-forsterite-pyrope at 40 kbars. Carnegie Inst. Wash. Y.B., 1963. Vol. 62. P. 165-171.

O'Hara M.J., Yoder H.S. Formation and fractionation of basic magmas at high pressures. Scott.J.Geol., 1967, v. 3(1). pp. 67-117.

Litvin Yu.A. Physico-chemical study of melting of deep-seated Earth's substance. Moscow: Nauka. 1991. 312 p.

Maaloe S., Wyllie P. The join grossularite-pyrope at 30 kb and its petrological significance // Amer. J. Sci. 1979. Vol.279. P. 288-301.

Malinovskii I.Y., Doroshev A.M., Kalinin A.A. «Investigashion of garnet stability at system pyrope-grossular at 30 kbar»// Doklady of Academy of Science USSR, 1982, v.268, pp.189-194.