MELTING RELATIONS ON THE OMPHACITE-GARNET JOIN AT PRESSURE OF 7.0 GPa: EXPERIMENTAL MODELING OF ORIGIN OF DIAMOND-BEARING ECLOGITES

Butvina V.G., Litvin Yu.A.
butvina@hotbox.ru
Tel: (095) 939-2971.

Herald of the Earth Sciences Department RAS, № 1(20)′2002
URL: *http://www.scgis.ru/russian/cp1251/h_dgggms/1-2002/informbul-1.htm#faza-3.engl*

The eclogite system on the omphacite-garnet join was chosen for experimental study as a model for the mantle source region and diamond-bearing rocks. The boundary multicomponent compositions are the next (in mol.%): Prp – 16.1; Grs – 30.9; Alm – 53.0 (for garnet) и Jd – 36.2; Acm – 53; Aug – 10.8 (for clinopyroxene). The compositions were calculated as the most representative for the Maksutov Complex (Southern Urals) and reflect some key peculiarities of eclogite minerals from the mantle nodules in kimberlite diatrems.

The omphacite-garnet join studied at 7.0 Gpa is the inner section of the ternary omphacite – (pyrope+grossular-30%) – (almandine+grossular-30%) system. The melting diagram of the omphacite-garnet join is on the fig.1.

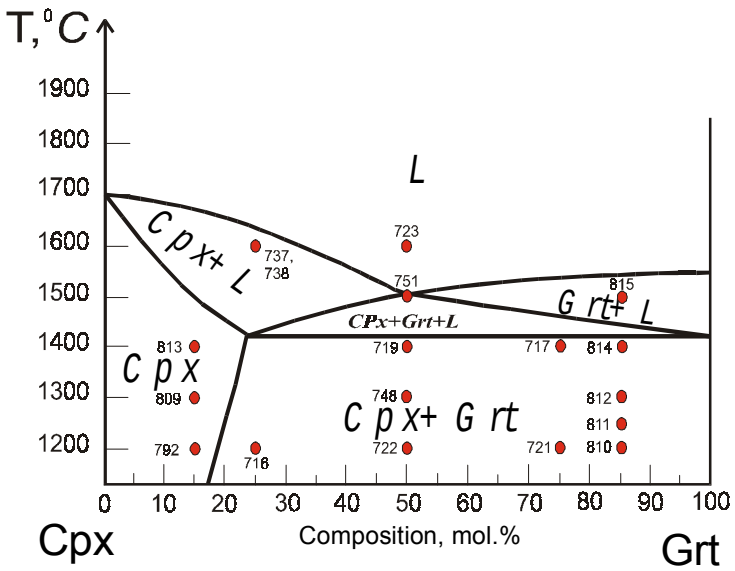

Fig.1. The binary melting diagram of garnet-clinopyroxene join at constant pressure 7.0 GPa.

Both, clinopyroxene (Cpx) and garnet (Grt) are the liquidus phases. For subsolidus conditions, the clinopyroxene solid solution and clinopyroxene-garnet assembly fields are identified. Melting relations are controlled by the eutectic relations Cpx+Grt+L, (respectively, invariant curve Cpx+Grt+L on the fig.2) within 1420-1500 C. Garnet phases show more uniform compositions than clinopyroxene for similar conditions of high-pressure experiments. In the course of quenching, completely melted compositions form dendritic structures. The experimental data combined with published data [1,2] for boundary components permit to construct a liquidus surface for the ternary omphacite – Mg-Ca-Grt – Fe-Ca-Grt system (fig.2). Melting relations on the multicomponent omphacite-garnet join are more under influence of the eutectic jadeite-pyrope system than the peritectic diopside-pyrope one if the relation revealed at 4 Gpa [1,2] is value for 7.0 GPa. Phase equilibria on the pyrope-almandine join at 7.0 GPa [3] are characterized by complete series of solid and liquid solutions without extreme points. Constitution of the ternary omphacite – (pyrope+grossular-30%) – (almandine+grossular-30%) phase

diagram may be rather influence with jadeite-pyrope system than diopside-pyrope one, and it is expected to characterize by divariant eutectic line and not include invariant equilibria at 7.0 Gpa.

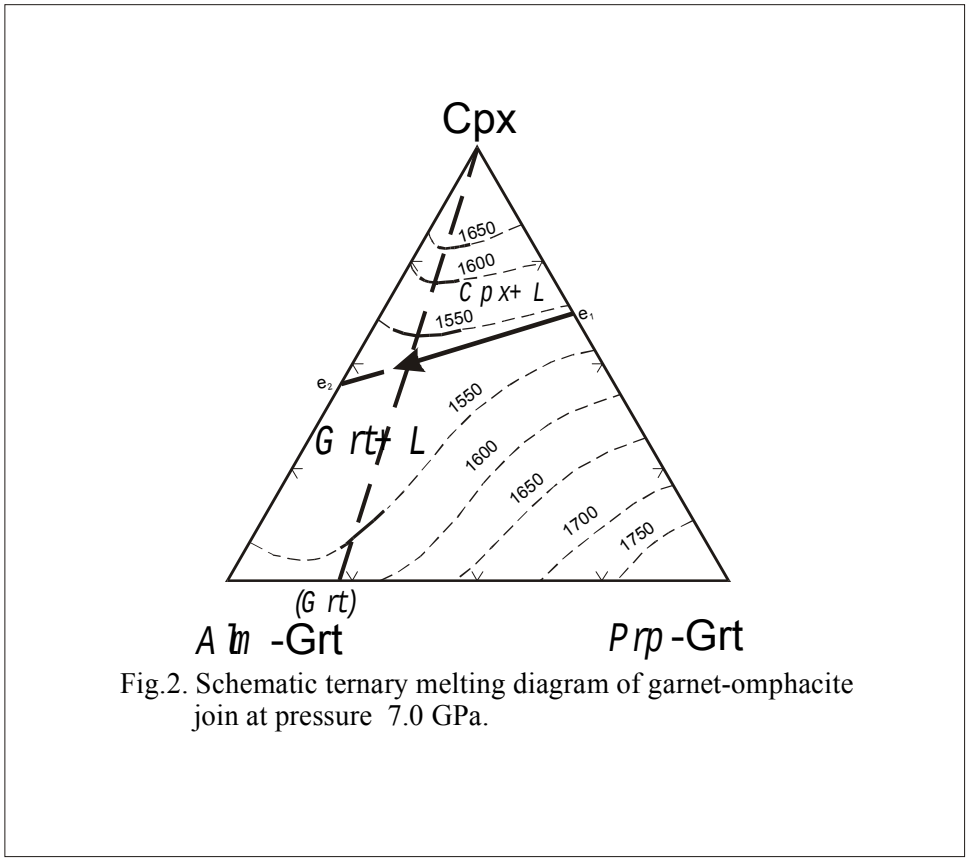

Fig.2. Schematic ternary melting diagram of garnet-omphacite join at pressure 7.0 GPa.

The ternary melting equilibria are of key importance for origin and evolution of diamond-bearing eclogites in the mantle conditions. The formation of mantle eclogites is controlled by the invariant Cpx+Grt+L equilibrium curve. Liquidus topology of the ternary system is not consistent with the formation of natural garnet crystals with inverse zonation at constant pressure.

References

1. *Litvin Yu.A.* Physico-chemical study of melting relations for the deep Earth's mantle substance. Moscow. Nauka. 1991. (in Russian).
2. *Bell P.M., Davis B.T.C.* Melting relations in the system jadeite-diopside at 30 and 40 kb // Amer. J. Sci. A. 1969. V.267. P.17-32.
3. *Butvina V.G., Bobrov A.V., Litvin Yu.A.* Experimental Studing the Pyrope-Grossular-Almandine System at 6.5 Gpa and 1500-1900 C // Doklady Academii nauk. 2001. V. 379. №5. P.655-658. (in Russian).