DIAMONDIFEROUS ECLOGITES FROM THE SIBERIAN PLATFORM: SAMPLES WITH PERIDOTITIC SIGNATURES?

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Xenoliths from the upper mantle have undergone a wide variety of processes at varying P&T, many of which are recorded in the mineral compositions and textures. Eclogites and peridotites are of great interest for having experienced such processes. However, the petrogenetic connection between these two xenolith types is not yet well understood. While peridotites are believed to be of true mantle origin, several models for the origins of eclogites have been proposed. Some workers believe that all eclogites are derived from the subducted oceanic crust (Jacob et al., 1994; Ireland et al., 1994), while others have proposed that at least some eclogite xenoliths could be derived from the mantle (McCulloch, 1988; Neal et al., 1990; Jerde et al., 1993; Snyder et at., 1993) or even that all of them represent high-pressure mantle cumulates (Smyth et al., 1989). Coleman et al. (1965), divided eclogites into three different groups A, B, and C, based on their origin. This classification was put into chemical framework by Shervais et al. (1988), Taylor and Neal (1989) and Neal et al. (1990). According to this later classification, Groups B and C represent subducted oceanic crust while Group A eclogites have a true mantle origin.

The Siberian Platform is located in northeastern Russia, occupying a large territory from Lake Baikal to the Arctic ocean. Eclogites studied represent part of an extensive collection of diamondiferous eclogites from the Udachnaya kimberlite. Three eclogite samples from the Udachnaya kimberlite were examined in this study. All samples are 7-10 cm on average in longest dimension, coarse-grained, and equigranular. Two eclogites (U-25/84 and U-281/84) consist of usual bimineralic assemblages of garnet and clinopyroxene in proportions from 45:50 and 60:40 respectively. Garnets in these samples are pale-orange in color and have grain size ranges from 1 to 8 mm in longest dimension. Embayed borders for garnet grains are a significant feature for both samples. Clinopyroxene is pale-green in color and interstitial to garnet grains. Both garnet and clinopyroxene are extensively fractured. Sample U-92/18 consists of a usual eclogitic mineral assemblage (i.e. garnet+clinopyroxene) plus orthopyroxene which occurs both as exsolution lamellae in clinopyroxene and as anhedral grains with size ranges from 0.2 to 0.4 mm. Garnet is pale-orange in one part of the sample and orange to pink-orange in another with grain size ranges from 0.2 to 3 mm in longest dimension. Clinopyroxene also varies in color from pale-green to grass-green. Rutile and ilmenite are present as inclusions in all mineral phases in this sample. These inclusions are very small, i.e. 20-40 μm in longest dimension.

Garnet and clinopyroxene grains are chemically homogeneous, without intra-grain compositional zonation. However, there is inter-grain variation in both garnet and clinopyroxene in samples U-25/84 and U-281/84. Clinopyroxene and garnet from these samples are also enriched in Cr_2O_3 when compared to other eclogites from the Udachnaya kimberlite (Fig. 1). Sample U-92/18 contains both "low" and "high"-Cr garnet and clinopyroxene. The amount of

Cr_2O_3 in both garnet and clinopyroxene increases from one part of the sample to another from 0.1-0.2 to 0.8-1.0 wt.%, respectively. Orthopyroxenes are homogeneous with Mg# equal to 94. Ilmenites are high-Mg in composition, having MgO 15.5-15.9 wt.%, similar to those from ultramafic assemblages described by Haggerty (1991). There are two types of rutile inclusions present in sample U-92/18. The first type is characterized by trace amounts of Cr_2O_3 (0.16-0.19 wt.%), and CaO (0.70-0.85 wt.%), while the second type contains 1.95-2.10 wt.% Nb_2O_5 with higher Cr_2O_3 (0.266-0.30 wt.%) and lower CaO (0.35-0.50 wt.%). REE abundances are "typical" for Group A eclogites in general both for garnets and clinopyroxenes (i.e. $La/Yb_{Gt} \approx 0.04$, $La/Yb_{Cpx} \approx 130$-270 as per Taylor and Neal, 1990). There are no differences in REE abundances between "high-" and "low"-Cr garnets and clinopyroxenes from sample U-92/18.

Garnets from studied eclogites are enriched in Cr_2O_3 contents which makes them similar to low-Cr peridotitic garnets (Fig. 2). Moreover, "high"-Cr eclogite garnets are nearly identical to some low-Cr garnets from peridotites. Clinopyroxenes show distinctive differences between Groups B/C and A, with Group A clinopyroxenes enriched in MgO, as was stated also for South African eclogites by Neal et al. (1990).

There is a good correlation between Mg and Cr content in both garnet and clinopyroxenes, i.e. increasing Mg with increasing Cr. It may well represent some kind of hybridization between eclogites and peridotites. This hybridization may have been caused by a process similar to that proposed by Ringwood (1989). According to Ringwood enriched "eclogitic" melts saturated with garnet and clinopyroxene are injected into a peridotitic layer where they react with Mg-rich substance. Although this process seems to be complicated it can well explain the origin of peridotitic phases in the eclogite rock. Xenolith U-92/18 represents all eclogite groups in one sample, and it is also metasomatised (rutile inclusions with high Nb content, high-Mg ilmenite). Therefore, the Group A eclogites may be the transitional samples between Group B/C eclogites and peridotites.

References

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Figure captions

Figure 1. CaO vs. Cr_2O_3 in clinopyroxenes for the Udachnaya eclogites.

Figure 2. Cr_2O_3 vs. CaO in garnets for the Udachnaya eclogites and peridotites.

Fig. 1

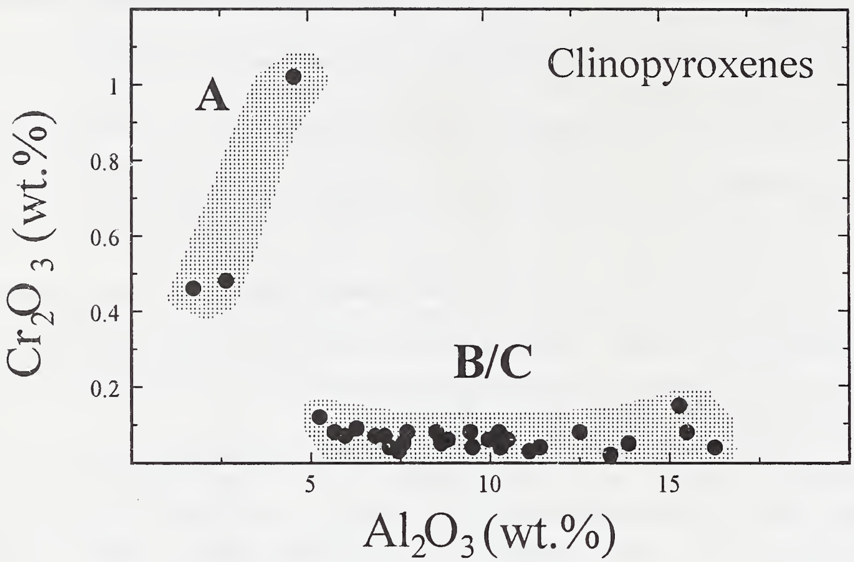
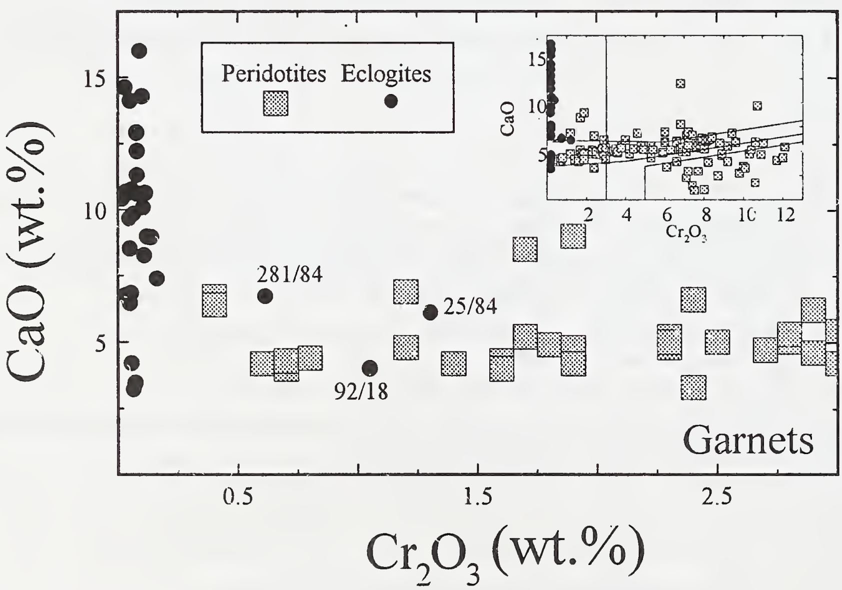

Clinopyroxenes
A
B/C
1
0.8
0.6
0.4
0.2
5
10
15
Cr_2O_3 (wt.%)
Al_2O_3 (wt.%)

Fig. 2


Peridotites Eclogites
281/84
25/84
92/18
Garnets
15
10
5
0.5
1.5
2.5
CaO (wt.%)
Cr_2O_3 (wt.%)
CaO
2 4 6 8 10 12
Cr_2O_3