Preliminary investigations of megacrysts and peridotite xenoliths from the Kelsey Lake kimberlite, Colorado-Wyoming, USA.

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The Kelsey Lake kimberlite cluster, situated on the Colorado-Wyoming border is within the State Line Kimberlite District (Coopersmith, 1991). Virtually all of the kimberlites in the district are diamondiferous, although only Kelsey Lake is economic. It is presently the only operational diamond mine in the United States.

The irregular shaped pipes and fissures of Kelsey Lake are hosted by Proterozoic granite, which dominates much of the Front and Laramie Ranges (McCallum et al., 1975). The Kelsey Lake cluster contains two large pipes, KL-1 and KL-2. Most of the material in this study is from the multiphase diatreme facies complex of KL-2. This pipe consists of varying types of highly altered tuffisitic kimberlite breccia.

Mantle xenoliths are abundant and include eclogites, lherzolites and harzburgites. Cr-poor megacrysts (garnet, clinopyroxene and ilmenite) are also common. All eclogites analyzed to date (Hozjan, 1996) correspond to Group II (after McCandless and Gurney, 1989). Peridotite xenoliths include garnet- and /or spinel-bearing lherzolites and harzburgites up to 30 cm in diameter. Extensive alteration has replaced the olivine and orthopyroxene by serpentine and calcite. The peridotites are rounded to oval in shape and light green to white in color. These xenoliths are not as silicified as those in the nearby Schaffer kimberlite. The only primary minerals remaining in the xenoliths are red-purple garnets, bright green clinopyroxene and black chromites.

Garnets in both lherzolites and harzburgites are mostly lherzolitic (G9, Gurney, 1984) with Cr_2O_3 values up to 14.5 wt% (Fig. 1.). One high Ca wehrlite garnet has been identified with 4.3 wt% Cr_2O_3 and 8.2 wt% CaO. Two diamondiferous garnet xenocrysts have been analyzed. They are G10 garnets with 7.8 wt% Cr_2O_3 , 5.0 wt% CaO and 10.8 wt% Cr_2O_3, 5.0 wt% CaO (Fig. 1.).

The garnet megacrysts have a wide range of Cr_2O_3 (0.1-6.5 wt%) and molar 100Mg/(Mg + Fe) (mg#) values (68.0-83.0). The higher Cr_2O_3 values relate to dark purple-black colored garnets. The megacryst garnets all belong to the Cr-poor suite, including the high Cr_2O_3-high mg# examples. They are compositionally distinct from the Cr-rich suite in other State Line kimberlites analyzed by Eggler et al. (1979). Garnets of the Cr-rich megacryst suite of Eggler et al. (1979) corresponds to pyropes in the peridotites of the State Line kimberlites (Eggler et al., 1979) and pyropes in the peridotites at Kelsey Lake (Cr_2O_3- 3.5-14.7 wt%: mg# 81-86). The diamondiferous Cr-pyropes also fall within this compositional range.

Cr-poor megacryst diopsides range from Cr_2O_3-0.0 wt%, mg#-85.0 to Cr_2O_3-1.0 wt%, mg#-90.0. Pyroxene thermobarometry suggests equilibration in the range 816° to 1318°C, similar to Cr-poor clinopyroxene megacrysts studied by Eggler et al. (1979). The peridotite clinopyroxenes (1.2 wt% Cr_2O_3 , 90.0 mg# to 3.0 wt% Cr_2O_3, 93.0 mg#) are similar to the Kelsey Lake megacrysts and peridotite clinopyroxenes from other State Line kimberlites (Eggler et al., 1979).

The Kelsey Lake peridotite xenoliths are classified as infertile based on molar ratio Cr/(Cr+Al) and Mg/(Mg+Fe) of the Cr-pyropes and Cr-diopsides (Eggler et al., 1987). Eggler et al.

(1987) determined that infertile peridotites extended to depths of 200 km, although, pressure estimates are not possible at Kelsey Lake due to the alteration of orthopyroxenes. Eggler et al. (1987) interpreted the infertile peridotites as residua from a Precambrian melting event involving the entire lithosphere, that were subsequently metasomatically enriched at shallower depths.

A peridotite source for Kelsey Lake diamonds is supported by the presence of diamondiferous low-Ca Cr-pyropes, a Cr-pyrope included within one diamond and the presence of low-Ca Cr-pyropes and high Cr-chromites in the xenocryst population.

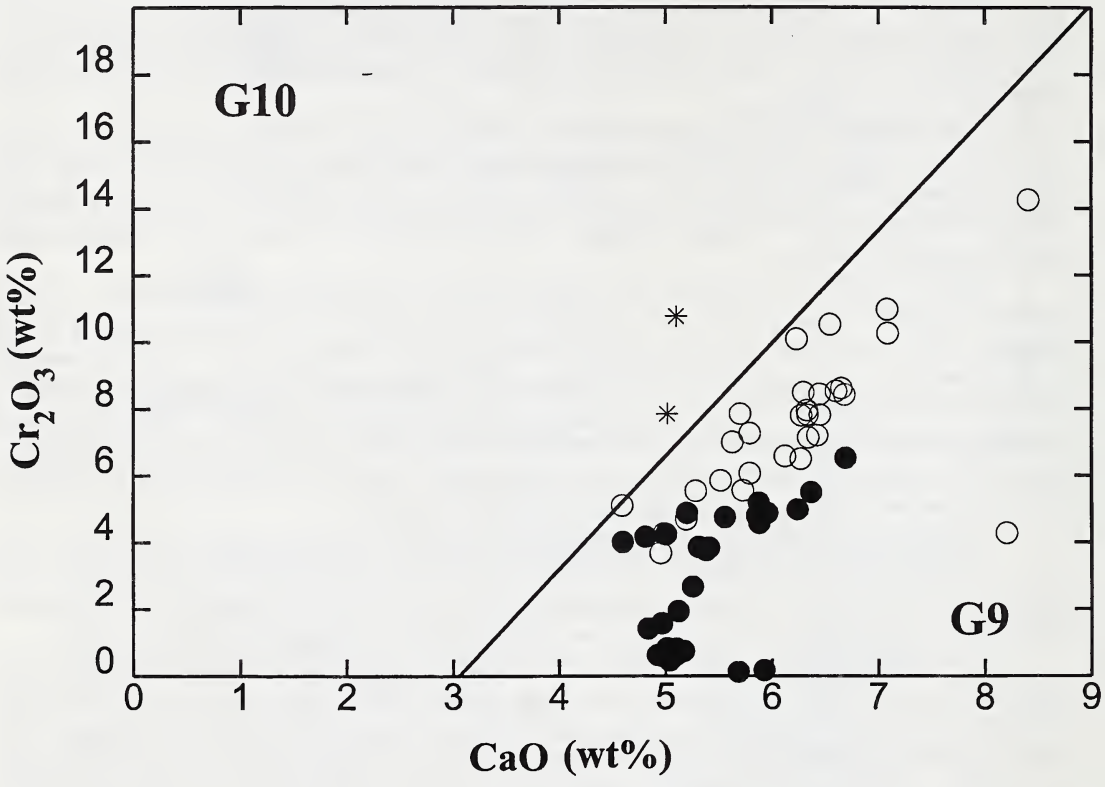

Fig. 1. Kelsey Lake garnet compositions. Diamondiferous pyrope xenocrysts-asterisks; Cr-poor megacrysts-filled circles; Cr-pyropes in lherzolites and harzburgites-open circles. G9 and G10 fields after Gurney, 1984.

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