

The unique Cr-rich megacryst suite from the Sloan kimberlite, Colorado: Comparison with other so-called “Cr-rich megacryst suites”

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A new study of Cr-rich and Cr-poor megacrysts (≥ 1 cm, $n=258$) from the Sloan kimberlite (Colorado, USA) corroborates the findings of the pioneering study by Eggler et al. [1] and provides a useful framework for reevaluating megacrysts subsequently described in the literature as belonging to the Cr-rich suite. New data confirm coexistence of garnet, clinopyroxene, orthopyroxene and olivine, the high (and restricted) values of molar Mg/(Mg+Fe) and wt% Cr₂O₃ (e.g., 0.925 to 0.929 and 0.78 to 1.70 in cpx, 0.791 to 0.837 and 6.1 to 13.0 in garnet) of Cr-rich suite megacrysts and the difference from equivalent minerals in the Cr-poor suite. Ilmenite is restricted to the Cr-poor suite. Like Cr-poor megacrysts worldwide, Cr-rich megacrysts from Sloan contain polymineralic inclusions, interpreted as representing liquids from which the megacrysts crystallized.

No other suites described in the literature as “Cr-rich megacrysts” or belonging to “the Cr-rich megacryst suite” meet these criteria. Use of samples <1.0 cm [e.g., 2-5] has contributed to peridotite xenocrysts being misclassified as Cr-rich megacrysts. Even among such suites, few garnets with Cr₂O₃ > 6 wt % have been documented and, within those populations, there is wide compositional scatter, unlike the tight clustering of the Sloan Cr-rich megacrysts. Many megacrysts of Cr-clinopyroxene are not associated with garnet or orthopyroxene, but in some populations coexist with ilmenite and phlogopite (e.g., Orapa, Jagersfontein, Balmoral). Such clinopyroxenes are not compositionally equivalent to those of the Sloan Cr-rich suite but are similar to Granny Smith suite clinopyroxene [6].

The Cr-rich megacryst suite [1] is apparently unique to the Sloan and Nix kimberlites of northern Colorado. Those described elsewhere are primarily various combinations of peridotite xenocrysts and members of Granny Smith and Cr-poor megacryst suites. Use of such populations as equivalents of the Sloan suite in

petrogenetic schemes for kimberlite origin and mantle evolution can lead to faulty conclusions.

[1] Eggler et al. 1979 *The Mantle Sample*; [2] Hunter and Taylor 1984 *Am. Mineral.*; [3] Pivin et al. 2009 *Lithos*; [4] Bussweiler et al. 2018 *Lithos*; [5] Nkere et al. 2021 *Lithos*; [6] Boyd et al. 1984 *GCA*.