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Interactive Comment

Interactive comment on "What olivine, the neglected mineral, tells us about kimberlite petrogenesis" *by* N. T. Arndt et al.

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Good to see a study on this subject - it is long due. However I have some reservation with the manuscript. As pointed out by reviewer#1, depletion of mantle peridotite by ancient melt extraction processes is a well-supported model for the formation of dunite and olivine-rich harzburgite xenoliths from Greenland cratonic mantle (Bernstein et al., 1998, EPSL, v154, p221-235; Hanghøj et al., 2000, G3, 2000GC000085; Bernstein et al., 2006, CMP, in press). From these studies of basalt-hosted xenoliths, and from studies of xenoliths in kimberlite dykes from SW Greenland (Garrit, 2002, unpublished phd thesis, Univ. Copenhagen; Bizzaro & Stevenson, 2003, CMP, v146, p223-240) it appears that olivine-rich peridotite (modal olivine $>$ 90%) or even pure dunite are abundant lithologies in at least the more shallow part of the lithospheric mantle. I therefore

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disagree with the statement in Abstract, line 14-15, that ‘dunite is a rare rock in the lithospheric mantle’. It is also worth noting that over the years, only few papers have dealt with the nature of the shallow cratonic mantle. It may well be that garnet-free olivine-rich harzburgites and dunites are as abundant in Siberian and South African cratonic mantle as they are in Greenland. Indeed, Arndt et al. stress that ‘olivine is the sole constituent of the vast majority of nodules in kimberlites’ (Discussion, line 9-10). How can we be sure that such olivine-rich peridotite is not characteristic of the cratonic mantle? Since dunites apparently are sampled both by alkali basalts and kimberlites/lamprophyres erupted in Archaean shield regions, I tend to conclude that dunite is a common lithology in the cratonic mantle. This said, dunite xenoliths reported from Greenland in the above publications generally have olivine with Mg#$>$91, and hence, the low Mg# in some dunite nodules in the two kimberlite samples, studied by Arndt et al., must reflect derivation from other domains in the lithospheric mantle. Here I think it would be useful a more rigorous approach, in which there is an analysis of the distribution of olivine grains/xenocrysts/nodules versus their Mg#. I.e. how abundant are low and high Mg# olivine, high Ca olivine etc. in the population of nodules and single olivine grains. Perhaps more than two thin-sections are necessary to give a more clear picture? Finally, in the manuscript, it is unclear which olivine grains that are interpreted to have crystallized from the kimberlite: In Interpretation, line 11-13 it is stated that high-Ca rims on olivine nodules ‘probably are the only parts of the olivine assemblage that can be assigned a magmatic origin’. But in line 10 (same section) we learn that some non-deformed olivine crystallized entirely from the kimberlite, and in Deformation features, line 5-7, some euhedral, tabular olivine grains with few dislocations are also interpreted to have crystallized from the kimberlite during ascent. It would be good to have the composition of these olivines clearly marked in Fig. 3, and also to add compositions of olivines from sample NCR 29 (that are solely of magmatic origin?).——
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Interactive comment on eEarth Discuss., 1, 37, 2006.