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

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We welcome the review provided by the anonymous referee and the comment from Stefan Bernstein. We are grateful for the suggestion that we use a higher distribution coefficient such as those of Dalton and Wood (1993) to calculate the composition of the kimberlitic liquid. We have made this change in the revised version.

However, we do not fully agree with the second comment of the reviewer, which was also made by Bernstein. We are well aware that parts of the lithospheric mantle are strongly depleted in terms of their major and trace element compositions. In most such samples there is a good correlation between the bulk-rock composition, the mineralogy and the olivine composition, as would be expected if the samples are the residues of variable extents of melt extraction. The most depleted samples have high MgO contents and little to no primary clinopyroxene and garnet – they consist mainly of

olivine, with or without orthopyroxene. The olivine itself has very uniform compositions, usually in the range Fo92-94, as noted by Bernstein et al. (1998) in their studies of xenoliths from the lithospheric mantle beneath Greenland. The characteristics of olivine these peridotites is in strong contrast with the wide range of compositions measured in the olivine grains of our Greenland kimberlites, which range from Fo93 to very forsterite-poor compositions such as Fo81. This range is well illustrated in the range of Mg and Ni contents recorded in the chemical maps plotted in our Fig. 2, and the olivine analyses plotted in our Figure 3. Thus we see in the nodules a peculiar contrast between the olivine-rich (dunitic) mineralogy, which is consistent with formation as depleted residues, and the range from Fo-rich to Fo-poor olivine compositions, which is not. We note that in other highly magnesian lavas such as meimechites and alkali picrites, the compositions of olivine phenocrysts are fairly constant, again in marked contrast to the range of compositions measured in the kimberlites. It is partly for this reason that we propose that the olivine nodules result from the "defertilisation" process. We do not know the exact nature of this process but it seems to have been capable to extracting all minerals other than olivine and in producing olivine with a wide range of forsterite compositions.

Bernstein, S., Kelemen, P.B. & Brooks, C.K. 1998 Depleted spinel harzburgite xenoliths in Tertiary dykes from East Greenland: Restites from high degree melting. Earth Planet. Sci. Lett. 154, 221-235

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