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eEarth Discussions

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

Anonymous Referee #1

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In this paper Arndt et al. describe two well preserved kimberlite samples from the west coast of Greenland. The samples contain much low-Ca olivine nodules of variable composition (Fo 81 to 93) and with thin high-Ca rims of Fo88, which supposedly crystallized from the parental kimberlitic liquid. Two main questions that are addressed by the authors are (i) the composition of the kimberlitic magma recorded by the rims and (ii) the nature of the process resulted in an essentially dunitic composition of the nodules.

(i) The idea to use the olivine grain rims to sample the composition of a metasomatizing agent is quite useful. Although the chemical heterogeneities in other minerals are being studied intensively (e. g., Burgess and Harte, 1999), the olivine has actually received little attention so far. However the numerical result of the analysis seems to be doubt-

ful. Based upon the Mg-number of the rims (Fo88), FeO abundance (10 to 11 wt%), and using the Roeder and Emslie's (1970) partition coefficient $KD_{\mathrm{MgO\text{-}FeO}}$=0.3, the authors arrive at an estimate of MgO content of the magma of 16 to 18 % that is too low in comparison with $\sim$25 wt% abundance characteristic of an average kimberlite. The distinction is quite significant, and, if it really were the case, needs a special explanation. I, however, do not see any problem with the magma composition. Really, due to highly carbonized nature of kimberlites, the Dalton and Wood's (1993) coefficient of Mg-Fe partition between olivine and carbonate melt (0.51 to 0.66) appears to be more appropriate for the estimate than the Roeder and Emslie's one. Using now the Dalton and Wood's values one finds a MgO range of 21 to 30 wt% in full agreement with both observations of natural kimberlites and laboratory experiments (e.g., Gudffinsson and Presnall, 2005). Also, this agreement gives an indirect evidence for a high CO_2 content of the magma.

(ii) Speculating on the reasons of the depletion of the mantle beneath Greenland Arndt et al. postulate a "defertilization process" responsible for it. I'd like to attract the authors' attention to the fact that the depleted nature of the mantle domain was discussed earlier (e. g., Bernstein et al., 1998; Hanghøi et al., 2000), and another process (high degree melting) was suggested to explain the observations. So, a comparison discussion is necessary.

A technical note: There's a misprint in Section 4 in the dimension of the rim thickness.

Interactive comment on eEarth Discuss., 1, 37, 2006.