The redox state of eclogite and peridotite xenoliths of the Udachanaya kimberlite pipe and implications for diamond stability

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Eclogite xenoliths generally make up only a small portion of the xenoliths in kimberlite pipes. However higher abundances of diamonds in them relative to peridotite xenoliths [1] may have implications for the origins of eclogite diamonds. $\delta^{13}C$ of diamonds and trace elemental and isotopic analyses of associated eclogite minerals established subducted altered oceanic crust as the initial source for such assemblage [2]. Diamond formation in relation to subduction is not only defined by PT-conditions, but also by oxygen fugacity (fO_2) [3].

A newly developed eclogite oxybarometer reaction [4] applied to 15 eclogite xenoliths from Udachanya kimberlite pipe show a correlation of redox state with equilibration pressure of the xenoliths (log fO_2 [ΔFMQ] =-2 to 1 and P=6 to 3 GPa). The fO_2 calculation is based on $Fe^{3+}/\Sigma Fe$ of garnet, which was accurately determined by 'flank' method [5]. Two diamond-bearing eclogite xenoliths from the batch have significantly reduced oxidation states, but higher fO_2 than reported for peridotite xenoliths of Udachanya pipe [6].

Eclogite and peridotite xenoliths of Udachnaya pipe that coexisted at the same PT-conditions have very different redox states. This could potentially influence the abundance of diamonds in eclogite xenoliths.

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