OXYGEN ISOTOPE OF ECLOGITES FROM THE ORAPA KIMBERLITE (BOTSWANA): POSSIBLE ORIGINS. P. Cartigny1, K. S. Viljoen2 and G. Wörner1

1Geochemisches Institut der Universität Göttingen, Goldschmidtstraße 1, 37077 Göttingen, Germany (pcharti@ugcvax.dnet.gwd.de, gwoerne@gwdg.de), 2De Beers Geoscience Center, PO Box 82232, Southdale 2135, South Africa (fviljoen@mhs7.tns.co.za).

Introduction: Xenoliths in kimberlites are our best window into the deep (i.e. >150 km) subcontinental mantle. Although generally rare, eclogites, bi-mineralic rocks constituted of omphacitic pyroxene and garnet, are ubiquitous. There is no consensus concerning their origin(s) and it was suggested that eclogites either represent pieces of archean recycled oceanic crust [e.g 1] or mantle-derived melts [e.g 2]. It was also suggested that eclogites are the residue after extraction of melts of Tonalite-Trondhjemite-Granodiorite (TTG) composition which make part of the archean crust [e.g 3]. Recycled ocean crust derived-eclogites were also invoked to account for the characteristics of the missing reservoir required for elemental and isotopic mass balance between depleted mantle and crust [4].

In understanding the origin of eclogites, oxygen stable isotopic composition plays the central role. It is generally argued that eclogites have δ18O-values (from +2 to +9‰ vs SMOW) which fall outside the mantle range, (i.e +5.5 ± 0.5‰). On the contrary, this δ18O-range is similar to that produced during hydrothermal alteration of the oceanic crust. However, if the range quoted above is valid for a mine like Roberts Victor, other mines yield more restricted δ18O-ranges.

Results: Major element analyses have now been obtained on the whole eclogite collection. Eclogite chemistry is best reflected in the garnet composition. Diamondiferous eclogites show striking similarities with diamond inclusions. Non diamondiferous Group I and, even more, Group II eclogites are more Ca-rich than diamondiferous samples. High-MgO eclogites (up to 17 wt% MgO) are present in every, i.e including diamondiferous, type of eclogites.

O-isotopes were measured on single mineral grains from 25 eclogites (diamond and non-diamond-bearing) eclogites. δ18O-values range from +5.0 to +8.3‰, most (i.e 80%) being contained within the mantle range and no obvious low δ18O-values (< 5.0‰) have been measured yet. Whereas several analyses of a single mineral grain gave reproducible δ18O-values, analyses of different grains from the same nodule suggest variations of about 1‰. Such an heterogeneity is surprising since low hydrothermal alteration that produces δ18O-enrichment is rather associated with Mg-enrichment. It could be suggested that the Orapa kimberlite sampled several populations of eclogites nodules. It is expected that the analysis of trace element data by laser-ablation ICP-MS. Also, a zonation cannot be rigorously demonstrated within the present set of data; accordingly δ18O-values are going to be measured directly along profiles on thick sections.

Garnet δ18O-values roughly correlate negatively with Mg-numbers. In other words, high MgO-eclogites yield mantle-like δ18O-values. Such a correlation is surprising since low hydrothermal alteration that produces the δ18O-enrichment is rather associated with Mg-enrichment. It could be suggested that the Orapa kimberlites sampled several populations of eclogites nodules. It is expected that the analysis of trace element data will allow to reveal or rule out the possibility of any genetical link between e.g high and low MgO eclogites.