OXYGEN ISOTOPE VARIATIONS IN METASOMATIZED MANTLE XENOLITHS

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It was shown in [1, 2, 3] that most mantle peridotites have narrow range of $\delta^{18}O$ values (5.5±0.2 ‰) and consist of minerals, which are in mutual oxygen isotope equilibrium predicted by experimental data [2,4]. However there are objects where $\delta^{18}O$ values vary in higher degree (wider range). So in [5] it was reported about inter-mineral isotopic disequilibrium and intra-crystalline zoning in differently metasomatized and recrystallized ultrabasic xenoliths from Kaapvaal Craton (South Africa), which was interpreted as the result of metasomatic fluid-rock interaction. Similar intra-crystalline oxygen isotope zoning was revealed by Deines and Haggerty [6] in ultrabasic xenoliths presumably erupted from ultra high depths.

Throughout these studies and for better understanding of oxygen isotope geochemistry in the process of mantle metasomatism we analyzed and compared variations of oxygen isotope compositions in mantle xenoliths from two different objects: in *modally metasomatized* (with changing of mineral associations) xenoliths from Saudi Arabian (SA) volcanic fields and in *crypto-metasomatized* (without changing of mineral associations) xenoliths from Dreiser Weier (DW) volcano, Germany.

Oxygen isotope analyses were performed by laser fluorination method in FEGI RAS on MAT-252 mass-spectrometer. The data summarized in table 1 and picture 1.

Table 1

Oxygen isotope composition in mantle xenoliths from Saudi Arabian and German volcanic fields

Sample	$\delta^{18}O$ ±0.20‰
SA84-63 Olv	5.69
SA84-63 Opx	5.16
SA84-63 Cpx	5.19
SA84-38 Olv	4.76
SA84-38 Opx	5.66
SA84-38 Cpx	5.10
SA84-38 Glass	4.66
SA84-128/3 Olv	5.15
SA84-128/3 Cpx	4.97
SA84-128/3 Amph	5.20
SA87-6/9 Olv	5.38
SA87-6/9 Opx	5.19
SA87-6/9 Cpx	5.23
SA84-42b Hbl	4.79
DW906 Ol	4.97
DW906 Cpx	5.18
DW918 Ol	5.11
DW918 Cpx	5.27
DW1 Ol	4.97
DW1 Opx	5.40
DW1 Cpx	5.33
DWAmph-2	4.75

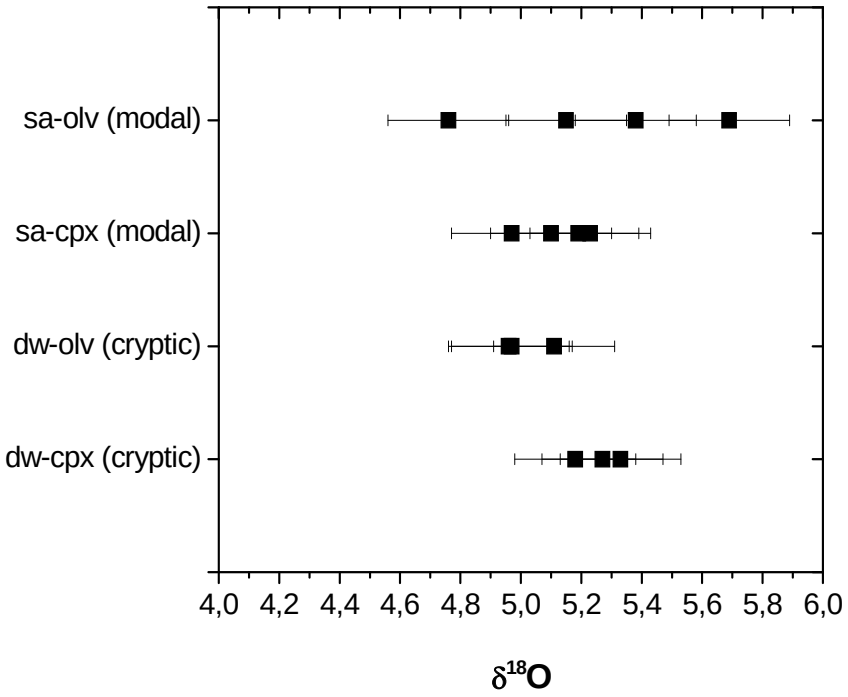

Fig.1. Oxygen isotope variations in olivines and clinopyroxenes from modally- (SA) and cryptometasomatized (DW) xenoliths

Two important differences in our two sample sets were revealed: 1. Variations of oxygen isotope compositions in modally metasomatized SA xenoliths significantly wider then the diapason of $\delta^{18}O$ variations in DW xenoliths (0.9 and 0.15 ‰ correspondingly); 2. In SA xenoliths (modal metasomatism) intermineral oxygen isotope disequilibrium is observed, whereas all DW xenoliths show equilibrium distribution of oxygen isotopes between associated minerals.

We suggest that one possible reason of the differences between our xenoliths' gropes could be interaction of the SA rocks with late metasomatism-2 [7] fluids, which could be in turn saturated with ancient sea water or other subsurface water [8, 9].

Variations of oxygen isotope compositions could occur as the result of fluid-mineral isotopic exchange. As known, changing of $\delta^{18}O$ value in minerals during exchange depends on temperature, time of exchange, mineral grains sizes, difference in oxygen isotope composition of mineral and fluid, and speed of the exchange of mineral and fluid. The speed of ascent is also an important factor influencing the degree of approaching to the equilibrium mineral oxygen isotope composition.

Experimental data show that at equilibrium distribution of oxygen isotopes $\delta^{18}O$ value in pyroxene is higher then in olivine. In 3 of 4 Saudi Arabian xenoliths there is an inverse relationship. Two conclusions can be done: 1. For one of the differences in our sample sets the ^{18}O depleted fluid is responsible; 2. Higher $\delta^{18}O$ value in olivine then in pyroxene could be explained in terms of higher isotopic exchange rates between pyroxene and isotopically "light" fluid, then between olivine and fluid.

Thus inter-mineral oxygen isotope disequilibrium in mantle xenoliths could be due to several parameters. Future studies should characterize all of them.

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