OXYGEN ISOTOPE FRACTIONATION IN SYSTEM CUPRITE-TENORITE

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The establishment of isotope distribution regularities between the mineral species as well as revealing of the processes leading to the isotopic fractionation in natural systems is accepted as main aims of the isotope geochemistry.

The study of oxygen isotope effects in the transformation of tenorite (CuO) to cuprite (Cu_2O) and *vica versa* is of great interest in terms of isotope chemistry as well as of structure transformation mechanism investigation.

The experimental study with copper oxides by using of the vacuum plant lead to the following results:

1. The molecular oxygen extracted from tenorite at 900^0C in vacuum is enriched of ^{18}O in relation to initial CuO. The dependence of $\delta^{18}O$ on the completeness of tenorite destruction was observed in the stepped oxygen extraction experiment such as following: 0 - 40%; 40 - 60%; 60 - 78%; 78 - 95% (fig.). Variation of $\delta^{18}O$ was found to have such character that it could be interpreted as the consequence of infrastructure oxygen isotope exchange in the system CuO - Cu_2O - O_2 . The value of isotope fractionation coefficient (α=0.9953) was obtained according to Rayleigh formula from reaction:

$$2CuO \rightarrow Cu_2O + 1/2O_2 \quad (1),$$

using the experimental data: CuO (($\delta^{18}O$ = + 8.6‰), Cu_2O ($\delta^{18}O$ = + 5.2‰), O_2 ($\delta^{18}O$ = + 11.6‰).

2. The experimental study of cuprite $\rightarrow$ tenorite transformation in vacuum shows that the 20% rest (residual) of the molecular oxygen after reaction:

$$Cu_2O + 1/2O_2 \rightarrow 2CuO \quad (2)$$

is enriched of ^{18}O in relation to the initial content by 3.0‰. Here α coefficient was found as 1.0041.

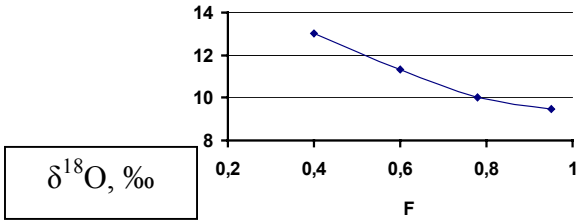

Fig. Oxygen isotope fractionation during of the extraction O_2 from cuprite.

3. A peculiar methodical approach was used for the evaluation of oxygen isotope equilibrium constant (K) of copper oxides and molecular oxygen by use of air oxygen as a standard ($\delta^{18}O$ = + 23.3‰). K-value for the system CuO - O_2 was calculated as 0.989, whereas the corresponding figures for Cu_2O were 0.991. The difference of α and K values for the reaction in study could be interpreted as the indication of the partial isotope exchange in such vacuum experiments.

4. The first oxygen isotopic data ($\delta^{18}O$ = + 6.8‰) for tenorite from Guneshevo mine and cuprite ($\delta^{18}O$ = + 9.6‰) from volcano Tolbachic, Kamchatka, were obtained. The isotope data could be considered as arguments for the possible air oxygen contribution in the reaction of cuprite generation in the exogenic geological processes according the scheme:

$$Cu_2S + 2O_2 + H_2O \rightarrow Cu_2O + H_2SO_4 \quad (3)$$

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