

HAVE THE MINERALS OF DEEP ORIGIN THE “MEMORY” AND THE INFLUENCE THE SIZE OF THE GRAIN ON THE INTRINSIC OXYGEN FUGACITY?

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Intrinsic oxygen fugacity in crystals, glasses and basalts control redox reactions in the rocks of upper mantle and in the products of their partial melting and allow to cleared up the mechanism of differentiation of the substance while upwelling it to the surface of the Earth.

The aim of this study is the experimental determination of the intrinsic oxygen fugacity (fO_2) of the minerals of deep origin and exposure the influence of the size of the mineral on the value of the intrinsic oxygen fugacity and has the minerals “memory” or not.

The experiments were carried out on high temperature furnace based on two solid electrolyte cells. They manufactured from zirconium dioxide and stabilized by yttrium oxide in order to make the cubic structure of the electrolyte. The temperature interval is 750°C-1100°C. The accuracy of determination is $\pm 0.2 \log fO_2$.

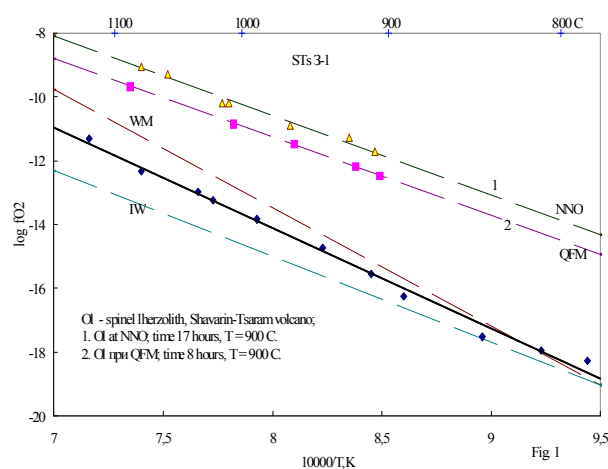


Fig.1.

We choose olivine (Ol), orthopyroxene (Opx) and spinel (Spl) from xenolith of spinel lherzolite from alkaline basalts of volcano Shavarin-Tsaram (Mongolia) and impactites from crater Elgigitgen.

In order to clearing up the question about the possibility of measuring crystals to keep the information of the intrinsic oxygen fugacity which is correspond with its growth were carried out the following experiments: crystals of Ol, Opx and Spl from xenoliths of spinel lherzolites of Mongolia which intrinsic oxygen fugacity lies in the field between of buffer equilibrium wustite-magnetite (WM) and iron-wustite (IW) (tab. 1, fig. 1-4) were put into gas atmosphere which correspond with intrinsic oxygen fugacity to the buffers nickel-nickel oxide (Ni-NiO) and quartz-fayalite-magnetite (QFM) at the temperature 900°C-1000°C during 8-17 hours. Then we measured the intrinsic oxygen fugacity of these crystals.

Table 1

The values of coefficients A and B in the equation of $\log fO_2 = A-B/T^\circ, K$ for Ol, Opx and Spl from spinel lherzolite of volcano Shavarin-Tsaram and for impactite from crater Elgigitgen

Samples	A	B	R	n
Ol	11,039	31435	0,992	11
Opx	13,421	33982	0,996	11
Spl	12,468	32913	0,998	11
MPR 79/1 Ol	9,379	29815	0,996	10
E 1a Imp	14,153	35285	0,994	9
E 37B Imp	18,060	39720	0,984	8
E 113 Imp	16,519	37653	0,979	7

R – Coefficient of correlation; n – the number of experimental points

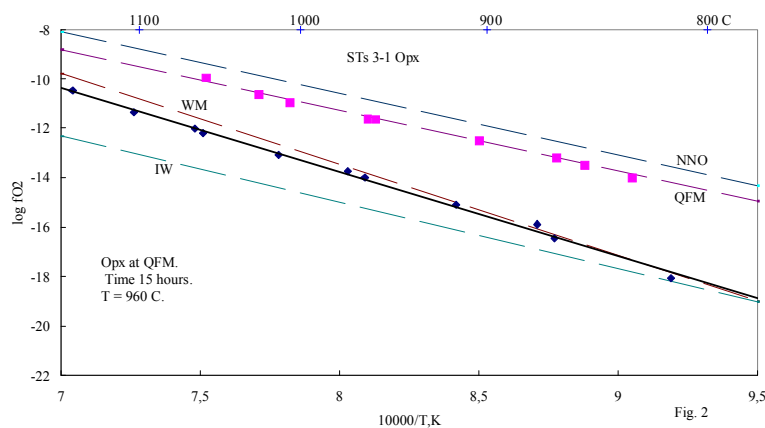


Fig.2.

At the result of the experiments the intrinsic oxygen fugacity begins to correspond to f_{O_2} of Ni-NiO and QFM buffers (fig. 1-3).

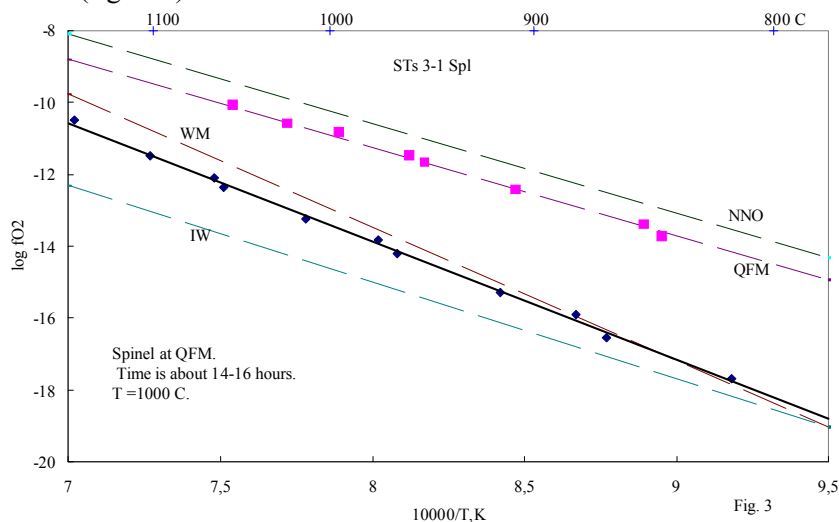


Fig.3.

We also carried out the experiments in order to clear up the influence the size of the crystals and the atmosphere inside the cell with the sample on the value of the intrinsic oxygen fugacity (fig. 4-6). We take the crystals of olivines which was divided into tree fractions: 1 – 1-0.5 mm: 2 – 0.2-0.1 mm: 3 – powder. At the result of the experiments we found out that the size of the grain didn't influence on the value of the intrinsic oxygen fugacity (fig. 4). The same experiments were carried out with impac-tites from crater Elgigitgen (fig. 5).

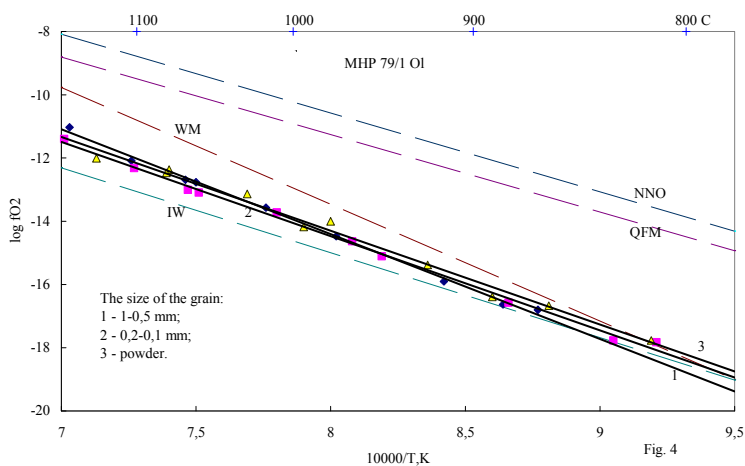


Fig.4.

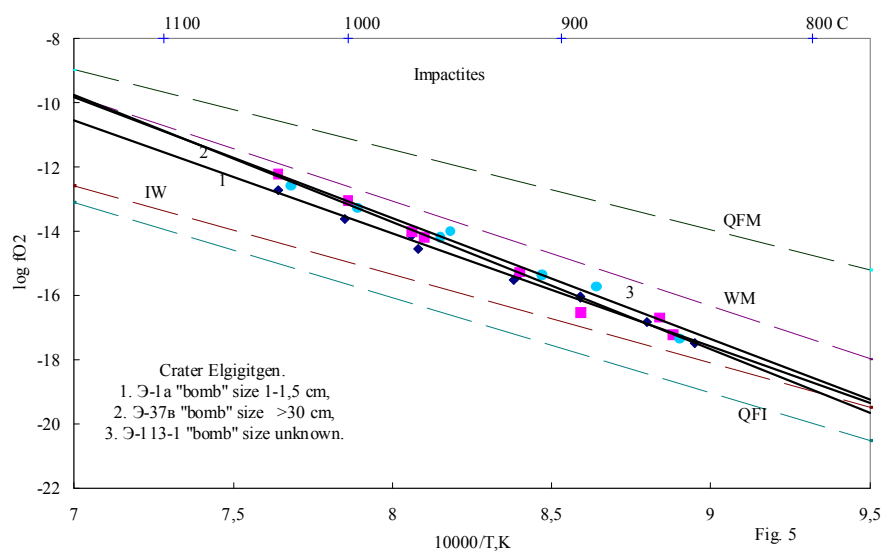


Fig.5.

The experiments show that atmosphere either vacuum or clear argon don't influence on the value of the intrinsic oxygen fugacity.

Thus, at the results of the experiments we show – if the crystals don't contain gas-fluid inclusions the size of the grain don't influence on the value on fO_2 . Also it was shown that crystals of olivines, orthopyroxenes and spinels carry the information about redox conditions of their formation that is mean – crystals has a “memory” and quenching don't influence on the “memory” of the crystals.

It should be mention that the furnace with two electrochemical cells allows to measure intrinsic oxygen fugacity not only in wide temperature diapason and with good accuracy.

In order to know the influence of the atmosphere inside the cell with the sample on the value of fO_2 we carried out the experiments in vacuum and in clear argon. (fig. 6). Thus we show, that the atmosphere inside the cell with the sample don't influence on measured intrinsic oxygen fugacity of the mineral.

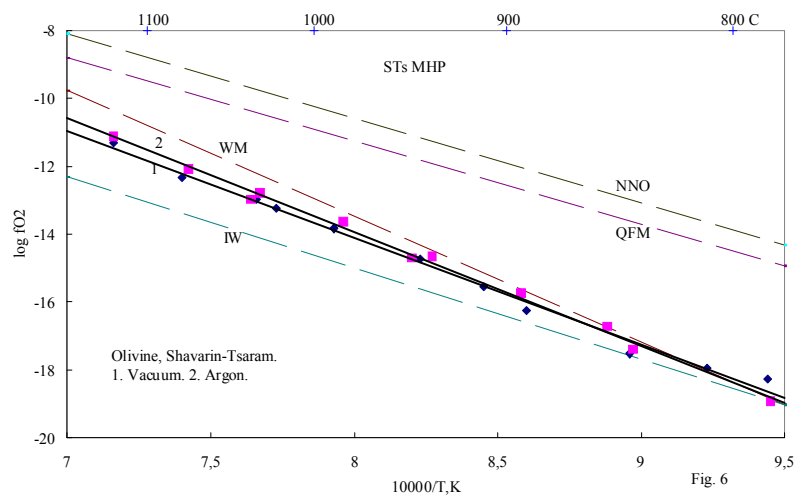


Fig.6.

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