



Oxygen Fugacity in the Laboratory and in Terrestrial Systems

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Several different synthetic phase assemblages – so called oxygen buffers that were devised by Eugster 1957, in order to adjust defined oxygen fugacities in laboratories for experimental petrology at given temperatures and pressures. The “oxygen buffers” – and the corresponding acronyms soon became popular and are now applied universally also to express fO_2 levels in natural systems where however any correlation with the phase assemblages of the originally defined buffers is not evident. A typical example is presented by the numerous analyses of basalts with oxygen fugacities of (QFM) (Ulmer *et al.*, 2008, this meeting).

From the fact that the fO_2 data of the majority of basalts worldwide are arranged in a narrow belt along (QFM) (Basaltic Volcanism Study Project, 1981) it is concluded that their redox state must be buffered. What may the properties and quality of the buffers involved be? It must be realized that:

-an oxygen buffer is a phase assemblage containing a certain element capable of coexisting in various oxidation states. The entire periodic system was scanned and elements capable of coexisting in various oxidation states were marked.

-any buffer assemblage may react with any other one until one phase from the buffered assemblage is quantitatively consumed and the latter buffer is thus annihilated. Eventually thus only one complete buffer assemblage can survive and will thus be dominating.

From the conditions cited above, it is concluded that only the reaction:

$2\text{H}_2\text{O} = 2\text{H}_2 + \text{O}_2$ may provide the required buffer. By thermodynamic calculations the oxygen fugacity for dissociating pure water is close to (QFM) for temperatures above 800 K, kinetically above the closing temperature of a reaction between basaltic magma and water, i.e., for the conditions prevailing for the eruption of MORBs.

The correlation between the oxidation state of a rock and the activity of water during its formation may be extended to further systems. Thus the fact that analyses of Nakhilites were showing an oxidation state close to (QFM) indicates that during their formation on Mars water must have been involved, although neither water nor copious hydrous components in Martian minerals directly seem to support this conclusion.

REFERENCES:

Eugster, H.P. (1957), J. Chem. Phys. 26, 1760-1761

Ulmer, G.C. & Woermann, E. (2008) this volume

Basaltic Volcanism Study Project 1981