

## Reappraisal of MORB redox state using both Fe and S speciation

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The oxidation state of MORB ( $fO_2$ ) has been vividly debated these recent years and several studies have yielded distinct values ranging from FMQ-1.2 to +1 and conclusions regarding the (lack of) variability and/or correlation with other geochemical indexes [1-3]. Historically, the oxidation state of Fe ( $Fe^{3+}/\Sigma Fe$ ) in glasses has been used to assess  $fO_2$  of magma. While less abundant than Fe, S oxidation shifts sharply from  $S^{2-}$  to  $S^{6+}$  at FMQ+1.0±0.5 [4], thus ideal to constrain MORB  $fO_2$ .  $Fe^{3+}/\Sigma Fe$  and  $S^{6+}/\Sigma S$  were determined by micro X-ray absorption near edge structure (ID21 ESRF) on the same shard of fresh MORB glasses (N=38) along with other trace lithophile and chalcophile trace elements by LA-ICP-MS.

The average  $Fe^{3+}/\Sigma Fe = 0.137 \pm 0.006$  yielding an average  $fO_2^{Fe}$  ca. FMQ-0.10±0.16.  $fO_2^{Fe}$  is positively correlated with V/Sc and S content. No other significant correlation with trace element fractionation (e.g., La/Sm, Nb/Zr) or radiogenic isotopes composition (e.g.  $^{206}Pb/^{204}Pb$ ,  $^{143}Nd/^{144}Nd$ ) have been found.  $S^{6+}/\Sigma S$  ranges between 0.03 and 0.17 average is  $0.09 \pm 0.02$  yielding  $fO_2^S$  ca. FMQ+0.01±0.05 within error of the Fe based estimate. However,  $S^{6+}/\Sigma S$  is not correlated with  $Fe^{3+}/\Sigma Fe$  nor with V/Sc but is negatively correlated with  $H_2O$  suggesting that  $S^{6+}/\Sigma S$  may have been slightly modified by post-emplacement processes.

[1] Christie DM, Carmichael ISE, Langmuir CH, 1986 EPSL. 79: 397; [2] Bézous A Humler E, 2005 GCA 69: 711; [3] Cottrell E, Kelley KA, 2013. Science 340: 1314; [4] Jugo PJ, Wilke M, Botcharnikov RE, 2010 GCA. 74:5926.