The effect of spreading rate on the compositions of MORB

MARCEL REGELOUS[1], CHRISTOPH WEINZIERL[1], KARSTEN HAASE[1], CHRISTOPH BEIER[1], DOMINIC WÖLKI[1]

[1]GeoZentrum Nordbayern, Friedrich-Alexander Universität Erlangen-Nürnberg, Erlangen 91054, Germany

Variations in global MORB major element compositions have been proposed to result from variations in mantle temperature, mantle composition, or spreading rate [1-5]. Spreading rate has a clear effect on ridge morphology and the magma plumbing system, which in turn influences the degree of fractionation, assimilation and homogenisation of melts erupted at the surface [6]. However, the effect of spreading rate on the decompression melting process and the composition of primitive MORB melts is less obvious. We have examined the role of variations of spreading rate on the major and trace element and isotope compositions of MORB, using the global compilation of Gale et al. (2014) [4]. If spreading ridge segments close to hotspots are excluded, there are clear variations in the major element composition of MORB averaged over single spreading ridge segments, and longer sections of the MOR system, with spreading rate. Very slow-spreading ridges (<30 mm/y) erupt MORB with higher Na_2O, K_2O, TiO_2, Al_2O_3, and lower FeO and CaO/Al_2O_3.

Although average MgO decreases by about 1% with increasing spreading rate between 30 mm/y and 150 mm/y, very slow-spreading ridges have similar average MgO to fast-spreading ridges, yet higher fractionation-corrected Na_{90}, K_{90}, Ti_{90} and Al_{90} and lower Fe_{90} than intermediate- and fast-spreading ridges. This indicates that most of the differences in major element composition between MORB erupted at very slow- and faster-spreading ridges are inherited from the melting process, rather than due to differences in the average degree of fractionation at crustal levels. MORB from very slow-spreading ridges are more 'enriched' in certain incompatible trace element ratios (higher La/Yb, K/Ti), but there is no clear relationship between spreading rate and Sr, Nd isotope composition. These observations are consistent with smaller degrees of melting of heterogeneous mantle beneath very slow-spreading ridges, compared to intermediate and fast-spreading ridges. Away from hotspots, variations in spreading rate, rather than mantle temperature, have the greatest influence on primitive MORB compositions.

[1] Klein & Langmuir (1987) *JGR* **92**, 8089; [2] Bown & White (1994) *EPSL* **121**, 435; [3] Niu & Hekinian (1997) *Nature* **385**, 326; [4] Gale et al. (2014) *J. Petrol.* **55**, 1051; [5] Niu (2016) *J. Petrol.* **57**, 2081; [6] Rubin & Sinton (2007) *EPSL* **260**, 257.