

A logical approach towards genuine understanding of the working of global ocean ridges

YAOLING NIU^{1,2,*} AND MICHAEL J. O'HARA³

¹Department of Earth Sciences, Durham University, UK

²Institute of Oceanology, Chinese Academy of Sciences, China

³Institute of Geography & Earth Sciences, Aberystwyth University, UK (*yaoling.niu@foxmail.com)

Plate tectonics and mantle plumes are different modes of thermal evolution of the Earth. Plate tectonics is driven by the top, cold thermal boundary layer (lithosphere/plates) and cools the mantle, whereas mantle plumes are driven by the basal hot thermal boundary layer (CMB) and cools the core. Both are independent and genetically unrelated, but when mantle plumes rise to reach the lithospheric plates, interaction between the two becomes inevitable. Because the lithosphere is the thinnest at ocean ridges, such interaction is best expressed as plume-ridge interactions with both thermal (ridge topography and morphology) and compositional (basalt chemistry) manifestations. The latter is an important subject to study ^[1]. However, plume-influenced ridges are not ideal locations for studying ridge processes of plate tectonics origin. Hence, to genuinely understand the working of global ocean ridges, we must avoid plume-influenced ridges (e.g., in the vicinity of Iceland) and remove/average out data from such ridges. As a result, a straightforward picture emerges, i.e., the correlated variations of global MORB chemistry (e.g., major element oxides corrected for fractionation effect to $Mg^{\#}=0.72$ to be in equilibrium with mantle olivine: Ti_{72} , Al_{72} , Fe_{72} , Mg_{72} , Ca_{72} , Na_{72} , Ca_{72}/Al_{72}) with ridge axial depth. This observation is best interpreted as resulting from fertile mantle compositional controls by means of (a) source compositional inheritance; and (b) physical properties (mineralogy, density, buoyancy, ridge axial depth, amplitude of decompression melting etc.) ^[2]. The most recent global MORB dataset made available by Gale *et al.* (2013) ^[3] confirms both observations and interpretations by [2]. Importantly, the new dataset also shows spreading rate control on the extent of melting, particularly at slow-spreading ridges as shown previously ^[4].

[1] Niu, Y. & R. Hekinian, in *Oceanic Hotspots*, 2004 [2] Niu, Y. & M.J. O'Hara, *J. Petrol.* 2008 [3] Gale, A. *et al Geochem. Geophys. Geosyst.*, 2013 [4] Niu, Y. & R. Hekinian, *Nature*, 1997.