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Goldschmidt 2008, Vancouver. Session 10b. Primary melt generation and dynamics of melt transport and storage.
Published (2008) GCA 72 (12S) A711.

Extra-thick plates: basis for a single model of mantle magmagenesis, all the way from MORB to kimberlite

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Tectonic evidence [1, 2], briefly outlined, that cratons have tectospheric keels that approach 660km, demands an appraisal of how this radical change reflects upon the genesis and significance of mantle-derived magmas, noting that this perspective extends (less deeply) all the way to MORs [2]. We show that without calling on extraneous heat sources magma-genesis by thick-plate splitting yields many rewarding insights.

The basic model [3] envisaged a split-induced diapir in a deep, narrow, mantle crack, and needed thick plates to be fully applicable. We present four simple variants of this model, adapted to each of MORB, OIB, CFB and kimberlite. Source compositions are still important but processing is central and (variably) thick plates provide the column-space to do it in, with a varying result. Among the notable features are:-

(a) Melting in the diapir decreases again as wall cooling asserts control. Enlarged by cumulate intergrowths, the solids form a 'log-jam' in the crack (familiar to engineers), and melt is forced through it (primary segregation). So this depth varies with current parameters (wall temperature, splitting rate), the jam providing xenoliths when ruptured. The force to do so and ability to extract melt increases with jam depth (kimberlite).

(b) Reduced pressure at the foot of the diapir causes incipient melting of mantle accessories, trace element contents being drawn, and gases diffuse, along melt pathways, resulting in light-isotope enhancement (OIB). MOR continuity promotes self-cancelling of this effect, so a common source is possible.

(c) Heated by an eruption, the big volume increase at the gt-sp peridotite phase change in the walls may close the crack, prising it apart elsewhere. In our MOR variant this is the push-apart force. In the OIB case, it may prolong volcanic chains.

(d) In the MOR variant, crystal accretion to narrow-crack walls uniquely explains the straightness, segmentation and seismic anisotropy [4], strongly supporting our basic model.

References

[1] Osmaston, M.F. (2006) In *Proc. ICAM IV*, OCS Study MMS 2006-003, p.105-124. Also at: http:\\www.mms.gov/alaska/icam.

[2] Osmaston, M. F. (2007) In *XXIV IUGG*, IASPEI JSS 011 Abstr. #2105. http://www.iugg2007perugia.it/webbook/ : Also at <http://osmaston.nmpc.co.uk>

[3] Osmaston, M. F. 2005. GCA **69**, (10S) A439.

[4] Osmaston, M.F. (1995) In *XXI IUGG*, Boulder, Colorado, Abstracts p. A472. (*N.B.'c-axes' should read 'a-axes'*)

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