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# Major element composition of melts formed during lithospheric extension

**J. Armitage** (1), T. Henstock (1), T. Minshull (1), J. Hopper (2) and S. Dean (1)
(1) National Oceanography Centre, Southampton, (2) Texas AM University
(john.armitage@noc.soton.ac.uk)

A dynamic model has been used to predict volume and major element composition of melt from rifting to steady state. We report on the results for steady state mid-ocean ridges.

The volume and composition of melt generated by decompression melting at a spreading centre primarily reflects the mantle potential temperature and rate of upwelling. Predictions of major element composition have previously been made from kinematic models of rifting. Here a dynamic model is implemented that solves Stokes equations for non-Newtonian mantle flow that includes the effects of buoyancy due to depletion and the presence of melt. Spreading is driven by a velocity condition on the upper boundary. Melting occurs adiabatically once the 'wet' solidus is reached. After 2 % of melt has been generated the rock is assumed to be dry and 'dry melting' progresses. Composition is related to depletion by empirical relationships.

The model predicts sensitivity of silicon oxide to spreading rate and insensitivity to mantle temperature. The opposite was found for magnesium oxide. Such results are in agreement with previous kinematic studies. Comparisons of the predicted composition are in agreement with available data with the exception of iron oxides at low spreading rates. Iron oxides are subject fractionation during the crystallisation of melt to olivine. The calculated compositions do not take this mechanism into account; normalisation of the compositions to 8 % MgO may rectify this.

Increased mantle potential temperature causes the crustal thickness to increase. A steady state thickness of $6\,\mathrm{km}$ is found for crust at a mantle potential temperature of $1275\,^{\circ}\mathrm{C}$ and $10\,\mathrm{km}$ for $1325\,^{\circ}\mathrm{C}$. Such thicknesses are once again in general agreement with measured crustal thicknesses.