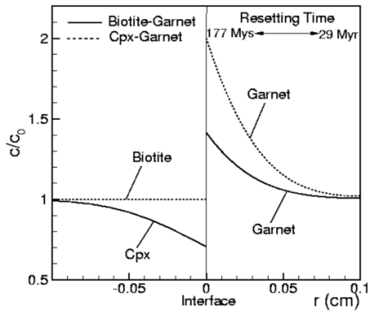
Closure- temperature and -age of minerals

J. GANGULY[1,2] AND M.TIRONE[3]

[1]Bayerisches Geoinstitüt, Bayreuth, Germany
[2]Department of Geosciences, University of Arizona, USA (ganguly@geo.arizona.edu)
[3]Institut für Meteorologie und Geophysik, J.W.Goethe-Universität Frankfurt am Main, Germany (mtirone@geophysik.uni-frankfurt.de)

Ganguly & Tirone (1999: EPSL) developed an extension of Dodson's classic formulation of closure temperature (T_C) in a mineral surrounded by a homogeneous infinite matrix so that it is applicable to the slowly diffusing systems. In addition to applying this formulation to calculate T_C to selected systems, we have, in this work, explored the effect of matrix phase on T_C. An illustration of this effect on the Nd diffusion profile in garnet (right panel) is shown below for an homogeneous infinite matrix (dashed line) and a matrix with the same D as in Grt. Conditions for the computation are taken from Ganguly & Tirone (1999: EPSL) (section 5) with M = 1 and partitioning between matrix and garnet = 0.5. T_C(Sm-Nd) for garnet should be significantly higher when it is surrounded by Cpx, for which D(REE) < or = D(REE) in Grt, than when it is surrounded by biotite.



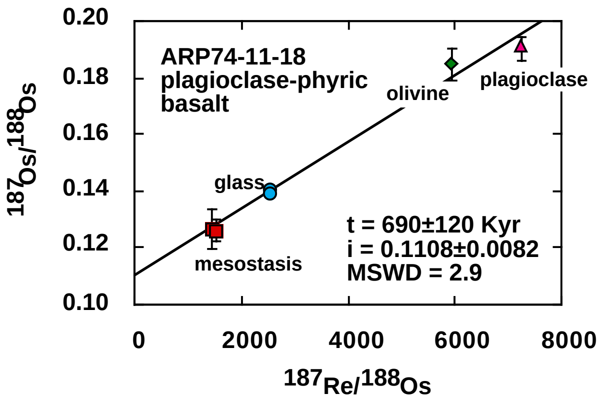
Our REE diffusion data in almandine garnet suggest that the Sm-Nd and Lu-Hf systems should have similar T_C for similar conditions. In contrast to the T_C calculated from the diffusion data of Van Orman et al. (2002: CMP), our data yield T_C for the Sm-Nd system that is in good agreement with that derived empirically by Mezger et al. (1992: EPSL) for garnet in a granulite sample when the same grain size, cooling rate and T_o are used. The cooling rate of a mineral can be directly retrieved from the difference between its peak metamorphic and cooling ages, as well as that between its core-age and the bulk age. In addition, it is also possible to derive the cooling rate and T_C from an isotopic concentration profile that can be measured in an ion probe.

Open-system behaviour in mid-ocean ridge basalts

ABDELMOUHCINE GANNOUN[1], LOUISE E. THOMAS[1], KEVIN W. BURTON[1] AND PIERRE SCHIANO[2]

[1] Department of Earth Science, The Open University, Walton Hall Milton Keynes, UK (A.Gannoun@open.ac.uk; L.E.Thomas@open ac.uk; K.W.Burton@open.ac.uk)
[2] Laboratoire Magmas et Volcans, Université Blaise-Pascal, 5 Rue Kessler, 63038 Clermont-Ferrand, France. (p.schiano.@opgc.univ-bpclermont.fr)

The chemical composition of MORB provides one of the best constraints on the composition of the Earth's upper mantle. The problem remains in deciphering the mantle signal from that of melting and magmatic processes. The Re-Os isotope system potentially holds key information on the nature of the chemical signature in MORB. Partly, because (unlike the lithophile elements) Re and Os can be measured in all phenocryst phases, but also because Re/Os are highly fractionated in such phases and the details of phase equilibration are thus readily observed. This study presents high-precision Re-Os and Th-U-Ra isotope data for MORB samples from the FAMOUS region on the mid-Atlantic ridge (36°50' N). Separated phases from a plagiclase-phyric basalt yield a best-fit line corresponding to an age of 690±120 Kyr (see figure).



A first sight, this regression might be taken to represent a crystallisation age, suggesting that the Os variations in MORB glasses reflect *in-situ* post eruption radiogenic growth. However, Th-U-Ra data suggest an age of <10 Kyr for this sample. Further data from a picrite and an olivine-basalt yields Re-Os regression ages of 1.2 and 2.5 Myr, respectively, for effectively zero-age basalts. These results are consistent with assimilation of phenocryst phases just prior to eruption, in accord with chemical zonation and melt inclisions in the same phenocrysts. Taken together, these results suggest that the Os isotope variations MORB glasses, reflect assimilation, rather than *in-situ* post eruption radiogenic growth or Os isotope heterogeneities in the mantle source.