Azores and MAR basalts similarity, a multidimensional analysis

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Basalts from the MAR near the Azores attest a 1000 km long asymmetric geochemical anomaly that begins near the Kurchatov FZ, maxes out near the Azores and diminish gradually southward. Basalts possess enriched composition in trace element and Sr isotopes relative to N-MORB, and is of general agreement, that the regional geochemical signature results from the interaction between the Azores Magmatic Anomaly (AMA) and MAR [4, 5, 6]. Principal Component Analysis (PCA) has been carried successfully by [3], on isotopes from MAR basalts (22º-35ºN), identifying the presence of E-MORB near 35ºN and N-MORB elsewhere. Also, [2] PCA coupled trace elements ratios from OIB and MORB with mantle end-member composition. Following [2], PCA (using software from [1]) was applied to eight incompatible trace element ratios (X/Th) to basalt from Azores region in a multidimensional diagram configured for OIB end-members (HIMU, EMI, EMII and Hawaii) and N-MORB from North Atlantic. The testing samples with average basaltic composition (MgO> 7%) are from: the Azores Islands, W of the MAR (ODP Leg82) and MAR at 38.7º and 39.7ºN [7]. The eight variables are reduced to two main principal components (F1 and F2) describing 91% of the variance of the data. F1 bears a maximum positive variance for N-MORB and a minimum negative variance for HIMU. F2 accounts for element ratios variance, ranking variables according with elements incompatibility. Results evidence that the Azores islands plot in the range of HIMU, EMI and EMII end-members, strengthening the existence of source heterogeneities. Also inter-island compositional variability agrees with the existence of heterogeneities beneath the islands, although geographically spaced islands show compositional similarity, e.g. São Miguel-Faial-Flores. Finally, except for ODP 33ºN N-MORB's, MAR and ODP E-MORB's PCA evidences a long living (>30 Ma) regional geochemical anomaly that could have resulted from similar interaction as the nowadays between AMA and MAR.

[1] PCA http,//biomonitor.ist.utl.pt/ajsousa/Andad.html Andad program [2] Allègre *et al.* (1995) *EPSL* **129**, 1-12. [3] Debaille *et al.* (2006) *EPSL* **241**, 844-862. [4] Dosso *et al.* (1999) *EPSL* **170**, 269-286. [5] Gente *et al.* (2003) *G3* **4**, 1-23. [6] Schilling (1975) *EPSL* **25**, 103-115. [7] Georoc+PetDB.

Numerical modeling of two-phase flow in geodynamics: State of the art, benchmark and perspectives

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The dynamics of two-phase (or two-component) media is a well-studied field with numerous natural applications to solid earth physics. Some important geophysical problems falling within the scope of the two-phase (or multi-phase) approach are for example: Magma segregation and dynamics, Earth's Core formation, tectonic plate generation, water transport at subduction zone, etc.

For some years, in addition to the commonly used set of equations derived by M^{c}Kenzie [1], a new theoretical formulation [2] is available to describe two-phase flow mixtures. In parallel, improvements of computers efficiency have made numerical solving of such a complex system more and more tractable. The combination of these two facts result in the existence of a large number of numerical codes not only using different numerical techniques to solve for the equations governing two-phase flow dynamics but also solving for different sets of governing equations.

For the sake of clarity, a benchmark of available codes has been launched. We have designed a set of 1-D and 2-D experiments that allowed to compare the efficiency (computer time) and accuracy of numerical schemes and the possibilities offered by different theoretical approaches. These experiments have been chosen to be general enough to permit the comparison of codes initially build to deal with very a large range of settings.

Among all two-phase geodynamical systems, the percolation of geophysical fluids at subduction zone is particularly complicated to model. This complexity comes from the richness and variety of processes taking place in subducting factories (melting, dehydration, diapirism, dykes, phase transition, dip angle, trench migration, etc.) and incidentally suggests paths to follow. A review of principal numerical approaches will be presented with special emphasis on the field constrains required by geodynamicists in their quest towards the big picture of subduction zones.

[1] M^{c}Kenzie D. (1984) *J. Petrol.* **25,** 713-765. [2] Bercovici *et al.* (2001) *J. Geophys. Res.* **106(B5),** 8887-8906.