Plume-ridge interaction: Dying from the feet up

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Intraplate melting anomalies ("plumes") appear to affect mid-ocean spreading axes over large distances, leading to changes in the composition of the axial magmas and thickening of the oceanic crust. Despite the importance of such plume-ridge interaction for plate production, there is no concencus on how or in what form material transfer from plume to ridge occurs. More problematic still, the compositions of the plume magmas also change, becoming more mid-ocean ridge-like as the plume approaches the ridge. Explaining this in terms of a mutual exchange of material between plume and ridge is difficult in a system characterised by strong focussing of mid-ocean ridge magmas to the narrow spreading axis. We will present a model based on major and trace element and isotopic (Sr, Nd, Pb, Ne) compositions of the Pacific Foundation Seamount Chain and adjacent Pacific-Antarctic spreading axis which explains these two apparently incompatible observations as facets of the same interaction between the cylindrical melting zone of the upwelling mantle diapir and the tent-shaped melting zone beneath the spreading axis. The model´s predictions can be tested using observations from near-ridge hotspot chains around the world.

A new precise calibration of the Na/K geothermometer using a world database of geothermal fluids and improved geochemometric techniques

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Temperature estimates of *Na/K* geothermometers can be inconsistent due to errors in calibrations, coefficients and chemical analyses. Differences are still observed between measured and predicted temperatures of geothermal wells. In light of these uncertainties, a new improved *Na/K* geothermometer has been developed. A new GEOthermal Fluid Database (GEOFD) was created using downhole temperature measurements and fluid compositions of wells from a wide variety of world geothermal fields. A total of 645 samples were compiled and evaluated by calculating ion charge balances (ICB), which enabled to select data with ICB<10% for a better geothermometer calibration. 380 samples were selected and re-evaluated for the detection of outliers in iterative ordinary linear regressions (*log Na/K* versus *1/T*) using combined geochemometric methods. Due to the size of GEOFD (n=380), the outlier detection was recursively examined by computing *studentized residuals*, which were analyzed as univariate data with 14 statistical discordant tests instead of bivariate discordant tests (which are only recommended for n<100). 38 outliers were detected to obtain a final structure of GEOFD with 342 samples. From this structure, 239 samples (70 %) were randomly taken out to derive the new geothermometer equation and the remaining 103 samples (30 %) were used for validation and comparison purposes. The new improved Na/K geothermometer (n=239) is given by the following equation:

$$t^{o}\,C = \frac{876.3(\pm 26.26)}{log\left(\frac{Na}{K}\right) + 0.8775(\pm 0.0508)} - 273.15$$

where the numbers in parentheses are the coefficient errors; and *Na* and *K* are concentrations (in ppm). This new equation was succesfully validated and applied to estimate subsurface temperatures in 103 geothermal samples, which showed a much better agreement with the measured well temperatures, than those predictions provided by all the previous *Na/K* geothermometers developed for the geothermal industry.