Development of cyber-infrastructure for experimental data and trace element partitioning (traceDs)

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The development of databases that support model development, e.g. LEPR, PetDB, and EarthChem in the past decade has greatly facilitated access to primary sources of both experimental, whole rock and phase chemistry. Our work focuses on the remaining missing component in this network, an exhaustive online database of experimental data on trace element partitioning between phases. This new 'traceDs' database will (i) provide community access to a dataset that is now effectively unavailable to more than a handful of 'micro-specialists' on each phase, (ii) provide a standard interface for model input, (iii) interoperate seamlessly in the existing cyber-infrastructure and (iv) enable independent development of partitioning constraints. The initial focus of the new traceDs database will include experimental partitioning data, together with major, minor and trace element compositions of phase (bulk, melt, fluids and minerals) assemblages, and physical conditions under which the experiments were carried out (e.g. temperature, pressure, volatile content, oxygen fugacity, doping methods, container material).

Our initial goals are to populate the database with the large existing clinopyroxene database as a model, and to develop a clear interface for users. We will then incrementally add new minerals (garnet, olivine, plagioclase, etc) and structure as we integrate user input. Specific challenges incurred with the development of this database relate to the significantly greater granularity and complexity represented in trace element experimental data compared to major element bulk rock or mineral chemistry (e.g. multiple analytical techniques). Development of this common resource becomes increasingly important as both the experimental database and the level of expertise required to apply the numerical constraints increase in quantitly and complexity.

Potassium and Uranium in the upper mantle controlled by Archean oceanic crust recycling

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The Earth's mantle is divided into separate reservoirs. From basaltic lavas erupted today we know that the upper mantle is depleted in incompatible trace elements, whereas ocean islands basalts (OIB) sample a deep, more enriched reservoir. The two incompatible elements potassium (K) and uranium (U) display a different ratio to each other in lavas from the upper and lower mantle reservoirs (Arevalo *et al.* [1]). This is surprising because they do not fractionate substantially during melting of the mantle and therefore continuous extraction of melts from the upper mantle over Earth's history cannot explain this disparity. Here a model is constructed in which U is insoluble during continental weathering in the anoxic conditions of the early Earth. This leads to recycling of oceanic crust with high K/U in the early Earth and low K/U after significant oxidative weathering commenced ~2200 million years ago. This concept reproduces the observed K/U in both the upper and lower mantle reservoirs as well as the continental crust. The model is also shown to account for the thorium/uranium ratios and thereby Pb isotope compositions in these reservoirs. Successful model solutions imply that (1) chemical weathering fluxes to the oceans on the early Earth was significantly higher than present day and (2) that the majority of the OIB reservoir is younger than 2200 million years.

[1] Arevalo, McDonough & Luong (2009) 'The K/U ratio of the silicate Earth: Insights into mantle composition, structure & thermal evolution' *Earth & Planetary Science Letters* **278**, 361–369.