How much potassium is in the Earth's core? New insights from partitioning experiments

A. CORGNE[1] S. KESHAV[2] Y. FEI[3] AND W.F. MCDONOUGH[4]

[1] Department of Earth and Planetary Sciences, Macquarie University; acorgne@els.mq.edu.au
[2] Bayerisches Geoinstitut, Universität Bayreuth; keshav@uni-bayreuth.de
[3] Geophysical Laboratory, Carnegie Institution of Washington; fei@gl.ciw.edu
[4] Department of Geology, University of Maryland; mcdonough@geol.umd.edu

Despite a large number of studies, it is not clear whether potassium is present in sufficient proportions in the core to contribute significantly to Earth's energy budget. Experimental studies on K partitioning between metal and silicate liquids have provided ambiguous results concerning the fate of potassium during the favored scenario of core formation in a silicate magma ocean, because of experimental and analytical artefacts, large extrapolation to higher pressures and temperatures, and use of oversimplified chemical compositions for study. Here, we report results of silicate melt–liquid metal partitioning experiments at 1800–2200 ºC and 1.0–7.7 GPa on a CI-chondrite major element composition appropriate to model bulk Earth's differentiation.

Our results reveal that K would not have entered metallic core materials segregating through the molten silicate mantle if the average equilibration pressure in the magma ocean was less than ~8 GPa. The effect of pressure on K partitioning appears negligible at least up to ~8 GPa. We find no evidence for an increase of K solubility in metal with increasing temperature. Unless K partitioning behavior changes drastically at higher pressures and higher temperatures, it seems unlikely that a significant amount of K was sequestered into Earth's core during a magma ocean event.