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Radiogenic heat production in the Moon: constraints from plagioclase-melt trace element partitioning experiments

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The total amount and spatial distribution of heat produced in the Moon through natural decay of U, Th and K are key input parameters for models of lunar thermal evolution, but both are poorly constrained. We performed high-temperature experiments to quantify the distribution of U, Th, K and a suite of other trace elements (including REE, LILE, and HFSE) between anorthite-rich plagioclase and silicate melt. Our results are combined with estimates of the U and Th concentrations of the primitive lunar highland crust and petrological models of lunar magma ocean (LMO) crystallisation, to assess heat production levels in the bulk Moon as well as in the cumulate layers resulting from LMO solidification.

Heat production calculations based on our measurements and previous work on U, Th and K partitioning in pyroxene-melt, ilmenite-melt, and olivine-melt systems show an approximately 500-fold enrichment in the total radiogenic heat budget in the ilmenite-rich cumulate layer crystallising towards the end of LMO solidification compared to the primary crust.

Cite abstract as:
de Vries, J., Mason, P.R.D., van Westrenen, W. (2012) Radiogenic heat production in the Moon: constraints from plagioclase-melt trace element partitioning experiments. Paneth Kolloquium, Nördlingen (Germany), abstract URL: http://www.paneth.eu/PanethKolloquium/2012/0206.pdf (abstract #0206).