

How much heat and REE in calcium silicate perovskite?

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A number of geochemical arguments suggest the existence of a deep mantle reservoir enriched in noble gases and heat producing elements and having a subchondritic $^{142}\text{Nd}/^{144}\text{Nd}$ ratio [1-4]. To test this hypothesis, the affinity of these elements for the phases involved in the differentiation of the deep mantle must be determined. Partitioning data between Mg- and Ca-silicate perovskites and silicate melts seem to forbid the long-term survival of a large perovskitic reservoir in the lower mantle [5-6]. These data indicate that the fractionation of such reservoir would have significantly altered the budget of the residual mantle in refractory lithophile elements, which is not observed. Despite some progress, the geochemical signature of the putative deep reservoir (either an accumulation of perovskites or a dense magma coexisting with these minerals [7-8]) has remained unclear mainly because the affinity of REE, U and Th for Ca-silicate perovskite (CaPv) seems to be affected by the CaO melt content. This dependence may reflect a substitution mechanism involving Ca-vacancy formation, as observed on CaTiO_3 , a low-pressure analogue of CaPv. Predictions based on this substitution mechanism indicate that the CaPv contents in REE, U and Th should increase significantly with decreasing CaO melt content. Since the experiments carried out so far have used CaO contents larger than values expected for the magma ocean, partitioning values appropriate to model mantle differentiation may have been greatly underestimated, leading to some uncertainties regarding the composition of the deep reservoir.

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