Where are Hf and REE hosted in CV – CK chondrites? Clues to understanding the ε_{Hf} heterogeneities in CHUR.

C. Martin[1], S. Goderis[1, 2], V. Debaille[3], Ph. Claeys[1]. [1]*Earth System Science, Vrije Universiteit Brussel, Pleinlaan, 2, B-1050 Brussels, Belgium,* [2]*Dept. of Analytical Chemistry, Ghent Univeristy, Krijgslaan 281-S12, B-9000 Ghent, Belgium,* [3] *laboratoire G-Time, Université Libre de Bruxelles, Av. F. D. Roosevelt 50, CP 160/2, B-1050 Brussels, Belgium.*

Chondrites, the most primitive objects in the Solar System, constitute the main building blocks of telluric planets. Among radiochronometers currently used for dating geological events, Sm-Nd ($l^{147}Sm=6.54x10^{-12}$ $year^{-1}$) and Lu-Hf ($l^{176}Lu=1.85x10^{-11}$ $year^{-1}$) are both composed of refractory and lithophile elements. They are considered to behave similarly during geological processes because the parent elements (Sm and Lu) generally act as less incompatible than the daughter elements (Nd and Hf). It is expected that the average of chondrites, called Chondritic Uniform Reservoir (CHUR), defines their respective average isotopic compositions for the solar system. However, where the Sm-Nd isotopic system shows an actual spread of less than 4% in the average chondritic record (Fig. 1 b), the Lu-Hf system displays a much larger range of up to 28% (Fig. 1b). To better understand these different behaviors, this work examined the evolution of REE and Hf distribution among mineral phases during metamorphism of Karoonda-like (CK) and Vigarano-like (CV) carbonaceous chondrites. Detailed trace-element patterns obtained in all the chondrite-forming minerals of a given class highlight many similarities between CV_{oxB} and CK, suggesting that these chondrites groups could have a closely related origin. They also reveal that phosphates are not the main carrier of REE, contrary to current assumptions. In fact only 30 to 40% of Sm and Nd are stored in phosphates (at least in chondrites type 3 to 5) where they behave concomitantly. As such, they are not mobilized during early stages of metamorphism. The part of phosphate in Lu budget significantly decreases as the degree of metamorphism increases (30% for type 3 and 4, less than 1% in type 6). On the contrary, silicates mainly host Hf, while phosphates do not contribute significantly to the Hf budget. These results indicate that the dichotomy of the main hosts of Sm, Nd and Lu on one hand and Hf on the other hand, and the resulting redistribution of Lu and Hf during metamorphism-linked recrystallization likely explain the heterogeneities observed in the CHUR for the Lu-Hf system.

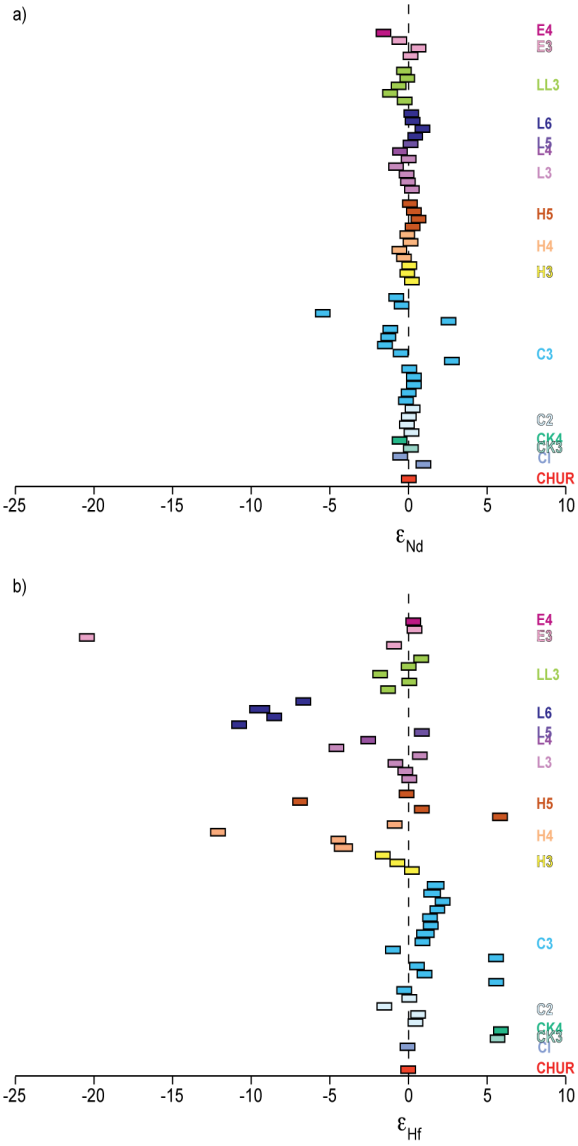

Fig.1: Epsilon values in chondrites compared to CHUR. a) for Nd and b) for Hf. Values from [1, 2].

References:

[1] Patchett, P. J., et al., (2004), Earth Planet Sci Lett 222, 29-41. [2] Bouvier, A., et al. (2008), Earth Planet Sci Lett 273, 48-57.