The formation of nuggets of highly siderophile elements in quenched silicate melts at high temperatures: Before or during the silicate quench?

V. MALAVERGNE*[1], E. CHARON[1], J. JONES[2], P. CORDIER[3], K. RIGHTER[2] AND L. HENNET[4]

[1]Université Paris Est-Marne La Vallée, LGE, 77454 Marne la Vallée, France. *corresponce: Valerie.Malavergne@u-pem.fr

[2]NASA Johnson Space Center, Houston, Texas 77058, USA

[3]Université Lille 1, UMET, UMR CNRS 8207 -59655 Villeneuve d'Ascq Cedex, France

[4]Université d'OrléansCNRS-CEMHTI, 45071 Orléans Cedex 2, France.

The Highly Siderophile Elements (HSE) are powerful tracers of planetary differentiation. Despite the importance for the understanding of planetary core formation, there is still a huge discrepancy between conclusions of different high temperature (HT) experimental studies. These disagreements may be due to the presence of HSE micro and nanonuggets in quenched silicate melts. The formation of these nuggets is still not well understood. One hypothesis is that these HSE nuggets formed during the quench of the silicate melt, while another hypothesis supposes that these nuggets formed before the quench and are artefacts of experiments.

The goal of this work is to clarify if the presence of HSE nuggets in silicate melts is linked to a quench effect or not. We performed new HT experiments at different oxygène fugacity fO_2, between ambient air up to ~5 log units below the Iron-Wüstite buffer, for two different silicate compositions (synthetic basalts) mixed with a metallic mixture of Pt-Au-Pd-Ru. Our samples underwent fine textural, structural and analytical characterizations (SEM, TEM observations). The distribution of the HSE nuggets in our runs was not homogenous throughout the quenched silicate melt. Dendritic textures from the quenched silicate melt formed around HSE nuggets during the quench. Finally, some nuggets also had strong heterogeneities suggesting a two-stage formation process under reducing conditions.

Consequently, our results show that HSE nuggets formed before the quench in the silicate melt. Their formation did depend on the fO_2, as reducing conditions favored nugget formation, even if oxidizing conditions did not prevent their formation.