Thursday 29 November 2018 – 16:00 AMGC Seminar:

"Making sense of destruction: Geochemistry of Chicxulub impact melt rocks and granitoid target recovered during IODP-ICDP Expedition 364"

By Sietze J. de Graaff (AMGC-DSCH, VUB)
Co-authors: P. Kaskes, S. Goderis, T. Déhais and Ph. Claeys

In 2016, the IODP-ICDP Expedition 364 sampled the peak-ring of the Chicxulub impact structure, Yucatán, recovering ±110 m of Paleogene sediments, ±130 m of suevite and impact melt rocks, and ±610 m of granitoid basement material. The latter is intruded by both pre-impact magmatic dikes and impact melt rocks. Geochemical variations in the impact melt rocks with stratigraphic depth highlight the complex and heterogeneous nature of the impact melt bodies. This is documented in the higher Al_2O_3 (up to 18 wt%) and CaO (up to 20 wt%) and generally lower Fe_2O_3 and MgO (around 5 and 2 wt% respectively) of the upper relative to the lower impact melt rocks. Moreover, the latter show trace elemental compositions closer to those of the crustal basement target rocks with a notably higher Sr isotopic composition ($^{87}Sr/^{86}Sr$ up to 0.7083, compared to ± 0.7077 of the basement). This shows that the upper impact melt rocks are closer to the composition of the carbonate platform on which the asteroid impacted, while the lower impact melt rocks are more similar to the crustal lithologies below it. Equally important, geochemical variations in the granitoid target rock show a distinct difference in the La, Ba, Dy and Yb concentrations and Sr isotopic composition between certain granitic samples. These variations indicate the presence of at least two types of granites, volcanic arc granites and those more akin to within plate granites. The former is represented by the majority of the sampled rocks, while the latter has only been sampled as a clast in the lower impact melt rocks.

These observed geochemical variabilities indicate that: 1) The formation of the upper and lower impact melt rocks is to some extent decoupled. Whether this implies discrete melt formation, and/or the immiscibility of carbonaceous and more siliceous melts formed during the impact is yet to be determined, and 2) The presence of distinct granitic target contributions sampled in the form of clasts in the lower impact melt likely indicate lateral movement of granitoid basement material during crater formation. However, due to the complex nature of the Yucatán basement, the extent of movement is difficult to determine. Ongoing work will better constrain both the extent of melt heterogeneity and movement of the granitoid basement material, and their implications on the emplacement mechanism.