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A volcanological approach to better understand impact-related aggregated particles: constraints from the Chicxulub proximal ejecta blanket

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Abstract (word count: 350; maximum: 350 words)
Aggregation processes have been extensively studied in the case of explosive volcanic eruptions. In contrast, the formation and emplacement mechanisms of meteorite impact-generated aggregates remain poorly understood. Particle aggregation consists of collision and adhesion of suspended particles in turbulent hot gas mixtures with a binding agent like water or electrostatic forces (e.g., in phreatomagmatic ash plume, or in co-ignimbrite cloud above pyroclastic density current). Aggregation can influence ash dispersal, and needs to be considered for ash plume forecasting, modelling, and potential climatic effects. Aggregates have been observed in proximal impact ejecta blankets of large impact structures on Earth, including e.g., Chicxulub (200-km-diameter, 66.05 Ma, Mexico) and Sudbury (~250-km-diameter, 1.85 Ga, Canada).

To understand aggregation processes occurring within impact plume, detailed petrographic and geochemical investigations are performed on aggregates found in two sites from the proximal continuous ejecta blanket of the Chicxulub impact structure, and compared with accretionary particles/lapilli found in explosive volcanic eruption deposits.

The aggregates ("pink spheroids", 1-10 mm) found in a bed of the Albion Formation (Belize, ~350 km southeast from Chicxulub) are mainly composed of calcite and dolomite. They appear either as an angular lithic core surrounded by a fine-grained rim of accreted particles, or as aggregates without obvious internal structure. The aggregates (~0.5-2 cm) from El Guayal (Mexico, ~520 km southwest from Chicxulub), similar to volcanic accretionary lapilli, are composed of a core (ash, rock, or mineral, ~100-400 µm) surrounded by several millimetre-sized concentric laminations. These accretionary lapilli are SiO_2-rich (~85.0 wt%), whereas the adjacent host matrix is relatively SiO_2-poor (~23.7 wt%) and CaO-rich (~52.4 wt%; Figure 1). Carbonate-dominated aggregates, in some cases coated with altered silicate melt, have previously been described at El Guayal.

A classification scheme (size, shape, petrographic texture) of impact-related aggregated particles will be proposed, similar to that of volcanic aggregates. Further investigations (e.g., shock effects in quartz, geochemical characterization, Re-Os, and clumped isotopes analysis) allow to estimate shock pressures, the possible source region(s), the temperature, and formation mechanisms of impact-related aggregates. The overall aim is to better constrain the impact plume dynamics and climatic response induced by the Chicxulub impact event.

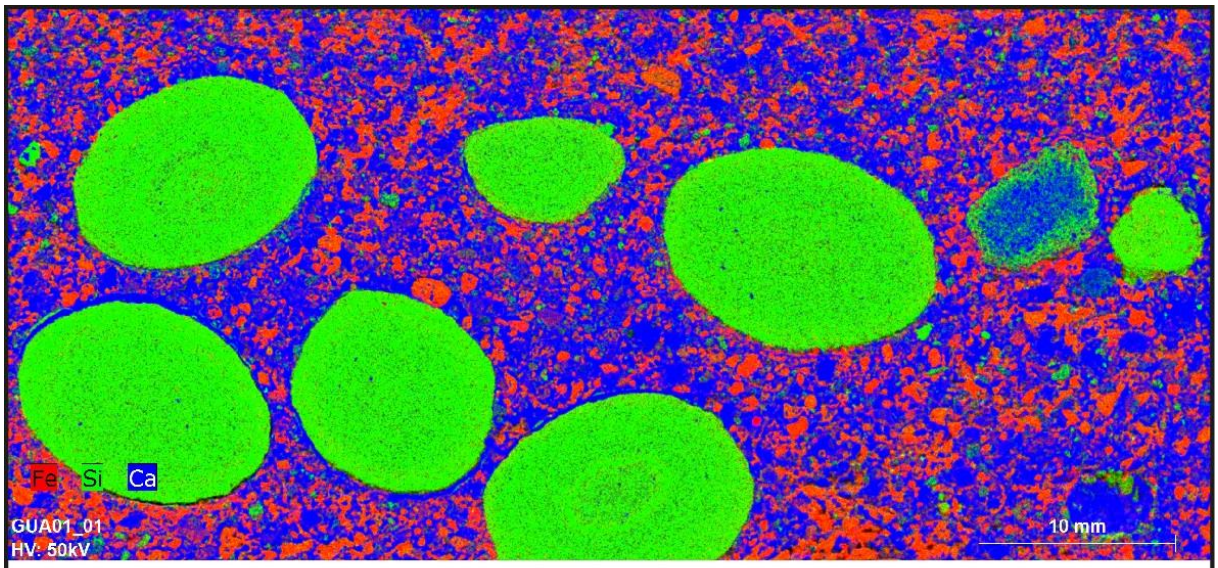

Figure 1. Micro-XRF chemical distribution map of accretionary lapilli from El Guayal proximal ejecta (Mexico).