IRON ISOTOPE COMPOSITIONS OF DISTAL IMPACT SPHERULES FROM THE K-Pg BOUNDARY: INSIGHT INTO THE PROCESSES TAKING PLACE DURING HYPERVELOCITY IMPACT EVENTS.

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An asteroid impact on the Earth produces an impact crater and terrestrial ejecta that represent eithers melts or condensates of vaporized target or/and projectile material. These ejecta, called distal impact spherules, are deposited over large areas (> 10 000 km) forming layers of which the thickness decrease away from the source crater. Distal impact spherules are essential to understanding large impact events and therefore cratering modeling. In the past years, non-traditional isotope systems have been applied to impact spherules in order to determine the nature of the impactor [1,2] and to understand the processes occurring during impact events [3,4]. A recent study of Chernonozhkin et al. 2021 [4] on Australasian microtektites, has suggested that the isotope ratios of the moderately refractory element Fe represent a valuable tracer to decipher the complex processes taking place during impact events such as melting, evaporation, condensation, mixing and ablative evaporation during atmospheric re-entry.

In this study, we plan to measure the iron isotope compositions of the distal impact spherules from the Cretaceous-Paleogene (K-Pg) boundary, presumably originating from the Chicxulub crater, by using a MC-ICP-MS Neptune Plus, after ion exchange chromatography [5]. K-Pg impact spherules can be divided in two main types: (1) Glassy spherules, called microtektites, found within 5000 km of the Chicxulub structure and (2) Microcrystalline spherules, referred to as microkrystites, that are located more than 5000 km from the impact crater. Microkrystites have been divided into 3 main groups: goethite spherules, K-feldspar spherules and smectite/glauconite spherules. Although rare other types are also encountered, such as unaltered Ca-rich clinopyroxene spherules at Shatsky rise (a.o. Deep Sea Drilling Project site 577 [6]). In this study, we will analyze microtektites from the Beloc locality (Jacmel highway, Southern Peninsula of Haiti) and microkrystites from Petriccio (Umbria-Marche region), DSDP site 596 (South Pacific) and DSDP site 577 (Shatsky Rise, Pacific) that are petrologically and geochemically well defined [6,7,8]. The aim of this study is to investigate whether Fe isotope variations are recorded and retained in Chicxulub impact spherules and whether such isotopic variability is related to the spherule formation processes or to differences in the transportation mechanisms. A major issue in this study is to analyze pristine materials, as Fe isotope compositions of the spherules can be severely affected by alteration processes [9]. Distal impact spherules from the K-Pg boundary are significantly older than the Australasian microtektites analyzed by Chernonozhkin et al. 2021 [4] and therefore most of the spherules are altered and diagenetically replaced. To remove any trace of secondary alteration and recover pristine glass cores from microtektites, leaching procedures relying on EATG and dilute HCl were optimized and applied to small sets of impact spherules. These two different leaching methods were selected in order to identify any potential isotopic fractionation related to the leaching processes. Concerning the microkrystites, most of the impact spherules are composed of secondary alteration phases [8] and original Fe isotope signatures are overprinted by diagenetic alteration. For this reason, we focus on the analyses of Ca-rich clinopyroxene spherules [6] and pristine magnesioferrite spinels present in the goethite spherules [8] as well as bulk isotopic signatures to highlight the direction of isotopic fractionation.

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