CARBONATE SPHERULES IN THE K-Pg EVENT DEPOSIT ARE CHICXULUB EJECTA

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Introduction: The Chicxulub impact event has affected ~25000 km³ of mostly carbonatic sediments. Deformed, and shocked carbonate clasts occur in breccias in and around the crater, together with Ca-rich silicic melt as wells as calcite (Cc) melt inclusions [1]. Chicxulub ejecta deposits in the Gulf of Mexico area contain Ca-rich silicic melt spherules, and they comprise ≤80 wt% carbonates [2]; the common view is that carbonate is of diagenetic origin (e.g., [3] with references). In accordance, the origin of sparry calcite (Cc) forming the core in ≤1 mm-sized spherules with a µm-thin outer clay shell (e.g., Shell Creek, AL [4]) have been interpreted by a four-step process: (1) The outer part of the silicate glass spherules was palagonized, (2) transformed to smectite, (3) followed by total dissolution of the remaining silicate glass, and (4) secondary filling with Cc.

Challenging the current interpretation: Processes outlined above are incompatible with petrographic and microchemical data as well as with physical constraints. For example, Cc spherules addressed as alteration product of silicic melt droplets display very complicated spherule in spherules textures that cannot be understood in terms of pseudomorphic replacement. Other arguments are the dull brick cathodoluminescence, the occurrence of Cc blebs in silicate glass spherules and, of Ti-seams in the outer shell documenting dissolution – precipitation during alteration of the silicate glass there, and lack of such Ti phases in the Cc core. Moreover, the K-Pg event bed in deep water carbonate marls at El Peñon and El Mimbral, N. Leon, Mexico, contain (i) silicate glass/smectite-coated Cc spherules, (ii) onion-shaped spherules with silicate glass core, rimmed by Cc, and a shell of smectite, (iii) spherules of silicate glass rimmed by feathery-grown Cc, and (iv) such one of Cc rimmed by silicate glass/smectite. As (i) and (ii), and (iii) and (iv) co-occur in thin sections, any diagenetic origin of the Cc can be excluded. Finally, the current view is ad odds with preservation of the delicate textures despite large the changes in density (ρ) and volume during the proposed transformations from fresh silicate glass (ρ ≤2.75 gcm^{-3}) over palagonite (ρ = 1.90 - 2.10) to Cc (ρ = 2.71).

Conclusion: Our observations indicate that large amounts of carbonate melt were generated and ejected by the Chicxulub impact. The carbonate ejecta frequently exceed that one of silicic melt spherules in K-Pg event beds. This view fits much better current models for the formation of the K–Pg boundary layer [4]. Carbonate and silicic melts were dispersed concurrent but as distinct melt batches that, in part, were mixed as evidenced by emulsion-like bubbly textures and Cc spherules with thin shells of silicic melt. Currently we are evaluating criteria for distinction of primary textures from those characteristic for alteration and diagenesis using electron back-scatter diffraction techniques.

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