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Dynamics during solidification of different impact melt zones from the peak ring of the Chicxulub crater, Mexico, inferred from Expedition 364

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IODP-ICDP Expedition 364 drill core from the peak ring of the Chicxulub crater consists from bottom to top of: (1) 587 m of shocked granitoid basement rock, (2) 36 m of impact melt rock, (3) 95.5 m of suevite, and (4) 112 m of post-impact platform carbonate rock. Impact melt rock occurs also in a 96 m thick zone at the bottom of the granitoid basement rock. Based on line scan, microstructural and electron microprobe analyses, we compare the structural and chemical characteristics of the two melt rock zones to better understand respective processes of emplacement and solidification of melt.

The upper zone of impact melt rock is layered and can be divided into four subunits. From bottom to top these are: i) A 9 m thick basal subunit consisting of at least two black silicate melt rock phases that are discernible by their plagioclase and texture. These melt rocks contain fragments derived predominantly from the underlying granitoid basement. The glassy and mottled texture of the phases indicates quenching and auto-brecciation of a solidifying melt, ii) a 16 m thick subunit characterized by two interlayered, immiscible melt rock phases, a silicate and a carbonate, displaying convoluted, centimetre-scale folds. Cusp-and-lobe geometry of the melt rock phases indicates that the silicate phase was more viscous than the carbonate phase during folding and solidification, iii) a 6 m melt breccia unit consisting of the same silicate and carbonate phases as the previous one. Flow-textured, carbonate melt rock envelop angular to rounded fragments of dark silicate melt rock, iv) a 5 m thick uppermost unit composed mostly of quenched fragments set in a brown calcareous matrix.

Melt rock of the lower zone is composed of silicates, shows evidence for viscous flow and is mixed with polymict breccia. The breccia consists of highly diverse basement rock and melt rock fragments, but is devoid of carbonate fragments. The structural characteristics of the lower melt rock zone point to juxtaposition of brecciated basement rocks, thereby entraining and sandwiching impact melt between basement rock slivers. This process can be explained by overthrusting of surficial impact melt by granitoid basement rock during peak ring formation. By contrast, the structural and chemical characteristics of the upper melt rock zone point to incomplete separation of a silicate and a carbonate melt during solidification and less severe deformation, likely caused by unrest of the peak ring during gravitational settling.