SUITABILITY OF IMPACT MELT LITHOLOGIES FROM THE CHICXULUB IMPACT STRUCTURE FOR $^{40}Ar/^{39}Ar$ GEOCHRONOLOGY.

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Introduction: The Chicxulub impact structure was recently drilled by the joint IODP-ICDP Expedition 364, at Site M0077A (21.45° N, 89.95° W), sampling rocks of the peak ring. Amongst the recovered impactite lithologies are impact melt rocks, breccias with impact melt fragments (suevites), and shocked target rocks [1]. These lithologies show a range of degrees of shock and hydrothermal alteration [see 2, 3, 4], and variable morphological and compositional characteristics. In the context of suitability for forthcoming $^{40}Ar/^{39}Ar$ geochronology, some characteristics of the most promising (i.e, least altered) "glass" impact melt rocks are discussed below.

Previous age determinations of Chicxulub. The Chicxulub structure was directly dated by $^{40}Ar/^{39}Ar$ geochronology in 1992 using glassy impact melt rock from the Chicxulub-1 core [5]. That work resulted in an age of 66.718 ± 0.132 Ma (1-sigma, full external precision, recalculated using the parameters of [6]) which was indistinguishable from the ages for the Beloc and Arroyo el Mimbral tektites that were determined in the same study [5]. However, this age does not agree at the 95% confidence interval with the more recently determined age for the Haitian (Beloc) tektites (66.038 ± 0.049 Ma [7]). The currently accepted age of the microtektites is resolvably younger than the age determined for Chicxulub. This discrepancy is likely due to the relatively low sensitivity of the mass spectrometers that were available in 1992, which were not ideal for dating the petrographically complex impact lithologies.

In addition to the Beloc tektites, the recent geochronological work on Chicxulub has focused on age determination of the K-Pg boundary using terrestrial bounding ash horizons [7]. The authors of [7] also discuss concerns about the accuracy and stated precision for the original $^{40}Ar/^{39}Ar$ age from the Chicxulub-1 core [5]. Therefore, we still lack a sufficiently accurate and precise age for the Chicxulub event. While age is not the only factor linking Chicxulub to the K-Pg boundary, critics of the link between Chicxulub and the K-Pg boundary question the provenance of the dated tektites, and use this, amongst other factors, to cast doubt on the relationship (e.g., [8]).

While $^{40}Ar/^{39}Ar$ age data will take time to collect, here we discuss some of the petrographic features of the Expedition 364 impact melt lithologies and their suitability for resolving the age discrepancies described above.

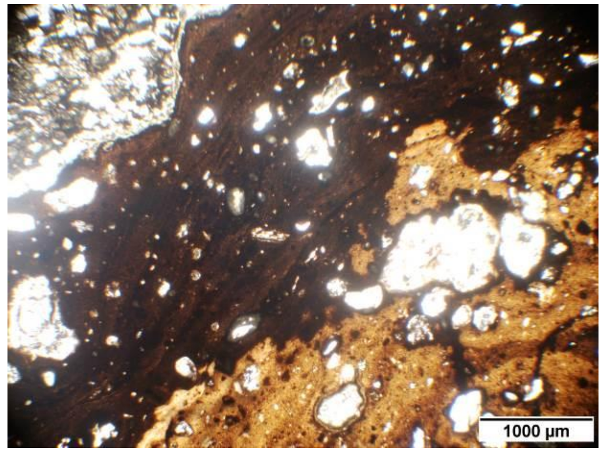

Fig. 1: *Red/brown recrystallized glass from an impact melt rock in sample M0077A_80R2_46-50 (706.4 mbsf). Evidence of flow textures come from variations in color. There are abundant lithic and mineral clasts. Thin section, plane-polarized light.*

Petrography of selected impact melt rocks/ glasses: Clasts with the morphology of impact melt (amoeboid/ragged/cuspate/sharp edges and flow banding) are present in various states of alteration /devitrification and show a variety of textures and colors. In hand sample, so-called "glass-" or "impact-melt-" clasts show a range of colors, from green to black, some with green rims and black centres. Impact melt rocks are similarly variable throughout the core.

Recrystallized glass is common – it has a dark red-brown color in plane-polarized light (PPL), amoeboid edges, and is often surrounded by darker brown to black areas with flow banding defined by variations in color (Fig. 1). Some birefringence is observed when examined in thin section between crossed polarizers. Crystallites ~10 µm in length now compose the bulk of the former "glass". Other areas of the impact melt rock generally have more gray to black coloration in plane-polarized light than the brown/red "glass" but are also composed of crystallites with no apparent common orientation and evidence of rapid growth through swallow-tail terminations. Local areas of relict perlitic fracturing are present, though recrystallization makes them difficult to identify.

Near a contact between an apparent dike of suevite cross-cutting a dike of impact melt rock, which itself cuts through basement granite, the impact melt rock has a very dark (near opaque in PPL) matrix with flow textures and abundant lithic and mineral clasts (~10 µm size). The suevite contains abundant lithic and mineral clasts of larger size (100-1000 µm) as well as clasts of partially recrystallized impact melt glass (Fig. 2). In cross-polarized light some areas show birefringence and others remain extinct. At high magnification some areas have visible microcrystallites and others do not, suggesting a state of partial crystallization.

Suitability of impact melt and melt-bearing lithologies: Based on appearance in hand specimen, the least altered impact melt clasts and impact melt rocks were selected for microanalysis, and will be downsampled for $^{40}Ar/^{39}Ar$ geochronology. In hand sample, green clasts with a morphology suggestive of glass were interpreted to be heavily altered to clay minerals, and dark or black clasts with the morphology of glass were interpreted to be less altered. Sampling for follow-up microanalysis was largely focused on those lithologies that are darker in hand-sample.

In comparison to much of the glass/impact melt fragments recovered from previous cores of the Chicxulub structure, this material seems less extensively altered, despite some level of devitrification. While no pristine glass has yet been found in the Expedition 364 core samples, which would be ideal for high precision $^{40}Ar/^{39}Ar$ age determination of the impact event, the relatively clean state of the impact melt rocks, and the abundance of materials available should provide enough material to help resolve some of the geochronological contradictions highlighted in the Introduction and in [8].

Future work: We will use the $^{40}Ar/^{39}Ar$ step heating approach on single grains of material from Expedition 364, terrestrial bounding ash horizons (IrZ Coal sanidine from Hell Creek, Montana), the Beloc tektites, and the Boltysh impact structure (considered by some to have formed at the same time as, or very near Chicxulub [9, 10]) to establish or rule out synchroneity of these events through high precision geochronology.

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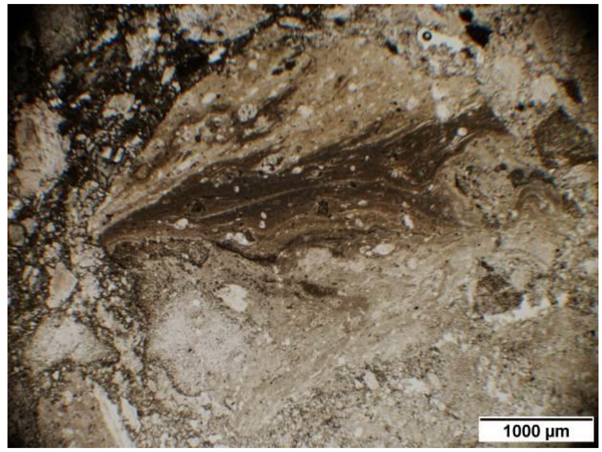

Fig. 2: *Partially recrystallized glass clast from suevite in sample M0077A_163R3_33.5-41 (917.1 mbsf). Evidence of flow textures defined by areas of different colored glass. Surrounding material is lithic and mineral clasts (mostly quartz and feldspar) set in a fine grained, dark brown (nearly opaque) matrix. Thin section, plane-polarized light.*

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