**IS THE CHICXULUB STRUCTURE IN N. YUCATAN A 200 km DIAMETER IMPACT CRATER AT THE K/T BOUNDARY? ANALYSIS OF DRILL CORE SAMPLES, GEOPHYSICS, AND REGIONAL GEOLOGY;** V. L. Sharpton, B. C. Schuraytz, *LPI, Houston, TX 77058*, D. W. Ming, J. H. Jones, *NASA/JSC, Houston, TX 77058*, E. Rosencrantz, *UTIG, Austin, TX 787511*, and A. E. Weidie, *UNO, New Orleans, LA 70148*

Following reports of half-meter-thick ejecta deposits at the Cretaceous-Tertiary (K/T) boundary in Haiti [1], efforts to locate the canonical K/T impact structure have focused on nearby regions of the Caribbean and the Gulf of Mexico. Three candidate structures have been proffered thus far [1, 2], but recent attention has focused on the "Chicxulub structure", a subsurface zone of upper Cretaceous igneous rocks and breccias in the northern Yucatan Peninsula. The spatial association of these lithologies with a multi-ring pattern evident in proprietary aeromagnetic data, led Penfield and Camargo [3] to suggest this structure was a buried impact crater, probably of K/T age. Estimates of its diameter range from 180 km to 230 km, based on interpretations of the outer magnetic ring, which roughly coincides with the arcuate-trending "ring of cenotes" [4] or karst features evident in Landsat images of the Miocene-Pliocene cover of northwesternmost Yucatan. Hildebrand and coworkers [5] have further heightened interest in this structure with their reports of finding shock-deformed quartz grains within samples from the uppermost Cretaceous unit, which they describe as "an 80-m-thick bentonitic calcareous breccia", and interpret as the ejecta blanket surrounding the 180 m Chicxulub crater. These samples were retrieved from Pemex drill-hole Yucatan-2, located approximately 130 km from the structure's center. We have examined the upper Cretaceous through Eocene samples from several exploratory wells, including Yucatan-2, along the southeastern flank of this structure. In this contribution we summarize the results of our analysis thus far and comment on the geophysical and geological observations salient to evaluating the size and origin of the Chicxulub structure.

*Yucatan-2 samples.* There is considerable disparity in various interpretations of the upper Cretaceous stratigraphic sequence at Yucatan-2, primarily because cores were taken intermittently and recovery was low. Nonetheless, the consensus of recent work [6] indicates that the K/T boundary occurs between 250 and 300 meters-below-sea-level and that the uppermost Cretaceous (and perhaps the lower Paleocene) interval consists of a thick (>500 m) sequence of poorly sorted evaporite-carbonate conglomerates interbedded with slightly fossiliferous dolomite and anhydrite. Paleontological data are sparse, but seem to indicate this sequence was deposited over a broad time interval. Table 1 lists the samples of Eocene and upper Cretaceous samples we have examined. Our sample suite includes the uppermost sample of these conglomerates (Y2-N6) which has been interpreted to represent an 80-m-thick ejecta blanket.

Table 1. List of analyzed samples from Yucatan-2

| Sample | Interval (m) | Lithology |
|---|---|---|
| N-3 | 204-207 | porous sparry micrite |
| N-5 | 254-257 | vuggy micrite |
| --------K/T Boundary-------- | | |
| N-6 | 301-303 | anhydrite/dolomite conglomerate |
| N-7* | 350-353 | anhydrite |
| N-9 | 500-503 | anhydrite/dolomite conglomerate |
| N-9* | 500-503 | laminated pel-biomicrite |
| N-11 | 701-704 | anhydrite/dolomite conglomerate |

*Data from Marshall [6].

Our analysis thus far has focused on constraining the mineralogy and petrology of the upper Cretaceous conglomerates in order to evaluate the hypothesis that (some part of) this unit may represent impact ejecta [5]. Petrographic analysis of 20 thin sections supports previous work [6] indicating these samples consist of mm- to cm-scale rounded-to-subangular clasts of anhydrite and dolomitic limestone contained in a groundmass of dolomitic micrite, fine-grained euhedral dolomite, and anhydrite. Clasts include abundant pebbles of fine-grained anhydrite, as well as micritic and pelleted carbonate lithoclasts; carbonate lithoclasts and bioclasts are typically embayed. No terrigenous clasts (including clasts of clay minerals) were evident in any of our samples from the uppermost portions of the anhydrite/dolomite conglomerate facies (samples Y2-N6; Y2-N9).

A 15 g to 30 g split of each sample was subjected to a sequence of HCl washes to concentrate any terrigenous component such as quartz and feldspar. These residues averaged <10 wt % of the original split for all upper Cretaceous samples. They consist predominantly of anhydrite laths with some undigested dolomite remaining. Quartz is present in concentrations less than 1 grain per 500 examined and consists of both authigenic (bipyramidal or cryptocrystalline) and detrital quartz. These quartz grains range in size from

<20 μm to ~80 μm; no indications of shock metamorphism were detected. Because sample Y2-N6 is possibly the uppermost Cretaceous sample in our suite, we evaluated the composition of the acid-washed concentrate using x-ray diffraction techniques. Diffraction patterns clearly demonstrate this material is anhydrite and its alteration product bassanite ($CaSO_4 \cdot {}^1/_2 H_2O$) with no discernable quartz component.

*Analysis and conclusions.* Given the geographic and stratigraphic position of the Chicxulub structure, it is an intriguing candidate for a K/T impact site. This site also satisfies the requirement for continental target rocks imposed by mineral clasts [7] and unaltered glass [8] at the K/T boundary. However, calculations [9] suggest that if the final crater diameter were 180 km to 230 km (i.e., 100 km $< D_{tc} <$ 140 km) as estimated, the ejecta blanket at Yucatan-2 should be 20 m to 90 m thick. Furthermore, since the post-Jurassic sedimentary sequence around this structure is at most 3.5 km thick, the excavation depth (10 km to 14 km) and shape of the excavation cavity indicate that this ejecta should consist predominantly of crystalline basement (including metaquartzites and Paleozoic igneous rocks). Analysis of the ejecta around the Ries crater [10] suggests this crystalline material should occur as weakly-shocked clasts, as well as minor amounts of highly-shocked (glassy) groundmass. The total lack of terrigenous clasts and the lack of anomalous amounts of clay minerals in the samples we have examined, therefore, indicates to us that none of our samples represent continuous impact ejecta. Subsequent processes such as tsunamis associated with crater collapse could dilute this ejecta signal, but even if mixed with several hundred meters of carbonates and evaporites, the predicted proportions of terrigenous material should be recognizable.

It is difficult to reconcile our findings with the interpretation of Hildebrand and coworkers [5]. While we do not discount the importance of their discovery of shocked quartz clasts, the mineralogy and fabric of the upper Cretaceous conglomerates do not support their interpretation that these units are impact breccia. At least two alternatives could be considered: *(i) Chicxulub is not the source of the shocked quartz detected in the Yucatan-2 sample.* Shocked quartz grains are characteristic of the K/T boundary virtually world-wide, and it is well established that some Caribbean sections have thickened K/T boundary layers. *(ii) Chicxulub is the source of the shocked quartz but is considerably smaller in diameter than previously estimated.* The distribution of possible impact melt deposits at the center of Chicxulub can be constrained by gravity data to be <60 km in diameter. Maximum regional anomalies in this zone are of the order of 15 mgal suggesting a melt-sheet thickness of ~750 m to 1500 m. The dimensions of this sheet are similar to the original dimensions of the melt-sheet of the 100 km Manicouagan impact structure [11] and suggest the Chicxulub structure could be of similar size.

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