ISLE OF PINES, CUBA: K/T IMPACT EVIDENCE NOT YET FOUND

J.F. McHone and R.S. Dietz Geology Dept., Arizona State University, Tempe, AZ 85287-1404

In 1980, a group of Berkely scientists touched off a revolution in geologic thinking by suggesting the major division between Mesozoic and Cenozoic time was caused by the impact of a giant meteoroid (ref.1). In the following decade more than 75 localities around the world were found with sediments preserved from this Mesozoic/Cenozoic ..or Cretaceous/Tertiary (K/T) boundary. Within these sediments are chemical traces of the projectile and tiny particles of the shattered earth target. However, no single impact crater has yet been clearly recognized which is both large enough and of the proper age to account for these observed global distributions of contaminants. Because K/T beds are thickest and granular components are largest at North American and Caribbean sites, the Caribbean has been considered a likely place to search for the missing giant crater. At least three localities have been suggested: 1) beneath North Yucatan (ref. 2), 2)beneath the Magdelena Fan (ref. 3), and 3) the western end of Cuba (ref. 4).

While attending the June 1990 2nd Congress of Marine Sciences in Havana, we conducted a geologic reconnaissance of the proposed Cuba site to assess four main points suggested by Bohor and Seitz:

- •The Isle of Pines may be an impact structure central uplift
- •Possible shatter cones in uppermost Cretaceous sediments
- •Possible ejecta deposits with boulder-sized clasts
- •Large thrust blocks (Magotes) possibly related to cratering mechanics

ISLE OF PINES

The Isle of Pines, now named Isla de la Juventud, consists of a northern highlands of mostly Jurassic metamorphic rocks and a southern lowlands of young carbonates. The surface is heavily vegetated and deeply weathered outcrops are poorly exposed. Geologic resources include statuary & dimension marble and ceramic-grade kaolinite. After considerable administrative effort it seemed not practical to visit the island for we had been able to obtain written permission to enter-- but not to leave-- this former prison colony. Fortunately metamorphic petrologist Guillermo Millan at the Institute of Geology and Paleontology has studied the Isle of Pines for several years and continues to refine his geologic maps. A fault zone divides the highlands into two roughly equal zones of slightly different metamorphic grades and most workers speculate two separate metamorphic events took place. In his Havana laboratory we examined nearly a hundred optical thin sections but only two showed properties resembling shock effects. In one, a slightly metamorphosed heterogeneous sandstone, individual grains are thoroughly fractured. In another, quartz and feldspar grains are squeezed together and clusters of microcracks and fissures radiate from contact zones. Unlike shock features these are open fissures, not stacks of optically dissimilar material, they are curved rather than planar, and they are randomly oriented rather than parallel to crucial crystal planes. Given the large number of samples examined, if the Isle of Pines were an impact structure central uplift, microscale damage should be far more common. We attribute the observed features to tectonic effects.

POSSIBLE SHATTER CONES AND EJECTA

On the mainland, in La Havana and Matanzas provinces, we examined three upper Cretaceous"megabeds": 1)Penalver Formation, 2)Bacunayagua Formation, and 3)Via Blanca Flysch. Pszczolkowski (ref. 5) suggested these massive submarine single-event deposits were triggered by huge earthquakes caused either by violent Caribbean tectonics or by a nearby impact event at the end of Cretaceous time.

CUBA: NO IMPACT YET, McHone and Dietz

Because of certain key words, early descriptions (ref. 6) of separate members of the Penalver unit had caught the attention of workers during literature searches (ref. 4).A "cone bed" containing conical fragments of host carbonate material was cautiously considered as a possible early description of shatter cones. These cones, now thought to be related to compaction and/or dewatering phenomena, are found low in the Penalver Fmtn. in coarse, porous sediments. A widespread "Big Boulder Bed" might be interpreted as scattered and fragmented target rocks ejected from the site of an impact event. The large boulders are, however, weathered by exfoliation from a compact, fine-grained limestone higher in the same section. Early workers tended to correlate boulder beds throughout Cuba. In actuality, although they may be of similar ages, they occur in separate basins and may not owe their existence to a common source or origin.

The Bacunayagua Fmtn., restricted to only one surface outcrop but widely known in drill holes, is readily recognized by its quartz and silicate clasts. This unit is of much interest because shock features are more readily recognized in silicates than in carbonates. To date we have detected no shock effects in these rocks.

At the Via Blanca Flysch outcrop an undisturbed flysch sequence is truncated obliquely by a unit of unsorted rubble containing boulders and fragments of all sizes. Deposits examined were so deeply weathered that large crystalline boulders visible in shape and color could be sampled with a stout trowel. Mineral grains from these transported rocks have not yet produced shock effects.

MAGOTES

Limestone megablocks known as Magotes are widely distributed in Cuba. Recent petroleum drilling has shown many to be thrust blocks stacked in an imbricated manner and as many as five blocks have been penetrated by a single drill effort (ref. 7). Because of a general lack of shattering and brittle deformation, magotes are here interpreted as the result of complex Caribbean tectonics.

In spite of its tantalizing morphology and geographical setting, we have been unable to detect any evidence of an impact history for the Isle of Pines in Cuba.

References:

(1) Alvarez, L. W., W. Alvarez, F. Azaro, H. V. Michel, (1980)*Science*, vol. 208, p. 1095. (2) Penfield, G.T., and A. Camargo, (1981)*51st Annu. Meeting Soc. Explor. Geophys. Abst.* p. 37. (3) Hildebrand, A.R. and W.V. Boynton, (1990)*Science*, vol. 248, p. 843. (4) Bohor, B.F. and R Seits (1990)*Nature*, vol. 344, p. 593. (5) Pszczolkowski, A. (1985) Bull. Polish Acad Sci, Earth Sci. vol. 34, No. 1., p. 81. (6) Palmer, R. (1934)*Jour. Geol.* vol. 42, p. 123.