Chicxulub YAX-1 impact breccias: Whence they come? B.O.Dressler[1] and V.L.Sharpton[2], L.E.Marin[3]; 1 - Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX, 77058 (dressler@lpi.usra.edu); 2 - Geophysical Institute, University of Alaska Fairbanks, 903 Koyukuk Drive, Fairbanks, AK 99775; 3 - Instituto de Geofisica, UNAM, Mexico City, Mexico.

The Yaxcopoil (YAX-1) drill site had been chosen to investigate a thick unit of impactite predicted, based on seismic profiles, to lie beneath approximately 800 m of Tertiary crater fill in an area just outside the excavation cavity but relatively close to its margin. Approximately 400 m of suevitic fallback breccia were expected to overlie an impact melt body that had been penetrated in a petroleum exploration well at a depth of about 1250 m, at a distance of about 20 km from YAX-1 towards the center of the structure. The drill string was expected to reach a final depth of about 1.8 km, possibly 100 to 200 m in the basement of the crater. The pre-drilling predictions appeared to be right-on when suevitic breccias were reached at a depth of 795 m. After drilling through only 100 m of impact breccias, however, the drill encountered megablocks of Cretaceous target rocks. Drilling stopped at 1511m, still in megablocks of Cretaceous sedimentary rocks. Table1 lists the field names of the six units of impact breccias encountered at YAX-1 and briefly describes them. In the following, a tentative interpretation of the depositional processes is provided. It is based on a still somewhat incomplete documentation of the clast populations and matrices of the breccia units and on an analysis of the six units as a sequence. All breccia units are allogenic and their obvious differences are most likely a result of different depositional processes.

Units 1 and 2 are suevites and, in analogy of suevites at other impact structures, their components were transported ballistically from the excavation cavity to their place of deposition. Clast-size sorting and lamination constitute the evidence for the interpretation of Unit 1 as being redeposited. Units 3, 5, and 6 are peculiar. Unit 3 has fewer large clasts than the suevite above and possesses a distinct fine-grained and homogeneous brownish matrix. Tiny melt particles, in places, are molded one against another with moderate compressions. Some thin-walled frothy glass or melt fragments have been observed that may represent immiscible carbonate-silicate melts. In Fig.1 the carbonate melt portion of such a melt particle is very similar to the matrix of Unit 3 breccia. Tiny silicate glass fragments derived from the broken immiscible melt fragment are imbedded in the “matrix” nearby. Target rock fragments in Unit 3, basement rocks and limestone fragments alike, are commonly subrounded to rounded and, in a few places, are wrapped by greenish glass. All these features are suggestive of breccia transport and deposition by a hot, very turbulent nuée ardente-like process.

Unit 4, is a very coarse and very heterogeneous breccia containing commonly contorted, flow-laminated and, in places, welded glass fragments of various colors. The matrix of the breccia, however, is, at least macroscopically, similar to the breccia of unit 3 above. Because of this similarity and because of the gradational contact between units 3 and 4, Unit 4 may represent the lower, coarser portion of the “nuée ardente” deposit. As such, it is similar to an ash-flow deposit in a volcanic environment.

Unit 5, described as “green monomict-autogene melt breccia” in the drill log, contains commonly flow-laminated, green fragments, which, in paces, are densily packed. Neighboring fragments have been noted that can be fit together like pieces in a jigsaw puzzle. The matrix in which the green melt rock clasts are embedded, in places, is carbonaceous, very fine grained or consists of melt or tiny melt particles. Molten basement rock clasts have been noted that completely fill the spaces between neighboring melt rock fragments. Most of the features of this Unit 5 observed so far lead us to believe that the unit is not some kind of suevitic air fall deposit and also was not deposited by a turbulent medium similar to that which was responsible for the transport of the components of breccias of units 3 and 4. It rather represents a fragmented impact melt breccia, either part of a thin melt sheet or a dike-like body similar to "melt rock" dikes of the Onaping Formation of the Sudbury Structure **[1].** Fragmentation of the melt breccia may be the result of post-deposition, explosive activity caused by the interaction of water with the hot melt rock.

Whereas the contact of Unit 5 with Unit 4 above is abrupt, its lower contact with Unit 6 is gradational. Size, abundance and diversity of target rock fragments increase and the color of melt fragments commonly change from green to a tan, light gray color. Thin sections from the lower parts of Unit 6 studied so far mostly contain a fine tan to light brown carbonate matrix. It is commonly flow-aligned and contains tiny, angular to rounded fragments of target rocks and glass or melt rocks. We interpret this matrix as carbonate melt but our limited number of samples does not allow us to characterize all of Unit 6 as carbonate melt breccia.

Assuming that our preliminary interpretation of YAX-1 impact breccias will survive our own scrutiny and that of our colleagues, units 6 and 5 were emplaced as lower carbonate/upper silicate melt breccia bodies, in some way representing a reverse stratigraphic order of target rocks. After the emplacement of these melts, a turbulent ground surge deposit (Units 3 and 4) blanketed the melts before suevite airfall covered the lower four units. Sea water currents reworked part of the upper suevite.

NB: Most YAX-1 "glass" fragments, sensu-stricto, are melt rock fragments.

References: **[1]** Muir, T.L. and Peredery, W.V. (1984), Ont.Geol. Survey, Sp. Vol.1.

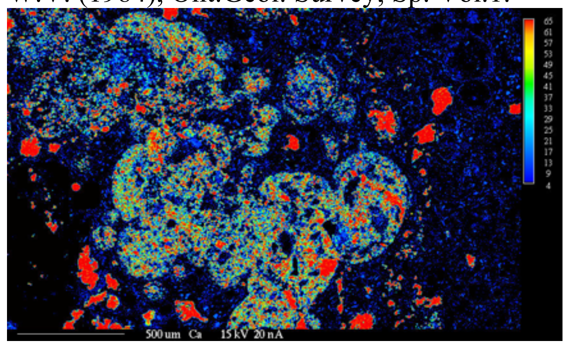

Fig. 1: Element maps (Ca top image: Si lower image) showing carbonate-rich, vesicle-like fillings in silicate glass. For interpretation see text above. Quartz clast at lower left.

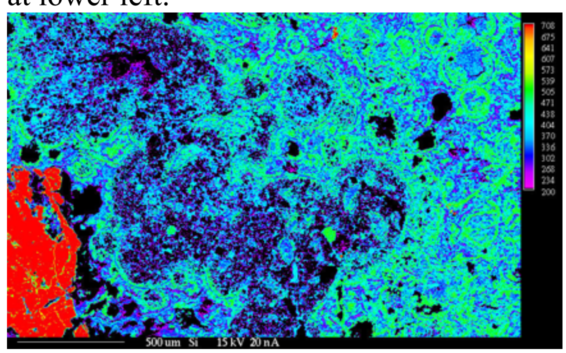

Table 1: Preliminary Stratigraphy of Well YAX-1; Chicxulub Impact Structure

	Depth [thickness]	Well Log Name	Petrography	Unit
Tertiary cover rocks	(m) 0.00 – 794.63 [794.63]	Tertiary sedimentary rocks	Massive, (cross-) laminated, soft-sedimentary deformation, foraminifers	
	794.63 – 808.02 [13.39]	Redeposited Suevite	Glass-rich, clast-size sorted.	1
	808.02 – 822.86 [14.84]	Suevite	Glass-rich, no clast-size sorting	2
	822.86 – 845.80 [22.84]	Chocolate-brown melt breccia	Homogeneous, very fine-grained matrix with tiny glass particles, welding features	3
Impactite	845.80 – 861.06 [15.26]	Suevitic breccia, variegated, glass-rich	Coarse, heterogeneous, matrix similar to that of Unit 3	4
	861.06 – 884.92 [23.86]	Green, monomict-autogene melt brc.	Laminated melt rock fragments. Texture, in places, suggestive of authigenic brecciation.	5
	884.92 – 894.94 [10.02]	Variegated, polymict, allogenic-clast melt breccia	Very coarse, rich in carbonate melt.	6
Megablocks of Cretaceous rocks (894.94 – 1510.97, 616.03); limestone, dolomite anhydrite (27.4%). In places, impact breccia and melt dikes; variable inclination of bedding planes; authigenic breccia zones.				