**CARBONATE EJECTA FROM THE CHICXULUB CRATER: EVIDENCE FOR ABLATION AND PARTICLE INTERACTIONS UNDER HIGH TEMPERATURES AND PRESSURES.** A.C. Ocampo[1], K.O. Pope[2], and A.G. Fischer[3], [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, aocampo@jpluvs.jpl.nasa.gov, [2]Geo Eco Arc Research, 2222 Foothill Blvd., Suite E 272, La Canada, CA 91011, kpope@primenet.com, [3]Department of Earth Sciences, University of Southern California, University Park, Los Angeles, CA 90089.

Deposits of coarse carbonate ejecta have been found at the K/T boundary in Belize 360 km (Albion Island) and 475 km (Cayo District) southeast of the Chicxulub crater [1, 2]. An unusual category of carbonate ejecta is represented by angular to rounded pebbles and cobbles that exhibit surface polish, striations, and penetration by impacting rock chips. We propose that these phenomena are the product of interactions between ejecta particles, the vapor plume, and the atmosphere during ejection from Chicxulub and atmospheric re-entry from high altitudes.

**Striations and Penetration Features**. The striae range in width from a few microns to a few millimeters and usually occur in parallel sets. Some clasts have as many as three overlapping and crosscutting sets (Fig. 1). Several examples have sets of striations that curve and jog giving a "wiped" appearance. Many sets of striations end in abrupt angular terminations or pits that rarely contain the rock chips that created the striations. Small craters (1 cm) with up-turned rims are also present.

**Polish**. The polish is remarkably fine giving many clasts a sparkling sheen. Scanning electron microscopy (SEM) reveals that the polish is so fine that the crystal boundaries between 1 micron grains appear annealed (Fig. 2). In most cases the polish occurred after the striations, although it tends not to remove the striations, but only smooths the edges. Many of the polished limestone clasts contain patches of coarse grained calcite crusts that have been polished along with adjacent areas without crusts.

**Lithology**. Ejecta clasts exhibiting these unusual features are rare at Albion Island and are composed entirely of dolomite, while they are more common in Cayo and are composed of limestone. The polished and striated Cayo limestones have been given the informal name "Pook's Pebbles" after the Pook's Hill Lodge near the type locality. The Pook's Pebbles are typically a microcrystalline pink limestone commonly containing veins and nodules of microspherulitic chert and degraded microfossils. Microspherulitic cherts are also present at Albion Island, but are more rare. A few Pook's Pebbles with microspherulitic chert were found where the chert stands in high relief with a rough bleached surface surrounded by polished and striated limestone.

**Theory**. Ballistic calculations (ignoring atmosphere) require ejection velocities of 1-2 km/s to reach Belize, which produce trajectories that reach altitudes of 100 km. Atmospheric drag would reduce the range and thus require slightly higher ejection velocities. Impact models [3] scaled to a 110 km diameter transient crater (the minimum appropriate for Chicxulub) indicate that most (90%) of the ejecta with sufficient velocity to reach Belize would come from the 3 km thick sedimentary layer composed of 70% carbonate and 30% sulfate [4]. With the exception of spallation blocks, most of this ejecta would be shocked >10 GPa. Thus, theory alone predicts that the Belize ejecta should be dominated by moderately shocked carbonates.

**Interpretations**. The lithological differences between Albion Island and Cayo may reflect ejection from different depths in the stratified carbonate platform at Chicxulub. The curving striations and penetration features indicate that the carbonates deformed plastically. Plastic deformation of limestones may be possible under partial melting conditions of >100 bars and >1500$_o$ K [5]. These temperatures and pressures can be produced during the impact ejection phase, especially when the expanding vapor plume passes through the ejecta curtain [6]. It is also possible to reach partial melting conditions for limestones by ablation during atmospheric re-entry [7]. Higher temperatures and pressures are required to melt dolomite [8], which might explain why these surface phenomena are rare at Albion Island, where dolomites predominate.

We propose that the penetration features and many of the striations found on the Chicxulub carbonate ejecta clasts from Belize result from high velocity particle interactions under sufficient temperatures and pressures to partially melt the clast surfaces. The microspherulitic texture of the cherts may be a product of shock, as such textures are common in devitrified volcanic glass. We also propose that the calcite crusts and the fine polish are products of ablation that partially melted the surfaces and annealed crystal boundaries. Ablation of the limestones preferentially over the cherts may also explain the clasts where the encrusted chert stands out in relief. Such ablation could occur either as the super heated vapor plume passes through the ejecta curtain, or when the high altitude ejecta re-enter the atmosphere.

**References**: [1] A.C. Ocampo, K.O. Pope, and A.G. Fischer, Geol. Soc. Amer. Spec. Paper 307, 75-88 (1996). [2] A.C. Ocampo et al., Geol. Soc. Amer. Abstr. Progr. 38, 182 (1996). [3] H.J. Melosh, Impact Cratering: New York, Oxford University Press (1989). [4] W.C. Ward, G. Keller, W. Stinnesbeck, and T. Adatte, Geology 23, 873-876 (1995). [5] J.A. Tyburczy and T.J. Ahrens, J. Geophys. Res. 91, 4730-4744 (1986). [6] A.M. Vickery, J. Geophys. Res. 91, 14,139-14,160 (1986). [7] P.H. Schultz and D.E. Gault, Geol. Soc. Amer. Spec. Paper 190, 153-174 (1982). [8] P.J. Wyllie and W.-L. Huang, Contrib. Mineral. Petrol. 54, 79-107 (1976).

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Fig. 1. SEM image of multiple striations on Pook's Pebble.
Field width 2.6 mm.

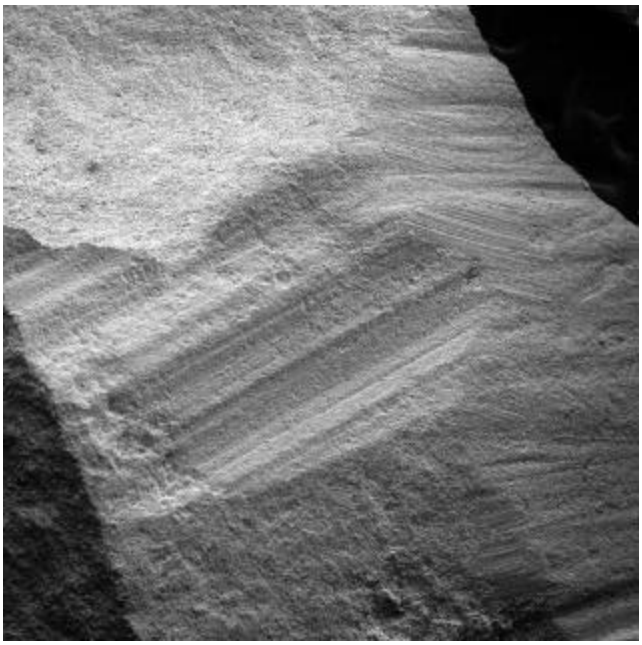

Fig. 2. SEM image of polish on Pook's Pebble.
Note faint, mostly annealed grain boundaries. Field width 27 um.