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Shocked minerals in the K-T boundary: implications for obliquity of impact

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Introduction: It is well-known that impact ejecta distribution is the most effective indicator of impact obliquity: while the majority of planetary craters are circular, ejecta distribution is not [1-2]. In this study we investigate whether the K-T global ejecta layer is likely to carry a signature of obliquity of impact at Chicxulub. The K-T boundary contains vaporised meteorite, spinels, and shocked fragments of target rock, and the only viable mechanism of distributing these globally is through their acceleration in the post-impact expanding vapor plume. However, the nature of the mechanics of ejection remains relatively poorly understood. Previous studies of the K-T ejecta have suggested some intriguing asymmetries in the ejecta pattern [3-5]. However, to-date, these observations are based upon data acquired using different analytical procedures, with few sites in the southern hemisphere, and it is difficult to make a quantitative assessment of ejecta asymmetry using these data.

Ejecta analyses: In this study we have systematically documented the size-distribution and degree of shock of quartz at a number of K-T sites world-wide. We see that the average number of shocked quartz grains per gram decreases with apparent paleodistance from Chicxulub and is best fit by a power law. There is more than an order of magnitude difference between the numbers of shocked quartz in North American sites and the rest of the world, and the next two closest sites, appear to have anomalously low amounts of quartz. The European sites contain more shocked quartz than expected, contrasting with previous comparisons between the Pacific and European sites (4-5), but it is apparent from our studies that results from unrelated studies cannot easily be compared. We also observe that the degree of shock (average nos PDFs) increases away from the impact site and that a site to the southeast of Chicxulub (207) has anomalously highly-shocked quartz.

Numerical modeling: We model the impact and high-velocity impact ejecta motion using 3D hydrocode SOVA [6] complemented by the ANEOS [7] equation of state for geological materials**.** We use a tracer (massless) particle technique to reconstruct dynamic (trajectories, velocities), thermodynamic (pressure, temperature) and disruption (strain, strain rate) histories in any part of the flow. The motion of ejecta in the post-impact plume is described in the frame of two-phase hydrodynamics: every ejected fragment is characterized by its individual parameters (mass, density, position, and velocity) and exchanges momentum and energy with surrounding vapor-air mixture. We use a simplified description of the Chicxulub target, with a 3-km-thick layer of sediments (calcite EOS), a 30-km-thick crystalline basement (granite EOS) and mantle (dunite EOS). To-date we have computed the early stage ejecta only. The distribution of ejected mass and its average velocity is symmetric for a vertical impact, and asymmetric for oblique impacts with 10 times more ejecta in the downrange direction for a 30 degree impact, and 3 times greater ejection velocities downrange than uprange. We also see that the ejecta uprange ejecta is much more shocked, on average, than downrange.

Conclusions: In view of the results of the modeling of the early stage ejecta, the high degree of shock in site 207 and the size-distribution of the shocked grains are indicative of a downrange direction to the north or northeast of Chicxulub. However, we need to continue the modeling to establish whether the late stage ejecta carries a similar signature of obliquity to that of the early ejecta.

References: [1] Gault DE, Wedekind JA. (1978) *Proc. LunarPlanet. Sci. Conf.* 9, 3843–75. [2] Schultz P. (1999) *Lunar Planet. Sci. Conf.* 30, Abstr. #1919. [3] Alvarez W., et al. (1995) *Science* 269, 930-935 [4] Zhou, L., Kyte, F., Bohor, B., (1991)Geology 19 694–697. [5] Bostwick, J. A. Kyte F.T. (1996) Geol. Soc. Amer. Spec. Pap., vol. 307, , pp. 403-415. [6] Shuvalov V. (1999 *Shock waves 9*, 381-390. [7] Thompson S.L. and Lauson H.S. (1972) SC-RR-61 0714. Sandia Nat. Laboratory, Albuquerque, NM.119 p.

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