CHARACTERISTICS AND VERTICAL PROFILE OF SHOCKED QUARTZ GRAINS IN THE YAX-1 CORE : CONSTRAINTS ON TRANSIENT CRATER SIZE AND EJECTA DEPOSITION PROCESS OF THE CHICXULUB IMPACT. Yu Chang[1*] , Kazuhisa Goto[2] , Yasuhito Sekine[3] , Eiichi Tajika[3], [1]Department of Eerth and Planetary Science, University of Tokyo. (joh@astrobio.k.u-tokyo.ac.jp) [2]IRIDeS.,Tohoku University, [3]Department of Complexity Science & Engineering, University of Tokyo.

Introduction: The Chicxulub crater, located in the Yucatan Peninsula in Mexico, is one of the largest impact structures on Earth (diameter of 180-200 km) [1]. Because the Chicxulub impact is considered to have caused a mass extinction at the Cretaceous-Paleogene (K-Pg) boundary [2], knowledge on the cratering process of the Chicxulub impact will be important not only for understanding a large-scale impact but also the environmental perturbations at the K-Pg boundary.

Despite such an importance, the detailed cratering process of the Chicxulub has been poorly constrained by geological evidence. First, the size of the transient crater has been largely unknown. Previous hydrodynamic simulations suggest that the diameter of the transient crater would have been 100 km to illustrate the size of the final crater [3], implying the Yaxcopoil-1 (YAX-1) drilling core located at 60 km from the center of the crater would have been outside the transient crater. However, no geological evidence has been reported to support the results of numerical calculations.

Second, it is still controversial whether water invation into the crater occurred associated with the impact. Some groups suggest that the upper parts of the impactites of the YAX-1 core are impact-induced tsunami deposits based on the observation of rock strata and geochemical analyses [4,5]. Nevertheless, others interpret that the same units of the YAX-1 core are ejecta deposits that fell in the air [6,7].

In this study, we analyzed both the size distribution and planar deformation features (PDFs) on shocked quartz grains contained in the YAX-1 core derived from the Chicxulub crater. Because the crystallographic orientation of PDFs preserves information of shock pressure achieved by impacts, characteristics and vertical profiles of PDFs along with the YAX-1 core will provide unique information on the excavation, transport, and deposition processes of each impactite unit of the YAX-1 core.

Method: Quartz grains were extracted from the YAX-1 drillcore samples by treating with hydrochloric acid (HCl), hydrogen peroxide (H_2O_2), and hydrofluosilicic (H_2SiF_6) [8]. After the acid treatment, resident quartz grains were mounted on glass plates with pedropoxy basin. Orientation of PDFs were measured and indexed using a four-axis universal stage (U-stage) microscope [9]. The obtained data was indexed following the method summarized in Nakano et al. [8].

Results & Discussions: We found 525 shocked quartz grains throughout the impactite sequences in the YAX-1 core (from Units 6 to 1 in ascending stratigraphic order). In the present study, 574 sets of PDFs were measured from fifteen vertical levels.

We found that all the shocked quartz grains contained in the impact melt layer (Unit 5) were predominantly undergone high shock pressures (> 25 GPa). Whereas, shocked quartz found in other impactite sequences are mixtures of quartz grains that were experienced various shock pressures. These results suggest that Unit 5 is likely to have been formed by an outward flow of impact melt-sheet from the transient crater cavity during the collapse of the central uplift and transient crater [6,7]. Shocked quartz in Unit 5 would have been originally located at the bottom of the transient crater and then transported by the outward flow of melt-sheet. Because impact ejecta are expected to contain mixtures of quartz with various shock pressures, they cannot explain the obtained PDFs pattern.

Given our interpretation of melt-sheet origin of Unit 5 together with the order of deposition of impact ejecta and melts suggested by numerical simulations [10], Unit 6 is considered to have be ejecta curtain deposits. The presence of ejecta curtain deposits in the YAX-1 core means that the core was located outside the transient crater, which support the results of hydrodynamic simulations [10].

In Unit 1, i.e., the uppermost impactite unit, we found an inverse correlation between shocked quartz grains undergone high shock pressures (> 25 GPa) and those undergone medium degree of shock pressures (12-25 GPa) associated with upward grain fining in the sequences. Such cyclic variations in PDFs pattern and grain size would be difficult to be explained by ejecta deposits. These results support the idea that Unit 1 was repeated impact-induced tsunami deposits [4], which suggest water invasions into the crater.

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