

Chicxulub crater-filling as a probable cause of giant tsunamis at the Cretaceous-Tertiary boundary

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A great number of Cretaceous/Tertiary (K/T) boundary tsunami deposits around the Gulf of Mexico have been reported (e. g., Smit, 1999). However, the origin, propagation process and magnitude of tsunamis have been poorly understood. Two different generation mechanisms are proposed for the giant tsunamis caused by the K/T boundary impact (Matsui et al., 2002). One is a landslide triggered by the impact seismic wave (landslide-generated tsunamis) and the other is a crater-filling of the ocean water (crater-generated tsunamis). There are thick (more than 250 m) landslide and gravity flow deposits of probable K/T boundary age reported around the Yucatan peninsula (e. g., Kiyokawa et al., 2002), which might have caused large tsunamis. On the other hand, if the ocean water invaded into the crater immediately after the impact, the crater-generated tsunamis would have been formed by the movement of water that fills and then flows out of the crater cavity. Although the latter mechanism has a potential to generate the largest tsunamis, no evidence of ocean invasion into the crater has been presented. So the examination of the sediments in the Chicxulub crater is critical to test the possibility of marine invasion and consequent generation of the large tsunamis. In this study, lithology, grain composition, chemical composition, grain size and nanofossil assemblage of the samples from YAX-1 core, drilled by the Chicxulub Scientific Drilling Program (CSDP), were analyzed to investigate the possibility of the marine invasion into the Chicxulub crater immediately after the impact. The impactite in the YAX-1 occurred between 794.60 (?) m and 894.94 m depth and is divided into two lithologic units: impact melt breccia unit (822.86 m to 894.94 m) and suevite unit (794.60 (?) m to 822.86 m). The impact melt breccia unit is mainly composed of infinite form of melt fragments with small amount of basement and carbonate rock fragments. The suevite unit overlies the impact melt breccia unit with irregular contact. The suevite unit is composed of fragments of rocks and minerals together with melt in a clastic matrix. Poorly-sorted, grain-supported fabric and intraclast-like nature suggest lower part of the suevite unit was re-deposited as a debris flow from the crater rim. On the other hand, normal grading, relatively well-sorting and K/T boundary cocktail (Bralower et al., 1998) nature of nanofossil assemblage in the upper part of the suevite unit suggest that this part was deposited from a dense sediment suspended cloud. Furthermore, compositional oscillations repeated by more than 5 times are observed in this part, similar compositional oscillations are observed in the K/T boundary deep-sea tsunami deposit in Cuba (Goto et al., 2002). The uppermost several tens centimeter of the suevite unit is composed of medium to coarse, greenish sandstone with parallel lamination, suggesting the influence of strong current during its deposition. The boundary cocktail nature of nanofossil assemblage, compositional oscillations and existence of parallel lamination in the upper part of the suevite unit is suggestive of the marine invasion into the crater cavity and potential generation of tsunamis. Further research is needed to confirm the timing of marine invasion, based on identification of iridium anomaly and the first appearance of Danian fossils.