The K/T boundary deep-sea deposits in the proto-Caribbean basin

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At the Cretaceous/Tertiary (K/T) boundary, some 65 million years ago, a large asteroid or comet impacted the Earth (Alverez et al., 1980). Because the bolide hit the shallow sea, the large tsunamis must have been generated. In fact, a lot of tsunami deposits have been reported around coastal area of the Gulf of Mexico (e.g., Bourgeois et al., 1988). Impact seismic wave must have induced mass wasting and large gravity flows around the Yucatan Platform (e. g., Norris et al., 2001). However, because the information of the deep-sea area in the proto-Caribbean sea was very poor, magnitude and influence of impact generated tsunamis and impact seismic waves have not been well known.

Since 1997, we have organized Japan-Cuban joint research group and investigated the Penalver Fm. and Cacarajicara Fm. in western Cuba. The Penalver Fm. would have been deposited at the 600 to 2000 m depth of the northern frank of the Cretaceous Cuban Arc, which existed approximately 1000 km east from the Yucatan Platform (Tada et al., submitted). The Cacarajicara Fm. would have been deposited at the deeper part of eastern frank of the Yucatan Platform. The lithology of the type locality of the Penalver Fm. and the Cacarajicara Fm. were described in detail by Takayama et al. (2000) and Kiyokawa et al. (in press), respectively. In this study, we describe grain and mineral composition and grain size distribution of the Penalver Fm. and the Cacarajicara Fm. and discuss the relationship between these formations.

The thickness of the Penalver Fm. varies from 60 to 180 m, and monotonous upward fining from calcirudite to calcilutite is observed. It is composed of a lower gravity flow unit and an upper homogenite unit, the latter being interpreted as a deep-sea tsunami deposit (Takayama et al., 2000). When the thickness of the Penalver Fm. becomes small, erosional and current structures can be seen in the upper homogenite unit, which probably reflect the difference of influence of tsunamis depending on the depositional depth (Goto et al., 2002). Although the upper homogenite unit of the type locality is homogeneous and has no erosional and current structures, there are slight compositional oscillations characterized by variation in serpentine lithic content within the upper homogenite unit, which is repeated more than 6 times. These oscillations most likely reflect inflow of the secondary gravity flows triggered by the repetition of tsunamis hitting the Cretaceous Cuban Arc into the dense sediment suspended cloud (Goto et al., 2002).

The Cacarajicara Fm. is equivalent to the Peñalver Fm., but its thickness varies widely from 80 to 700 m. The Cacarajicara Fm. is also subdivided into lower gravity flow unit and an upper homogenite unit (Tada et al., submitted). At the Soroa area (approximately 100 km west from Havana), the lower gravity flow unit is composed of 250 m thick boulder breccia without matrix, which has been considered as a gravity flow deposit from Yucatan marginal slope (Kiyokawa et al., in press). However, because this thick boulder breccia is only observed around Soroa area, it probably deposited within submarine channels in the Yucatan margin. Although, the thickness and lithology of the lower gravity flow unit have lateral lithological variation and different from those of the Penalver Fm., grain and mineral composition and grain size distribution of the upper homogenite unit are very similar to the upper homogenite unit of the Peñalver Fm.. The upper homogenite unit of the Cacarajicara Fm. is 70 to 400 m thick, normally graded from calcarenite to calcilutite. These similarities may suggest that the upper homogenite unit of the Cacarajicara Fm. was also formed as a result of large tsunamis associated with the K/T boundary impact.