# Discovery of the possible Cretaceous/Tertiary boundary spherule layer in the Fomento section, central Cuba

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It is believed that the Cretaceous/Tertiary (K/T) boundary mass extinction, some 65 million years ago, was resulted from the impact on the earth of a large asteroid or comet (Alvarez et al., 1980). Since the discovery of the Chicxulub crater in the Yucatan peninsula, Mexico (Hildebrand et al., 1991), focus of K/T boundary studies shift toward magnitude and mode of the impact and its environmental consequences. During 1997 to 2001, we carried out a Japanese-Cuban joint research project on the K/T boundary in Cuba in order to understand the nature and magnitude of environmental perturbations immediately following the impact at proximal deep-sea sites, with emphasis on the impact generated tsunamis. The result of our study suggests that the thick calcareous clastic mega-bed near Havana is the deep-sea K/T boundary deposit of probable tsunami origin (Takayama et al., 2000). Following studies confirmed the presence of the K/T boundary deposit at multiple sites in western and northwestern Cuba, approximately 500 to 1000 km away from the Chicxulub crater, and revealed spatial variation in the thickness and facies of the deposits (Kiyokawa et al., 2002; Tada et al., 2002, 2004). However, variations of influence and duration of impact-generated tsunami and seismic wave with the distance from the impact site have not still well understood yet, because there is few data at the eastern site of 1000~2000 km away from the Chicxulub crater. In this study, we report a new possible K/T boundary deposit in the Fomento Formation in central Cuba, which was formed on the upper slope of the Cretaceous Cuban arc of approximately 1200 km away from the Chicxulub crater.

The Fomento Formation is exposed near the town of Fomento. It is composed of an approximately 270 cm thick calcareous clastic bed, and is divided into lower, middle and upper units in ascending order. The Fomento Formation overlies upper Maastrichtian reddish marl with an irregular erosional surface. The thickness of lower unit is 170 cm, and its lower 110 cm consists of light gray to gray, poorly-sorted, very coarse- to coarse-grained calcarenite. Reddish rip-up intraclasts of up to 40 cm in diameter, probably derived from the underlying marl, are common in this part. Calcirudite contains abundant ~30 cm-grained, well-rounded rudist fragments of Maastrichtian age and limestone lithics. The upper 60 cm of lower unit consists of light gray to gray, poorly-sorted, coarse- to middle-grained calcarenite. Cross laminations are observed in this part. The middle unit is 70 cm thick and is composed of light gray to gray, poorly-sorted, very coarse- to coarse-grained calcarenite. Cross lamination is observed in lower 40 cm part. Upper 30 cm part is massive and contains abundant ~10 cm-grained rudist fragments. The upper unit is approximately 30 cm thick and is composed of light gray to gray, massive, coarse- to middle-grained calcarenite. Approximately 1cm thick dark brown clay (lower clay) layer is observed in 24 cm above the base of upper unit. Bioturbation is observed only in above this clay layer. Another 1cm thick dark brown clay (upper clay) layer is also observed in approximately 15 cm above the lower clay layer. Upper clay layer is overlain by reddish marl, presumably in Paleocene age.

The Fomento Formation is mainly composed of rudist fragments, limestone lithics, and spherules. Contents of rudist fragments and limestone lithics decreases upward, whereas content of spherules increases upward. Presence of spherules in lower and middle units indicates that they arrived at the depositional site before the sedimentation of these units. Spherules in upper unit seem to keep its original morphology, although those in lower and middle units are usually broken. This implies that spherules in upper unit were probably suspended during the deposition of lower and middle units by wave activity and then quietly settled on the ocean floor.