MORE THAN 500M THICK K/T BOUNDARY SEQUENCE; CACARAJICARA FORMATION, WESTERN CUBA.-IMPACT RELATED GIANT FLOW DEPOSIT-

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Introduction: The KT boundary sequence has been found with the Tsunami sequence and the fireball layer around the Yucatan Peninsula [1]. However, because the Yucatan Peninsula is covered with thick Tertiary carbonate sequence proximal evidence of the impact related sequence had been reported at a few places, like Belize. The western Cuba preserves a thick KT boundary sequence comprising Cretaceous to Paleogene sedimentary units [2][3][4]. These sequence was exposed as a result of arc-continent collision of Cretaceous Cuban arc and North America. Based on the plate reconstruction, western Cuba was situated less than 400 km to the south east of the Chicxulub impact crater of the Yucatan peninsula during the late Cretaceous time [5][6]. Thus the KT boundary of western Cuba may preserve proximal evidence of geological processes related to the impact. Here, we describe the evidence of KT boundary origin for a more than 500 m thick event deposit of the Cacarajicara Formation in western Cuba, which is the thickest KT boundary formation in the world.

Tectonic setting of the western Cuba: According to a recent study, western Cuba is tectonically divided into three belts; Los Organos, Rosario and La habana (Bahia Honda to Matanzas) belts (Fig. 1) [4]. Each belt is composed of continental shelf to oceanic slope and deep-sea sediments sediments. Oceanic crustal material, such as pillow basalt and high grade metabasite, also preserved in these belts which have been deformed by Oligocene strike-slip deformations. All of these sequences were truncated by the left-lateral Pinaer Fault [7][8]. Based on the stratigraphic and fossil fauna relationships, Los Organos and Rosario belts had been situated near the Yucatan block (North American Craton) during Jurassic time [7][8].

The Cacarajicara Formation is situated within the south subcomplex of the Rosario belt which represents a more distal facies than that of the Los Organos belt during upper Cretaceous time [8][10][11]. It unconformably overlies the upper Cretaceous deep marine sandstone-mudstone alternation. The Cacarajicara Formation is distributed over an area more than one hundred kirometer long and a few hundred meters wide. It is situated at the top-to-the north northwest fold-thrusted Rosario belt [8][10][11]. A continuous section of at least 500 m thick sediments, that is situated in the southeast limb of synclinal syncline, is exposed 15 km to the north of Soroa. Bedding dip decreased upward from 80° to 30° the northwest.

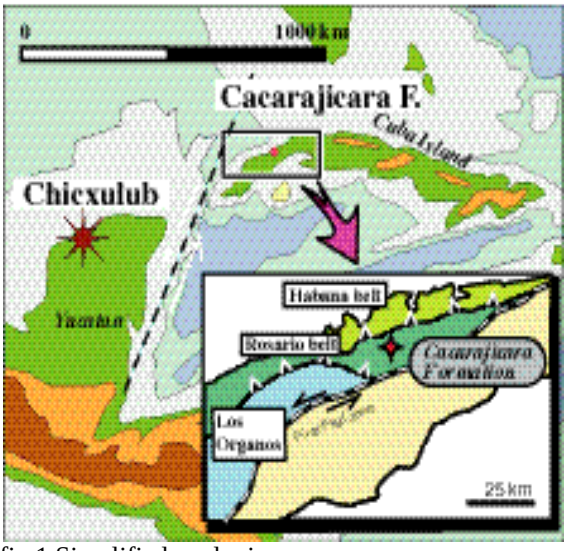

fig.1 Simplified geologic map

Stratigraphy: The Cacarajicara Formation is characterized by a upward-fining carbonate clastic sequence which is subdivided into two members. The Lower breccia member is approximately 150 m thick and is represented by grain-supported boulder breccia. This member disconformably overlies the middle Cretaceous Poriel Formation which is composed of carbonate-rich sandstone-shale alternations formed by a distal sequence of gravity flow. Rock components of the breccia include micritic limestone, foraminiferal limestone, rudist-bearing shallow water limestone, banded radiolarian chert and radiolarian-bearing black chert. We conducted identification, counting, and diameter measurement of the breccia. Based on diameter measurement, two modes of breccia size are identified which are grouped into two classes. The first group is pebble size class which consists of breccia with less than 20 cm in diameter. The second group is cobble-boulder size class which occasionally contains 1-3 m oblate-shape breccia. The pebble size class is composed of more than 90% carbonate breccia and less than 10% volcanics and metamorphic rock fragment. The cobble-boulder size class contains oblate-shape radiolarian chert, black chert and chert-micritic limestone boulder which is similar to those of the underlying Middle

Cretaceous sequence (Poriel Formation). The orientation of imbricated oblate breccia suggests that the paleoflow direction of this member is from north to south, if there was no rotation of the belt.

The breccia of this member has less than 1% of matrix that is dark brown in color. The dark brown matrix is composed mainly of siltstone that contains small amount of foraminifers, carbonate clast, volcaniclastics and spherule-like grains. A few spherule grains were extracted from the matrix using the hydrochloric acid dissolution method (Fig. 2). The spherules are gray color transluscent and approximately 150Éin diameter. Under the EDS electron microscope, they preserved smooth surface and very homogenous in composition.

Outcrop scale and microscopic scale matrix intrusions are preserved in this member. This evidence suggests that the lower breccia member was formed under a high pore-pressure with high-energy condition flow. Breccia size and composition changes from the Lower breccia to the Upper sandstone-slit member.

The Upper sandstone-silt member which is approximately 350 m thick composed mainly of a coarse-to-fine massive carbonate sandstone which is composed of mainly micritic limestone, foraminifera, rudist fragments with minor amounts of quartz, serpentinite and volcanics grains. This member is homogenous and well sorted. A dewatering pipe or web structure is observed in the middle part of this member. Sedimentary structures such as cross-bed, cross- to parallel-laminations and bioturbation are not observed. The lithology of this member is similar to that of the middle part of the Peñalver Formation [9]. The shocked quartz is also found in this member of this sequence. The quartz contains the É and ξ planes characteristic of the planer deformation features. According to microscopic observations, grain boundaries are partly recrystalized and low-grade metamorphic minerals were formed. Most mafic mineral has changed to the chlorite. Thus the sequence was affected by low-grade metamorphism and original sedimentary structures may have been destroyed.

The upper most part of this member consists mainly of calcareous silt and clay which contain fine-grained carbonate, foraminifera and quartz grains. It contains uppermost Masstrichtian nanofossils, such as *Micula murus*, *Mucula decussata*, and does not yield any Paleocene fossils. The Paleocene micritic limestone (Ancon Formations) overlies this member. However, the boundary between them is not well exposed.

Discussion and Summary: Characteristics of the Cacarajicara Formation are summarized as follows; 1) more than 300 m thick upward-fining sequence, 2) well-sorted stratigraphic sequence, 3) very thick boulder zone and homogenized upper zone, 4) high water-pressure and high energy conditions during the time of deposition of the lower breccia member, 5) presence of the shocked quartz in the upper member and spherule in the lower member (analyses of these grains are now in progress). The high-energy matrix condition for the Lower breccia member may be formed by the dilatant flow and the homogenized Upper sandstone-silt member is identified as fall deposits. These two different flow pattern in a fining upward sequence suggests that the Cacarajicara Formation is formed by a hyperconcentrated flow. The existence of an extremely thick sedimentary sequence with exotic blocks and impact related materials indicates that the Cacarajicara Formation is probably an impact-related mega flow sedimentary sequence deposited on the continental slope of the Yucatan platform.

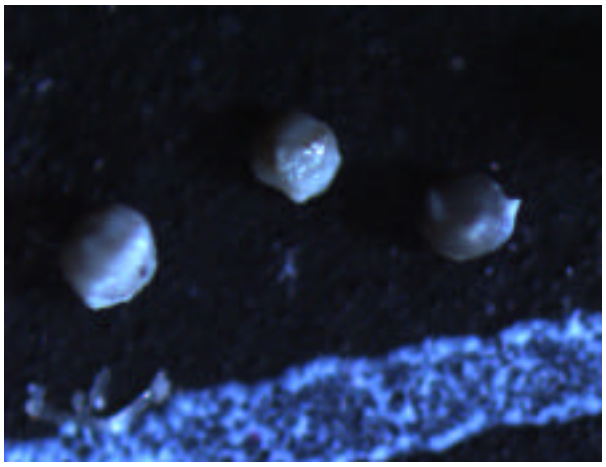

fig.2 Spherule in the Lower conglomerate unit

References:

[1] Smit et al. (1996) *GSA special paper* 307, 151-182. [2] Plamer R. H. (1934) *J. Geol.*, 43, 123-145. [3] Plamer R. H. (1945) J. *Geol.*, 53, 1-34. [4] Pazczolkowski (1986) *A. Bull. Pol. Acad. Sci.* (Earth Sci.) 34, 81-94. [5] Pindell, J. L. and Barrett, S.F. (1990) Geology of North America, *GSA* 405-432. [6] Bohor, B. F. and Seitz, R. (1990), *Nature*, vol 344, 593. [7] Gordon et al. (1997) *J. Geophys. Res.* 102, 10055-10082.[8] Iturralde-Vinent, M. A. (1994) *J. Petrolumme Geology*, vol 17 (1). 39-70. [9] Takayama et al., *Sedimentary Geology* (axccepted). [10] Iturralde-Vinent, M. A. (1994) *Tectonophysics*, 234, 345-348. [11] Piotrowska K. (1978) *Acta Geol. Pol.*, 28, 97-170.