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Sedimentological and Petrological Characteristics of Post-Impact Carbonate Sequence in Yaxcopoil-1 Borehole, Chicxulub Crater

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The Chicxulub crater located in Yucatan Peninsula, Mexico is a complex multiring structure with an approximate rim diameter of 200 km. Chicxulub is buried beneath a carbonate and evaporitic sequence. Here we present results of a study of the post-impact carbonate sequence sampled in the Yaxcopoil-1 borehole.

Yaxcopoil-1 borehole (20º 74´N, 89º72´W), located at the south of Merida, Yucatan, approximately 62 km from the center of the Chicxulub impact crater was drilled by the Chicxulub Scientific Drilling Program (CSDP). Major objectives of this program include: study of role of the Chicxulub impact event in the Cretaceous/Paleogene (K/Pg) mass extinction, investigation of the impact breccias and melt and characterization and documentation of post-impact sediments. The well reached a depth of 1510.6 m. The contact between the Paleocene carbonates and impact breccias lies at about 792 m.

Aim of present study is to document the lithological, sedimentological and petrological characteristics of the carbonates in the interval from 404.01 m to 792.17 m (overling the K/Pg impact deposits and the marly clay layer marking the limit). Second objective is making a paleonvironmental interpretation from samples obtained in Yaxcopoil-1 borehole. Sequence is composed mainly of limestones, dolomitized carbonates and calcarenites, with some fossiliferous horizons.

We first describe the Paleocene sequence, characterizing lithological changes, facies, contacts and observed sedimentary structures in the cores. We identify 10 units. In a second phase petrographic analyses are made on 231 samples in thin-sections for all units.

Unit 1 extends from 785.47 m to 792.17 m thick. Sequence consists of dolomitic calcareous layers and thin marly clay layer. There are some sedimentary structures as cross and hummocky laminations. Several sedimentary structures are observed in the following two units with thin polymict breccias, cyclic graded bedding and stylolitic structures (776 m) and some intercalated calcareous sandstone layers.

Unit 3 extends from from 740.42 m to 772.40 m. It consists of a micritic clay limestone, a shale layer, calcareous marls with siliceous and some evaporitic clast within an argillaceous matrix. Conglomerate layers and erosional contacts are intercalated.

Unit 4 extends from 723.42 m to 740.42 m. It is composed by a shale layer and intercalated calcareous sandstones. Current flow structures and lenticular lamination (laterally discontinuous) are observed as erosional surfaces in the upper part of this unit.

Unit 5 extends from 698.88 m to 723.42 m. At the base, there are cross-lamination and eroded surfaces, described by festoon lamination (swaley cross-bedding). Cross-bedding is observed in sporadic intervals for this unit. In top of the unit was recovered a thin conglomerate layer (708.36 m) and some stylolite structures.

Unit 6 extends from 659.20 to 698.88 m. It is characterized by large clasts (8 cm of diameter) towards the bottom, interbedded laminations, and different colors of limestone and shale. Along the unit it is possible to observe lenticular siliceous lamination, evaporitic clasts, diagenetic processes and gravity flow structures.

Unit 7 extends from 643.48 m to 659.20 m. It has a dolomitic limestone and interbeded clay limestone, with a cross-lamination in a shale layer of 5 cm thick and lenticular siliceous stratification. At the base it is observed an erosive surface marking the contact with Unit 8.

Unit 8 extends from 611.50 to 643.48 m. It shows strong variations in color or hue of the sediments, reflecting changes in composition and texture. Cross-lamination and micro-faults are intebedded in a marly clay layer.

The last two units (Units 9 and 10) from 611.50 to 404.01 m were recovered with calcareous sands and clay limestone are interbedded with thin shale layers in the upper part of the unit. Cross-lamination and parallel lamination are the typical sedimentary structures. Unit 10 is a white color limestone and clay limestone interbedded. Festoon

lamination (swaley cross-bedding), composed by calcareous sandstone and different colors limestone are present. Lenticular chert of 24 cm thick and clay lamination with oxides and dolomite limestone are interbedded.
In the microfacies study we observe several major changes in the microfacies. Based Dhunkam classification, we observed from bottom of the sequence two textural changes from bioclastic planctonic foraminifera wackestone to bioclastic grainstone, two textures dominated in all calcareous sequence. Depositional environments range from internal carbonate ramp to external carbonate ramp neritic environments with possible local subsidence and depend in the facies watches that were established once the Yucatan platform had prograded seaward. This analysis have been corroborated with some fauna Morozovelas (M. velascoensis) that indicate deep environments and other fauna Ranikothalia bermudezi, Ranikothalia sp and Neodiscocyclina cf. Barkeri, which indicate external carbonate ramp environment. Biostratigraphic evaluation of the last two batches of samples is yet been completed.