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Chicxulub: old and recent results to document the best peak-ring crater on Earth

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The Chicxulub crater in Yucatan (Mexico) results from the asteroid or comet impact that is linked to the K-T (or K-Pg) boundary mass extinction. The Chicxulub structure has a diameter between 190 and 210 km and lies buried under several hundred meters of Cenozoic sediments, onshore and offshore the Yucatan Peninsula (Hildebrand et al. 1991). Chicxulub is the one of the largest terrestrial craters and, based on geophysical imaging, certainly the best-preserved peak-ring basin on the planet. From the PEMEX oil exploration wells around the sixties, in search of an extension to the highly-productive Cantarell oil field, to the 2016 IODP-ICDP expedition 364, Chicxulub has been subject to several drilling exploration programs, together with various geophysical campaigns (Fig. 1). The abstract reviews existing data in the light of the recent developments regarding the cratering process and K-T boundary deposits. The PEMEX exploration program extended from the fifties to the late 1970's and about 8 holes were drilled, which remain among the deepest within the structure (Perez-Drago, et al. 2008). Being dry holes, limited studies were carried out and today very little core material remains. Well Yucatan-6 (1631 m), located on the onshore part of the peak-ring yielded a succession of suevite (Claeys et al. 2003), and below it, coarse impact melt-breccia which was used to confirm the impact crater origin (Kring and Boynton, 1992). Well Chicxulub-1 (1582m), close to the crater center, bottomed in fine impact-melt rock, and provided the first ⁴⁰Ar-³⁹Ar ages linking Chicxulub to the K-T boundary (Swisher et al. 1992). In the 1990's, the Universidad Nacional Autónoma de México (UNAM) drilled several shallow (700 m) wells outside the crater rim (Urrutia-Fucugauchi et al., 1996). They revealed a proximal ejecta blanket composed of suevite, and thick carbonate- and evaporite-breccias. Seismic experiments, conducted in 1996 and 2005 imaged the different impact lithologies down to the bottom of the crust and highlighted the well-preserved 80-km in diameter peak-ring morphology of the structure (Morgan et al. 1999; Gulick et al. 2008). The seismic data also illustrate pre-impact conditions and advocate deeper-water conditions and thicker Mesozoic sediments in the northeast quadrant. In 2001-2002, the International Continental Drilling Project (ICDP) drilled in the trough zone, outside the peak-ring (Urrutia-Fucugauchi et al., 2004). The recovered core is composed of Cenozoic carbonates (from 404 m where coring started down to 795 m), a thin impactite succession (795 – 895) most likely spilled over from the peak-ring area, and a down to 1511 m, carbonate and evaporite units from the upper part of the target rock. Their preserved stratigraphic orientation indicates that this (or these) or mega-block(s) gently “slid” inward from the rim zone (Belza et al. 2012). Drill core M0077A was recovered in April 2016, by the International Ocean Discovery Program (IODP) and ICDP into the peak ring of Chicxulub offshore the Yucatán Peninsula. Three main lithological units encountered are: 1) Paleogene sedimentary rocks (Post-Impact section), 2) Suevite and impact melt rock (Upper Peak ring section), and 3) Granitic peak ring rocks intruded by pre-impact dikes and intercalated with suevites and impact melt rocks (Lower Peak Ring section). The recovered highly shocked granitic rocks, originating from deep within the Yucatan basement, support the dynamic collapse model to explain the formation of the uplifted peak-ring zone (Morgan et al. 2016).

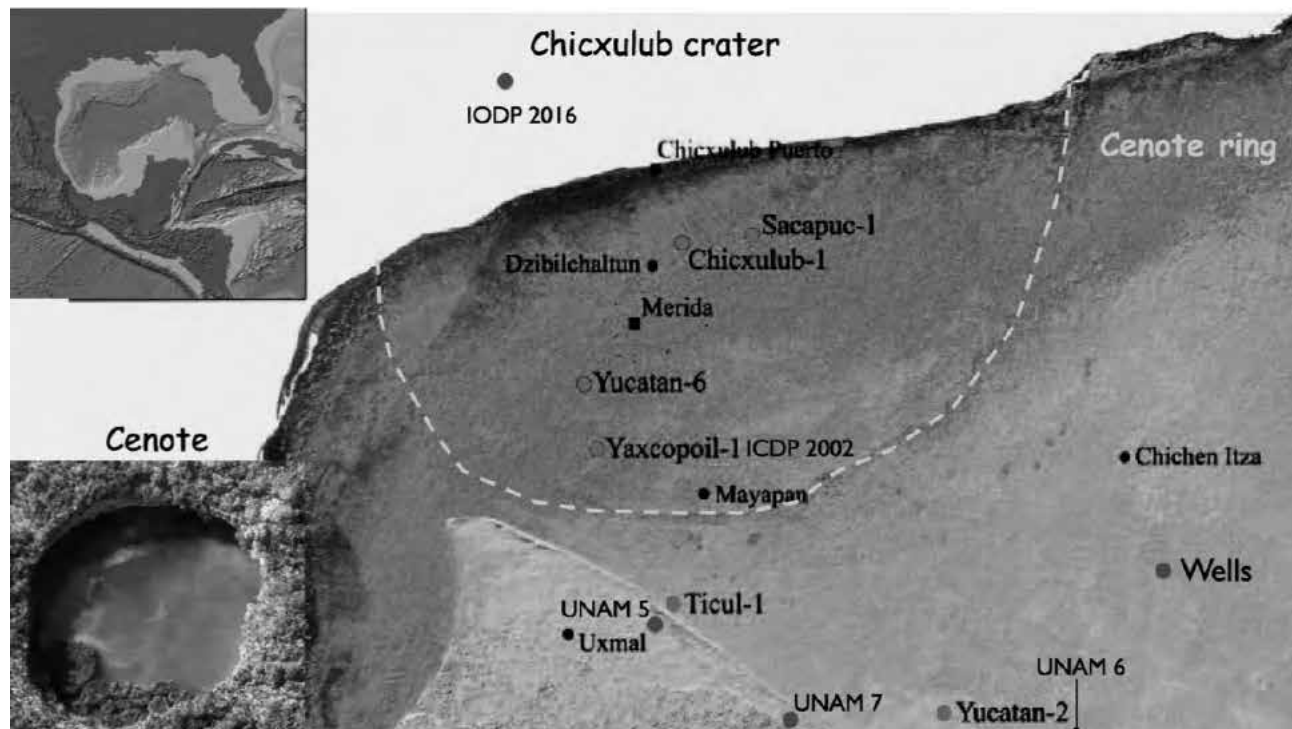


Fig. 1 - Localization of the wells drilled in and around the Chicxulub structure

References

- Belza, J., Goderis, S., Keppens, E., Vanhaecke, F., Claeys, Ph., An emplacement mechanism for the mega-block zone within the Chicxulub crater (Yucatan, Mexico) based on chemostratigraphy, *Meteoritics and Planetary Science*, 47, 3, 400-412, 2012
- Claeys, P., Heuschkel, S., Lounejeva-Baturina, E., Sanchez-Rubio, G., and Stöffler, D., The suevite of the Chicxulub impact crater: *Meteoritics and Planetary Science*, 38, 1299–1317, 2003.
- Gulick, S.P.S., Barton, P.J., Christeson, G.L., Morgan, J.V., McDonald, M., Mendoza-Cervantes, K., Pearson, Z.F., Surendra, A., Urrutia-Fucugauchi, J., Vermeesch, P.M., and Warner, M.R., Importance of pre-impact crustal structure for the asymmetry of the Chicxulub impact crater: *Nature Geoscience*, 1, 131–135, 2008.
- Hildebrand, A.R., Penfield, G.T., Kring, D.A., Pilkington, M., Camargo-Z., A., Jacobsen, S.B., and Boynton, W.V., Chicxulub Crater: A possible Cretaceous/Tertiary boundary impact crater on the Yucatán Peninsula, Mexico: *Geology*, 19, 867–871, 1991.
- Kring, D.A. and Boynton, W.V., Petrogenesis of an augite-bearing melt rock in the Chicxulub structure and its relationship to K/T impact spherules in Haiti: *Nature*, 358, 141–144, 1992.
- Morgan, J., and Warner M., Chicxulub: The third dimension of a multi-ring impact basin, *Geology*, 183, 347-354, 1999.
- Morgan, J., and IODP cruise members, The formation of peak rings in large impact craters, *Science*, 354, 6314, 878-882, 2016.
- Pérez-Drago, G.; Gutierrez-Cirlos, A. G.; Pérez-Cruz, L.; Urrutia-Fucugauchi, J. Chicxulub Impact Crater and Yucatan Carbonate Platform - PEMEX Oil Exploratory Wells Revisited, American Geophysical Union, Fall Meeting 2008, abstract #V53A-2141, 2008
- Urrutia-Fucugauchi, J., Marin, L., and Trjo-Garcia, A., UNAM Scientific drilling program of Chicxulub impact structure – Evidence for a 300 kilometer crater diameter: *Geophysical Research Letters*, 23, 1565–1568, 1996.
- Urrutia-Fucugauchi, J., Morgan, J., Stoeffler, D., Claeys, Ph., The Chicxulub Scientific Drilling Project (CSDP), *Meteoritics and Planetary Science* 39, 6, 787-790, 2004.