THE 2005/2006 ICDP-USGS DEEP DRILLING PROJECT NEAR THE CENTER OF THE CHESAPEAKE BAY IMPACT STRUCTURE, VIRGINIA, USA: A 2007 UPDATE. Christian Koeberl[1], W. Uwe Reimold[2], Gregory S. Gohn[3], Kenneth G. Miller[4]. [1]Center of Earth Sciences, University of Vienna, Althanstrasse 14, A-1090 Vienna, Austria (christian.koeberl@univie.ac.at); [2]Museum of Natural History, Humboldt-University, Invalidenstrasse 43, D-10115 Berlin, Germany (uwe.reimold@museum.hu-berlin.de); [3]U.S. Geological Survey, Reston, VA 20192, USA (ggohn@usgs.gov); [4]Rutgers University, Department of Geological Sciences, Piscataway, NJ 08854, USA (kgm@rci.rutgers.edu).

Summary: The International Continental Scientific Drilling Program (ICDP) and the U.S. Geological Survey (USGS) completed two deep coreholes to a composite depth of almost 1.8 km into the Chesapeake Bay impact structure during September-December 2005. Post-impact sediments were cored from land surface to a depth of 140 m in a third corehole during April and May 2006. A total of 444 m of post-impact sediments were cored above the crater's impactite section (1,322 m), which consists (in descending order) of sediment-clast breccia, sediment megablocks, a large granitic megablock, smaller sediment blocks, suevite and lithic breccia, and a section of brecciated mica schist and pegmatites with varied breccia veins. An international sampling party was held March 19-22, 2006, at the USGS National Center in Reston, Va., USA. Including the samples taken at the drill site, approximately 3,800 samples have since been distributed for study and are currently being investigated by scientists in about 30 teams from about a dozen countries.

Introduction: The late Eocene Chesapeake Bay impact structure is among the largest and best preserved of the known impact craters on Earth [1]. It has a diameter of 85 km (Fig. 1) with what has been called an "inverted sombrero"-.shape cross section. Chesapeake Bay is distinctive among impact craters on Earth because it is a relatively young and well-preserved structure, which is the source of the North American tektites – one of only 4 known tektite strewn fields on Earth. The structure is situated on a passive continental margin that has prevented tectonic or orogenic distortion; marine deposition resumed immediately following the impact, resulting in rapid burial and thus preventing subsequent erosion. The breccia body is known to contain a substantial volume of impact-related brine, which is of importance to the about two million people living in the area. The ICDP drilling project also included a deep biosphere research opportunity.

Drilling: Field operations began in July 2005 with site preparations at Eyreville Farm in Northampton County, Virginia; subsequently, three coreholes were drilled at the Eyreville site (Fig. 2). Eyreville hole A was cored between depths of 125 m and 941 m from September through early October 2005. Problems with lost mud circulation and swelling clays in Eyreville A led to a lengthy period of reaming and ultimately to deviation of the bit from Eyreville A to a new hole, Eyreville B, at a depth of 738 m. Eyreville B was cored from that depth to a final depth of 1,766 m from October through early December 2005. Post-impact sediments were cored from land surface to a depth of 140 m in the Eyreville C hole during April and May 2006.

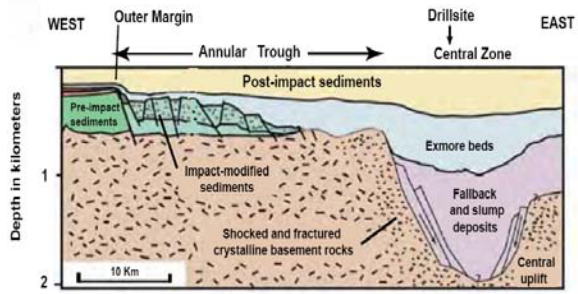

Figure 1. Schematic cross section through half of the Chesapeake Bay impact structure, showing the deep central part of the crater (including the central uplift), and the location of the ICDP-USGS deep corehole (from [2]).

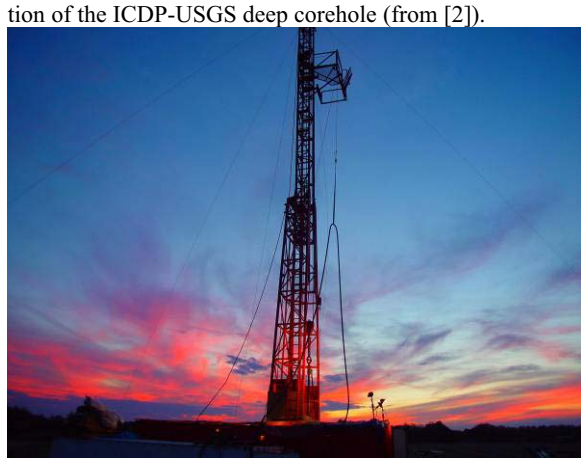

Figure 2. Drillsite of the ICDP-USGS Chesapeake Bay coring project at night.

Drilling Results: A first report on the drilling was given at LPSC in 2006 [3]. The cored impactite section (Fig. 3) consists of five major lithologic units. The lowest unit consists of about 216 m of fractured mica schist and pegmatite with minor gneiss and sev-

eral impact breccia veins. These rocks could represent the autochthonous crater floor or they could be parautochthonous basement blocks. Above these rocks follow about 157 m of suevitic and lithic impact breccias that are considered fallback and (or) ground-surge deposits.

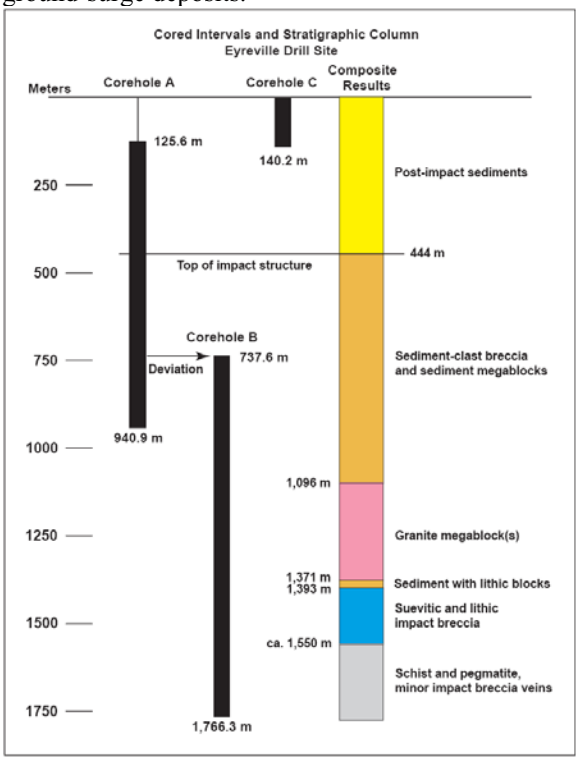

Figure 3. Cored intervals and a composite geological/lithostratigraphic cross section of the Eyreville corehole (after [4]).

Above these breccias, a thin interval of quartz sand (22 m) contains lithic clasts of varied size (cm to decimeters); it occurs below a 275-m-thick megablock of granitic rock, which appears unshocked and thus must have been transported tens of kilometers during the cratering process. The uppermost and thickest impactite unit consists of about 652 m of deformed sediment megablocks and overlying sedimentary breccia (Exmore beds – Fig. 1). The sedimentary breccia at the top of the impactite section contains clasts of target sediments and crystalline-rock ejecta and is interpreted to represent late-stage collapse of the marine water column and its catastrophic flow into the crater.

The post-impact sedimentary section consists of 444 m of upper Eocene to Pliocene marine sediments and Pleistocene paralic sediments. Preliminary studies indicate thick upper Eocene and middle Miocene to Pliocene successions and relatively thin lower Miocene and Oligocene sections.

Sample Distribution and Recent Research: The research phase of the project began on March 19-22, 2006, with an international sampling party at the USGS National Center in Reston, USA. At that time, the cores from the Eyreville A and B coreholes were displayed for examination by the project science-team members. About thirty project scientists from eight countries attended the sampling party. Approximately 2,200 core samples identified at the sampling party in March 2006 (and several individual follow-on viewings) were cut and distributed to project scientists during March-July 2006. Including the samples taken at the drill site, a total of approximately 3,800 cores samples have been distributed for study.

The USGS acquired two 1.5-km-long, high-resolution seismic lines across the Eyreville drillsite in September 2006 using seisgun and small explosion sources. These surveys should produce reflection images to the depth reached by the corehole. Processing is currently in progress.

In October 2006, Project scientists from USGS used a GeoTek scanner to record physical properties of representative core samples selected from all but the uppermost part of the core. The measured properties included: density, P-wave velocity, magnetic susceptibility, porosity, and electrical resistivity.

A limitation in the project was the lack of detailed reflection seismic in advance of the drilling, though refraction data provided decent predictions. Our success in this corehole was a result of extensive pre-drilling planning for onsite core curation, persistence in reaching stated drilling goals, and the financial and operational contingencies to address the inevitable problems encountered during deep drilling.

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References: [1] Poag, C.W., Koeberl, C., and Reimold, W.U., 2004, Chesapeake Bay Crater: Geology and Geophysics of a Late Eocene Submarine Impact Structure. Springer, 522 pp. [2] Gohn et al. (2006) *Scientific Drilling* No. 3, p. 34-37. [3] Gohn et al. (2006) Lunar Planet. Sci. 37, abs. No. 1713. [4] Gohn, et al. (2006) *EOS, Trans. Am. Geophys. Un.* **87**, 349, 355.