RECENT RESEARCH IN THE CHESAPEAKE BAY IMPACT CRATER, USA—PART 1. STRUCTURE OF THE WESTERN ANNULAR TROUGH AND INTERPRETATION OF MULTIPLE COLLAPSE STRUCTURES. D.S. Powars1, G.S. Gohn1, R.D. Catchings2, J.W. Horton, Jr.1, and L.E. Edwards1; 1USGS, MS 926A, National Center, Reston, VA 20192; 2USGS, 345 Middlefield Rd., Menlo Park, CA 94025

Introduction: The buried late Eocene Chesapeake Bay impact structure is a complex crater formed in a multi-layered, marine target. The target consisted of a neritic water column, 400 to >750 m of lower Tertiary and Cretaceous sediments, and underlying crystalline rocks. The 85-km-wide crater has a subquadrate, ~38-km-wide inner basin that is surrounded by a ~24-km-wide, flat-floored annular trough. The annular trough’s outer margin has a slumped terrace zone surrounded by a ~35-km-wide outer fracture zone.

New insights into the stratigraphic and structural configuration of the annular trough come from correlation of four deep coreholes and two corehole velocity logs with marine seismic-reflection surveys and a high-resolution, land-based, reflection survey (CDP spacing of 2.5m). The high-resolution survey is adjacent to two of the coreholes and provides sufficient resolution to delineate small structures.

Outer-margin structures: On the seismic profiles, the outer margin of the annular trough separates discontinuous, locally inclined or offset reflectors, which are interpreted as large slumped fault blocks and overlying ocean-resurge and tsunami deposits, from relatively continuous, horizontal reflectors that represent little-disturbed Cretaceous sediments outside the margin. These relatively undisturbed sediments appear fractured and faulted but to a much lesser degree than the slump blocks. Inward-dipping normal faults and antithetic faults define the typically rotated slump blocks. The major normal faults displace the sediment-crystalline rock contact, indicating that they are relatively deep seated.

Resurge-tsunami and overlying post-impact sediments buried the irregular upper surface of the slump blocks. Observed thickness variations, dip reversals, and fault displacements of these sediments probably result from differential compaction across the underlying irregular surface. The impact-generated resurge-tsunami deposits are up to 100 m thick in the annular trough but abruptly thin to 7.5 m just outside the outer rim in one corehole.

Collapse structures: Interpretation of the marine seismic surveys indicates that numerous extensional collapse structures are present across the western annular trough. Most of these structures disrupt parautochthonous Cretaceous sediments, resurge-tsunami sediments, and post-impact sediments but do not deform the underlying crystalline rocks, thereby suggesting detachment zones within the sedimentary section. The high-resolution survey shows a collapse structure that significantly affects only the variably deformed parautochthonous beds below the resurge-tsunami and post-impact sediments. The high-resolution survey also shows that the extensional collapse structures are formed by abundant short, small-displacement faults and are not grabens bounded by a few long, large-displacement normal faults.

Correlation of the collapse structures across the seismic grid suggests that they are concentrated in three narrow structural rings. The width of these rings varies from 0.5 to 3.9 km, and their inner edges are located at about 8, 15, and 22 km from the inner-basin rim. Between these rings, the sedimentary section appears relatively undeformed. A denser seismic dataset likely would reveal a more complex pattern with discontinuous individual structures and intervening transfer zones.

The internal structure of the sedimentary section of the annular trough of the Chesapeake Bay impact crater typically has been described as slumped, normal-fault-bounded megablocks overlain by a resurge-tsunami diamicton (Exmore beds). This model likely remains accurate for the large slump blocks at the outer margin but may need to be revised to account for the shallow collapse structures, and a paucity of megablocks, in the remainder of the annular trough. The shallow collapse structures invite comparison with similar shallow extensional features recently observed in the Silverpit crater of the North Sea.

Figure 1. Map showing interpreted structural rings (heavy dotted lines) superimposed on seismic tracks (thin dashed lines) in the Chesapeake Bay impact crater.