WETUMPKA IMPACT STRUCTURE (ALABAMA): TSUNAMI GENERATION AND SUBSEQUENT RESURGE.
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Introduction: Wetumpka impact structure, an approximately 5-km Late Cretaceous marine-target crater (Figure 1a, b), is situated in central Alabama at the boundary between the Appalachian piedmont and the coastal plain [1, 2]. At the time of impact, 84.4 +/- 1.4 m.y. ago [3], the target was a shallow continental shelf with approximately 100 m of mainly unconsolidated Upper Cretaceous coarse clastic sediments covering a weathered basement schist-gneiss complex. An overlying marine water layer, a few 10s of meters in depth, was swept away from the impact site and the surrounding area by the impact. This seawater eventually returned initially as a debris flow-like resurge [4, 5, 6]. The main aqueous deposit from this resurge is a chalky deposit that is akin to the Mooreville Chalk of the adjacent coastal plain, but it contains impact ejecta and marine components (glauconite and fossils) otherwise not encountered in this location relative to the paleoshore [5, 6]. In other words, this resurge deposit looks like the Mooreville Chalk, but it is in fact a resedimented deposit derived in large part from the Mooreville across the target area and adjacent ejecta zone. These discontinuous chalky resurge deposits in and near the crater vary widely in thickness from several 10s of meters to only a few centimeters [7].

Methodology and Preliminary Results: In this paper, we analyze the mechanisms behind the formation of these deposits by means of sedimentological studies of outcrops and drill core (including CT drill-core scans) and simple 2D numerical simulation of the impact event. The sedimentology of the resurge deposits indicates that some of the material had its origin far offshore from the impact site [4, 5, 6]. The location of the deposits in low-lying parts of a hummocky crater interior shows that the resurge occurred well after the slumping of the unconsolidated target sediments and that it followed depressions in the terrain [6]. CT scans of drill core show that there are multiple graded layers within a 25-m thick deposit of the resurge chalk [4]. This finding suggests multiple complex aspects to the resurge flow (or flows?) [5, 6]. The 2D numerical simulation shows that the ejection of the water layer followed the crater ejecta curtain on the seafloor (i.e., no "outer crater" formed in the water layer as at Lockne [8]; Figure 2). However, it can be seen how an outwards tsunami could have been generated by the emplacement of the ejecta layer. The ejecta pushed the water away from an area well beyond that to be covered by the continuous ejecta layer (i.e., one crater radius beyond the rim). It took several minutes before water returned to the crater site (Figure 2). The crater rim might have prevented a forceful entry of the resurge. However, geological evidence tells us that the southern sector of the rim was unstable, possibly due to high content of unconsolidated target sediments, and collapsed early on to allow the debris/laden resurge flow to come into the crater [6, 7].

References: [1] King Jr. D. T. et al. (2002) EPSL 202, 541-549. [2] King Jr. D. T. (2006) MAPS 41, 1625-1631. [3] Wartho J.-A. et al. (2012) MAPS, 47, 1243-1255. [4] Markin J. K. et al. (2011) LPS XLII, Abstract #2379. [5] Markin J. K. and King Jr. D. T. (2012) GCAGS Trans. 62, 265-272. [6] King D.T. Jr. and Ormö J. (2012) GSA Spec. Paper 483, 287-300. [7] King Jr. D. T. et al. (2013) GSA Ann. Mtg. Abst. 226-2. [8] Ormö et al. (2002) Journ. Geophys. Res.: Planets 107 (E12), 3-1–3-9. [9] Tabares Rodenas P. et al. (2012) LPS XLIII, Abstract #2522. [10] Neathery et al. (1976) GSA Bull. 87, 567-573.

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Figure 1a. Location of Wetumpka (circled) on the DEM of Elmore County, Alabama [9]. LiDAR-based DEM with approximately 2-m resolution.

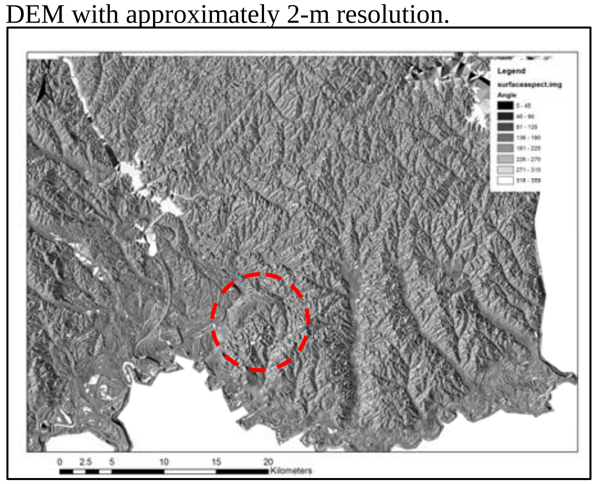
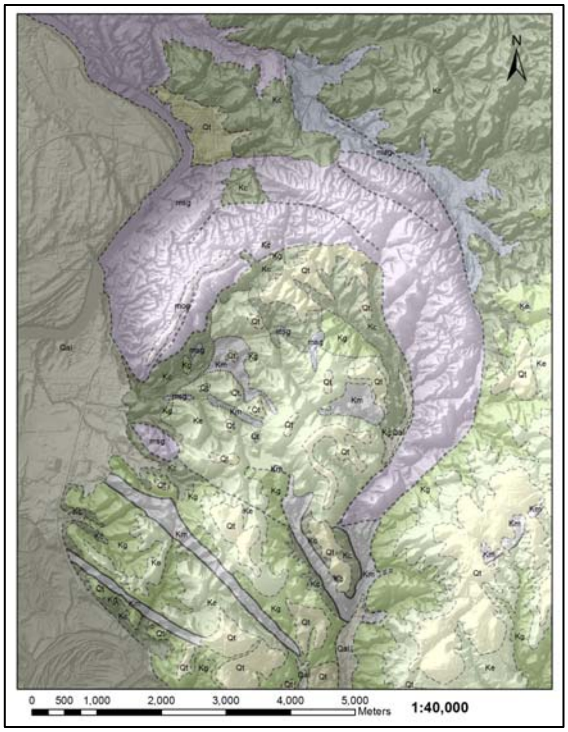


Figure 1b. *See next page.* Present distribution of muddy chalk resurge deposits within and near the crater [9, 10]. This map labels resurge deposits as *Km* (Mooreville Chalk), but in fact the sediments derived from erosion of the Mooreville Chalk (as explained above).



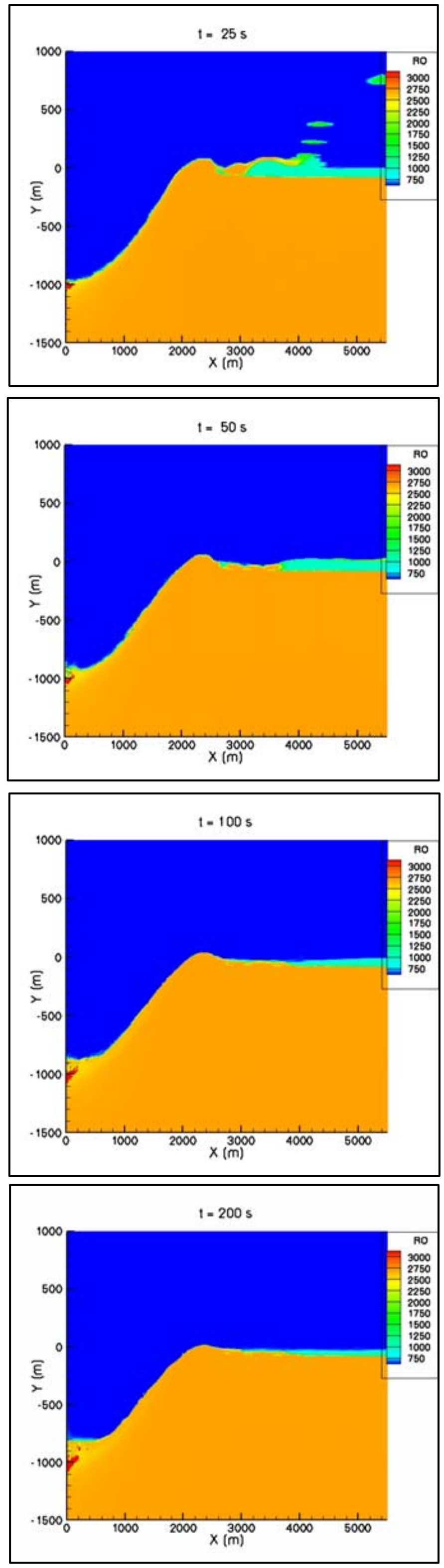


Figure 2. Outwards tsunami generation. 2D numerical simulations of the impact event ranging from 5 to 200 sec. These simulations show that the ejecta curtain collapse pushes the shallow water away [7].