Wetumpka Impact Structure, Alabama
LiDAR Digital Elevation Model and Topographic Cross-sectional Analysis*

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Search and Discovery Article #50696 (2012)**
Posted August 27, 2012

*Adapted from oral presentation at AAPG Annual Convention and Exhibition, Long Beach, California, April 22-25, 2012
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Abstract

The Wetumpka impact structure (near the town of Wetumpka, Alabama) has a semi-circular crystalline rim that is ~ 5 km in diameter. This well-exposed, marine-target impact structure developed in both poorly consolidated, water-saturated sediments, and underlying crystalline basement. Our previous studies have described a semi-circular, crystalline rim, an interior structure-filling unit, and an exterior disturbed area developed within the sedimentary target sequence outside the southwestern part of the central, basement crater. Based on field and drill-core observations, we recognize the following specific structural and lithological impact-related terrains: overturned crystalline rim flap; slumped interior megablock terrain; central polymict breccia (originating as near-field ejecta); interior marine chalk deposits and reworked glauconitic sands (formed by resurge and post-impact deposition); and a collapsed southern part of the rim with overturned flap (mainly developed within the sedimentary target rocks). In this paper, we examine what we know of these terrains so far and review how using new LiDAR data (sub-meter resolution) has given us new insights into the nature and origin of these impact-related terrains and their post-impact erosional history.

References


Website

Wetumpka impact structure, Alabama

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Red dots show locations of known impact craters on Earth

http://www.passc.net/EarthImpactDatabase/index.html

As of 1/2012
Red dots show locations of known impact craters on Earth

As of 1/2012

http://www.passc.net/EarthImpactDatabase/index.html
North America, 84.4 million years ago.
Wetumpka asteroid over shelf target
Wetumpka asteroid impacts shelf target
Wetumpka impact structure – ground view

crater rim
(Bald Knob)
**“Proof of impact” discoveries made during 1998-2002.**

Core hole 98-01 (Schroeder well) – June-July 1998

* Shocked quartz and iridium found first in this sample.

Photo by Bill Hames
"Proof of impact"
discoveries made during

Discovery core box

Core hole 98-01 (Schroeder well) – June-July 1998

"Proof of impact"
discoveries made during

Photo by Bill Hames.

Shallow-marine impact origin of the Wetumpka structure
(Alabama, USA)

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Received 11 December 2001; received in revised form 27 March 2002; accepted 28 June 2002

Abstract

The Wetumpka structure, an arcuate, 7.6 km diameter, rimmed feature of the inner Coastal Plain, Alabama, is a Late Cretaceous shallow-marine impact crater. In this paper, we show unequivocal evidence of Wetumpka’s impact origin. Within and about this structure, pre-existing Upper Cretaceous stratigraphy was reseated and/or deformed, thus creating distinctive intra-structure and extra-structure terrains. These terrains are located, respectively, within Wetumpka’s crystalline-rim terrain and adjacent to the structure on the southern side. Core drilling near the structure’s geographic center revealed that Wetumpka’s basin-filling sequence has two distinctive units, suggestive of a two-stage filling process consisting of (1) fall-back plus resurge followed by (2) a later secondary seawater resurge event. Wetumpka’s lower subsurface unit includes polymict impact breccias, which contain quartz grains displaying shock-characteristic multiple sets of planar deformation features. Selected subsurface samples of this breccia also contain elevated Ir, Co, Ni and Cr concentrations indicative of a minor extraterrestrial component. © 2002 Elsevier Science B.V. All rights reserved.

Role of water in the formation of the Late Cretaceous Wetumpka impact structure, inner Gulf Coastal Plain of Alabama, USA

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Abstract—The effect of shallow marine water (~30–100 m deep) in the late excavation and early modification stages of a marine-target crater 5 km in diameter, as exemplified by the Late Cretaceous Wetumpka impact structure in Alabama, USA, is manifest in the early collapse of a weak part of the rim. Excavation flow and connate marine water are interpreted to be factors in this collapse. This partial rim collapse catastrophically emplaced an upper-structure-filling unit of broken and redistributed sedimentary target formations, which presently mantles the deeper fallback breccia deposits within the structure. Furthermore, rim collapse flow facilitated the formation of a structurally modified, extracrater structure terrain, which is located outside and adjacent to the collapsed rim segment. This extracrater terrain appears to be the product of extensive slumping of poorly consolidated target sedimentary formations.
New LiDAR study of Wetumpka impact crater

LiDAR means light detection and ranging

LiDAR uses laser light to map elevations and locations with extreme accuracy.

LiDAR data used in this study were given to us by the Elmore County Revenue Commissioner’s Office.
Views of Wetumpa impact crater: from Bald Knob

|------- 3 miles -------|
LiDAR DEM geological map of Wetumpka impact structure, Alabama

LiDAR-based elevations within 1 m

STRATIGRAPHY
Qt – terrace
Km – Mooreville Chalk
Ke – Eutaw Formation
Kc – Coker Formation
Kg – Gordo Formation
mag & msg – metamorphic rocks
LiDAR DEM geological map of Wetumpka impact structure, Alabama

Precise control on locations
LiDAR DEM geological map of Wetumpka impact structure, Alabama

STRATIGRAPHY
Qt – terrace
Km – Mooreville Chalk
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mag & msg – metamorphic rocks
LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama
LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama

What would deeper cross sections look like?
LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama

- Impact melt?
- Parauthonous breccia
- Impact breccia
LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama
Examples of ways we will be using LiDAR-based data in the future at Wetumpka impact structure, Alabama
1. Deposits of the muddy tsunami (t)
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Scientific core hole #09-03 – muddy tsunami evidence

Muddy tsunami is composed of chalk eroded from Montgomery County area.

Odontochitina operculata

Images by Dr. Lucy Edwards, USGS Reston
Scientific core hole #09-03 – tsunami evidence

Melt droplets are thought to form in the vapor plume above the impact.

Muddy tsunami is composed of chalk eroded from Montgomery County area.
Scientific core hole #09-03

*Inoceramus* – a large clam that lived in deep water
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami ($t$)
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami (t)
Deposits of the muddy tsunami

“Wetumpka Public Seashore”
LiDAR DEM geological map of Wetumpka impact structure, Alabama

LiDAR-based elevations within 1 m

Deposits of the muddy tsunami:

Km areas and small smooth terrains
2. Outcrop studies
3. Digital geological mapping
3. Digital geological mapping
3. Digital geological mapping

Toward a more “planetary geologic map” …
Acknowledgements

Thanks to local citizens who allow us to work on their lands.