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

Pascual Tabares Rodenas[1], David T. King Jr.[2], Luke J. Marzen[2], Lucille Petruny[2], and Jens Ormö[3]

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

King, D.T., Jr., J. Ormo, L.W. Petruny, and T.L. Neathery, 2006, Role of water in the formation of the Late Cretaceous Wetumpka impact structure, inner Gulf Coastal Plain of Alabama, USA: Meteoritics & Planetary Science, v. 41/10, p. 1625-1631.

King, D.T., Jr., T.L. Neathery, L.W. Petruny, C. Koeberi, and W.E. Hames, 2002, Shallow-marine impact origin of the Wetumpka structure (Alabama, USA): Earth and Planetary Science Letters, v. 202, p. 541-549.

Petruny, L.W., D.T. King, Jr., and P. Tabares-Rodenas, 2012, A shallow excavation transect across the Wetumpka impact structure, Alabama-The El Paso Gas Company pipeline cut: Lunar and Planetary Science Conferences, March 19-23, 2012, The Woodlands, Texas, Abstract. Web accessed 14 August 2012, http://www.lpi.usra.edu/meetings/lpsc2012/pdf/2546.pdf.

Website

Earth Impact Database. Web accessed 14 August 2012, http://www.passc.net/EarthImpactDatabase/index.html.

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Jens Ormö
Centro de Astrobiologia, Madrid

Red dots show locations of known impact craters on Earth

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

Red dots show locations of known impact craters on Earth

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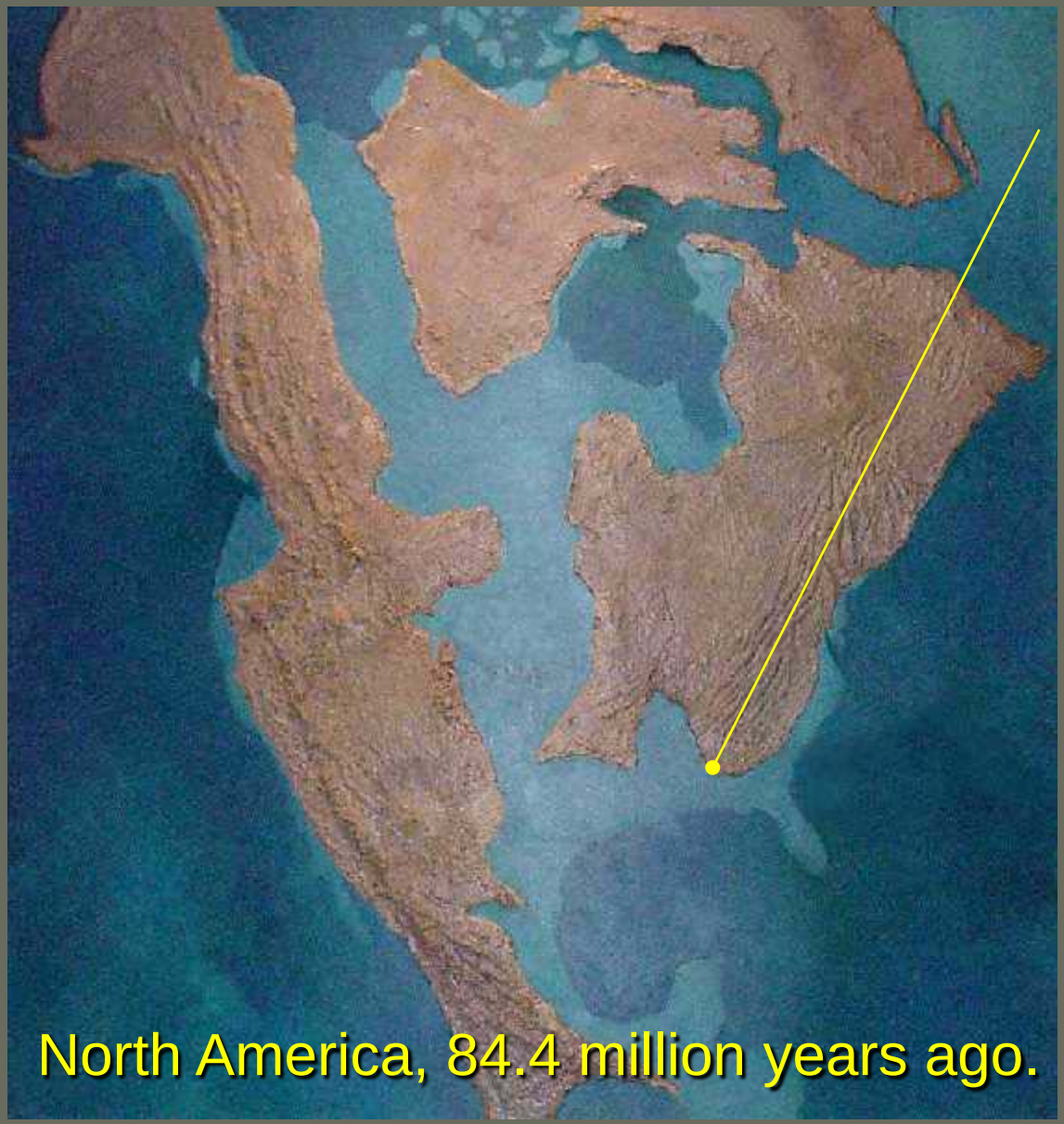
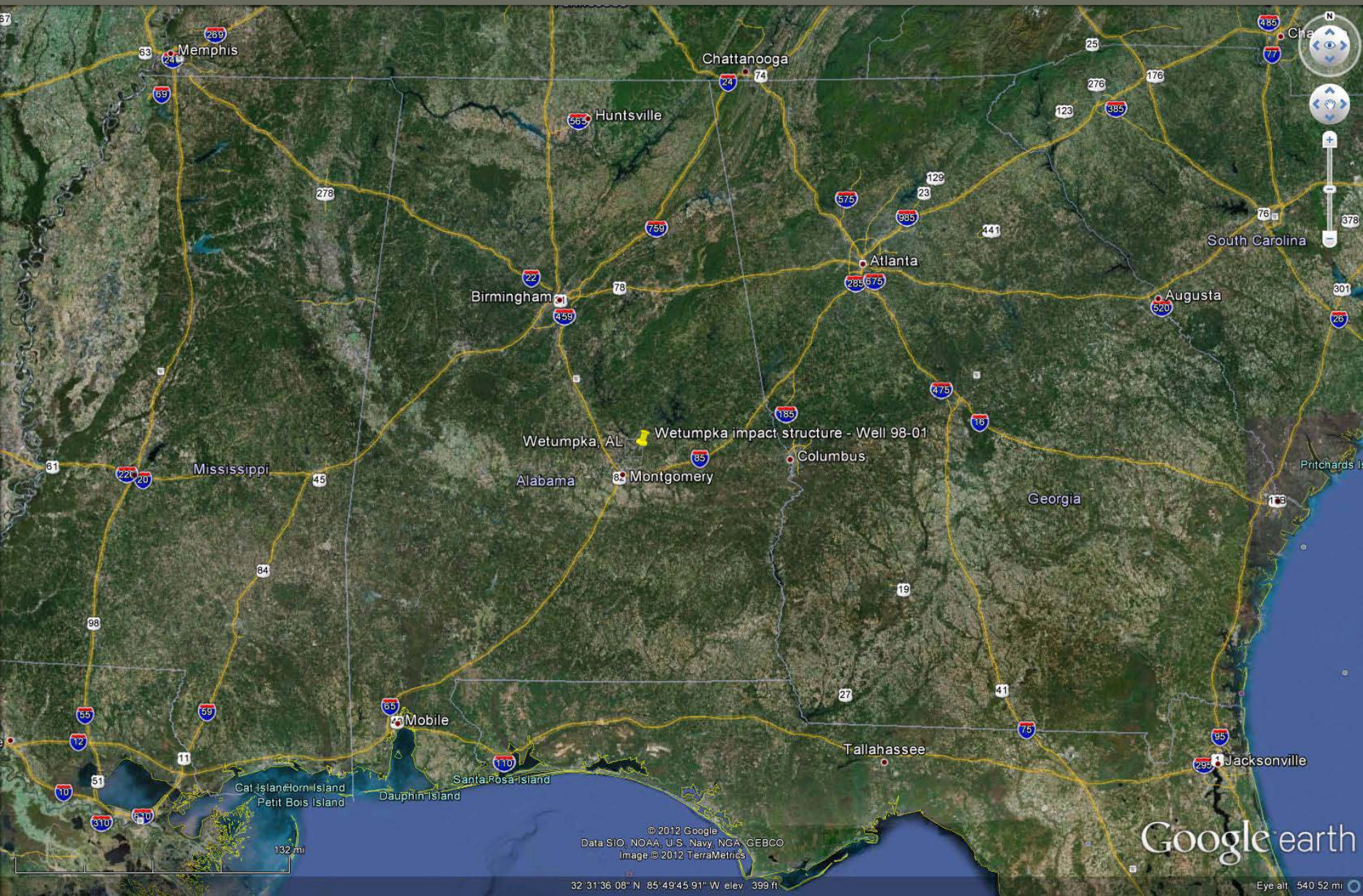
General paleogeography



Wetumpka asteroid over shelf target

Wetumpka asteroid impacts shelf target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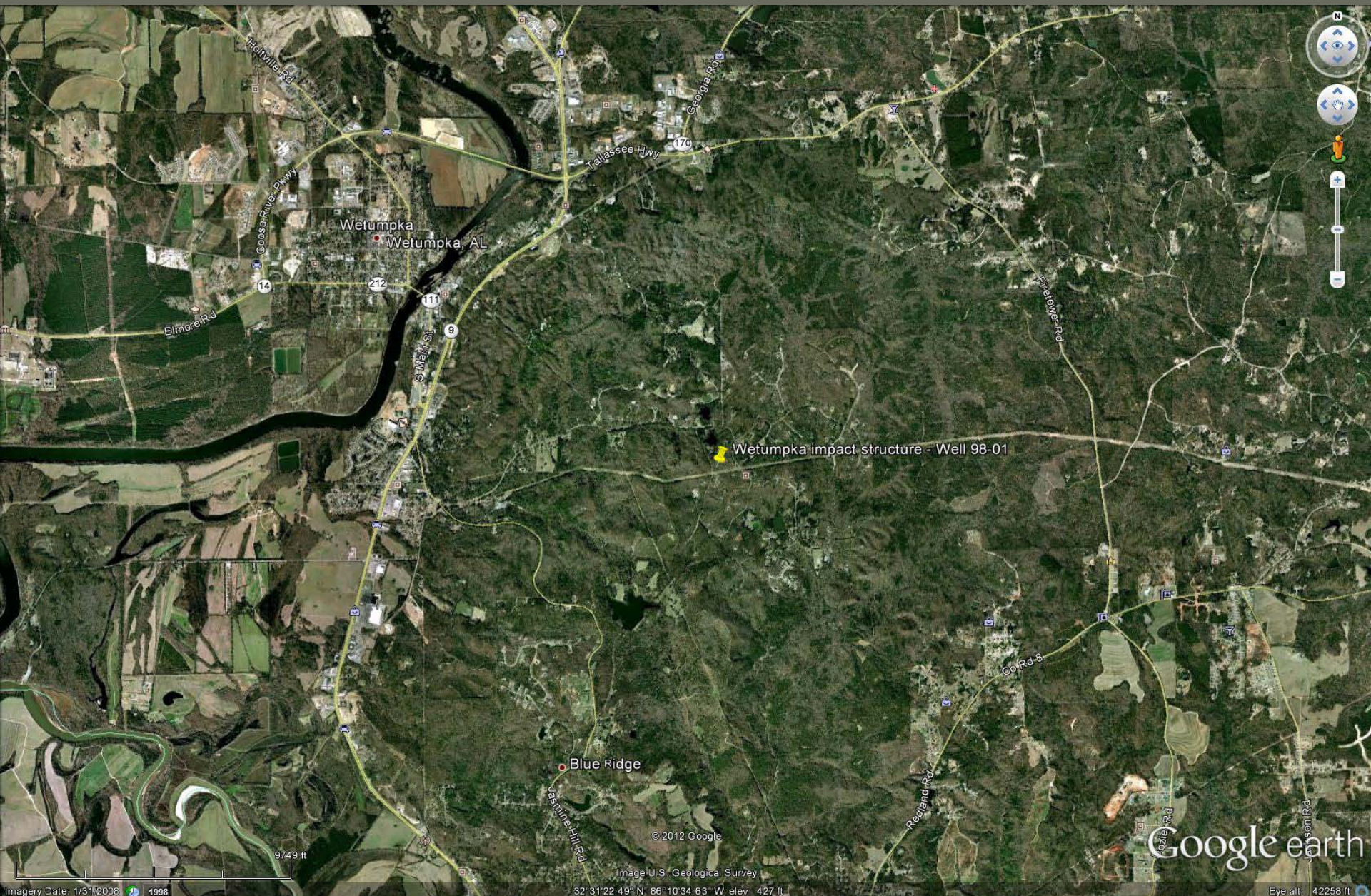
Chattanooga
Huntsville
Birmingham
Atlanta
Augusta
South Carolina
Wetumpka, AL
Wetumpka impact structure - Well 98-01
Columbus
Montgomery
Alabama
Mississippi
Georgia
Mobile
Tallahassee
Jacksonville
Cat Island
Horn Island
Petit Bois Island
Dauphin Island
Santa Rosa Island
© 2012 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2012 TerraMetrics
Google earth
32°31'36.08" N 85°49'45.91" W elev 399 ft
Eye alt 540.52 mi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Wetumpka, AL
Wetumpka impact structure - Well 98-01
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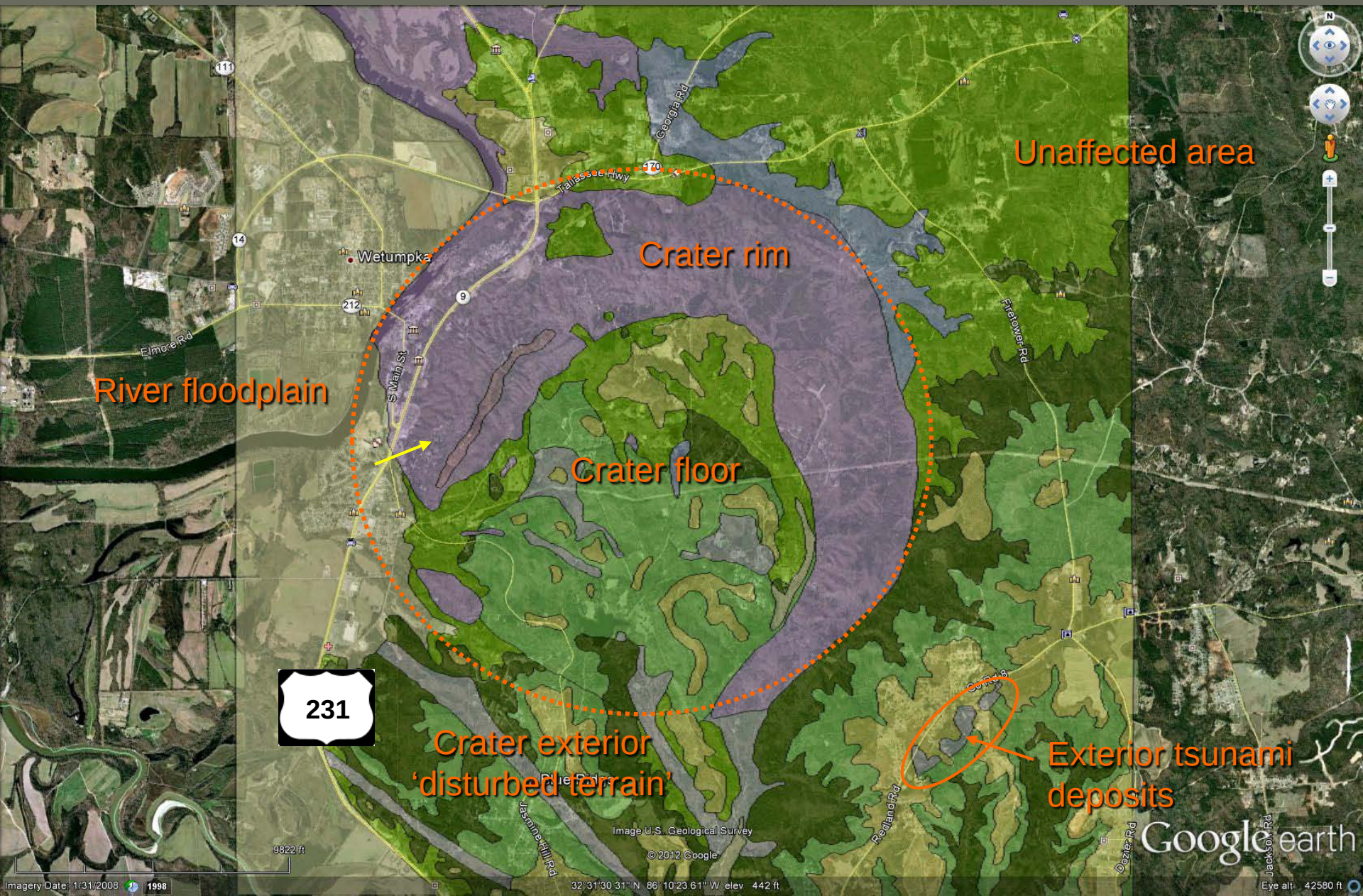
Coosa River Pkwy
Elmore Rd
Talassee Hwy
Georgia Rd
S Main St
Firetower Rd
Co Rd 8
Redland Rd
Jasmine Hill Rd
Jasper Rd
14
212
111
9
170
9749 ft
© 2012 Google
Image U.S. Geological Survey
Google earth
Imagery Date: 1/31/2008
1998
32°31'22.49" N 86°10'34.63" W elev 427 ft
Eye alt 42258 ft

Wetumpka impact structure – 5 km diameter



Wetumpka impact structure – ground view

“Proof of impact” discoveries made during 1998-2002.

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

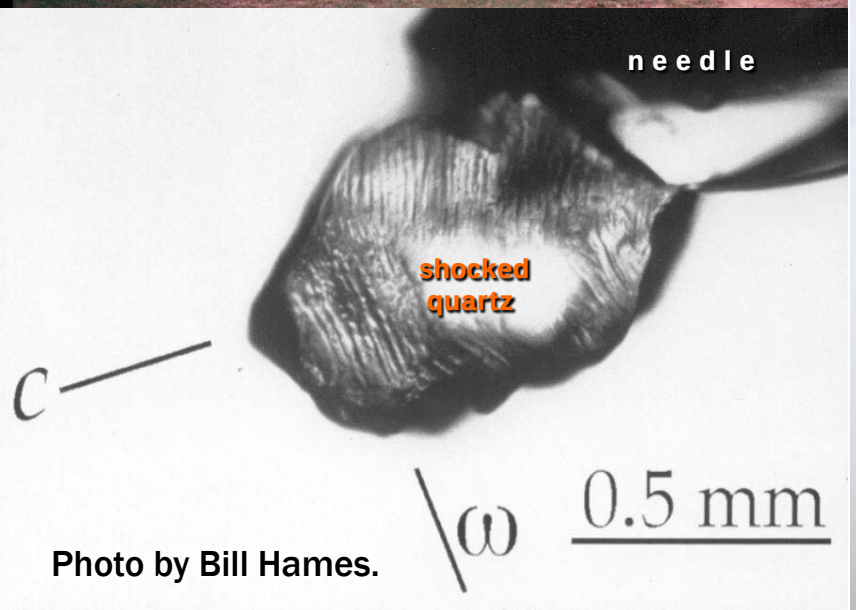


Photo by Bill Hames.

Discovery core box

"Proof of impact" discoveries made during 1998-2002.

Core hole 98-01 (Schroeder well) – June-July 19

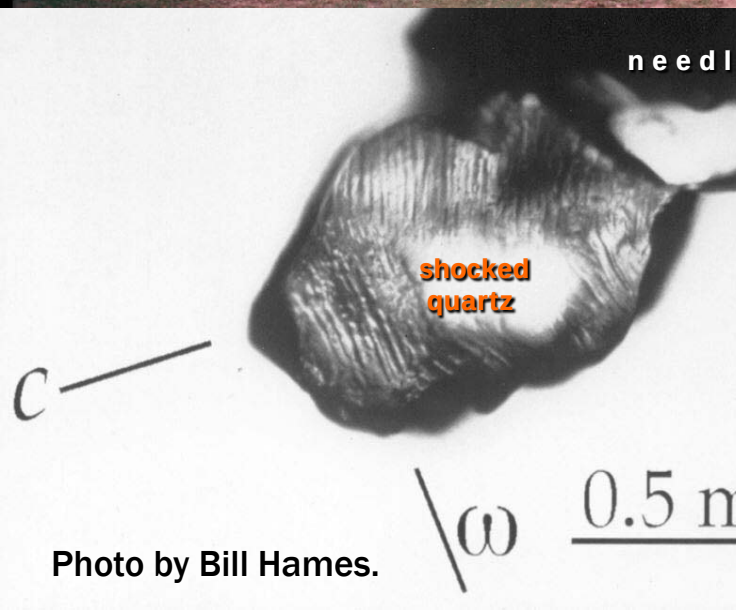


Photo by Bill Hames.

Discovery core box

2002

ELSEVIER

Earth and Planetary Science Letters 202 (2002) 541–549

EPSL

www.elsevier.com/locate/epsl

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

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[b] *Neathery and Associates, 1212-H 15th Street East, Tuscaloosa, AL 35404, USA*
[c] *Astra-Terra Research, Auburn, AL 36831-3323, USA*
[d] *Institute of Geochemistry, University of Vienna, Althanstrasse 14, 1090 Vienna, Austria*

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 resedimented 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.

"Proof of impact" discoveries made during 1998-2002.

Core hole 98-01 (Schroeder well) – June

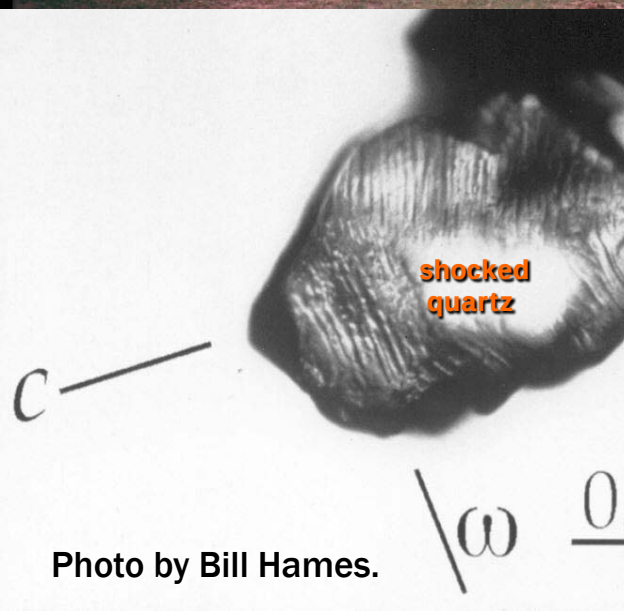


Photo by Bill Hames.

Discovery core box

Meteoritics & Planetary Science 41, Nr 10, 1625–1631 (2006)
Abstract available online at http://meteoritics.org

2006

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

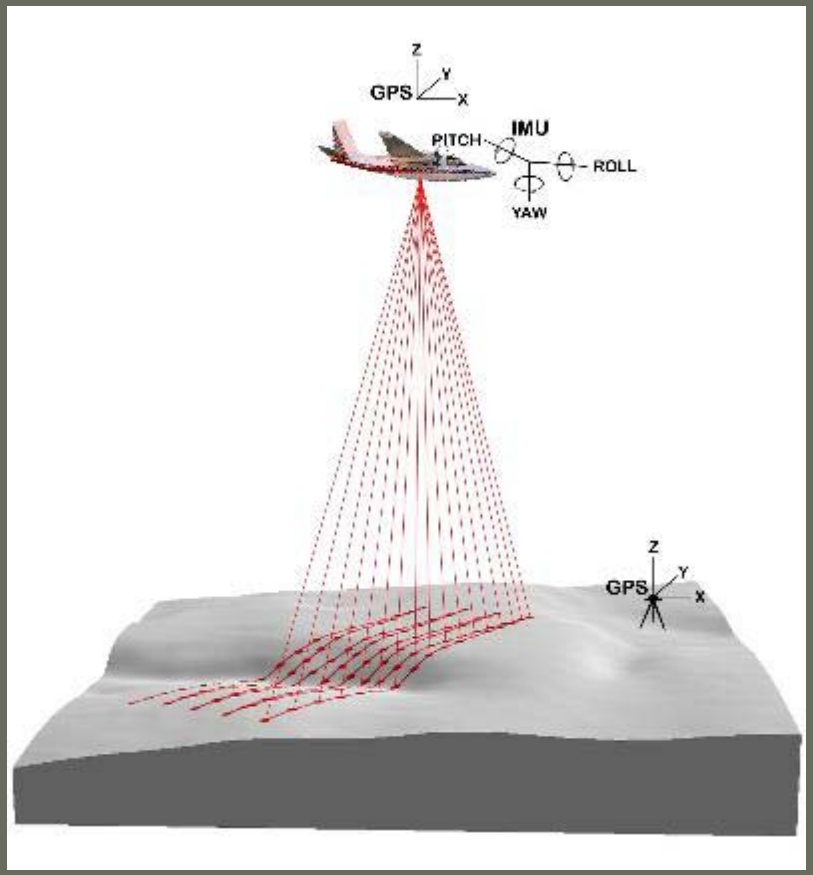
David T. KING, Jr.[1*], Jens ORMÖ[2], Lucille W. PETRUNY[3], and Thornton L. NEATHERY[4]

[1]Department of Geology, Auburn University, Auburn, Alabama 36849, USA
[2]Centro de Astrobiología (INTA/CSIC), Madrid, Spain
[3]AstraTerra Research, Auburn, Alabama 36831–3323, USA
[4]Neathery and Associates, 1212-H Veterans Parkway, Tuscaloosa, Alabama 35404, USA
[*]Corresponding author. E-mail: kingdat@auburn.edu

(Received 11 October 2005; revision accepted 03 March 2006)

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, extrastructure terrain, which is located outside and adjacent to the collapsed rim segment. This extrastructure terrain appears to be the product of extensive slumping of poorly consolidated target sedimentary formations.

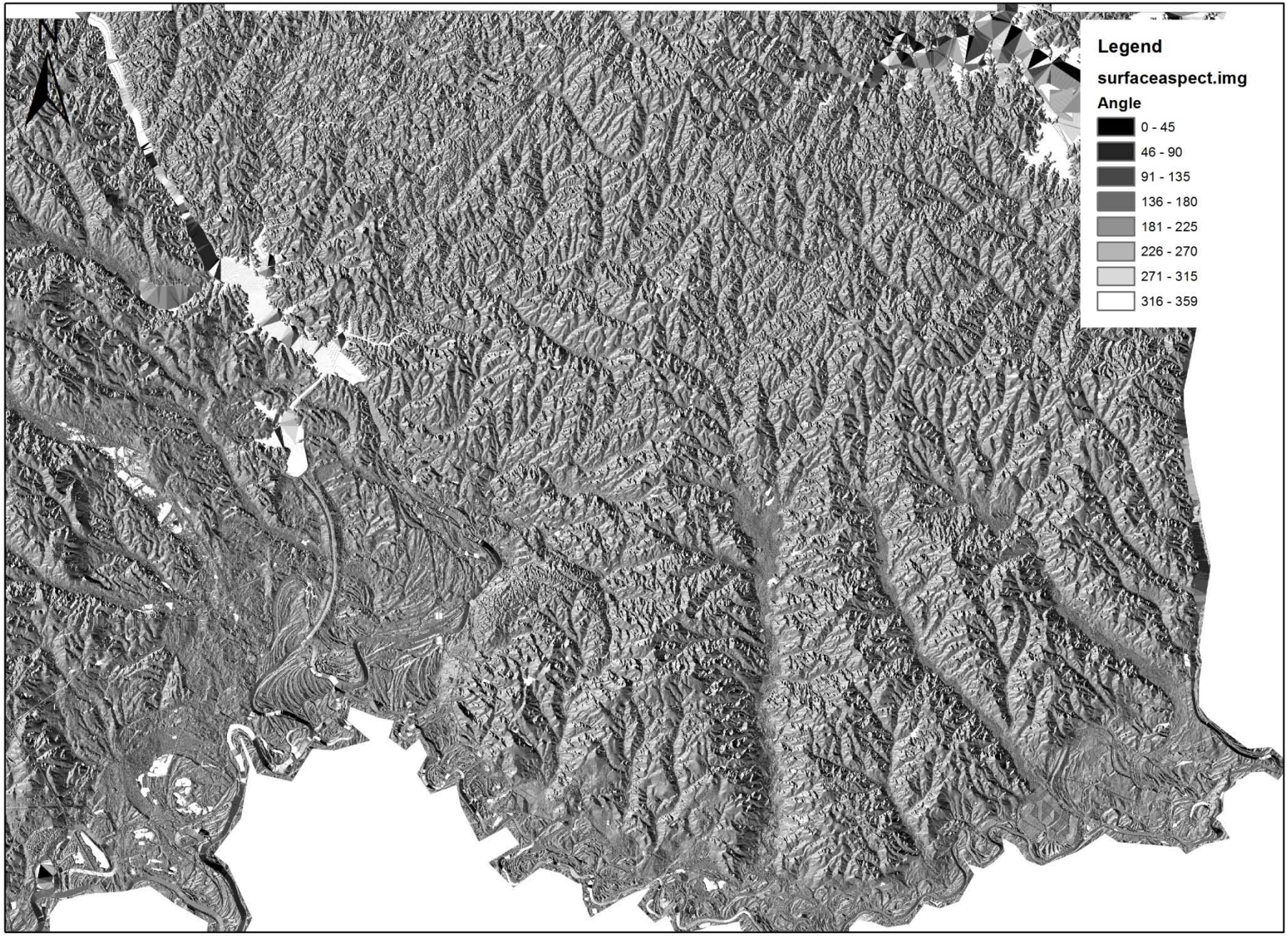
New LiDAR study of Wetumpka impact crater



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.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Legend
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Angle
0 - 45
46 - 90
91 - 135
136 - 180
181 - 225
226 - 270
271 - 315
316 - 359
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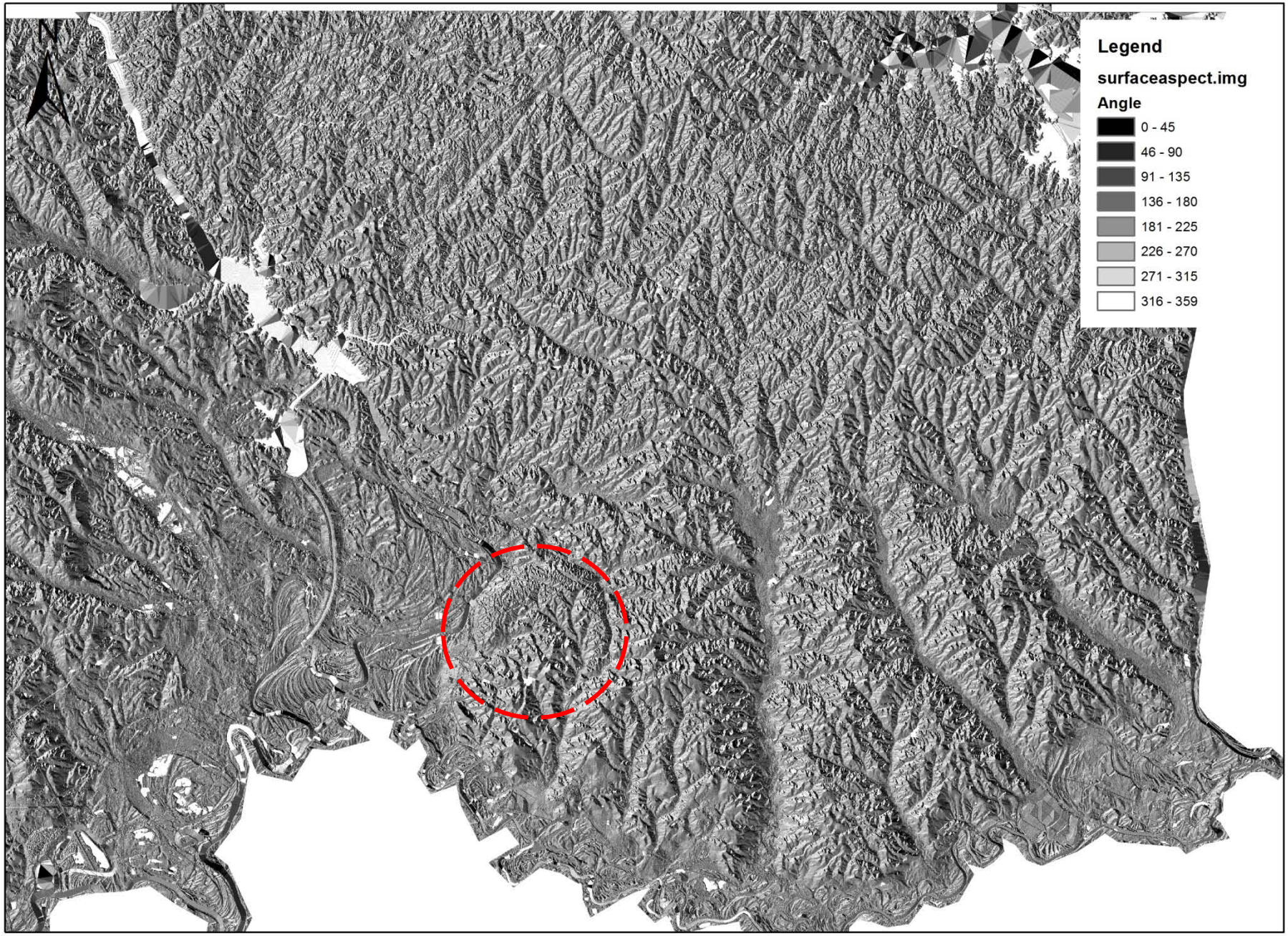
Kilometers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46 - 90
91 - 135
136 - 180
181 - 225
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0
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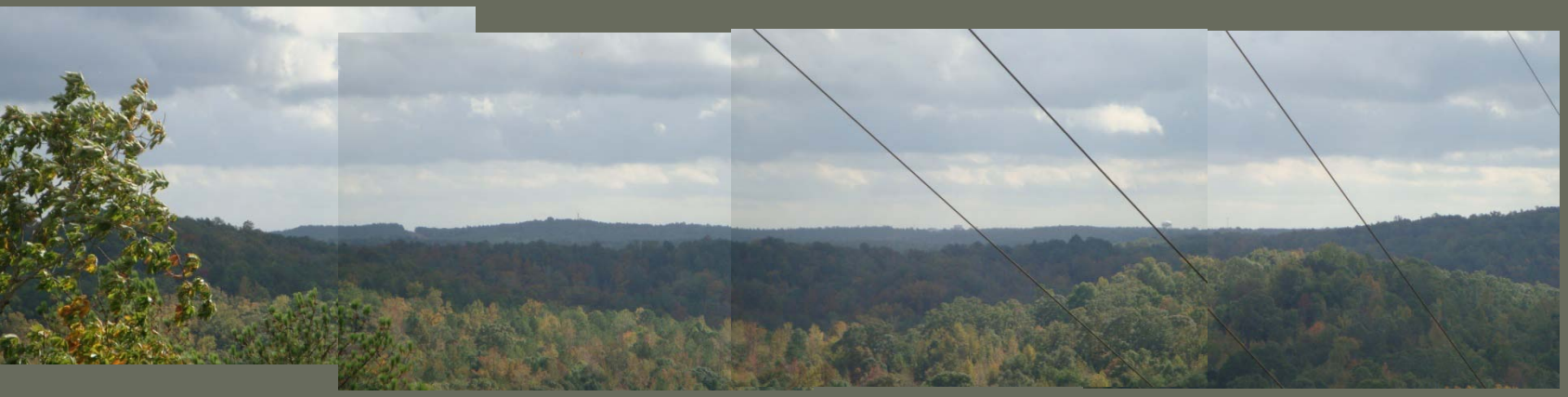
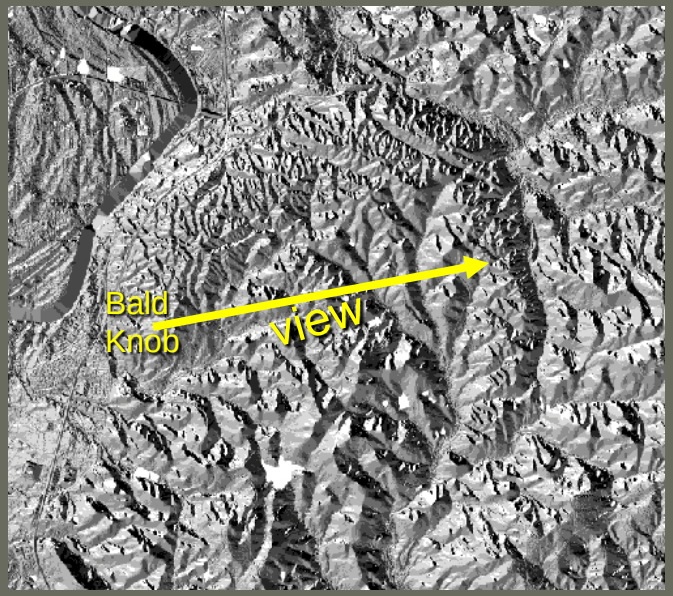
10
15
20
Kilometers

Views of Wetumpa impact crater: from Bald Knob

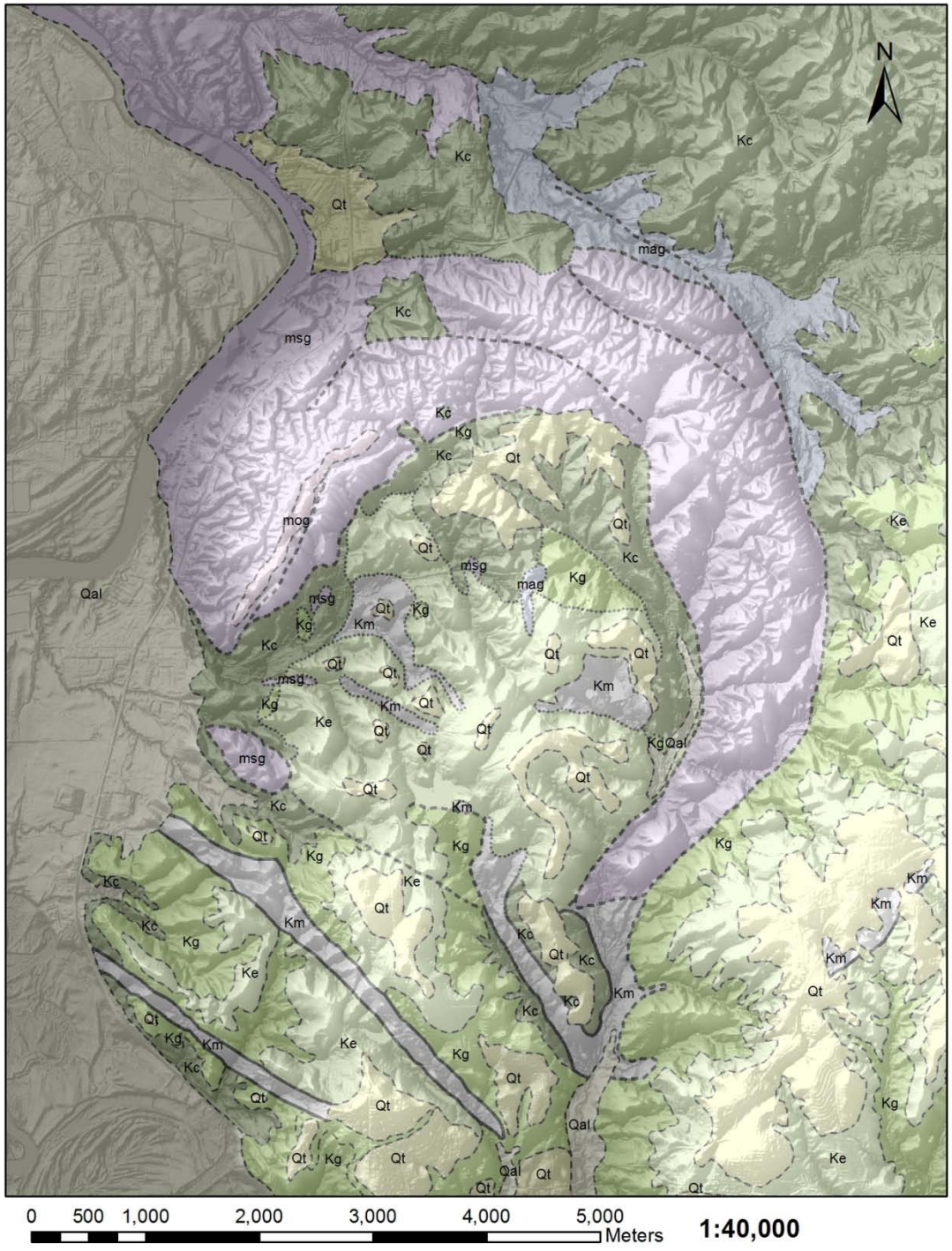




|------- 3 miles -------|

LiDAR DEM geological map of Wetumpka impact structure, Alabama

LiDAR-based elevations within 1 m



STRATIGRAPHY

Qt – terrace

Km – Mooreville Chalk

Ke – Eutaw Formation

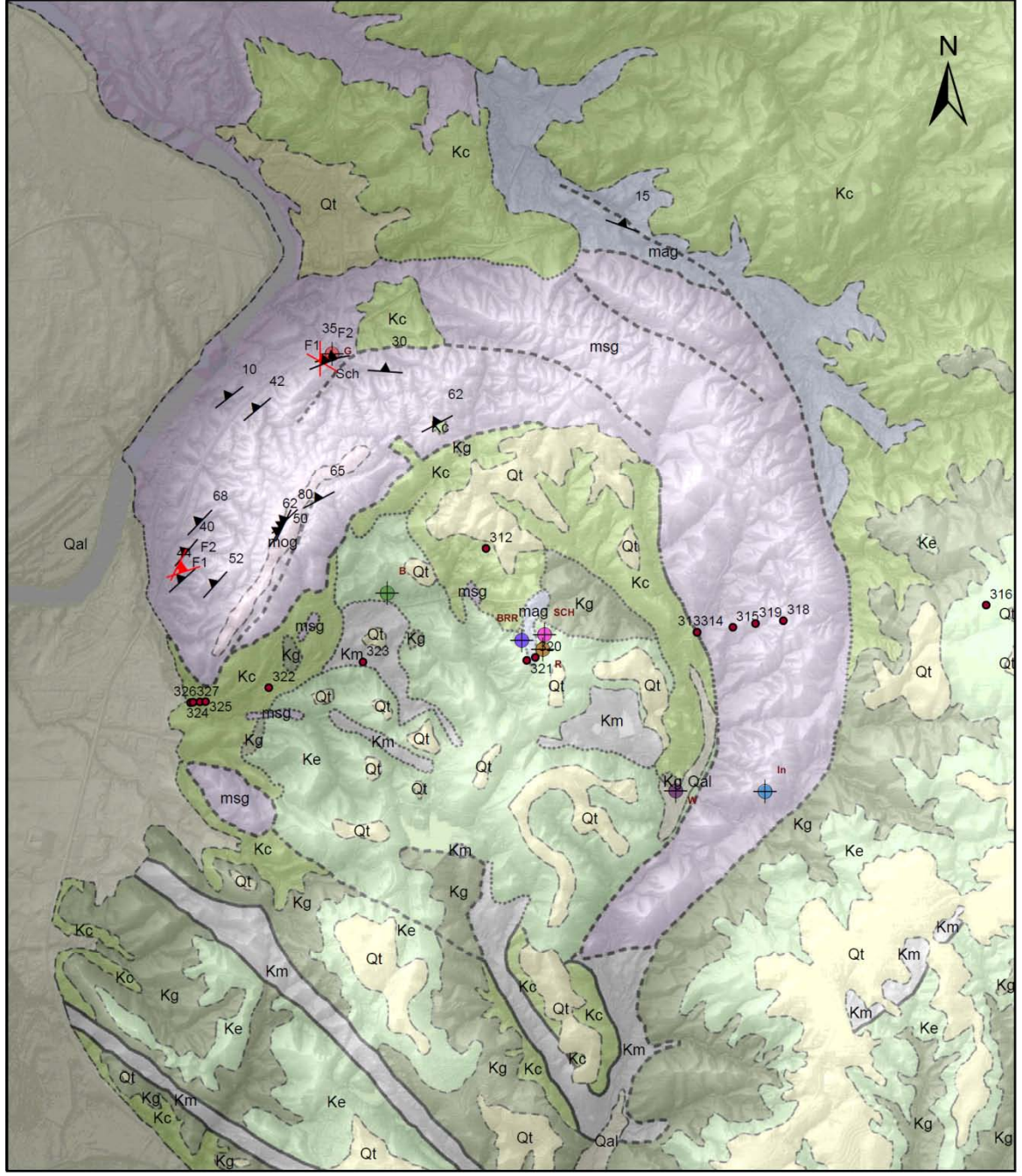
Kc – Coker Formation

Kg – Gordo Formation

mag & msg – metamorphic rocks

LiDAR DEM geological map of Wetumpka impact structure, Alabama

Precise control on locations



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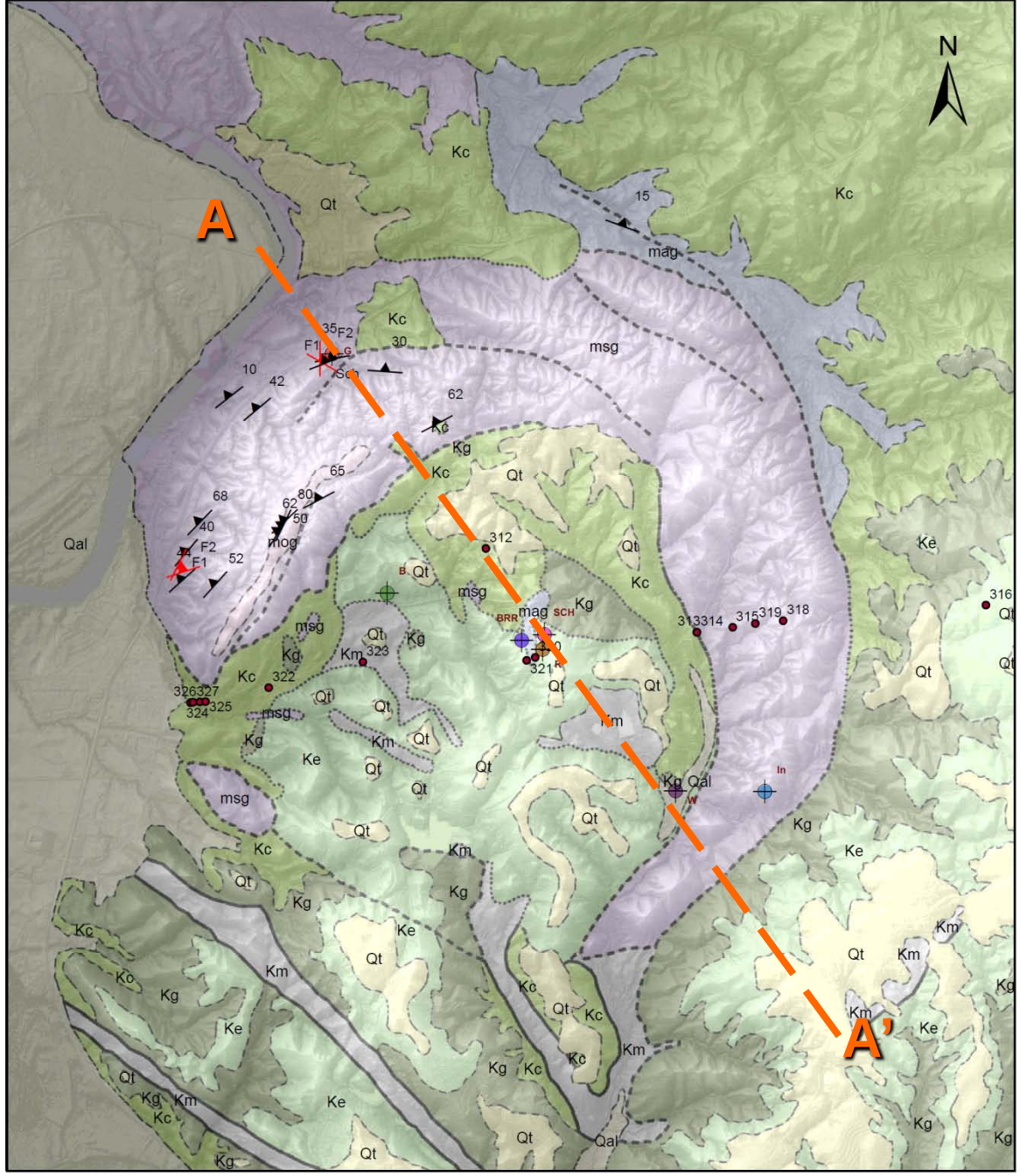

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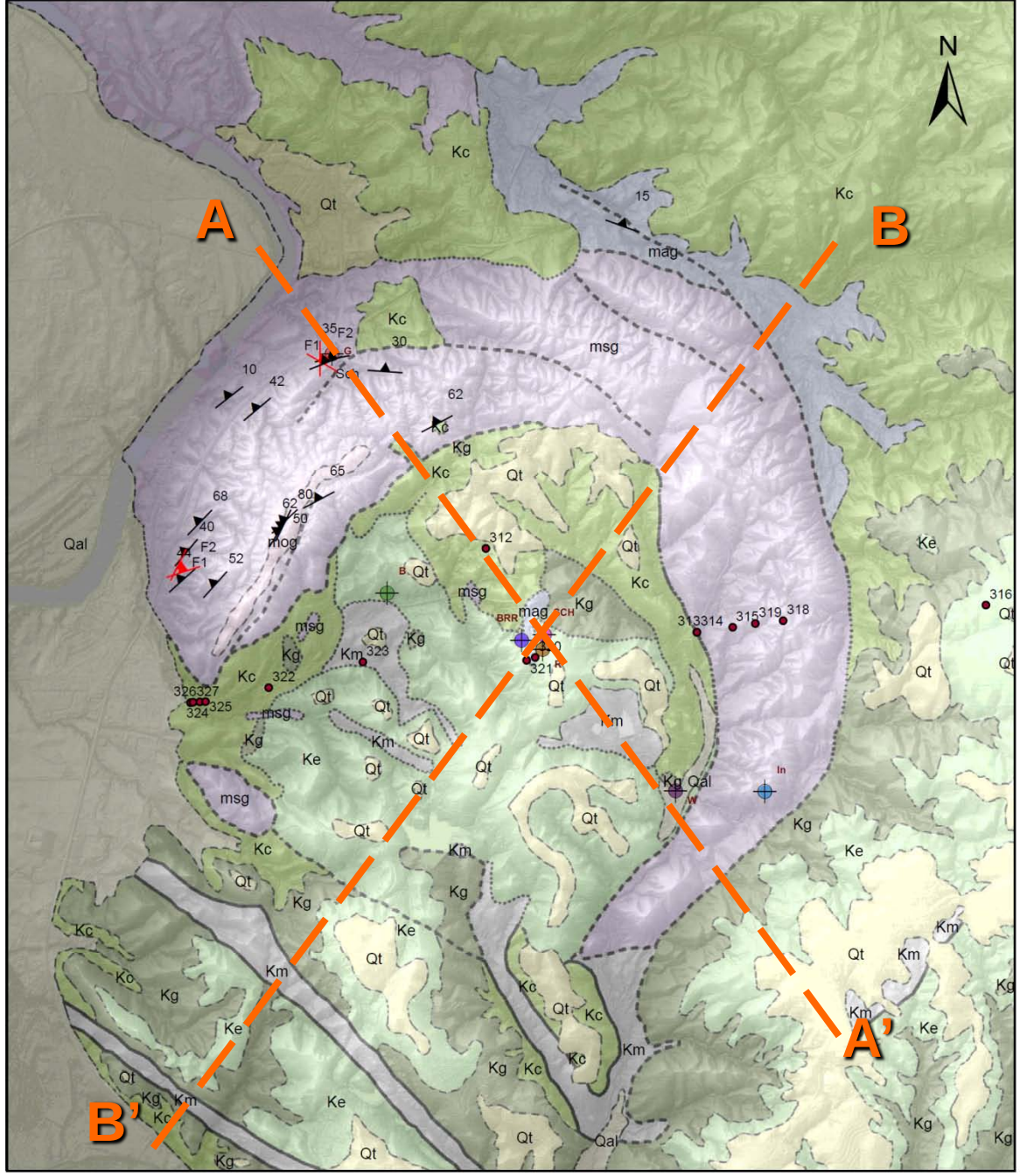

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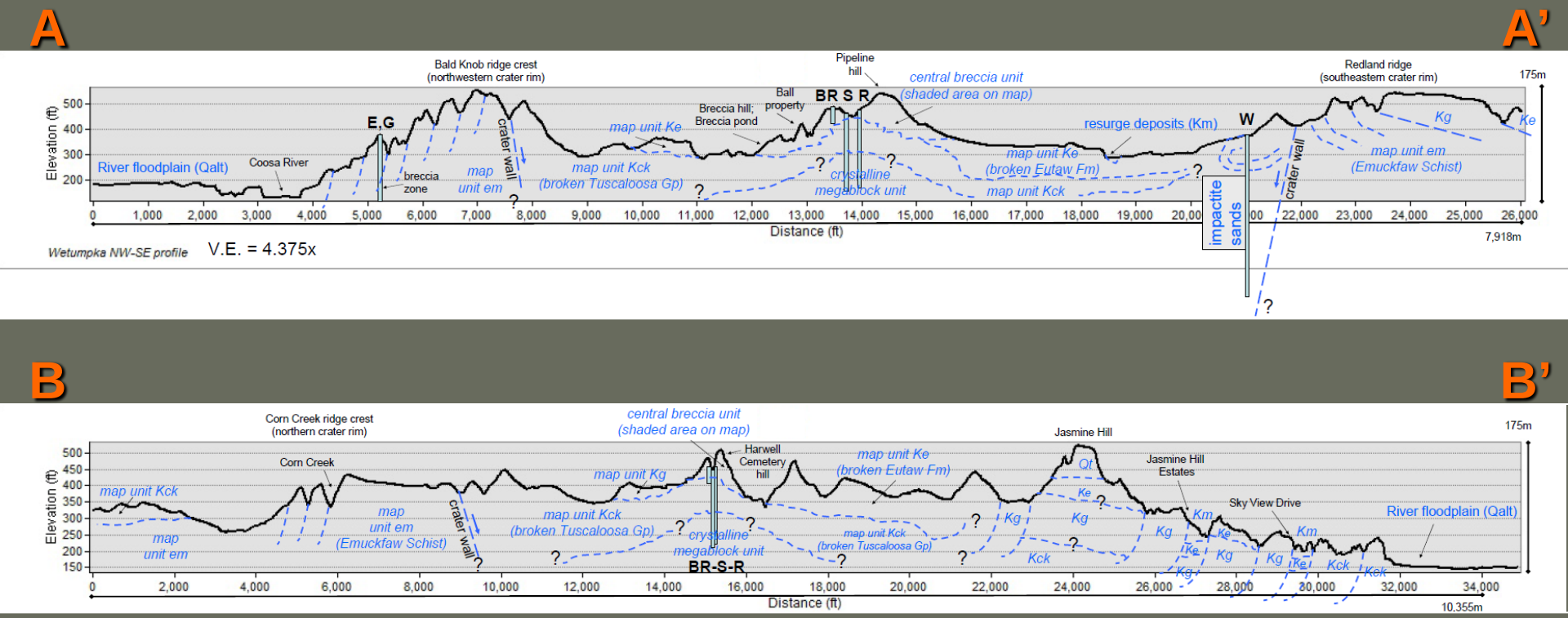
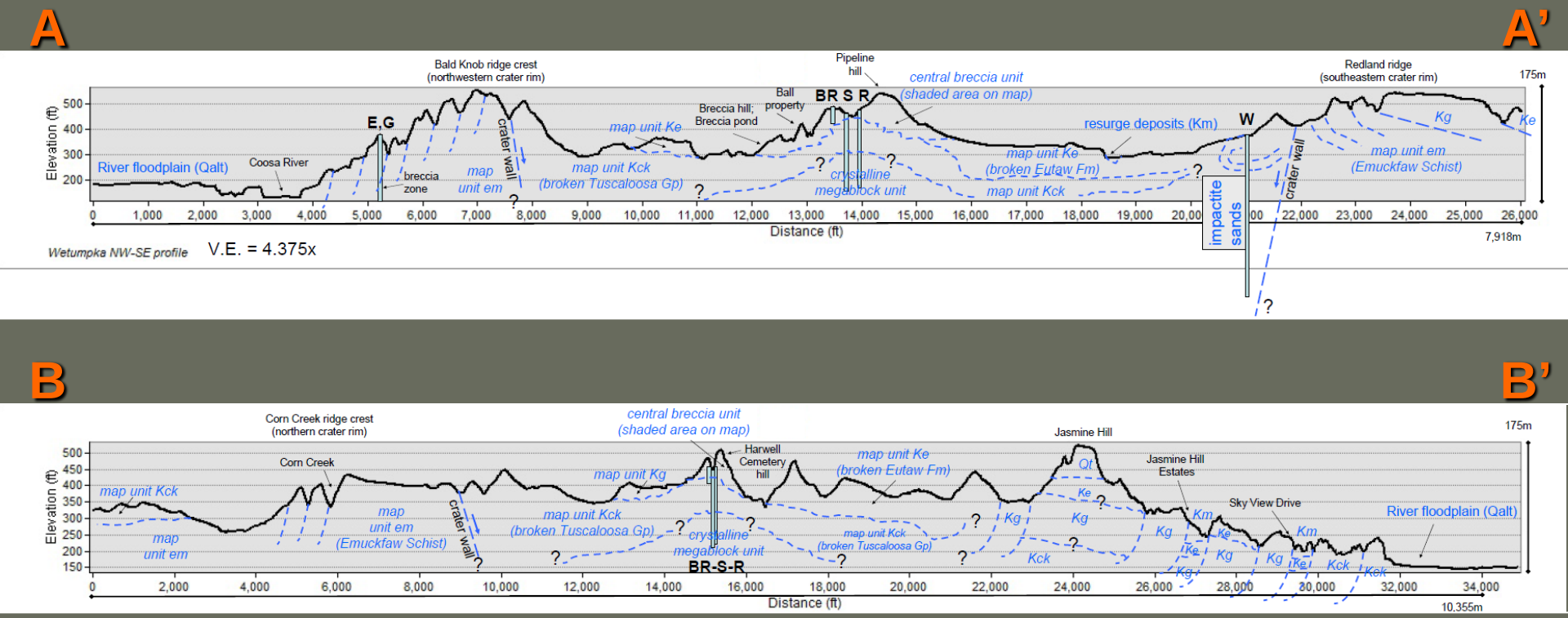
LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama



LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama

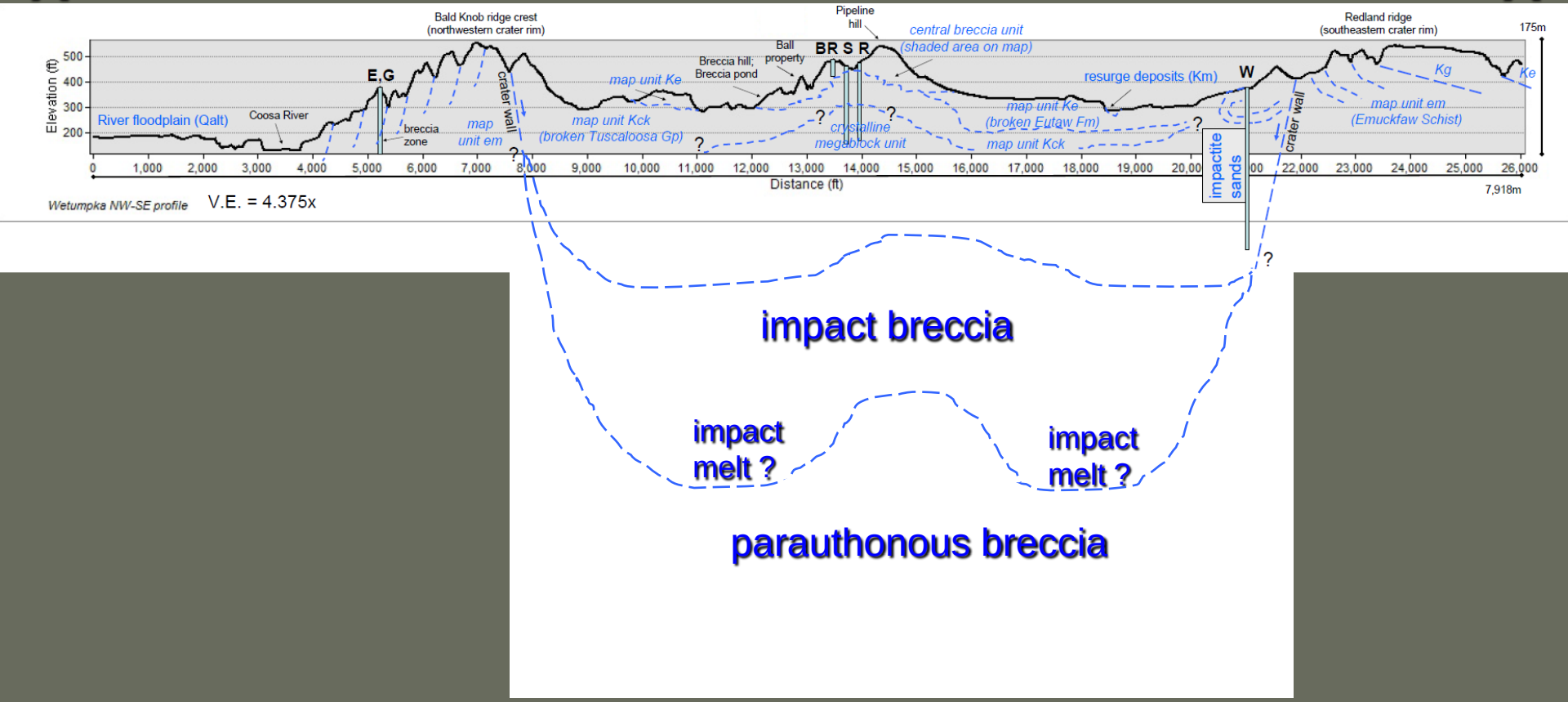


What would deeper cross sections look like?

LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama

A

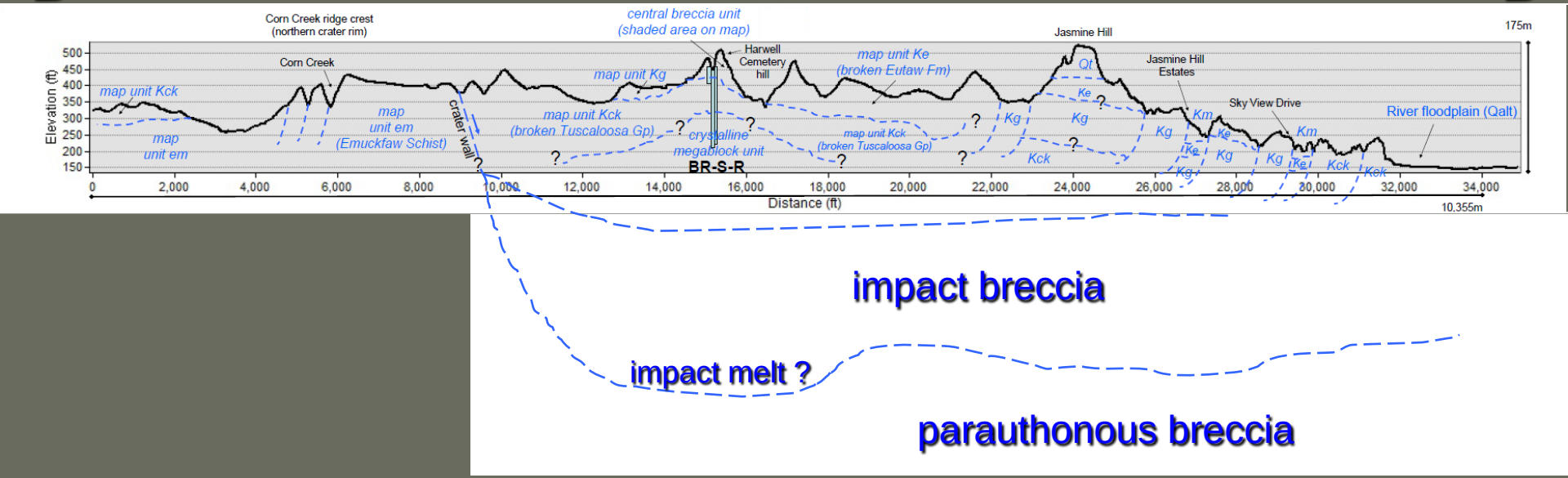
A’



LiDAR-DEM-based geological cross-sections of Wetumpka impact structure, Alabama

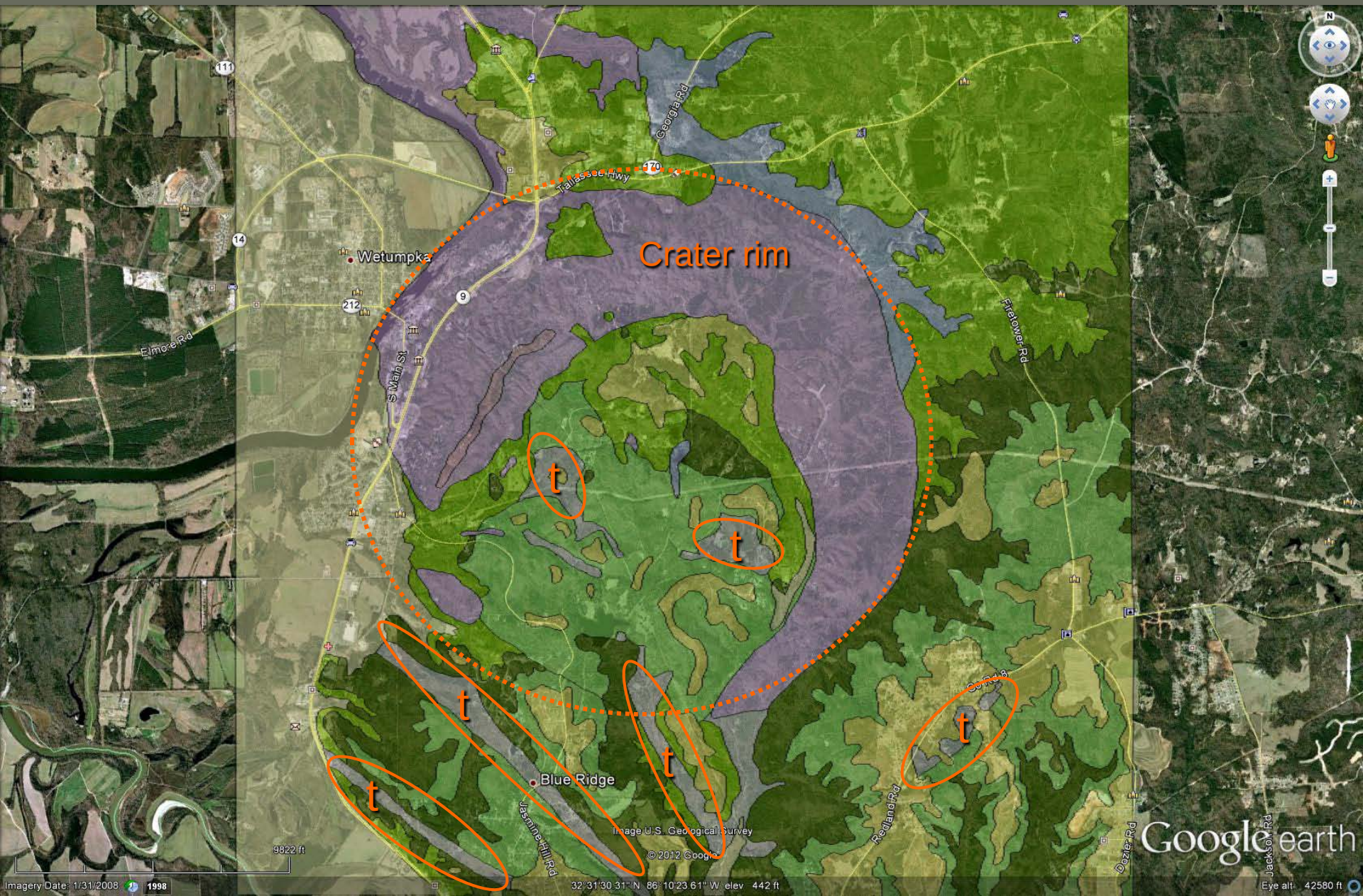
B

B’



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)



1. Deposits of the muddy tsunami (t)

1. Deposits of the muddy tsunami (t)

Scientific core hole #09-03 – muddy tsunami evidence


melt-damaged microfossil


melt-damaged microfossil

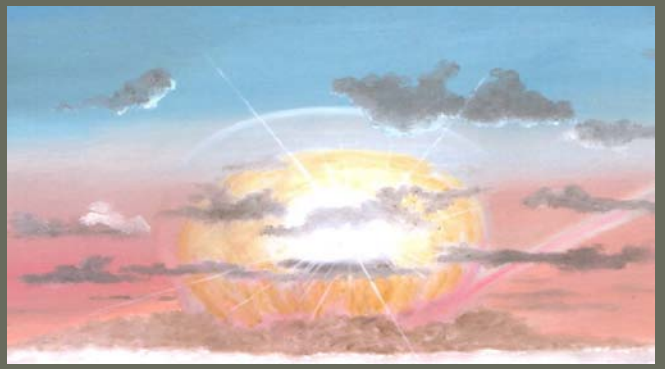

undamaged microfossil

Odontochitina operculata

Images by Dr. Lucy Edwards, USGS Reston

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

Scientific core hole #09-03 – tsunami evidence



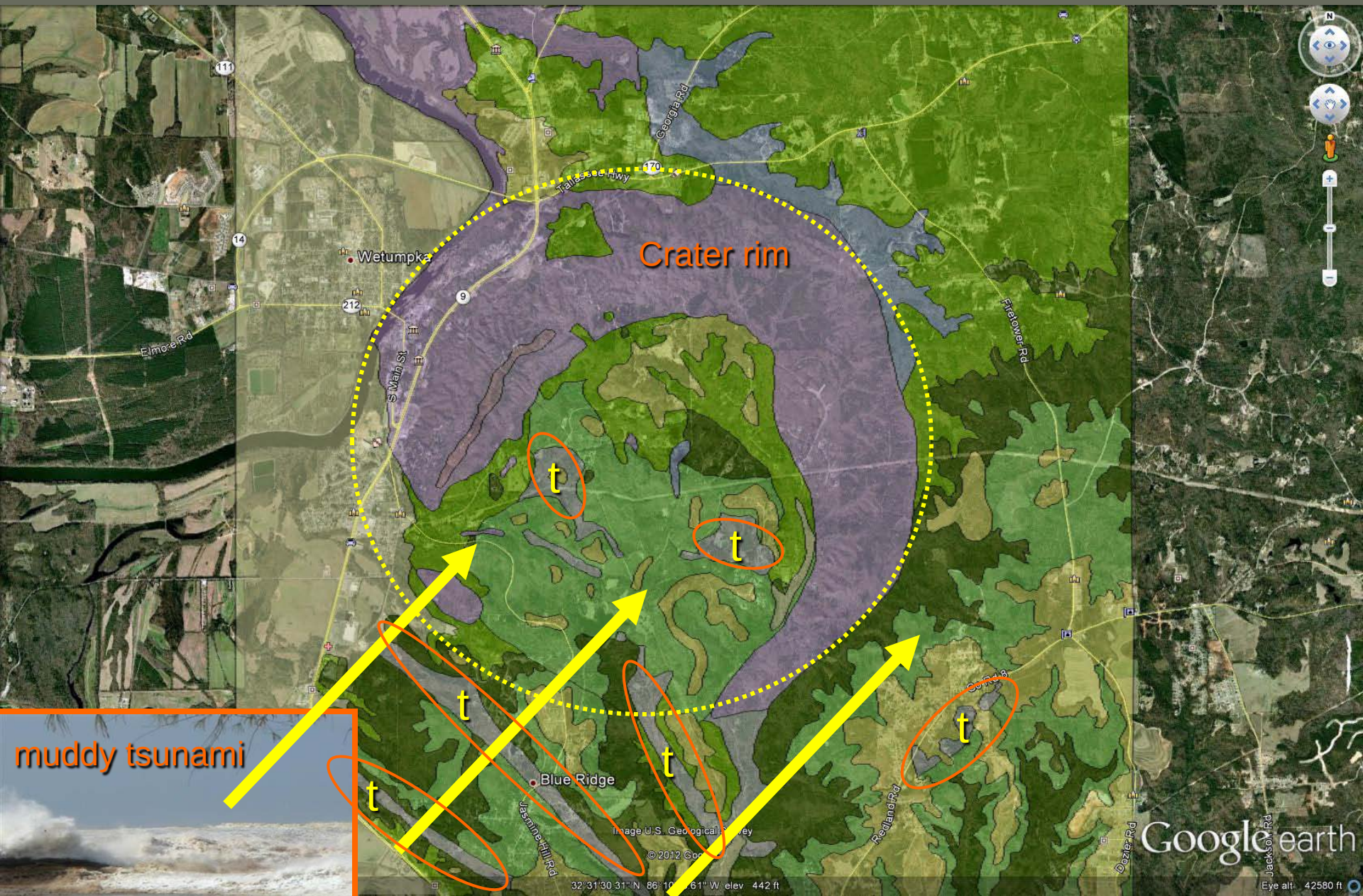
Melt droplets are thought to form in the vapor plume above the impact.

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)

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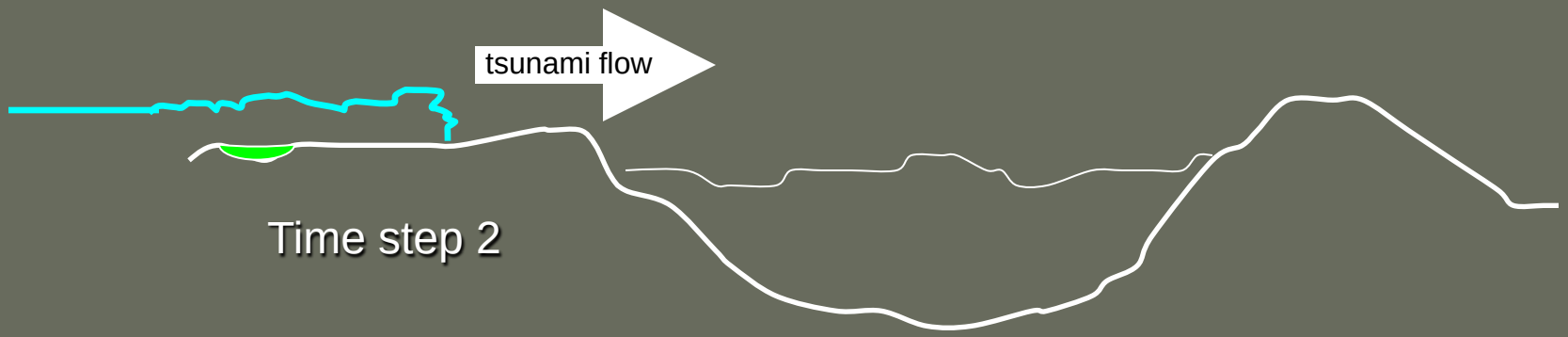

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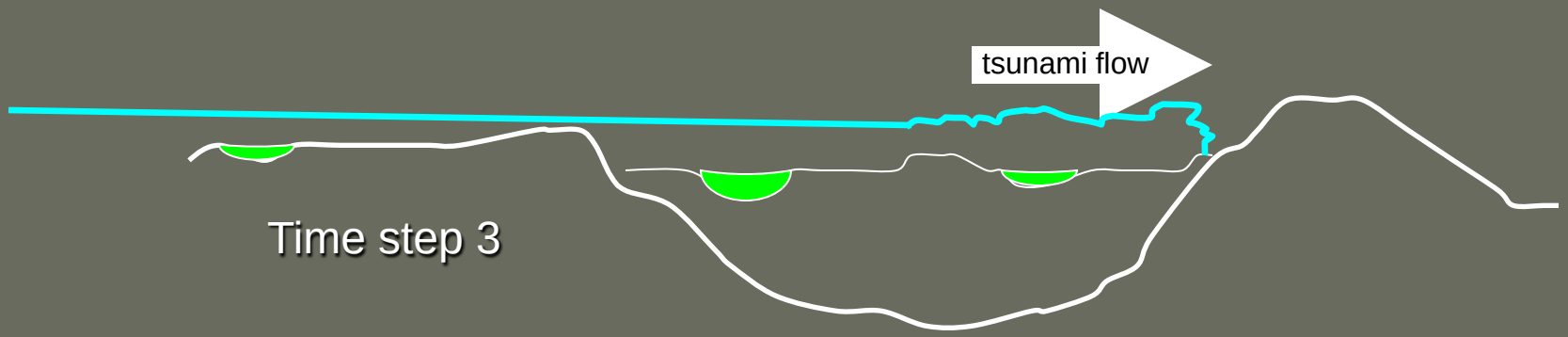

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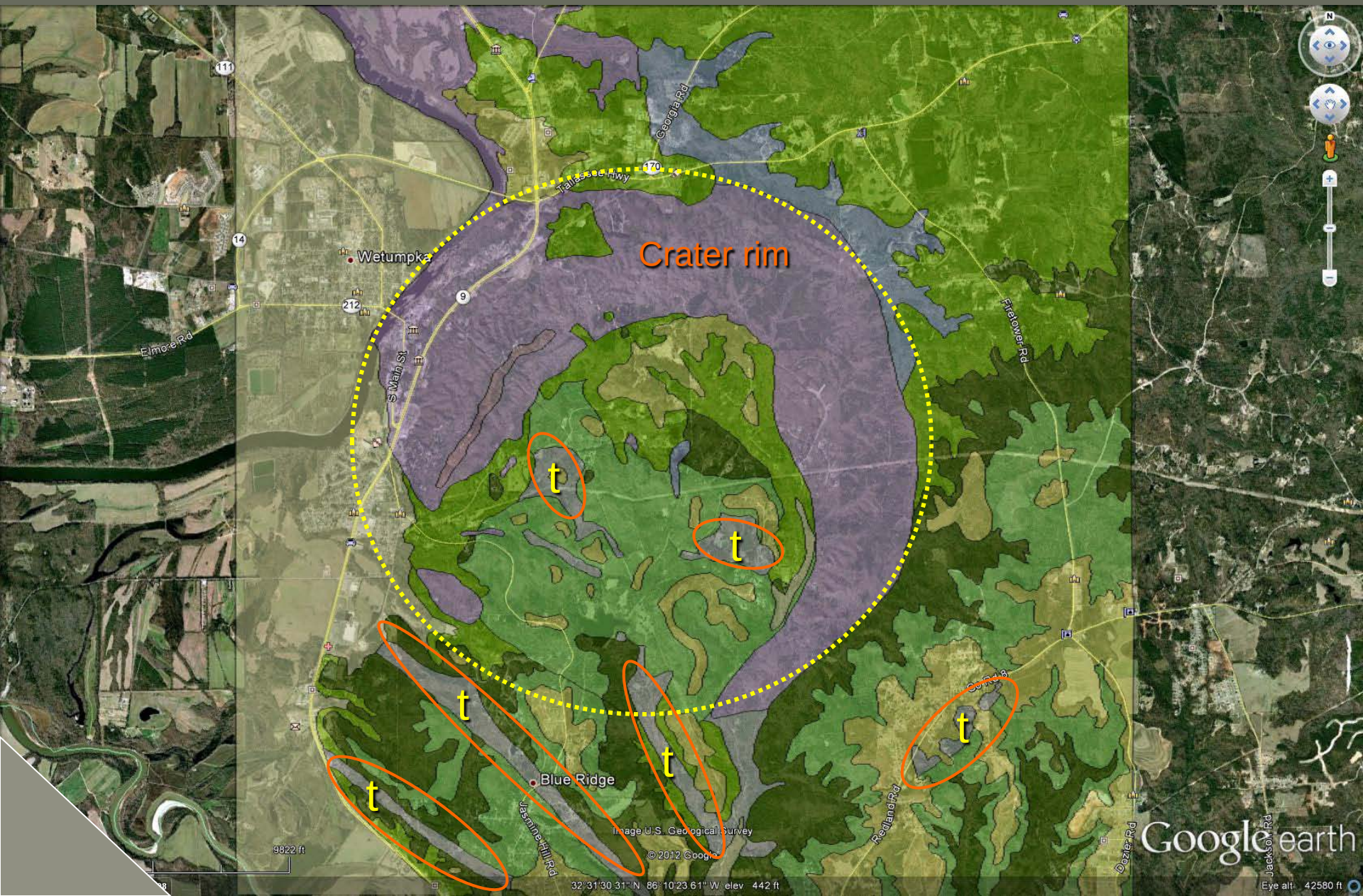
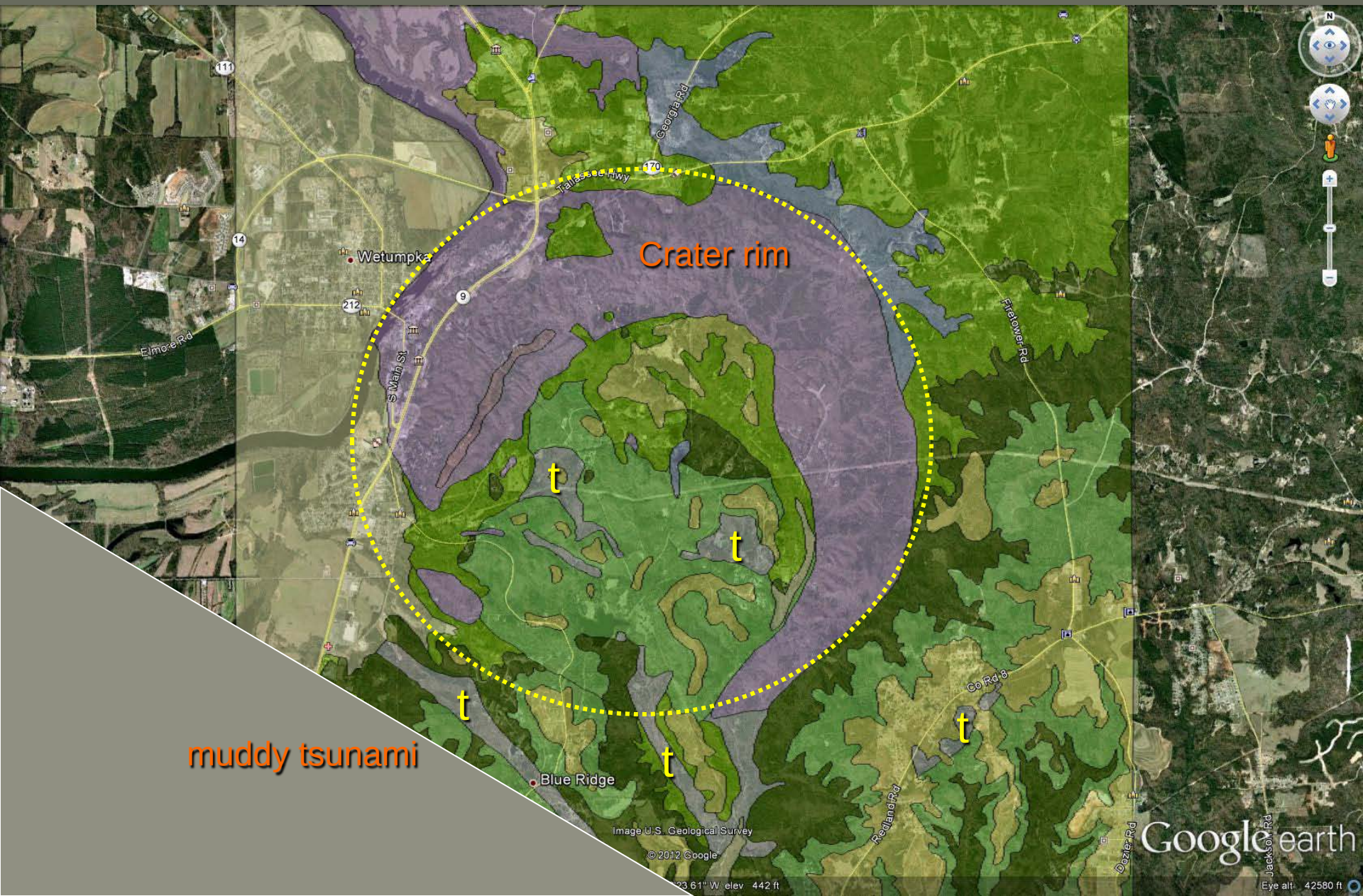
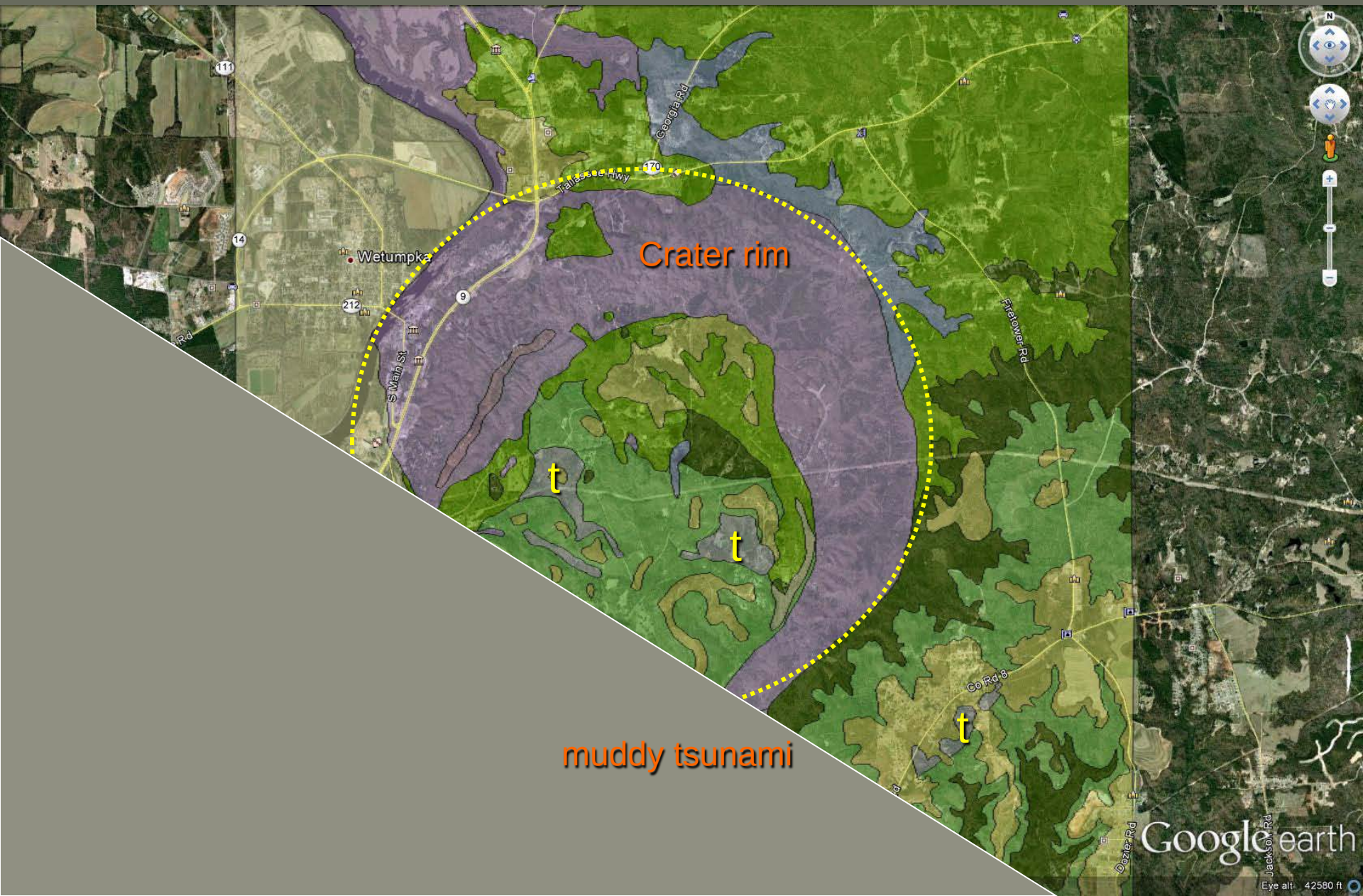


Deposits of the muddy tsunami (t)



Deposits of the muddy tsunami (t)

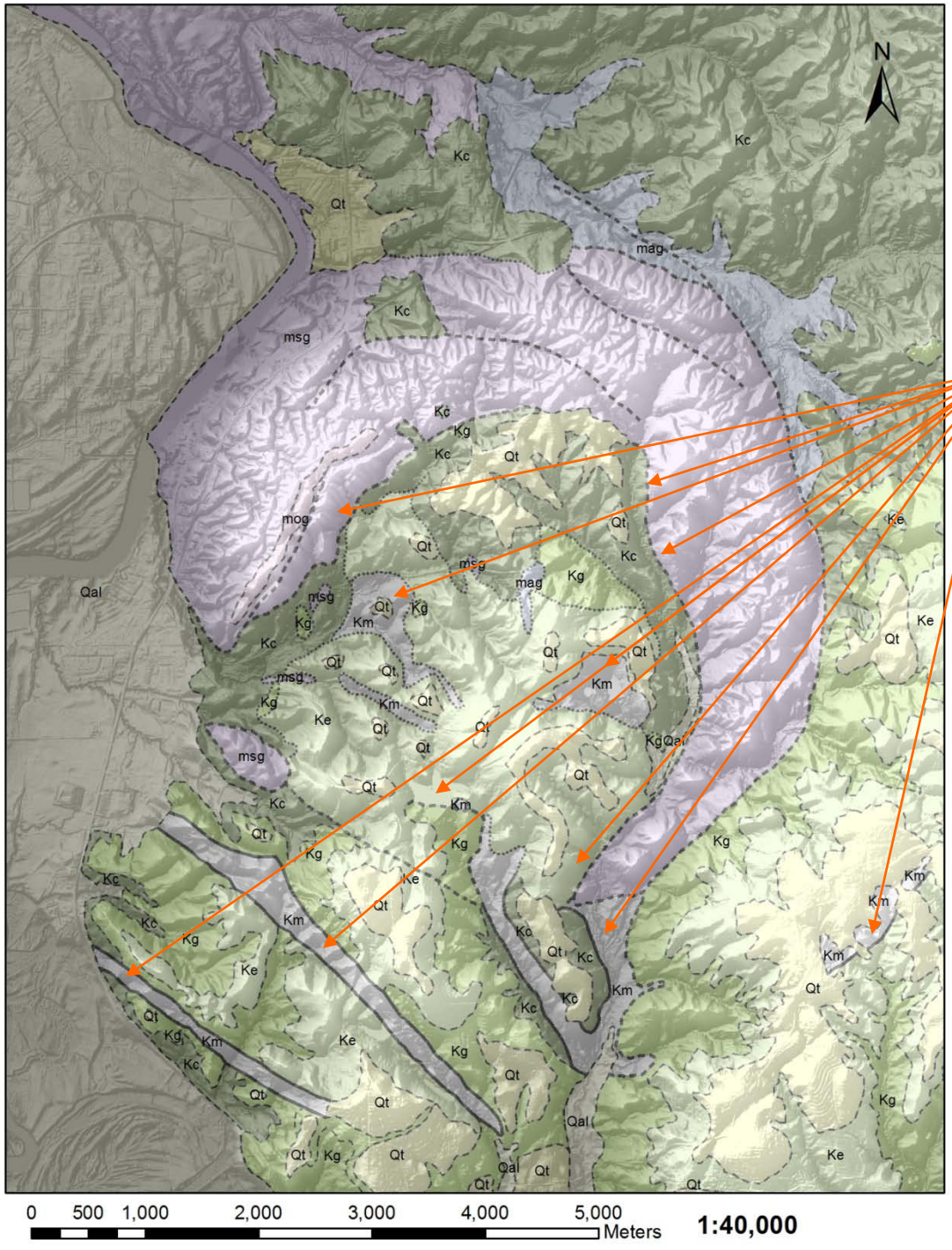


Deposits of the muddy tsunami (t)

Deposits of the muddy tsunami

LiDAR DEM geological map of Wetumpka impact structure, Alabama

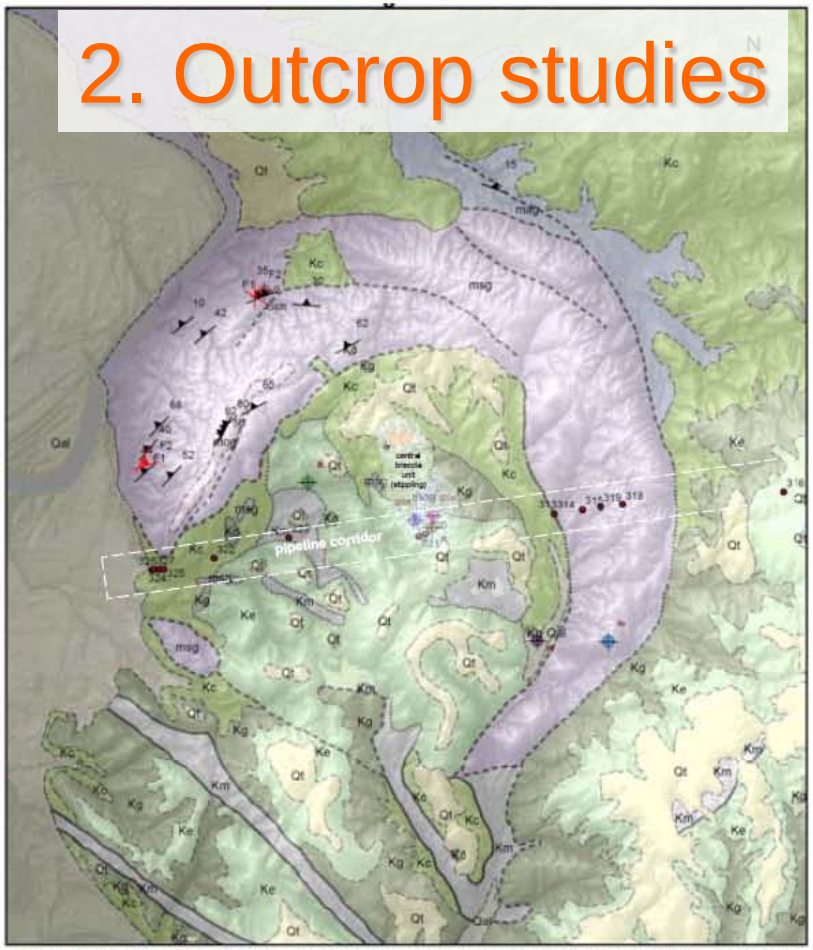
LiDAR-based elevations within 1 m

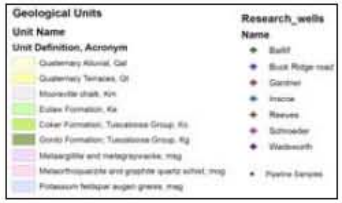


Deposits of the muddy tsunami:

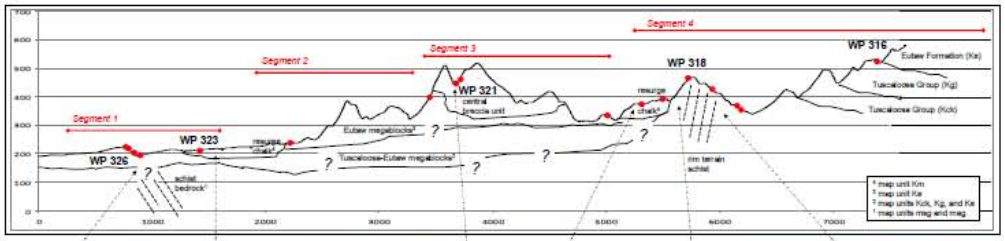
Km areas and small smooth terrains

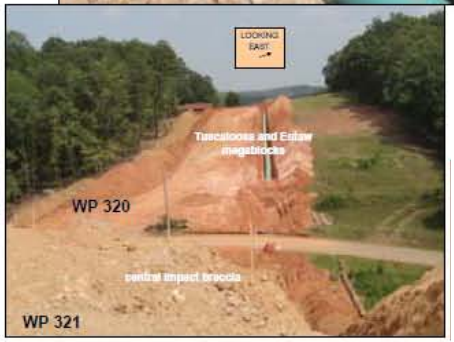
2. Outcrop studies





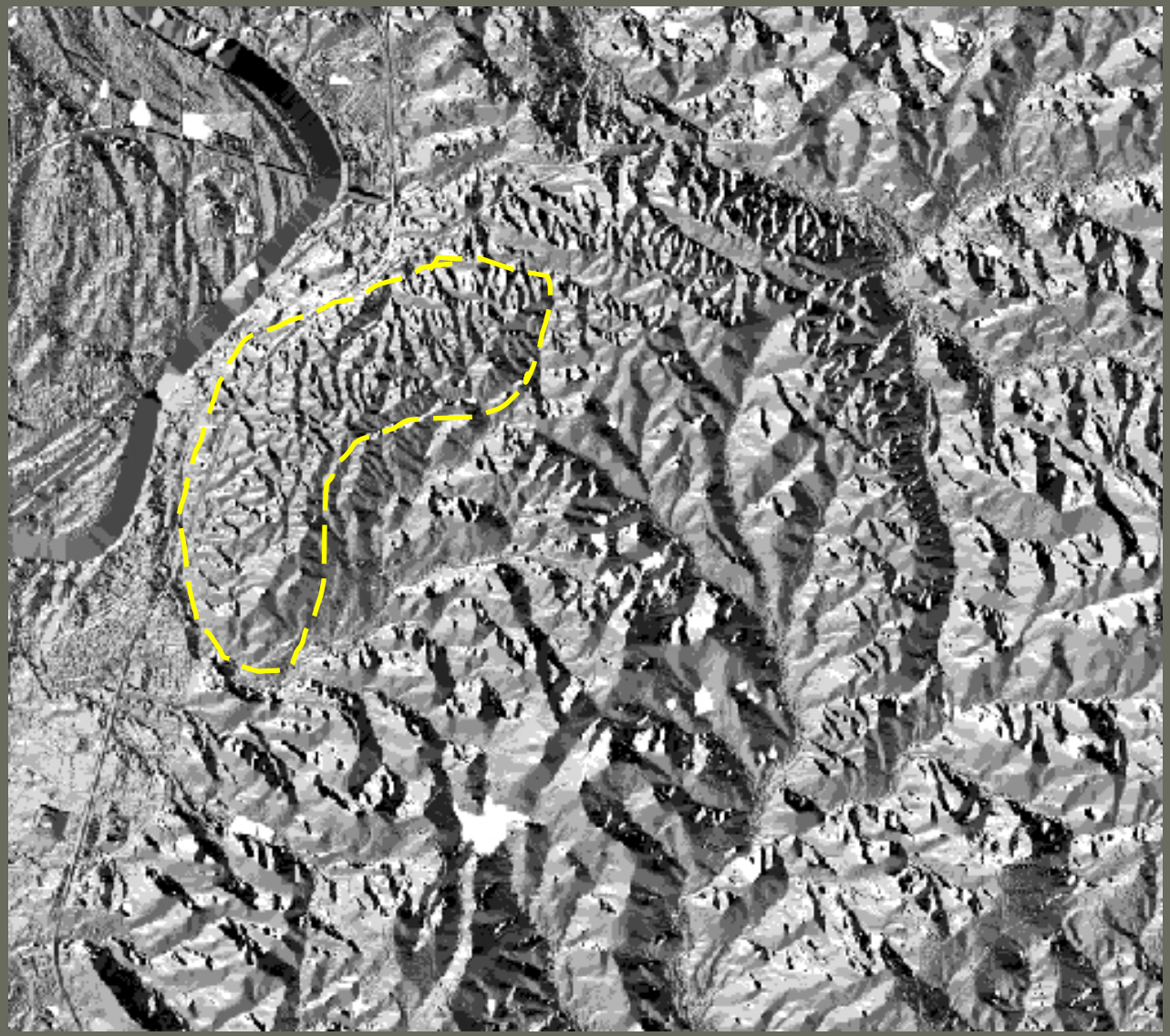
EL PASO GAS PIPELINE CUT TRANSECT





Petruny et al. 2012 LPSC abstracts

3. Digital geological mapping



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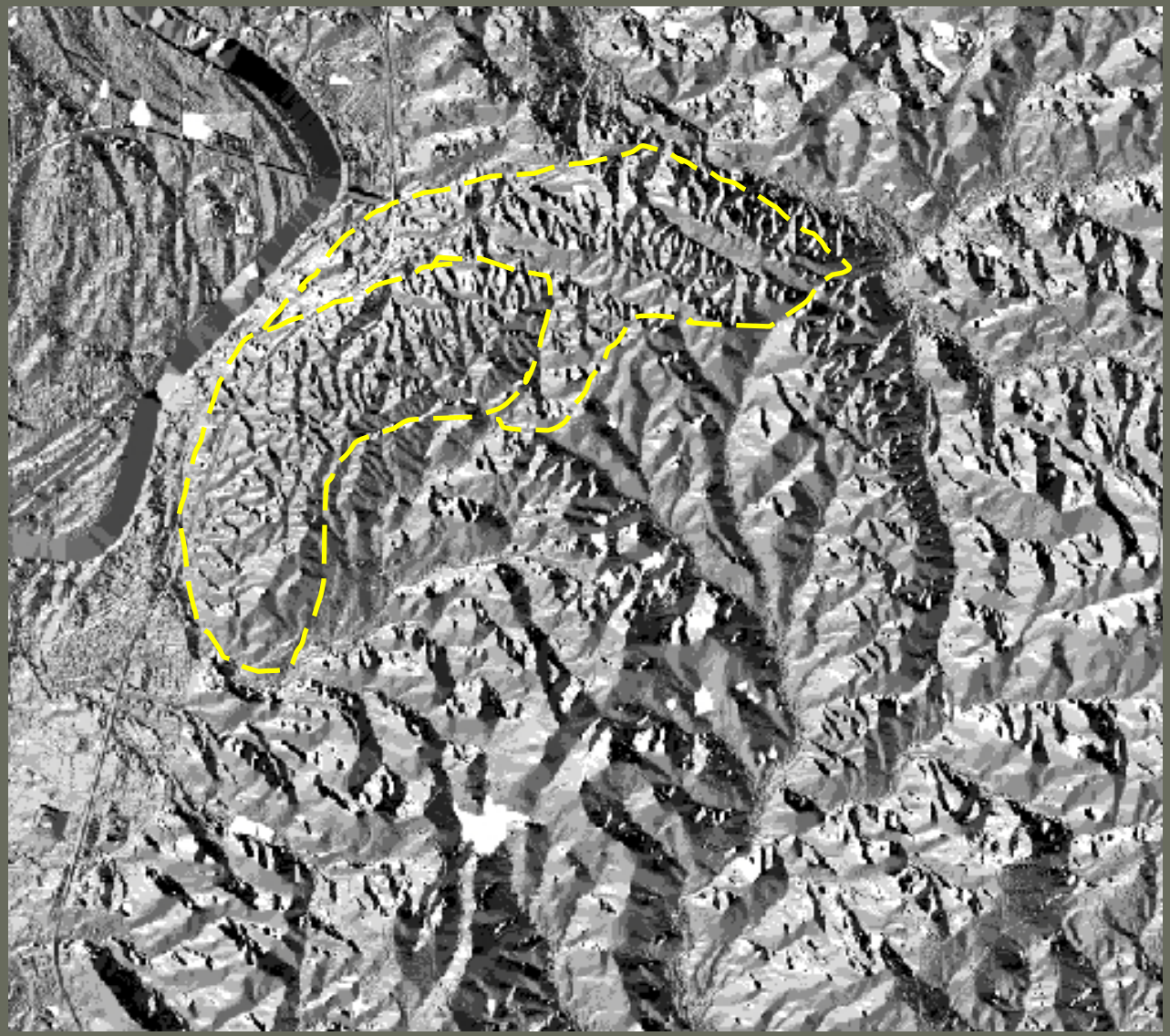

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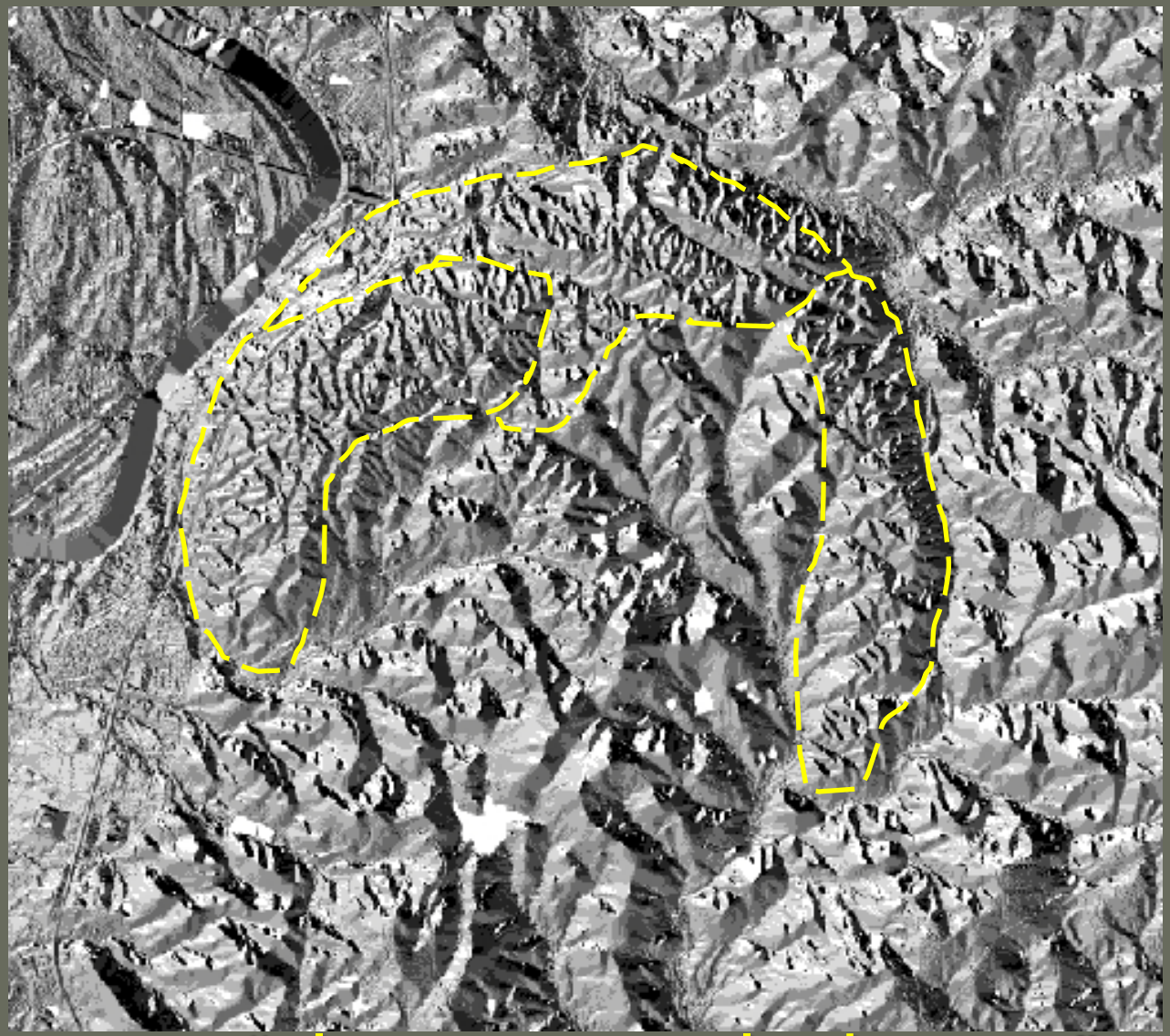
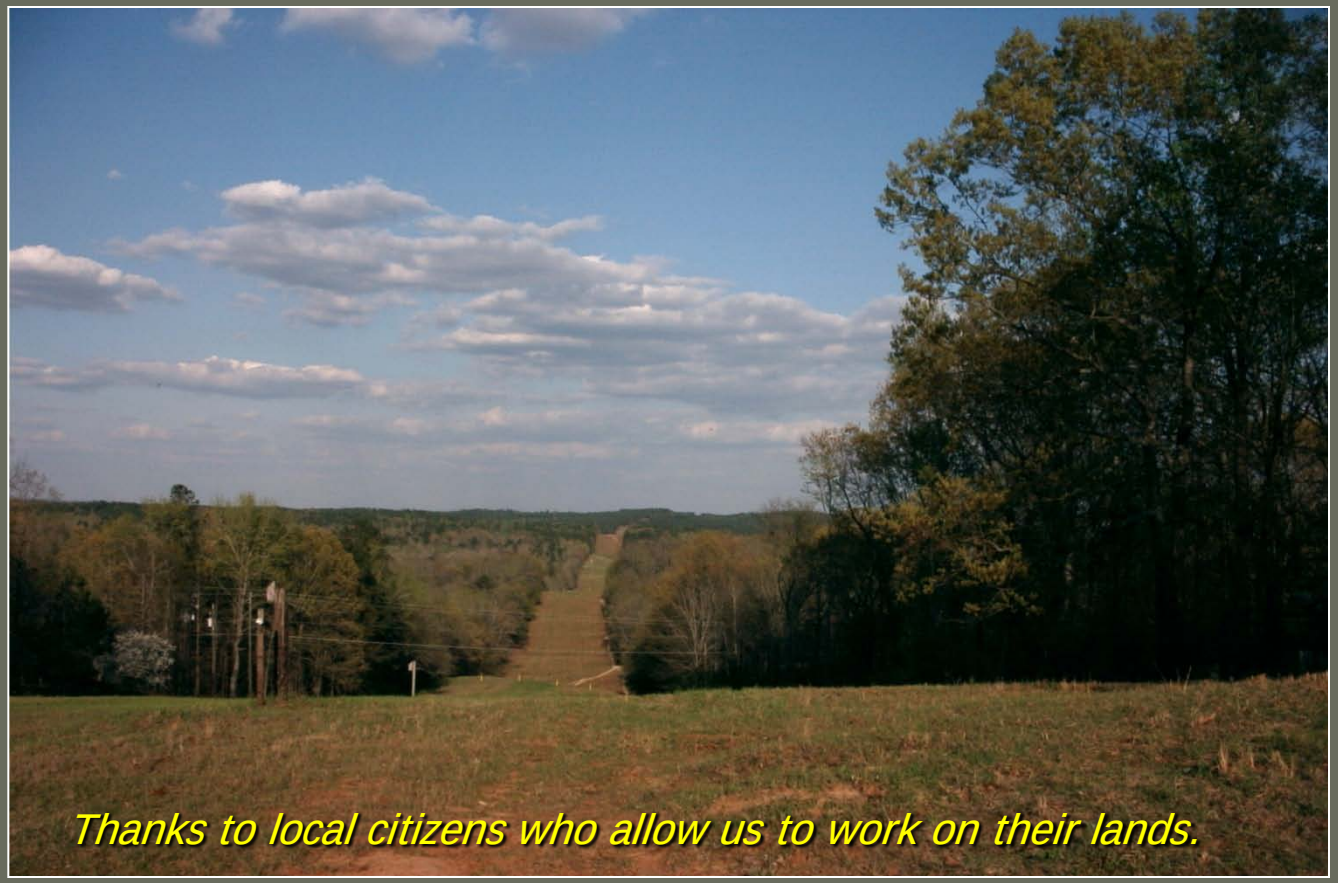


Toward a more “planetary geologic map” …

Acknowledgements



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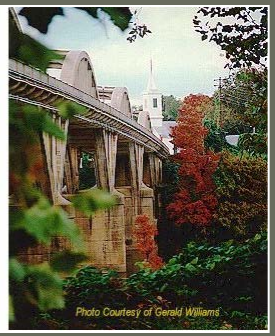

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