Gravity and Magnetism Suggest Earth's Second-Largest Asteroid Impact Structure Underlies Southeast Missouri, USA

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Detailed analysis of the Missouri State Gravity and Magnetism maps reveals an apparent, enormous Asteroid Impact Structure in the older, buried (Paleoproterozoic) Precambrian rocks of southeast Missouri.

The apparent Impact Structure underlying much of southeastern Missouri remains about 124 miles wide after more than half a billion years of erosion. At the moment of impact, the crater was much wider and over a mile deep.

The southeastern Missouri crater was formed approximately 1.5 billion years ago during a low-angle impact at -35 degrees by a metal-rich (M-type) Asteroid, assumed to have been spherical and estimated at 10 to 12 miles in diameter. Iron metal and iron oxides in the Asteroid dispersed widely, creating a Metallogenic Province of iron-enriched rock.

On a list, sorted by size, of Earth's Largest Known Asteroid Impact Structures, Number 1 is the giant Vredefort (Goldfields) Impact Structure in South Africa.

Vredefort Crater is estimated to have been 155–174 miles wide and several miles deep at the moment of impact 2 billion years ago. The impacting Asteroid (or Comet?) is estimated to have been 12 - 16 miles in diameter. Erosion reduced Vredefort Crater to 56 -75 miles wide today.

Number 2 on the current list is the Chicxulub "Dinosaur Killer" Impact Structure at Yucatan, Mexico, 110-120 miles wide, 66 million years old, created by the impact of a 6-mile-diameter asteroid, and completely buried, with no surface exposure.
The Chicxulub impact structure was discovered during petroleum exploration while mapping gravity and magnetism. Drilling and geological investigations confirmed the presence of remnants of a buried Asteroid.

A similar investigation would examine evidence suggesting that a large Asteroid Impact Structure underlies southeastern Missouri.

The Missouri State Gravity Map's southeast corner displays a large circular pattern and related evidence diagnostic of big Asteroid Impact Structures in Precambrian rocks.

With the abundant and diverse evidence now available, I estimate a buried Asteroid in southeast Missouri has a 98% probability of existence. When rock drills start bringing up core containing Asteroid rock, I'll say 100%

It's a close call, but the slightly elongate JUD-SEMO ASTEROID IMPACT STRUCTURE could be just wide enough to secure the Number 2 position on the size list and bump Chicxulub to Number 3.

By definition, the Impact Crater had to exist before and must be older than the 1.48-1.5 billion-year-old volcanic rock that fills the crater.

Geological research is just beginning, so expect numbers and the conceptual model to change as fieldwork gets underway and new data accumulate.

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THE BIG CRASH:

Interpretation of the Missouri State Gravity Map and the Magnetism Map tells what happened about 1,500,000,000 years ago when a VERY BIG ROCK fell out of the Precambrian sky.

The JUD-SEMO (pronounced “See - Mo”; Southeast Missouri) ASTEROID was assigned a spherical shape because there is no way to know the actual shape, and a sphere is probably close to correct and easy to handle mathematically.

The Impact Event included the main large Asteroid, a swarm of smaller Asteroids orbiting it, and fragments that broke off during atmospheric entry.

The 10- to 12-mile asteroid diameter is estimated from the ratio of Impactor Diameter to Crater Diameter for large impactors.

The Gravity Map indicates that the JUD-SEMO Impact Structure is currently about 124 miles wide.

The Magnetism Map indicates that the Impact Structure is deeper than 2,000 feet.

The Crater was much wider at the time of impact. Crater size implies an Asteroid about 10 to 12 miles wide with a radius of 5 to 6 miles.

Early data could be considerably in error and depend on several estimated factors, including impactor orientation, Asteroid density, Asteroid mass, and the relative speed of the Asteroid/ impacted body.

The equation for calculating spherical volume is (4/3 pi) x (radius cubed).

Plug in the numbers. (4/3 pi) x (5- or 6-miles radius, cubed) = 523 or 904 cubic miles. That’s CUBIC MILES!! Either way, that was an enormous rock.

Probably core material from a small, smashed planet.

May have been famous Asteroid 16 Psyche’s little brother.

The impact would have destroyed advanced life on Earth had there been anything to destroy. Fortunately, life was then restricted to Cyanobacteria and Algae, which can tolerate extreme environments and reproduce quickly.

Life survived.

THE JOURNEY:

Missouri did not exist when the Asteroid crashed and would not exist for hundreds of millions more years.

The JUD-SEMO ASTEROID crashed into the Precambrian continent of Columbia.

Around the time of the crash, the Precambrian continent Laurentia broke off from Columbia and took the Asteroid Impact Site along. It is unclear whether the impact occurred before or after Laurentia separated from Columbia. The impact may have initiated separation if separation was already primed and just waiting for a triggering event.

Laurentia took the Asteroid Impact Structure on a world tour, joining and then separating from Gondwana, Pangaea, and other early continents and landmasses.

During this global travel, Laurentia steadily grew in size by bumping into and merging with other tectonic plates before becoming the deep ‘basement rock’ now underlying much of eastern North America. That includes southeast Missouri, where the Asteroid Impact Structure now resides.

HAWN STATE PARK, SOUTHEAST MISSOURI:

There is a very rare outcrop of Laurentia Tectonic Plate ‘basement rock’ in southeast Missouri at Hawn State Park in Ste. Genevieve County.

Although exposure is rare in the United States, the Laurentia Tectonic Plate is the surface rock in much of central and eastern Canada, where it forms the Canadian Shield.

Before you visit the outcrop, read the excellent geology summary of Hawn State Park by Aster

Cowart, Planetary Geologist,
https://jccwrt.neocities.org/geology/hawn_state_park

To reach Hawn State Park, begin on Highway 32, between Farmington and Ste. Genevieve. Turn onto Highway 144, 14 miles west of Ste. Genevieve. 37°50′16″N, 90°12′06″W.
Telephone: +1 (573) 883-3603

At Hawn Park, you can see, stand on, and touch a real, actual piece of the Laurentia Tectonic Plate that broke off of the Precambrian continent of Columbia about 1,500,000,000 years ago.

Leave the rock hammer and collection bag in your car. This is a State Park. Rock collecting is not allowed.

The best rock specimens to see are in adjacent Pickle Creek, where moving water keeps the rocks washed clean.

Drive past the Park Headquarters and down a steep hill to a fork in the road. A campground is to the left. The trail to the xenolith outcrop is to the right. Park at the picnic shelter and walk a few hundred feet upstream on the hiking trail with Pickle Creek to your left.

Where the easy hiking trail becomes rocky and rough, you are standing on the Laurentia Tectonic Plate Xenolith outcrop.

The rock's official name is HAWN PARK GNEISS, a metamorphic rock type pronounced: "Nice". A XENOLITH is a foreign rock that originated outside the magma and is embedded in volcanic rock.

GOLDILOCKS ZONE:

In the story "Goldilocks And The Three Bears", Goldilocks tests three beds in the Bears' house. Mother Bear's bed is too soft for comfort. Father Bear's bed is too hard. Baby Bear's bed is Just Right, and Goldilocks jumps in for a nap.

Baby Bear's bed is in the Goldilocks Zone, a more favorable midway point in a continuum of less desirable options. Also applicable to Space exploration, economic decisions, marriage partner selection, and ROCKS.

VIOLENCE UNLEASHED:

Laurentia was the surface rock 1.5 Ga ago (Ga = Giga annum = one billion years) when a huge rock traveling nearly due east fell from the sky and blasted out the JUD-SEMO ASTEROID Impact Crater.

The Impact Site and Crater center are in present-day Shannon County or Carter County, between Eminence and Van Buren.

Kinetic energy immediately became extreme-temperature heat during impact, melting much of the Asteroid and burning much of the metallic iron to iron oxide.

Chunks of Laurentia and Asteroid rock up to several miles long went airborne and rained down as a Debris Field north, east, and south (but not west) of the crash site.

Molten glass from melted Asteroid rock covered and surrounded the Debris Field rocks, protecting them from erosion and further oxidation, extinguishing burning metal fires.

Molten glass particles fused together to form an aquiclude blanket restricting future groundwater movement.

The disintegrating Asteroid continued blasting a downward, eastward path of destruction until its kinetic energy was exhausted, creating a Plunging Anticline filled with rock rubble.

Think of the Asteroid as a cannonball 10 - 12 miles wide, moving at miles-per-second speed and very hot, tearing through Precambrian rock like a rampaging monster mole.

Impact shock opened a rubble channel downward through the thin Precambrian Crust into the underlying Asthenosphere, creating a permeability channel and Mantle Plume.

Magma surged upward through the channel, building volcanoes on the surface. Geologists recently measured a 5-mile-thick outcropping of volcanic rock on the Eminence-Van Buren Volcano, immediately downrange of the Impact

Site, with a large but unknown additional thickness underground.

Somewhere, a large piece of the Laurentia Tectonic Plate was caught up in rising magma, creating the future Hawn Park xenolith within volcanic rock.

Lamotte Sandstone covered the volcanic rock during the Cambrian period, starting 550 million years ago.

Today, partial erosion of the Lamotte Sandstone has uncovered the xenolith in the Goldilocks Zone of rock exposed at Hawn State Park.

The xenolith's location is critical. A mile away in any direction would render the xenolith out of range for erosional exposure.

At the xenolith's current location, 500 feet less of vertical erosion might not expose it. 500 feet more erosion might entirely remove the xenolith.

Only the actual depth of erosion within a narrow vertical range allows us to visit the Hawn Park Gneiss Xenolith.

The Goldilocks Zone is still at work at Hawn State Park in southeast Missouri.

Think of all the places that the World Traveler Laurentia Tectonic Plate visited: the violent breakup by an impacting Asteroid, the journey to the surface in volcanic magma, and now re-exposure at Hawn Park as a xenolith in volcanic rock.

That rock really got around.

I suggest we give Hawn Park Gneiss a nickname. Let's call it TRAVELER ROCK.

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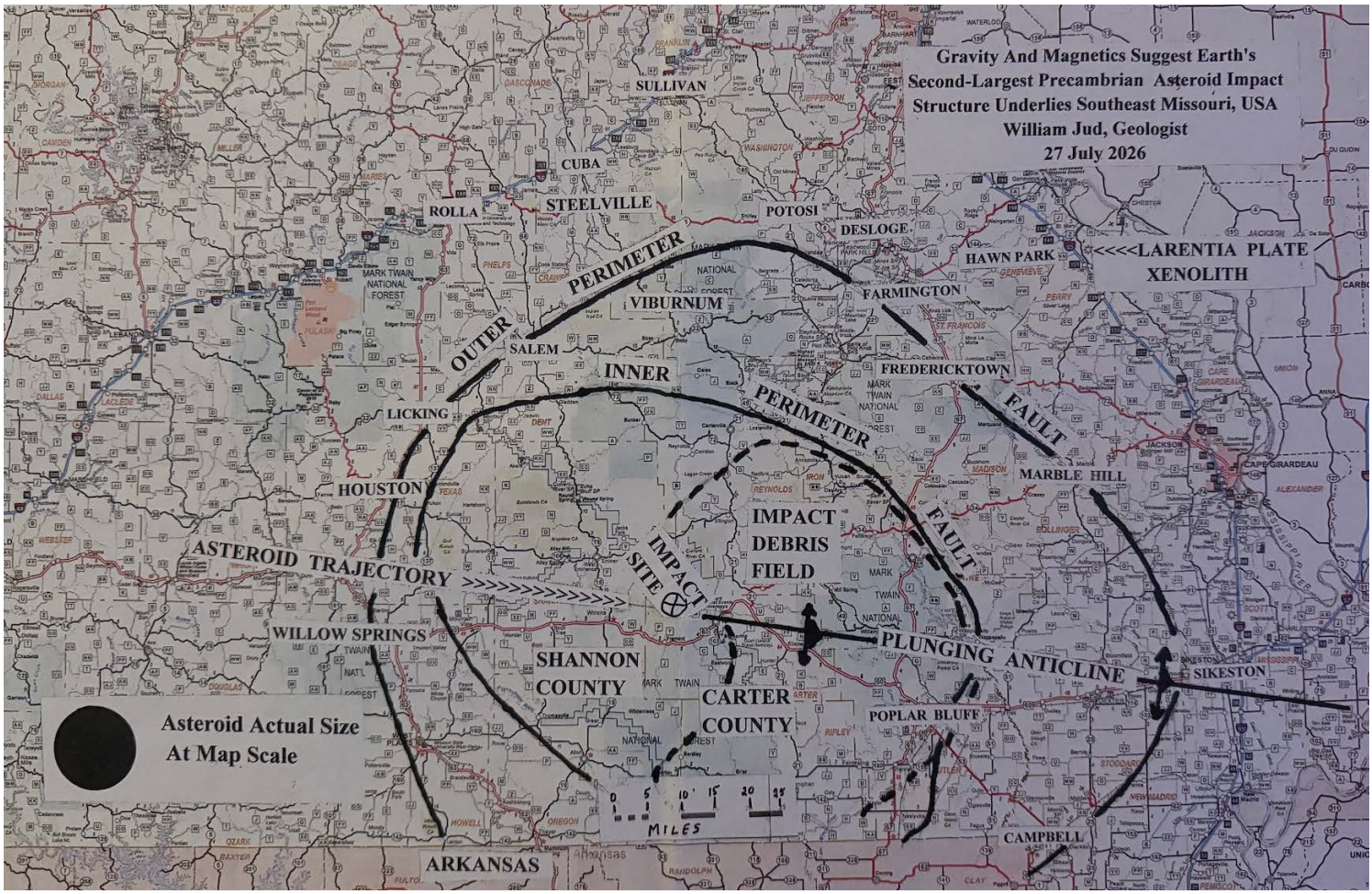

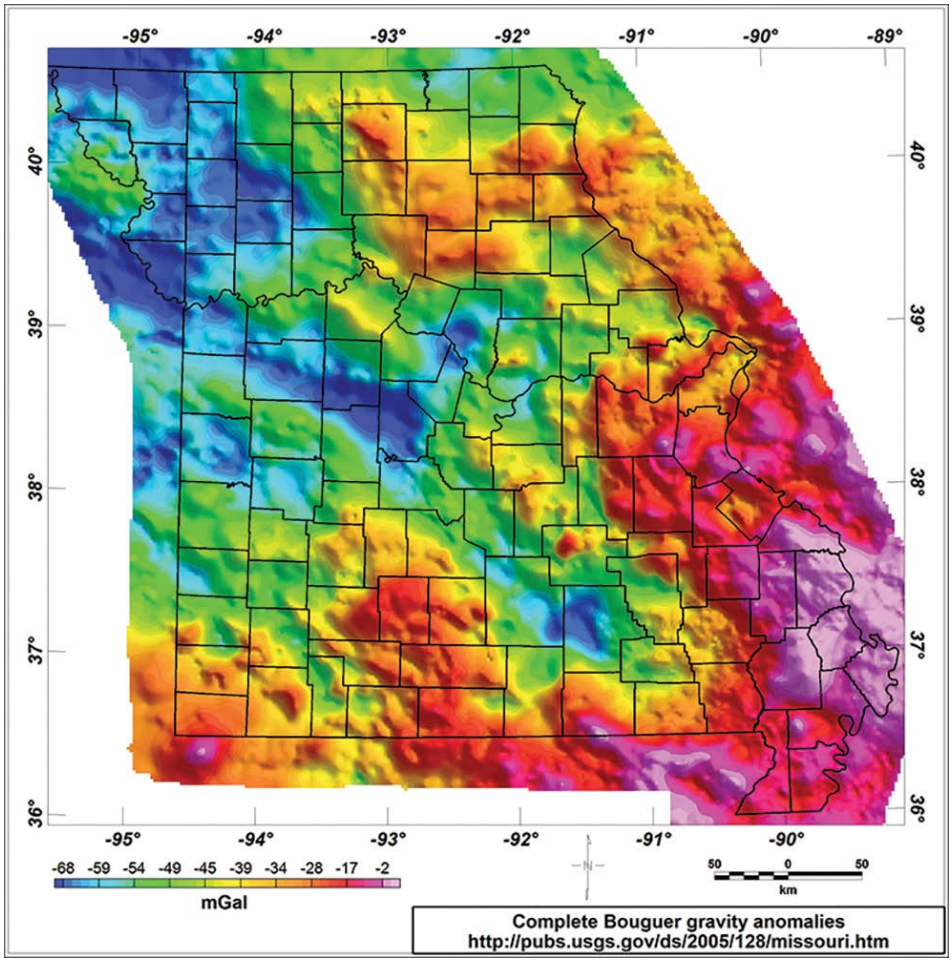

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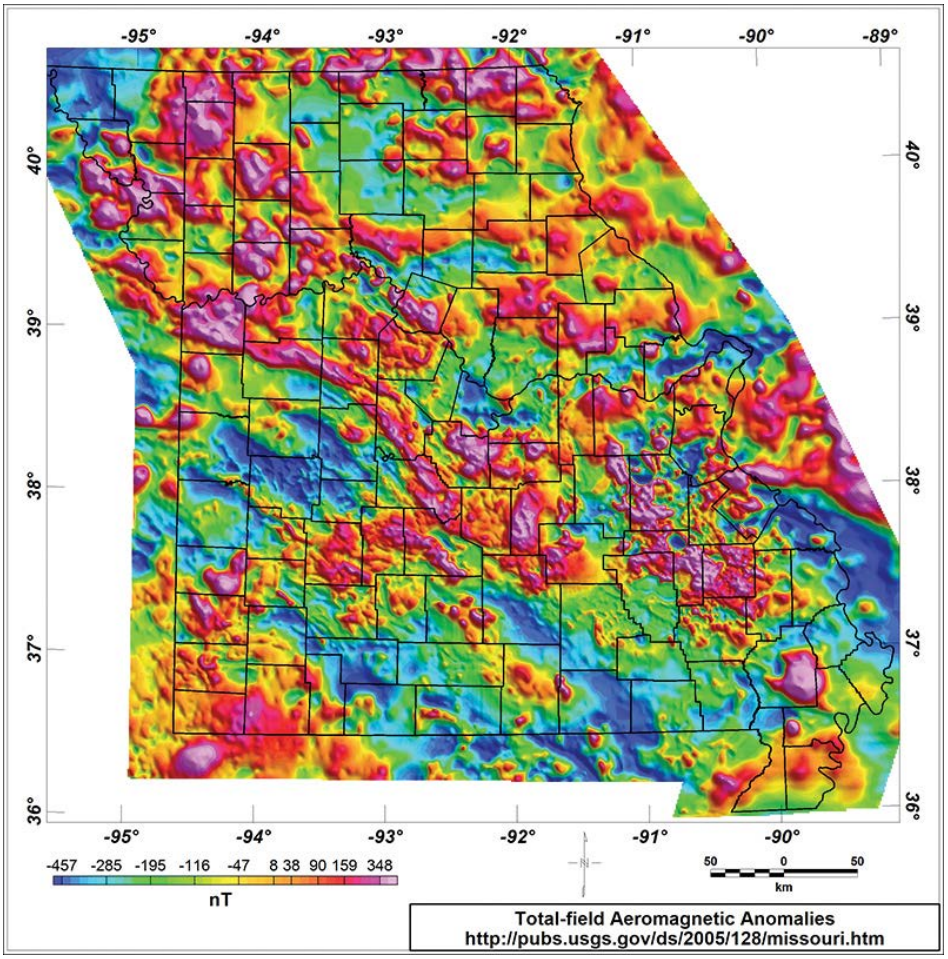
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