Watts Up With That?

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Uniformitarian Impact Craters… "Same as it ever was."

David Middleton / April 25, 2018

Guest essay by David Middleton

Over the past few years (2010-2018), WUWT has featured at least 14 posts on the possibility that the Younger Dryas stadial could have been triggered by an impact event. It's an interesting debate… Proponents of a Younger Dryas impact event have been able to put forward some interesting evidence; however their hypothesis is not yet widely accepted.

One of the things I have noticed in the debates of this subject is that anything short of hailing the Younger Dryas boundary (YDB) as the equivalent of the K-T boundary tends to cause the impact aficionados to wield the words "uniformitarian" and "uniformitarianism" as if they were some sort of logical weapons. Here are a couple of examples from the comments on Don Easterbrook's post on the Younger Dryas:

In a uniformitarian-only world, this conclusion is warranted. But as Stephen J Gould determined in paleontology, evolution isn't one big slow, creeping gradualism. Instead, a punctuated equilibrium shows up in the record. Punctuated equilibrium MUST also apply to geology, no matter how much geologists resist.

[…]

Why geologists insist that Xixcalub was a catastrophe but there hadn't been one since makes little sense. It is not as if they haven't seen a comet cause monumental fireballs on a planet before – in the time of man. In the time of video, even. Was there an impact at the YD onset? Evidence keeps accruing that it did.

Since it is controversial, the old guard will – of course – continue to pull up the uniformitarian spiel and argue that nothing could possibly have happened in the time of Man. That mind set was set in stone the minute Lyell latched onto Agassiz' ice ages: Nothing happens that isn't happening in their 19th century micro-moment in time. Framed within uniformitarian perception, all evidence will, OF COURSE, be seen by the old guard to support their gradualistic memes. What's new? Science has ever been thus. New ideas are

rebutted as long as possible by old frameworks – until the day comes when the old guard dies off – and new blood sees that the new framework answers more questions than did the old.

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And another:

Some of the denials of the YD impact event are getting ludicrous.

There can no longer be any argument that the YDB layer is in fact a global impact layer. There is only one other global stratigraphic horizon with the same assemblage of impact markers; the Cretaceous/Tertiary Boundary layer.

[…]

But to pretend that an impact event of such magnitude had no effect on the climate, or biosphere of this world is absurd. And to leave the old Uniformitarian/Gradualist assumptive theories in the box in the light of this new knowledge doesn't make a lot of sense either.

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These comments simply demonstrate that the authors don't have the slightest clue about the principle of uniformitarianism (more on this subject later).

In one discussion in which I was involved, the blog **A Catastrophe of Comets** was cited as evidence of the Younger Dryas impact hypothesis. The owner, "Crater Hunter," circles up things that he thinks are impact craters on Google Earth images and the rails about *"uniformitarian geologists"* being unable or unwilling to see these obvious impact features because we blindly adhere our outdated principle of "uniformitarianism."

Here are a couple of prime examples:

1. The Mexican Impact Zone
2. The Benavides Impact Feature

The Mexican Impact zone

Three years ago I noticed some catastrophic geology, consisting of thousands of cubic miles of blast melted rock forms in north central Mexico, that, for numerous reasons, could not be confidently explained by volcanism. In what sparse literature you can find about them, they are referred to as the 'Chihuahuan Ignimbrites'.

The geology maps described the materials that had gotten my attention as volcanic tuff, or ‘ignimbrite’ (the word is from the Latin for ‘Fire Cloud Rock’). But in the same way you can visually recognize which way the materials in a flow of spilled paint, mud, or lava, moved while they were liquid, even after they have come to rest, and solidified. In good satellite imagery, the emplacement motions of those rivers of melted stone in central Mexico can be easily read. And It’s when you begin to study the directionality of the fluid emplacement motions of those pyroclastic materials that you run into a mystery.

At this altitude you can’t easily determine the condition, or the actual patterns of movement, and flow, in the impact melt.

[…]

A fundamental characteristic of the formation, and emplacement of a fluid density current, is violent, explosive motion. And when you zoom in close anywhere in that area, and you study the perfectly pristine ejecta, breccias, and rivers of flash melted stone, the easily discernable patterns of emplacement motion are all consistent with very quick motion like ejecta in an impact event.

The landforms rising among the pristine rivers of melted stone weren't heavily eroded for millions of years. They were heavily ablated a few thousand years ago in a giant, multiple fragment, thermal airburst, event that lasted just a few seconds.

The materials described here, and on the page I've labeled A Thermal Airburst Impact Structure are the pristine product of that ablation.

[…]

Crater Hunter, 24 April 2010

There is nothing mysterious about the "Chihuahuan Ignimbrites." Nor is there any possibility that they occurred recently, the rhyolitic eruptions from which they were sourced occurred in the Mid-Tertiary…

Petrogenesis of voluminous mid-Tertiary ignimbrites of the Sierra Madre Occidental, Chihuahua, Mexico

Maryellen Cameron, William C. Bagby and Kenneth L. Cameron

Abstract

The mid-Tertiary ignimbrites of the Sierra Madre Occidental of western Mexico constitute the largest continuous rhyolitic province in the world. The rhyolites appear to represent part of a continental magmatic arc that was emplaced when an eastward-dipping subduction zone was located beneath western Mexico.
In the Batopilas region of the northern Sierra Madre Occidental the mid-Tertiary Upper Volcanic sequence is composed predominantly of rhyolitic ignimbrites, but volumetrically minor lava flows as mafic as basaltic andesite are also present.

[…]

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Major ignimbrites and volcanic centers of the Copper Canyon area: A view into the core of Mexico's Sierra Madre Occidental

Eric R. Swanson, Kirt A. Kempter, Fred W. McDowell and William C. McIntosh

Abstract

Reconnaissance mapping along Copper Canyon highway has established ignimbrite stratigraphic relationships over a relatively large area in the central part of the Sierra Madre Occidental

volcanic field in western Chihuahua, Mexico. The oldest ignimbrites are found in the central part of the area, and they include units previously mapped from north of the study area, in and around the Tomóchic volcanic complex. Copper Canyon, at the southern end of the study area, exposes younger units, including the intracaldera tuff of the Copper Canyon caldera and five overlying ignimbrites. Well-exposed calderas are found near San Juanito, in the central part of the map area, and at Sierra Manzanita, to the far north. Stratigraphic evidence for yet another caldera in the northern part of the area is found in the Sierra El Comanche. The stratigraphic and limited available isotopic age data suggest that volcanism was particularly active ~30 m.y. ago. This reconnaissance survey also documented lava-flow lithologies consistent with previous observations from Tomóchic that intermediate lavas have erupted throughout that area's volcanic history and that basaltic andesite became particularly abundant as felsic volcanism waned.

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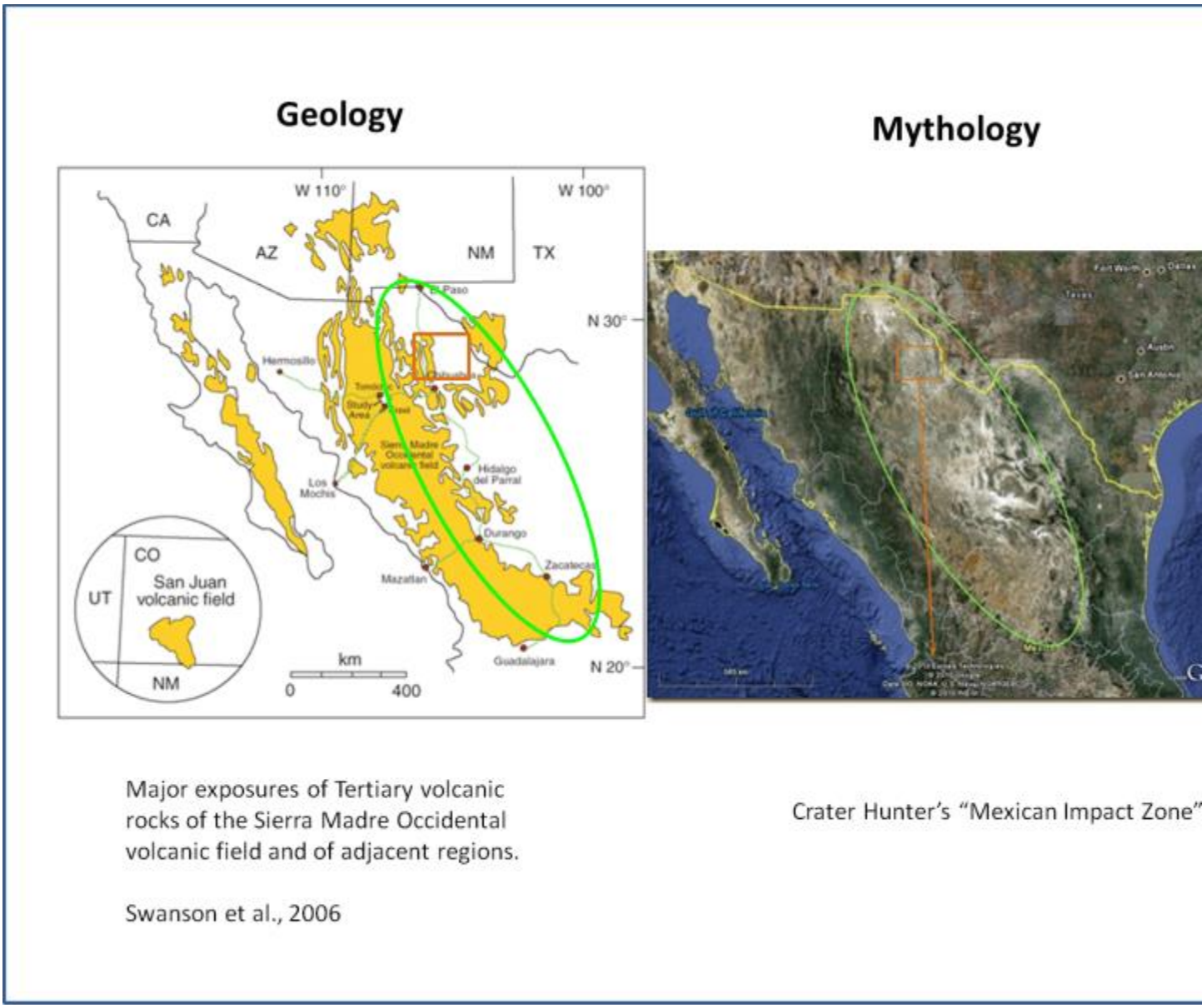
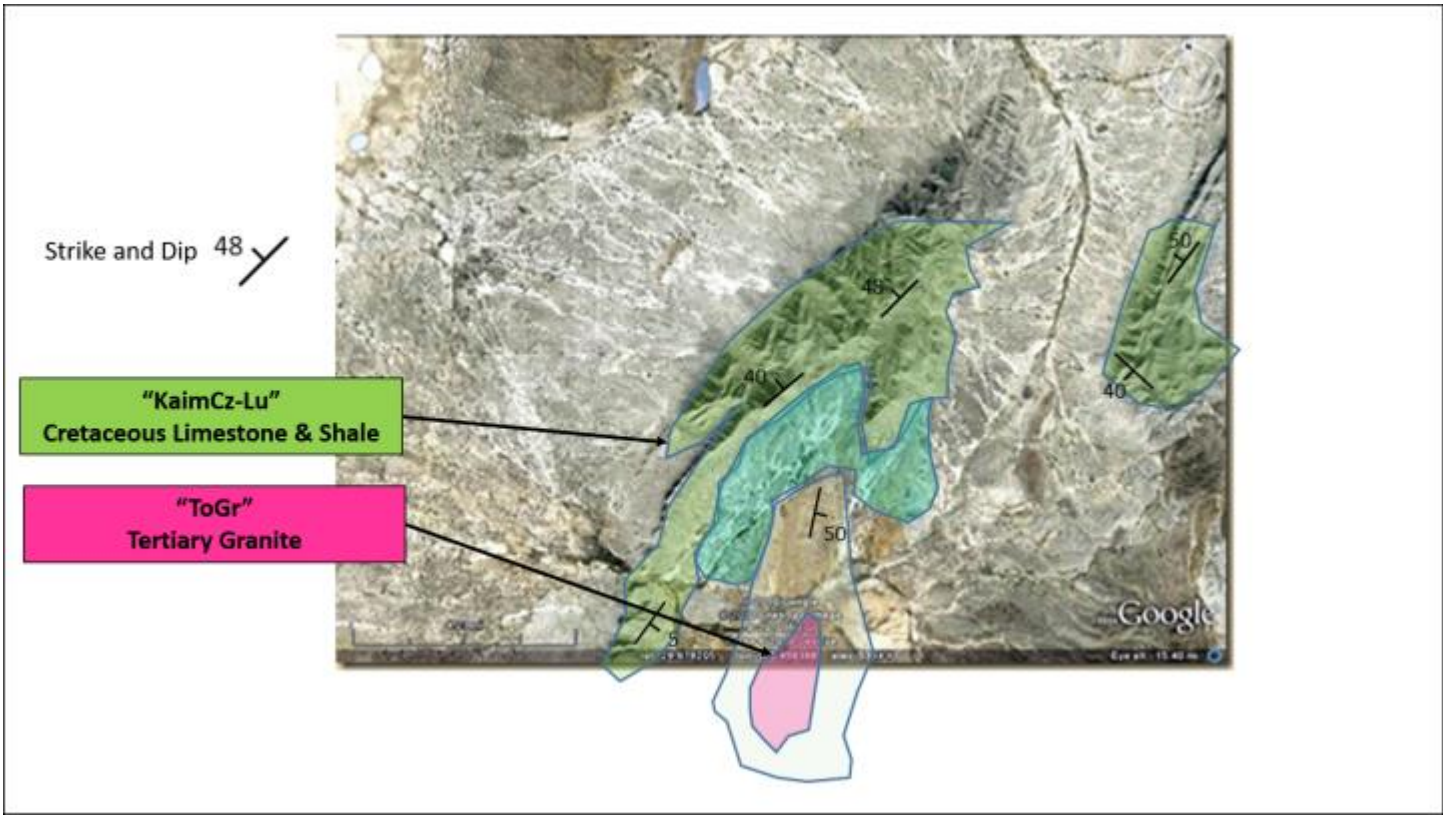
Even if the mid-Tertiary ignimbrites of the Sierra Madre Occidental of western Mexico were caused by an extraterrestrial impact event, they would have occurred ~30 million years prior to the extinction of the North American megafauna. The Chihuahuan Ignimbrites aren't even remotely related to a possible impact event within the past few thousand years and the features identified as "the pristine radial outwards flowing pyroclastic density current surrounding the mountain a couple of hundred miles away," were a series of ridges composed of Cretaceous limestone and shale.



This region of Mexico was over a subduction zone during the Tertiary. The region is rife with intrusive and extrusive Tertiary-aged igneous rocks and Cretaceous sedimentary rocks.

Crater Hunter seemed to be focused on a lineation that he claimed was part of "the pristine radial outwards flowing pyroclastic density current surrounding the mountain a couple of hundred miles away." As nearly as I could tell, he thought the NE-striking lineation in the image below was part of a recent radial pyroclastic flow…

A quick look at a geologic map of the region shows that the lineation is a ridge composed of NW-dipping Cretaceous-aged limestone & shale.



Schematic representation of geologic map of the area. The strike and dip symbols indicate the azimuth (strike) of the structure and the angle at which the formation is tilted (dip). The symbol in the legend indicates a strike of N 45° E and a dip of 48° to the NW. This is a very steep dip.

There are lots of volcanic and igneous outcrops in the area… All of them of Tertiary age and most rhyolitic or granitic… None of them are even remotely associated with impact-related geology and "the pristine radial outwards flowing pyroclastic density current" isn't even part of the Chihuahuan Ignimbrites. They are ridges composed of Cretaceous limestone and shale.

On to the Benavides Impact Structure…

The Benavides Impact Structure

A large, multiple airburst, geo-ablative impact structure.

The semi circular ring of The Benavides Impact Structure is 17 miles wide. Just across the border from Terlingua, Texas, and Big Bend National Park, USA.

[…]

The melted material did not come out of the ground. There is no vent, magma chamber, or any volcanic system whatsoever. The blankets of melt, and ejecta, consist of the original surface terrain, flash melted from above, and quickly blown away, from its points of origin.

[…]

As for the age? That remains to be determined. But, as you can see for yourself, since the moment of their emplacement, these splashes of ejecta, and impact melt, have not undergone any significant weathering at all. What ever else they are, those pristine ejecta curtains are not old at all.The maps show this area to be volcanic due to the melt formations. But don't you believe it. There is no volcanic vent here.

[…]

Most uniformitarian geologists agree that terrestrial volcanism is the only possible source of enough heat, and pressure to melt rocks on the Earth. And most of them don't believe in impact events. I disagree with both of those assumptions.

But you can't have a 'vent' without a magma chamber to vent from. And there is no seismic, ground penetrating radar, aeromagnetic, or any other data that describes a magma chamber under the Benavides structure. There is also no convincing explanation in the literature for the crazy mantle physics required for a 25 kilometer diameter, perfectly circular, "hinged trap door" vent.

And, at 60 bucks for a copy of the map, I'm not buying any.

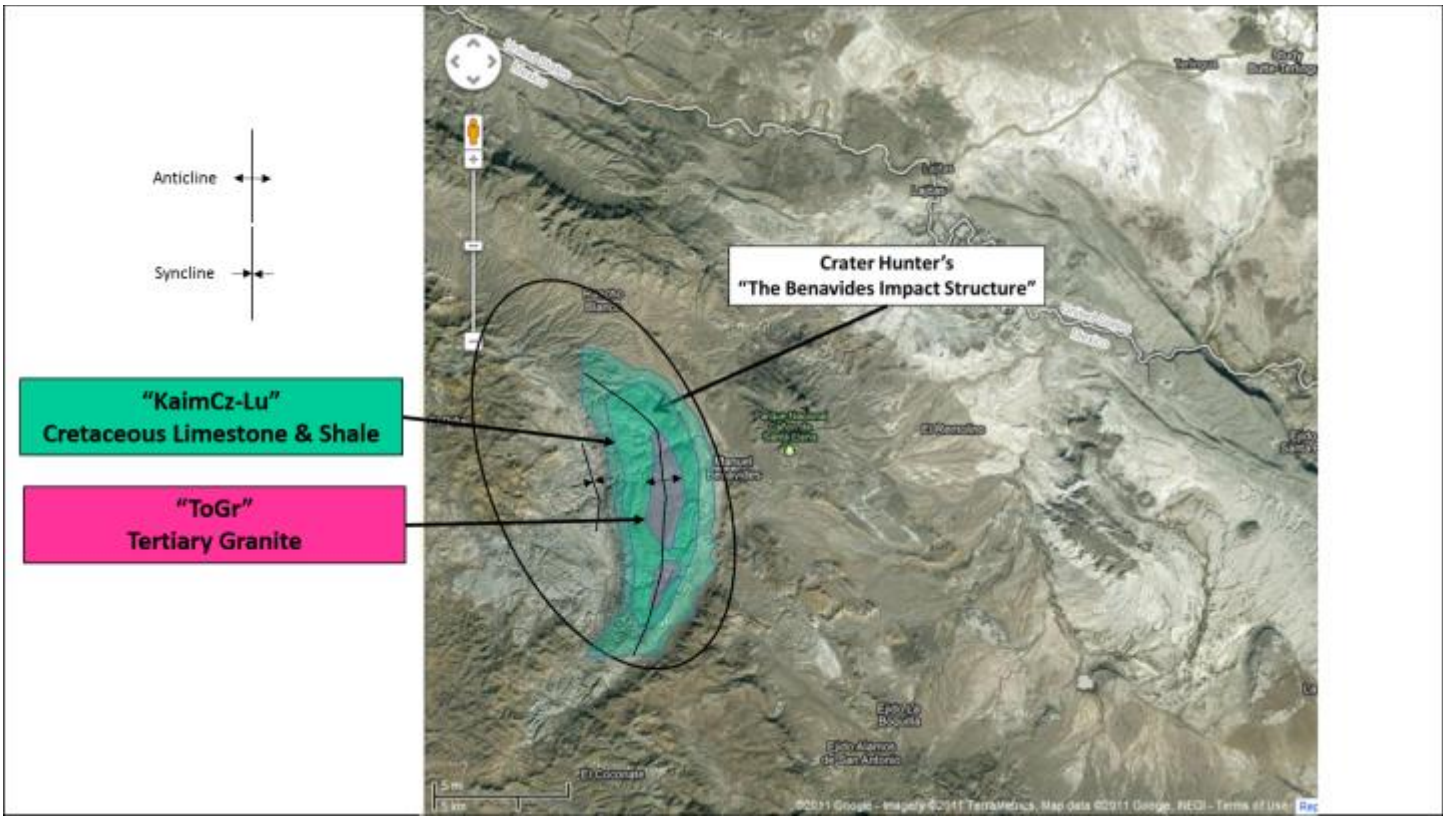
[…]

Crater Hunter, 28 December 2009

The geologic maps of the area are free, if you know where to look and read a little Spanish. Since the terms of usage prohibit reproducing the maps, I have just sketched schematic representations of the geologic maps over key portions of Crater Hunter's impact fantasies.

"The semicircular ring of The Benavides Impact Structure" is a granite-cored anticline…

Geologic map of the Benavides area…



Schematic representation of Benavides area geologic map. Original geologic maps available form sgm.gob.mx.

Granite is an intrusive igneous rock – It didn't erupt. It was emplaced ~30 mya during the mid-Tertiary. It intruded into a section of Cretaceous carbonates and marine shales that were deposited ~90-120 mya. The rocks dipping away from the Tertiary-aged granite intrusion are composed of Lower Cretaceous limestone and marine shale. There are also some extensive Tertiary-aged andestite lava flows to the east of the anticline.

These rock outcrops are not pristine… 10's of millions of years' worth of section have been eroded from this area. The areas that I think he is describing as ejecta fields are among the youngest rocks in the region. These are mostly Quaternary polymictic conglomerates… Consolidated piles of angular, chunky rock and dirt that have been eroded from the cuestas and other positive features over the last few 10's to 100's of thousands of years. This area doesn't get a lot of rainfall; but when it does get rain, it rains torrentially. The v-shaped notches were cut by running water. These intermittent streams (arroyos) are only active during the brief periods of heavy rain. The rock fragments eroded from the ridge-lines remain angular and large because they are only transported a short distance before the arroyo dries up.

As for there being no "vent, magma chamber, or any volcanic system whatsoever"… The region is riddled with vents and magma chambers. The outcrops of intrusive igneous rocks (granite, syenite, porphoritic andesite, etc.) are the surface expression of eroded batholith-type and other

intrusive features… They are ancient magma chambers. During the Tertiary, this area was directly over an active subduction zone.

Geologists actually went out there and looked at the rocks. They measured strikes and dips. They collected samples of the rocks for mineralogical analyses and then, they actually mapped the geology.

They didn't sit at home and draw pictures on Google Earth images.

This Crater Hunter comment is truly uniformed, *"Most uniformitarian geologists agree that terrestrial volcanism is the only possible source of enough heat, and pressure to melt rocks on the Earth. And most of them don't believe in impact events. I disagree with both of those assumptions."*

This brings us to the actual point of this post: Uniformitarianism.

Every geologist I've ever met, went to school with or have worked with knows what an astrobleme is.

- Here's a real impact crater… Barringer Meteorite Crater.
- Here's a possible astrobleme… Upheaval Dome.

Upheaval Dome is fascinating. Geologists with extensive experience studying impact features conclude that it is an astrobleme (eroded remnant of a meteoroid or asteroid impact crater). Geologists with extensive experience in salt tectonics tend to conclude that it is the eroded remnant of a "pinched-off salt diapir". The late Eugene Shoemaker was probably the foremost expert on impact features and he was certain that Upheaval Dome is an impact feature. Martin Jackson, with the Texas Bureau of Economic Geology, is probably the foremost expert in salt tectonics and he was certain that Upheaval Dome was a salt tectonics feature. Both hypotheses are the result of geologists employing the principle of uniformitarianism.

How could uniformitarianism "blinded" geologists confirm the impact origins of Barringer Meteorite Crater or allow for a debate about the origins of Upheaval Dome? In the case of Upheaval Dome, either method of formation would be an oddity… An oddity that may just merit a future detailed post.

Uniformitarianism

The layman's misunderstanding of uniformitarianism is at the core of this issue.

UNIFORMITARIANISM VS CATASTROPHISM

Initial thinking on earth history was inspired by the bible. The recognition that major rock series are characterized by a distinct set of fossils lead to the belief that the fossils of each rock series were result of a creation and then were subsequently destroyed by some catastrophic event (e.g. the biblical flood). The main proponent of this theory was the French naturalist Georges Cuvier.

In the 18th century there was even a case when some unfortunate geologist (Johann Jacob Scheuchzer, 1672-1733) found skeletons of giant salamanders and identified them as the victims of the biblical flood. The problem was that upon close inspection, these flood victims had long tails and sharp claws. Thus, it earned the proponent quite a bit of ridicule. Generally speaking, this way of looking at the geologic record, namely to assume that a series of immense, brief, and worldwide upheavals changed the earth greatly and produced mountains, valleys, and various other large scale features, came to be known as **catastrophism.**

The theory of catastrophism was challenged by James Hutton in the late 18th century, who in his theory of **uniformitarianism** proposed that uniform gradual processes (such as for example the slow erosion of the coast by the impact of waves) shaped the geologic record of the earth over an immensely long period of time. He assumed that the acting processes were the same than those that we see in action at present (rivers, volcanoes, waves, tides etc.). Darwin later on based his theory of the origin a species on Hutton's theory.

The sedimentary structures that we saw earlier in this lecture serve as a good illustration how uniformitarianism works. Cross-bedding for example can be observed to form in modern river channels and also in experimental setups called flumes. We learn from these observations what kind of current velocities are needed to produce cross-bedding in a given grain size, and we realize that cross-bedding can be used as an indicator of current flow direction. We can apply what we learn from modern cross-beds to interpret the rock record in terms of flow velocities and flow direction. Likewise, finding ancient equivalents of modern mudcracks suggests to us that we look at sediments that dried out beneath the air, and were thus deposited on land.

In more modern times, some amendments have been made to the theory of uniformitarianism. One of these would be that it was recognized that catastrophic events are as much part of geologic history as the uniform action of the everyday processes. For example, sediment supply to the oceans is not a constant flux of matter. There is a considerable episodic component to sedimentation, e.g. storms are major agents of sediment redistribution in shelf seas, floods and exceptionally strong rains are responsible for most of the erosion and sediment redistribution on the continents. Undoubtedly, the physical and chemical principles (e.g. gravity, thermodynamics) that govern geologic processes of the present have also applied in the past. Yet as is visible in the present, frequent small deviations from equilibrium and unstable behavior (minor catastrophes, such as earthquakes, floods, storms) must have been an integral part of these processes. Similarly, the evolution of life was not a single succession of tiny evolutionary steps as originally envisioned by Darwin. We are now able to see that there were episodes of accelerated (punctuated) evolution, usually as a response to a change in environmental conditions, such as climate (ice ages, warming of the earth), the advent or immigration of new predators and the utilization of new food sources. Extremely rare (and catastrophic) events, such as the impact of large meteors, may have had a profound influence on our planet. Yet meteors fall onto the earth on a daily basis, just as it rains every day. In that sense, meteorite impacts are quite normal and part of the spectrum of everyday processes. Only very rarely does a "doomsday" meteorite that is 10 or more km in diameter hit the Earth and cause severe disruptions. To sum it up: The natural laws do not change with time and they have and will determine interior and external processes of the earth. Even the extremely rare event (e.g. meteor impacts) is part of the many geologic processes governed by these laws. Even though something,

like for example the December 2004 tsunami, appears to us as a unique catastrophe, over the long run it is a normal and recurring event. It does not follow, however, that the rate of geologic processes is the same today as it was in the past. Some processes, such as mantle convection do probably stay stable over long time periods, but others, such as glaciation were at times very intense in the past (ice ages), but are presently less significant for continental erosion. So, **a brief definition of Uniformitarianism would be: the natural laws that govern geologic processes have not changed over geologic time, but the rate at which certain geologic processes operate can vary**. Uniformitarianism also has been paraphrased as "**The Present is the Key to the Past**".

Indiana University

Uniformitarianism doesn't preclude catastrophic events; nor does it stipulate that all processes must occur at a constant gradual rate. And it certainly doesn't blind geologists to actual evidence of impact features. Many of the world's 190 confirmed impact craters (technically 189 because they count Upheaval Dome as confirmed) would be unknown if not for geologists employing uniformitarian methods to identify them. 34% of the confirmed impact craters are not exposed at the surface. 53% of the confirmed impact craters have been drilled, either intentionally or inadvertently while drilling for something else. The craters without surface expressions were identified by uniformitarian geologists/geophysicists interpreting geological and geophysical data.

Uniformitarianism says "The Present is the Key to the Past." Understanding present day geological processes enables geologists to decipher the geologic past.