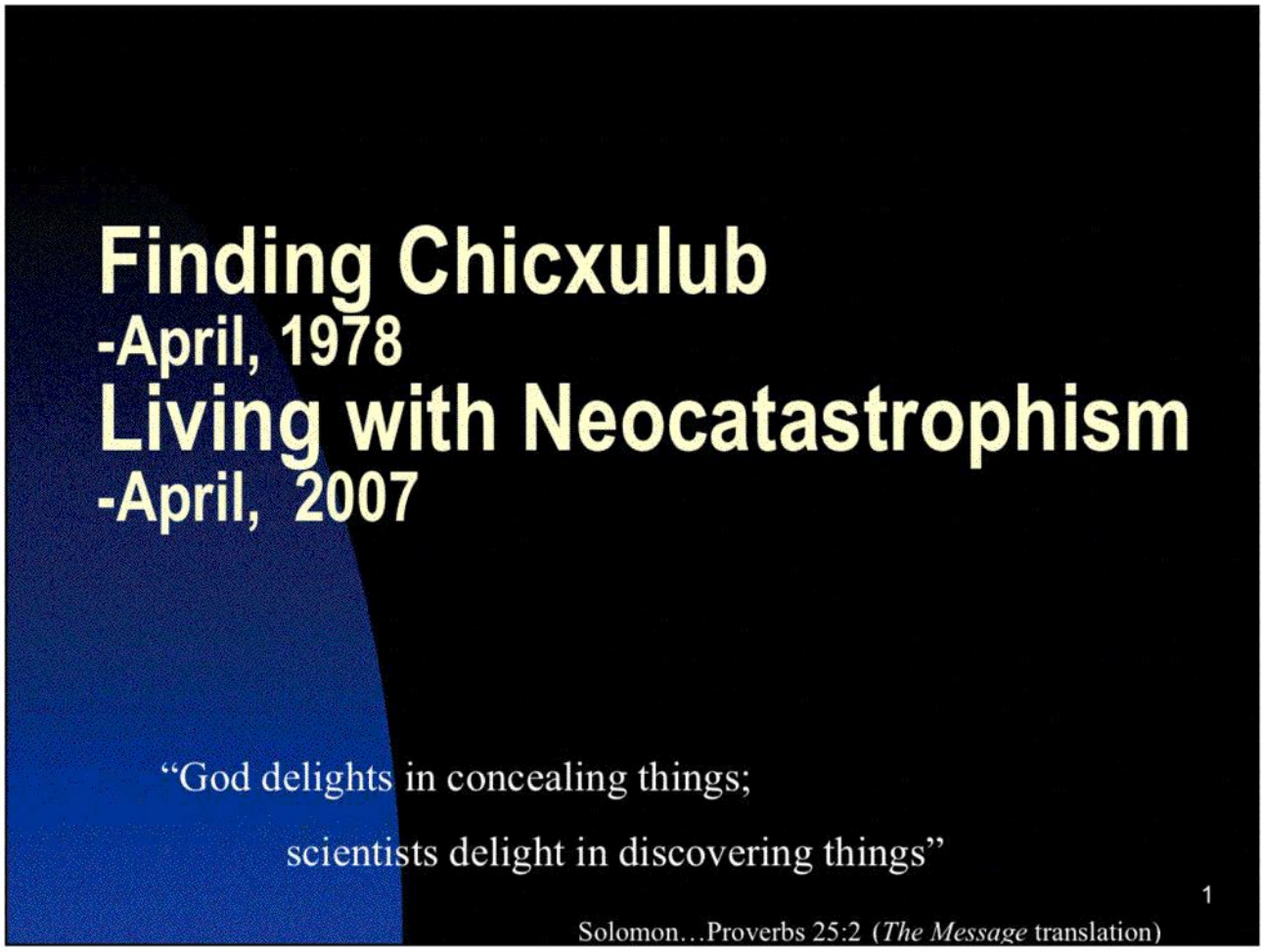

This talk was originally given in April 2007 as an invited lecture at Santos Americas Ltd. in Houston, Texas. Unless otherwise credited on individual figures, all figures are from the Univ. of Arizona website.

Finding Chicxulub
-April, 1978
Living with Neocatastrophism
-April, 2007

- The Surprising story of how the Chicxulub crater was found before anyone was really looking for it in April 1978.
- And how 29 years on….crater recognition, NeoCatastrophism, impending impacts, and planetary defense became topics of nearly universal interest.

Part one: Finding Chicxulub

- What the Chicxulub impact was and what it did - current consensus view
- What were the techniques/tools used in the discovery – with a comment about today's visualization tools and new geophysical technologies
- The 'politics' of discovery – "Success has 100 parents, failure is an orphan" *American Proverb*

Outline of Part 1

Outline of Part 2

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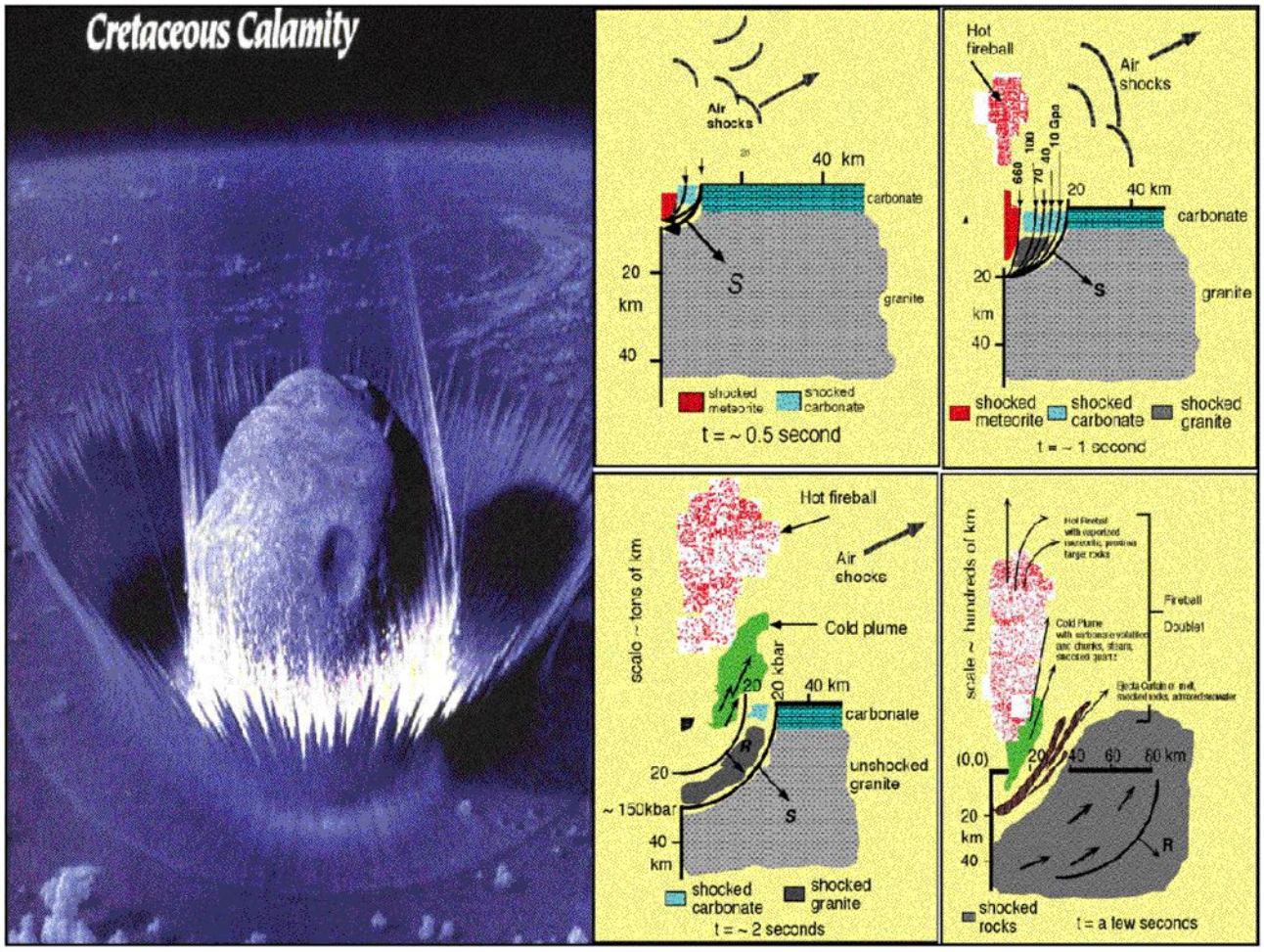
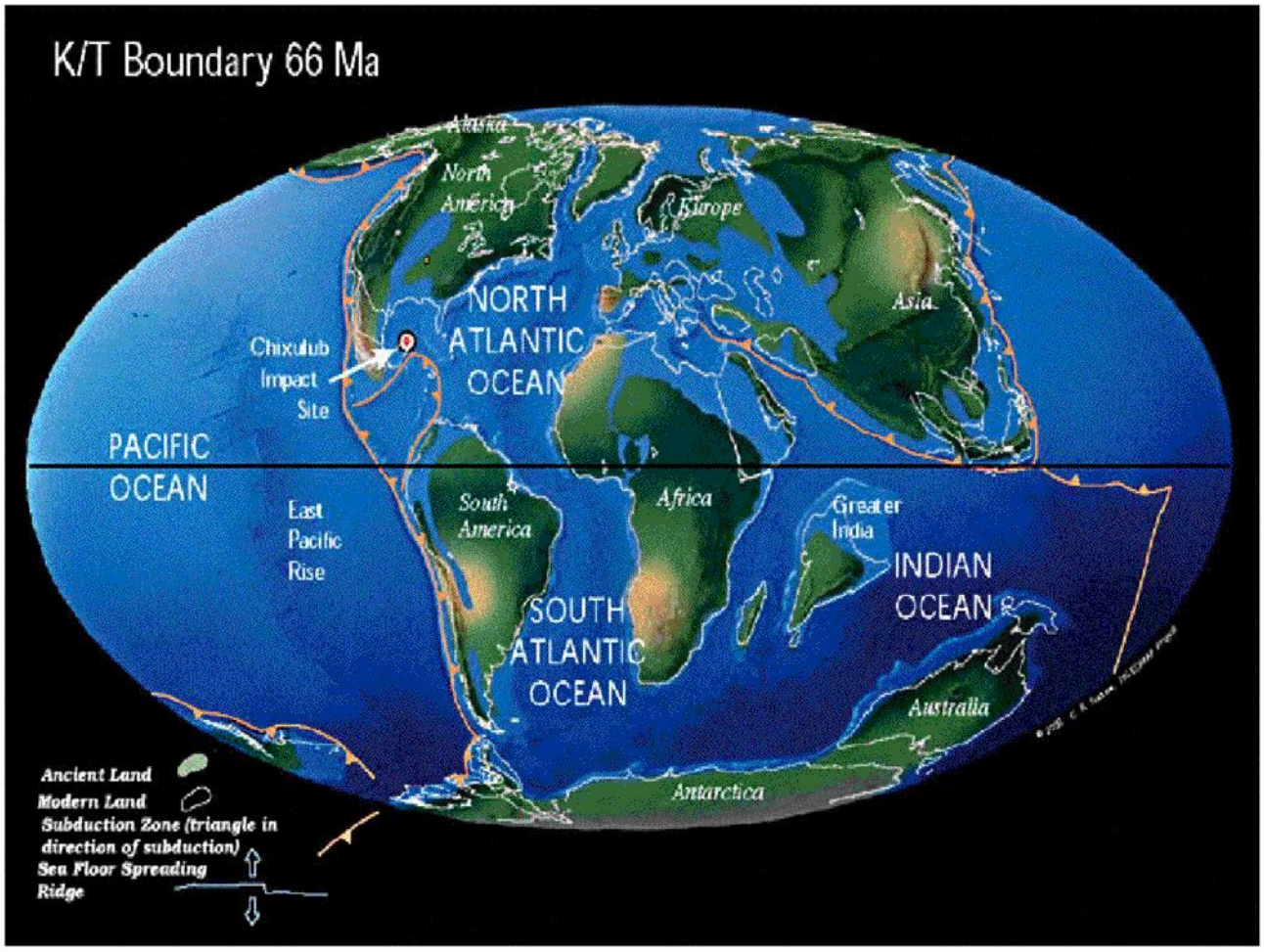
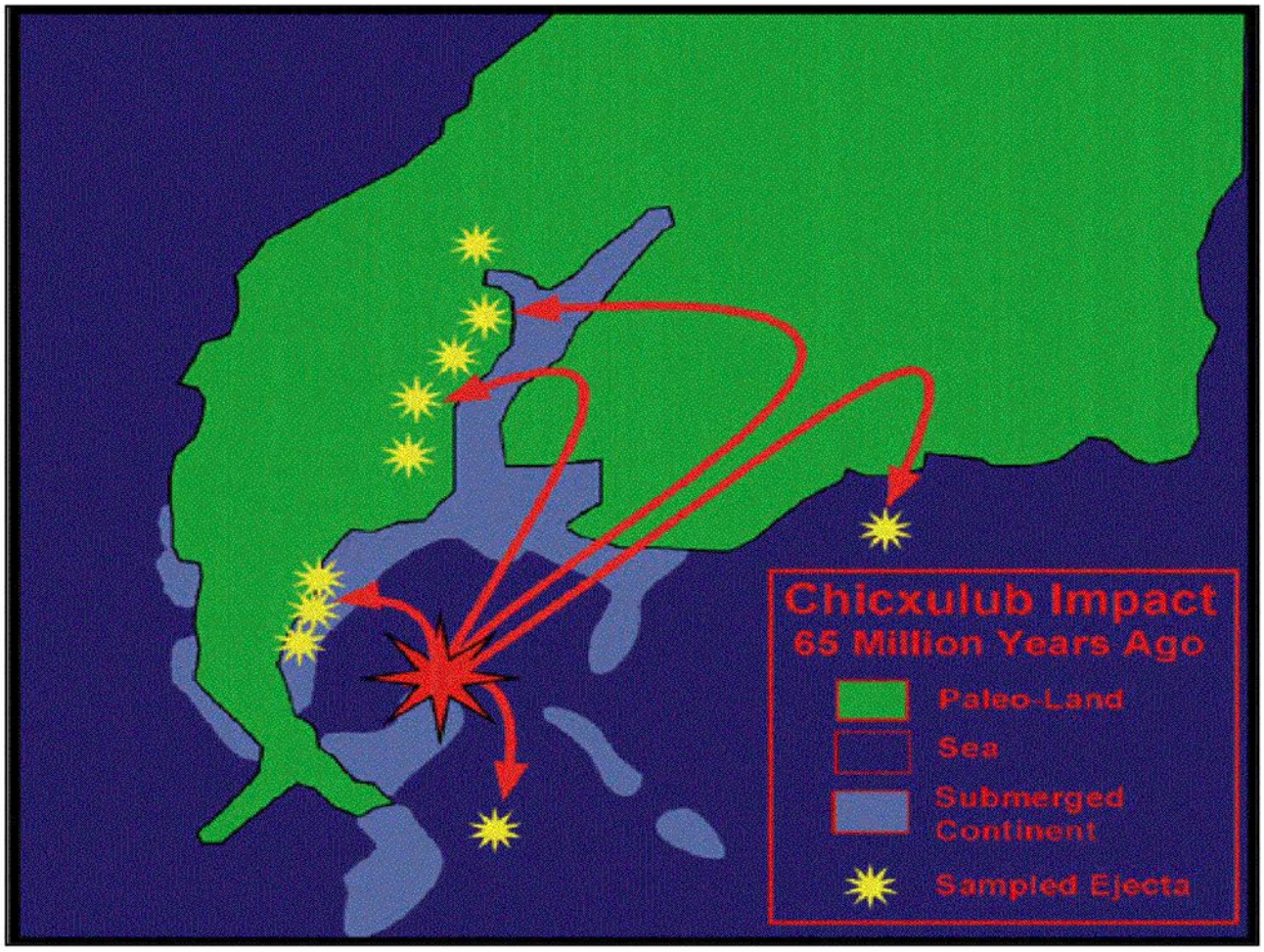


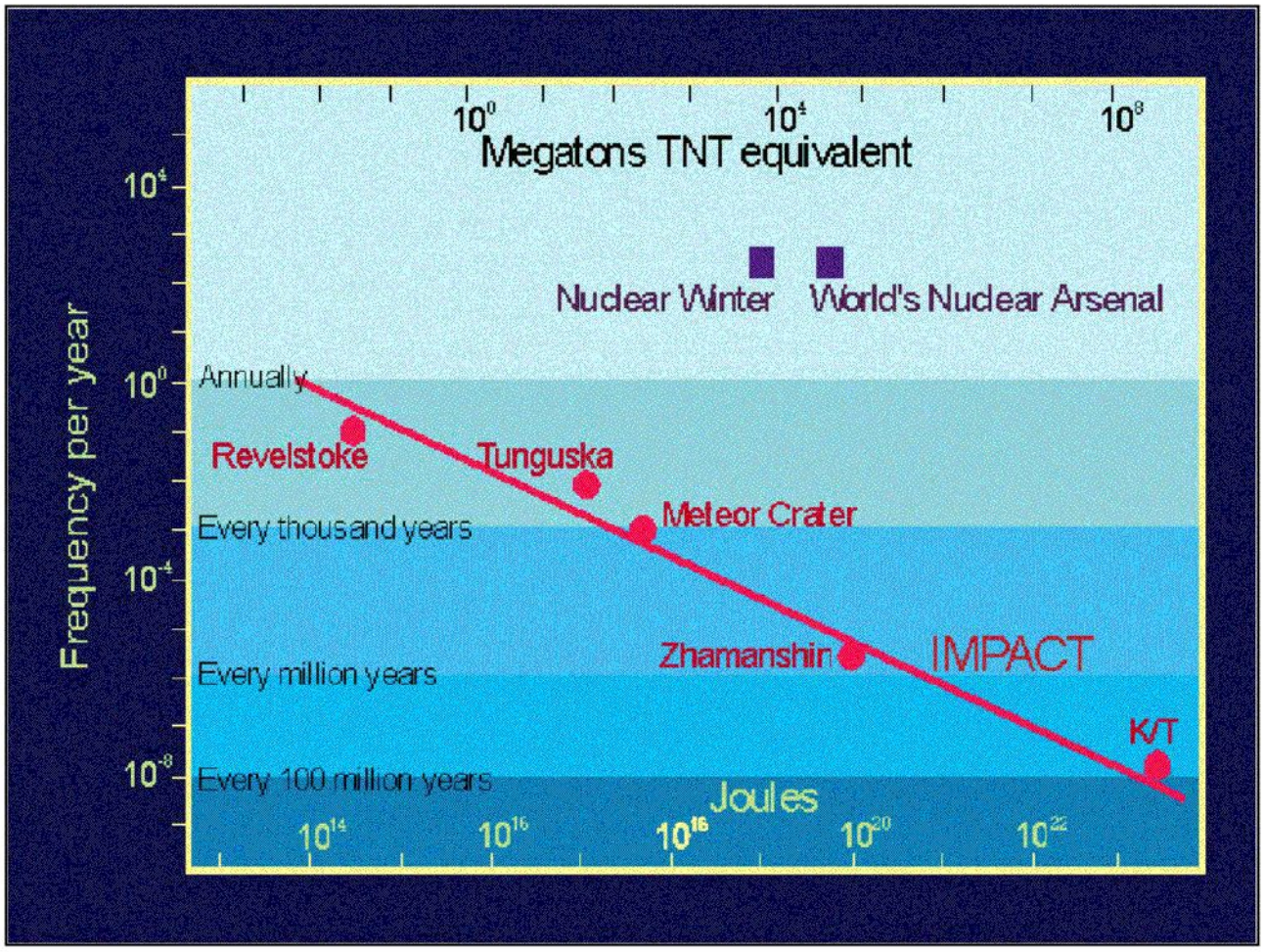
The effect of a 10km diameter impactor moving at perhaps 50,000km per hour hitting a target with 5km of carbonate sedimentary rocks covering igneous and metamorphic basement rock. The atmosphere is traversed in <2sec and the impactor creates a 35 km deep instantaneous crater which collapses to a 180km diameter.



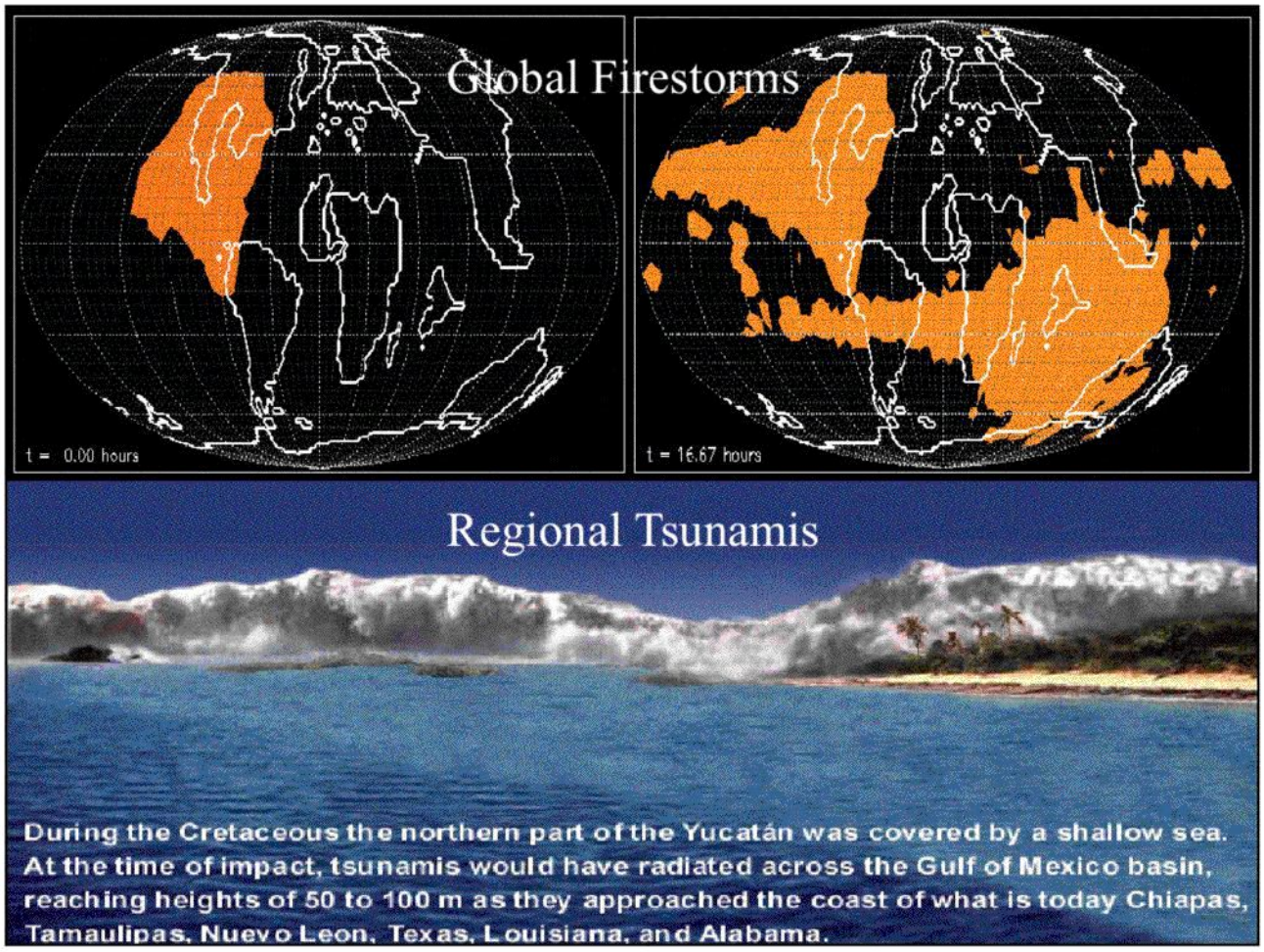
The impact site is a stable shallow water carbonate shelf similar to todays Florida and Bahamas area. Tsunamis have access to large parts of North America and leave distinctive beds.



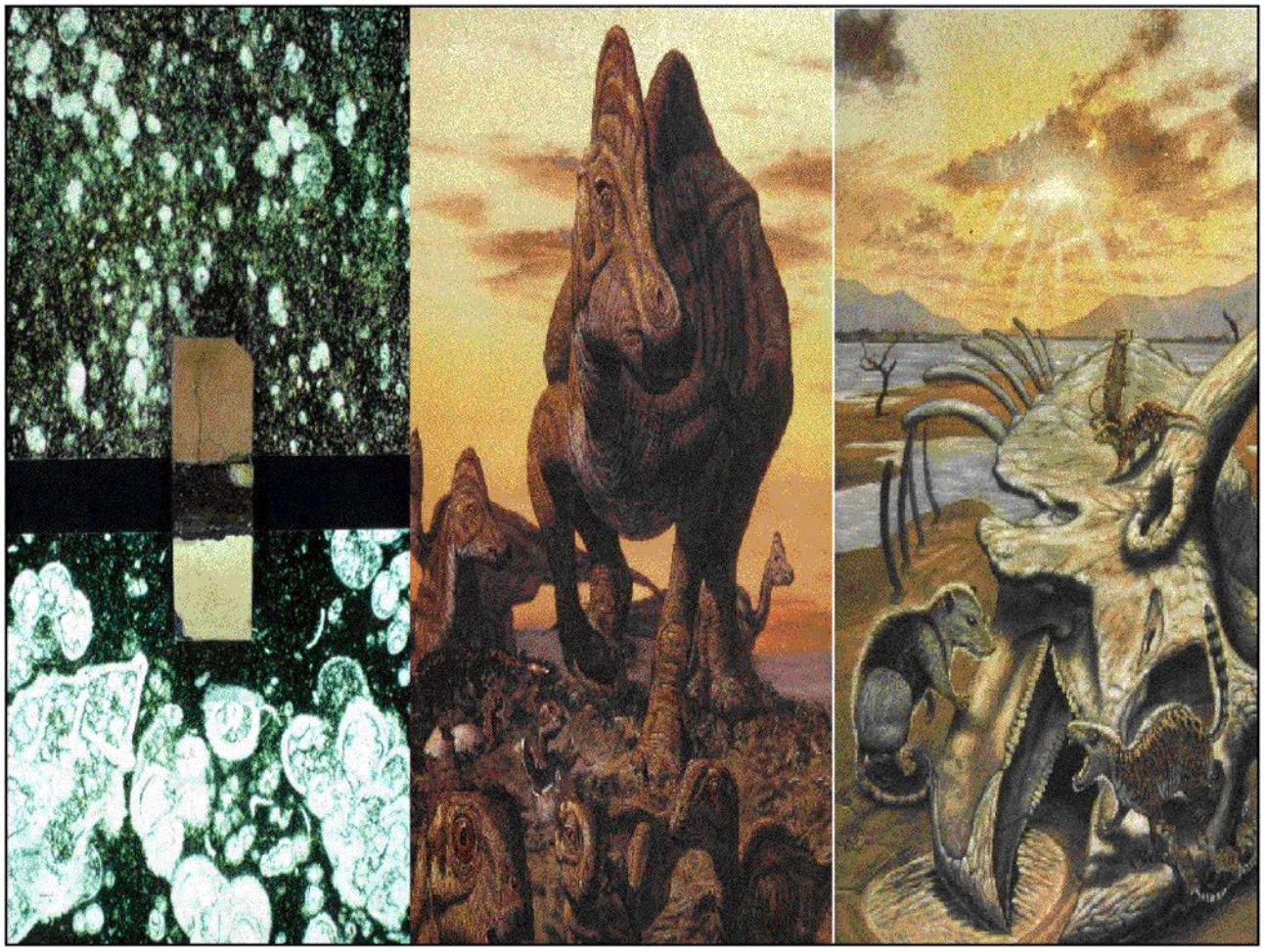
Airborne ejecta deposits are thicker in North America, but exist almost worldwide.



The energy release is 4 orders of magnitude (10000 times) greater than all the worlds nuclear arsenal detonated at once! One million times greater than the energy released at meteor crater in Arizona! Such events are estimated to occur about every 80-100 million years.



A global firestorm from hot ejecta propagates around the earth in 17 hours. Regional Tsunamis with heights of 50 to 100 meters cover much of the North American coast.



The event leaves a distinct synchronous marker bed enriched in Iridium around much of the earth and a dramatic changes in the fossil record above and below the event. The end of the age of dinosaurs being one of the most notable probable effects.

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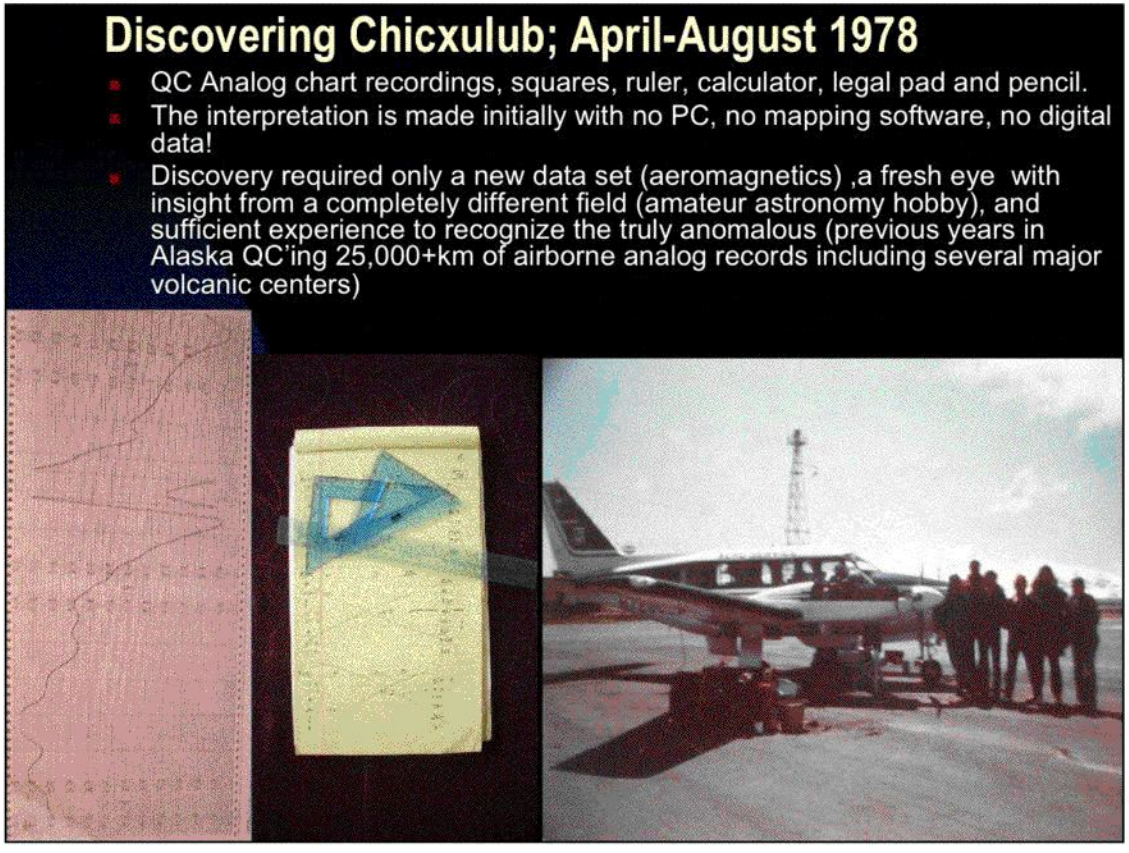
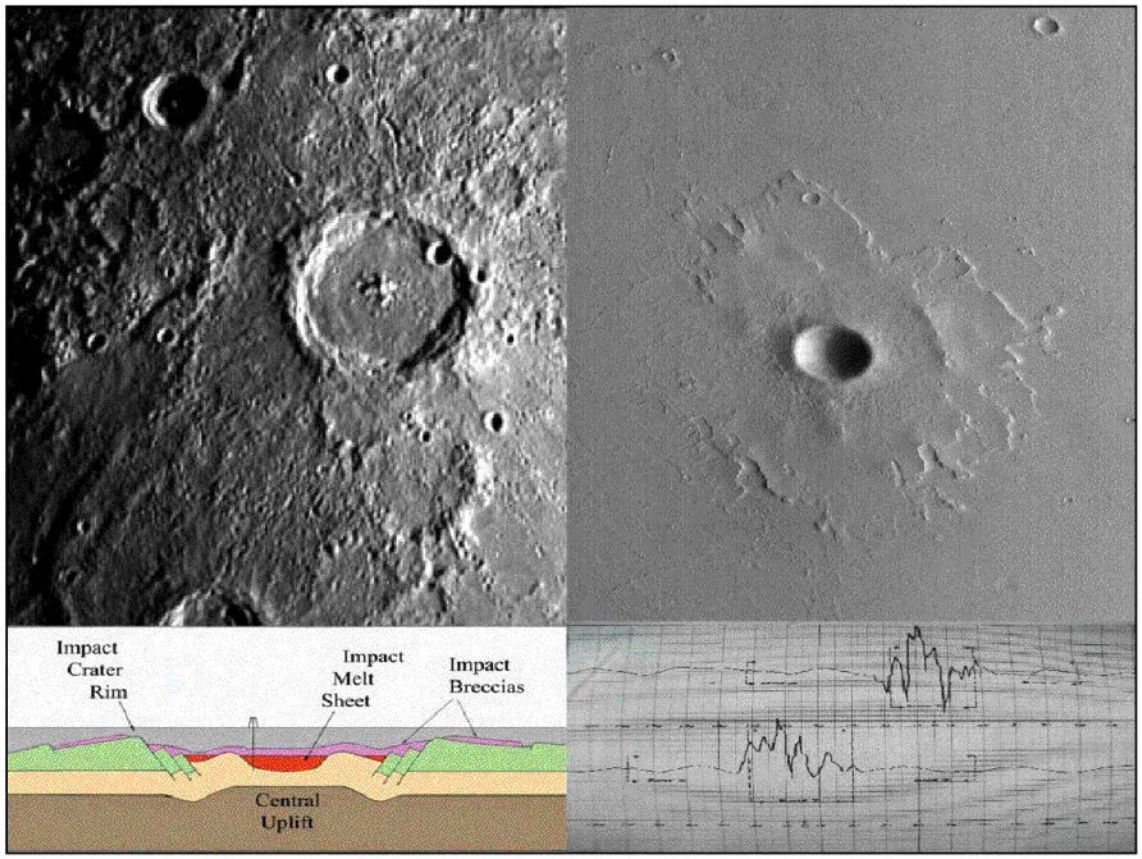
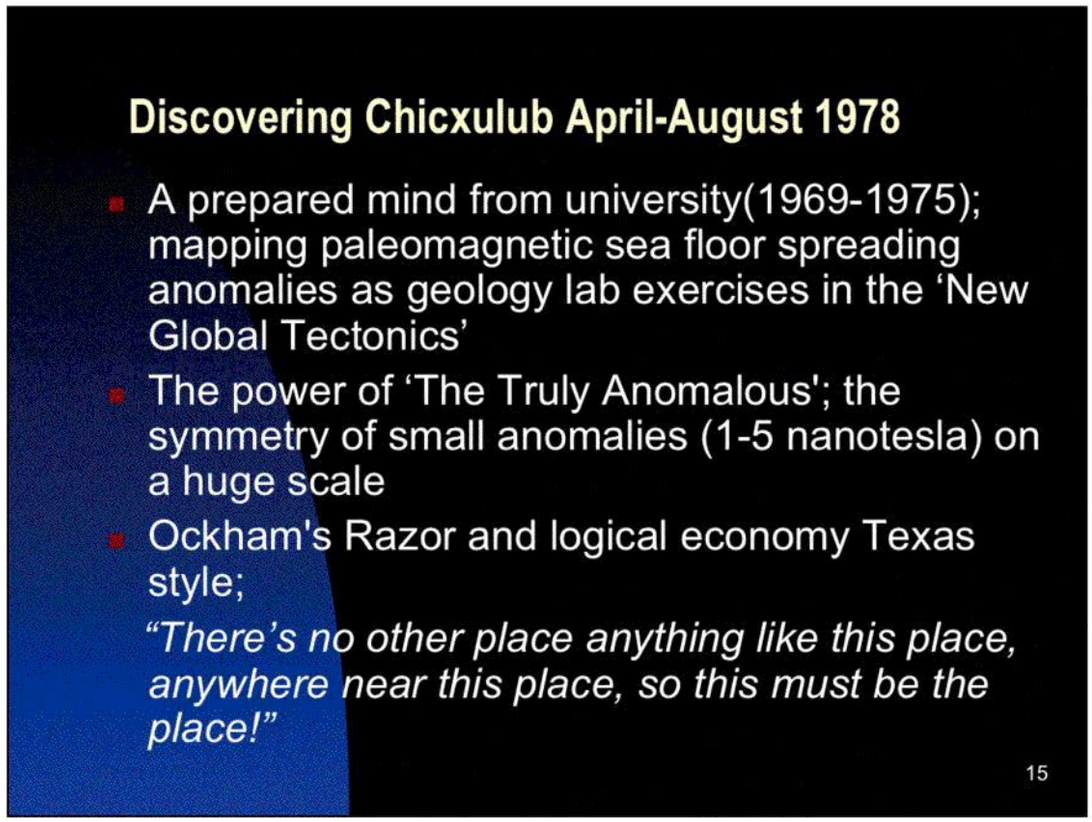


Two years before the Chicxulub discovery (1976) I spent three months in Alaska as a field geophysicist surveying the Bering Sea Basins with an airborne magnetometer crew for the Aero Service division of Western Geophysical company. This was done from bases of operation on the Pribilof islands and Cold Bay on the Aleutian Peninsula. I would examine airborne and ground station diurnal magnetic records from chart recorders for data quality issues such as avoiding flying during magnetic storms. We flew over a number of major volcanic centers so I became very familiar with the magnetic signature of numerous examples of both buried and outcropping volcanoes. This would allow me to recognize almost immediately that the Chicxulub feature I found in 1978 was certainly not simply a volcanic complex as conventional wisdom and existing well data suggested to both PEMEX and NASA. I am second from the left in the crew photo.



A childhood interest in amateur astronomy, led me to carry a small Celestron telescope with me wherever I went on geophysical surveys. I wondered what the magnetic signature of a major crater into a uniform two layer geologic target (non-magnetic carbonate sedimentary rock and deeper igneous basement rock would look like. Most recognized large craters on the earth are in ancient exposed basement shield areas with pre-existing and often complex magnetic fabrics of their own. The Chicxulub signature is much simpler and more perfect. This image shows large Lunar and Martian craters; a 200km peak and ring crater on the left and a 40km crater with a large ejecta blanket outside the crater wall. The magnetically clean Yucatan rocks allowed me to recognize not only the high amplitude magnetic anomalies associated with the uplift and impact melts but very low amplitude micromagnetic anomalies associated with the impact breccia sheets. In May of 1978 when the field survey was about 50% complete, I had an “Ah Ha” moment when I realized I was looking at the magnetic signature of a nearly perfectly preserved 180km+ crater.



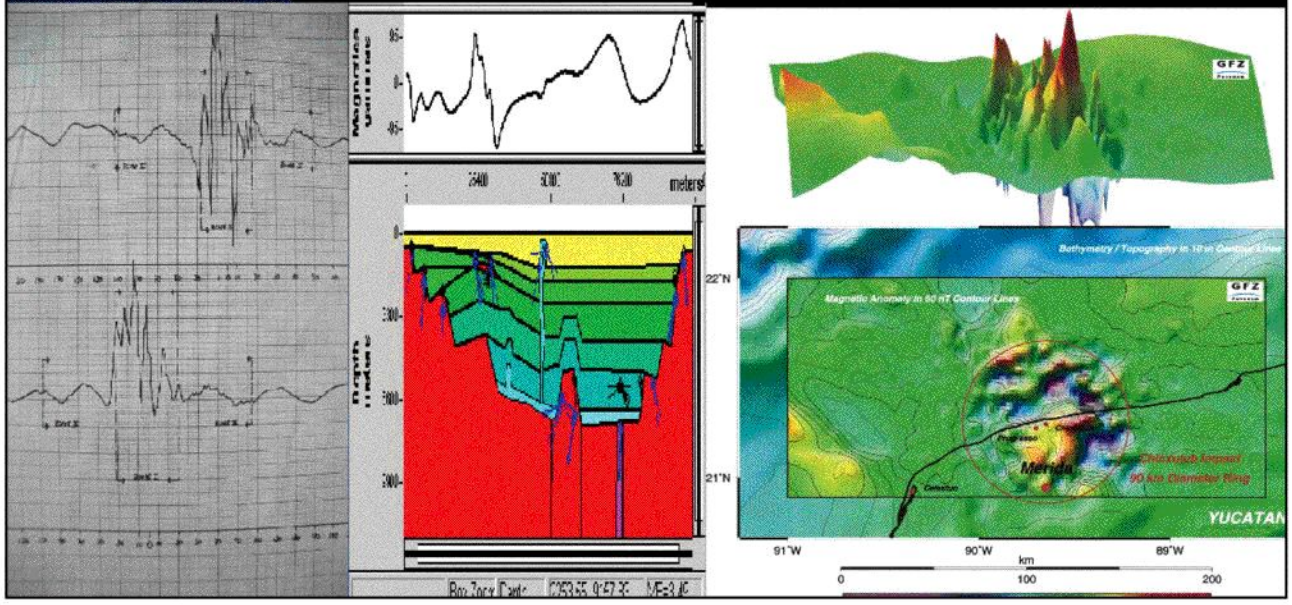
1.My college geologic training at The College of Wooster and Oberlin College (1969-1975) coincided with the beginning of widespread teaching of the new plate tectonics paradigm. Seafloor spreading magnetic anomalies were an important part of this new model.

2.The symmetry of the small anomalies I recognized on the analog chart records was unlike anything I had seen elsewhere in the world. I had by then geologically interpreted about 60,000 line km of magnetic data in Alaska, Iran, Eastern North America, and elsewhere in my 3 years with Aero Service (in addition to >50,000 line km of field QC in Alaska and Mexico).

3. The presence of a massive crater so close to the K/T boundary almost certainly had to be a result of the K/T impactor although the PEMEX well logs for the wells drilled in the 1950's considered the 'volcanic' rocks they encountered to be several million years earlier in age. They have failed to take into account the violent overturning and disruption of bedding associated with a colossal impact vs. a simple volcanic eruption. The 'volcanic' origin of the Yucatan igneous rocks found in those 1950's wells had just been 'enthroned' in 1979 in the massive new volume "The Geology of Mexico" by Mexico's most distinguished geologist. (Not appropriate for a 26 year old gringo junior geophysicist to disagree).

Discovering Chicxulub; August 1978 - March1979

- Convincing other people **DOES** require visualization tools; colored maps and Werner Deconvolution profiles with solutions to body type, depth, dip, and magnetic susceptibility (December 1978-March1979)



1. Original strip charts on left, 2-D models in center, visualization of magnetic fields on right.

Excessive visualization tool dependency vs. new data types

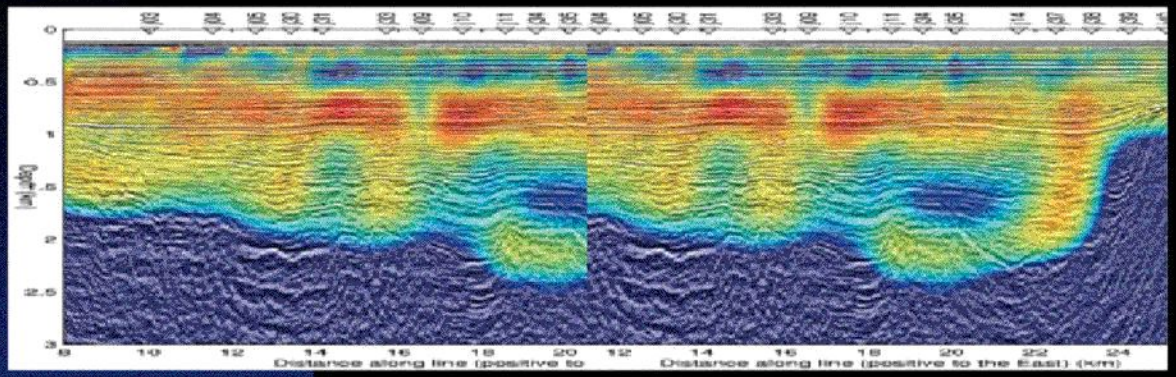
Excessive visualization tool dependency can lead to wrong conclusions from interpreting noise/artifacts or interpreting spectacular, high quality, but non-diagnostic data sets, a few notable examples;

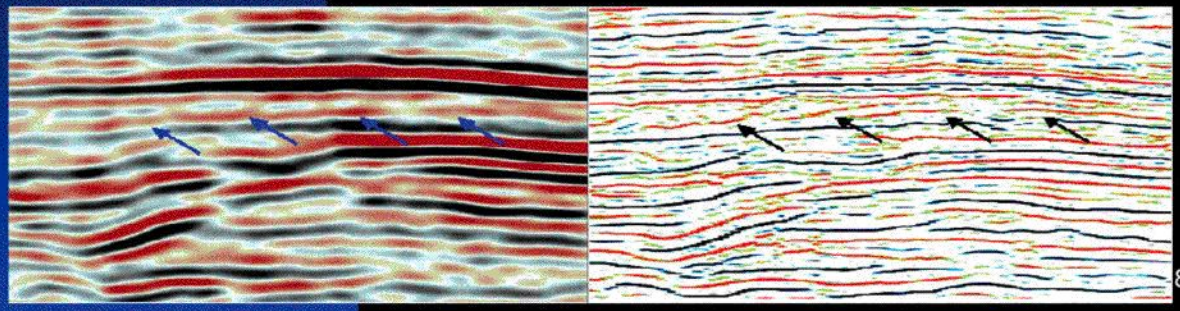
- Sharptons' (NASA) 320km diameter crater
- Cerillos' (PEMEX) 'Chicxulub Double impact'
- Bridges' 2004 Volcanic interpretation of Chicxulub from new seismic data

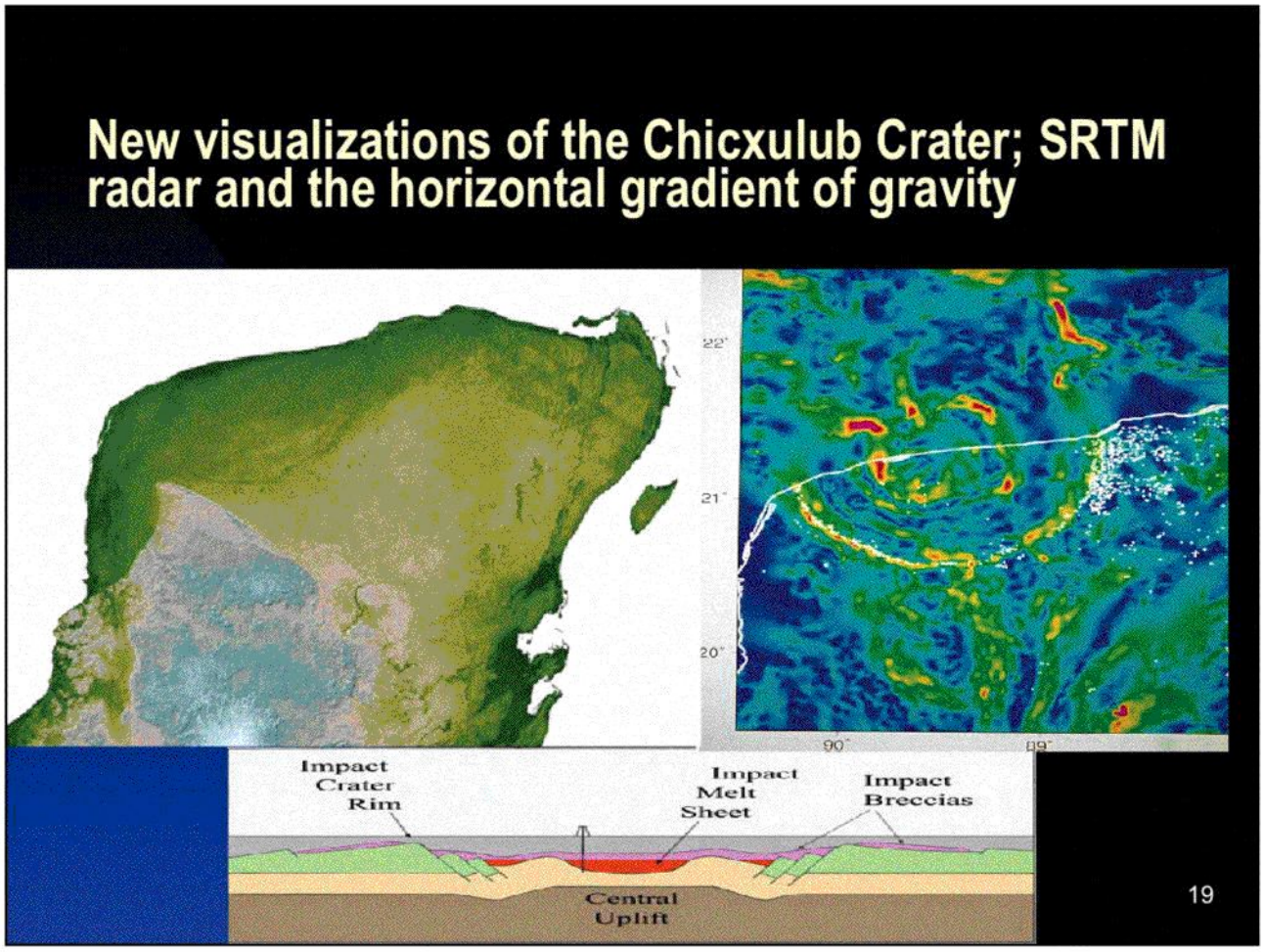
1. Three examples of later erroneous interpretations.

New Data Types and New Visualization Techniques

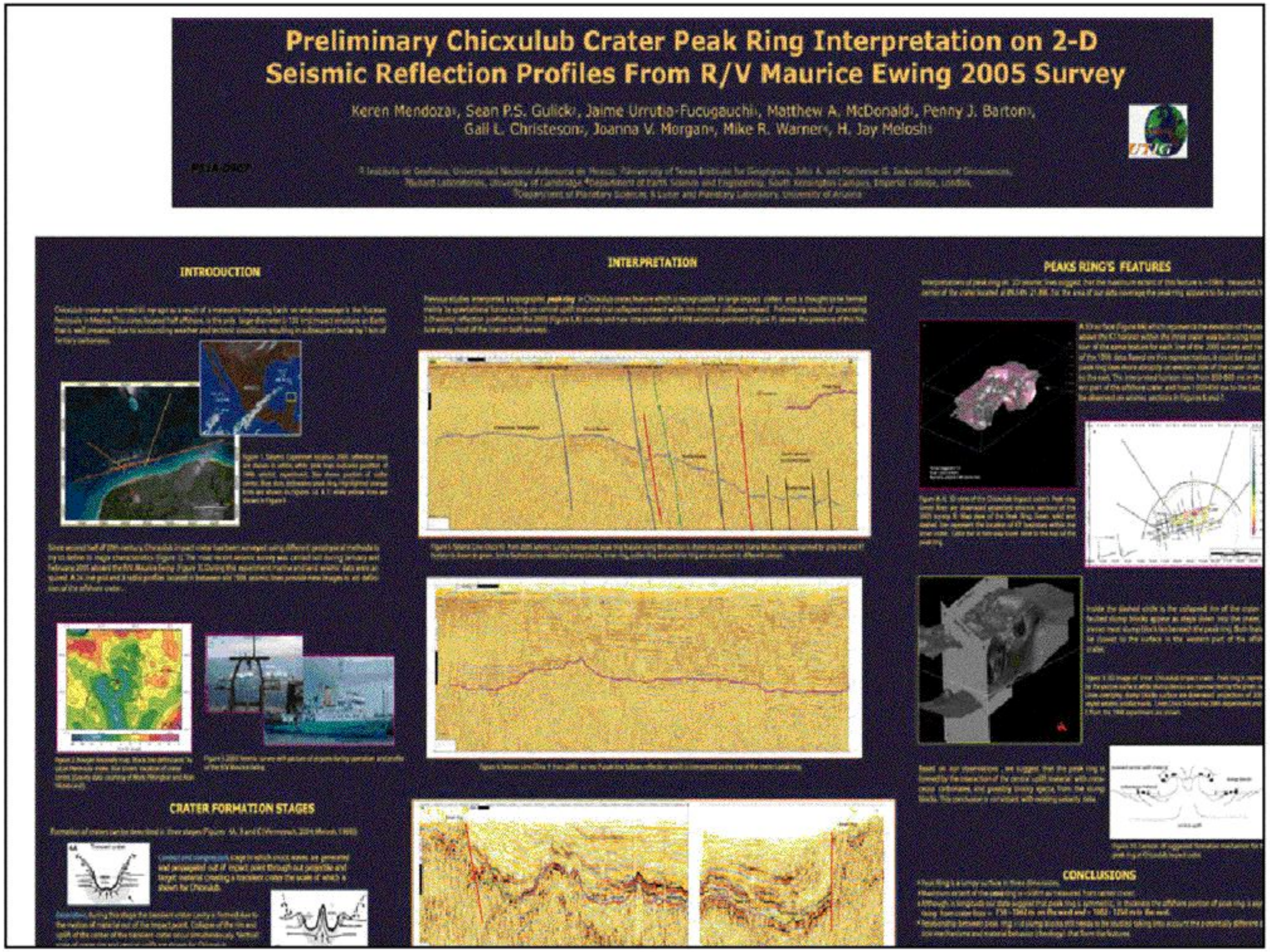
An example of a new data type today is CSEM, not a visually spectacular tool but one which may contain significant information on deep resistivity and fluids- OHM data from the Falkland Islands(above), and Fusions ThinMan™ broadband spectral inversion technique (great visualization of thin beds-below)







1. The first image to actually show a surface expression of Chicxulub.


Preliminary Chicxulub Crater Peak Ring Interpretation on 2-D
Seismic Reflection Profiles From R/V Maurice Ewing 2005 Survey
Keren Mendoza, Sean P.S. Gulick, Jaime Urrutia-Fucugauchi, Matthew A. McDonald, Penny J. Barton,
Gail L. Christeson, Joanna V. Morgan, Mike R. Warner, H. Jay Melosh
INTRODUCTION
INTERPRETATION
PEAKS RING'S FEATURES
CRATER FORMATION STAGES
CONCLUSIONS

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Discovering Chicxulub; March1979-February 1990 11 years of 'Deafening Silence':

'Publication'

- **November 1981** Society of Exploration Geophysicists (SEG)Los Angeles Abstract and technical presentation of Central Yucatan Igneous Zone as a likely Crater and site of K/T impact
- **December 13,1981** Front page Houston Chronicle Carlos Byars article/interview which discusses likely contribution to K/T extinctions
- **March 1982** issue of Sky and Telescope Magazine p249-250 discusses the excellent preservation of the crater, it's K/T extinction implications and several other aspects

The Reaction?

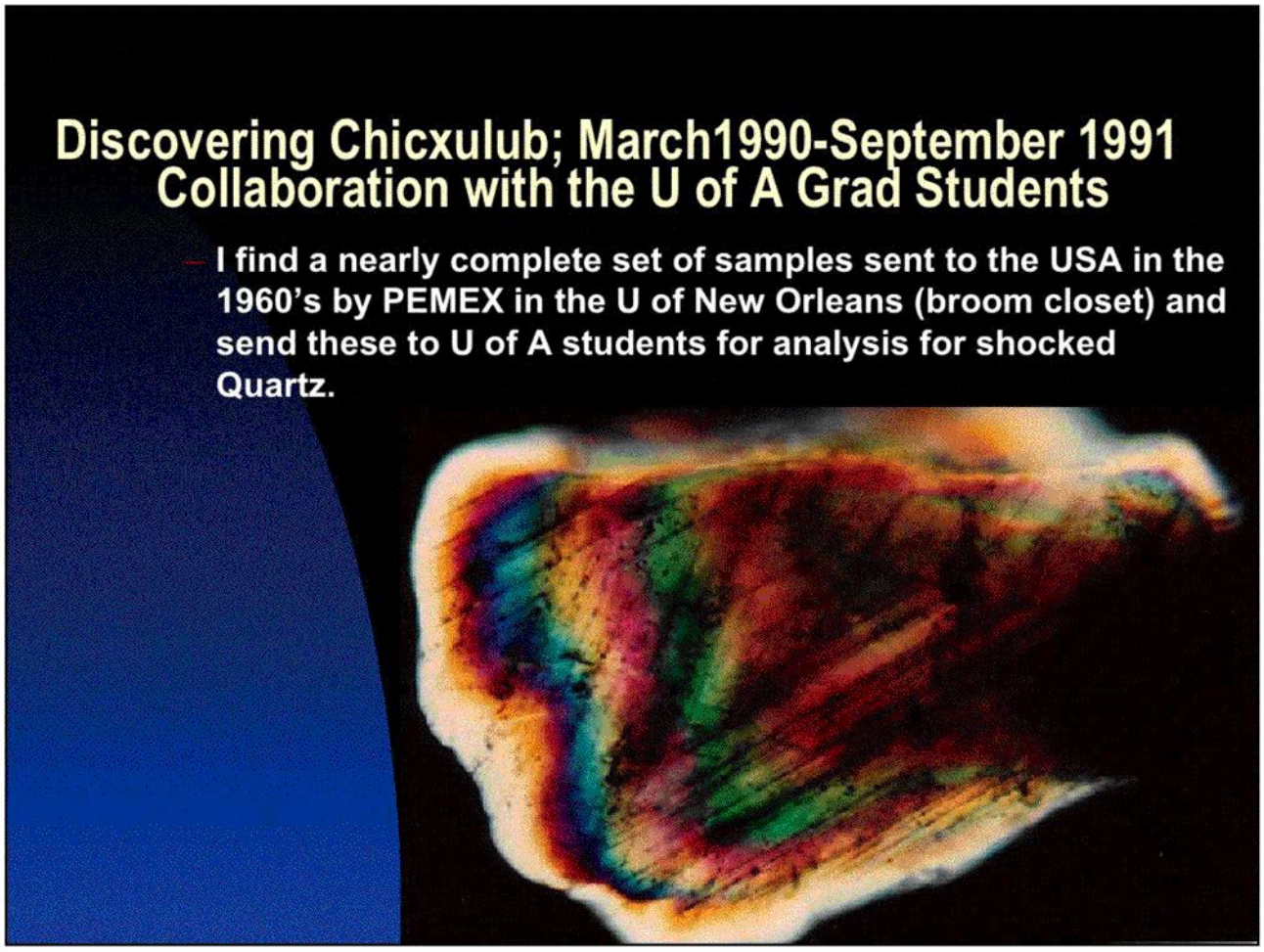
- Famous Rice University Seismologist,
- Famous NASA Lunar and Planetary Inst. Cratering Expert,
- Famous UC Berkeley Impact Geologist all 'POO POO' the Crater'; "It's volcanic", *"We already know about it",*
- *"It's the wrong age",* 'The seismic doesn't show any crater' *'Who is this guy?'*

Discovering Chicxulub; March1979-February 1990 A Comedy of Errors:

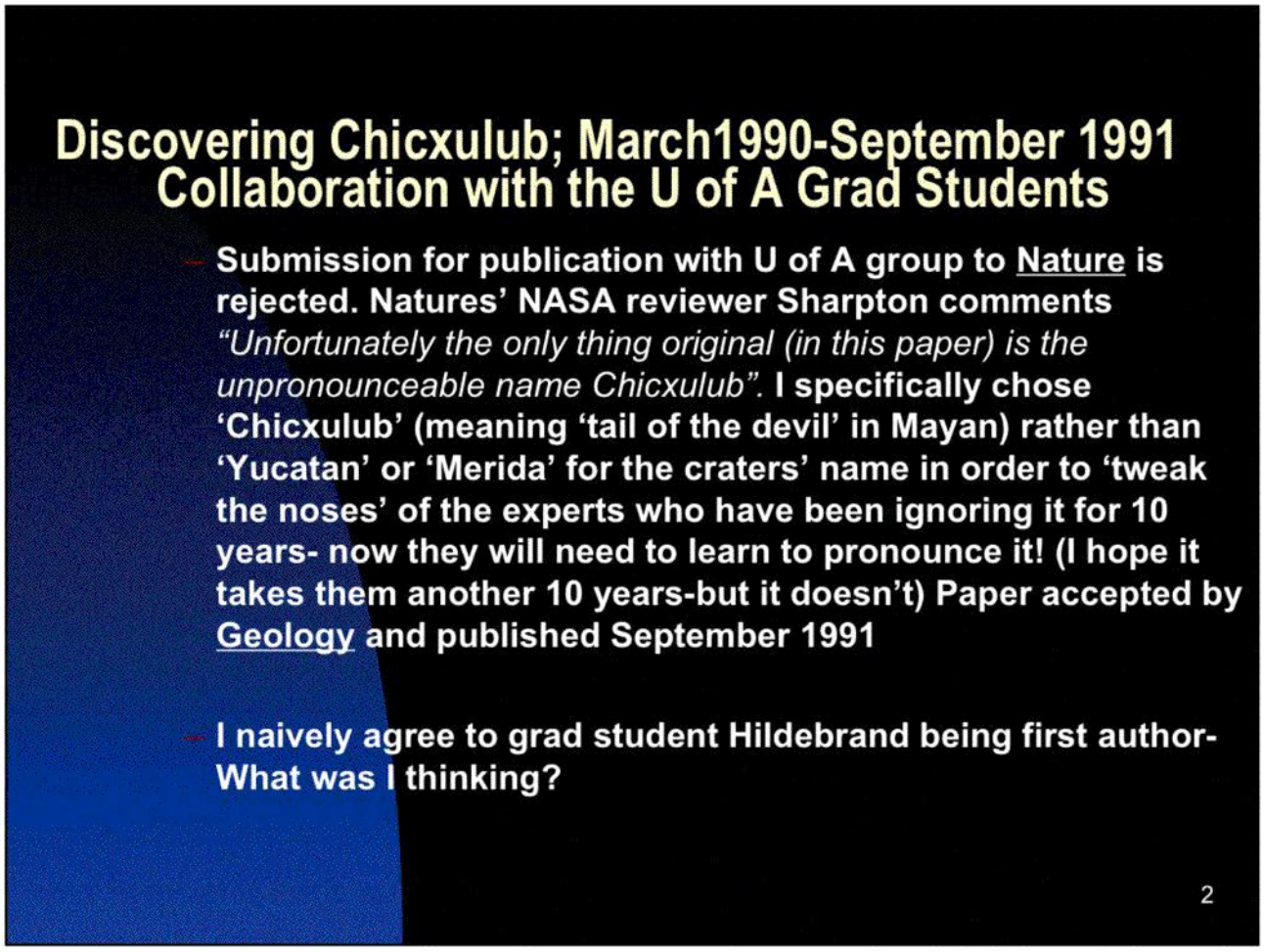
- Lost well samples for the 1950's and 1960's Yucatan wells in a warehouse fire in Coatzacoalcos.

- Lost Data, original magnetic data are 'upward continued' from 500 meter flight altitude to 4500 meters altitude by the Mexican Petroleum Institute (IMP) to make a uniform national high altitude map, then the original tapes are inexplicably erased, thereby loosing all high resolution of low amplitude, high frequency anomalies. In 1980's downturn Aero Service discontinues policy of holding archival copies of clients data, "What's gone is gone".

- 'We can't see the crater for the hole' (the infamous "seismic bad data" zone below the base Tertiary unconformity, which actually mapped the crater In PEMEX seismic data !)



Shocked quartz from a sample I recovered from storage at the Univ. of New Orleans.



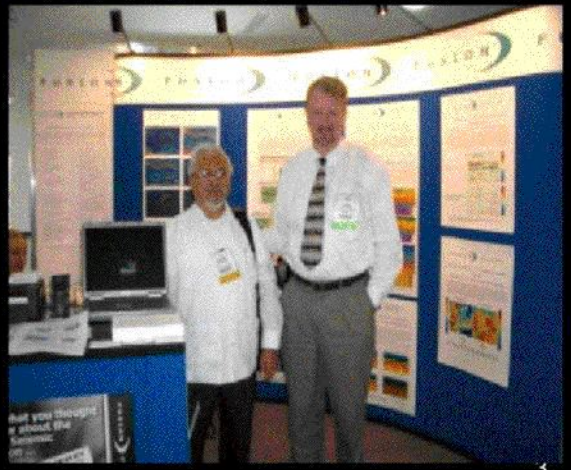
Alan Hildebrand, one of the grad students goes on to claim credit for the crater discovery.

Discovering Chicxulub; >September 1991
Rewriting History at the U of A, and UC Berkeley

- U of A grad students Hildebrand and Kring "discover" Chicxulub after all! *"… Soon after Melosh reported (1990) his findings, a team of seven American, Canadian and Mexican scientists (including one of us, Kring) discovered that Chicxulub was the impact site."*

Alvarez, Penfield, and Camargo, Houston 1994

Camargo and Penfield, Cancun 2005



Still Friends After 29 Years!