A COMPARISON of $\delta^{13}C$ & pmC VALUES for TEN CRETACEOUS-JURASSIC DINOSAUR BONES from TEXAS to ALASKA USA, CHINA & EUROPE with COAL & DIAMONDS PRESENTED IN THE 2003 AGU MEETING

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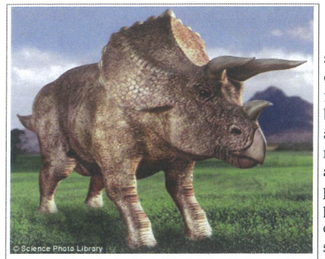

Lower Cretaceous Triceratops #1
AMS collagen 30,890 ± 200 years
Conventional β 33,830 +2910/ -1960

B31E-0068

Abstract

There is convincing evidence that soft tissue and other biomolecules can survive long periods of fossilization by their interaction with blood iron and/or carbonate absorption. Here are presented the results of investigations showing that ancient biomolecules and their decay products contain significantly more pmC's ($^{14}C/C$) than diamond and coal presented during a poster session held at the AGU 2003 SF convention. The title was: *The Enigma of the Ubiquity of ^{14}C in organic samples older than 100 Ka.* The given range for five diamonds from Botswana and South Africa ranged from 0.096 to 0.146 pmC. Ten coal specimens from the United States from the Eocene to Pennsylvanian geologic interval was 0.1 to 0.46 pmC's. In our extensive field and lab study ten dinosaurs from Texas to Alaska, and China yielded much higher pmC's of 0.76 to 5.59 after pretreatment to remove modern contaminants.

When 2 g of a Belgium Mosasaur from Europe was pretreated to remove contaminants the pmC was 4.68 or 24,600 RC years on Lund Un AMS in Sweden (Lindgren et al. 2011, PloS ONE, page 9). The endogenous sources of dinosaur pMC's were further enhanced by the $\delta^{13}C$ range of -20.1 to -23.8 for collagen, 16.6-28.4 for bulk organic and -3.1 to -9.1 for CO_3 fractions. The $\delta^{13}C$ values compare favorably to $\delta^{13}C$ values of -23 to -27 in a similar study of dinosaur $\delta^{13}C$ values from the Judith River formation in Alberta, Canada (Ostrom et al. 1993, Geology, v. 21). Diamonds from South America (Taylor-Southon, Nuclear Instruments, 2007) yielded ages of 66,000 to 80,000 years leaving little doubt that at least the dinosaur ages of 22,020 ± 50 to 39,230 ± 140 were not machine error or a result of contamination anymore than the coal samples.

This data explains more clearly why such biomolecules have persisted and therefore should be studied, since the implications are of utmost importance to science and humanity. The experimental results presented here demonstrate the need for systematic ^{14}C dating of samples from different parts of the entire geologic column to discover patterns of ^{14}C retention and to arrive at a coherent explanation.

FIGURE 1: Age results of AMS & Conventional β for various fossils.

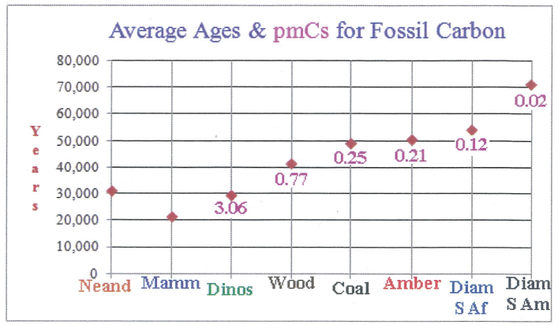

TABLE 2: Results for ^{14}C in wood, coal, amber & soil.

Type of wood, amber, or coal Soil and Location	Formation/Geologic Age (Years)	$\delta^{13}C$/pmC (a)	^{14}C Age (Years)
1. Carbonized, Paluxy River TX In clay between rock strata	Cretaceous--108 Million	-20.9	37,480 ±≈2000
		-22.4	37,420 ±≈2000
2. Carbonized, Paluxy River TX In limestone rock	Cretaceous--108 Million	-22.4	>49,900
3. Carbonized or coalified, CO	Jurassic?--150 Million	-23.4/0.41	44,200 ± 2100
4. Unfossilized, North Slope, AK	Cretaceous?--65 Million	-24.8	43,380 ± 380
5. Unfossilized, Fairbanks, AK	Quaternary < 10 thousand		2,510 ± 50
6. Mummified, Ellef Ringnes Can	Cretaceous?--45-65 Million	-25.2	>45,700
7. Mummified, Ellef Ringnes Can	Cretaceous?--45-65 Million	-23.2/0.14	52,820 ±≈3000
8. Lignite Lens, MT Badlands	Cretaceous--65 million	-27.5/0.52	42,560 ±340
9. Fern tree, MT Badlands	Cretaceous--68 million	-25.0	45,190 ±≈ 6000
10. Soil around Tric. Femur, MT	Cretaceous--68 million	-24.4	19,820 ± 80
11. Soil around T-rex femur, MT	Cretaceous--68 million	-24.7/2.77	28,820 ± 130
12. Coal from Europe	Pennsyl.?--225 million	-24.7/0.2	49,690 ± 640
13. Amber in Dino burial strata	Cretaceous--68 million	-24.01	>46,450
Amber from Saxony	Upper Oligocene--30 million	-22.11	>49,210
Amber from Russia	Upper Eocene--40 million	-21.88	>51,900

Table 3.
$\delta^{13}C$ for Dinosaur Bones

Collagen	Collagen & Biproducts	Bioapetite (Inorganic)
-23.8	-23.8	-8.3
-20.1	-28.4	-4.7
-23.5	-16.1	-6.6
-22.7	-16	-3.1
	-18.4	-4.7
	-15.7	-6.4
		-5.4
-22.5 Average	-19.7 Average	-5.6 Average

$\delta^{13}C$ values for 20 Alberta (Canada) dinosaurs range from -23 to -27, but the collagen contents were much larger: 3% aver. for Canadian dinosaurs vs. 0.3% for U.S. Triceratops. Conclusion: there was more Canadian collagen possibly due to the fec Axe.(1) (2) (3) (4) (5)

(a)
$$\delta^{13}C_{sample} = \left(\frac{^{13}C/^{12}C_{sample}}{^{13}C/^{12}C_{PDB}} - 1\right) \times 1000$$
22.4 is normal C-3 cycle plant material
$^{13}C_{PDB}$ PDB refers to the Cretaceous belemnite formation at Peedee in South Carolina, USA. This nomenclature has recently been changed to VPDB (Coplen, 1994).
Belemnite "is a conical calcareous fossil, tapering to a point at the lower extremity."
pmC = percent of modern
^{14}C using a half-life of 5,568 years as employed by major labs.

THE SEARCH FOR SOLUTIONS TO MYSTERIOUS ANOMALIES IN THE GEOLOGIC COLUMN

In the 1980's the Alverez Theory that an asteroid caused the extinction of dinosaurs 66 Ma BP motivated some of us in 1990 to analyze surface scrapings for the presence of carbon, as most dinosaur bones have a black coating. At that time we proposed to the Carnegie Museum of Natural History that this black coating could be the residue resulting from dinosaurs burned to death by fires started by one or more asteroid impacts, such as made by the one creating the impact crater in Chicxulub, Mexico. We discovered 2% to 7% carbon on the surface of eight dinosaur bone fragments that the museum gave us plus two that our team unearthed. The museum samples appeared to have no protective coatings, such as shellac (which was sometimes used in the early 20th century for large bones), since one coat of shellac would have yielded ≈15% carbon and two coats ≈30%. Starting in 1983, some of our team helped excavate the top two Cretaceous limestone strata on a river ledge in TX, each 12 inches thick separated by 3 inches of clay. The top stratum contained only one trial of 5 dinosaur prints. The next stratum below contained several hundred dinosaur footprints and about 80 human-like footprints, which were excavated over a decade or so. At Univ. Arizona, we also ^{14}C dated fossil wood found in the clay portion between these rock strata. Thus, since carbon has been found on dinosaur bone fragments and significant ^{14}C content in fossil wood (see **Table 2**), we correctly predicted that there would also be significant ^{14}C content in dinosaur bones. Careful ^{14}C studies of freshly excavated dinosaur bones showed that the prediction was correct. **Until this time, no one had thought of carbon-dating dinosaur bones because everyone assumed they were too old!** The results are listed in **Table 1**, for ^{14}C dating dinosaur bones from TX to AK, and also in Europe and in China. The confirming European evidence comes from a Swedish team at Lund Univ. that reported a pmC of 4.6 for an age of 24,600 years for a mosasaur (a marine reptile).

Methods

We used five different accelerated mass spectrometer (AMS) labs and conventional β labs, all giving ages in thousands of years. The modified Longin method by Arslanov et al. [6] was used for extraction of collagen for Triceratops #1 and Hadrosaur #2 femur bones; it combines two methods of purification as follows as described in the lab reports:

> "The bones were mechanically cleaned and washed, then pulverized and treated at low temperature (4-6 °C) by 2-3 fresh solutions of 0.5-1.0 N HCl for a few days (depending on preservation condition) until mineral components dissolved completely. We washed the collagen obtained in distilled water until no Calcium was detectable. We then treated the collagen with 0.1 N NaOH at room temperature for 24 h, and washed it again in distilled water until neutral. We treated the collagen with a weak HCl solution (pH = 3) at 80 – 90 °C for 6-8 h. Finally, we separated the humic acid residue from the gelatin solution by centrifugation, and the solution was evaporated. Benzene was synthesized from the dried gelatin by burning in a "bomb" or by dry pyrolysis, using the standard methods …."

AMS allows for extraction of different dinosaur bone fractions such as collagen, calcium carbonate from bioapetite, total collagen and breakdown products, and specific contaminants [7] [8] so as to ensure that all ^{14}C is endogenous.

Results

(1) The ^{14}C or pmC content seems to vary in steps from one sample type to another - from the youngest being fossil dinosaur bones to wood, to amber, to coal, and finally the oldest being diamonds – The reservoir effect?
(2) The ^{14}C content of diamonds gave the oldest ages, but differed considerably from S. Africa to S. America.
(3) Dinosaurs gave much younger ages than coal or diamond (as reported in AGU, 2003 poster session). There were
(4) no significant pmC differences measured between Cretaceous and Jurassic dinosaur fossils.
(5) The average ^{14}C ages of 360 mammoths (range 9,000-52,000 yrs) are similar to those of ten dinosaurs (22,000 – 39,000 yrs).
(6) The average ^{14}C ages for 12 saber tooth tigers from Labrea Tar Pits is 19,000 RC years (12,000 to 28,000 years).
(7) The range of ^{14}C ages for fossil wood (**Table 2**) from Quartenary to the Jurassic is 2,500 to 44,300 RC years. Many more wood samples need to be dated.
(8) The range of ^{14}C ages for amber from the Cretaceous to the Eocene 46,500 to 52,000 RC years.
(9) Ten coal sample ^{14}C ages ranged from Cretaceous/**Pennsylvanian/Eocene** are **56,000/43,000/50,000** years (note that the youngest RC age came from the oldest formation alleged to be 225 Ma) - The reservoir effect?

Table 6. Summary of Possible Contaminants & Mitigation Methods

Possible Contaminants (a)	Pretreatments And/Or Alternate Tests Performed	Contaminant Detected
Young burial carbonate (b)	Hot dilute Acetic acid under vacuum (h)	None
Old burial carbonate	Hot dilute Acetic acid under vacuum	None
Young Humic acid (c)	Hot dilute acid-base-acid (ABA) (i)	None
Old Humic acid	Hot dilute acid-base-acid (ABA)	None
Collagen impurities	Tested other bone fractions for reproducibility and/or tested for ^{14}C in extracted precipitate from alkaline liquid (j)	None
In-situ bone carbonate	After removal of burial carbonate, the bone sample is treated in dilute HCl under vacuum to collect CO_2 for testing for ^{14}C content (k)	None
Cluster decay of U & Th causing N of collagen into ^{14}C (d)	Analysis for U and Th showed only ppm U and Th in bones that contained small amounts of collagen. (l)	None
Incomplete removal of Contaminants (e)	Reproducibility among multiple labs and between bone fractions (m)	None
Shellac type preservatives on museum bones (f)	Refluxed in a mix of two hot organic solvents until discolorations dissipated, followed by ABA etc. removes shellac, glue and PVC coatings (n)	None
Reservoir effect causing possible old ages (g)	Source of nutrition during lifetime of dinosaurs cannot be determined, therefore the ^{14}C ages are considered the oldest possible ages	None
Bacteria and fungus	According to RC Laboratories bacteria is removed by ABA pretreatment. Plus, microbes would be the same age as the bones they feed upon (o)	None
^{14}C signature an artifact of low sample numbers	Age concordance between 25 separate ^{14}C ages	None
^{14}C signatures an artifact of geological or geographical province	Age concordance between dinosaur material from eight widely divergent geographical and geological provinces	None
^{14}C signatures an artifact of sampling location on fossil	Age concordance between samples collected from a variety of locations within bone samples	None
^{14}C signature an artifact of faulty or outdated detection technique	Age concordance between samples tested by AMS sensitive to 40ka, AMS sensitive to 60ka, and Beta counting technologies	None
^{14}C concordance an artifact of inadequate sample size	Sample sizes ranged from 0.05g to 160g with concordant ^{14}C fractions	Sometimes, with Beta detection
^{14}C signature a result of inadequate sample prep	24 samples prepared with acid/base/acid wash yielded concordant pmCs. Three poorly prepared samples yielded discordant pmCs	Yes, without acid/base/acid prewash

Please ask for hardout containing Table 6 with footnotes [a to o]

TABLE 7. Known & Unknown Contaminants in Dinosaur Bone Samples

Dinosaur	Lab/method/fraction Report	^{14}C Years	$\delta^{13}C$	Discovery Date	Location
Hadrosaur #2	GX-31950-AMS/col	1950 ± 50	-23.5/ -	01/18/2006	MT
Unknown contaminant [sample was too small at 2.7 g; next sample was 57 g					
Hadrosaur #2	UGAMS-01938/AMS/hum	2,560±70	-21.5/72.7	04/10/2007	MT
Humic acid contaminant was isolated from the alkaline pretreatment solution & dated.					
Psittacosaur	UGAMS-8824/AMS/Carb	4,017±50	-7.2/60.2	05/31/2011	Asia
Burial carbonate was the known contaminant from the acetic acid pretreatment. It can be either young or older than the bone and is removed by hot dilute acetic acid under vacuum and then ^{14}C dated.					

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(2) Vasil'Chuk, Y., J. M. Punning, A. Vasil'Chuk (1997) Radiocarbon ages of mammoths in Northern Eurasia: Implications for population development and late quaternary environment. Radiocarbon 39 (1): 1-18. [Average was for only 67 mammoths from Eastern Europe covering an age range of 9,900 +/- 260 to 44,200 +/-1000 years BP]
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(10) Berthault, G., Towards a Reforndation of Historical Geology. 2012, 24 Geresources.

TABLE 1. ^{14}C Results for dinosaur bone collagen & other fractions from TX to AK, United States, Europe & China

Dinosaur (a)	Lab/method/fraction (b) (c)	^{14}C Years B.P. (d)	δ13C/ pmC(e)	Date of Report	Discovery Location
Acrocanthosaurs	GX-15155-A/Beta/bio	>32,400	-8.3/-01	01/10/1989	TX
Acrocanthosaurs	**GX-15155-A-AMS/bio**	**25,750 ± 280**	**-8.3/4.08**	**06/14/1990**	**TX**
Acrocanthosaurs	AA-5786-AMS/bio/scrape	23,760 ± 270		10/23/1990	TX
Acrocanthosaurs	**UGAMS-7509a/AMS/bio**	**29,690 ± 90**	**-4.7/2.48**	**10/27/2010**	**TX**
Acrocanthosaurs	UGAMS-7509b/AMS/bow	30,640 ± 90	-23.8/2.21	10/27/2010	TX
Allosaurus	**UGAMS-02947/AMS/bio**	**31,360 ± 100**	**-6.6/1.98**	**05/01/2008**	**CO**
Hadrosaur #1	KIA-5523/AMS/bow	31,050 + 230/-220	-28.4/2.10	10/01/1998	AK
Hadrosaur #1	**KIA-5523/AMS/hum**	**36,480 + 560/-530**	**-25.5/1.07**	**10/01/1998**	**AK**
Triceratops #1	GX-32372-AMS/col	30,890 ± 200	-20.1/2.16	08/25/2006	MT
Triceratops #1	**GX-32647-Beta/bow**	**33,830 +2910/-1960**	**-16.6/1.38**	**09/12/2006**	**MT**
Triceratops #1	UGAMS-04973a-AMS/bio	24,340 ± 70	-3.1/4.83	10/29/2009	MT
Triceratops #2	**UGAMS-03228a-AMS/bio**	**29,230 ± 140**	**-4.7/0.76**	**08/27/2008**	**MT**
Triceratops #2	UGAMS-03228b-AMS/col	30,110 ± 80	-23.8/2.36	08/27/2008	MT
Hadrosaur #2	**GX-32739-Beta/ext**	**22,380 ± 800**	**-16.0/-**	**01/06/2007**	**MT**
Hadrosaur #2	GX-32678/AMS/w	22,990 ±130	-18.4/-	04/04/2007	MT
Hadrosaur #2	**UGAMS-01935/AMS/bio**	**25,670 ± 220**	**-6.4/4.09**	**04/10/2007**	**MT**
Hadrosaur #2	UGAMS-01936/AMS/w	25,170 ± 230	-15.7/4.36	04/10/2007	MT
Hadrosaur #2	**UGMAS-01937/AMS/col**	**23,170 ± 170**	**-22.7/5.59**	**04/10/2007**	**MT**
Hadrosaur #3	UGAMS-9893/AMS/bio	37,660 ± 160	-4.9/-	11/29/2011	ND
Stegosaurus	**UGAMS-9891/AMS/bio**	**38,250 ± 160**	**-9.1/-**	**11/29/2011**	**CO**
Psittacosaur	UGAMS-8824/AMS/bio	22,020 ± 50	-5.4/6.45	05/21/2011	Asia
Psittacosaur	**UGAMS-8824/AMS/Carb**	**4,017±50**	**-7.2/60.2**	**05/31/2011**	**Asia**
Mosasaur	Lund, Sweden AMS Lab(f)	24,600	/4.8	2011	Europe

(a) (b) (c) (d) (e) *Please ask for Table 1 Handout for these footnotes.*

Table 4: Results of ^{14}C analyses of Ten Coal samples.

Sample	Coal Seam	State	County	Geological Interval	$^{14}C/C$ (pmc)
DECS-1	Bottom	Texas	Freestone	Eocene	0.30±0.03
DECS-11	Beulah	North Dakota	Mercer	Eocene	0.20±0.02
DECS-25	Pust	Montana	Richland	Eocene	0.27±0.02
DECS-15	Lower Sunnyside	Utah	Carbon	Cretaceous	0.35±0.03
DECS-16	Blind Canyon	Utah	Emery	Cretaceous	0.10±0.03
DECS-28	Green	Arizona	Navajo	Cretaceous	0.18±0.02
DECS-18	Kentucky #9	Kentucky	Union	Pennsylvanian	0.46±0.03
DECS-21	Lykens Valley #2	Pennsylvania	Columbia	Pennsylvanian	0.13±0.02
DECS-23	Pittsburgh	Pennsylvania	Washington	Pennsylvanian	0.19±0.02
DECS-24	Illinois #6	Illinois	Macoupin	Pennsylvanian	0.29±0.03

Averaged over geological interval, the AMS determinations yield remarkably similar values of 0.26 pmc for the Eocene, 0.21 pmc for the Cretaceous, and 0.27 pmc for the Pennsylvanian samples.

Ref: AGU poster session 2003, see handout.

Table 5: Results of AMS ^{14}C analyses of Nine Diamond Samples.

South African Diamonds (pmC)	South African Diamonds (Years)
0.138	52,994
0.105	55,194
0.12	54,119
0.146	52,541
0.096	55,915

Ref: AGU poster session 2003, see handout.

S. American Diamonds (pmC)	S. American Diamonds (Years)
0.031	64,900
0.005	80,000
0.018	69,300
0.015	70,600

Ref : Taylor, R.E., J. Southon. 2007. Use of natural diamonds to monitor C-14 AMS instrument backgrounds. Nuclear Instruments and Methods in Physics Research B 259 282-287.

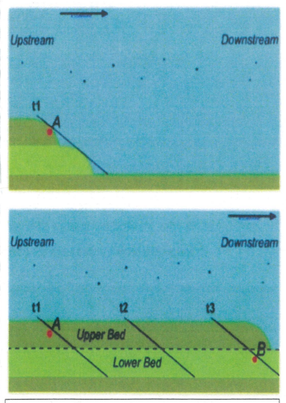


Figure 2: **How Sediments Form in Moving Waters: Fossil A in the upper bed is older than Fossil B in the lower bed, since Fossil A was deposited before Fossil B.**

Prof. **Gabriel Gohau** of the *French Geological Society* in *A History of Geology* (1990): "Time is measured by the interval required for sediments to deposit, a fact upon which everybody is more or less agreed, and not by orogenesis or 'biological revolution.' " The above figure has been confirmed by lab and flume studies: **Makse, H.A.**, et al. *Spontaneous Stratification in Granular Mixtures*, ***Nature*** Vol. 386, 27 March 1997; **Berthault, Guy** 2002. *Geological dating principles questioned. Paleohydraulics: a new approach*, ***Journal of Geodesy and Geodynamics*** 22 (3): 19-26, China.

Schieber, J., and J. B. Southard (2009), Bedload transport of mud by floccule ripples-Direct observation of ripple migration processes and their implications, **Geology**, 37(6), 483-486. **Schieber, in his flume studies found that over 60% of the geologic column which are mudstones, formed in moving waters rather than in the bottom of stationary lakes.**


Figure 3: Sawing Triceratops#1 femur bone to extract samples for ^{14}C dating from cross section.


Figure 4: Psittacosaurus tail bone from Gobi Desert, China. Contributed from Mt. Blanco Fossil Museum.


Figure 5.


Figure 6


Figure 7: Dinosaur depiction on King Francios I's chateau Sculptured in 1536.

Tentative Conclusions

A Wake-up Call to the Earth: The recent unexpected explosion of an estimated 60 foot diameter asteroid over Russia in 2013 injuring over 1000 people has intensified interest in determining more accurate asteroid numbers, orbits, and a realistic collision frequency on land and in oceans. Findings presented in the 2003 AGU ^{14}C dating poster along with this presentation strongly suggest a much higher asteroid risk due to a significantly shorter interval among impacts and explosions, urgently supporting expanded asteroid chronology research for the safety of life on Earth.

The anomalous but consistent findings that various geological samples, thought to be millions of years old, actually contain ^{14}C suggest a much younger geologic column. These anomalous results are consistently found in samples that should contain zero ^{14}C, including fossils of all kinds such as wood, amber, coal, dinosaurs, and most surprisingly even in diamonds. The recent ^{14}C dating of dinosaurs presented here reinforces similar ^{14}C data presented at the 2003 AGU convention. Thus, the tentative conclusions derived from both this and AGU 2003 coal and diamond studies include:

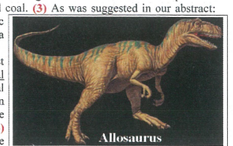
(1) The 65 to 150 Ma between dinosaurs and man do not apparently exist.
(2) The 70 Ma between late Cretaceous and late Jurassic periods are also non-existent.
(3) Diverse evidence suggest that both Neanderthal and modern man coexisted with dinosaurs.
(4) This diverse evidence helps explain the existence of soft tissue and large bio-molecules in dinosaur fossils which should not survive more than 100,000 years under the best conditions.
(5) Thus, distinct dinosaur depictions exist world-wide apparently because some people actually depicted them.
(6) Fossil evidence shows the destruction of many organisms occurred simultaneously along with most dinosaurs.
(7) The 19th century hypothesis that sedimentary formations took millions of years to form is clearly contradicted by ^{14}C ages for wood, coal, amber, dinosaurs, along with sedimentary studies. These new studies indicate deposition occurred in rapidly moving waters [10]. This and other data seem to confirm that the sedimentary formations were deposited by one or more cataclysmic events only 1000's of years BP, not the accepted 66 Ma.

Serious Implications and the Need for Further Research

Two other teams have informed us that they have corroborated our ^{14}C content in other dinosaur bones. They are currently preparing papers. Thus this anomalous hard experimental data shown herein and in the 2003 AGU poster session on ^{14}C dating coal and diamond requires further scientific confirmation or rejection. Therefore, this issue should be resolved quickly through an increase in research should we need to enhance Earth's defense systems against asteroids (NEO's) to fully protect our environment. Therefore, unanswered anomalies concerning the actual geologic time frames involved in historical impacts, need to be addressed in a straight-forward and logical manner, as required for the advancement of science and of course the protection of Earth and its inhabitants:

- **How many impacts and when?** So far, at least 185 asteroid impacts on Earth land masses have been identified—but over what time period? If geophysics data are correct for land mass impacts, there would have been an additional 400 or more impacts in the oceans which compose 70% of the Earth's surface—but over what time period?
- **Previous disasters--**Here are three asteroid impacts in the oceans and when they supposedly occurred: **(a)** New Jersey coast with a 20 meter tsunami up the Hudson River, 2200 years BP **(b)** Chesapeake Bay, 500 meter tsunami, 35 Ma BP. **(c)** Indian Ocean, 200 meter tsunami 4400 years BP. Significant knowledge is lacking about where and when.
- **Research needed includes: (1)** Initiating new projects on mapping ocean and large lake floors to help detect such impacts off the coast of the USA and India in particular. **(2)** Intensive ^{14}C dating of fossils in both core samples and near surface fossils as was done with dinosaur bones, wood, amber, and coal. **(3)** As was suggested in our abstract: "…using ^{14}C-dating of samples from different parts of the entire geologic column will help discover patterns of ^{14}C retention and to arrive at a coherent explanation of the results.
- **Science advances only by addressing anomalies.** World events suggest the need for the immediate search for greater accuracy in the natural sciences, such as the important subjects of: **(1)** Chronology of historical and pre-historical Earth catastrophes and global weather changes **(2)** Open communication of scientific findings and **(3)** The expansion of these findings throughout the world as part of scientific literacy and progress. **(4)**

The question must be asked: If science is off by a factor of 2,000 for the demise of dinosaurs, how can we expect space agencies to protect the world from asteroids when they may not have the correct chronological model of past events on Earth???



Lower Jurassic Morrison Formation AMS (60,000 year sensitivity) **31,360 ± 100 ^{14}C years**