Scanning Electron Microscope Study of Mummified Collagen Fibers in Fossil *Tyrannosaurus rex* Bone

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Abstract

A specimen of hip bone from a *Tyrannosaurus rex*, excavated from a ranch in Wyoming over 100 years ago, and thought to be 65 million years old is shown, by scanning electron microscopy, to have intact, mummified microscopic collagen fibers and other ultrastructural features within compact bone. Bone Haversian canals as well as lacunae and canaliculi are well preserved. Networks of collagen fibers remain intact within lacunae and what may be mummified osteocytes are shown to be present. Twenty-year-old, similarly fractured natural human hip bone shows comparable patterns of canals, collagen networks and cells, including crenated erythrocytes. Hip bone from "Moab man," human remains collected from Utah and thought to be less than 200 years old, contains no such soft tissue features within compact bone. Moab man specimens appear cleanly stripped of soft tissues and harbor burrowing insect remains. These data call into question the long ages ascribed to these dinosaur fossils and support their rapid preservation in the absence of decomposers. The high level of ultrastructural preservation also implies that these dinosaur bones are simply not very old.

Introduction

The remarkable preservation of macro and microscopic structures of fossils in general and fossilized dinosaur bones in particular, has been the subject of many creationist books, articles and reviews (Calais, 1994; Helder, 1992; Howe, 1997; Taylor, 1999; Weiland, 1997b).

What appear to be red blood cells have been described from *Tyrannosaurus rex* bones (Weiland 1997a), while other dinosaur bones have been found which "cannot be distinguished from modern bone" (Weiland, 1999). Additionally, soft muscles, internal organs and even microscopic fibers have been well preserved in a juvenile dinosaur recovered in China (Snelling 1998).

In some of these writings it is often charged or implied by creationists that evolutionists are reluctant to make these startling revelations, even in recent times because it does not support their position that these fossils are over 65 million years old, or that they took millions of years to fossilize. Although the process of fossilization is not completely understood, it is assumed by both evolutionists and creationists that most fossils must be buried or stabilized very quickly in order to stand any chance of being preserved. Briggs states: "Of course fossilization is time dependent. But although the age of most fossils is measured in millions of years (and some diagenic processes are certainly long term), whether or not an organism is destined to become a fossil may be determined very rapidly" (Briggs, 1995). Mineralized and petrified oddities such as bowler hats, fencing wire and sacks of flour (Walker, 2000; Weiland 2000) certainly show us that fossilization can take place quite rapidly, "freezing" the feeding practice or even the process of giving birth, forever into rock.

It is incorrect, however, to state that evolutionists have not been forthcoming with data that may show that fossilization and mineralization of biological materials can happen so rapidly as to preserve microscopic structures. As early as 1962 these scientists have shown that microscopic structures, such as bone collagen are well preserved in dinosaur bones (Little, Kelly and Courts, 1962). This work was followed by a series of studies by Pawlicki and his associates demonstrating by scanning and transmission electron microscopy that not only were collagen fibers found in dinosaur bones (thought to be 80 million or more years old), but that blood vessels, osteocytes (bone building cells) and even intact proteins, lipids, mucopolysaccharides and DNA were found (Pawlicki, Korbel and Kubiak, 1966; Pawicki, 1975; 1977a; b; 1985; 1995). There are also good data in the literature that rapid fossilization of soft body structures may occur under certain anoxic or pH regulated (low pH level) conditions (Briggs and Kear 1993a;

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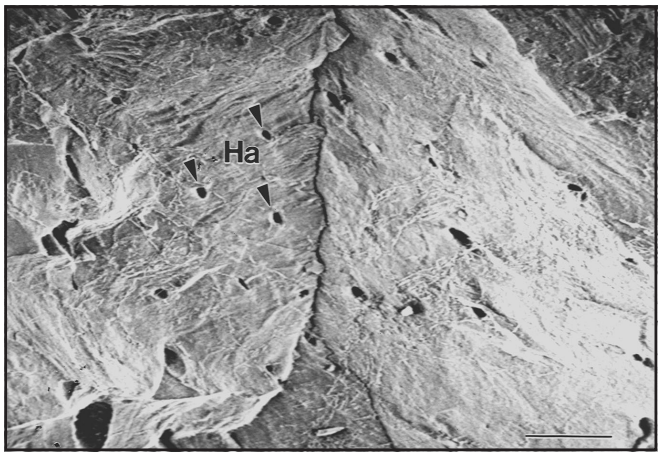

Figure 1. Low power micrograph of fractured dinosaur bone showing Haversian canals (Ha) through which blood vessels normally protrude (arrows). Scale bar = 3 mm (mm = millimeters; m = micrometers).

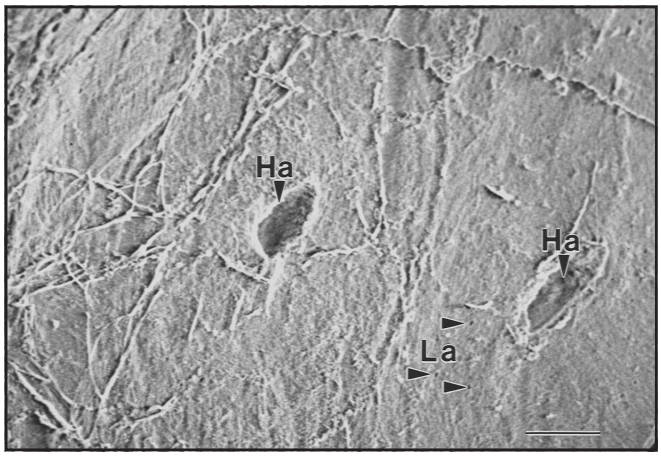

Figure 2. Micrograph showing two Haversian canals and surrounding bone matrix laid down by osteocytes. Small black dots as indicated by arrows are lacunae (La) Some collagen fibers are now evident. Scale bar = 400 m.

1993b; Briggs, 1995). Experimental taphonomy (the study of the transition of organic remains from biosphere to lithosphere) is ongoing in many paleontology laboratories. To quote Briggs (1995, pp. 539, 544), "Unless the morphology of the most labile tissues is 'stabilized' before the decay (within days or weeks) nothing remains…The results demonstrate that replication of soft-tissue can take place within weeks, even where the only major source of the phosphate is the carcass itself. They also show that the closure of the system is as important, at least in some cases, as the absence of oxygen."

In addition, some paleontologists are quite candid about the fact that the excellent preservation in many fossils must mean that fossilization or burial was instantaneous (Martill, 1989, p. 204). Martill even demonstrated muscle banding and cell nuclei in highly magnified fossilized fish muscle and stated that phosphatization (mineralization) must have been complete "within a few (probably less than 5) hours." Thus, for over 40 years evolutionist workers have reported openly on the presence of such remarkable preservation in dinosaur and other fossils.

In this study, fossilized bone from a *T. rex* dinosaur recovered from a dig at New Castle, Wyoming was evaluated for the presence of microscopic cells, vessels and fibers under the scanning electron microscope. These results were compared to recent human hipbone fragments supplied by an anatomical supply company and human hip fragments from a mine at Moab, Utah.

Materials and Methods

This study examined a museum specimen of *T. rex* hipbone (compact bone), approximately 3 X 2 cm in size. The specimen had been shellacked on one side and was indicated to have been in a museum drawer in Newcastle, WY for about 100 years (Taylor, 2000) The bone fragment was pressure fractured in half, exposing the inner structure. It was affixed to a metal SEM stub, sputter coated in gold, and viewed at 15kv on a JEOL scanning electron microscope. Low power light micrographs were also made of the unprocessed bone fragments under a dissecting microscope. Recent human hipbone was used as a comparative control. The control bone was acquired from Carolina Biological Supply Co. (Burlington, NC) in a "kit" of processed human bones for the purposes of anatomical education approximately 20 years ago. According to the supply company (Hardy, 2001), these bones were fixed, cleaned of tissues by maceration, degreased in gasoline and air dried, but were not lacquer coated. They were shipped from India to the U.S. in the 1980's. Additionally, specimens of "Moab man" (AKA Malachite Man) hipbone were received from Mr. Joe Taylor (Taylor, 1999, p. 62). Moab man human skeletons were discovered in Big Indian Copper mine in 1971 and are considered by some to be intrusional skeletons and not *in situ* fossils (Berger and Protsch, 1989). These human bone fragments were similarly pressure fractured and processed for electron microscopy as above.

Results

In the dinosaur bone, Haversian bone canal systems (arrows, Figure 1) with their associated lacunae (Figure 2, arrows) are quite visible under low magnification and appear as deep impressions within the bone matrix under higher magnification (Figures 3, 4). Haversian canals contained no remnants of vessels and little loose collagen or other tissues, although their surfaces had a matte appearance. This was due to a carpet of collagen, thus, the calcium phosphate crystalline nature of the bone surface was not visible

Figure 3. Individual lacuna, now showing abundant numbers of well preserved collagen fibers and cellular debris (osteocytes?) at the bottom of each lacuna. Scale bar = 4 m.

Figure 4. Another lacuna, also showing abundant numbers of well preserved collagen fibers and cellular debris (osteocytes?) at the bottom of each lacuna. Arrows represent possible mummified osteocyte. Scale bar = 3 m.

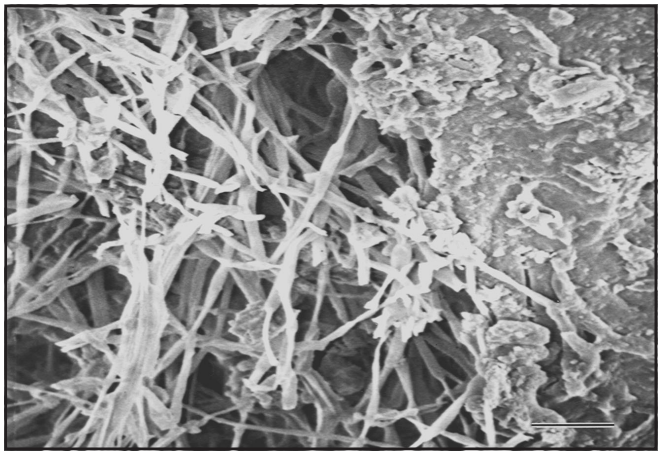

Figure 5. Network of collagen fibers, probably a precursor to bone matrix, laid down by osteocyte. Scale bar = 1.25 m.

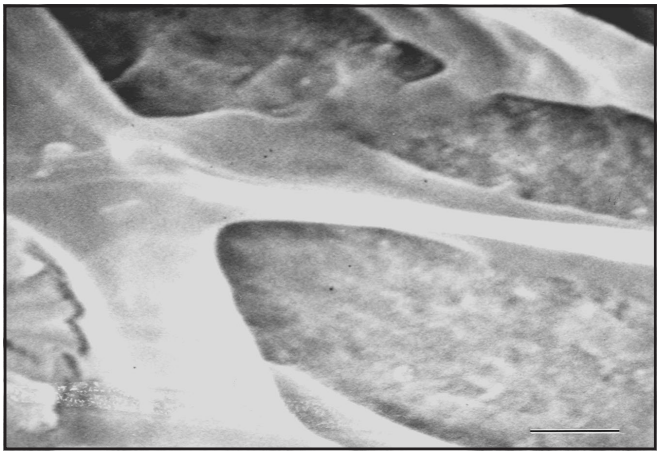

Figure 6. Very high magnification micrograph of a bifurcation junction on a collagen fiber. Note smooth and well-rounded surfaces denoting mummification rather than mineralization. Scale bar = 0.15 m

(Kessel and Kardon, 1979). Canaliculi were also observed along the walls within canals. Lacunae, on the other hand, were often surrounded and filled with large masses of unconsolidated, mummified (or otherwise preserved) fibers, probably polymerized collagen or possibly fibrin (Figures 3, 4, 5). Often there appeared a network of fibers (probably a precursor to the calcium phosphate bone matrix) as seen in Figure 5. Mummified cellular debris, including possible osteocytes, was also found within the bottom of many lacunae (Figure 4, arrows). Canaliculi could be easily seen perforating the lacunae walls and are seen as black dots also surrounding lacunae (Figures 3, 4). It was clearly evident that no mineralization of these collagen fibers had occurred, since well-rounded birfurcations characterized fiber junctions (Figure 6).

Collagen fibers from a fresh human wound scab (Figure 7) and similarly positioned *T. rex* bone collagen at the same magnification (Figure 8) are remarkably similar. The *T. rex* collagen appears somewhat shrunken and deformed compared to the human specimen, but in all other respects could pass as recently laid down collagen. In comparison, the Moab man samples seemed devoid of any soft tissue at all. A Haversian system is shown in Figure 9, and there are no fibers associated with the canal, nor were there any fibers or other soft tissues seen in or around lacunae. In addition, when pressure fractured, a minute (1–2 mm in size) insect exoskeleton (resembling a Springtail of the Order *Collembola*) was observed, affixed to the surface of a trabecular process in the cancellous bone section of the sample. This exoskeleton, probably the remains of a molt, was lost in processing. If boring insects had access to this Moab man skeletal sample, as have been discovered at other fossil sites in Utah (Hasiotis and Fiorillo, 1997), then this might explain the lack of soft tissue remains in the Moab man samples examined. In stark contrast, however,

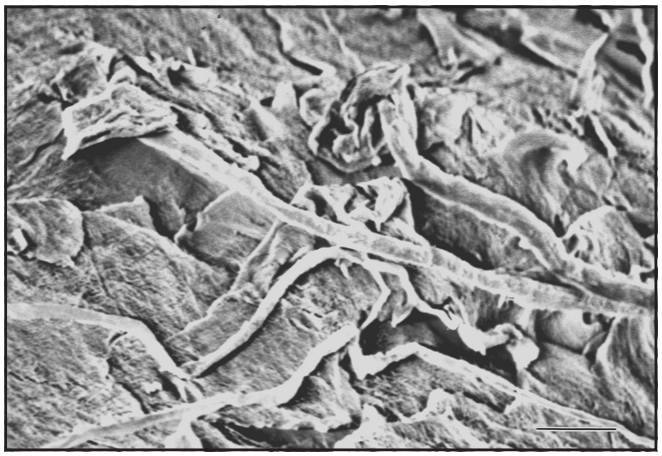

Figure 7. Human collagen fibers on a wound scab. Scale bar = 0.5 m.

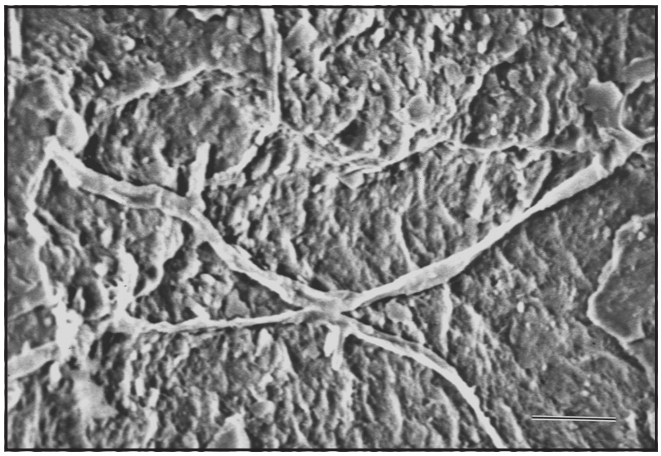

Figure 8. Collagen fibers from *T. rex* bone. Same magnification as Figure 7.

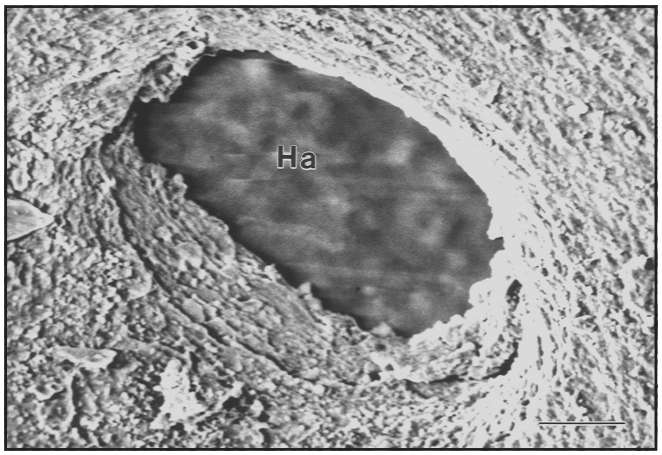

Figure 9. Portion of fractured surface of human bone, Moab man specimen. Note large Haversian canal and absence of fibers and other soft tissues. Scale bar = 85 m.

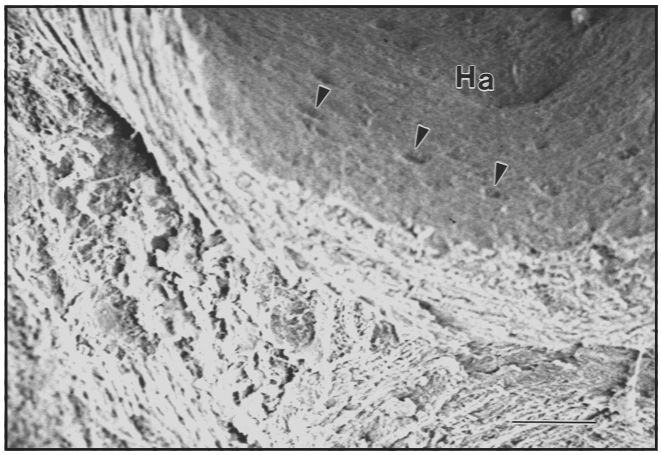

Figure 10. Portion of fractured surface of human bone, recent anatomical specimen. Network of collagen fibers is clearly visible, as are canaliculi (arrows) on inside surface of Haversian canal wall. Scale bar = 12.75 m.

are the results from the recent human hipbone from the anatomical supply company. Internal bone surfaces were thickly populated with collagen mats while canaliculi showed up well on the inner surfaces of Haversian canals (Figure 10, arrows). In addition to webs of collagen, compressed soft tissues, resembling what might be osteocytes were observed (Figure 11), as well as crenated erythrocytes which were plentiful (Figure 12).

There is also good correlation between dinosaur collagen and human collagen fibers at similar magnifications, which are otherwise indistinguishable (Figures 8 and 12).

Discussion

Controversy surrounds the "Moab man" skeletons in several regards. There is general consensus that these remains are unfossilized and that they represent an intrusive aspect to the Dakota sandstone (Cretaceous) rock where they were found and not humans buried *in situ* (Taylor, 2000; Berger and Protsch, 1989). They have been renamed by Mr. Taylor as "Malachite man" (Taylor, 1999) due to the bright green patina they display as a result of the high concentration of copper (solution?) from the formation in which they are buried. This green stain was observed to extend almost completely through the compact bone, but it did not extend into the cancellous sections of the bone. The discovery of insect remains inside this bone indicates that they may have been exposed to the elements and to decomposers prior to the infiltration of the copper into the bone matrix, but in any event it seems the copper was not sufficient to preserve collagen fibers. This might explain the lack of soft tissues within the bone as it may have been consumed before any preservation or mummification could have taken place. Preserved human collagen fibers have been found, however, in ancient human remains from Egypt (Hino, Ammitzboll, Moller and Asboe-Hansen, 1982). Even though preservation of collagen and other ultrastructural features were observed (as a result of

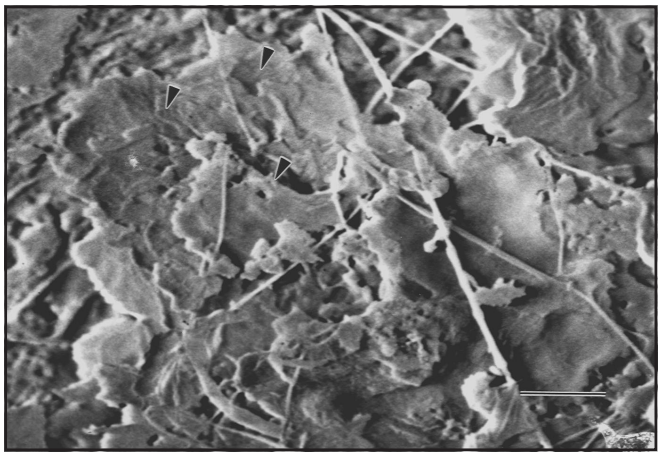

Figure 11. Recent human bone specimen. Collagen fibers crisscross a matrix of soft tissue (osteocytes?) Scale bar = 2 m.

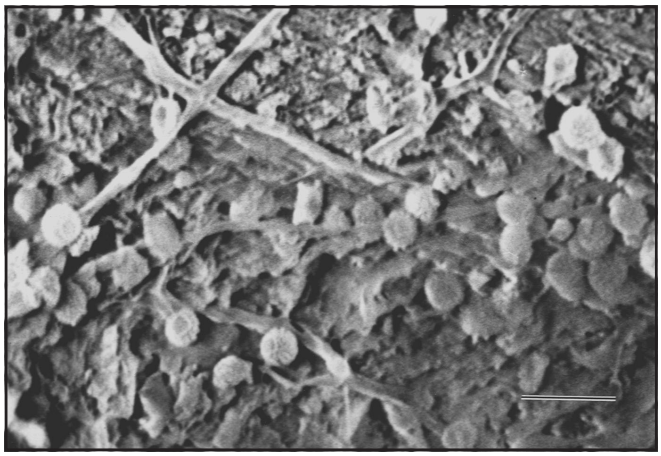

Figure 12. Recent human bone specimen. Collagen fibers surrounded by crenated erythrocytes (arrows). Scale bar = 15 m.

the embalming process), they were approximately one half normal size and were significantly deformed after only 1700 years postmortem. Alternately, osteocytes have been discovered in a state of perfect preservation within the temporal bone of a 2600-year-old Egyptian mummy, but in this case, the bone was impregnated and preserved by a hard resin polymer (Benitez and Lynn, 1975).

In contrast, the dinosaur specimen exhibits remarkable preservation of soft tissues to the ultrastructural level. The state of preservation in this *T. rex* bone resembles that of *fixed tissues* found in recent human bone, thus the preservation, or fossilization process must have immediately followed or have been concurrent with death. It must also have been rapid enough to foil decomposers, but the fine structure of the soft tissue does not exhibit the effects of any mineralization. Additionally, the fact that this level of preservation has remained to this day casts doubts on the time period that may have elapsed between fossilization and the present. The collagen fibers in the dinosaur bone appear to be mummified and not fossilized, therefore they would have been subject to the same sorts of time-related processes that have affected human remains embalmed in Egypt in 100–300 A.D (Hino, et. al, 1982). The *T. rex* specimen examined does not show these age-related effects.

Conclusion

Numerous microscopic structures such as bone lacunae, canaliculi, osteocytes and collagen fibers, protected from the elements deep within bone, have been found under scanning electron microscopy in a *T. rex* hip bone specimen which has been in a museum for about 100 years. These structures appear to be mummified and were not mineralized by the fossilization process. It is possible that fossilization events might be so rapid that preservation of such structures is guaranteed, and perhaps these specimens are not as old as the literature suggests.

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CRSQ: Creation Research Society Quarterly
CEN: Creation Ex Nihilo

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Book Review

***Impeaching Mere Creationism* by Philip Frymire**
Writer's Club Press, San Jose, CA. 2000, 102 pages, $11.95

Frymire is a petroleum geologist by profession and admits he is "not a practicing professional zoologist" but enjoys "keeping up with the latest developments in evolutionary theory" (p. viii). In this work he attempts to refute creationism, specifically the intelligent design (ID) branch. The key sentence in understanding the book is his admission that "I had never read a creationist book" until reading Philip Johnson's *Defeating Darwinism* (p. viii). He then read two other of Johnson's books, and from this reading of creationist literature endeavored to refute the entire creation movement. The results of his admitted lack of study and research on creationism show on every page.

To write a book about something typically takes years of study, or at least it should if one wants to produce an accurate book. Frymire has read several books written against the creation movement such as by Richard Dawkins, Carl Zimmer, and Niles Eldridge, and repeats many of the mistakes commonly made over and over again. An example is the claim that the vertebrate eye retina is inverted, i.e., light has to travel through blood vessels and nerves before it reaches the rods and cones, an "absurd" design that he concludes is proof that there was no intelligent creator (p. 36). This claim has been thoroughly refuted in the creationist and the scientific literature in general (see for example, Bergman, 2000).

As is typical of critiques of creationism, name calling is found on almost every page, such as that creationists spout "anti-evolution twaddle" (p. vii). He claims while evolution-