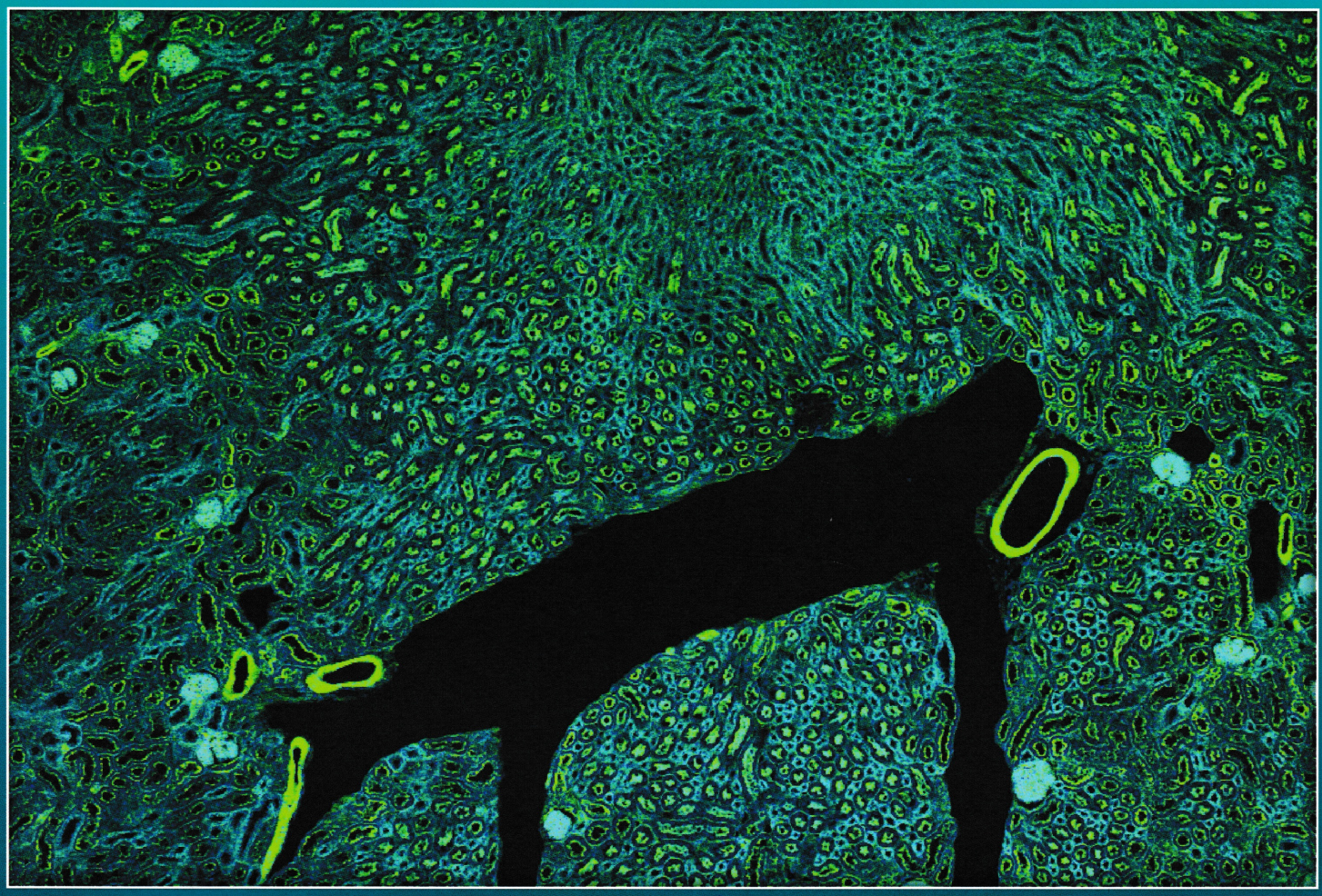
Texas Journal of Microscopy



Volume 56
Number 1, 2025
ISSN 1554-0820

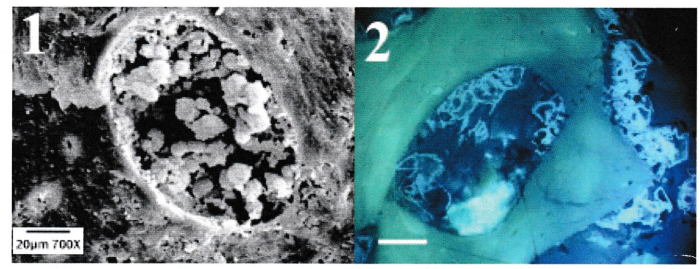
Visit our website at https://texas.microscopy.org/

LIGHT AND ELECTRON MICROSCOPE STUDIES OF IRON OXIDE FRAMBOIDS IN VESSELS OF DINOSAUR BONES.

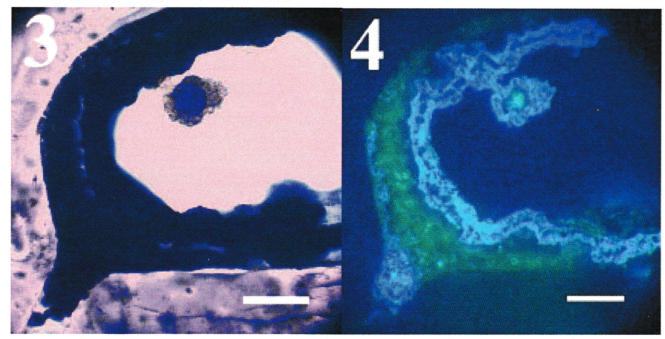
Mark H. Armitage, Keith Holcomb, Kersten Peterson, DSTRI.org, Sequim, WA, 98382.

The findings of soft tissue in dinosaur bones remain controversial, yet reports of soft tissue continue to be made [1, 2, 3]. To date, approximately 140 individual dinosaur bones have been demineralized (and reported) specifically for the purpose of collecting and characterizing soft tissues that might remain within them [1].

We collected *Edmontosaurus* post-cranial limb elements at Hell Creek Formation in Glendive, MT, USA, and limb bone elements from *Camarasaurus* at the Morrison Formation in CO, USA. Bones were subjected to fixation in formalin at the site for transport to the lab. Bones were rinsed in pure water, air-dried and ground thin sections were made to 40 micron thickness, Sections were affixed to glass slides and were examined without coverslip under reflected light UVFL for the presence of auto-fluorescing framboids within microvascular bone canals. Framboids are microscopic (about 20u in diameter) spherical aggregates of iron oxide or iron-pyrite, common in sedimentary layers and often found in dinosaur bone canals. Sections were also imaged under both secondary and backscattered electrons. Framboids were identified as spheres of varying sizes (Figures 1, 2). Elemental analysis revealed a substantial presence of iron and oxygen in framboids. Bones were also subjected to decalcification in EDTA and vessels with framboids within them were photographed in brightfield and UVFL microscopy. All framboids auto-fluoresced brightly under UV illumination indicating massive presence of iron-probably from heme in blood, especially *Edmontosaurus* (Figure 2) and *Camarasaurus* (Figure 4). Despite deep-time environmental factors, (erosion, water infiltration, annual freeze-thaw cycle, radiation) and predation (by bacteria, fungi, microbes, insects and worms), framboids adhered tenaciously within bone matrix walls and often completely occluded blood canals for the entire depth of sections (Figure 2). We were stunned that fixation, washing, dehydration and mechanical vibration (during intense grinding for sectioning), did not dislodge framboids or even separate them from canal walls. They form tight and uniform junctions against the hydroxyapatite walls of bone they are lodged in. Framboids are present in Volkmann canals as well. Intrusion of calcite or silica were not observed under polarized light. Many reports of putative blood cells have been made in the dinosaur soft tissue literature [4, 5], however as we have shown here, these structures are the wrong size and shape for red blood cells or white cells. They vary greatly in size but are present as round spheres, composed mostly of iron oxide.



Figures 1,2 SEM and UV Fluorescence (UVFL) framboids in *Edmontosaurus* limb microvascular canal, 40 micron ground section (Figure 2).



Figures 3,4 Brightfield (BF) and UV Fluorescence (UVFL) framboid in *Camarasaurus* limb microvascular canal, 40 micron ground section.

References

1. PV Ulman and MH Schweitzer, *Palaios* **38**(5) (2023), p. 246-257 DOI: doi.org/10.2110/palo.2022.026.
2. LA Anderson, *Earth Science Reviews* **240** (2023), 104367 DOI: https://doi.org/10.1016/j.earscirev.2023.104367.
3. JA Cruz and MH Armitage, *Microscopy and Microanalysis* Conference Proceedings (2024), https://doi.org/10.1093/mam/ozae044.998.
4. MH Schweitzer, *Scientific American* 303 (2010), DOI: https://www.jstor/stable/26002305.
5. AK Huttenlocker and CG Farmer, *Current Biology* **27** (2017), DOI: http://dx.doi.org/10.1016/j.cub.2016.10.012.