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THE HISTOLOGICAL ONTOGENY OF ORNAMENTED TRIONYCHIANS FROM THE KAIPAROWITS FORMATION OF UTAH

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Among the fossil vertebrate faunal assemblage from the late Campanian Kaiparowits Formation are at least 14 different genera of turtles, each with a distinct shell structure (Hutchison et al 2013). Surficial ornamentation of the bony shell, which often looks like ridges or pitting on the outer surface, differs between most turtle taxa. Due to the fragmentary nature of most turtle fossils from the Kaiparowits Formation, ornamentation patterns are often used to identify specimens to a generic level. Despite this, intergeneric variation of said ornamentation is still poorly understood. To document this variation and understand its influences, 27 specimens were selected for histological sampling. From these specimens, two adocusians and two trionychids from various growth stages are represented.

Once selected, specimens were documented using photography, molding and casting, and 3D scanning. Upon their approval for destructive analysis, specimens were embedded in epoxy and sectioned into one- to three-millimeter wafers. These wafers were mounted onto frosted glass microscope slides and manually ground to an average thickness of 90 microns using progressively-finer silicon carbide grit. Completed slides were evaluated under a standard petrographic microscope and composite images of each slide were generated using a Zeiss Axiomager M2 motorized microscope running Zen Professional Blue Software. While an emphasis is placed on external ornamentation, bulk histological anatomy is also described herein and again contextualized within a broader framework.

Consistent with previous studies (i.e. Scheyer et al 2007), relative zone thickness is ecologically and ontogenetically derived. Terrestrial turtles exhibit relatively thick and avascular cortices, while the cortices of aquatic and semiaquatic genera are generally thin and vascularized. As predicted by a standard reptilian growth model, rapid juvenile deposition is followed by slow and asymptotic adult deposition.

Ornamentation is also an ontogenetically-derived feature, with mature specimens exhibiting increasingly-defined ornamental morphologies in all genera. The mechanisms through which ornamentation develops are defined along higher taxonomic classifications. The trionychids will rapidly deposit a basal layer, then continue laminar deposition at an asymptotic rate. The adocusians will erode the external surface of the basal ornamentation and laminarily deposit derived ornamentation a top it. As a result, adocusian specimens exhibit resorption lines wherever lateral migration exceeds radial growth. While radial vascularization of the ornamentation suggests exogenic derivation, the varying depth and orientation of intruding Sharpey's Fibers suggests varying degrees of biomechanical influence.

The trionychid plywood-like structure expands externally, with additional layers being added along the distal margins of the shell. Although biomechanical testing is needed, we hypothesize that the structure laterally-thickens in response to mechanical stress inflicted upon

the shell. The lower ECO of the adocusians exhibits a dense and chaotic mat of secondary osteons, which would have similar biomechanical outcomes to that of the plywood-like structure.

Slight variations in the size, shape, and distribution of medullary lacunae are spatially- and taxonomically-derived. Variations in the thickness and vascularization of the internal cortex are ecologically-derived.

Although these observations go beyond the externally-identifiable histological structures used in field identification, they can still be used to identify the taxon of a sectioned specimen.

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