

## EXPANDED DORSAL RIBS IN THE LATE TRIASSIC PSEUDOSUCHIAN REPTILE *EUSCOLOSUCHUS OLSENI*

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The presence of expanded dorsal ribs is an unusual feature found only in a small number of tetrapod taxa. This condition, characterized by broadening of much of the entire rib shaft, differs from one where only a portion of the rib shaft is expanded or bears an uncinatate process (e.g., birds, crocodylians, and *Sphenodon*; Jenkins, 1970). Recently, there has been renewed interest in the structure and development of dorsal ribs among amniotes in connection with the evolutionary development of the carapace in turtles (Lyson et al., 2013; Schoch and Sues, 2015). Reinterpretation of the anteroposteriorly broadened dorsal ribs in the Middle Permian putative stem turtle *Eumotosaurus* (Lyson et al., 2013) and the discovery of similar ribs in the more derived Triassic stem turtles *Odontochelys* (Li et al., 2008) and *Pappochelys* (Schoch and Sues, 2015) suggest that this feature represented an important step in the early evolution of the turtle carapace.

Sues (1992) described a series of dissociated cervical and dorsal osteoderms and an incomplete dorsal vertebra of a new archosaurian reptile, *Euscolosuchus olseni*, from the Vinita Formation (formerly Turkey Branch Formation; Upper Triassic; Carnian) in the Richmond Basin of the Newark Supergroup at Midlothian, Virginia. Sues et al. (1994) have discussed the fossil locality and its geological context. Based on apomorphic features of the osteoderms, which formed two rows of dermal armor over at least the neck and trunk, Sues (1992) suggested referral of *Euscolosuchus olseni* to Pseudosuchia (Crurotarsi). A nearly complete rib was found together with disarticulated but still associated osteoderms and a dorsal vertebra of *Euscolosuchus olseni*. It was not included in the original description by Sues (1992) because it was not recognized as a rib at the time. In addition, a proximal end of another rib was recovered on an earlier occasion, but it articulates almost perfectly with the left transverse process of the dorsal vertebra. Referral of these elements to *Euscolosuchus olseni* is further supported by the distinctive external ornamentation on part of the rib shaft, which is indistinguishable from that on the external surfaces of the osteoderms and comprises round to oval pits of various sizes bounded by low ridges. The ribs clearly differ in their structure from those of *Doswellia kaltenbachi*, an unusual, heavily armored non-archosaurian archosauriform recovered from the Falling Creek Formation (Carnian) of Hanover County, Virginia (Dilkes and Sues, 2009). We here present a description of the two rib fragments referred to *Euscolosuchus olseni* and review their possible implications.

**Institutional Abbreviation**—USNM, National Museum of Natural History (formerly United States National Museum), Smithsonian Institution, Washington, D.C.

### METHODS

The better-preserved specimen, USNM 544104, was sectioned longitudinally and transversely to assess its histological structure, both in the proximal part as well as in the more distally situated ornamented shaft region. After molding and prior to sectioning with a diamond-sintered saw blade, the specimen was embedded in Technovit synthetic resin to prevent spalling of the outermost bony lamellae. Using the petrographic sectioning procedure outlined by Scheyer et al. (2014), sections were then ground manually using a series of silicon carbide powders (SiC 500, 800) to a thickness of 60 to 80  $\mu\text{m}$ . The thin-sections were studied using a Leica compound microscope DM 2500 M equipped with a Leica digital camera DFC 420C.

### DESCRIPTION

#### USNM 448590

This specimen is an incomplete right rib that lacks part of the bony substance of the anteroposteriorly broad and ornamented shaft (Fig. 1). Fortunately, distinct impressions in the matrix on both the part and counterpart blocks of this specimen permit reconstruction of the rib.

Details of the impression of the proximal rib head are difficult to interpret. The somewhat constricted ‘neck’ region is more strongly flattened dorsoventrally than in USNM 554104 and has an almost flat rather than concave, smooth dorsal surface. It is 16 mm wide at the widest point and up to 6 mm thick at the broken proximal end. Its anterior margin is more rounded and thicker than its posterior edge. The ventrolaterally and posteromedially extending expanded portion of the rib shaft is set off from the ‘neck’ portion by an angle of about 45°. Its greatest width is 35.05 mm, and it is about 80 mm proximodistally. The expanded region has a nearly straight posterior and a convex anterior edge and tapers slowly toward the apparently rounded-off distal end, resulting in a leaf-like outline. Its external surface is gently convex dorsoventrally and anteroposteriorly. The posterior portion of the expanded portion of the rib extends much further posteriorly relative to the neck region than the anterior one does anteriorly. Except for an about 6-mm-wide band along the anterior margin of the rib, the lateral surface of the proximal region of the expansion bears well-developed ornamentation comprising pits with greatest diameters ranging from 2 to 3 mm and bounded by low ridges. This

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