

# PRELIMINARY OBSERVATIONS ON A SKULL OF THE AMIID FISH *MELVIUS*, FROM THE UPPER CRETACEOUS KIRTLAND FORMATION, SAN JUAN BASIN, NEW MEXICO

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**Abstract**—The most complete skull of the amiid fish *Melvius* was recently recovered from the Upper Cretaceous (upper Campanian) lower Kirtland Formation (Hunter Wash Member) in the San Juan Basin, New Mexico. The specimen (SMP VP-1485) is identified as *M. chauliodous* based on its large size, and the fact that it comes from the type area and type stratum of *Melvius chauliodous*. It is significant for preserving numerous cranial elements that represent new osteological details for *Melvius*. The most notable elements include the brachiostegals, dermopterotic, extrascapular, intercalar, and parasphenoid (including the tooth patch and both ascending rami). The postinfraorbital bone has pronounced sculpturing similar to that seen in *M. thomasi*, the only character that is presently used to distinguish the species from *M. chauliodous*, so this calls into question the distinctiveness of the two named *Melvius* species. *M. chauliodous* is known solely from the lower Kirtland Formation (Hunter Wash Member) and possibly the upper part of the Fruitland Formation (Fossil Forest Member), San Juan Basin, New Mexico, so the species is restricted to strata of Kirtlandian age.

## INTRODUCTION

Late Cretaceous amiid fishes are the oldest representatives of a clade of haleocomorph fishes whose sole living representative is *Amia calva* (Patterson, 1973; Grande and Bemis, 1998). In the Upper Cretaceous strata of the San Juan Basin, New Mexico, one of the oldest amiids, *Melvius*, has been known from some disarticulated and disassociated cranial material and isolated vertebrae (Hall and Wolberg, 1989; Grande and Bemis, 1998; Lucas and Sullivan, 2000). The species *Melvius chauliodous*, known solely from the San Juan Basin, is considered an index taxon of the Kirtlandian land-vertebrate age (Sullivan and Lucas, 2006). Here, we add to the fossil record of *Melvius* an incomplete skull and some limited vertebral remains from the lower Kirtland Formation (Hunter Wash Member). This specimen includes the most complete known cranial material of *Melvius* (Sullivan, 2006), and our goal is to present a preliminary description and illustrations of the fossil pending a more detailed study. In this article, KUVP = University of Kansas, Natural History Museum, Lawrence; SMP = The State Museum of Pennsylvania, Harrisburg; and UCMP = University of California Museum of Paleontology, Berkeley.

## PROVENANCE

The *Melvius* specimen (SMP VP-1485) was collected by Denver Fowler and Robert M. Sullivan at SMP loc. 281 (“Denver’s Blowout”) in Ah-shi-sle-pah Wash, San Juan County, New Mexico. This locality is in the Hunter Wash Member of the Kirtland Formation, so it is of Kirtlandian (late Campanian) age, ~ 74 Ma (Sullivan and Lucas, 2006) (Fig. 1).

## SYSTEMATIC PALEONTOLOGY

### Amiidae Bonaparte, 1838

### Vidalmiinae Grande and Bemis, 1998

### Vidalmiini Grande and Bemis, 1998

### *Melvius* Bryant, 1987

*Amia* (in part), Linnaeus, 1766.

**Type species:** *Melvius thomasi* Bryant, 1987.

**Distribution:** Late Cretaceous (Campanian through Maastrichtian) of North America.

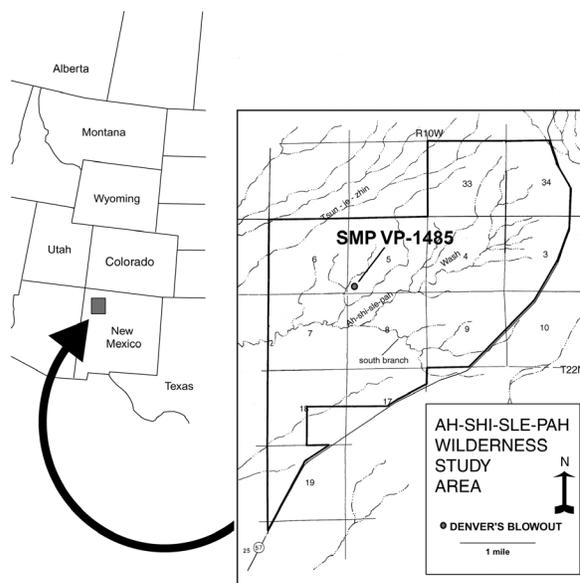


FIGURE 1. Index map of New Mexico showing the *Melvius* locality.

### *Melvius chauliodous* (Hall and Wolberg, 1989)

Figs. 2-5, 6A-B, 7

*Amia? chauliodeia* Hall and Wolberg, 1989, p. 108, figs. 2-4.

*Melvius chauliodous* Grande and Bemis, 1998, p. 401, figs. 288-289.

**Referred material:** SMP VP-1485, incomplete skull, lower jaws, and incomplete centra and one complete centrum.

**Occurrence and Distribution:** Hunter Wash Member, Kirtland Formation, New Mexico. This is the same horizon as that of the holotype (KUVP 88378), which was reported as the Fruitland Formation (in the Fossil Forest RSA), San Juan Basin, New Mexico (Hall and Wolberg, 1989) based on mapping by Brown (1983).

**Age:** Late Cretaceous (late Campanian).

## DESCRIPTION

SMP VP-1485 (Figs. 2-5, 6A-B, 7) is an incomplete skull, including some skull roof bones, incomplete left and right maxillae, the parasphenoid and some cranial elements. Also associated are a nearly complete right dentary with one complete tooth *in situ* and several partial teeth, a cleithrum and two incomplete vertebral centra. At least 20 incomplete bones/bone fragments with dermal texture represent bones of the skull roof. A few of these bones are complete enough to be tentatively assigned to a specific element. Other bones pertain to the cranium, maxillary, dentary and proximal axial skeleton. What follows is a preliminary description of key elements from this new and important specimen.

### Parietal

The right parietal is a large, nearly rectangular piece ornamented by curved ridges that radiate away for a single point at which the ridges form a cross-hatched texture (Fig. 2A-B). The identity of this bone is based on similarity to the parietal figured for *Melvius thomasi* in Grande and Bemis (1998, fig. 287b). What we interpret as the anterior edge of this bone is narrow and blade-like in cross section and is slightly concave anteriorly. The ventral surface of this bone is nearly smooth, with a slightly radiating texture that mimics the texture of the dorsal (external) surface. Toward the antero-medial edge of the bone there is a process with a sutural edge along the antero-medial margin of the bone. We identify this as the frontal suture. The lateral and posterior edges of the parietal are broken, so the incomplete bone measures 78 mm in maximum antero-posterior length, and 49 mm in width. A similar, but smaller fragment is tentatively identified as the center portion of the left parietal (Fig. 2C-D).

### Dermopterotic

An incomplete sub-rectangular ornamented bone with radiating ridges is identified as the left dermopterotic (Fig. 3A-B). The radiating ridges emanate from the posterolateral part of the bone, with the long ridges extending anteriorly.

### Extrascapular

The extrascapular is a moderately thick element bearing a dorsal (external) texture consisting of a complex network of short irregular ridges posteriorly, with well-defined elongated ridges extending anteriorly (Fig. 3C-D). The anterolateral edge bears a concave articular surface for the dermopterotic. The remaining edges of the bone are broken and incomplete. The ventral surface of the bone is smooth except for several small foramina and a broken flange near the posterior margin. We identify this element as the right extrascapular based on comparison to that of *Pachyamia mexicana* (see Grande and Bemis, 1998, fig. 278). This element has not been previously identified in *Melvius* (Bryant, 1987; Hall and Wolberg, 1989; Grande and Bemis, 1998).

### Postinfraorbital

The postinfraorbital is a thick, sub-ovoid bone that has deep, irregularly spaced ridges that converge anteriorly (Fig. 3H-I). The pronounced ornamentation differs from that seen in the holotype of *Melvius chauliodus*, which happens to be the sole character that serves to distinguish *M. chauliodus* from *M. thomasi* (Grande and Bemis, 1998, p. 401). Although it is incomplete, this element is most certainly a right postinfraorbital based on comparison to those figured in Bryant (1987, fig. 6) and Grande and Bemis (1998, figs. 287G, 288E).

### Maxilla

The right maxilla (Fig. 4) is a rod-like, curved element bearing the round alveoli/root bases of at least 12 closely-spaced teeth. The outlines of the posterior alveoli are damaged and impossible to discern, so the number of tooth sockets exceeds 12 (Fig. 4A, C). The anterior process of

the maxilla is a long, pointed, edentulous process with a triangular cross-section. The posteriormost edge of the right maxilla is damaged, but the thick narrow ventral process, characteristic of the Vidalamiini (*sensu* Grande and Bemis, 1998), is preserved and nearly complete (Fig. 4A-B). Total length of the right maxilla (as preserved) is 203 mm, and the maximum diameter of its edentulous portion is ~21 mm. The incomplete left maxilla has the same morphology.

### Dentary

The right dentary (Fig. 5) conforms to other specimens of *Melvius*, but it is more complete than other known dentaries (Bryant, 1987, figs. 9-11; Grande and Bemis, 1998, figs. 286B, 287D; Lucas and Sullivan, 2000, fig. 6A-C). This dentary preserves 15 tooth positions as either teeth in sockets (tooth positions 1, 5, 7, 8, 10, 12, 14, and 15) or as aveoli, some with root/tooth bases in the sockets (tooth positions 2, 3, 4, 6, 9, 11, and 13). The posterior end of the dentary is broken, and the total preserved length = 240 mm.

The teeth are conical with stout root bases, rounded cross sections and enameloid tips (crowns) that are pointed and curved medially. Only the tooth crown in position 8 is complete (Fig. 5). The dentary is smoothly convex laterally, with rugose or lined lateral and ventral surfaces marked with small foramina. The dorsal surface of the dentary, medial to the tooth row, is smooth and concave dorsally. A prominent Meckelian groove extends from the symphysis back along the entire tooth row. Posterior to tooth position 10, the medial surface of the dentary has a large Meckelian fossa.

### Cleithrum

The right cleithrum (Fig. 6A-B), is a boomerang-shaped bone with the distance between both tips is 220 mm. The dorsal arm of the cleithrum differs from that described for *Melvius thomasi* (UCMP 129601) by Bryant (1987, fig. 8) and Grande and Bemis (1998, fig. 287E) in being slightly more gracile and taller. The anterior facing dorsal tip of the dorsal arm is broken. SMP VP-1485 has an ~112° angle between the dorsal and ventral arms, measured medially. It also lacks ornamentation on the posterolateral surface of the dorsal arm. The angle between the two cleithrum arms of *M. thomasi* is 90° (Bryant 1987; Grande and Bemis, 1998). SMP VP-1485 also has a long, anteriorly directed ventral arm that is broken along its ventral border.

Another somewhat more complete and better preserved right cleithrum (SMP VP-3383; Fig. 6C-D), of approximately the same size, was recently discovered in the upper Fruitland Formation, close to the Fruitland-Kirtland boundary. The dorsal ascending arm is nearly complete, while the ventral anterior extension of the arm is broken anteriorly. The angle between the two arms of SMP VP-3383 is 100°, suggesting that the angle between the arms of the cleithrum may be variable among specimens of *Melvius*. This latter specimen is referred to *Melvius* sp.

### Other cranial elements

Part of SMP VP-1485 is a block of sandstone with most of the parasphenoid prominently exposed, together with branchiostegals, opercular elements and the left frontal in ventral aspect (Fig. 7). These elements have not been described for *Melvius* and will be studied in greater detail when preparation is complete. Briefly, the parasphenoid is a long, nearly tubular bone that widens posteriorly to have a nearly flattened, rectangular cross section. An ovoid tooth patch, measuring 4.5 cm in length and 1.7 cm wide, is present on the anterior half of the ventral surface. The ascending rami of the parasphenoid flank the lateral margins of the tooth patch region. Lateral to the parasphenoid are the prootic and the intercalar, which partially cover seven thin, rod-like branchiostegals. The frontal is long and narrow, with a concave posterior articulation for the dermopterotic and a blunt anterior edge where it meets the nasal.

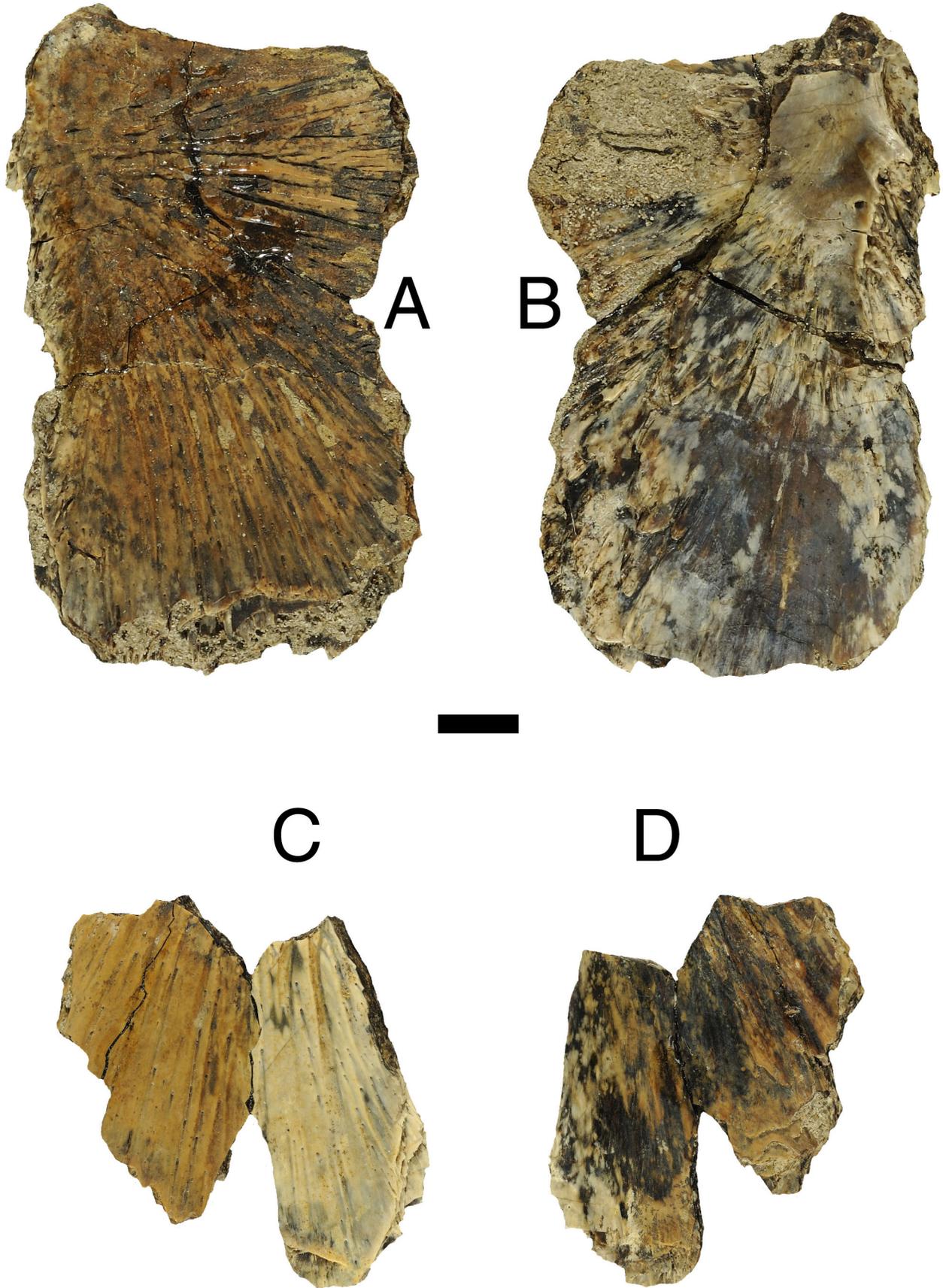


FIGURE 2. *Melivius chaultodous*, SMP VP-1485, A-B, right parietal in A, dorsal and B, ventral views. C-D, ?central portion of left parietal in C, dorsal and D, ventral views. Scale bar = 1 cm.

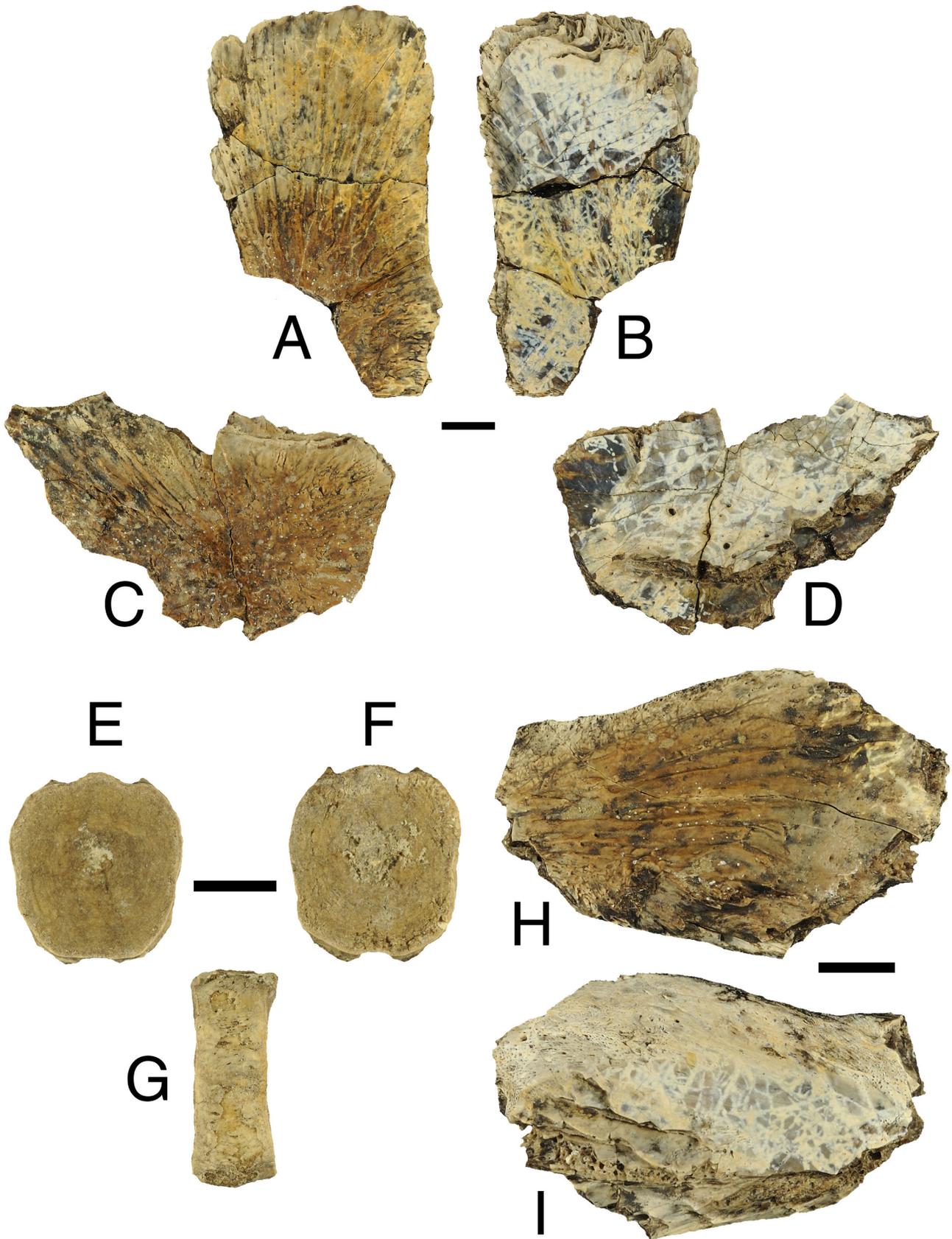


FIGURE 3. *Melvius chauliodous*, SMP VP-1485, A-B, left dermopterotic in A, dorsal and B, ventral views. C-D, right extrascapular in C, dorsal and D, ventral views. E-G, centrum in E, anterior, F, posterior and G, left lateral views. H-I, right postinfraorbital in H, dorsal and I, ventral views. Scale bar = 1 cm.



FIGURE 4. *Melvius chauliodous*, SMP VP-1485, right maxilla in **A**, medial, **B**, lateral, **C**, ventral and **D**, dorsal views. Scale bar = 10 cm.

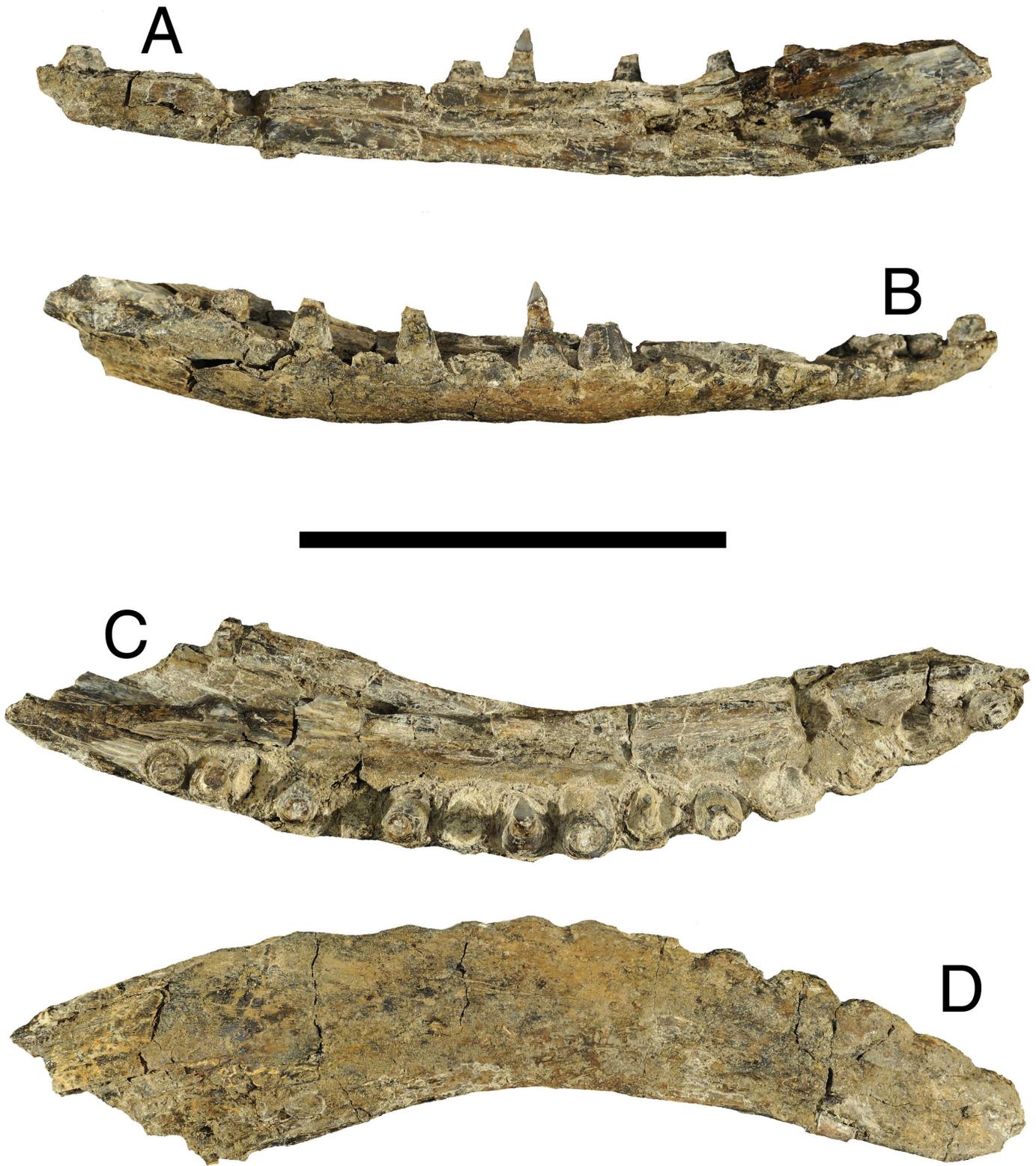


FIGURE 5. *Melvius chauliodous*, SMP VP-1485, right dentary in **A**, medial, **B**, lateral, **C**, dorsal and **D**, ventral views. Scale bar = 10 cm.



FIGURE 6. *Melvius chauliodous*, SMP VP-1485, incomplete right cleithrum in A, medial and B, lateral views. SMP VP-3383, incomplete right cleithrum in C, medial and D, lateral views. Scale bar = 10 cm.

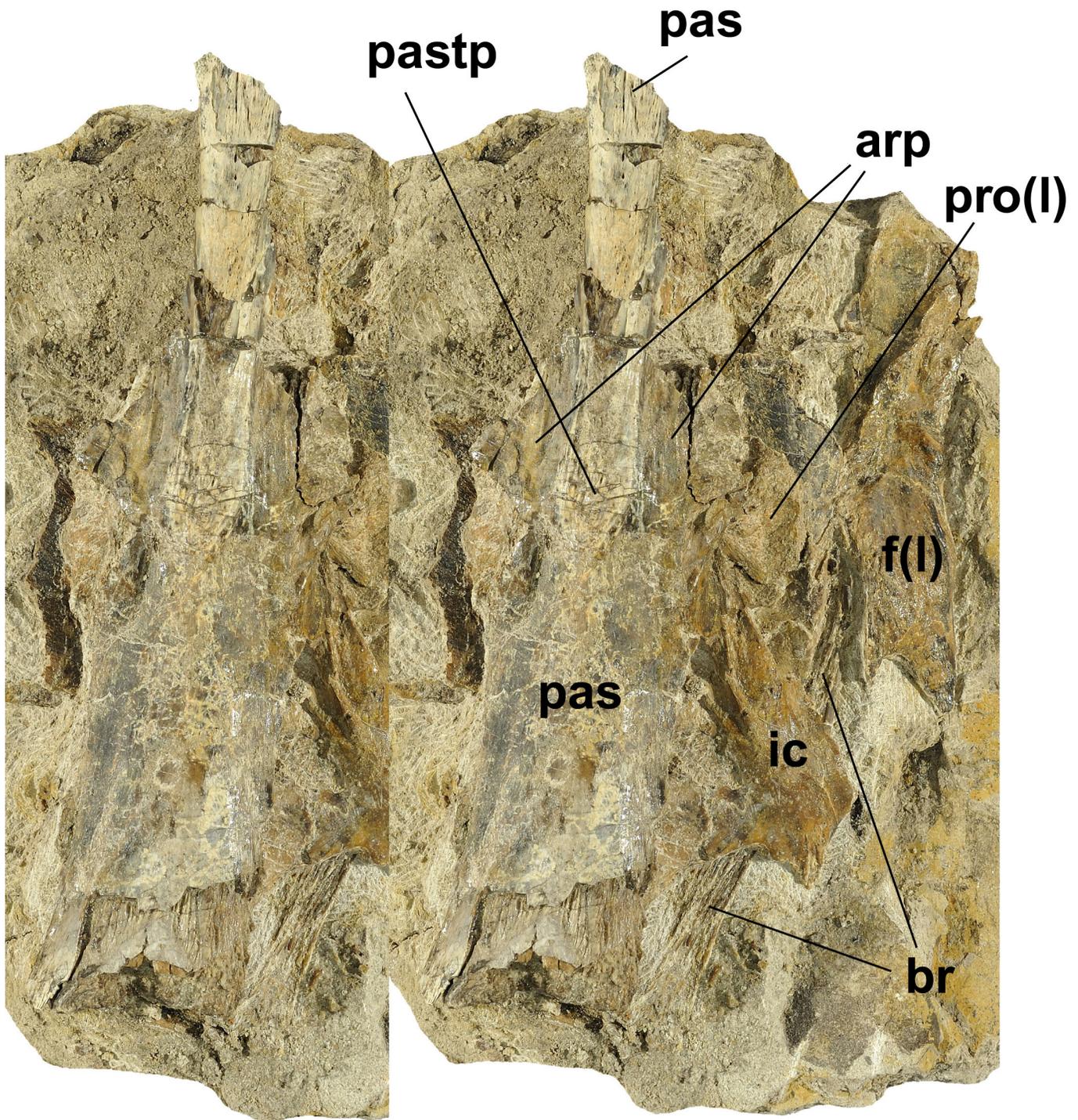


FIGURE 7. *Melvius chauliodous*, SMP VP-1485, ventral side of semi articulated skull in sandstone matrix (stereo). **Abbreviations:** **arp**, ascending ramus of parasphenoid; **br**, branchiostegals; **f(l)**, left frontal; **ic**, intercalar; **pas**, parasphenoid; **pastp**, parasphenonoid tooth patch; and **pro(l)**, left prootic. Scale bar = 10 cm.

### Vertebrae

A minimum of four vertebral centra are part of SMP VP-1485, including one complete caudal centrum (Fig. 3E-F). They are characteristically antero-posteriorly short, biconcave spools with a ventro-lateral concavity.

### DISCUSSION

SMP VP-1485 is significant because it is the most complete skull of *Melvius* known. Many cranial elements represent new osteological details for *Melvius*, including the brachioistegals, dermopterotic, extrascapular, intercalar, and parasphenoid (and its associated tooth patch and ascending rami). Grande and Bemis (1998) diagnosed *Melvius chauliodus* in having a less defined ornamentation pattern of the postinfraorbital compared to the only other known species *M. thomasi*. However, SMP VP-1485 has a well defined ornamentation, suggesting that this character is variable in *Melvius*, which thus calls into question the distinctiveness of the two named species. The specimen is identified as *Melvius chauliodus* based on morphological similarity to the holotype and paratype (KUVF 88378 and 15241, respectively) and large size. The new material is also from the type area of *M. chauliodus* and

from the same strata, so it is likely to be the same species, and not necessarily assignable to *M. thomasi*, which is from the younger upper Hell Creek Formation in the geographically separate region of northeastern Montana. A more detailed study of SMP VP-1485 may further help to distinguish *M. chauliodus* from *M. thomasi*. Presently, *Melvius chauliodus* is known solely from the lower Kirtland Formation (Hunter Wash Member) and possibly the upper part of the Fruitland Formation (Fossil Forest Member), San Juan Basin, New Mexico, so it is restricted to strata of Kirtlandian age.

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