Homoplasy in the ear region of Tethytheria and the systematic position of Embrithopoda (Mammalia, Afrotheria)

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Supplementary materials

Appendix A-1. List of characters and character matrix for the cladistic analysis.

Appendix A-2. CT slides of *Numidotherium koholense* (UOK5).

Appendix A-1. List of characters and character matrix for the cladistic analysis.

List of characters:

1. Hypoglossal foramen (Court, 1992b): (0) absent, fused to the posterior lacerate foramen; (1) present.
2. Paroccipital process (Court, 1992b): (0) reduced; (1) developed.
3. Foramen ovale (Court, 1992b): (0) absent, fused to the medium lacerate foramen; (1) present.
4. Postglenoid foramen or ventral foramen for the temporal canal (after Gheerdrant et al., 2005b): (0) absent; (1) present.
5. Location of the external auditory meatus (Court, 1992b): (0) on the ventral margin of the squamosal; (1) deep into the squamosal.
6. Posttympanic process and postglenoid process of the squamosal (Gheerbrant et al., 2005b): (0) unfused; (1) fused ventrally.
7. Epitympanic sinus of the squamosal (coded after Van der Klaauw (1931)): (0) absent; (1) present.
8. Epitympanic sinus of the exoccipital: (0) absent; (1) present.
9. Ossification of the bulla: (0) annular (ectotympanic only); (1) fully ossified (ectotympanic + entotympanic); (2) petrosal contribution to the bulla (Fischer, 1989).
10. Petrosal pachyosteosclerosis (Benoit et al., 2013b): (0) absent; (1) present.
11. Course of the carotid artery (Wible, 1986): (0) lateral (transpromontory sulcus present); (1) medial (transpromontory sulcus absent).
12. Stapedial sulcus (Thewissen and Domning, 1992): (0) absent; (1) present.
13. Shape of the *tegmen tympani* in ventral view (Benoit et al., 2013b): (0) other shape; (1) kydney shaped.
14. Tegmen process: (0) absent; (1) present, forms a large squared process.
15. Shape of the *fenestra vestibuli*: (0) oval (stapedial ratio >1.7); (1) round (stapedial ratio <1.7). According to Segall (1970), the shape of the *fenestra vestibuli* and stapedial footplates is an important taxonomic character. For example, it distinguishes the marsupials, which tend to have a rather round *fenestra vestibuli* (ratio below 1.8), from placentals in which the *fenestra vestibuli* is comparatively more oval (ratio at or above 1.8) (Segall, 1970).
16. Fusion of the cochlear canaliculus and the *fenestra cochleae* (Court, 1990): (0) absent, foramina separated by the *processus recessus*; (1) present, *processus recessus* absent.
17. Point of entry of channel of the cochlear canaliculus and the *fenestra cochleae* into the *scala tympani*: (0) distant from one another; (1) close to one another.
18. *Hiatus fallopi*: (0) forms a discrete foramen within the petrosal; (1) forms a notch (fallopian notch).
19. Prootic sinus: (0) absent, (1) present.
20. *Crista falciformis*: (0) thick; (1) thin.
21. Mastoid apophysis: (0) developed; (1) reduced; (2) sirenian state (Novacek and Wyss, 1987).
22. Occipital fenestra (coded after Novacek and Wyss, 1987): absent or small mastoid foramen present (0), present and large (1).
23. Subarcuate fossa: (0) deep; (1) shallow.
24. Morphology of the cochlear canal: (0) planispiral (cochlear ratio < 0.6); (1) conical (cochlear ratio > 0.6).
25. Relative volume of the cochlear canal: (0) >40%; (1) approximates 30%.

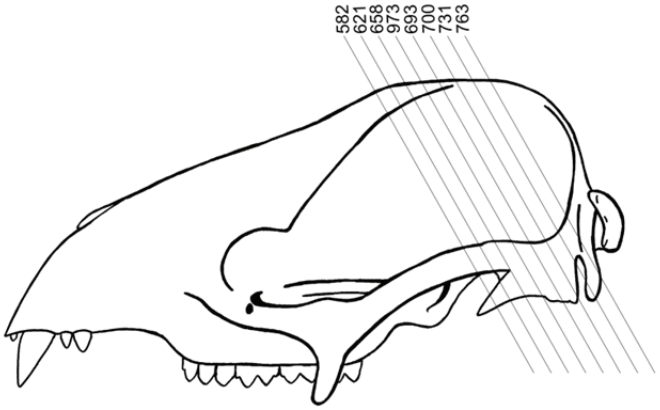
26. Secondary bony lamina: (0) absent; (1) present.
27. Secondary common crus: (0) absent; (1) present.
28. Position of the lateral canal with respect to the posterior canal: (0) high, the lateral canal crossing the space defined by the posterior canal; (1) low, the posterior limb of the lateral canal running along the ampullar limb of the posterior canal.
29. Mean of the angles between the plane of semicircular canals: (0) acute, mean angle <85°; (1) nearly right, mean angle >85°.
30. Shape of the posterior semicircular canal: (0) rounded; (1) oval.
29. Semicircular canals radii: (0) different, the anterior and/or posterior canal is the larger; (1) nearly equal.
32. Semicircular canals aspects: (0) slender; (1) stocky.
33. Shape of the crural limbs of the vertical canals: (0) cylindrical; (1) flattened.

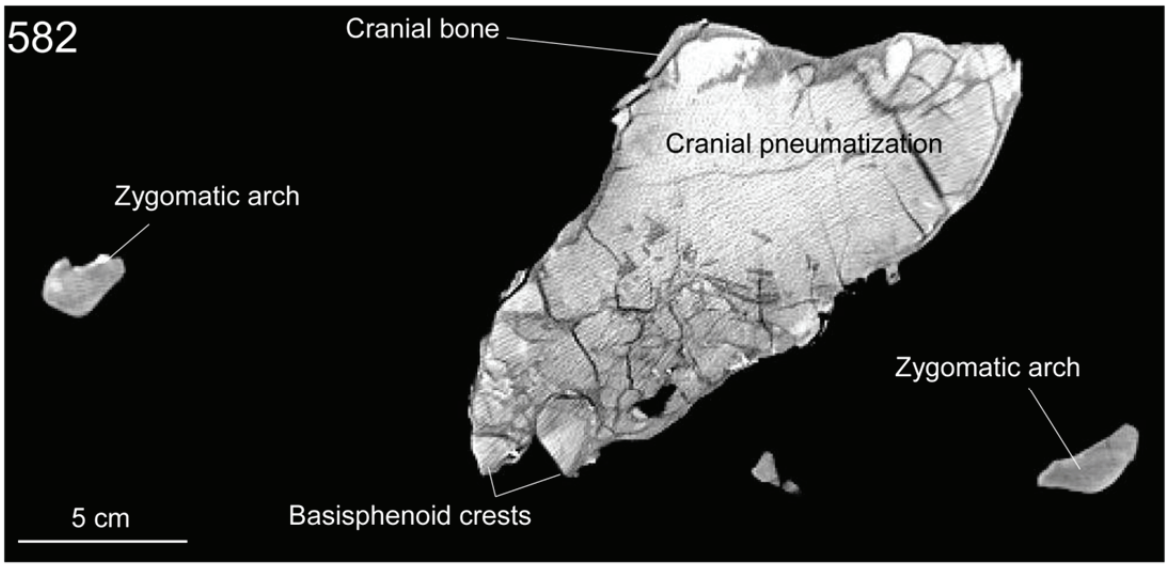
Character matrix:

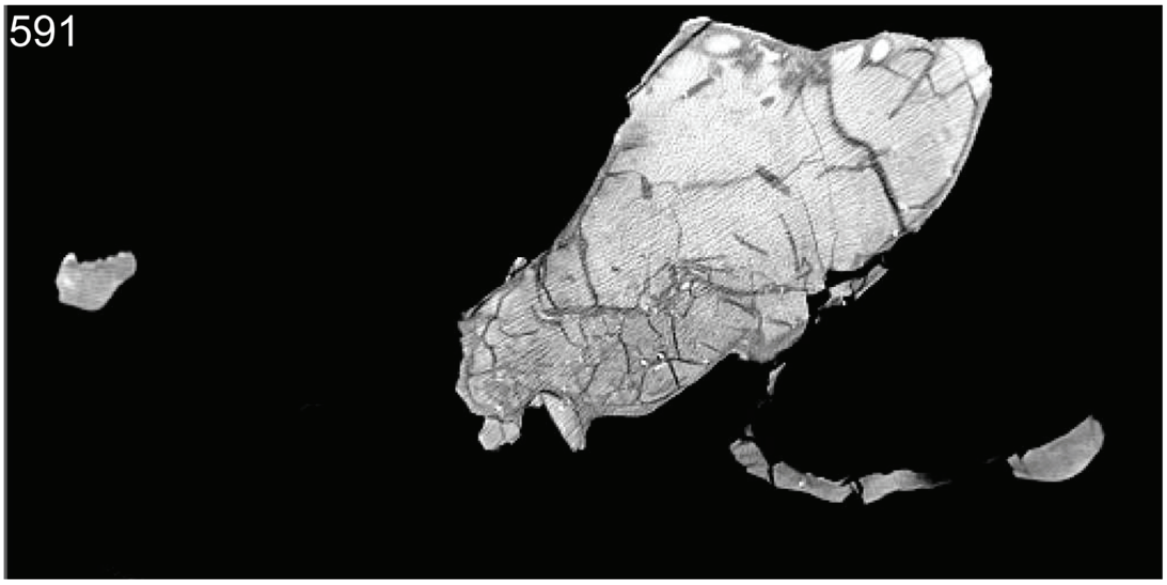
	1	*11*	*21*	*31*
Zalambdalestes	11110-00??	110000?010	0000?11-10	000
Marsupialia	11110-1000	1000101010	000(01)011-10	000
Chambius	??????????0	01000-0000	0?01011-10	000
Orycteropus	10100-1000	01--1-0000	0010011-01	000
Procavia	11100-?020	10000-0000	1011010010	001
Arsinoitherium	00011(01)10?0	100111?101	1010100101	011
Desmostylus	111011101?	??????????1	111???????	???
'Chambi sirenian'	??????????1	101000?000	1??1001-00	100
Prorastomus	11100-00?1	1011101100	2110000101	100
'Extant sirenians'	(01)1000-0001	1010111100	21100001(01)0	100
Phosphatherium	101100???0	10???0?001	101???????	???
Numidotherium	001?10?110	0001001101	1010011-0?	000
Moeritherium	010111?1??	10???1???1	1011??????	???
Elephantimorpha	0001111110	1001(01)11(01)01	1010(01)00100	011

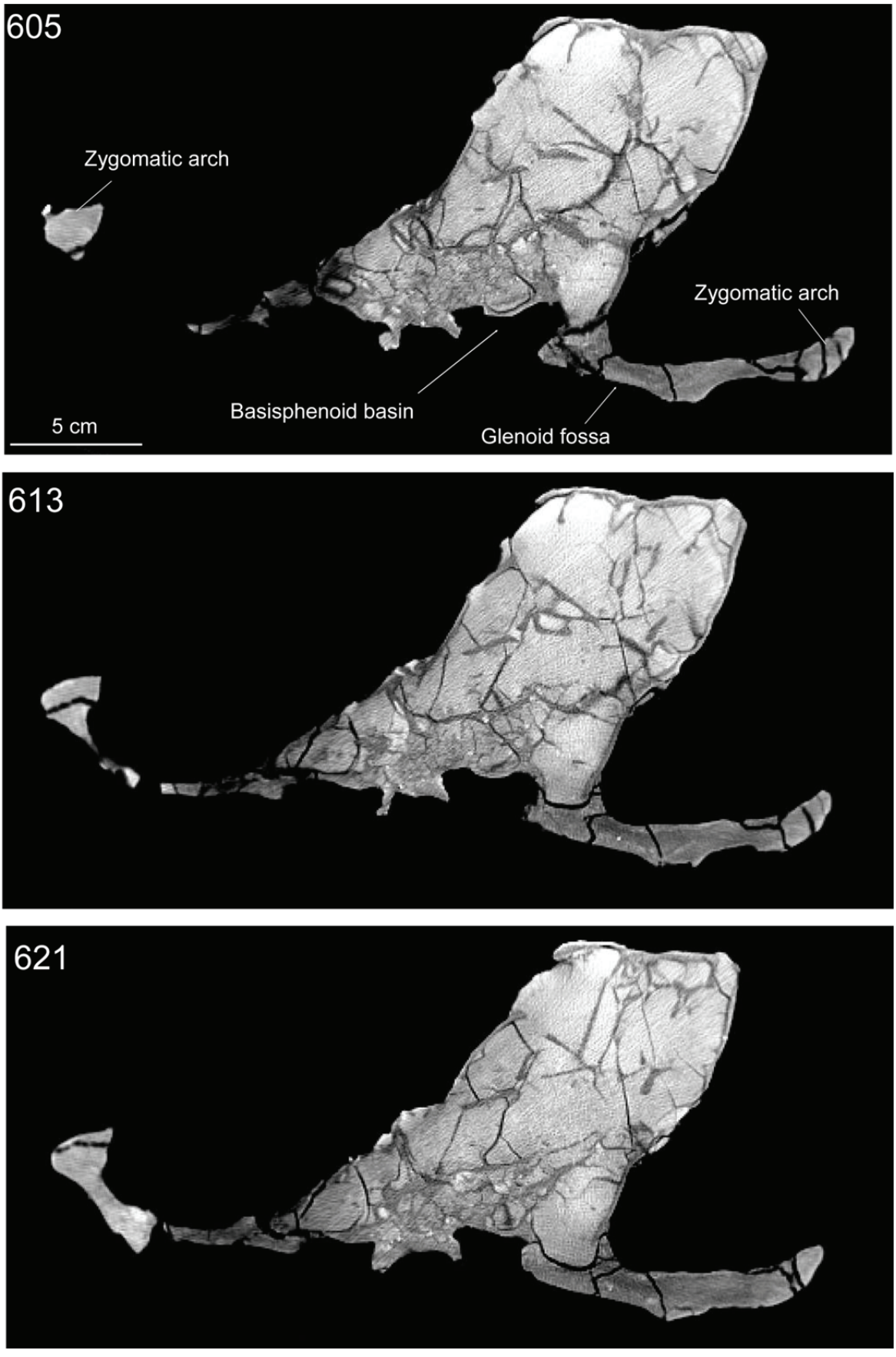
Appendix A-2. CT slides of Numidotherium koholense (UOK5).

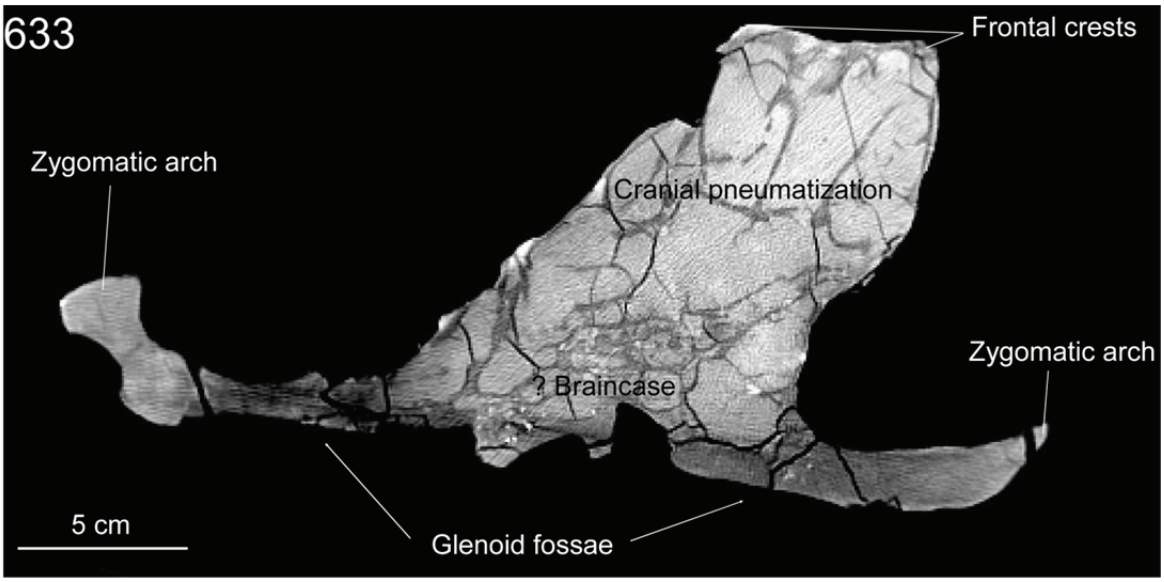
Drawing of the skull is a composite reconstruction mainly based on UOK 5 and UOK 6. UOK 5 has been crushed by diagenesis but many features of the skull can be observed on CT images. The main feature of the internal morphology is the extensive pneumatisation of cranial bones. These bones display many cavities which are separated by many thin bony septa. The braincase seems to have been crushed under the weight of sediments, but the point of entry of the spinal cord (*foramen magnum*) is highlighted on CT scans because an isolated numidothere's tooth has been stuck within.

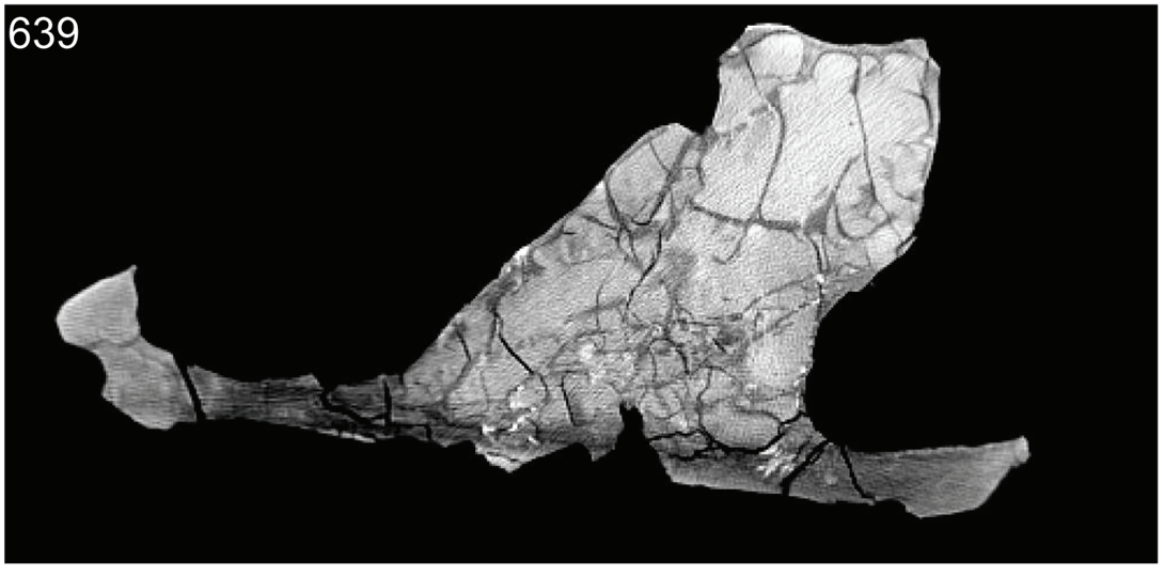


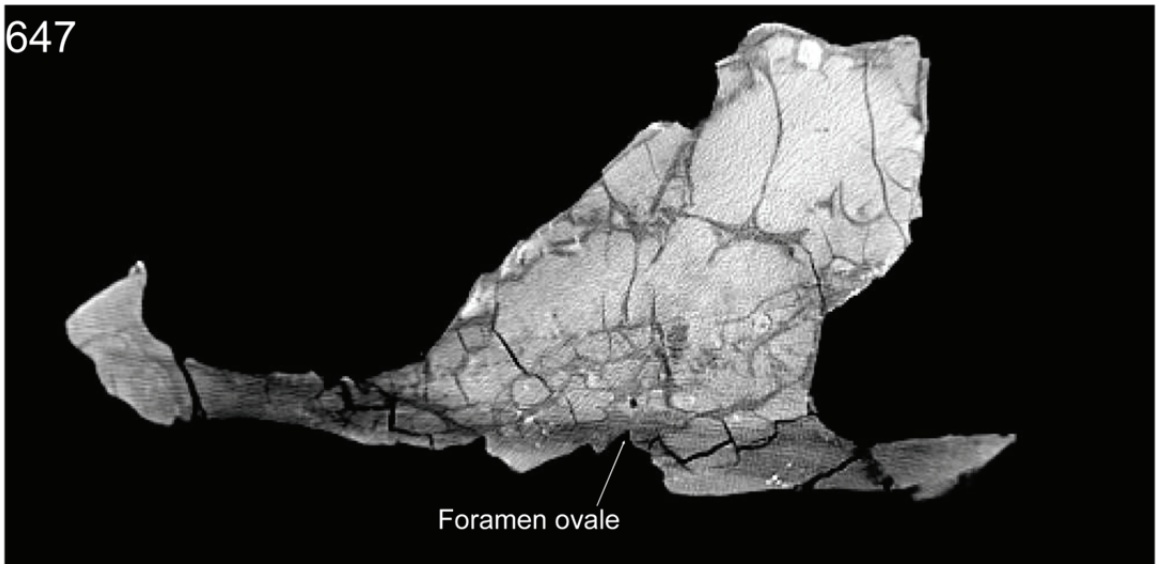


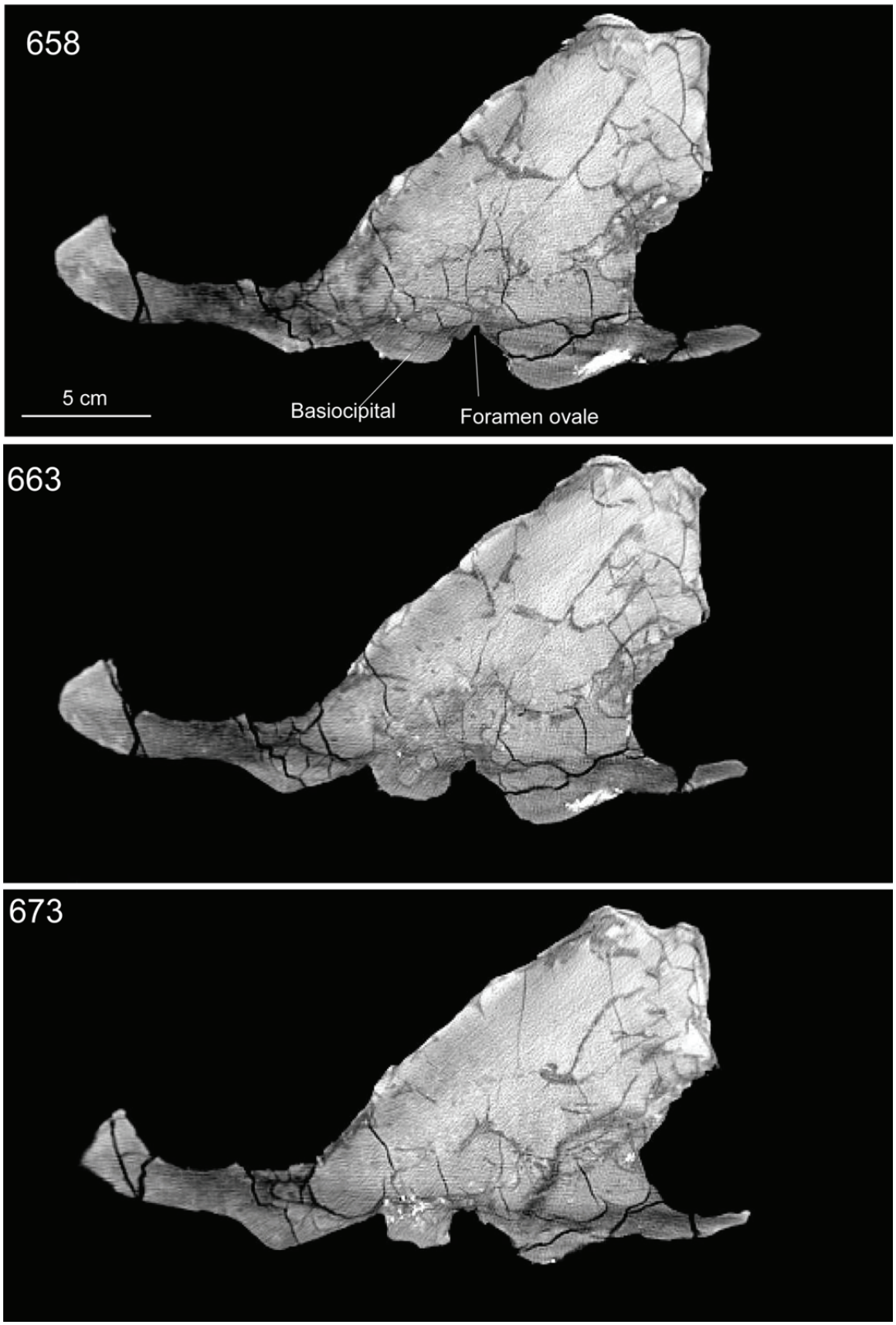


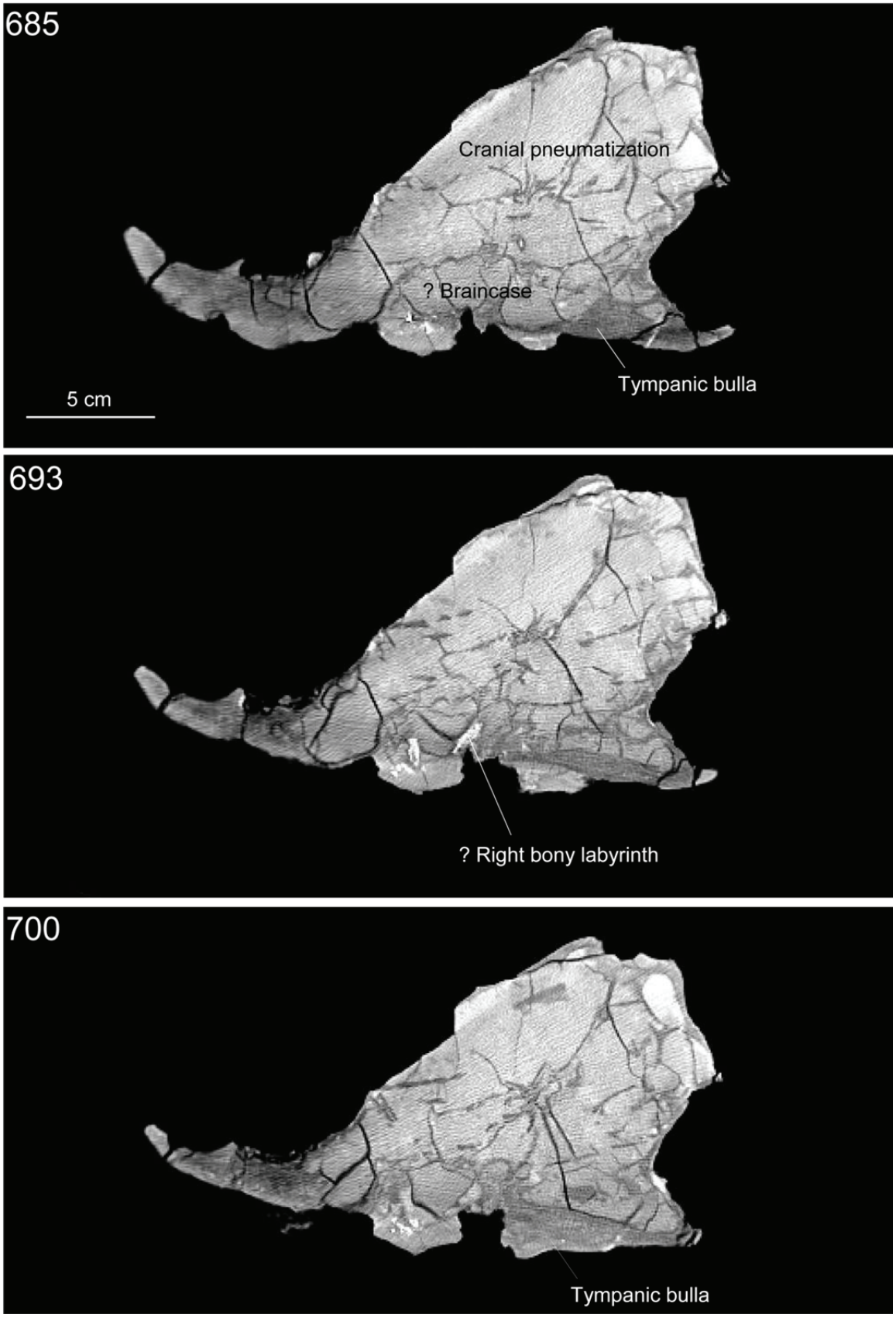

605
Zygomatic arch
Zygomatic arch
Basisphenoid basin
Glenoid fossa
5 cm
613
621

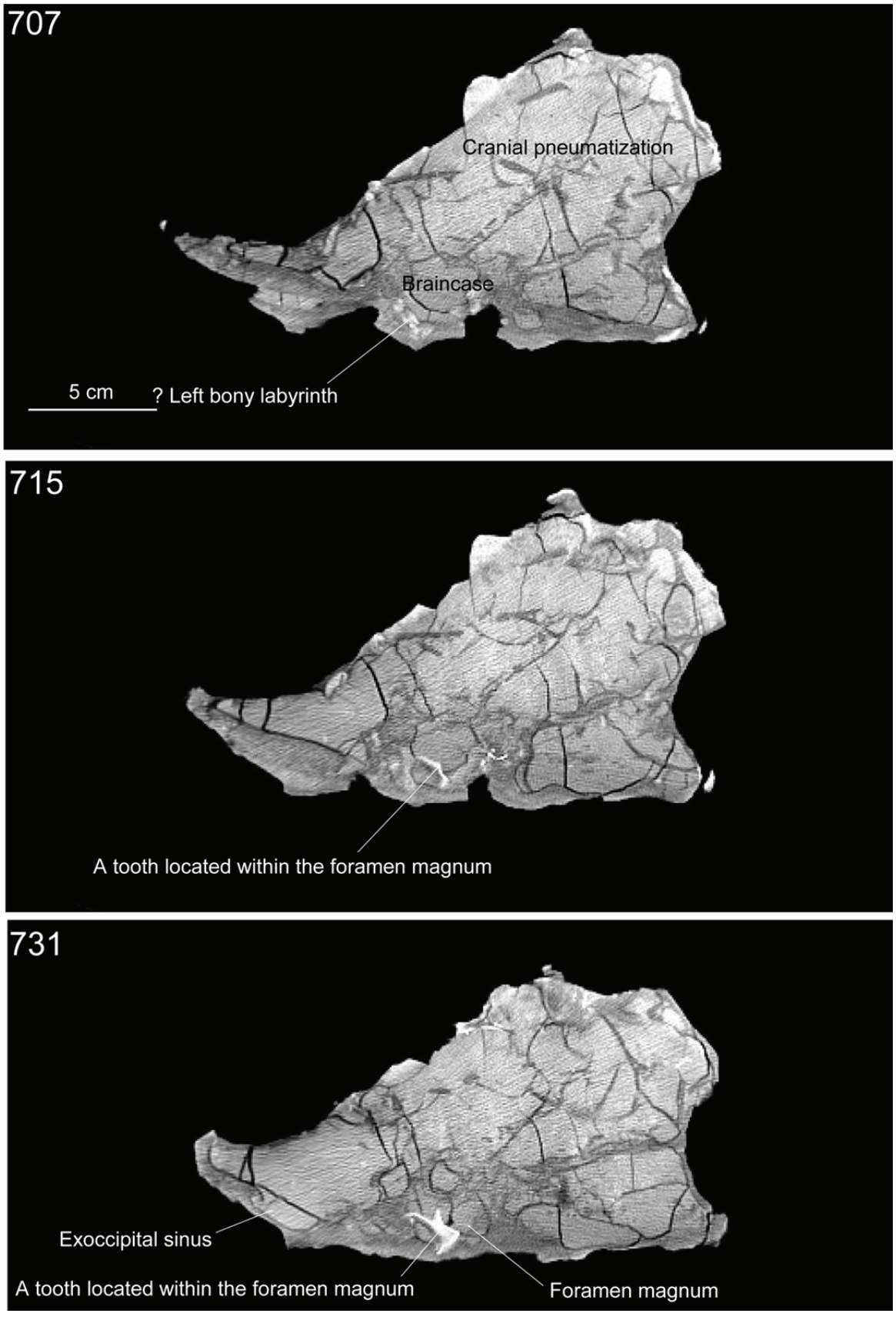

633
Frontal crests
Zygomatic arch
Cranial pneumatization
Zygomatic arch
? Braincase
5 cm
Glenoid fossae

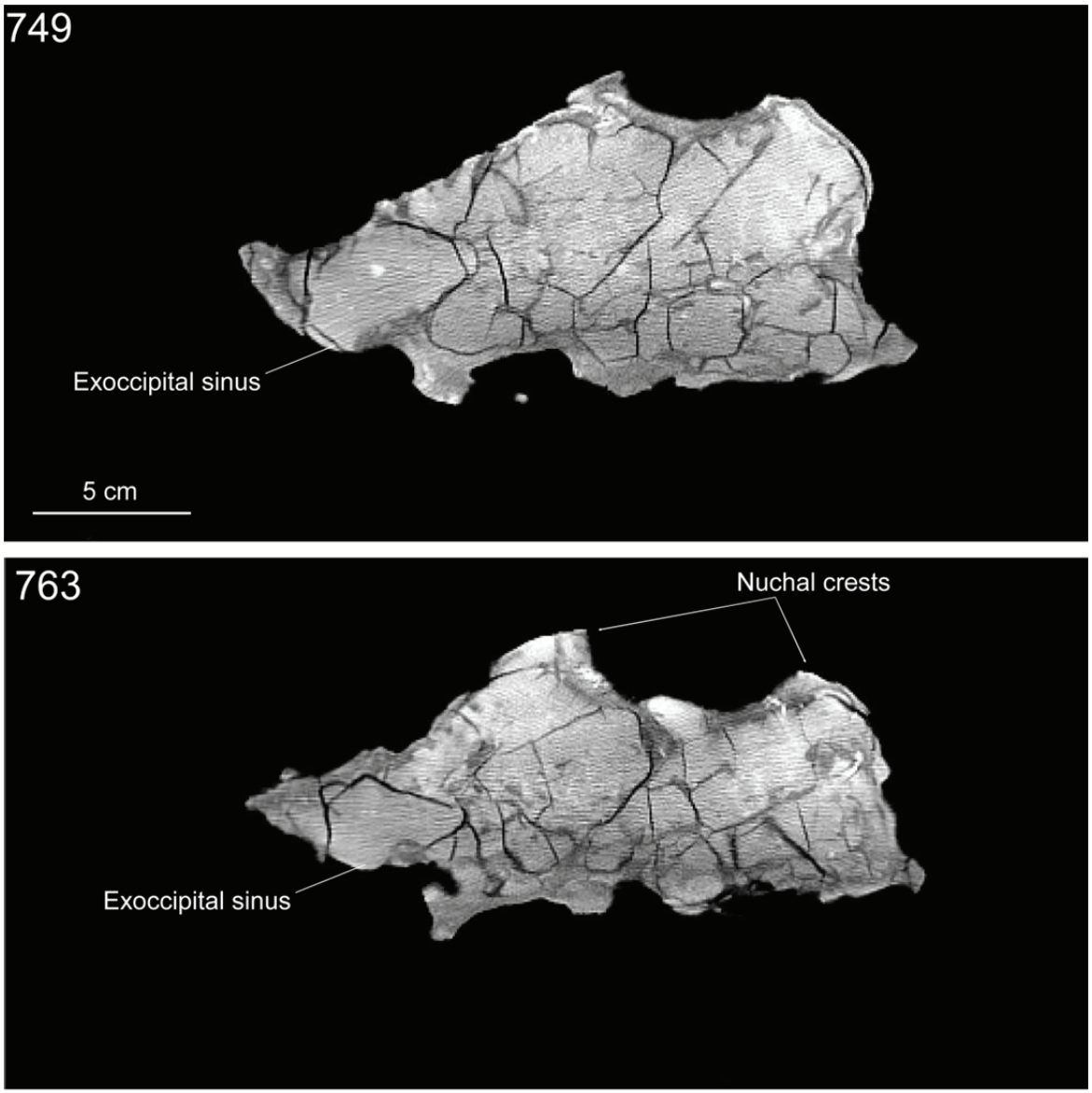

639


647
Foramen ovale


658
5 cm
Basiocipital
Foramen ovale
663
673


685
Cranial pneumatization
? Braincase
Tympanic bulla
5 cm
693
? Right bony labyrinth
700
Tympanic bulla


707
Cranial pneumatization
Braincase
5 cm
? Left bony labyrinth
715
A tooth located within the foramen magnum
731
Exoccipital sinus
A tooth located within the foramen magnum
Foramen magnum


749
Exoccipital sinus
5 cm
763
Nuchal crests
Exoccipital sinus