Turtle assemblages of the Jehol Biota in Northeast China

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Background. Cryptodires represent the largest group of living turtles (Testudines) with a wide range of habitat preferences from terrestrial through freshwater to marine. Their origin and early evolution can be traced back to the extinct pancryptodires of the Middle to Late Jurassic and particularly to the Early Cretaceous of East Asia. In the last two decades, plenty of turtle fossils have been discovered in the Jehol Biota of Northeast China but very few of them have been described. Until now, only four taxa have been reported from western Liaoning and adjacent areas including *Manchurochelys manchoukuoensis*; *Ordosemys liaoxiensis*; *Liaochelys jianchangensis*; and the soft-shelled turtle *Perochelys lamadongensis*. Here we recognize that the Jehol Biota opens an important window into the origin and early evolution of Cryptodiran turtles.

Results. Based on our preliminary study, two more taxa can be added to this list, implying a high diversity of the turtle assemblage in these areas. The first is from the Yixian Formation of Ningcheng, Inner Mongolia and diagnostic by an unusual combination of features: midline contact of prefrontals; elongated supraoccipital crest; fourth cervical vertebra biconvex; preneural absent; eight neurals; two subequal suprapygals; pygal present; third costals with parallel anterior and posterior sides; narrow distal ends of posterior costals; closed costo-peripheral, lateral and central plastral fontanelles. The second taxon is from the Jiufotang Formation of Lingyuan, western Liaoning and distinct with its hyperphalangy in pedal digit V. Phylogenetic analysis places the first taxon as the basal most member of Sinemydidae that in turn furthermore includes *L. jianchangensis* and *Ordosemys leios* (which are sister taxa) and a clade consisting of *M. manchoukuoensis*, *Dracochelys bicuspis* and *Sinemys* spp.

Discussion. The new phylogeny confutes recent tentative hypotheses that consider Sinemyididae and closely allied taxa as stem-turtles or stem-chelonioid sea-turtles. Instead, they populate the diverse stem-lineage of Cryptodira together with other Jurassic and

Cretaceous Asian and North American taxa including at least xinjiangchelyids, *Judithemys sukhanovi* and *Kirgizemys* spp. The addition of two more taxa further increases the taxonomic diversity of the turtle assemblages in the Jehol Biota. Moreover, turtles appear to show a complex paleobiogeographical and stratigraphic distribution in the area with some taxa that appears to be endemic for local basins. Although these patterns are poorly documented at present, they hold the potential for a new biostratigraphic tool for correlating faunas and sedimentary basins within the Jehol Biota.

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