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Research Advances

The First Discovery of the Late Cretaceous Protoceratopsid Fauna from Alxa, Inner Mongolia, China

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Objective

Alxa, located in western Inner Mongolia, is covered by desert in many places with few Cretaceous outcrops. Only some Early Cretaceous dinosaur fossils have been discovered from several areas in Alxa Zuoqi and Ejin Qi, but no Late Cretaceous dinosaur fauna has been formally reported in Alxa. Fortunately, some remains of dinosaurs have been found from the central Alxa in the Late Cretaceous Wulansuhai Formation recently. This finding is significant for the evolution and migration of the western Inner Mongolian dinosaur faunas, and also provides important evidence for the division and correlation of Late Cretaceous terrestrial strata and sedimentary environments.

Methods

Based on a series of field investigations, we discovered and excavated diagnostic dinosaur fossils, measured the fossil-bearing stratigraphical sections, and gathered other geological information. After identifying the systematic positions of these dinosaurs, we have primarily revealed the contents of this newly discovered dinosaur fauna and the relationship with other related fauna, further discussed its geological age and sedimentary environments.

Results

The dinosaur fossils were discovered from the Late Cretaceous Wulansuhai Formation in northeastern part of Alxa Youqi, central Alxa. The Wulansuhai Formation here mainly consists of purplish red conglomerates, conglomeratic sandstones, and fine grained sandstones that yielding the dinosaur bones and eggs.

At least five dinosaur groups have been confirmed, i.e., ceratopsians, ankylosaurians, dromaeosaurids and two kinds of dinosaur eggs (Fig. 1). Ceratopsians are represented by different sized protoceratopsid skulls (subadults or adults), postcranial bones and isolated teeth, which occupying more than 80% of the uncovered bones in number. All specimens should be included within the genus *Protoceratops*. Ankylosaurians are known by a partial postcranial skeleton, showing some characters of the ankylosaurid genus *Pinacosaurus*. Only one weathered dromaeosaurid skull together with some disarticulated postcranial bones was found, its generic level need more evidences. Egg shells are also common, most of which belong to *Elongatoolithus* and only two partial eggs should be assigned to *Prismatoolithus*. These two different kinds of eggs are regarded to be related with oviraptorian and troodontid theropods, respectively.

This dinosaur fauna is featured by abundant protoceratopsids, thus can be called as the protoceratopsid fauna, representing the first convincible record of protoceratopsid fauna in Alxa. The correlative dinosaur faunas have ever been reported to be present both in the Bayan Mandahu area (Inner Mongolia), and in pre-Altai Gobi (Mongolia) during the Late Cretaceous. This finding further enlarges the geographical distribution of the protoceratopsid fauna. In Bayan Mandahu, rich fossil dinosaurs have been recognized from the Late Cretaceous (Campanian) Wulansuhai Formation, containing ceratopsians, ankylosaurians, theropods, several kinds of dinosaur eggs, and some other tetrapods. Protoceratopsids and ankylosaurians are also index fossils in Bayan Mandahu, and occupy obvious advantages in the number. The comparative fossil dinosaur assemblages in both central Alxa and Bayan Mandahu remarkably indicate that

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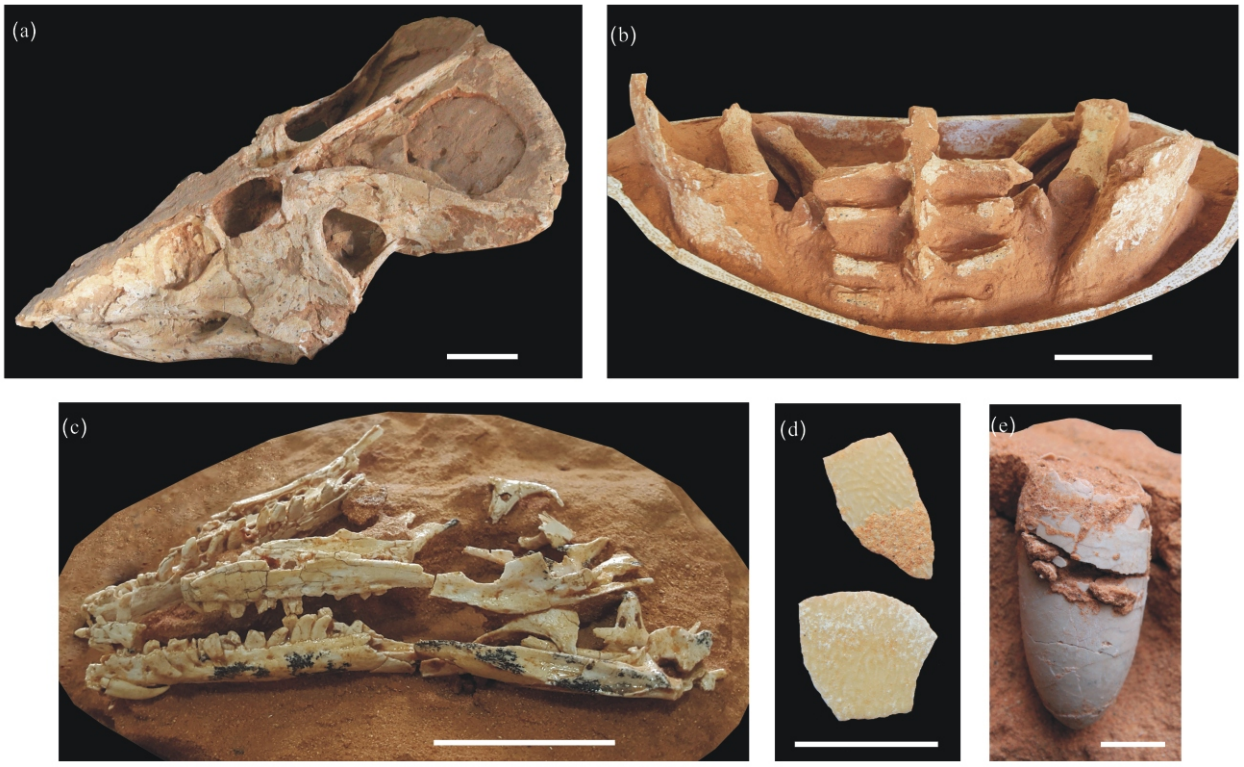

Fig. 1. Late Cretaceous dinosaur kinds from central Alxa, Inner Mongolia.
(a), Protoceratopsid – nearly complete skull and mandibles of *Protoceratops*; (b), Ankylosaurid – sacrum and paired ilia of *Pinacosaurus*; (c), Dromaeosaurid – incomplete skull and lower jaws; (d), Oviraptorian – egg shells of *Elongatoolithus*; (e), troodontid – partial egg of *Prismatoolithus*. Scale bars equal 10 cm in (a) and (b), 5 cm in (c), and 2 cm in (d) and (e), respectively.

the protoceratopsid fauna of the central Alxa should also be Campanian in geological age.

Moreover, the fossil-bearing redbeds of central Alxa share the similar sedimentary facies with those in Bayan Mandahu that were deposited in semiarid, alluvial to eolian environments. The structureless fine grained sandstones with poorly to moderately cemented texture and many articulated to partially-articulated fossil dinosaur skeletons in central Alxa provide more evidences for the interpretation of such sedimentary environments.

Conclusions

The Late Cretaceous dinosaur fauna from the central Alxa contains several groups such as ceratopsiands, ankylosaurians, dromaeosaurids, oviraptorians (eggs), and troodontids (eggs), with the protoceratopsids as the dominant groups. These dinosaur fossils represent the first reliable record of protoceratopsid fauna in Alxa, western Inner Mongolia during the Campanian age, Late Cretaceous. This finding also enlarges the geographical distribution of the fauna. The fossil-bearing redbeds in central Alxa were deposited in semiarid, alluvial to eolian environments.

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