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The relationships between Middle-Late Jurassic tectonics and formation of the Yanliao biota

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The well-known Yanshan Movement is traditionally characterized by the unconformity below the Jiulongshan-Tiaojishan formations in western Beijing, or between the Haifanggou Formation and Beipiao Formation in western Liaoning; they are comparable to each other. The Daohugou beds provide significant insights to understanding the early stage of the Jurassic Yanshan Movement. The bottom conglomerates of Daohugou beds unconformably overlies the Precambrian metamorphic rocks, which is equivalent to the unconformity between the Haifanggou Formation and Beipiao Formation. The top of Daohugou beds were subject to remarkable erosion, and were an angular unconformity underlying beneath the volcanic rocks of the Tiaojishan Formation. Thus, the unconformity below the Jiulongshan - Tiaojishan formations in western Beijing is inconsistent with that between the Haifanggou Formation and Beipiao Formation in western Liaoning. Instead, they represent two tectonic phases of the Jurassic Yanshan Movement respectively, i.e., the Initiation Stage and the Volcanism Stage (Huang [1]).

These two unconformities are widespread in northern, southwestern, and southern China, and are probably developed in Mongolia, Kazakhstan of middle Asia. They were likely caused by the westward subduction of the Pacific Plate and the close of Sea of Okhotsk (Davis et al. [2]). Thus, to recognize the unconformities is important for division of the Jurassic strata in China and adjacent area, and for calibrating ages of a series of exceptional faunas.

In core areas of the Yanliao biota, there are two key exceptional faunas, namely the Daohugou biota and the Linglongta biota. Vertebrate fossils such as feathered dinosaurs, pterosaurs with soft tissues and early mammals have been recovered from both biotas, which bear very important implications. Both biotas are generally considered to be equivalent to each other, and belong to or equivalent to the Yanliao biota (e.g. Wang et al. [3]). By re-evaluation of the top and bottom of the Daohugou beds, we found that the Daohugou biota lies between the Initiation Stage and the Volcanism Stage, but the Linglongta biota lies above the Volcanism Stage. An interval of circa 5 Ma existed between them; a huge tectonic movement led to major changes of the ancient environment and climate, showing a significant change in the assemblage of biota. Our new geochronological research shows that the age of Daohugou biota is at the boundary of the Late and Middle Jurassic, about 164–163 Ma (Liu et al. [4]); the Linglongta biota is of the Late Jurassic, with its key layer of about 158 Ma (Wang et al. [3]). Therefore, the Daohugou biota represents the early assemblage of the Yanliao biota, while the Linglongta biota represents the late assemblage.

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