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Early to Middle Jurassic vegetation and climatic events in the Qaidam Basin, Northwest China

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Abstract

Jurassic deposits are well exposed in the Qaidam Basin, Qinghai Province, northwest China, and are regarded as one of the most completely developed Early–Middle Jurassic plant-bearing sequences in northern China. The Early to Middle Jurassic palynoflora in this basin shows a high diversity of spores and pollen grains, which are characterized by four palynological assemblage zones corresponding to the Pliensbachian, Toarcian, Aalenian–Bajocian and Bathonian in age. Vegetation reconstruction demonstrates four vegetation types: upland coniferous forest in the Pliensbachian, coastal cheirolepidiacean forest in the Toarcian, lowland fern forest in the Aalenian–Bajocian and a mixed forest in the Bathonian. Nearest living relative analysis of the major plant groups shows that the Early to Middle Jurassic vegetation in the Qaidam Basin not only consists of plants with tropical–subtropical climate requirements, but also those indicating temperate climatic conditions. In addition, bryophytes and fungi as well as Cheirolepidiaceae, which are generally considered to indicate warmer and/or drier conditions, are also documented in the palynofloras. It is suggested that a temperate to subtropical climate generally prevailed during the Early to Middle Jurassic in this basin. However, the vegetation features and the sedimentary data signify that an overall humid to semi-humid phase was punctuated by warmer and locally dry and/or arid episodes. The two higher temperature and aridity events occurred in the Toarcian and Bathonian–Callovian periods in the Qaidam Basin. These climatic events can be inferred by increase of relative abundance of *Classopollis* pollen, some tropical–subtropical fern spores, and the occurrences of variegated, red beds and evaporite rocks. These events may either be associated in some way with a transient global warming phenomenon due to an enhanced greenhouse effect, or be linked with intensification of a potential monsoonal circulation. Such events finally caused a weakening and even arrested coal-accumulation in the Qaidam Basin during the Toarcian and the Bathonian–Callovian intervals.

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Keywords: Early to Middle Jurassic; Palynofloras; Vegetation; Climate; The Qaidam Basin; China

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1. Introduction

The Qaidam Basin, located in northwest China and situated in northeast Qinghai–Tibetan Plateau, is a typical Mesozoic–Cenozoic basin. It is up to 720 km long and 200 km wide, covering over 150,000 km² between latitudes 36°N–39°N and longitudes 91°E–98°E in Qinghai Province (Fig. 1). Because of its special geographical location in between the North China, Tarim, Qiangtang and Lahsa Blocks, the Qaidam Basin has increasingly become the focus for understanding climate change and tectonic evolution in the Tibetan Plateau and in Central Asia (Wang et al., 1999; Jiang and Robbins, 2000; Ritts and Biffi, 2001; Chen et al., 2002; Dupont-Nivet et al., 2002; Halim et al., 2003). Furthermore, the Qaidam Basin plays an important role for investigating the Mesozoic nonmarine petroleum system in northwest China due to abundant hydrocarbon source rocks in the Jurassic (Ritts et al., 1999). Particularly, the Jurassic coal measures strata are

well developed in the northeastern margin of the Qaidam Basin, including several sections located in Dameigou, Iqe (Yuka), Baishushan and Wanggaxiu areas (Fig. 1). Among them, the Dameigou section is continuously exposed and has been regarded as one of the most complete Early–Middle Jurassic sequences in Northern China (Li et al., 1988; Zhou, 1995). The Lower–Middle Jurassic strata consist of organic-rich, fluvial and lacustrine sediments yielding abundant fossil remains such as megaplants and palynomorphs. They provide favourable conditions and evidence for investigating the biostratigraphy, vegetation and palaeoclimatic changes in the Qaidam Basin.

Today the Qaidam Basin is a dry, cold and salty region with an altitude of 3000 m above sea level. The annual mean temperature is 2–4 °C and annual mean precipitation is less than 100 mm (less than 25 mm in the basin center), while the annual evaporation is over 25 times greater than precipitation, generating a temperate arid type of climate. As a result,

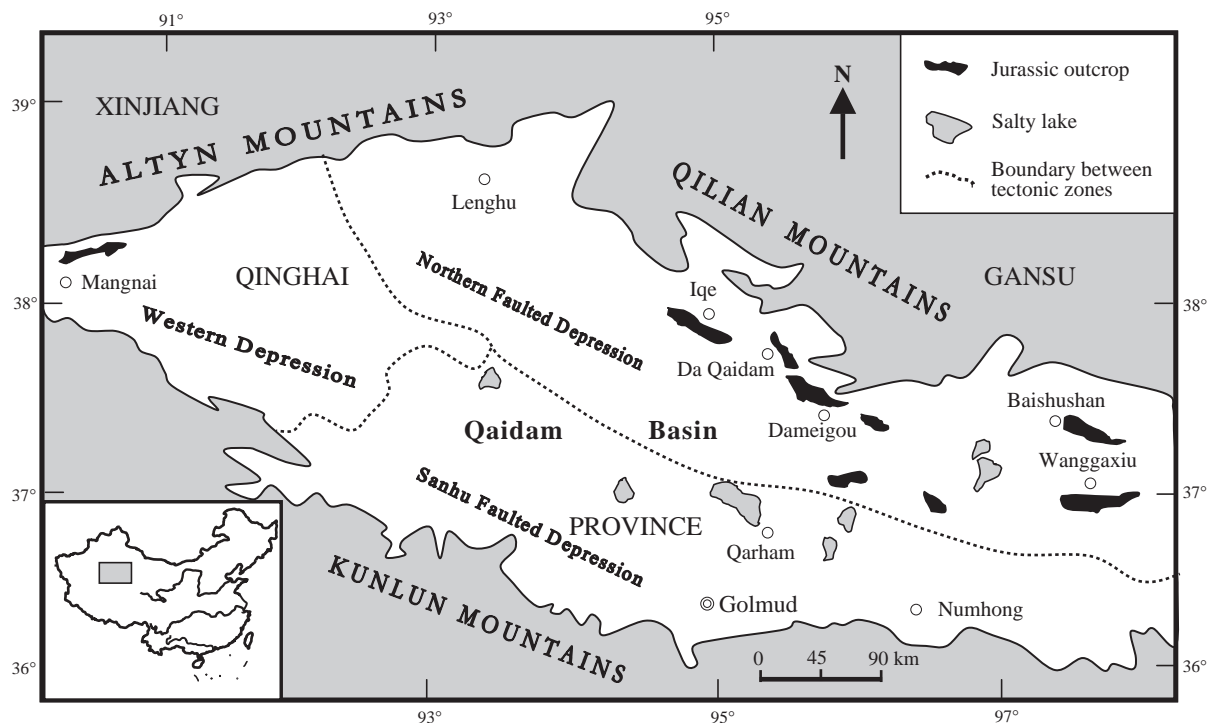


Fig. 1. A sketch map showing the geographical location, the tectonic subdivisions and Jurassic outcrops of the Qaidam Basin, Qinghai Province, Northwest China.

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