

Research Advances

Desertification Direction of the Northern Margin of Hobq Desert

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The Hobq Desert, located in the northern Ordos Plateau is a typical in-situ desertification desert, which is quite different in characteristics and genesis from the Tengger Desert to the west and Muus Desert to the south. The northern margin of Hobq Desert is strictly constrained to the south bank of the Yellow River. This relationship between deserts and rivers indicates that desertification may cause passive migration of river channels(Fig. 1a).

The satellite remote sensing image data in different time shows that the desertification area of Guangmao Village at the south bank of the Hetao Basin in 2007 is twice larger than that in 1975, and the desert has marched to north significantly during these 30 years; the thickness of the desert has increased. The ecological environment of the almost 800 km-long main streams of the Yellow River and its south bank has changed greatly, and there is an evident trend that the desertification expands to the northwest(Figs. 1b,c).

As the sand thickness is relatively small in the Houtao Plain of the northern Hobq Desert, the vestigial playas and oxbow lakes may represent ancient channel of the Yellow River (Fig. 1d). A typical fluvial sedimentary association was found at the east Dengkou north of Ordos Plateau, 40 km away from the Yellow River (GPS: N40° 10'46.30", E107° 27'13.60"). The sedimentary section's thickness is greater than 1 m, with its lower part consisting of medium-thick bed cross-bedded sandstone and pebbly sandstone, while the upper part is dominated by conglomerate interbedded with pebbly sandstone. Pebbles are mostly quartzite pebbles, with good gradation and fine psephicity, generally smaller than 5 cm.

The proven faults in the northern Ordos Plateau are F1 to F7, which controlled the depression development of the Hetao Basin, and affected the evolution and erosion intensity of the rivers. Comprehensive aeromagnetic, gravity, magnetotelluric and ancient earthquake data reveal that the fault zone in the northern Ordos has been active since the Late Pleistocene, and that they are distinctive from those in surrounding areas. The faults controlling the northern basin is intensely active from 15 ka to 10 ka with an activity rate of 0.2 to 4.5 mm/a. The Daqingshan piedmont fault in the east is the most active

part, while the activity rates of Ural Mountain piedmont fault (F4) and Seertang Mountain piedmont fault (F2) were the smallest (Gong et al., 2013). In the middle to late Holocene, earthquakes occurred at the eastern segment of the Lang Mountain piedmont fault (F1), indicating that the faulting activity was intensified. According to the uplift of the low platform lacustrine sediments in Wulanhashao piedmont, the minimum average active rate was 0.53 mm/a (Gong et al., 2013). In contrast, the northern Ordos fault F7 controlling the southern boundary of the Hetao Basin is covered by lacustrine sediments of about 30 kyr, indicating that this fault has not been active or dislocated since 30 ka. Therefore, the northern peripheral faults controlling the depression of Hetao Basin are more active than those in the south. This feature caused the development of the basin from south to north, and resulted in the northern Hobq Desert marching to the north. In the view of geomorphology, the boundary of Hobq Desert to the west of Urad Front Banner lies closely to the Yellow River, forming an obvious arc shape channel protruding to the north; the boundary to the east of Urad Front Banner is more distant from the channel, and desertification has not arrived at the Yellow River, but this channel may migrate passively to the north along with the increasingly intense desertification.

Geomorphology and sedimentary studies indicate that the changes of the Yellow River channels are closely related to the evolution of the desert. Interior lake basins - connect and outflow - interior lake basins - connect and outflow was a common style of the Yellow River. With frequent diversions in the Hetao region, historical channels spread over the fluvial basins of Yellow River, and widespread fluvial and lacustrine sediments provided abundant sand to promote the formation of Hobq Desert.

The optical stimulated luminescence (OSL) dating shows that the northwestern and eastern parts of Hobq Desert have started to accumulate aeolian deposit since 19 ka and 9 ka, respectively. Aeolian activity markedly enhanced since 7 ka, especially since 2ka, desertification developed to the south and the north (Fan et al., 2013). The dating of the piedmont platform sediments at the western margin and the northern margin of Hetao Basin suggests that, the ancient lake retreated from east to west

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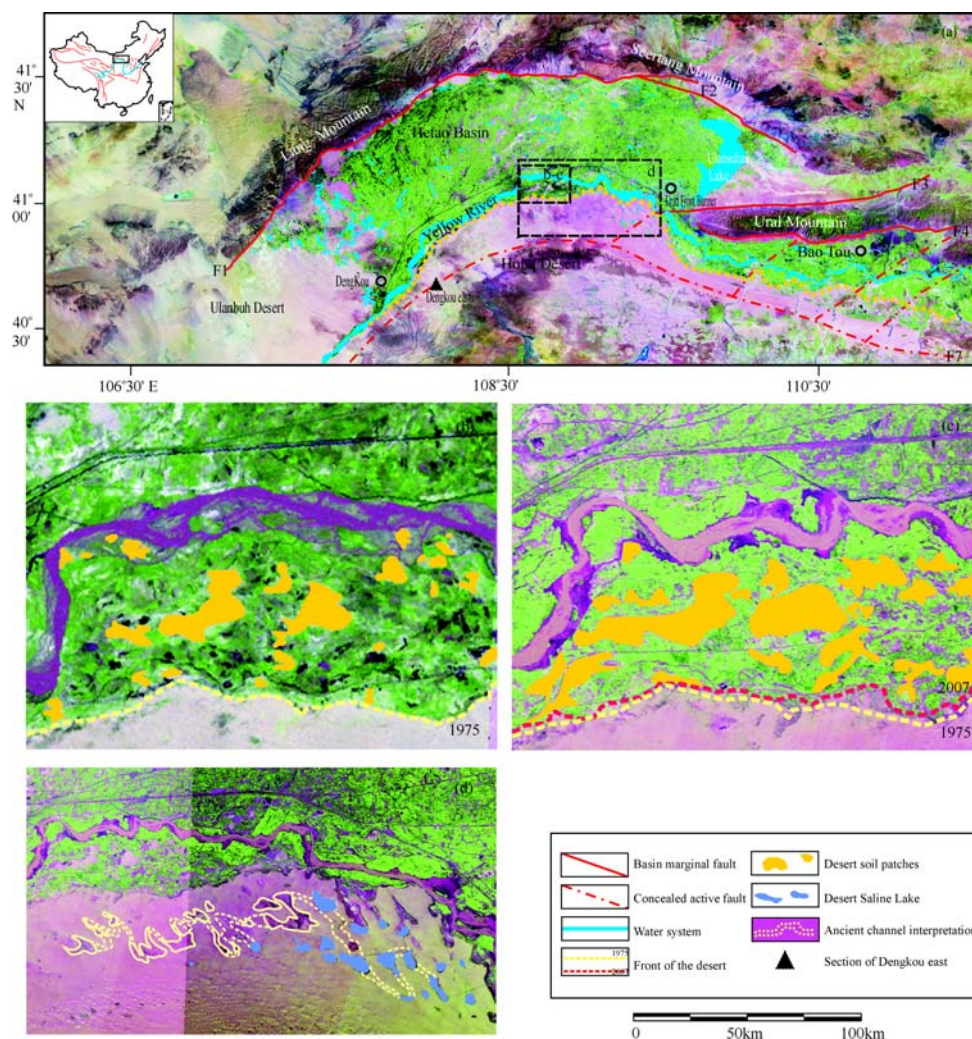


Fig. 1. Contrast on remote sensing images of desertification and interpretation of ancient channel in the northern Ordos Plateau.

(a), Geological map of the northern Ordos Plateau; (b), Remote sensing image of Guangmao Village in 1975; (c), Remote sensing image of Guangmao Village in 2007; (d), Ancient lake distribution and ancient channel interpretation.

because of the diverse activity of periphery faults (Gong et al., 2013). The dying out of the Jartai-Hetao ancient lake is closely related to the outflow of the Yellow River. It is noted that the monsoon in North China flows from northwest to southeast, while the northern Hobq Desert marches from south to north. Aeolian deposit studies show that it is impossible for desertification to develop against wind. In our study, we consider that the Lang Mountain-Zhaertai Mountain block the monsoon and make a shelter, and even form a backward wind region in Hetao Basin, which means that the wind blows from south to north to the south of Lang Mountain-Zhaertai Mountain.

Therefore, the northern Hobq Desert marching from south to north may be caused by two reasons: (1) Structural activity makes the basin develop from south to north; and (2) Backward wind is pushing the Yellow River channels from south to north with an arc shape, and, on the other hand, directly impacts the eco-environment

safety of the wetlands in Hetao Basin.

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