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The Lithofacies Paleogeography and Paleoenvironmental evolution of the Cenozoic in the Weihe Basin, China

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The Weihe Basin, which is known as a Cenozoic rift Basin, is special for its location where not only enrich oil, gas and water, but also is a "sweet" for environment evolution research. It sits in the transition area between the Ordos basin with full of oil and gas resources in the north and the Qinling Orogenic Belt with rich mineral resources in the south. What is more, the basin occupies an important geographic location that is the transitional region of climate and biocenose between north and south, which has drawn much attention in all industries.

The research on the sedimentation and environmental evolution has great guiding significance for the study of oil-gas-water distribution, the coupling of the Weihe basin and Qinling Orogenic Belt, the patterns of climate evolution and so on. Basing on the combination of abundance of previous studies, outcrops observations and measurements, well logging interpretations and usage of theories and methods in various subjects, e.g. petrology, sedimentary geology, geochemistry and paleontology etc., this study rearranged the Cenozoic strata in the Weihe Basin, systematically carried out the works of provenance analysis, depositional system division and sedimentary environment research and finally completed the reconstruction of lithofacies paleogeography and environment evolution processes. The main results and understanding in this study are concluded as follows:

On the basis of summarizing previous results, Paleontological materials, paleomagnetic data and fieldwork observation and measurement, the lithostratigraphic units of the Cenozoic in the Weihe basin can be divided into the Eocene Honghe Formation; the Oligocene Bailuyuan Formation; the Miocene Lengshuigou Formation, Koujiacun Formation and Bahe Formation; the Pliocene Youhe formation; the Pleistocene Sanmen Formation, Xiehu Formation, Qianxian Formation; the Holocene Banpo Formation. After completing the correlation of Strata in east-west direction and south-north direction, the framework of

Cenozoic layer's division and correlation in study has been set up.

The analysis results of light and heavy mineral, major and trace elements, rare-earth element have confirmed the material sources of sediment. The majority came from the Weibei uplift in the north, Qinling Mountain in the south and the Zhongtiao Mountain in the east, all at close ranges. While from the Bahe Stage, in addition to the small-scale provenance provided by the Lishan Mountain, there also appeared Aeolian material from the northwest.

According to the characteristics of sedimentary, five depositional systems were distinguished in the Weihe basin, i.e., alluvial fan, fluvial, deltaic, lacustrine and eolian deposits. After that the space-time distribution of facies zone were expounded and the mode pattern of sedimentary facies were set up, respectively. The results suggested that: Due to the fault, subsidence and filling during the depositional process, the basin is extremely dissymmetric in profile and has the depocenter location southerly. The basin is narrower in the west and wider in the east. Alluvial fan is predominant in the marginal area, which gradually transforms into the delta and then the lake towards the center. The Weihe Basin began to deposit since the Eocene. It was uplifted and had a hiatus during the Late Oligocene. During the Miocene, it restarted to deposit in the Lengshuigou age; as the distribution range of water body gradually expanded, it widely developed lakes in the Koujiacun Age; up to the Bahe Age, the sedimentary range expanded further, and the Lishan Mountain started to uplift. During the Pliocene Youhe Age, it formed two major depositional depressions within the basin, i.e., the Xi'an Depression and the Gushi Depression; meanwhile, the eolian deposits firstly appeared at the basin margin. During the Quaternary, with the uplift of the western region in the Basin, the depocenter moved to the east in Sanmen Age, and the range of lakes gradually shrunk. From the Middle Pleistocene to the Holocene, the lakes shrank

into small sags locally. Based on the studies above, the Cenozoic lithofacies' paleogeographic maps of the Weihe Basin were composed in each age, and we discussed the sedimentary history of the Cenozoic in the Weihe Basin.

The results of Paleosalinity show that the Weihe Basin is a freshwater lake and has a low salinity with regional brackish water environment, which is influenced by both sedimentary facies and climate. When it is in a humid climate, the paleosalinity reduces, whereas it rises in a dry and cold climate. In addition, when the sedimentary facies transform from lacustrine, deltaic, fluvial to alluvial, the salinity will gradually increase.

It is shown by the Mammal fossils and Sporopollen data that the Weihe area was characterized by relatively dry and hot weather in Honghe Age, but the climate

gradually became mild and humid in the Bailuyuan Age and then dry and cold in the late stage of Bailuyuan Age, which probably related to the overall uplift of the Basin. From Lengshuigou Age to Koujiacun Age the climate became relatively warm and wet, which also existing climatic fluctuations, and gradually became dry and warm in Bahe Age. By the Youhe Age the climate became hot and humid, which correspond with the global climate transformation. However, with the strengthening of monsoon climate and uplift of Qinling Mountain, the climate began to be cold and dry in the late period of Youhe Age. With the coming Quaternary, the climate turned cold and dry with significantly swinging between cold-dry and warm-humid, which constituted the semiarid and subhumid environment in this area.