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Using UAV and drilling to detect Quaternary activity of the Zhuozishan West Piedmont Fault, provides insight into the structural development of the Wuhai Basin and Northwestern Ordos Block, China

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The Wuhai Basin is in the northwestern corner of the Ordos Block. Analyzing the geometry, and kinematic and dynamic characteristics of the boundary fault, the Zhuozishan West Piedmont Fault (ZWPF), will elucidate the regional tectonic environment and guide earthquake prevention and disaster reduction projects. Six presentative sites were selected for topographic measurements, from northern, middle and southern parts. Displacements of the ZWPF were calculated by measuring the top surface elevation of a widely distributed lacustrine layer in the footwall from outcrops at the sites (using UAV), and in the hanging wall from boreholes. The vertical slip rate of the ZWPF was then calculated based on the displacement and age of the lacustrine layer. Three to four normal fault-controlled terraces have developed on the footwall of the ZWPF, and the top surface of the lacustrine layer is at 1092–1132 m elevation. Data from boreholes showed that the top surface of the lacustrine layer is at an elevation of 1042–1063 m in the hanging wall. Vertical slip rates since 70 ka were estimated as 0.5 ± 0.2 to 1.0 ± 0.2 mm/a. The highest rate of vertical slip was observed at Fenghuang Ridge, in the central part of the fault system, and the vertical slip rate reduced to the south. In the northern Wuhai Basin, normal faulting still controls the piedmont landscape. However, NW-SE trending reverse faults and secondary folding have resulted from dextral strike-slip movement of the fault. The Wuhai Basin developed as a dextral-tensional negative flower structure. This study indicated that stress conditions of the northwestern margin of the Ordos Block include NE–SW compression and NW–SE extension, and an S-shaped rift zone has dominated the scale, structure, and evolution of the Yinchuan, Wuhai and Hetao Basins, and the active mode of faulting in these basins.