Mechanism of Carboniferous-Permian transgression/regression in the east Ordos basin and associated paleoecological variability: Insight from detrital geochronology and palaeontology data

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Developed on the North China Craton, the intra-cratonic Ordos basin contains a complete Paleozoic to Cenozoic sediment record allowing long-term paleo-environmental and climate change investigation. During the Carboniferous-the early Permian period, convergence between the North China block and the paleo-Yangtze plate to the south lead to a general marine regression characterised by a series of second-order transgression/regression cycles diachronous along the eastern margin of the Ordos. However, the detailed mechanisms that induced these cycles, as well as the associated paleoecological changes, are still unknown. In this study, we integrated the description of numerous core samples with electric-log data and 2-D seismic data to reconstruct the sediment facies associations across the first-order regression from the Carboniferous tidal flat depositional system to the early Permian prograding fluvial delta system. δ18O, δ13C and clay content (w(Illite + Kaolinite)/w(smectite) ratio) stratigraphic variations were then used to reconstruct the paleo-sea level from the late Carboniferous to the early Permian. We conclude that the direction of second-order transgression/regression mainly stroke to the east during the late Carboniferous and switched clockwise towards the north during the early Permian. We suggest that the variability of the second-order cycles, diachronous in space and time was mainly linked to local variations in sediment supply and regional uplift. Using detrital zircon U-Pb data, major and trace elements content and heavy minerals assemblages (HMA), we estimated the sediment provenance area. The sediment volumes deposited in the basin through time were obtained using 3D seismic data. During the Carboniferous, the coarse-grained sediments deposited in the eastern Ordos were derived from the uplifting Helan Mountain. By the early Permian, the detrital material became multi-sourced issuing from both the Yinshan range to the north and the Qinling range to the south. During the first stage, regression was controlled by regional uplift, while the sediment supply controlled the second stage. Indeed, based on sediment dispersal volume calculation, we can infer that the sediment supply during the early Permian was more extensive than during the Late Carboniferous – early Permian. We correlate this observation to a more humid climate during the early Permian: multi- paleoecological indexes, including the sporopollenin content and microsomal type assemblage, suggest that glaciation prevailed during the Late Carboniferous – early Permian shallow-marine stage. In contrast, the early Permian...
alluvial and deltaic series were deposited under a warmer, interglacial climate (Sakmarian). Finally, the typical interglacial coal accumulation pattern occurs earlier than the Pennsylvanian-Permian transition it characterises around the world (Artinskian).