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Basin-mountain structures and hydrocarbon exploration potential of west Junggar orogen in China

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Situated in northern Xinjiang, China, in NE-SW trend, West Junggar Orogen is adjacent to Altai fold belt on the north with the Ertix Fault as the boundary, North Tianshan fold belt on the south with the Ebinur Lake Strike-slip Fault as the boundary, and the Junggar Basin on the southeast with Zaire-Genghis Khan-Hala'alat fold belt as the boundary. Covering an area of about 10×104 km2 in China, there are medium and small intermontane basins, Burqin-Fuhai, Tacheng, Hefeng and Hoxtolgay, distributing inside the orogen. Tectonically West Junggar Orogen lies in the middle section of the Palaeo-Asian tectonic domain where the Siberia, Kazakhstan and Tarim Plates converge, and is the only orogen trending NE-SW in the Palaeo-Asian tectonic domain. Since the Paleozoic, the orogen experienced pre-Permian plate tectonic evolution and post-Permian intra-plate basin evolution. Complex tectonic evolution and multi-stage structural superimposition not only give rise to long term controversial over the basin basement property but also complex basin-mountain coupling relations, structures and basin superimposition modes. According to analysis of several kinds of geological and geophysical data, the orogen was dominated by compressive folding and thrust napping from the Siberia plate in the north since the Late Paleozoic. Compressive stress weakened from north to south, corresponding to subdued vertical movement and enhanced horizontal movement of crustal surface from north to south, and finally faded in the overthrust-nappe belt at the northwest margin of the Junggar Basin. The variation in compressive stress is consistent with the surface relief of the orogen, which is high in the north and low in the south. There are two kinds of basin-mountain coupling relationships, i.e. high angle thrusting and overthrusting and napping, and two kinds of basin superimposition modes, i.e. inherited and progressive, and migrating and convulsionary modes. West Junggar orogen has rich oil and gas shows, and oil and gas fields have also been discovered in the Zaysan Basin in adjacent Kazakhstan and in adjacent Junggar, Tuha and Santanghu Basins. Drilling data, geochemical analysis of outcrop data, and the disection of ancient Bulongguoer oil reservoir at the south margin of the Hefeng Basin show there developed two sets of good transitional source rocks, the lower Hujierste Formation in the Middle Devonian (D2h1) and the Hebukehe Formation in the Upper Devonian and Lower Carboniferous (D3-C1h) in this area, which, 10 to 300 m thick, mainly distribute in the shoal water zone along Tacheng-Ertai Late Paleozoic island arc belt. Reservoirs were mainly formed in the Jurassic and then adjusted in two periods, one from the end of the Jurassic to middle Cretaceous and the other in early Paleogene. Those early oil reservoirs might be destroyed in areas such as Bulongguoer with poor preservation conditions, but in an area with good geologic and preserving conditions, oil and gas might accumulate again to form new reservoirs. Therefore, a potential Middle Devonian-Lower Carboniferous petroleum system may exist in Tacheng-Ertai island arc belt, which may become a new domain for exploration, north faulted fold belt in the Heshituoluogai basin, and Hongyan fault bench zone in north Ulungur Depression in the Junggar Basin are promising areas for hydrocarbon exploration.