Genesis and Growth Mechanism of Strike-Slip Fault Systems in the Tarim Cratonic Basin, NW China

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Abstract

Large strike-slip fault systems and fault-controlled carbonate oil and gas fields have been discovered within the Tarim Craton. However, the formation mechanisms of the "small-displacement" intra-cratonic strike-slip faults that extend over 100 km remain unclear, which has constrained further fault structure analysis and oil-gas exploration and development. Based on fault structure analysis, new U-Pb dating methods for faults, regional structural analysis, and microscopic structural data from outcrops and cores, this study investigates the formation and development mechanisms of the continental strike-slip faults in the Tarim Basin. The results indicate that: (1) A diverse set of small-displacement, ultra-long continental strike-slip fault systems in the northern and central Tarim Basin. These faults began to form around 460 Ma, controlled by the near north-south remote compression generated by the closure of the Proto-Tethys Ocean along the southern margin of the plate. (2) In the northern Tarim Basin, on the basis of the Andersonian mechanism, the strike-slip faults primarily developed through linkage growth mechanisms, accompanied by non-Andersonian fault mechanisms such as fault tip expansion. Large conjugate strike-slip faults were formed through successive slip and cutting to adjust deformation at the intersection areas. (3) In the central Tarim Basin, influenced by the north-northeast oriented weak basement zones, tear faults developed within the oblique thrust fault blocks to accommodate deformation. These faults then grew through linkage and outward expansion to form large continental strike-slip faults. (4) The conjugate strike-slip faults in the northern Tarim Basin adjusted the main displacement and deformation through intense local weakening in the overlap zones. The growth of the strike-slip fault tips in the central Tarim Basin (especially the micro-grabens) and the accumulation of more strike-slip deformation and strain in the strike-slip segments within the thrust zones contributed to the overall deformation. In summary, under the remote stress of near north-south compression during the Middle Ordovician, the strike-slip fault system in the Tarim Basin formed and grew through linkage growth as the primary mechanism, combined with various non-Andersonian fault mechanisms and different local weakening effects. This process led to the continuous linkage and elongation of the faults with minimal displacement increments, resulting in a diverse set of "small-displacement" long faults.

Keywords

Tarim Basin, Strike-Slip Faults, Subduction, Fault Mechanism