Fault zone architecture and geochemical sealing process: A case from the Hong-Che Fault Zone of the Junggar Basin, northwestern China

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Fault is an important structural type in the sedimentary basin. It can act as the conduits or the barrier for oil and gas migration. Most of the previous studies suggest that the internal architecture of a fault is complex and can be composed of the fault core and damage zone with different physical characteristics. However, until now most of the research was carried based on field observation. In the petroleum industry, actually, the internal architecture of the buried faults in the sedimentary should be well studied. Besides, although it is widely accepted that faults can be an important conduits or barrier for the fluids, the detailed fault sealing process is still need to be discussed. In this study, combined with the seismic data, well logs and drill core data, we put forward a comprehensive method to recognize the internal architecture of buried faults. The results suggest that the internal architecture of the buried faults also can be divided into fault core and damage zone. There is an obvious positive relationship between the width of the fault core and the displacement, and the power-law relationship also exists between the width of the fault core and damage zone. In order to study the fault sealing process, 19 samples from different component of the fault were collected for the geochmical analyses. The major and trace elements data reflect that the fault core has relatively higher LOI, potassium loss, CIA, PIA, and lower HFSE, LILE and REE compared with the damage zone, implying the fault core endures more serious elemental loss and weathering. The carbon and oxygen isotope data suggest that the cement in the Hong-Che Fault Zone is formed by the mixture sources of fluids, and the fault core is mainly affected by the deep source fluids. Finally, an ideal model of fault sealing process has been set up. During faulting, the fault core acts as the fluid conduit. After faulting, the fault core is cemented and become a barrier, and the damage zone changes into the major conduit of fluid migration. The cementation firstly occurs on two sides of the damage zone in the upper part of the fault based on permeability and geochemical studies and then expands to the whole fault.