Seismicity and the State of Stress in the Dezful Embayment, Zagros Fold and Thrust Belt

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Abstract

This study focuses on determining the orientation and constraining the magnitude of the present-day stress in the Dezful Embayment in Iran's Zagros Fold and Thrust Belt. Two datasets are used: the first includes petrophysical data from 25 wells (3 to 4 km), and the second contains 108 earthquake focal plane mechanisms mostly occurring in blind active basement faults (5 to 20 km). Formal stress inversion analysis of the focal plane mechanism demonstrates that the major basement faults are reverse faults with (=2.0-2.2). The seismologically determined S_{Hmax} direction is 37{degree sign}{plus minus}10{degree sign}, nearly perpendicular to the strike of most faults in the region. However, borehole geomechanics analysis using rock strength and drilling evidence leads to the counterintuitive result that the shallow state of stress is a normal/strike-slip regime. These results are consistent with the low seismicity level in the sedimentary cover in the Dezful Embayment, and may be evidence of stress decoupling due to the existence of salt layers. This finding also aligns with the Mohr-Coulomb faulting theory in that the N-S strike-slip basement Kazerun fault has an unfavourable orientation for slip in a reverse fault regime with an average SW-NE S_{Hmax} orientation. The stress state situation in the field was used to identify the optimally oriented fault planes and the fault friction factor. The results are useful for determining the origin of seismic activity in the basin and better assessing fault-associated seismic hazards in the area.

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Keywords: Stress State, Borehole Breakout, Focal mechanisms, Fault Mechanics, Seismicity, Dezful Embayment, Zagros Fold and Thrust Belt.

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