AP35

Roles of Predicting Fracture Patterns in Fold and Thrust Belts - A Case Study from the Salakh Arch, Sultanate of Oman

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SUMMARY

The Salakh Arch is an arcuate chain of six doubly plunging anticlines that collectively extend for about 75 km in the southern edge of the northern Oman Mountains. The anticlines are interpreted as buckles of more than 2 km carbonate thick sequence (from Natih to Khuff formations), underlain by less competent inter-bedded sandstone and shale sequence, detached on a regionally-extensive evaporite horizon. The outcrops of Natih and Upper Kahmah formations, along with the seismic data in the area, offer a good framework to assess the relation between the structural evolution of the Arch at a regional scale and the fracture development at a local scale. Results from this study indicate that fractures relate to the orientation of the local structure, with some sets parallel and some sets perpendicular to local hinge lines. The majority of fractures have orientations consistent with having formed by flexural slip/flexural flow on fold limbs. These structures can be predicted from finite stratal dip, simple curvature and 3-D folding restoration maps, whereas Gaussian curvature and 3-D faulting restoration maps can be used as proxies for fault-related fractures. Local hinge-related fractures may reflect local tangential longitudinal strain during large-scale fold-tightening. Those fold structures that have formed obliquely to the regional shortening direction show additional hinge-perpendicular fracture arrays indicating weak axial extension, presumably developed as the arcuate thrust belt amplified. Our analysis illustrates the importance of taking a 3-D approach, especially within non-cylindrical fold.