Structural evolution and fracture patterns in the front range of northern Oman Mountains

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The front range of northern Oman Mountains (Salakh-Arch) consists of five doubly-plunging anticlines that collectively extend for 75km. It forms an excellent structural and stratigraphical analogue for hydrocarbon fields and the area can be a host for hydrocarbon accumulations. Comprehensive field work and seismic interpretation were conducted to evaluate the structural style and fracture patterns in the Arch. Measurements from seismic data show detaching folds along the salt. The results from fracture mapping show variable orientations through the Arch. Fractures mainly trend parallel and perpendicular to fold axes indicating that they are genetically related to the folding process. Static geometrical analyses using 3DMove of Jebel Qusaibah, the western anticline of the Arch, were compared to robust fracture field data from Natih-A in the Jebel to evaluate their significance to fracture orientation, density and aperture. Finite dip, Simple and Gaussian curvature analyses show strong relation to fracture density and Cylindricity Deviation influences the main fracture orientations particularly in the SE corner of the anticline. 3D restoration using 3DMove of the fold and bounding faults show strain concentration in the backlimb and eastern plunge respectively, and considered responsible for the E-W and NE-shear fractures in these areas. The fracture patterns are generally explored using a faulted detachment-fold model. Analytical solutions and numerical methods indicate that the fold developed as a wide wavelength and as the shortening proceeded, the hinge narrows and limbs' length and dip increase by the inward propagation and rotation of the inner axial surfaces. Generally, results show that fractures are mainly induced by layer-parallel shortening and outer arc extension. However, local fold-related strains at different stages of fold evolution have formed various fracture sets and commonly altered the type and orientation of dominant sets.