**Timing and Mechanisms of Fracturing within the Irish Canyon-Vermillion Creek Area, Moffat County, Colorado**

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Abstract

Effective exploitation of low permeability reservoirs requires the understanding of the local tectonic history and the present day stress regime. The industry's current focus on fractured, liquids-rich gas and tight oil plays makes the southwestern Sand Wash Basin, with high-quality, lower maturity source rocks and structural complexity, an ideal place to study fracturing in tight rocks. Orientations of minor faults and extensional fractures within variably oriented structures formed during the Laramide Orogeny and Brown's Park Extension were analyzed to unravel modes and mechanisms of fracturing and paleostress trends. Cross-cutting relations observed in outcrop and geologic maps were used in an attempt to characterize the local Cenozoic strain history.

The 59° orientation of Laramide σ₁ suggests oblique thrust and left-lateral slip on the E-W striking North Boundary Fault. N-S trending Laramide extensional fractures and out-of-the-basin flexural-slip suggest strain partitioning within this zone of oblique deformation. NW-striking extensional fractures and compatible conjugate strike-slip faults cross-cut Laramide structures and show Brown's Park deformation resulted in extension of the hanging wall of the northeastern Uinta Arch and transtensional strike-slip along the Axial Fold Belt, southern Sand Wash and the North Park Basins. NW-SE and WNW-ESE trends of SHmax determined from wellbore failure observed in image logs suggest this early- to middle-Miocene stress field has been slightly perturbed or mostly unaffected by Basin and Range Extension and Rio Grande Rifting.
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Abstract

(abstract text)

Introduction

Hypotheses of Fracture Mechanisms

- Post-Miocene (<10 Ma) faulting and superposition of the present day SHmax and the ENE-striking set are 70° oblique to the present day SHmax.
- Strikes of Navajo Sandstone Joints average 071° (n=641).
- Strikes of Browns Park Formation Joints average 320° (n=355).

Methods

- Detailed field mapping
- 120 microseismic and 60 joint measurements
- Stereonets of joint planes within the Navajo Sandstone superimposed on the geologic map.

Irish Canyon Observations

- 059° orientation of Laramide superimposed on the geologic map.
- Figure 1. Geologic map of NW Colorado. Field area denoted by translucent box. Structural axes suggest partitioning of strike-slip and dip-slip strain in the hanging wall of the NUT.

Conclusions

- Figure 8. Structural cross-section through study area.
- Figure 9. Stereonets of joint planes within the Navajo Sandstone superimposed on the geologic map.