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PS Two-Stage Mechanical Stratigraphy and Extensional Fracturing in the Wind River Basin, Wyoming*

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Abstract

Open, extensional fractures observed in the Wind River Basin differ from what is expected of syn-Laramide extension and it is possible that a two-stage mechanical stratification influences these fractures with important implications for the prolific hydrocarbon and uranium resources of the WRB. Hypotheses for mechanisms forming the extensional fractures include: pre-Laramide regional compression or fore-bulge migration; syn-Laramide regional compression or fold-localized extension; syn to post-Laramide regional strike-slip faulting; post-Laramide regional extension; exhumation due to uplift and/or overburden removal, gravity collapse of topographic highs; release of an elastic strain component; back-sliding on Laramide thrusts; and proximity to major post-Laramide normal faults. Fracture data was collected in the eastern WRB from Cambrian to Eocene strata and compared to previous studies, digitized fracture traces from geologic maps, and a large industry data set from micro-resistivity image logs. Low-angle thrust faults generally trended NW while high angle strike-slip faults trended E and NE for left and right-slip faults, respectively. These were observed in strata as young as the Paleocene. Normal faults of moderately high angle, and systematic, bedding-perpendicular, primary joints had varying orientations, but not a constant rotation, between NW and WSW. Secondary joints, that abutted the primary joints, were sub-orthogonal and were not present in the micro-resistivity image logs. The majority of these normal faults and joints were taken from the shallow dipping, Eocene Wind River Formation, which is in angular unconformity with older strata and forms most of the surface. Seismic data, as interpreted, shows a change in structural style across the Cretaceous shales in the basin. Basement-involved compression, seen as thrusting, is present at depth, while extensional grabens are shallow. Neither obviously transects these shales. Further, a thin-skinned thrust, at the stratigraphic level of these shales and on the southern margin of the basin, supports the

hypothesis of a layer-parallel detachment that acts as a plane of weakness to separate these two stages. In conclusion then, two distinct stages of deformation were observed and confirmed by the fracture data. NE-SW compression is consistent with the Laramide while the highly localized NE-SW to NNW-SSE extension is post-Laramide.

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