Influence of Graphite on Strain in a Gently Dipping Fault Zone

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Abstract

The eastern Boulder and western Pioneer Mountains of South-Central Idaho expose a polytectonic structural terrane including Lower Paleozoic rocks that exhibit an Antler Orogeny penetrative cleavage, overlain by Upper Paleozoic rocks. These Paleozoic rocks were shortened during the Sevier Orogeny and subsequently extended during Late Paleogene formation of the Pioneer Mountains metamorphic core complex. Thick marine clastic sequences of the Mississippian Copper Basin and the Pennsylvanian-Permian Wood River Basin were spatially separated during deposition and were later juxtaposed by Late Cretaceous Sevier contraction and Neogene extension. Neogene unroofing of the Pioneer Mountains core complex was accommodated by numerous oblique-slip extensional faults. In the Rock Roll Canyon Quadrangle, strain was focused in three major detachment faults: the Lake Creek, Trail Creek and Pioneer faults (Pioneer thrust of Dover, 1983). The Pioneer fault juxtaposes lower Paleozoic rocks in the hanging wall against Mississippian Copper Basin rocks in the footwall. In the Little Fall Creek study area, the Pioneer fault juxtaposes the Silurian to Ordovician Phi Kappa Fm, a black carbon-rich graptolite bearing argillite and Silurian Trail Creek Fm in the hanging wall against the Mississippian Copper Basin Group. We consider this older on younger relationship - previously mapped as a thrust fault - to be an oblique-slip extensional fault, possibly having reactivated an older contractional structure. Slip surfaces within the 32-meter-thick curviplanar fault zone dip gently (average 29°) and are characterized by polished surfaces. Quartz mineralization, stylolitic textures, fault breccia, fault gouge, boudinage, syntaxial veins and crack-seal textures are observed within the damage zone. Slickenlines on highly polished fault surfaces consistently indicate an oblique-normal sense of motion with a mean orientation of 300°, identical to the direction

of extension in the Lake Creek and Trail Creek faults. In the field we observe graphite concentrated at slip surfaces, preliminary results from whole-rock loss-on-ignition analysis indicate a similar total carbon content within the fault rocks and adjacent protolith. We interpret that pressure solution processes resulted in concentration of graphite at slip-surfaces and lubricated the fault thereby accommodating higher magnitude strain than adjacent extensional faults which cut rocks that are not rich in carbon. The results of ongoing studies seek to determine the effect of the carbon-rich nature of lithofacies on structural style and strain partitioning in accommodating crustal extension.

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