Fault-Propagation Folding in the Livingstone Range of Southern Alberta: Faulting, Folding and Fluids in a Hangingwall Ramp Anticline

Michael A. Cooley*, Raymond A. Price, John M. Dixon and T. Kurtis Kyser
Queen's University, 99 University Drive N.W. Kingston, ON K7L 3N6
cooleym@students.geol.queensu.ca

ABSTRACT

A series of balanced cross sections through the southern Livingstone Range outlines the morphology of the fault-propagation folds that make up the anticlinorium. The location and spacing of individual folds are controlled by the ramp/flat morphology of the underlying Livingstone thrust. Anticlines are located above where the underlying Livingstone thrust changes up-fault from a hangingwall flat to a hangingwall ramp. The synclines are located where the hangingwall ramp changes up-dip to a hangingwall flat. Apparently enigmatic relationships observed in the core of the Center Peak anticline can be attributed to a combination of flexural slip and limb rotation about a fixed hinge, concurrent with forelimb extension.

Stable isotope geochemistry of veins from the blind thrusts in the cores of the fault-propagation fold anticlines indicates a partially meteoric source for the fluids. Steeply-dipping faults that cut across the folds have a formation-fluid signature. This isotopic pattern is also exhibited in larger structures such as the Daisy Creek fault system which comprises a shallow back thrust and an underlying fore-thrust that are linked by a tear fault. The back thrust has meteoric isotopic signatures and the connected tear fault has formation fluid signatures. The veins from the Daisy Creek back thrust have a very strong meteoric isotopic signature that indicates local infiltration of meteoric waters during thrusting.

The regional dolomitization event that altered the rocks prior to deformation may have occurred as late as the Upper Carboniferous, as inferred by the presence of hydrothermal quartz+calcite+dolomite veins in the Etherington Formation and underlying Mount Head and Upper Livingstone Formations. Jasperoid quartz in these hydrothermal veins commonly contain inclusions of euhedral dolomite rhombs. Trails of dolomite rhombs occur along vein margins. Geochemical analyses of the quartz+calcite veins indicate that the veins have a hydrothermal signature, and contain anomalous lead and zinc.