

Fold-related-fracturing at the Livingstone River anticline (AB; Canada) by coupling field surveying and numerical modelling

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The interpretation of fold-related joints and faults is of primary importance in terms of fluids prospection (e.g. water, oil, gas, CO₂) since anticlines are potential structural trap while fracturing can strongly influence the storage capacity as well as the migration pathways.

Located at the front of the Foothills of the Rocky Mountains in Alberta (Canada), the Livingstone Range (LRA) is analogous to hydrocarbon reservoir that occur elsewhere in the Foothills (Cooley et al., 2011). The Livingstone Range fold system is related to the development of the Livingstone thrust that cuts around 1000m up-section from a regional decollement in the Palliser Formation (Devonian) to another in the Fernie Formation (Jurassic).

Our study focuses on the detailed structural investigation of the Livingstone River anticline (northern part of the LRA). It aims at characterizing the anticline geometry as well as the fracturing pattern (orientation, mode, infilling, spacing, trace length, density, and cross-cutting relationships) in order to propose a kinematic interpretation of the fold-related fracturing genesis. The study area is investigated at different scales by combining field surveys with remote sensing (HR-Digital Elevation Model, Ground-based LiDAR, Gigapixel photography) and thin-sections analyses.

In a second step we performed finite difference 3D numerical simulations in order to compute the evolution of local principal stress orientation during folding. We compared the fracture (or plastic bands) distribution in the field with 1) a dynamic numerical model of detachment folding; and 2) an instantaneous numerical model based on the final fold geometry.

Cooley, M.A., Price, R.A., Dixon, J.M., Kyser, T.K. 2011. Along-strike variations and internal details of chevron-style flexural slip thrust-propagation folds within the southern Livingstone Range anticlinorium, a paleo-hydrocarbon reservoir in southern Alberta Foothills, Canada. AAPG bulletin, 95 (11), 1821-1849.