



Geometry and Kinematic Interpretation of a Triangle Zone in the Central Alberta Foothills

Josgre Salazar*

University of Calgary, Calgary, AB

jasalaza@ucalgary.ca

and

Deborah Spratt and Don Lawton

University of Calgary, Calgary, AB

Summary

This study shows preliminary results of an integrated structural interpretation of a triangle zone in the central Alberta Foothills (Figure 1). A data set comprising 3D seismic data, well logs and surface geology has been interpreted and integrated resulting in a better understanding of the geometry and kinematics of structures in the area.

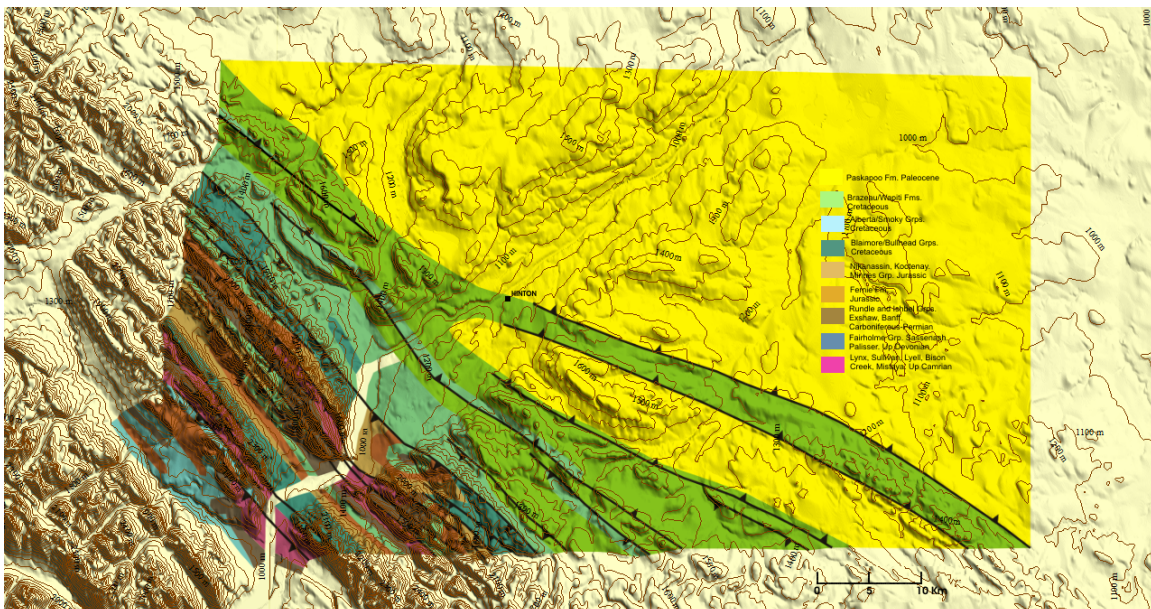


Figure 1: Semi-regional geological map of the central Alberta Foothills based on Lebel, et al., 1996; Langenberg, 1993; Langenberg and LeDrew, 2000; and Price, et al., 1979. Satellite images and topographic data were used as well.

We have interpreted a triangle zone composed of three tectonic blocks: upper, middle and lower (Figure 2). The middle and lower blocks consist of northeast-verging duplexes and an antiformal stack, part of which crops out at the surface. The southwest-verging upper block has been passively uplifted and folded as the underlying blocks advanced toward the foreland. Bedding-parallel detachment faults separate the blocks such that the middle block consists of Cretaceous strata and the lower block consists primarily of Triassic-Jurassic strata.

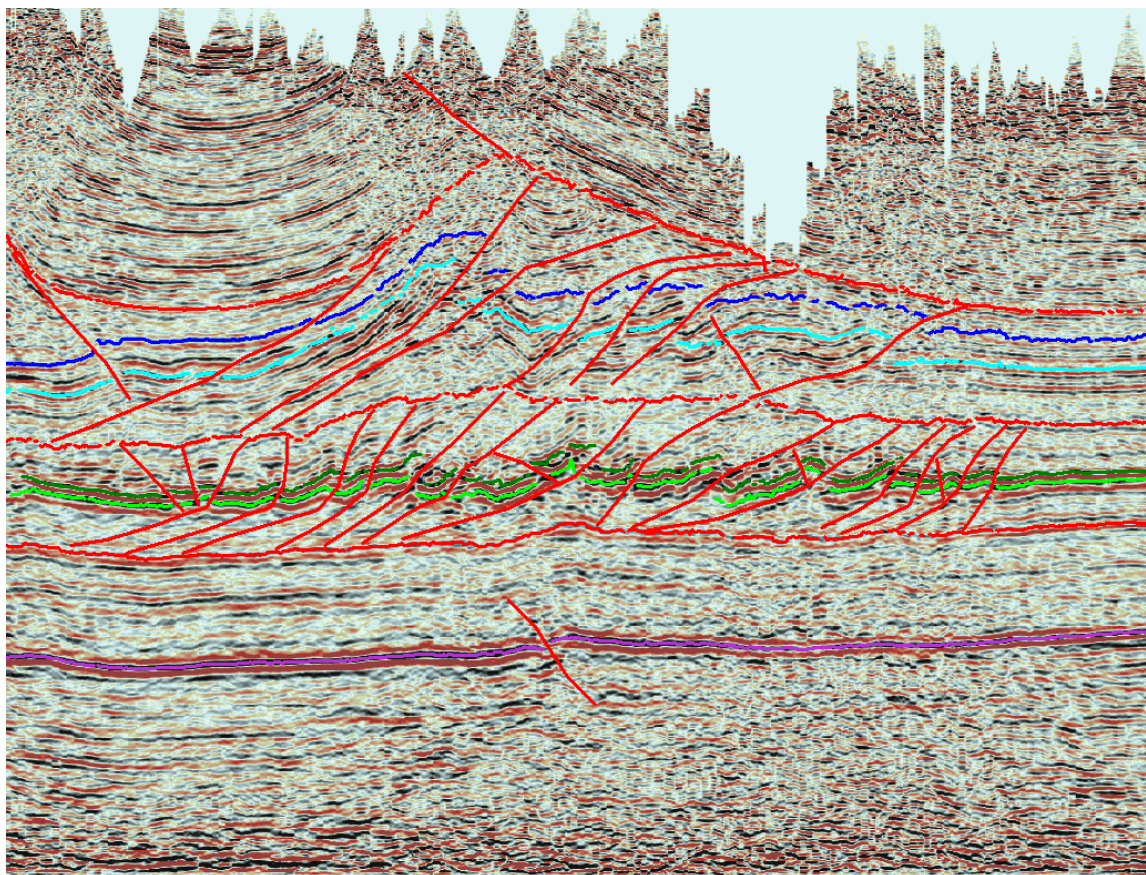


Figure 2: Seismic dip line depicting the structural interpretation.

A piggyback sequence of deformation appears to have occurred in the area, with the middle block of Cretaceous strata deforming first and then deforming further in conjunction with the underlying block. Both blocks contain blind duplexes and pop-up structures. Some of the pop-ups in the lower block of Triassic-Jurassic strata may have initiated as detachment folds that were later breached by thrusts.

Three widespread bedding-parallel detachment surfaces in the Wapiabi, Blackstone and Fernie shales have been interpreted to be the boundaries between the tectonic blocks. They acted as glide horizons allowing slip transfer to the foreland; ramps branching from them transferred displacement to higher stratigraphic and structural levels. The upper detachment is a continuous southwest-verging backthrust (the Pedley Fault) that is a major structural element at the surface. Several other backthrusts have been interpreted; they die out laterally into only a few backthrusts, indicating a transfer zone (Dahlstrom, 1970).

Our interpretation indicates changes in the geometries of folds, pop-ups and thrust faults along strike, suggesting the presence of oblique or lateral ramps (Dixon and Spratt, 2004). Thrusts appear in an échelon fashion, dying out laterally and gradually transmitting slip to the adjacent thrust.

Partial restorations by line length balance (Cooper, et al., 1983) have been carried out over dip-oriented seismic lines, resulting in shortening of 11-14% for the middle block and 8 -11% for the lower block.

Acknowledgements

We thank CGGVeritas for providing access to the data used in this study and we thank all of the sponsors of the University of Calgary's Fold-Fault Research Project (FRP) for their support of this research. We thank IHS for providing AccuMap and AccuLog, and Seismic Micro Technology for providing Kingdom Suite to the Department of Geoscience at the University of Calgary, and Midland Valley for providing Move software to FRP. Adriana Taborda, Dr. Helen Isaac, Leslie Desreux and Mark Kirtland provided help and support with software and interpretations.

References

- Cooper, M.A., Garton, M.R., and Hossack, J.R., 1983, The origin of the Basse Normandie duplex, Boulonnais, France: *Journal of Structural Geology*, v. 5, p. 139-152.
- Dahlstrom, C.D.A., 1970, Structural geology in the eastern margin of the Canadian Rocky Mountains: *Bulletin of Canadian Petroleum Geology*, v. 18, p. 332-406.
- Dixon, J.M., and Spratt, D.A., 2004, Deformation at lateral ramps and tear faults - centrifuge models and examples from the Canadian Rocky Mountain Foothills, in K.R. McClay, ed., *Thrust Tectonics and Hydrocarbon Systems: AAPG Memoir 82*, p. 239-258.
- Langenberg, C.W., 1993, Geological Map: Cadomin, NTS Mapsheet 83F/3, 1:50,000 map with cross sections. Alberta Geological Survey Map 217.
- Langenberg, C.W., and LeDrew, J., 2000, Geological Map: Coal Valley, NTS Mapsheet 83F/2, 1:50,000 map with cross sections. Alberta Geological Survey Map 237.
- Lebel, D., Langenberg, C.W., and Mountjoy, E.W., 1996, Structure of the central Canadian Cordillera thrust and fold belt, Athabasca-Brazeau area, Alberta: a large, complex intercutaneous wedge: *Bulletin of Canadian Petroleum Geology*, v. 44, n. 2, p. 282-298.
- Price, R.A., Stott, D.F., Campbell, R.B., Mountjoy, E.W., and Ollerenshaw, N.C., 1979, Athabasca River, Alberta - British Columbia, Sheet 83, Geological Survey of Canada, Map 1339A, 1:1,000,000.