Structural styles of the of the Central Alberta Foothills, Brown Creek area

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Introduction

Triangle zones located along the foreland edge of the Rocky Mountain fold and thrust belt of Canada have a similar overall architecture: a tectonic wedge, tapered towards the foreland, bounded by upper and lower detachment surfaces. From the US-Canada border to the Yukon-BC border the triangle zone occurs between the Foothills and Plains. Detailed analysis of these triangle zones show variations that provide opportunities to understand their genesis and development. The upper and lower detachments develop in a variety of stratigraphic levels and the internal volume of the tectonic wedge comprises a surprising variety of complex structural geometries that continue to inspire structural geologists. Integration of geological surface mapping, subsurface imaging by modern 2-D and 3-D seismic data, wireline well logs recorded in recently drilled wells and structural analysis have lead to an improved description of these structures.

Brown Creek Structures

Brown Creek is located within the Alberta Foothills of west central Alberta, less than an hour's drive on the Forestry Trunk road northwest of Nordegg. The creek traverses three relatively narrow but large amplitude triangle zones that trend parallel to the fold and thrust belt. Map and cross-section views suggest older strata have been squeezed up in a diapiric manner that Dahlstrom (1970, p. 365) called “style ejectif”. For decades producing viable geometric and kinematic descriptions of these structures has been challenging. These structures are enormously complex. Processes that lead to the style ejectif geometry include: bedding parallel delamination and associated distributed back-slip, duplexing, shimming and folding. The amount of back-slip within the Mesozoic section, just above the Paleozoic carbonates, can be large and has led to the emergence of a fault at surface just forelandward of its location at depth. In some places the deformation is facilitated by a relatively dense, three dimensional network of faults. Kinematic analysis demonstrates that a myriad of faults must act together simultaneously to maintain the simple uniform geometry of the overlying units. At broad scales the deformation is pervasive and the volume of rock appears to behave in a ductile manner. The deformation is clearly simple shear and the rocks do behave in a brittle manner, but the density of faults is very high. Some of this pervasive deformation is below the resolving power of the seismic method. Immediately above the zones of complex deformation are great panels of rock units that appear unaffected, their bedding geometry remaining simple and uniform. Thickness analysis suggests that the overlying "undeformed" upper panels have in fact been shortened and thickened significantly but in a uniform manner.

References

Dahlstrom, C.D.A., 1970, Structural geology in the eastern margin of the Canadian Rocky Mountains, Bulletin of Canadian Petroleum Geology, Vol. 18, No. 3, p. 322-40.