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GEOLOGICAL SURVEY OF CANADA / COMMISSION GÉOLOGIQUE DU CANADA

SALT TECTONISM IN THE FORT NORMAN AREA, NORTHWEST TERRITORIES, CANADA

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Note: Although every effort has been made to ensure accuracy, this Open File Report has not been edited for conformity with Geological Survey of Canada standards.

ABSTRACT

A study of petroleum exploration wells and seismic in the Fort Norman area has revealed the presence of mobile Cambrian age salt. Should this mobile salt extend under the Franklin Mountains it could provide an explanation for the sudden changes in thrust vergence mapped there.

Although the most obvious salt movement is of Laramide age, careful examination of unconformity and bed thickness relationships within areas flanking the diapirs reveals at least three, and possibly five, periods of movement. Well-documented phases include: post-Devonian – pre-Turonian; Late Cretaceous; and post Cretaceous (including post-Paleocene). Cambrian and pre-Devonian phases are deduced from equivocal data and may be related to epeirogenic events along the Keele Tectonic Zone.

'Transect A' crosses several pillows of varying complexity. Part c of this transect has had the Base of Cretaceous restored to horizontal to better present the post-Devonian pre-Turonian deformation. Devonian beds are seen here uplifted over pillows and bevelled by the unconformity.

A grid of five lines from the K'Alo area near Brackett Lake reveals additional pillows and supports a more regional interpretation of the distribution of mobile salt. Map 2 outlines the pillows and differentiates between controlled and uncontrolled boundaries.

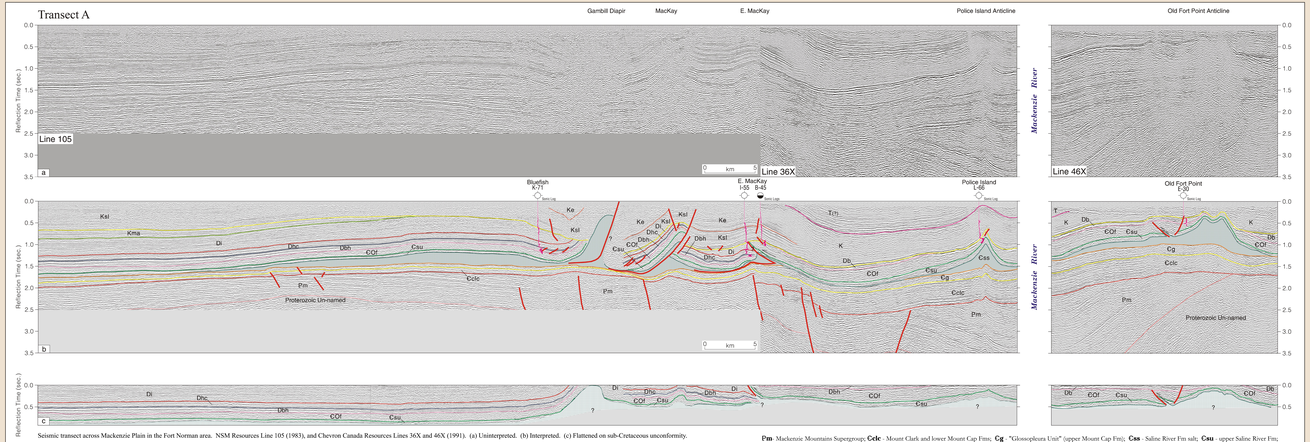
Changes of fault vergence along strike are a feature of the Franklin Mountains. Map 1 and Photos A and B illustrate the abrupt nature of these vergence flips. Such abrupt changes would be facilitated by a highly ductile layer in the fault zones and cores of associated anticlines.

REFERENCES

Cook, D.G.
1983: The northern Franklin Mountains, Northwest Territories, Canada - A scale model of the Wyoming Province. *In* Rocky Mountain Foreland Basins and Uplifts, J.D. Lowell and R.Gries (eds.); Rocky Mountain Association of Geologists, Denver, Colorado.

MacLean, B.C. and Cook, D.G.
1999: Salt tectonism in the Fort Norman area, Northwest Territories, Canada; Bulletin of Canadian Petroleum Geology, v. 47, p. 104-135.

Transect A

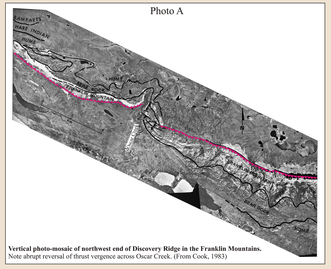


Seismic transect across Mackenzie Plain in the Fort Norman area. NSM Resources Line 105 (1983), and Chevron Canada Resources Lines 36X and 46X (1991). (a) Uninterpreted. (b) Interpreted. (c) Flattened on sub-Cretaceous unconformity.

An ancestral broad pillow of mobile Cambrian salt of the Mount Cap and Saline River formations has developed over time into a number of areally smaller but higher pillows and diapirs. Salt flow occurred during a number of discrete periods of time: pre-Devonian; post-Imperial Formation (pre-Late Devonian) to pre-Slater River Formation (pre-Turonian); pre-East Fork Formation (late-Cretaceous Campanian); and post-Cretaceous (Laramide). Adjacent lines show post-Laramide diapirism.

Pm- Mackenzie Mountains Supergroup; **Cclc** - Mount Clark and lower Mount Cap Fms; **Cg** - "Glossopleura Unit" (upper Mount Cap Fm); **Css** - Saline River Fm salt; **Csu** - upper Saline River Fm; **COf** - Franklin Mountain Fm; **Db** - Bear Rock Fm; **Dbh** - Bear Rock and Hume fms; **Dhc** - Hare Indian and Canol Fms; **Di** - Imperial Fm; **Kima** - Martin House and Arctic Red fms; **Ksl** - Slater River and Little Bear fms; **Ke** - East Fork Formation; **K** - Cretaceous (undivided); **T** - Tertiary.

Photo A

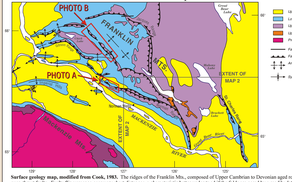


Vertical photo-mosaic of northwest end of Discovery Ridge in the Franklin Mountains. Note abrupt reversal of thrust vergence across Oscar Creek. (From Cook, 1983)

Photo B

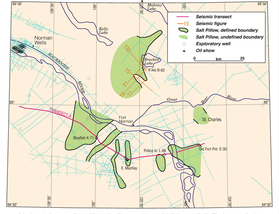
Oblique view to northwest along an unnamed ridge of the Franklin Mountains. The white exposures are carbonates of the Cambro-Ordovician Franklin Mtn. Formation and the dipping strata are 70° to east. Along strike to the northwest, vergence marks an abrupt reversal of thrust vergence. (From Cook, 1983)

Map 1



Surface geology map, modified from Cook, 1983. The ridges of the Franklin Mts., composed of Upper Cambrian to Devonian aged rocks, are raised to the surface over thrust faults. Faults flip vergence over very short distances, a characteristic better understood if the folds are cored by a readily deformed material such as salt.

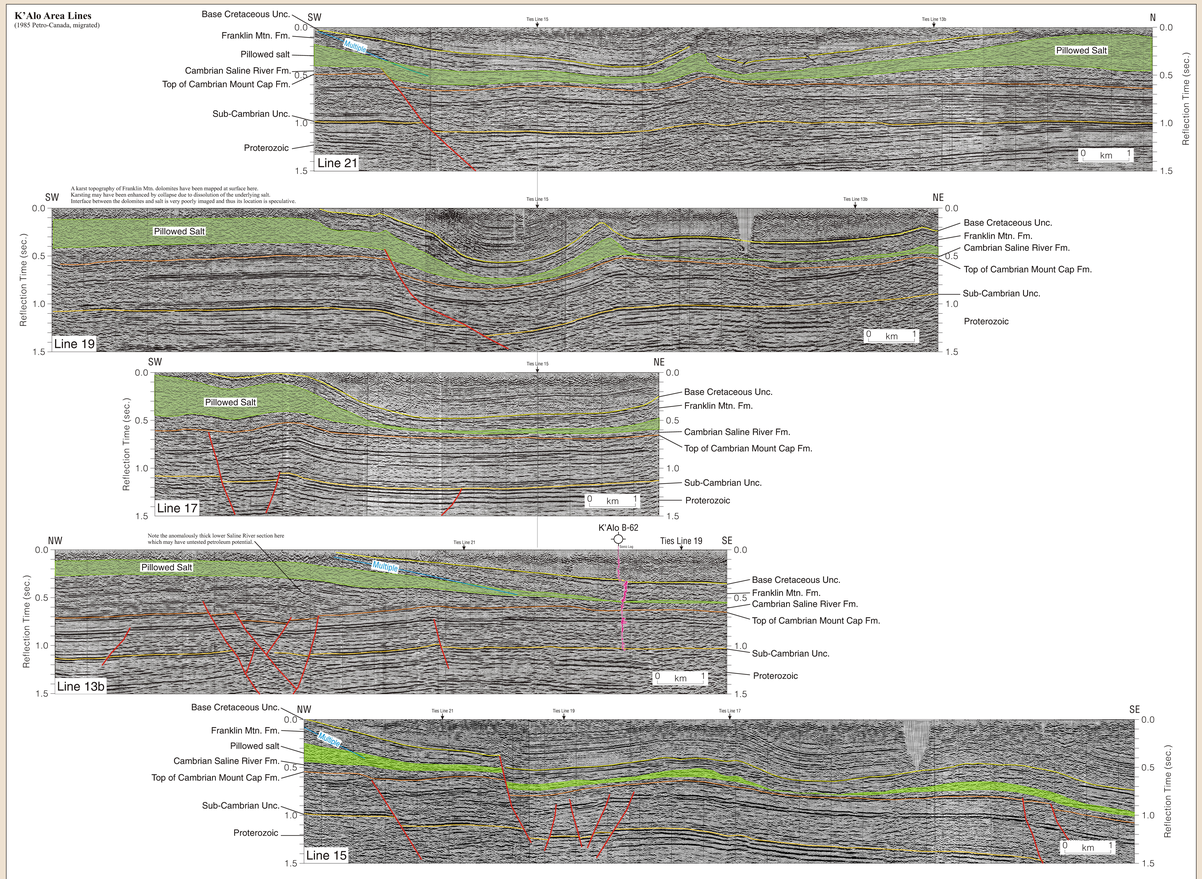
Map 2



Seismic track line and well map. Lines and wells presented here are labelled. Areas of salt pillowing are outlined. Note the undefined northwest limit of the K'Alo area pillow permits deformed salt to extend under the Norman Range and possibly further north. The salt pillow labelled 'St. Charles' underlies the informally named St. Charles Range.

K'Alo Area Lines

(1985 Petro-Canada, migrated)



A karst topography of Franklin Mtn. dolomites have been mapped at surface here.
Karsting may have been enhanced by collapse due to dissolution of the underlying salt.
Interface between the dolomites and salt is very poorly imaged and thus its location is speculative.

Note the anomalously thick lower Saline River section here which may have untested petroleum potential.