STRUCTURE SECTION ACROSS SOUTH CENTRAL MACKENZIE MOUNTAINS, N.W.T.

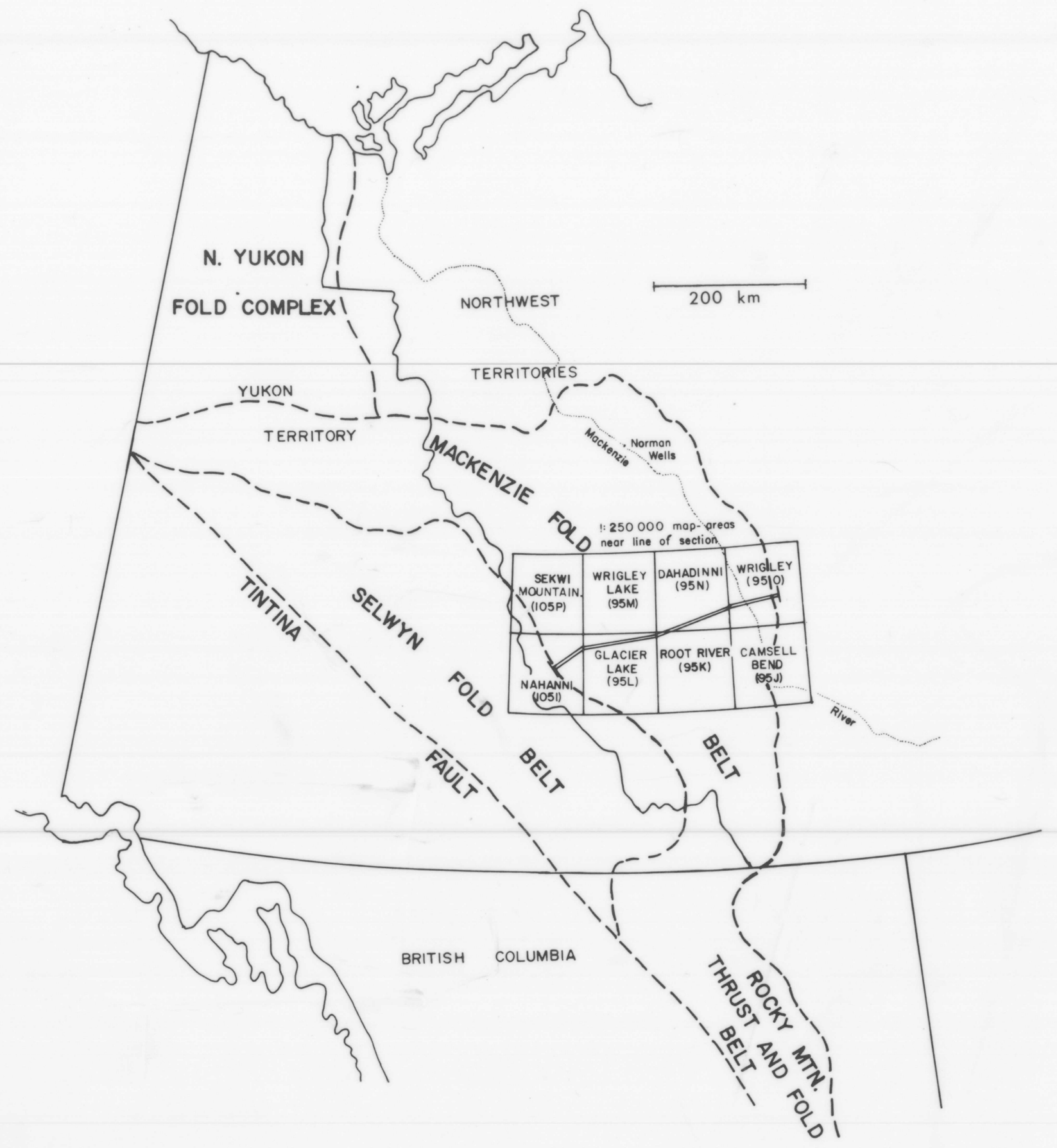
THE MACKENZIE MOUNTAINS ARE INTERPRETED AS A THIN-SKINNED DETACHMENT TERRANE COMPRISING NORTHWEST TRENDING DECOLLEMENT FOLDS AND LISTRIC THRUST FAULTS THAT ARE THE EXTENSION OF THE NORTHERN ROCKY MOUNTAIN FOLD AND THRUST BELT. A CROSS SECTION IS PRESENTED IN WHICH BED LENGTHS ARE CONSERVED AND INTERNAL GEOMETRIC CONSISTENCY IS MAINTAINED.

THIS APPROACH SUGGESTS THAT THE SIGNIFICANT STRUCTURAL RELIEF OF REDSTONE PLATEAU RESULTED FROM EASTWARD TRANSLATION OF SUPRACRUSTAL ROCKS ACROSS A LARGE PRE-EXISTING BASEMENT RAMP AND ONTO A HIGHER DETACHMENT SURFACE THAT EXTENDS BENEATH THE ENTIRE DEFORMED BELT. THRUST FAULTS BOUNDING THE EAST MARGIN OF THE PLATEAU ARE SPLAYS FROM THE SOLE FAULT AND MAY HAVE ORIGINATED AT THE POSITION OF THE STEP BEFORE SIGNIFICANT SHORTENING MOVED THEM AND THE HANGINGWALL ASSEMBLAGE OVER IT AND ALONG THE FLAT PLATEAU DECOLLEMENT. SHORTENING ABOVE THE DETACHMENT EAST OF THE PLATEAU IS THE AMOUNT GEOMETRICALLY NEEDED TO COMPENSATE FOR OVERLAP BENEATH THE PLATEAU.

RESTORATION OF THE STRUCTURE SECTION TO ITS UNDEFORMED LENGTH SHOWS THAT THE RAMP IS COINCIDENT WITH RAPID WESTWARD THICKENING OF PROTEROZOIC RAPITAN GROUP STRATA, SUPPORTING THE CONCEPT OF PRE-RAPITAN EXTENSION AND CRUSTAL THINNING.

TOTAL SHORTENING ACROSS MACKENZIE MOUNTAINS IS ABOUT 53 KM, VERY SIMILAR TO THAT SUGGESTED (55 KM) BY GABRIELSE AND TALYOR FOR NORTHERN ROCKY MOUNTAINS.

COMPRESSIONAL DEFORMATION IS BROADLY DATED AS LOWER CRETACEOUS TO TERTIARY, AND MIGRATED WITHIN THIS INTERVAL FROM SOUTHWEST TO NORTHEAST. LITTLE CONSTRAINT EXISTS ON THE AGE OF INDIVIDUAL STRUCTURES SO IT IS NOT KNOWN IF SHORTENING WAS ACCOMPLISHED THROUGH A SINGLE PROTRACTED EVENT OR AS A NUMBER OF DISCRETE PULSES. AT THE SOUTHWEST END OF THE SECTION DEFORMATION IS EARLY CRETACEOUS AS DISCORDANT MID-CRETACEOUS (100 TO 80 MY) QUARTZ MONZONITE PLUTONS CROSS-CUT AN ALREADY FOLDED SUCCESSION. IN SEKWI MOUNTAIN AREA SOUTHWEST OF REDSTONE PLATEAU, NON-MARINE CLASTIC ROCKS BROADLY DATED AS CRETACEOUS ARE DEFORMED (BLUSSON, 1971). IN THE FORT NORMAN AREA, NEAR THE EASTERN LIMIT OF DEFORMATION, TERTIARY (EOCENE ?) STRATA ARE DEFORMED WITH DIPS AS HIGH AS 20° (AITKEN AND COOK, 1974).


N. YUKON
FOLD COMPLEX
NORTHWEST
TERRITORIES
YUKON
TERRITORY
200 km
Mackenzie
Norman Wells
MACKENZIE FOLD BELT
1:250 000 map-areas near line of section
SEKWI MOUNTAIN (105P)
WRIGLEY LAKE (95M)
DAHADINNI (95N)
WRIGLEY (95O)
NAHANNI (105I)
GLACIER LAKE (95L)
ROOT RIVER (95K)
CAMSELL BEND (95J)
River
TINTINA FAULT
SELWYN FOLD BELT
BRITISH COLUMBIA
ROCKY MTN. THRUST AND FOLD BELT

LEGEND

QUATERNARY

Qa	alluvium

MESOZOIC — CRETACEOUS

Kqm	quartz monzonite
Ks	sandstone, shale

PALEOZOIC — DEVONIAN AND MISSISSIPPIAN

DMs	shale, sandstone (Horn River, Fort Simpson)[1]

DEVONIAN

uDl	limestone (map only)
mDl	limestone (Landry, Headless, Nahanni, Funeral)
mDd	dolostone (Arnica, Bear Rock, Manetoe)

UPPER ORDOVICIAN TO DEVONIAN

ODl	limestone (Road River, Natla)
uODd	dolostone, limestone (Whittaker, Delorme, Camsell, Sombre)

UPPER CAMBRIAN AND ORDOVICIAN

u€Od	dolostone, limestone (Broken Skull, Franklin Mountain)
u€l	limestone (Rabbitkettle)
u€e	shale, salt, gypsum (Saline River) (map only)

CAMBRIAN

€se	l€s + u€e undivided (section only)
m€l	limestone (Rockslide)
m€d	dolostone (Avalanche) (map only)
l€sd	shale, sandstone, dolostone, limestone (Backbone Ranges, Sekwi)
l€s	sandstone (Mount Clarke) (map only)

PROTEROZOIC — HADRYNIAN

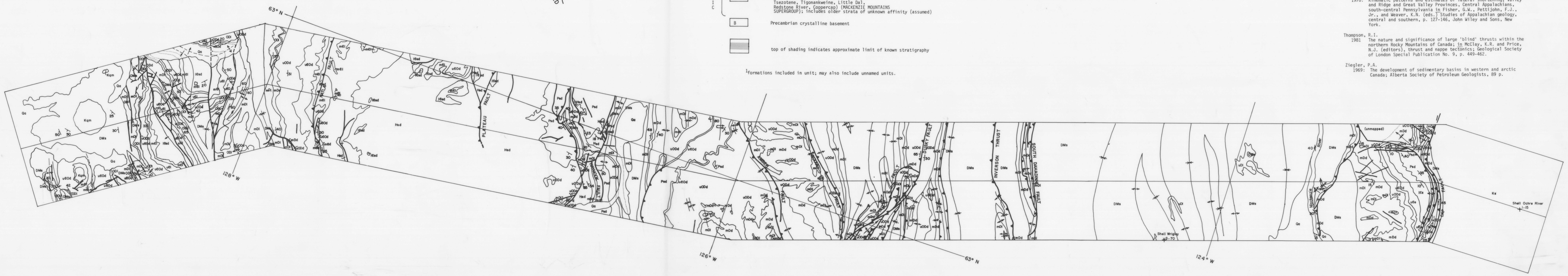
Hsd	shale, sandstone, conglomerate, dolostone (Rapitan Group, Sheepbed) (WINDERMERE SUPERGROUP)

HELIKIAN

Psd	shale, dolostone, sandstone (Lone Land, Tsezotene, Tigonankweine, Little Dal, Redstone River, Coppercap) (MACKENZIE MOUNTAINS SUPERGROUP); includes older strata of unknown affinity (assumed)
B	Precambrian crystalline basement
▨	top of shading indicates approximate limit of known stratigraphy

[1] formations included in unit; may also include unnamed units.

geologic contact (defined, extrapolated)
bedding (inclined, overturned)
fault (defined, extrapolated)
thrust fault (defined, extrapolated)
anticline (upright, overturned)
syncline (upright, overturned)
monocline
well


63° N
128° W
126° W
124° W
63° N
PLATEAU FAULT
FAULT
HAYHOOK FAULT
AMBER FAULT
ROUGE FAULT
DUSKY FAULT
INVERSON THRUST
SOUTH DAHADINNI FAULT
Mackenzie River
(unmapped)
CAP FAULT
Shell Wrigley G-70
Shell Ochre River I-15
Qa
Kqm
DMs
Hsd
Psd
Ks

MACKENZIE FOLD BELT
MACKENZIE MOUNTAINS
MACKENZIE PLAIN
FRANKLIN MOUNTAINS
INTERIOR PLAINS
H
G
F
E
D
C
B
A
REDSTONE
PLATEAU
Natla Fault
Plateau Fault
Hayhook Fault
Amber Fault
Rouge Fault
Spirit Fault
Dusky Fault
Inverson Thrust
South Dahadinni Fault
Shell W. Wrigley G-70 (projected)
Mackenzie River
Camsell Thrust
Cap Fault
Shell Ochre River I-15
sea level
km
x 10³ ft
decollement, at unknown level above crystalline basement, disrupted by post-tectonic intrusion of quartz monzonite
level of basement unknown
step in basement (diagrammatic)
structure hypothetical to fill 'hole' to decollement
reference line
possible Psd
top of crystalline basement, not necessarily flat, at unknown depth beneath basal decollement
top of crystalline basement (diagrammatic)
Windermere syndepositional tectonics, as in area near Hayhook Fault, may indicate Selwyn Basin is underlain by extended and faulted basement overlain by a complex assemblage of faulted Proterozoic sediments Eisbacher (1981)
In the area of Hayhook Fault Eisbacher (1981) indicates that abrupt facies and thickness changes (not incorporated at this scale) in pre- and basal Windermere strata reflect major contemporaneous block faulting and local compressive deformation.
Frontal anticline is interpreted to reflect change in level of detatchment from Proterozoic to Cambrian evaporite similar to that proposed by Aitken and Cook (1974) in Carcajou Canyon area. Position of known crystalline basement east of Cap Fault from Ziegler (1969) and Douglas and Gabrielse (1970).
TOTAL SHORTENING = 53 km (14%)
datum-base of Paleozoic
datum-top of mDl
L = 85 km
Dd = 2.75 km
De = 7.50 km
Vi = 436 km²
Vf = 450 km² (measured)
L = 26 km
Dc = 7.50 km
Dd = 8.25 km
Vi = 205 km²
Vf = 202 km² (measured)
L = 123 km
Db = 6.00 km
Dc = 7.50 km
Vi = 830 km²
Vf = 846 km² (measured)
METHOD OF DETERMINING DEPTH TO DECOLLEMENT
RESTORED SECTION
SELWYN BASIN
REDSTONE ARCH
ROOT BASIN
INTERIOR PLATFORM
(future site of pluton)
horizontal datum - base of DMs
B

For a 'balanced' section the area bounded by the decollement, reference lines, and datum must be the same in deformed and restored (original) states. An implied relationship between bedding line length and depth of decollement allows positioning of the detachment.

$$A_i = A_f$$

$$\text{(approx.)}\ L \cdot 1/2(D_b + D_c) = A_f$$

$A_{i,f}$ = area; initial, final
L = bedding line length
$D_{b,c}$ = depth at reference line B, C etc

The area diagrams show the depicted depth to decollement is reasonably consistent with area conservation and amount of shortening. Bedding line length was adjusted within geological constraints to obtain consistent depth to decollement for the three segments shown. For other applications of the area method see Gwinn (1970) and Thompson (1981)

STRUCTURE SECTION — MACKENZIE FOLD BELT

SCALE 1:250,000
miles 4 0 4 8 12 miles
kilometers 6 0 6 12 18 kilometers

S.P. GORDEY

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