MONASHEE MOUNTAINS

QUATERNARY

Qa — *Till, alluvium*

PROTEROZOIC

UPPER PROTEROZOIC

WINDERMERE SUPERGROUP

MICA CREEK SUCCESSION (Pg - Pspa)

Pspa — *SEMIPELITE-AMPHIBOLITE UNIT: semipelite, psammite, micaceous psammite, amphibolite,pelitic schist, and grit; local matrix-supported pebble to boulder conglomerate with clasts of quartzite, marble, calcsilicate, and granitoid rocks; minor calcareous psammite, marble, and micaceous quartzite; minor migmatite; a: amphibolite; cbt: carbonatite*

Plc — *LOWER CARBONATE UNIT: marble, calcareous psammite, calcsilicate, pelite; minor semipelite and amphibolite (schematic stratigraphic diagram only)*

Plp — *LOWER PELITE UNIT: pelitic schist, semipelite; minor local amphibolite and marble*

Plg — *LOWER GRIT UNIT: pelitic schist, conglomerate, minor psammite, grit and amphibolite*

Pmci — *MICA CREEK SUCCESSION; Undivided*

MALTON COMPLEX

PROTEROZOIC

UPPER PROTEROZOIC

WINDERMERE SUPERGROUP

Pcs — *COVER SEQUENCE TO MALTON GNEISS: pelite, semipelite, minor grit, local quartzite and l or conglomerate at base (similar to lower pelite unit of Mica Creek succession and lower Miette Group)*

Pbc — *BASAL CONGLOMERATE UNIT: Matrix- to clast-supported pebble to cobble conglomerate with brownish biotite-rich calcareous matrix. Clasts of underlying quartzite, amphibolite, and granitoid units. Abundant boudinaged quartz veins appear as clasts. Pbc unconformably overlies quartzite or gneiss and forms the base to the Windermere Supergroup (schematic stratigraphic diagram only)*

UPPER PROTEROZOIC?

Pq — *QUARTZITE UNIT: fine-grained foliated to mylonitic muscovitic quartzite, minor quartz-pebble conglomerate, orthoquartzite*

LOWER PROTEROZOIC

Pmg3 — *MALTON GNEISS UNIT 3: foliated granitic augen orthogneiss, probably 1870 Ma, minor amphibolite (unit Pmg2 of northern Malton gneiss; see Note 8)*

Pmg2 — *MALTON GNEISS UNIT 2: foliated biotite, hornblende granodioritic to dioritic augen orthogneiss; U-Pb zircon ages are 1987 Ma and 2060-2100 Ma (Note 7)*

Pmg1 — *MALTON GNEISS UNIT 1: layered quartzose paragneiss, mafic amphibolitic gneiss, and amphibolite; locally intruded by granitic gneiss of Pmg3, and augen gneiss of Pmg2*

Pmgi — *MALTON GNEISS; Undivided*

CARIBOO MOUNTAINS

TERTIARY

INTRUSIVE ROCKS

Tg — *Muscovite, biotite granite, quartz monzonite (see Note 9)*

MESOZOIC

INTRUSIVE ROCKS

JKpeg — *Jura-Cretaceous pegmatite sills and dykes*

JKg — *Jura-Cretaceous foliated and/or lineated granite*

PROTEROZOIC

UPPER PROTEROZOIC

WINDERMERE SUPERGROUP

Kaza Group

Upper Kaza Group

Pku — *MASSIVE CONGLOMERATIC SANDSTONE (GRIT); sandstone; minor grey green to grey pelite; intervening grey-green and lesser black pelite map units (stratigraphic diagram only)*

Pof — *OLD FORT POINT FORMATION EQUIVALENT: pink quartzite; calcareous cross-bedded psammite Pof and green laminated pelite; calcareous psammite, laminated pelite, and buff sandy marble; black graphitic schist (stratigraphic diagram only)*

Middle Kaza Group

Pkm — *MASSIVE CONGLOMERATIC SANDSTONE (GRIT); sandstone and conglomeratic sandstone; minor grey-green to grey pelite; intervening grey-green and lesser black pelite map units; minor sulphide-rich graphitic pelite near the base*

Lower Kaza Group

Pkl3 — *CARBONATE UNIT: (Division Carbonate of Pell, 1984): cycles of semipelite and grit, graphitic pelite, impure buff-coloured sandy marble*

Pkl2 — *Black graphitic phyllite, dark grey to black silty pelite; minor slate*

Pkl1 — *Semipelite, biotite schist; minor grit, calcareous amphibolite*

Pkl — *LOWER KAZA GROUP; Undivided*

MICA CREEK SUCCESSION (Pspa - Pmcm)

Pmcm — *MIDDLE MARBLE UNIT: white to grey marble; minor pelite, calcsilicate; locally subdivided into lower and upper marble units with an intervening pelite unit (Pmcm1-Pmcm3)*

Pspa — *SEMIPELITE-AMPHIBOLITE UNIT: semipelite, psammite, micaceous psammite, amphibolite, pelitic schist, and grit; local matrix-supported pebble to boulder conglomerate with clasts of quartzite, marble, calcsilicate, and granitoid rocks; minor calcareous*

Geological boundary: (defined, approximate, assumed, arbitrary boundary between subdivided and non-subdivided units)

Thrust fault: (teeth on hanging wall; defined, approximate, assumed, projection under younger deposits)

Detachment: (teeth on hanging wall; defined, approximate, assumed, projection under younger deposits)

Normal fault: (symbols on hanging wall; defined, approximate, assumed, projection under younger deposits)

Anticline, trace of axial surface: (defined, approximate, projection under younger deposits; upright, overturned)

Syncline, trace of axial surface: (defined, approximate, projection under younger deposits; upright, overturned)

D_3 fold nappe, trace of axial surface; S, syncline; A, anticline; vergence unknown where unadorned: (approximate)

Bedding, tops known: (inclined, vertical, overturned)

First foliation (S_1,$_2$): (inclined, vertical)

Second foliation (S_3): (inclined, vertical)

Mesoscopic F_2 fold axis: (inclined, horizontal)

Mesoscopic F_3 fold axis: (inclined, horizontal)

Stretching lineation (D_3): (inclined; horizontal)

Fibrolite lineation: (inclined)

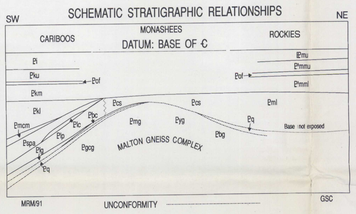
Mineral isograds (ticks on high grade side):
- staurolite/kyanite
- staurolite-out
- sillimanite

Geochronological data (Note 7)

Line of section

Mineral occurrence:
- Carbonatite

SCHEMATIC STRATIGRAPHIC RELATIONSHIPS



NOTES

1. Geology of the Malton Range by Campbell (1968), Morrison (1982), Doucet *et al.* (1985), Digel (1989), Digel *et al.* (1989), and unpublished mapping by P.S. Simony. Geology of the Cariboo Mountains by Pell (1984), Dechesne (1986), Currie (1988), and unpublished mapping by P.S. Simony.

2. Bedding parallel to -subparallel S_1 foliation of the Rocky Mountains is equivalent to S_{1+2} of the Monashee and Cariboo mountains; S_2crenulation cleavage of the Rockies is equivalent to S_3crenulation cleavage of the Monashee and Cariboo mountains (see Simony *et al.* 1980; Morrison, 1982; McDonough and Simony, 1988; McDonough, 1989).

3. The gneisses of the Malton Complex are typically separated from their cover by thermally annealed pre-metamorphic shear zones that indicate the Windermere cover rocks are detached from the basement (Morrison, 1982; McDonough and Simony, 1988; McDonough and Morrison, 1990; McDonough *et al.* 1992; McDonough and Parrish, 1991). Although the contacts are generally sheared and thermally annealed, the Early Proterozoic gneisses of the Malton Complex are unconformably overlain by a pre-Windermere quartzite unit, which in turn is unconformably overlain by the basal conglomerate of the Windermere Supergroup (Murphy *et al.* 1991.; McDonough *et al.* 1991, 1992). Inward facing stratigraphy within exposures of cover rocks that are encased by basement gneisses suggest that the cover is deformed into large infolds. These are interpreted as D_3 structures of possible westerly vergence: no D_3 fold closures have been identified in the Malton Complex. Above the Malton décollement, large D_3 structures are known to be westerly vergent, and refolded by northeasterly vergent D_3structures (Simony *et al.* 1980). The Scrip nappe is the largest of these D_3 nappes, having a limb length of about 50 km (Reeside and Simony, 1983; Digel *et al.* 1989; Sevigny and Simony, 1989). The Malton décollement was probably active during formation of D_3 nappes. Fabric analysis indicates that it was active during D_3, facilitating northeastward translation of the hotter rocks of the cover over the cooler basement of the Malton Complex (Morrison, 1982; Sevigny *et al.* 1989). Note the comminution of the staurolite-out and sillimanite isograds with the Malton décollement.

4. The timing of metamorphism and syn-metamorphic northeasterly vergent D_3deformation in the Valemount region is constrained by U-Pb monazite and zircon data of Currie (1988), Sevigny *et al.* (1989), Scammell (1991), and Currie *et al.* (in prep.) to between 135-100 Ma (Early Cretaceous).

5. Orogen-parallel (OP) D_3stretching lineations are ubiquitous in the gneisses of the Malton Complex, and where not annealed consistently express dextral kinematics throughout the Valemount region. In the Rockies, sub-horizontal D_3thrust faults (e.g., the Bear Foot thrust and its footwall expression the Valemount strain zone, and the Valle thrust,) are part of a dextral oblique-slip thrust system that carried basement gneisses of the Malton Complex into the Rocky Mountain belt (see McDonough and Simony, 1988; McDonough and Simony, 1989). OP stretching lineations also occur in conglomerates and in the Thunder River thrust zone in the Cariboo Mountains (McDonough *et al.* 1992), and in the Windermere cover rocks in the Monashees (McDonough *et al.* 1991).

6. The North Thompson-Albreda normal fault is a brittle fault with fibre data indicative of west-side-down displacement (Morrison, 1982; Pell, 1984). Geobarometric considerations suggest that displacement is less than 3 km. No data indicative of strike-slip displacement have been reported for this zone. However, if the segment of the fault south of Clemina Creek is essentially dip-slip, then the Albreda River section of the fault must have a substantial dextral strike-parallel component of displacement. Mesoscopic scale brittle faults in the northern Malton Range that are parallel to the strike of the Albreda segment of the NTANF are dextral oblique-slip normal faults (McDonough *et al.* 1992).

7. U-Pb zircon and allanite data for orthogneisses of the Malton Gneiss Complex are reported by McDonough and Parrish (1991). K-Ar data for micas and hornblende from the Cariboo Mountains are reported by Currie (1988), Currie *et al.* (in prep.), and Hunt and Roddick (1990; 1992). The date(s) for the Lempriere map-sheet (83D/6) are:

A: zircon U/Pb 2060-2100 Ma (biotite-hornblende granodioritic augen orthogneiss, Malton gneiss unit 2; sample MGM-01, collected by MRM).

8. Dioritic to granodioritic foliated augen gneisses of unit Pmg2 occur as map-units in the southern Malton gneiss (Lempriere and Howard Creek map-sheets), but as thin units dispersed within the layered gneisses (Pmg1) in the northern part of the Malton gneiss (Ptarmigan Creek and Canoe Mountain map-sheets; McDonough and Morrison 1990; McDonough *et al.* 1992). Therefore, the granitic orthogneisses shown here and on the Howard Creek map-sheet (McDonough *et al.* 1991) as unit Pmg3 are the same ass those of unit Pmg2 of the northern Malton gneiss.

9. The Murtle Pluton is a weakly deformed to undeformed body of granite and quartz monzonite that appears to truncate earlier formed fabrics of the Cariboos. K-Ar cooling ages for biotite and muscovite recalculate to 50.9±6 Ma and 54.3±6 Ma, respectively (Wanless *et al.* 1966; GSC64-13,14; UTM grid reference 720350mE, 5805450mN, Angus Horne map-sheet, 83D/5). A new U-Pb zircon date is 55±1 Ma (L.C. Struik and R.R. Parrish, unpublished data, 1991).

10. The stratigraphy of the Mica Creek succession is discussed in detail by Simony *et al.* (1980), who referred to the package as part of the Horsethief Creek Group. The type Horsethief Creek Group is probably correlative with the Miette Group of the Rockies, however. Some of the marbles shown within the Semipelite-Amphibolite Unit may actually be carbonatites (see Pell, 1985). An alternative view of the stratigraphy of the Cariboos (and by inference the Monashees) is presented by Murphy (1991: see also Murphy *et al.* 1991) in which the Mica Creek succession is separated from the Kaza Group by a southwesterly vergent Jurassic thrust, the Pleasant Valley thrust of Struik (1986). Murphy (1991) also assigned the Middle Marble at Milledge Creek to the lower Kaza carbonate (Division carbonate of Pell, 1984).

11. Structure sections 22 and 23 show a fan in the vergence direction of D_2structures mapped by Pell (1984). The Slide Mountain synform forms the axis of the fan. It is proposed here that the change in D_2vergence may be related to a tectonic wedge(s) beneath the west-vergent structures, in the hanging wall of the Camp Creek thrust. The upper detachment of such a wedge would be a blind west-vergent thrust that is cut by the Murtle pluton, before merging with the east-vergent Thunder River thrust on the west side of the pluton.

12. *References cited:*

Campbell, R.B. 1968. Canoe River (83D), British Columbia. Geological Survey of Canada, Map **15-1967**, 1:253 454 scale (1 inch=4 miles).

Currie, L.C. 1988. Geology of the Allan Creek area, Cariboo Mountains, British Columbia. Unpublished M.Sc. thesis, The University of Calgary, Calgary, Alberta. Unpublished M.Sc. thesis, The University of Calgary, Calgary, Alberta.

Dechesne, R.D. 1986. Structure, stratigraphy, and metamorphism of the Blue River, British Columbia area. Unpublished M.Sc. thesis, The University of Calgary, Calgary, Alberta.

Digel, S.G. 1989. Metamorphic and structural geology of the Mt. Cheadle area, northern Monashee Mountains, British Columbia. Unpublished M.Sc. thesis, The University of Calgary, Calgary, Alberta.

Digel, S.G., Ghent, E.D., and Simony, P.S. 1989. Metamorphism and structure of the Mount Cheadle area, Monashee Mountains, British Columbia. *In* Current research, Part E, Geological Survey of Canada, Paper **89-1E**, pp. 95-100.

Doucet, P.D., Ghent, E.D., and Simony, P.S. 1985. Metamorphism in the Monashee Mountains east of Blue River, British Columbia. *In* Current research, Part A, Geological Survey of Canada, Paper **85-1A**, pp.69-71.

Hunt, P.A., and Roddick, J.C. 1990. A compilation of K-Ar ages: Report 19. *In* Radiogenic Age and Isotopic Studies: Report 3. Geological Survey of Canada, Paper **89-2**.

Hunt, P.A., and Roddick, J.C. 1992. A compilation of K-Ar ages: Report 21. *In* Radiogenic Age and Isotopic Studies: Report 4. Geological Survey of Canada, Paper **91-2**, in press.

McDonough, M.R., and Morrison, M.L. 1990. Ptarmigan Creek, West-half, British Columbia (83D/10). Geological Survey of Canada, Open File Report 2305, 1:50 000 scale.

McDonough, M.R., Morrison, M.L., Currie, L.D., Walker, R.T., Pell, J., and Murphy, D.C. 1992. Canoe Mountain, British Columbia (83D/11). Geological Survey of Canada, Preliminary Map **92-XX**, 1:50 000 scale, in press.

McDonough, M.R., and Parrish, R.R. 1991. Proterozoic gneisses of the Malton Complex, near Valemount, British Columbia: U-Pb ages and Nd isotopic signatures. Canadian Journal of Earth Sciences, v.**28**, 1202-1216.

McDonough, M.R., and Simony, P.S. 1988. Structural evolution of basement gneisses and Hadrynian cover , Bulldog Creek area, Rocky Mountains, British Columbia. Canadian Journal of Earth Sciences, v.**25**, p.1687-1702.

McDonough, M.R., and Simony, P.S. 1989. The Valemount strain zone: A dextral oblique-slip thrust system linking the Rocky Mountain and Omineca belts of the southeastern Canadian Cordillera. Geology, v.17, p.237-240.

McDonough, M.R. (compiler), Simony, P.S., Morrison, M.L., Okulitch, A.V., Okulitch, C., Sevigny, J.H., Robbins, D.B., Digel, S.G., and Grasby, S. E. 1991. Howard Creek, British Columbia (83D/7). Geological Survey of Canada, Open File Report **2411**, 1:50 000 scale.

Morrison, M.L. 1982. Structure and petrology of the Malton Gneiss Complex. Unpublished Ph.D. thesis, The University of Calgary, Calgary, Alberta.

Murphy, D.C. 1991. Canoe River (83/D), Geological Survey of Canada, Open File **2324**, 1:250 000 scale.

Murphy, D.C., Walker, R.T., and Parrish, R.R. 1991. Gold Creek gneiss, southeastern Caribou Mountains, British Columbia: Age, geological setting, and regional implications. Canadian Journal of Earth Sciences, v. **28**, 1217-1231.

Pell, J. 1984. Stratigraphy, structure, and metamorphism of Hadrynian strata in the southeastern Caribou Mountains, B.C. Unpublished Ph.D. thesis, The University of Calgary, Calgary, Alberta.

Pell, J. 1985. Carbonatites and related rocks in British Columbia. *In* Fieldwork 1984, B.C. Ministry of Energy, Mines and Pet. Res., pp.85-94.

Pell, J. and Simony, P.S. 1987. New correlations of Hadrynian strata, south-central British Columbia. Canadian Journal of Earth Sciences, v.**24**, p.302-313.

Reesides, R., and Simony, P.S. 1983. Stratigraphy and deformational history of the Scrip Nappe, Monashee Mountains, British Columbia.. Canadian Journal of Earth Sciences, v.**20**, p.639-650.

Scammell, R.J. 1991. Tectonic implications of new U-Pb dating of high-grade metamorphic events and granite crystallization in the southern Scrip Range, Omineca belt, southern British Columbia. Geological Association of Canada, Program with Abstracts, v.**20**, p.A110.

Sevigny, J.H., Parish, R.R., and Ghent, E.D. 1989. Petrogenesis of peraluminous granites, northern Monashee Mountains, southeastern Canadian Cordillera, British Columbia. Journal of Petrology, v.**30**, p.557-581.

Sevigny, J.H., Parish, R.R., Donelick, R., and Ghent, E.D. 1990. Tectonic evolution of the northern Monashee Mountains: constraints on the timing of metamorphism and tectonic denudation of the southern Omineca Crystalline belt. Geology, v.**18**, p.103-106.

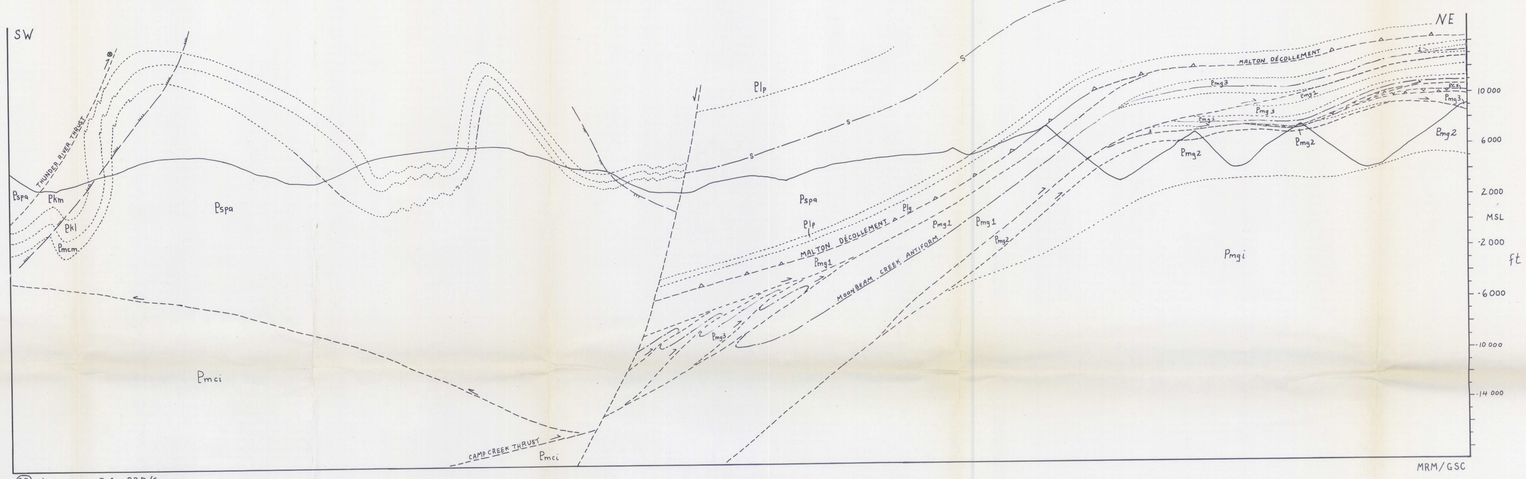
Sevigny, J.H., and Simony, P.S. 1989. Geometric relationship between the Scrip Nappe and metamorphic isograds in the northern Adams River area, Monashee Mountains, British Columbia. Canadian Journal of Earth Sciences, v.**26**, p.606-610.

Simony, P.S., Ghent, E.D., Craw, D., Mitchell, W., and Robbins, D.B. 1980. Structural and metamorphic evolution of the northeast flank of the Shuswap Complex, southern Canoe River area, British Columbia. *In* Cordilleran metamorphic core complexes, *edited by* M.D. Crittenden, P.J. Coney, and G.H. Davis. Geological Society of America, Memoir **153**, pp. 445-461.

Struik, L.C. 1986. Imbricated terranes of the Cariboo gold belt with correlations and implications for tectonics in southeastern British Columbia. Canadian Journal of Earth Sciences, v.**23**, p.1047-1061.

Wanless, R.K., Stevens, R.D., Lachance, G.R., and Rimsaite, J.Y.H. 1966. Age determinations and geological studies, K-Ar isotopic ages: Report 6. Geological Survey of Canada, Paper **65-17**.

Recommended citation: McDonough, M.R. (compiler), Simony, P.S., Pell, J., Morrison, M.L., Doucet, P., Digel, S.G., Dechesne, R. D., and Currie, L.D. 1991. Lempriere, British Columbia (83D/6). Geological Survey of Canada, Open File,. scale 1:50 000.



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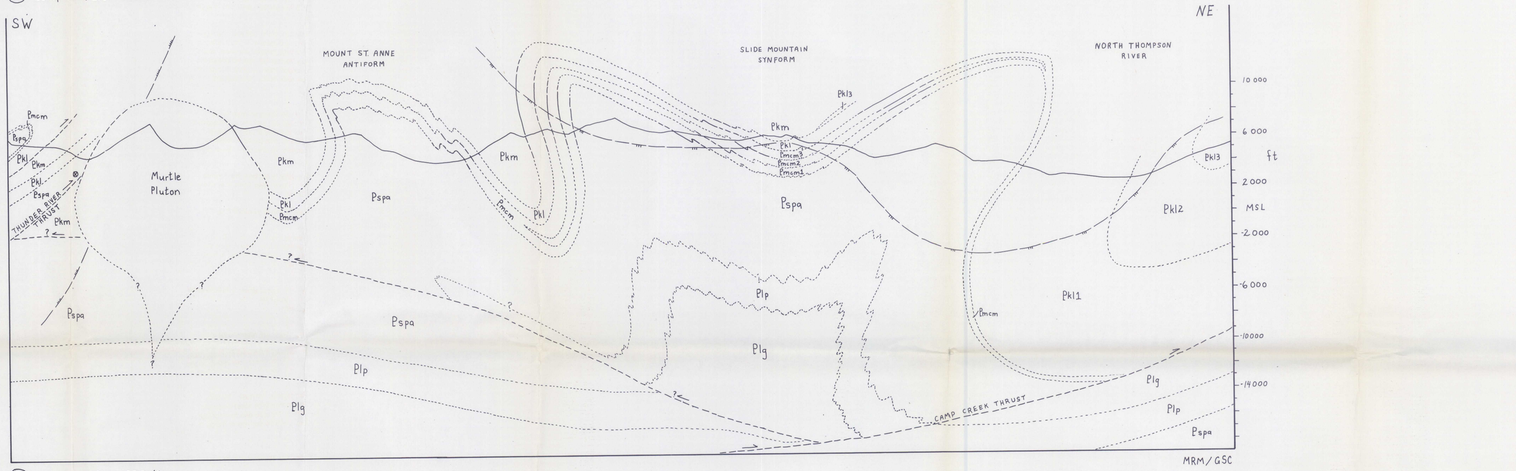

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