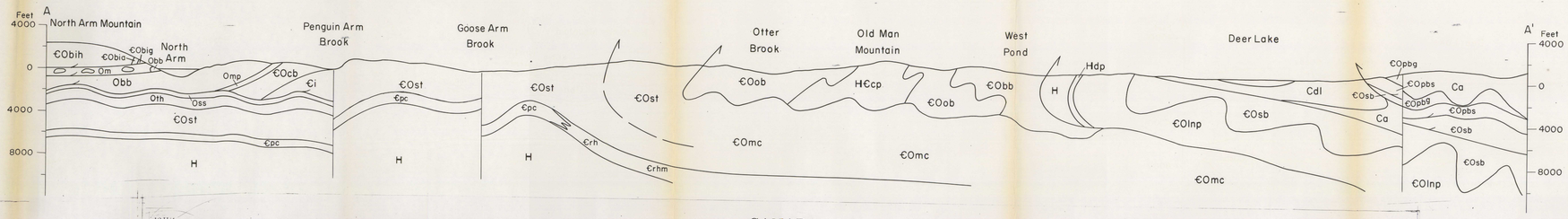
STRUCTURAL SECTION A-A' (simplified and schematic)



LEGEND

CARBONIFEROUS

Cdl — DEER LAKE GROUP: buff to reddish and brown pebble to boulder conglomerate, grey and red shale and sandstone

Ca — ANGUILLE GROUP: thick bedded grey sandstone and black shale, minor conglomerate

PYNNS BROOK STRUCTURAL SLICE

UPPER CAMBRIAN AND LOWER ORDOVICIAN

PYNNS BROOK COMPLEX

€Opbv — Mafic volcanic rocks, minor conglomerate

€Opbg — Mainly altered gabbro

€Opbs — Serpentinite and altered ultramafic rocks

HUGHES LAKE STRUCTURAL SLICE

CAMBRIAN AND LOWER ORDOVICIAN

MOUNT MUSGRAVE GROUP

€Osb — SOUTH BROOK FORMATION: micaceous quartz-feldspar pelitic to psammitic schists; $€O_{sbt}$, tan quartz-micaceous schist, minor marble

€Olnp — LITTLE NORTH POND FORMATION: coarse arkosic meta-greywacke, schistose greywacke and phyllitic schist, quartz pebble conglomerate at base

HADRYNIAN

Hdp — DEER POND VOLCANICS: massive to amygdaloidal and schistose mafic flows now metamorphosed to biotite, chlorite, epidote greenschists; H_{dp}, meta-rhyolite and pink silicic volcanic breccia, associated albite schist

HELIKIAN (?)

H — Massive to mildly foliated and schistose pink granite, albite-chlorite schist, biotite amphibolite and meta-diabase

OLD MANS POND ALLOCHTHON

UPPER CAMBRIAN AND LOWER ORDOVICIAN

€Og — Meta-gabbro and serpentinized ultramafic rocks

OLD MANS POND GROUP

CAMBRIAN AND LOWER ORDOVICIAN

€Obb — BOBBYS BROOK FORMATION: metamorphosed thin bedded limestone and shale, limestone breccia

€Oob — OTTER BROOK FORMATION: grey shale and siltstone, phyllite, prominent thick white quartzite units

HADRYNIAN AND LOWER CAMBRIAN

H€cp — CANAL POND FORMATION: grey to green greywacke, white to pink quartz sandstone, quartzite, pebble conglomerate and grey to purple argillite

HUMBER ARM ALLOCHTHON

UPPER CAMBRIAN AND LOWER ORDOVICIAN

BAY OF ISLANDS COMPLEX

€Obih — Harzburgite and serpentinized ultramafic rocks

€Obia — Black amphibolite and garnetiferous amphibolite

€Obig — Greenschist

HUMBER ARM SUPERGROUP

LOWER ORDOVICIAN

Om — Chaotic mixture of Irishtown quartzite, Blow Me Down Brook greywacke and Cooks Brook limestone blocks in a black shaly matrix

Obb — BLOW ME DOWN BROOK FORMATION: coarse greywacke, pebble conglomerate, arkosic sandstone, quartz sandstone, minor red shale

Omp — MIDDLE ARM POINT FORMATION: thin bedded dark grey shale and buff dolomitic siltstone

MIDDLE CAMBRIAN TO LOWER ORDOVICIAN

€Ocb — COOKS BROOK FORMATION: thin bedded dark grey shale and light grey platy limestone, coarse limestone breccia units

LOWER AND MIDDLE CAMBRIAN

-€i — IRISHTOWN FORMATION: dark grey shale and siltstone with thick white quartzite and quartz pebble conglomerate units

HADRYNIAN AND LOWER CAMBRIAN

HCs — SUMMERSIDE FORMATION: grey to green greywacke, quartz pebble conglomerate, white to pink weathering quartz sandstone, local grey to purple argillite

CARBONATE TERRANE

MIDDLE ORDOVICIAN

Oss — Dark grey shale and grey sandstone

UPPER CAMBRIAN TO MIDDLE ORDOVICIAN

€Ost — ST. GEORGE AND TABLE HEAD GROUPS: medium- to thick-bedded limestone and dolomite with thin shale units; O_{st}, Table Head Group, thick bedded limestone, limestone breccia and minor shales; $€O_{stc}$, recrystallized limestone and deformed grey to white marble, metamorphic equivalents of $€O_{st}$

LOWER AND MIDDLE CAMBRIAN

Crh — RELUCTANT HEAD FORMATION: thin bedded grey limestone and buff shale, limestone breccia, oolitic limestone at tops. Crhm, metamorphosed equivalents of Crh

€pc — PENGUIN COVE FORMATION: thin bedded limestone and shale with quartzites toward base and button algae and oolitic beds at top

GEOLOGY OF PASADENA MAP AREA, 12H/4, WESTERN NEWFOUNDLAND

by

Harold Williams, R.T. Gillespie and D.A. Knapp

1983

Geologic contact (defined, approximate, assumed) . . .

Thrust fault, commonly modified by later structures, teeth on upper plate with direction of dip where overturned and vertical (defined, approximate, assumed)

High angle fault, dot on downthrown side (defined, approximate, assumed)

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

Bedding, tops unknown (inclined, vertical) . . . . . .

Main schistosity or foliation in metamorphic rocks, dominant cleavage in sedimentary rocks (inclined, vertical, dip unknown)

Late fracture cleavage in carbonates, North Lake area (inclined, vertical)

Layering in ultramafic rocks (inclined). . . . . .

Axis of anticline (upright, overturned) . . . . . .

Axis of syncline (upright, overturned) . . . . . .

Logging road . . . . . .

Mineral Prospect . . . . . .

Commodities: asb-asbestos, Pb-lead, U-uranium, Zn-zinc

PASADENA
NEWFOUNDLAND
Scale 1:50,000 Échelle

Kilometres 1 0 1 2 3 4 Kilomètres

Universal Transverse Mercator Projection
Projection transverse universelle de Mercator

DESCRIPTIVE NOTES

The Pasadena area has rugged terrain that is heavily tree covered, except for the highest hills in its central parts and the area of ultramafic rocks at North Arm Mountain.

Rocks of the Pasadena area range in age from Precambrian to Carboniferous. Foliated granitic rocks (H) in the vicinity of Hughes Lake are interpreted as Helikian basement. Overlying mafic volcanic rocks (Hdp) and metamorphosed fragmental silicic volcanic rocks (Hv) are probably of Hadrynian age. Lower Paleozoic rocks can be separated into five contrasting assemblages, all partly coeval. The most extensive is a mainly carbonate sequence that is essentially autochthonous and comprised of the Penguin Cove (€pc) and Reluctant Head (€rh) Formations, the St. George (€Ost) and Table Head (Oth) Groups, and overlying sandstones and shales (Oss). The other four lower Paleozoic assemblages are all structurally above the carbonate terrane (see structure section A-A'). From northwest to southeast, these are the Humber Arm Supergroup (HCs, Ci, €Ocb, Omp, Obb, and Om) and the Bay of Islands Complex (€Obih, €Obia, and €Obig) that together make up the Humber Arm Allochthon; the Old Mans Pond Group (H€cp, €Oop, and €Obb) and small gabbroic to ultramafic bodies (€Og) of the Old Mans Pond Allochthon; the Mount Musgrave Group (€Olnp and €Osb) together with Helikian and Hadrynian rocks (H, Hv) of the Hughes Lake Structural Slice; and transported ophiolitic rocks of the Pynns Brook Complex (€Opbs, €Opbg, and €Opbv). Carboniferous rocks of the Deer Lake Group (Cdl) unconformably overlie the lower Paleozoic and older rocks in the vicinity of Deer Lake.

Foliation in granitic rocks (H) is cut by mafic dykes that are probably coeval with overlying mafic volcanics (Hdp), thus implying Precambrian deformation. The Cambrian-Ordovician rocks have been affected by early to middle Paleozoic deformation, which has also affected the oldest rocks (H). Carboniferous rocks west of Deer Lake form a subhorizontal cover upon deformed Cambrian-Ordovician rocks. East of Deer Lake, Carboniferous rocks are deformed and locally overturned where overthrust by the South Brook Formation (€Osb) and the Pynns Brook Complex.

Rocks of the carbonate sequence have been described by Lilly (1963), Levesque (1977) and Williams et al. (1982). The Penguin Cove Formation has an exposed thickness of about 200 metres. Early Middle Cambrian or younger strata at its top (Levesque, 1977) suggest a late Early Cambrian age for underlying clastic units and correlation with the Hawke Bay Formation (Schuchert and Dunbar, 1934) of western Newfoundland. Both the Reluctant Head and Penguin Cove Formations contain oolitic limestones at their tops and both are conformably overlain by limestones and dolomites of the St. George Group, suggesting that the Penguin Cove and Reluctant Head are correlatives.

The St. George and Table Head Groups have a combined thickness of well over a kilometre. East of Hughes Brook and in the vicinity of North Lake the carbonate rocks are recrystallized (€rhm and €Omc). At Penguin Arm and west of Hughes Brook the carbonate section is overlain by a thin unit of dark grey shale and sandstone (Oss), in turn succeeded by chaotic rocks (Om) of the Humber Arm Allochthon. At Penguin Hills, a structural slice of carbonates (€Ost) overlies the chaotic rocks.

In the western part of the area, bedding and cleavage of the carbonate rocks trend northeast and the rocks are involved in folds that are upright to westerly inclined and locally overturned to the west, e.g. at Penguin Head and Raglan Head. Farther east at Old Mans Pond, folds in the Reluctant Head Formation face east with axial plane cleavage dipping moderately west. These opposing directions of structural polarity are a most prominent feature of the Pasadena area.

The Humber Arm Allochthon consists of sedimentary rocks overlain by a high slice of igneous and metamorphic rocks. Five sedimentary formations of the Humber Arm Supergroup are represented within the allochthon and these are correlatives of the Summerside, Irishtown, Cooks Brook, Middle Arm Point, and Blow Me Down Brook Formations in the type area to the south at Humber Arm (Curling Group of Stevens, 1970). Metamorphic and igneous rocks of the overlying slice are part of the Bay of Islands Complex. At the base of the Bay of Islands slice the Humber Arm rocks are chaotic with blocks of greywacke (Obb) in a dark shaly matrix (Om).

Structural complications are common along the east margin of the Humber Arm Allochthon and these complications contrast with the clear succession of autochthonous units and sharp structural base of the allochthon along its western leading edge. At the east side of Kennedy Lake, chaotic shales with greywacke blocks are in sharp vertical contact with deformed and recrystallized limestone. A similar steep contact between grey slates and deformed limestone occurs at the head of Penguin Arm. Both contacts are interpreted as faults because of stratigraphic omissions at the top of the autochthon. The contact is also steep at the south side of Goose Arm with possible repetition of Humber Arm clastics and autochthonous contacts, i.e. a steep equivalent of the relationships at Penguin Hills. Farther south at Frenchmans Pond, stratigraphic omission at the top of the autochthon implies either later faulting or deformation and truncation of the carbonate sequence during emplacement of the allochthon.

Rocks of the Old Mans Pond Allochthon (Canal Pond, Otter Brook, and Bobbys Brook Formations) resemble the Summerside, Irishtown and Cooks Brook Formations, respectively, of the Humber Arm Allochthon. Button algae beds and local oolitic limestones in the Bobbys Brook Formation further imply correlation with the Cambrian Penguin Cove and Reluctant Head Formations. Two small bodies of altered gabbro in the vicinity of Long Pond are viewed as ophiolitic and localized at the tectonic contact of the allochthon with the adjacent carbonate terrane.

The Old Mans Pond Allochthon has little morphologic expression. Its western boundary with the carbonate terrane is a west dipping fault. Elsewhere the contact is marked by topographic depressions and stratigraphic omissions in both the carbonate sequence and rocks of the Old Mans Pond Group.

A pervasive northeast-trending cleavage dips moderately northwest across the central portion of the Old Mans Pond Allochthon. This cleavage is axial planar to isoclinal folds that face upward toward the southeast. Since no earlier fabrics are present, the folds are interpreted as first phase structures.

The Hughes Lake Structural Slice contains possible Helikian rocks (H), Hadrynian meta-volcanic rocks (Hdp), and Hadrynian and Lower Cambrian metaclastic rocks (H€lnp and H€sb). Foliated pink granite, granitic gneiss, and magnetite-quartz-feldspar schist are the oldest rocks in the structural slice. These contain biotite-chlorite schists and amphibolitic bands which are probably metamorphosed mafic dykes related to the overlying Deer Pond mafic volcanic rocks. Pink fragmental silicic volcanic rocks (Hv) may be related to Deer Pond volcanism, or they may be part of the underlying basement complex. Their relationships to foliated granitic rocks at Hughes Lake to the southwest (H) are unknown.

The Little North Pond Formation forms a continuous cover above the Deer Pond volcanics and older rocks. A quartz pebble conglomerate at its base is overlain by more than a kilometre of arkosic metagreywacke. Crossbedding indicates that the sequence is homoclinal and overturned. The Deer Pond volcanics and overlying Little North Pond Formation resemble the Lighthouse Cove mafic flows and overlying Bradore sandstones, respectively, that occur above the Grenvillian basement in the Strait of Belle Isle area (Williams and Stevens, 1969). The South Brook Formation appears to overlie the Little North Pond Formation with stratigraphic conformity. Its lithology, structural style and metamorphic grade resemble those of the Fleur de Lys Supergroup of the Baie Verte Peninsula.

The order of lithic units in the Pynns Brook Complex suggests it is in an east facing ophiolite sequence. Its structural position with respect to polydeformed metaclastic rocks to the west and its geographic position with respect to similar ophiolite occurrences to the north at Baie Verte and to the south at Glover Island suggest that the complex marks the Baie Verte-Brompton Line (Williams and St. Julien, 1982). Emplacement of the Pynns Brook Complex above the South Brook Formation probably occurred in the early Paleozoic. Its position now is the result of Carboniferous thrusting.

Subhorizontal Carboniferous rocks of the Deer Lake Group unconformably overlie older deformed rocks along the west side of Deer Lake and at Pasadena. East of Deer Lake the same Carboniferous rocks are steeply dipping to overturned where they are overthrust by rocks of the Pynns Brook Complex and South Brook Formation. The Anguille Group is everywhere deformed and faulted against rocks to the west.

Rocks of the map area fit well with Appalachian models of an evolving North American continental margin that was destroyed by the obduction of oceanic crust and the tectonic transport of slope/rise sediments westward across the continental shelf. According to this model, granitic rocks at Hughes Lake represent a basement complex that was rifted with concomitant volcanism (Deer Pond volcanics) and clastic deposition (Mount Musgrave Group). The Humber Arm Supergroup and Old Mans Pond Group represent slope/rise deposits that accumulated to the east of the carbonate sequence. In the map area, both the Humber Arm and Old Mans Pond allochthons may have been physically continuous before erosional separation in the vicinity of Hughes Brook. The Bay of Islands Complex represents oceanic crust and mantle that acquired a dynamothermal aureole (€Obia and €Obig) during initial obduction. Melange formation (Om) accompanied the later assembly of sedimentary parts of the Humber Arm Allochthon and the assembled package was emplaced upon the relatively undeformed rocks of the carbonate bank.

Polyphase deformation of the Mount Musgrave Group followed emplacement of the Humber Arm Allochthon. Assembly and emplacement of the Old Mans Pond Allochthon, Hughes Lake Structural Slice and Pynns Brook Complex may have started as early as Early Ordovician (like the Humber Arm Allochthon) or as late as Devonian. Initial emplacement structures faced westward but folds and cleavage in the Old Mans Pond Allochthon, Hughes Lake Slice, as well as easterly parts of the carbonate terrane were subsequently overturned to the east (see section A-A'). This phase of structural development preceded the deposition of Carboniferous cover rocks. After deposition of the Deer Lake Group, the rocks to the east of Deer Lake were affected by thrusting that emplaced the Pynns Brook Complex.

Mineral occurrences in the area include lead and zinc in the carbonate rocks, asbestos in the Pynns Brook serpentinites and uranium in Carboniferous rocks of the Deer Lake Group.

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