Newfoundland Labrador

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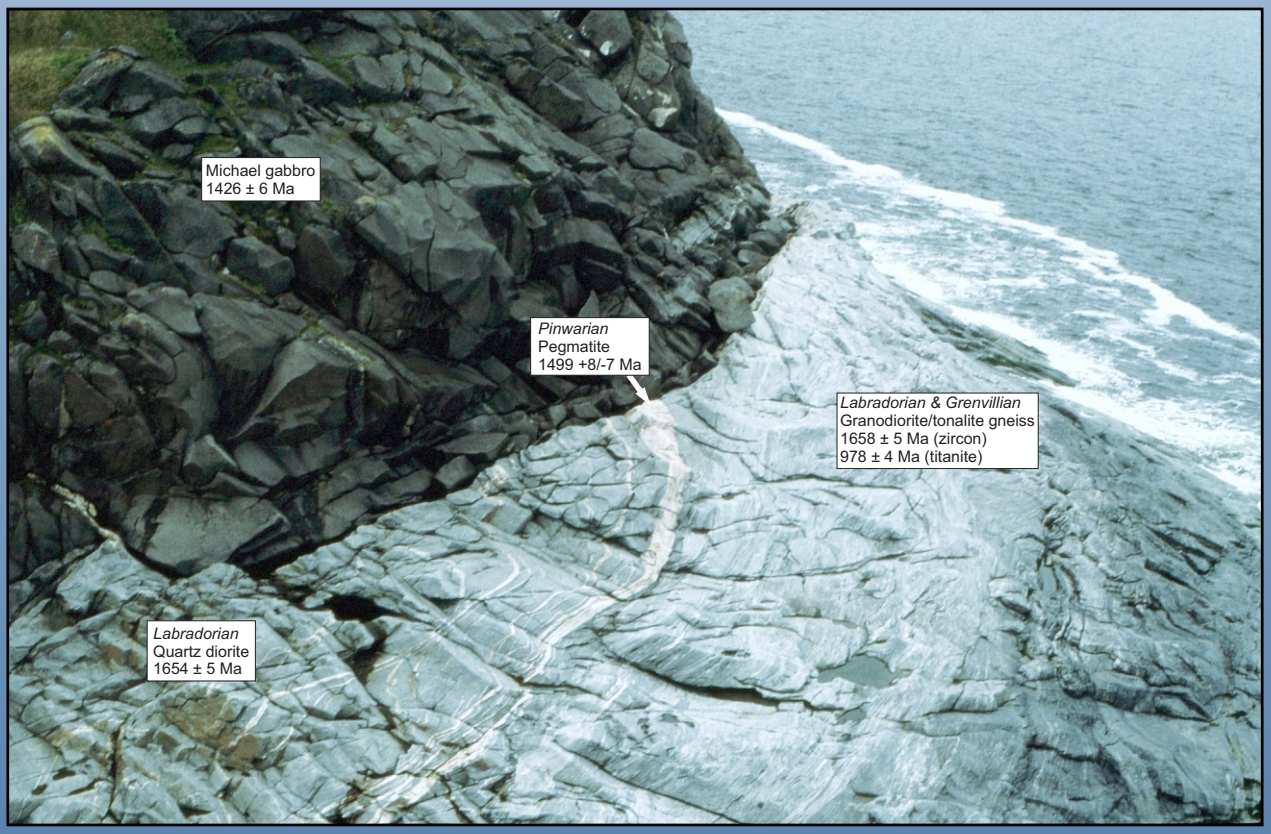
REGIONAL GEOLOGY OF EASTERN LABRADOR (EASTERN MAKKOVIK AND GRENVILLE PROVINCES)



C.F. Gower Memoir 4

St. John's
Newfoundland and Labrador
2019

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C.F. Gower

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GEOLOGICAL SURVEY NEWFOUNDLAND AND LABRADOR 1864

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Recommended citation:
Gower, C.F.
2019: Regional geology of eastern Labrador (eastern Makkovik and Grenville provinces). Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, St. John's, Memoir 4, 654 pages. [Geofile LAB/1752]

ISBN: 978-1-55146-697-2

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FRONTISPIECE

Although not all encompassing, the image captures some of the key events (U–Pb zircon dates) in the geological history of the Grenville Province in eastern Labrador. Late Paleoproterozoic Labradorian granitoid rocks are intruded by Early Mesoproterozoic Pinwarian pegmatite and then mid-Mesoproterozoic Michael gabbro. Pre-Grenvillian history is well displayed because Grenvillian effects were modest at this outcrop. Grenvillian orogenesis is expressed by boudinage of the Michael gabbro (outside frame of image), accentuation of fabric in Labradorian granitoid rocks, and U–Pb titanite age. *See* Plate 10.2 for more detail.

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ABSTRACT

This report, in conjunction with already published 1:100 000-scale geological maps, addresses the regional geology of the eastern parts of the Makkovik and Grenville provinces in Labrador, Canada.

The Makkovik Province *represents the remnants of a former Paleoproterozoic accretionary orogen that developed on the southern flank of pre-Makkovikian Laurentia, mostly between 1900 and 1790 Ma. It comprises three structural domains, namely: i) the Kaipokok domain in the west, ii) the Aillik domain in the centre, and iii) the Cape Harrison domain in the east. Only the Cape Harrison domain is considered in this report. It includes remnants of Aillik Group 1855 Ma felsic volcanic rocks, but mostly consists of various Paleoproterozoic granitoid and gneissic rocks, namely the 1840 Ma Deus Cape granitoid, the 1820–1790 Ma Numok and related intrusive suites, the 1720 Ma Strawberry Intrusive Suite, and late Paleoproterozoic (1650 Ma) plutons.*

The Grenville Province *in eastern Labrador comprises late Paleoproterozoic and Mesoproterozoic rocks that formed during multiple orogenic events between* ca. *1810 and 950 Ma. Six stages of geological development can be identified, namely: i) 'Eagle River' (late Makkovikian correlative) orogenesis (1810–1775 Ma), ii) Labradorian orogenesis (1710–1600 Ma), iii) Pinwarian orogenesis (1520–1460 Ma), iv) Post-Pinwarian–Pre-Grenvillian events (1460–1090 Ma), v) Grenvillian orogenesis followed by late- to post-Grenvillian events (1090–985 Ma; 985–920 Ma), and vi) Neoproterozoic and Phanerozoic events. The Eagle River, Labradorian, Pinwarian and Grenvillian orogenies were active-margin accretionary events, whereas the Grenvillian orogeny represents a continent–continent collision, which also terminated active Proterozoic accretionary tectonism in this region. The Grenville Province in eastern Labrador is subdivided into five terranes, which are, from north to south, Groswater Bay terrane, Hawke River terrane, Lake Melville terrane, Mealy Mountains terrane, and Pinware terrane. These have most geological significance in a Grenvillian context, but are referenced in a geographical sense when referring to earlier rocks.*

Rocks formed during the Eagle River orogeny *can be divided into granitoid units and metasedimentary gneiss. The granitoid rocks have 1810–1775 Ma ages and clearly established the existence of a magmatic event in the Grenville Province well before Labradorian orogenesis. It was coeval with, or partially slightly younger than, the Numok intrusive event in the eastern Makkovik Province. The metasedimentary gneiss protolith was overwhelmingly pelitic, but associated rocks include psammitic gneiss, quartzite–metachert, mafic volcanic rocks, and rocks derived from calcareous protoliths. The depositional age of the metasedimentary gneiss remains uncertain, but is argued to have been between 1810 Ma and 1770 Ma.*

Labradorian orogenesis *in the eastern Grenville Province entailed an evolving series of events reflecting accretion of an outboard arc. The Labradorian orogeny has, traditionally, been defined as commencing at 1710 Ma, but scattered 1740–1700 Ma dates from the Groswater Bay terrane suggest greater affinity with the Strawberry Intrusive Suite in the Makkovik Province than hitherto supposed. There may have been a hiatus in activity between 1705 and 1680 Ma, after which voluminous Labradorian calc-alkaline magmatism occurred (1680–1655 Ma). Deformation and metamorphism were concentrated between 1665 and 1655 Ma, followed by a change in tectonic conditions, heralding the start of Trans-Labradorian magmatism (1655–1645 Ma). Post-Trans-Labradorian magmatism involved emplacement of trimodal mafic–anorthositic–monzogranitic rocks. Both time range and composition of trimodal magmatic products overlap with those of the preceding Trans-Labradorian magmatism (1655–1625 Ma), and were accompanied by deformation and metamorphism between 1645 and 1625 Ma. Late Labradorian events, between 1625 and 1600 Ma, involved the emplacement of minor granitic intrusions and sporadic, diverse, and dwindling metamorphism–deformational activity.*

The key feature that characterizes dated Pinwarian magmatism *(1520–1460 Ma) is an overwhelmingly granitic (*sensu stricto*) character. Large bodies are confined to the southern part of the eastern Grenville Province, with only minor Pinwarian felsic magmatism farther north. In addition to widespread granitic magmatism, Pinwarian activity also involved metamorphism and deformation. The Pinwarian event is interpreted as reflecting a continental-margin arc over a north-dipping subduction zone.*

Post-Pinwarian–Pre-Grenvillian events *(1460–1090 Ma) do not involve orogenesis. Early post-Pinwarian–pre-Grenvillian activity (1460–1350 Ma) in eastern Labrador is represented by the Michael gabbro (1450–1425 Ma) and the 1417 Ma Mokami Hill quartz monzonite in the Groswater Bay terrane. The middle phase (1350–1290 Ma), in eastern Labrador, is*

marked by the 1296 Ma Upper North River granite and coeval felsic volcanism, both found in the Lake Melville terrane. The late phase (1290–1230 Ma) in eastern Labrador is exemplified by the 1250 Ma Mealy dykes in the Mealy Mountains terrane. The lead-up to the start of Grenvillian orogenesis in eastern Laurentia was largely a period of inactivity, but is signposted in eastern Labrador by the deposition of the Battle Island supracrustal rocks and the emplacement of the Gilbert Bay granite.

Grenvillian orogenesis *in the eastern Grenville Province extended from 1090 to 985 Ma, followed by late- to post-Grenvillian events between 985 and 920 Ma. It is interpreted in terms of a tectonic indentor model. In the Groswater Bay and Hawke River terranes, Grenvillian orogenesis was modest and unaccompanied by magmatism. Pre-Grenvillian titanite ages are commonly preserved. The Lake Melville terrane was the scene of the most severe Grenvillian activity, being characterized by northwest-verging thrusting north of Lake Melville and dextral strike–slip transposition from Lake Melville to the southern Labrador coast. Deformation and metamorphism were associated with emplacement of minor granitoid intrusions – at least, during the early stages of activity. Orogenesis started in the Lake Melville terrane at 1090 Ma, much earlier than in the other terranes (*ca. *1050 Ma). The Mealy Mountains terrane also experienced mild Grenvillian orogenesis. Magmatism was very minor, except in southern parts of the terrane, which were affected by late- to post-Grenvillian granitoid pluton emplacement. The Pinware terrane, in contrast to the other terranes, was characterized by extensive granitoid pluton emplacement accompanied by moderate- to high-grade metamorphism, commencing at* ca. *1040 Ma, and continuing until 985 Ma, at which time metamorphism and deformation declined significantly. Later Grenvillian events are divided into two groups. The older event (985–975 Ma) included alkalic mafic dyking and anorthositic–mafic–alkalic magmatism, whereas the younger event (975–955 Ma) was one of monzonitic, syenitic and granitic magmatism. The first clearly developed into the second without any hiatus, but there are sufficient time–compositional contrasts to distinguish them.*

Late Neoproterozoic events *are related to the rifting and drifting phases of the opening of Iapetus Ocean. Rifting was marked in the region by the emplacement of the 615 Ma Long Range dykes, huge quartz veins, deposition of the Double Mer Formation in the Lake Melville Rift System and Sandwich Bay graben, deposition of the Bateau Formation, and extrusion of the Lighthouse Cove mafic volcanic rocks. The start of the drifting phase in the early Phanerozoic is marked by flooding of the ancient Laurentian margin, as indicated by deposition of ferruginous clastic and mixed clastic–carbonate of the Bradore and Forteau formations. At least two, and possibly three, mafic dyke-emplacement events of uncertain specific age occurred later during the Phanerozoic.*

ACKNOWLEDGMENTS

Acknowledgment is due to my former field assistants; all of them hard working, enthusiastic and conscientious – they made a huge contribution. They are as follows: Robin Burry (1979); Randy Gillespie, Lester Green, Andy Hopkins, Nath Noel, Max Roberts and Mike Tubrett (1980); John Blagdon, Greg Finn, Helen Norman, Victor Owen, Anne Walsh and Gerry Whelan (1981); Peter King and Tony Power (1983); Celeste O'Flaherty, Nath Noel, Janet O'Neill, John Smyth, Tim van Nostrand and Michel Wawrzkow (1984); Loretta Crisby, Peter Jeon, Bernadine Lawler, Gordon McRoberts, Steve Prevec and Tim van Nostrand (1985); Dennis Brown, Janet Dunphy, Mark Harris, Sigrid Neuland, Mark Newman and John Smyth (1986); Campbell Churchill, Joan Dicks, John Smyth, Glenda Stratton, Tim van Nostrand and Gale Wiseman (1987); Joe Anderson, Dean Fraser, Vince Peckham, Craig Scott and Tim van Nostrand (1992); Dawn Evans-Lamswood, Phyllis McCrindle, Wayne Mitchelmore and Tim van Nostrand (1993); Gary Bugden, Andy Churchill and Tim van Nostrand (1995; shared with colleague Ges Nunn); John Hinchey (1997); Craig Rowe (1998); Byron Malloy and Steve Power (1999); Wanda Maddox and Diane Mitchinson (2000). Also acknowledged are assistants employed on projects conducted by colleagues in the region. Al Doherty was accompanied by Bill Collins (1979); Philippe Erdmer was accompanied by Glenn Bursey, Chris Pinsent, Tony Power and Mark Wilson (1982); Tim van Nostrand was accompanied by Joe Anderson, Mark Blake, Don Dunphy, Darrell Eddy and Bob Patey (1991). Also appreciated are the contributions of students in the office, Nicole Deveraux and Leah Powers.

The contributions of students who have carried out university thesis studies in the region that were connected in some manner with the mapping deserve mention. These are Victor Owen (1985, Ph.D.), Celeste O'Flaherty (1986, B.Sc.), Steve Prevec (1987, M.Sc.), Tim van Nostrand (1988, M.Sc.). Other student theses relevant to the region were completed by Rebecca Hewitson (2010, M.Sc.), Nicole Devereaux (2011, B.Sc.), Rebecca (formerly Hewitson) Moumblow (2014, Ph.D.), James Haley (2014, M.Sc.), Grant Bybee (2013, Ph.D.), Chris Spencer (2014, Ph.D.) and Chris Rogers (2017, Ph.D.).

The formidable task of piloting this report through to publication was accomplished by Chris Pereira (text editing), Des Walsh (copy editing), Joanne Rooney (desktop publishing) and Kim Morgan (figure editing). Database editing by Pauline Honarvar and GIS map editing by Neil Stapleton were both expertly and thoroughly carried out. An enormous debt of gratitude is owed to all.