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GEOLOGY OF THE ARCHEAN ASHUANIPI COMPLEX, WEST OF LABRADOR CITY, LABRADOR

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ABSTRACT

The 1992 field season involved mapping of the Archean Ashuanipi Complex in the area west of Labrador City. This marked the completion of 1:100 000-scale mapping of the Superior Province in western Labrador, south of 54°N.

The 1992 study area is subdivided into northern and southern domains. The northern domain consists chiefly of orthopyroxene-bearing granodiorite (diatexite), whereas the southern domain consists of upper amphibolite-facies metasedimentary migmatite and orthogneiss, and younger, variably deformed granite. The lithologic and metamorphic differences between the domains suggest that they are separated by a prograde metamorphic transition; the southern domain representing a more shallow level of Archean crust than is exposed in areas to the north. There are no data to suggest that the domains are linked by a tectonic boundary.

Overprinting the Archean rocks in the area are a set of northeast-striking reverse faults of Grenvillian age.

INTRODUCTION AND OBJECTIVES

In 1992, 1:100 000-scale mapping of the Archean Ashuanipi Complex in western Labrador, south of 54°N, was completed. Mapping occurred in NTS map areas 23G and 23B, including parts of NTS map areas 23 G/2, G/3, G/7 and 23 B/14 (Figure 1). The mapping in 1992, which was conducted in the first several weeks of June, represents completion of a mapping program initiated in 1991 (see James and Stephenson, 1992).

Prior to the 1991 field season, the Ashuanipi Complex in western Labrador, south of 54°N, had only been covered by small-scale, reconnaissance mapping, hence the geology was not known in adequate enough detail to meet current exploration needs. The purpose of this field program was to address these needs. The results provide a regional geological context for the gold reconnaissance investigation of the Ashuanipi Complex carried out by the Newfoundland Department of Mines and Energy in the 1980's, and earlier, lake-sediment geochemistry programs carried out jointly with the Geological Survey of Canada. Gold mineralization discovered in high-grade supracrustal rocks of the Ashuanipi Complex northwest of Schefferville, Quebec (Lapointe, 1986), and gold occurrences in other high-grade Archean terranes suggest that this area could have comparable economic potential. This study will also make a contribution to the

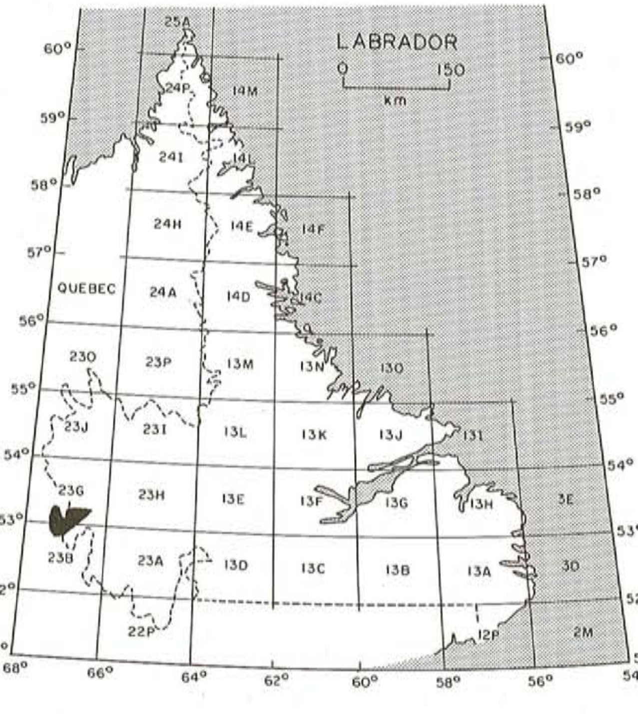

Figure 1. *Index map of Labrador showing the location of the 1992 study area.*

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overall understanding of structural, metamorphic and intrusive relations in this part of the Archean Ashuanipi Complex.

PREVIOUS INVESTIGATIONS

Parts of the area mapped in 1992 have been previously covered by 1":4-mile-scale mapping by Stevenson (1964) and Fahrig (1967). Studies focussed mainly on the Lower Proterozoic Knob Lake Group and Middle Proterozoic intrusive rocks, which occur to the east and south of the study area, and their included Grenvillian structures (e.g., Rivers 1985a, b, c; Brown, 1988; Brown *et al.*, 1991) have also included cursory examinations of the Ashuanipi Complex. Detailed mapping and an upgraded 1:100 000-scale compilation map of the Knob Lake Group and contiguous Ashuanipi Complex in the Labrador City area by van Gool (1992), have outlined areas of Ashuanipi Complex rocks, which occur in tectonic slices in a Grenvillian fold and thrust belt; these were not examined as part of this study.

The area has been covered by a regional-scale, lake-sediment geochemistry program (Geological Survey of Canada, 1982a, b) and subsequent gold-related studies by Thomas and Butler (1987), Butler (1987), McConnell *et al.* (1987) and McConnell and Newman (1988), which concentrated on locating the source of geochemical anomalies discovered during the lake-sediment geochemistry program.

The areas mapped in 1991 and 1992 represent a southward continuation of the 1:125 000-scale mapping of the Ashuanipi Complex north of 54°N, in NTS map area 23J, by Percival (1987, 1989) and Percival and Girard (1988). Prior to Percival's work, the Ashuanipi Complex in NTS map area 23J had been mapped at a scale of 1":4 miles by Frarey (1961) and Stevenson (1963), and farther north, in NTS map area 23O, by Baragar (1967).

GENERAL GEOLOGY

REGIONAL FRAMEWORK

The Ashuanipi Complex is a 90 000 km² high-grade Archean gneiss domain that makes up the southeastern corner of the Superior Province (Figure 2). On the basis of reconnaissance mapping of this domain, which was conducted as part of more detailed investigations of the Lower Proterozoic rocks of the Labrador Trough in western Labrador in the 1950's and 1960's, the Archean metamorphic and intrusive rocks of the Superior Province were collectively named the Ashuanipi Group by Frarey (1961). Subsequently, the rocks were renamed the Ashuanipi Complex by Fahrig (1967). Card and Ciesielski (1986) elevated the Ashuanipi Complex to subprovince status, although the term Ashuanipi Complex is still in widespread use (e.g., Percival, 1987, 1989, 1990, 1991; Percival and Girard, 1988; Michado and Chevé, 1991).

The Ashuanipi Complex is composed of high-grade supracrustal rocks, mainly biotite migmatite derived from greywacke, metamorphosed plutonic rocks, orthopyroxene-bearing granitoid rocks, and minor amounts of unmetamorphosed tonalite, granodiorite, granite and rare syenite plutons (Eade, 1966; Percival, 1987, 1989, 1990, 1991; Percival and Girard, 1988; Machado and Chevé, 1991). Most of the complex is composed of granulite-grade rocks, although there are zones of retrogression to amphibolite facies (Herd, 1978).

A sequence of events in the eastern part of the Ashuanipi Complex established by conventional and ion-probe U–Pb geochronology (see authors referred to below) suggests the following history:

1) deposition of sedimentary rocks was completed by approximately 2.7 Ga (Mortensen and Percival, 1987; Chevé and Brouillette, 1991; Percival *et al.*, 1991),

2) intrusion of tonalite plutons and sills into the supracrustal rocks at 2.7 to 2.69 Ga (Chevé and Brouillette, 1991; Machado and Chevé, 1991; Percival, 1991; Percival *et al.*, 1991),

3) high-grade metamorphism and voluminous, syn- to late synmetamorphic orthopyroxene-bearing granodiorite (diatexite) intrusions; these events are approximately constrained to the interval 2.685 to 2.650 Ga (Mortensen and Percival, 1987; Percival *et al.*, 1988; Percival *et al.*, 1991; Chevé and Brouillette, 1991),

4) initiation of cooling following peak metamorphism at 2.67 to 2.64 Ga; this is based on U–Pb monazite ages (Mortensen and Percival, 1987; Percival *et al.*, 1988; Percival *et al.*, 1991); the monazite ages suggest rapid cooling following the metamorphic peak (Percival, 1990),

5) intrusion of late pegmatites; one of which is dated by U–Pb monazite to be 2654 ± 5 Ma (Mortensen and Percival; 1987), and leucogranite dated at 2.65 Ga (Percival *et al.*, 1991),

6) post-metamorphic-peak thermal events; these are dated, by growth of new zircon in a diatexite, at 2642 Ma (Mortensen and Percival, 1987), and monazite at 2619 ± 6 Ma (Chevé and Brouillette, 1991; Machado and Chevé, 1991), and,

7) intrusion of nepheline syenite at 2625 ± 3 Ma (Chevé and Brouillette, 1991; Machado and Chevé, 1991).

To the west, the Ashuanipi Complex passes into the lower grade Opinaca River and La Grande River subprovinces, which are composed dominantly of metasedimentary rocks, and metamorphosed volcanic and plutonic rocks respectively (Card and Ciesielski, 1986). The boundary between the Ashuanipi Complex, and the OpinacaRiver and La Grande

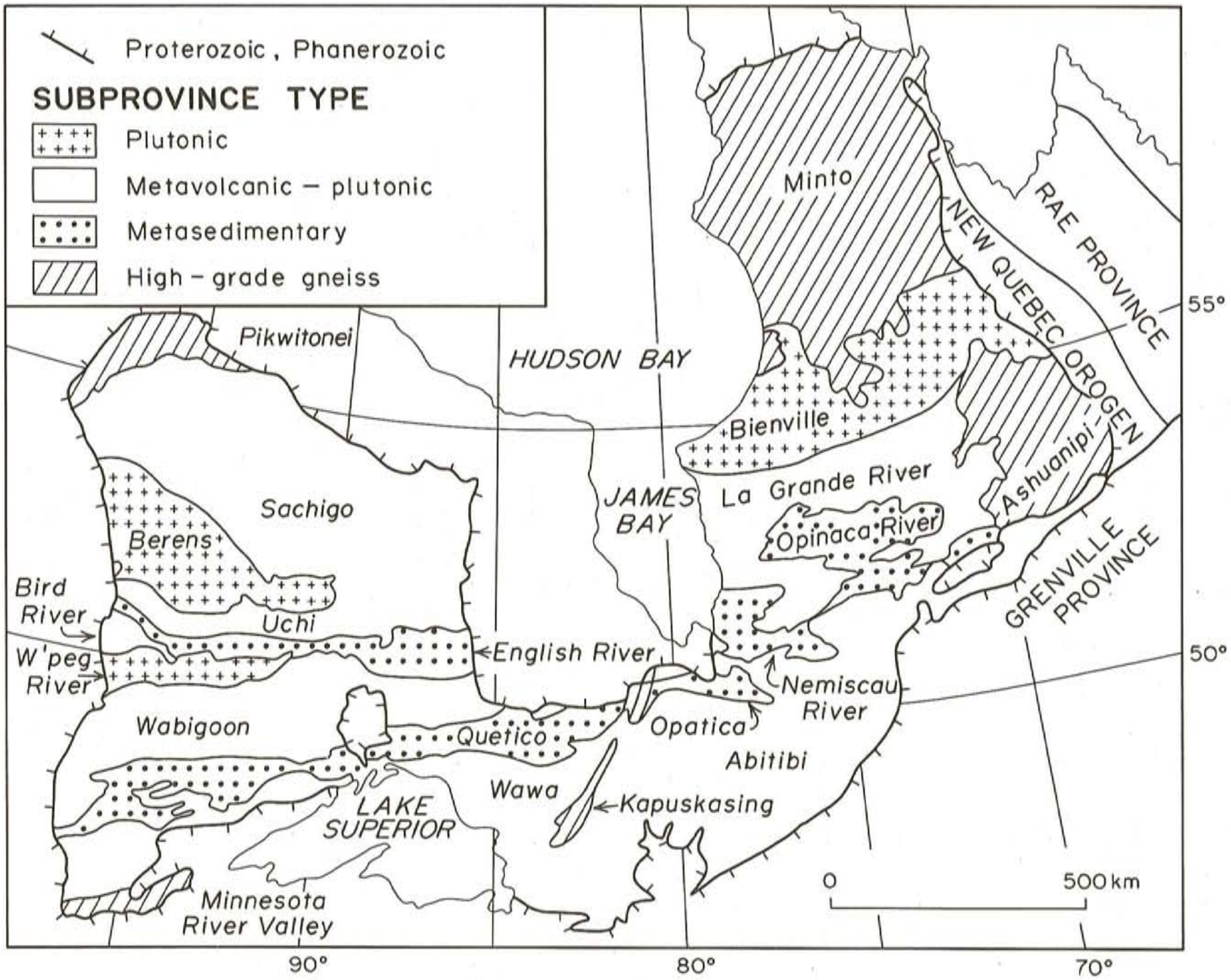

Figure 2. *Generalized geological map of the Superior Province showing the distribution of subprovinces (modified after Card and Ciesielski, 1986). The 1992 study area is located in the southeast corner of the Ashuanipi Complex.*

River subprovinces is a gradational amphibolite–granulite-transition zone, which has prograde and retrograde components (Percival, 1990). To the north, the Ashuanipi Complex is bound by the Bienville Subprovince (Card and Ciesielski, 1986), which is composed mainly of orthogneiss, but has a minor amount of supracrustal rocks (Ciesielski, 1991).

On a larger scale, Mortensen and Percival (1987) have recognized a similarity in rock types, structural style and orientation, and a synchroneity in intrusive and metamorphic events between the Ashuanipi Complex and the Quetico Subprovince of northwestern Ontario. On this basis, Percival (1990) and Percival *et al.* (1991) infer the Ashuanipi Complex to be a continuation of the major metasedimentary subprovinces that occur in the central part of the Superior Province. These subprovinces, including the Ashuanipi, Opinaca River, Nemiscau River, Opatica and Quetico, collectively make up a metasedimentary-dominated belt that is more than 2100 km long, although stratigraphic and structural linkages between some of these subprovinces remain to be firmly established. Percival and Williams (1989) and Williams (1990) speculate that the metasedimentary subprovinces in the Superior Province may have developed as sedimentary prisms between accreting volcanic arcs.

To the east, the Ashuanipi Complex is unconformably overlain by the Lower Proterozoic Knob Lake Group (Frarey and Duffell, 1964) of the Labrador Trough. Along the southeastern and southern boundary of the Ashuanipi Complex, the Ashuanipi Complex–Knob Lake Group contact is a Grenvillian-age reverse fault along which Knob Lake Group rocks are emplaced over the Ashuanipi Complex (see Rivers, 1983, 1985a, c; van Gool *et al.*, 1987, 1988; Brown, 1988; Brown *et al.*, 1991; van Gool, 1992). Locally, Grenvillian faulting also involves Ashuanipi Complex rocks.

UNIT DESCRIPTIONS

Figure 3 is a geological map of the area studied in 1992.

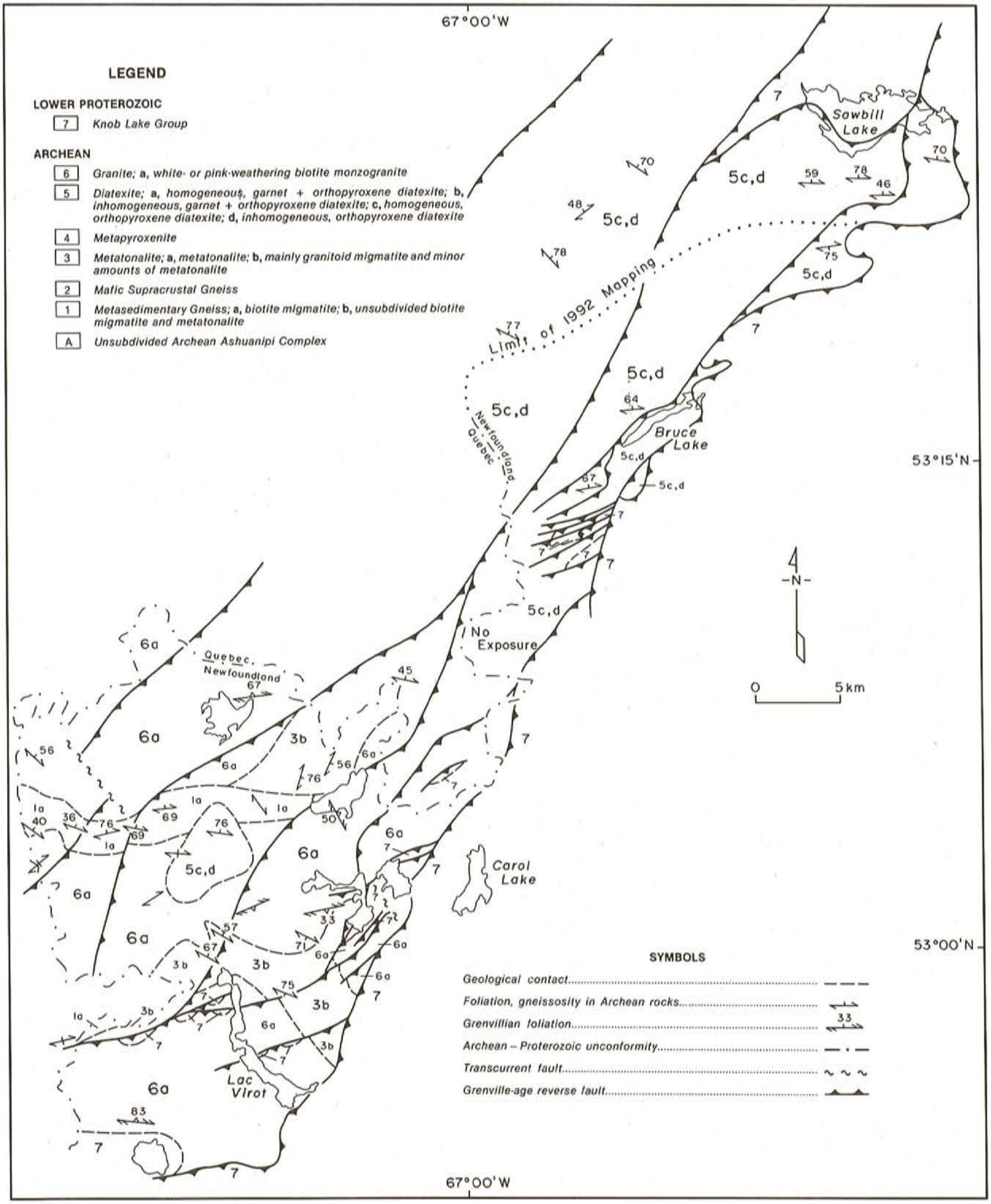

Figure 3. *Geological map of the Ashuanipi Complex in the 1992 study area.*

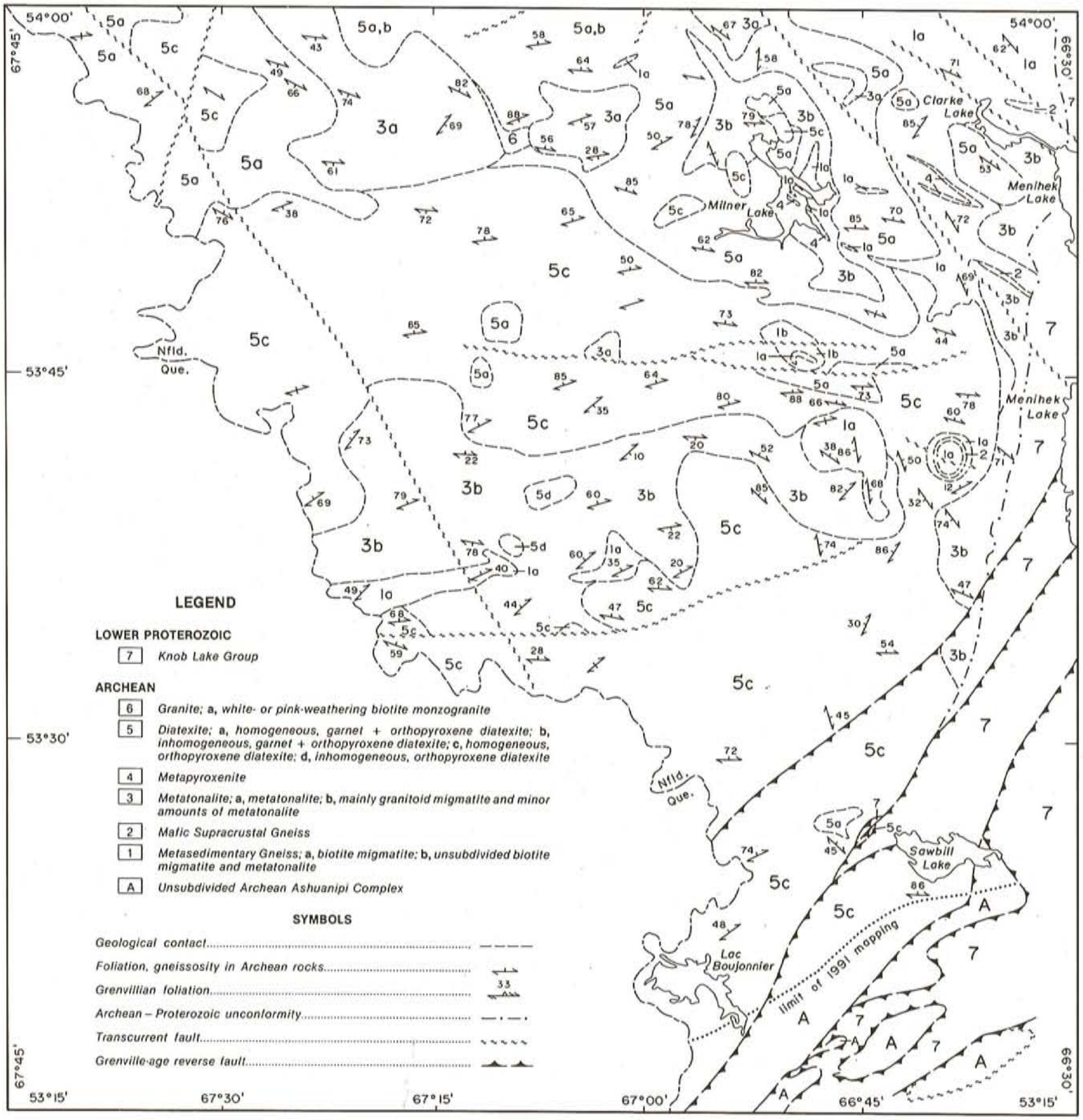

Figure 4. *Geological map of the Ashuanipi Complex in the 1991 study area (from James and Stephenson, 1992). The 1992 study area (Figure 3) joins the southern margin of the 1991 study area.*

Units described from this area are designated using the numbering scheme and legend conceived in 1991 (Figure 4). Granitic rocks mapped in 1992, and designated here as subunit 6a, were not observed in 1991. Descriptions of the units which appear on the legend in Figure 4, but were not mapped in 1992, are found in James and Stephenson (1992).

Biotite Migmatite (subunit 1a)

On the basis of intrusive relations observed in the field, the biotite–migmatite unit is determined to be the oldest in the study area. The rocks consist of grey-, brown- or rusty-weathering restite and white-weathering leucosome. The restite is a quartzofeldspathic rock containing abundant biotite. Cordierite is suspected to occur locally, and garnet occurs in the restite in only a few outcrops. Locally, layering in the restite, which is defined by the percentage of biotite, is inferred to represent relict sedimentary layering.

The percentage of leucosome in the unit is varied, although it is generally less than 35 percent. Commonly, the rocks contain two phases of leucosome, which are distinguished on the basis of texture and structural relations. The older phase forms thin (<10 cm), approximately parallel layers that occur throughout the restite. The younger phase, which is discordant to the first phase, is somewhat coarser grained than the first phase and forms layers that are up to 1 m thick.

The biotite migmatite is inferred to be derived from a greywacke or greywacke–mudstone sedimentary rock.

Granitoid Migmatite (subunit 3b)

The granitoid migmatite unit consists of a biotite-bearing tonalite to granodiorite migmatite. The unit contains local granite migmatite. Rocks have a grey- or white and black-weathering restite and white leucosome. The amount of leucosome is generally less than 40 percent.

The restite contains variable amounts of biotite and locally the unit is somewhat similar to the biotite–migmatite unit (subunit 1a). Contact relations between outcrops containing a relatively biotite-rich restite and outcrops that contain lesser amounts of biotite (<10 percent) are undefined, and it is possible that some of the former may be derived from sedimentary rocks. Metasedimentary rocks contained within the granitoid migmatite unit may occur as inclusions, or they may form mappable units, which could not be outlined at the present scale of mapping.

The parts of the unit that contain minor amounts of biotite are presumed to be orthogneisses derived from granitoid rocks that intruded the sedimentary rocks prior to Archean metamorphism.

Diatexite (subunits 5c and 5d)

Coarse-grained, orthopyroxene-bearing igneous rocks, which have compositions from granodiorite to monzogranite, are the most abundant rock type in the northern part of the study area and make up a small body in the south. These rocks, termed diatexites, following the definition of Brown (1973), have been subdivided in the Ashuanipi Complex using the scheme of Percival (1989), which is based on the presence or absence of garnet and the abundance of gneissic inclusions. Gneissic inclusions make up to 25 percent of homogeneous diatexite, and from 25 to 50 percent of inhomogeneous diatexite. Diatexite in the Ashuanipi Complex has been subdivided into four units: subunit 5a–homogeneous, garnet and orthopyroxene diatexite, subunit 5b–inhomogeneous, garnet and orthopyroxene diatexite, subunit 5c–homogeneous, orthopyroxene diatexite, and subunit 5d–inhomogeneous, orthopyroxene diatexite.

The 1992 study area contains occurrences of subunits 5c and 5d. The quantity of gneissic inclusions in diatexite is quite variable and the units could not be subdivided at the present scale of mapping. The rocks contain inclusions of biotite migmatite and lesser amounts of mafic gneiss. The rocks have a characteristic maple sugar–bronze colour on the weathered surface. Foliation is defined by biotite and alignment of deformed inclusions.

In the Sawbill Lake and Bruce Lake areas, the diatexite typically consists of two phases. The older phase is finer grained and contains more biotite than the younger phase, and it occurs as disrupted layers and cognate inclusions within the younger phase. The younger phase commonly contains coarse-grained orthopyroxene.

The small body of diatexite, which occurs in the southern part of the study area, contains abundant inclusions of biotite migmatite and has gradational contacts with the biotite migmatite that it intrudes. The diatexite contains local occurrences of orthopyroxene and is similar in most aspects to the diatexite, which occurs to the north.

Granite (subunit 6a)

Subunit 6a is a composite unit consisting of white- and locally pink-weathering monzogranite and granodiorite. The unit includes rocks, which are mainly medium and fine grained, and isotropic to variably foliated. Younger pegmatitic phases make up a minor amount of the unit. The rocks contain a few inclusions of biotite migmatite (Unit 1) and granitoid migmatite (subunit 3b). Diatexite (subunit 5c) in the Bruce Lake and Sawbill Lake areas contains common, small granite intrusions and dykes and these may be related to the more extensive granitic intrusions in the south.

The rocks contain approximately 5 percent biotite, which is variably replaced by chlorite. Plagioclase is also variably pseudomorphed by light-green-weathering minerals. Quartz commonly has a blue to mauve colour.

STRUCTURE AND METAMORPHISM

On the basis of rocks types and Archean metamorphic grade, the 1992 study area is subdivided into northern and southern domains. The northern domain, including areas around Sawbill Lake and Bruce Lake, consists mainly of granulite-facies, homogeneous and inhomogeneous orthopyroxene-bearing diatexite containing a small number of granitic intrusions. The southern domain, including the area west of Labrador City, consists mainly of upper-amphibolite-facies, migmatite and granite. There are only a few occurrences of orthopyroxene in southern domain gneisses.

The area between the northern and southern domains is not exposed in the study area although there are no data to

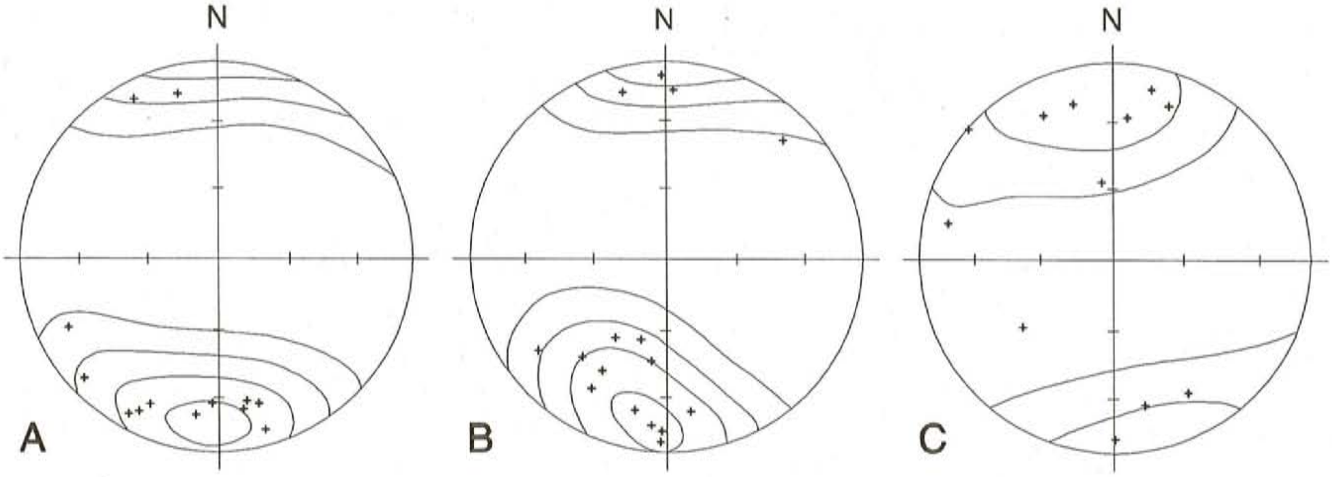

Figure 5. *Contoured, lower-hemisphere, equal-area projections of poles to foliation and gneissosity. Contours are in increments of 2σ; A—Poles to Archean foliation and gneissosity in diatexite in the northern domain; n=14, σ=0.91; B—Poles to Archean foliation and gneissosity in biotite migmatite and granitoid migmatite in the southern domain; n=19, σ=1.02; C—Poles to suspected Grenvillian foliation, and C fabric in minor, Grenvillian high-strain zones in granite (subunit 6b) in the southern domain; n=12, σ=0.86.*

suggest that they are separated by a structural break. The lithologic and metamorphic differences between the northern and southern domains suggest that the latter represents a somewhat lower grade and more shallow level of Archean crust than is exposed in areas to the north. The absence of widespread retrogression of Archean granulite-facies assemblages in the southern domain suggests that the domains are separated by a prograde metamorphic transition.

Archean structures in gneissic rocks in both domains are similar. In the northern domain, shallow, east-plunging folds fold gneissosity and foliation, which are defined by the high-grade Archean assemblage, and older isoclinal folds of gneissosity (Figure 5a). Similarly, in gneissic rocks in the southern domain, shallow to moderate, east-plunging folds deform the metamorphic foliation and gneissosity, and refold older folds (Figure 5b).

The gneissic rocks in both domains are locally retrogressed to greenschist facies. Retrogression is expressed by replacement of orthopyroxene by light-green-weathering minerals, by retrogression of feldspar, and by the presence of muscovite and chlorite. Retrogression is presumed to be a Grenvillian feature. Retrogressed rocks do not appear to contain a penetrative, macroscopic Grenvillian foliation.

Deciphering the age(s) of foliation in granite in the southern domain is somewhat more problematic. Occurrences of foliated inclusions of biotite migmatite (subunit 1a) and granitoid migmatite (subunit 3b) contained in isotropic granite indicate that intrusion postdated the main deformation in the gneisses and the peak of Archean metamorphism. However, granitic rocks containing a relatively well-preserved phaneritic texture are locally foliated and the relations defined by the aforementioned inclusions do not preclude the existence of an Archean foliation in some phases of the granite unit. In other granite outcrops, the rocks are more extensively recrystallized and contain retrogressed feldspar and local muscovite. Foliation in these rocks is varied in attitude and intensity, although it is mainly east-striking (Figure 5c). It is suspected that the foliation in the recrystallized and retrogressed rocks is a Grenvillian feature. Although the number of data is low, the attitude of foliation in recrystallized and retrogressed granite is broadly similar to the attitude of the foliation in phaneritic-textured granite.

The northern and southern domains are cut by steeply dipping reverse faults, which locally place the Ashuanipi Complex rocks over the Lower Proterozoic Knob Lake Group rocks. These faults, studied in some detail by van Gool (1992), are Grenvillian structures related to approximately northwest contraction and transport of Lower Proterozoic cover rocks over Ashuanipi Complex basement. In the Ashuanipi Complex, rocks along fault traces are poorly exposed and the locations of regionally persistent faults are mainly interpreted from aeromagnetic data. Locally, greenschist-facies mylonite is developed in Ashuanipi Complex rocks along the traces of faults.

ECONOMIC GEOLOGY

Gold mineralization is not commonly associated with high-grade supracrustal terranes although reported occurrences of gold by Böhmke and Varndell (1986) and Barnicoat *et al.* (1991) from Archean high-grade supracrustal terranes in Zimbabwe and Australia, suggest that supracrustal rocks in the Ashuanipi Complex may be an exploration target for gold. This is supported by regional geochemical studies in the Ashuanipi Complex by the Geological Survey of Canada (1982a, b) and Hornbrook and Friske (1989), and combined geochemical and geological studies by Thomas and Butler (1987), Butler (1987), McConnell *et al.* (1987) and

McConnell and Newman (1988), which showed local anomalous concentrations of gold in lake sediment and local bedrock samples. These results, combined with the reported occurrence of gold associated with shear zones and metamorphosed iron formation that are contained within biotite (metasedimentary) migmatite in the Ashuanipi Complex in Quebec (Lapointe, 1986; S. Chevé, personal communication, 1992), demonstrate that the Ashuanipi Complex has some exploration potential. However, the paucity of supracrustal rocks in the 1992 study area compared with areas to the north suggests that the former may be less attractive for gold exploration than the latter.

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REFERENCES

Baragar, W.R.A.
1967: Wakuach Lake map-area, Québec-Labrador (23O). Geological Survey of Canada, Memoir 344, 174 pages.

Barnicoat, A.C., Fare, R.J., Groves, D.I. and McNaughton, N.J.
1991: Synmetamorphic lode-gold deposits in high-grade Archean settings. Geology, Volume 9, pages 921-924.

Böhmke, F.C. and Varndell, B.J.
1986: Gold in granulites at Renco Mine, Zimbabwe. *In* Mineral Deposits of Southern Africa (Volume 1). *Edited by* C.R. Anheusser and S. Maske. Geological Society of South Africa, Special Publication, pages 221-230.

Brown, D.L.
1988: Thin-skinned, basement-involved thrust tectonics in the Emma Lake area, Grenville Front zone, western Labrador. B.Sc. thesis, Memorial University of Newfoundland, St. John's.

Brown, D., van Gool, J., Calon, T. and Rivers, T.
1991: The geometric and kinematic development of the Emma Lake thrust stack, Grenville Front, southwestern Labrador. Canadian Journal of Earth Sciences, Volume 28, pages 136-144.

Brown, M.
1973: The definition of metatexis, diatexis and migmatite. Proceedings of the Geologists' Association, Volume 84, pages 371-382.

Butler, J.
1987: Detailed lake-sediment surveys in western Labrador for gold and associated elements. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File Lab 716, 16 pages.

Card, K.D. and Ciesielski, A.
1986: Subdivisions of the Superior Province of the Canadian Shield. Geoscience Canada, Volume 13, pages 5-13.

Chevé, S.R. and Brouillette, P.
1991: Radiogenic age constraints on the geological evolution of the northeastern Ashuanipi Complex, Superior Province, New Québec. Geological Association of Canada–Mineralogical Association of Canada, Joint Annual Meeting, Program with Abstracts, Volume 16, page A23.

Ciesielski, A.
1991: Archean orthogneiss in the NW Bienville Subprovince: an extended calc-alkaline suite in the NE Superior Province, Quebec. Geological Association of Canada–Mineralogical Association of Canada, Joint Annual Meeting, Program with Abstracts, Volume 16, page A23.

Eade, K.E.
1966: Fort George River and Kaniapiskau River (west half) map-areas, New Quebec. Geological Survey of Canada, Memoir 339, 84 pages.

Fahrig, W.F.
1967: Shabogamo Lake map-area, Newfoundland-Labrador and Quebec, 23GE½. Geological Survey of Canada, Memoir 354, 23 pages.

Frarey, M.J.
1961: Menihek Lakes, Newfoundland and Quebec. Geological Survey of Canada, Map 1087A.

Frarey, M.J. and Duffell, S.
1964: Revised stratigraphic nomenclature for the central part of the Labrador Trough. Geological Survey of Canada, Paper 64-25, 13 pages.

Geological Survey of Canada
1982a: Regional lake-sediment and water geochemistry reconnaissance data, NTS 23G, Labrador. Geological Survey of Canada, Open File 903.

1982b: Regional lake-sediment and water geochemistry reconnaissance data, NTS 23J, Labrador. Geological Survey of Canada, Open File 903.

Herd, R.K.
1978: Notes on metamorphism in New Quebec. Geological Survey of Canada, Paper 78-10, pages 79-83.

Hornbrook, E.H.W. and Friske, P.W.B.
1989: National geochemical reconnaissance lake-sediment and water geochemical data, west-central Labrador (parts of 23I, 23J and 23O). Geological Survey of Canada, Open File 2037.

James, D.T. and Stephenson, D.T.
1992: Geology of the southern part of the Archean Ashuanipi Complex, Shabogamo Lake map sheet (NTS 23G), western Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Geological Survey Branch, Report 92-1, pages 367-379.

Lapointe, B.
1986: Reconnaissance géologique de la région du lac Pailleraut, Territorie du Nouveau Québec. Ministere de l'Energie et des Ressources, Gouvernment du Québec, MB85-73, 11 pages.

Machado, N. and Chevé, S.
1991: U–Pb geochronology of the northeastern Ashuanipi Complex, Superior Province, Québec. Geological Association of Canada–Mineralogical Association of Canada, Joint Annual Meeting, Program with Abstracts, Volume 16, page A78.

McConnell, J.W. and Newman, L.A.
1988: Surficial geochemical surveys of auriferous portions of the Ashuanipi Complex, western Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 88-1, pages 397-401.

McConnell, J., Whelan, G. and Newman, L.
1987: Bedrock gold analyses and geology of metalliferous areas of the Ashuanipi Complex, western Labrador. Newfoundland Department of Mines and Energy, Mineral Development Division, Open File Lab 735, 16 pages.

Mortensen, J.K. and Percival, J.A.
1987: Reconnaissance U–Pb zircon and monazite geochronology of the Lac Clairambault area. Ashuanipi complex, Quebec. *In* Radiogenic Age and Isotope Studies: Report 1. *Edited by* O. van Breemen. Geological Survey of Canada, Paper 87-2, pages 135-142.

Percival, J.A.
1987: Geology of the Ashuanipi granulite complex in the Schefferville area, Quebec. *In* Current Research, Part A. Geological Survey of Canada, Paper 87-1A, pages 1-10.

1989: Geology of the Ashuanipi Complex in the Schefferville (23J) area, Quebec-Newfoundland. Geological Survey of Canada, Open File Map 2050, scale 1:125 000.

1990: Archean tectonic setting of granulite terranes of the Superior Province, Canada: a view from the bottom. *In* Granulites and Crustal Evolution. *Edited by* D. Vielzeuf and Ph. Vidal. Kluwer, Dordrecht, pages 171-193.

1991: Orthopyroxene-poikilitic tonalites of the Desliens igneous suite, Ashuanipi granulite complex, Labrador-Quebec, Canada. Canadian Journal of Earth Sciences, Volume 28, pages 743-753.

Percival, J.A. and Girard, R.
1988: Structural character and history of the Ashuanipi complex in the Schefferville area, Quebec–Labrador. *In* Current Research, Part C. Geological Survey of Canada, Paper 87-1C, pages 51-60.

Percival, J.A., Mortensen, J.K. and Roddick, J.C.M.
1988: Evolution of the Ashuanipi granulite complex: conventional and ion probe U–Pb data. Geological Association of Canada–Mineralogical Association of Canada–Canadian Society of Petroleum Geologists, Joint Annual Meeting, Program with Abstracts, Volume 13, page A97.

Percival, J.A., Mortensen, J.K., Stern, R.A., Card, K.D. and Begin, N.J.
1991: The high-grade Ashuanipi and Minto subprovinces of the Superior Province, Québec. Geological Association of Canada–Mineralogical Association of Canada, Joint Annual Meeting, Program with Abstracts, Volume 16, page A78.

Percival, J.A. and Williams, H.R.
1989: Late Archean Quetico accretionary complex, Superior province, Canada. Geology, Volume 17, pages 23-25.

Rivers, T.
1983: The northern margin of the Grenville Province in western Labrador–anatomy of an ancient orogenic front. Precambrian Research, Volume 22, pages 41-73.

1985a: Geology of the Wightman Lake area, Labrador-Quebec, 23G (SE). Newfoundland Department of Mines and Energy, Mineral Development Division, Map 85-28.

1985b: Geology of the Evening Lake area, Labrador (23G NE). Newfoundland Department of Mines and Energy, Mineral Development Division, Map 85-27.

1985c: Geology of the Lac Virot area, Labrador-Quebec (parts of 23G and 23B). Newfoundland Department of Mines and Energy Map 85-25.

Stevenson, I.M.
1963: Lac Bazil, Quebec (23J W½). Geological Survey of Canada, Report and Map 47-1962.

1964: Lac La Jannaye, Quebec and Newfoundland. Geological Survey of Canada, Report and Map 1-1964.

Thomas, A. and Butler, J.
1987: Gold reconnaissance in the Archean Ashuanipi Complex of western Labrador. *In* Current Research. Newfoundland Department of Mines and Energy, Mineral Development Division, Report 87-1, pages 237-255.

van Gool, J.
1992: The Grenville Front foreland fold-and-thrust belt in southwestern Labrador: mid-crustal structural and metamorphic configuration of a Proterozoic orogenic thrust wedge. Ph.D. Thesis, Memorial University of Newfoundland, St. John's, Newfoundland.

van Gool, J., Brown, D., Calon, T. and Rivers, T.
1988: The Grenville Front thrust belt in western Labrador. *In* Current Research, Part C. Geological Survey of Canada, Paper 88-1C, pages 245-253.

van Gool, J., Calon, T. and Rivers, T.
1987: Preliminary report on the Grenville Front tectonic zone. Bruce Lake area, western Labrador. *In* Current Research, Part A. Geological Survey of Canada, Paper 87-1A, pages 435-442.

Williams, H.R.
1990: Subprovince accretion tectonics in the south-central Superior Province. Canadian Journal of Earth Sciences, Volume 27, pages 570-581.