

Geotectonic evolution by asymmetric rifting of the Proterozoic Cape Smith Belt, New Quebec

Christian Picard, Danièle Giovenazzo and Daniel Lamothe

Volume 16, Number 3, September 1989

URI: https://id.erudit.org/iderudit/geocan16_3art05

[See table of contents](#)

Publisher(s)

The Geological Association of Canada

ISSN

0315-0941 (print)

1911-4850 (digital)

[Explore this journal](#)

Cite this article

Picard, C., Giovenazzo, D. & Lamothe, D. (1989). Geotectonic evolution by asymmetric rifting of the Proterozoic Cape Smith Belt, New Quebec. *Geoscience Canada*, 16(3), 130–134.

Article abstract

The tectonostratigraphic units of the Cape Smith Belt are interpreted as having accumulated in two distinct basins: (1) an older northern oceanic basin in which the Purtunigophiolite was formed; and (2) a younger southern Povungnituk - Chukotat basin. A comparison with present-day rifting processes suggests that the younger Povungnituk - Chukotat basin evolved as an asymmetric rift leading to the successive accumulation of the sediments of the Lamarche sub-group, the continental tholeiitic basalts of the Beuparlant subgroup, and the oceanic basalts of the Chukotat Group. In response to a north-south compression, the northern Chukotat Group basalts were probably subducted northward, thus initiating the development of a magmatic arc system (Parent Group).

Acknowledgements

I thank M.R. St-Onge, S.B. Lucas, D.J. Scott, and N.J. Begin for collecting samples, a great field visit which included engaging geological mapping and discussions, and an excellent geological database. The staff of the geochronology section and M. Villeneuve are thanked for assistance in generating age determinations. I am grateful to S. Hanmer, S.B. Lucas, and M.R. St-Onge for thoughtful reviews.

References

- Bergeron, R., 1957, Cape Smith-Wakeham Bay belt, New Quebec: Quebec Department of Mines, Preliminary Report 355 and Preliminary Maps 1090 and 1196, 8 p.
- Bergeron, R., 1959, Povungnituk Range area, New Quebec: Quebec Department of Mines, Preliminary Report 392 and Preliminary Map 1279, 9 p.
- Doig, R., 1987, Rb-Sr geochronology and metamorphic history of Proterozoic to early Archean rocks north of the Cape Smith fold belt, Quebec: Canadian Journal of Earth Sciences, v. 24, p. 813-825.
- Hoffman, P.F., 1985, Is the Cape Smith Belt (northern Quebec) a klippe?: Canadian Journal of Earth Sciences, v. 22, p. 1361-1369.
- Hoffman, P.F., 1987, Early Proterozoic foredeeps, foredeep magmatism, and Superior-type ironformations of the Canadian Shield, in Kröner, A., ed., Proterozoic Lithospheric Evolution: American Geophysical Union, Geodynamic Series, v. 17, p. 85-98.
- Hynes, A.J. and Francis, D.M., 1982, A transect of the early Proterozoic Cape Smith foldbelt, New Quebec: Tectonophysics, v. 88, p. 23-59.
- Lucas, S.B., in press, Structural evolution of the Cape Smith Thrust Belt and the role of out-of-sequence faulting in the thickening of mountain belts: Tectonics, in press.
- Machado, N., Goulet, N. and Gariépy, C., 1989, U-Pb geochronology of reactivated Archean basement and of Hudsonian metamorphism in the northern Labrador Trough: Canadian Journal of Earth Sciences, v. 26, p. 1-15.
- Parrish, R.R., Roddick, J.C., Loveridge, W.D. and Sullivan, R.W., 1987, Uranium-Lead analytical techniques at the geochronology laboratory: Geological Survey of Canada, Paper 87-2, p. 3-7.
- Roddick, J.C., 1987, Generalized numerical error analysis with applications to geochronology and thermodynamics: Geochimica et Cosmochimica Acta, v. 51, p. 2129-2135.
- St-Onge, M.R., Lucas, S.B., Scott, D.J., Bégin, N.J., Helmstaedt, H. and Carmichael, D.M., 1988, Thin-skinned imbrication and subsequent thick-skinned folding of rift-fill, transitional-crust and ophiolite suites in the 1.9 Ga Cape Smith Belt, northern Quebec: Geological Survey of Canada, Paper 88-1C, p. 1-18.
- St-Onge, M.R. and Lucas, S.B., in press, Evolution of the Cape Smith Belt: Early Proterozoic continental understrutting, ophiolite obduction and thick-skinned folding, in Lewry, J.F. and Stauffer, M.R., eds., The Early Proterozoic Trans-Hudson Orogen: Lithotectonic Correlations and Evolution: Geological Association of Canada, Special Paper, in press.
- Taylor, F.C., 1982, Reconnaissance geology of a part of the Canadian shield, northern Quebec and Northwest Territories: Geological Survey of Canada, Memoir 399, 32 p.



Geotectonic evolution by asymmetric rifting of the Proterozoic Cape Smith Belt, New Quebec

Christian Picard

Mineral Exploration Research Institute
Succ. A., CP 6079
Montréal, Québec H3C 3A7

Danièle Giovenazzo

Département des Sciences de la Terre
Université du Québec à Chicoutimi
Chicoutimi, Québec G7H 2B1

Daniel Lamothe

Ministère de l'Énergie et des Ressources du Québec
Québec, Québec G1S 4N6

Summary

The tectonostratigraphic units of the Cape Smith Belt are interpreted as having accumulated in two distinct basins: (1) an older northern oceanic basin in which the Purtuniqu ophiolite was formed; and (2) a younger southern Povungnituk - Chukotat basin. A comparison with present-day rifting processes suggests that the younger Povungnituk - Chukotat basin evolved as an asymmetric rift leading to the successive accumulation of the sediments of the Lamarche subgroup, the continental tholeiitic basalts of the Beauparlant subgroup, and the oceanic basalts of the Chukotat Group. In response to a north-south compression, the northern Chukotat Group basalts were probably subducted northward, thus initiating the development of a magmatic arc system (Parent Group).

Résumé

La bande du Cap Smith correspond à l'évolution successive de deux bassins océaniques, chevauchés l'un sur l'autre lors de l'orogénèse trans-hudsonienne. Si nos données sur l'ophiolite de Purtuniqu sont encore insuffisantes pour établir un modèle précis de l'histoire du bassin océanique nord (le plus précoce), la comparaison des données obtenues sur le bassin méridional avec les modèles récents sur l'évolution des rifts, évoque pour ce dernier une évolution selon un mécanisme de "rifting" disymétrique avec

mise en place successive des sédiments du sous-groupe de Lamarche, des basaltes continentaux du sous-groupe de Beauparlant et des basaltes océaniques du Groupe de Chukotat. La présence des roches volcaniques calco-alcalines du Groupe de Parent à l'interface des deux domaines suggère que les laves océaniques du Groupe de Chukotat ont été subduites vers le nord, entraînant le développement d'un magmatisme d'arc.

Introduction

The Cape Smith Belt in northern Quebec (Figure 1) contains two tectonostratigraphic domains separated by the east-west Bergeron fault (Bergeron, 1957, 1959; Hynes and Francis, 1982; St-Onge and Lucas, in press; Picard *et al.*, in prep.).

Southern domain. In the southern portion of the belt, the Povungnituk Group (Figure 1) comprises mostly sandstones, conglomerates, dolomites, quartzites and shales with a few ironstone formations (Lamarche subgroup, Lamothe, 1986). The sediments interfinger or are overlain by moderately LREE-enriched, massive and pillowed, tholeiitic, plagioclase-phyric basalts of continental affinity ($MgO < 10\%$, $TiO_2 = 1.2-3.6\%$; Hynes and Francis, 1982; Francis *et al.*, 1983; Picard, 1986, 1989a, b; Picard *et al.*, in prep.) which belong to the Beauparlant subgroup (Lamothe, 1986). The Beauparlant subgroup also includes ultramafic to mafic intrusions (Picard and Giovenazzo, in press), rhyolite domes and limited sequences of high-Ti basanites and phonolites (Picard, 1986, 1989a; Gaonac'h *et al.*, 1989 - this issue, p. 137-139) which locally overlie the pillowed basalts. The Chukotat Group (Figure 1) structurally overlies the Povungnituk Group. It includes several superposed sequences of slightly LREE-enriched, olivine-phyric komatiitic basalts ($MgO = 19-11\%$, $TiO_2 < 0.9\%$) and pyroxene-phyric tholeiitic basalts ($MgO = 12.5-7\%$, $TiO_2 = 0.8-1.1\%$; Picard, 1986, 1989a, b; Picard *et al.*, in prep.) which evolve, in its central part, to oceanic LREE-depleted olivine- and pyroxene-phyric basalts (Hynes and Francis, 1982; Francis *et al.*, 1981, 1983; Picard, 1986, 1989a, b; Picard *et al.*, in prep.). The upper section of the Chukotat Group comprises essentially LREE-depleted, pillowed and massive, plagioclase-phyric basalts ($MgO < 8\%$, $TiO_2 = 1.3-2.8\%$) typical of oceanic tholeiites. Local olivine-phyric or pyroxene-phyric basalt flows occur at the base of the latter sequence. In some locations, plagioclase, pyroxene and amphibole-porphyrific basalts and volcanoclastic rocks overlie the plagioclase-phyric basalts (Picard, 1989a).

Northern domain. The northern portion of the Cape Smith Belt contains a vast dismembered ophiolitic complex (Purtuniqu ophiolite, Figure 1, St-Onge *et al.*, 1987, 1988; St-Onge and Lucas, in press; Scott *et al.*, 1988, 1989 - this issue, p. 144-147; Picard *et al.*, in prep.).

In the lac Watts area (Figure 1), the ophiolite suite is composed of: (1) chromite rich, dunite peridotite and pyroxenite layered cumulates; (2) layered gabbros and anorthosites; (3) intrusive clinopyroxenites; and (4) slightly LREE-depleted tholeiitic diabase (in sheeted dykes) and massive or pillowed basalts ($MgO = 9.80-5.76\%$, $TiO_2 = 0.65-2.21\%$). In the rivière Déception area (Figure 1), the ophiolite includes (1) layered gabbros and anorthosites; (2) peridotitic and pyroxenitic layered cumulates; (3) gabbros and ferrogabbros; and (4) strongly LREE-depleted tholeiitic basalts ($MgO = 8.91-5.55\%$, $TiO_2 = 0.33-1.14\%$). The ophiolite structurally overlies a poorly documented sequence of greywackes and basalts to the north, and siltstones, sandstones and greywackes to the south (Figure 1). In the western part of the belt, the sediments are intercalated with basaltic to rhyolitic microporphyratic lavas and pyroclastic rocks (Parent Group, Lamothe, 1986) of calc-alkaline affinity (Picard *et al.*, in prep.). Finally, the northern domain is intruded by several massive to foliated felsic plutons ranging in age from about 1880 Ma to 1840 Ma (St-Onge and Lucas, in press; Parrish, 1989a, b - this issue, p. 126-130).

Geotectonic Evolution

Over the last twenty years, several magmatic and tectonic models have been proposed to integrate the structural, petrographic, and geochemical data for different portions of

the Cape Smith Belt. Gibb and Walcott (1971), Burke *et al.* (1977) and Thomas and Gibb (1977) proposed that the belt resulted from the collision of two continents. At the same time, Dimroth *et al.* (1970) and Baragar and Scoates (1981) interpreted the Cape Smith Belt as an autochthonous segment of the Circum-Superior Fold belt. Hoffman (1985) proposed that the belt is essentially a klippe, isolated from its root zone (geosuture) to the north by a post-thrusting basement antiform.

Hynes and Francis (1982), Francis *et al.* (1981, 1983) and later Picard (1986, 1989a, b) and Picard *et al.* (in prep.) have demonstrated that the southern Povungnituk and Chukotat Groups were the result of the progressive opening of an oceanic rift in four stages: (1) the creation of an ensialic fault basin into which were accumulated shallow water sediments of the Lamarche subgroup; (2) the formation of an ensialic proto-rift into which enriched plagioclase-phyric basalts of the Beauparlant subgroup were emplaced with local emission of peralkaline volcanic rocks; (3) the progressive opening of an oceanic rift and subsequent eruption of weakly enriched, then depleted, olivine- and pyroxene-phyric basalts of the Chukotat Group; and (4) the formation of an oceanic crust comprising the depleted plagioclase-phyric basalts of the Chukotat Group.

In the northern domain, Hynes and Francis (1982) interpreted the Watts Group as

the metamorphic equivalent of the southern Povungnituk Group. Nevertheless, St-Onge *et al.* (1987, 1988), St-Onge and Lucas (in press) and Scott *et al.* (1988, 1989 - this issue, p. 144-147) have shown that the northern domain is essentially composed of a vast ophiolitic complex (the Purtuniqu ophiolite). Scott *et al.* (1988, 1989 - this issue, p. 144-147) and Picard *et al.* (in prep.) have demonstrated that the tholeiitic diabase and basalts associated with the ophiolite are LREE-depleted, while the Povungnituk basalts are LREE-enriched (Picard *et al.*, in prep.).

U-Pb dating of zircon shows that the layered gabbros of the Purtuniqu ophiolite are older (1998 ± 2 Ma, Parrish, 1989a, b - this issue, p. 126-130) than the Povungnituk and Chukotat rocks which are bracketed in age between 1960 and 1920 Ma (Parrish, 1989a, b - this issue, p. 126-130). Thus, the geotectonic evolution of the Cape Smith Belt has to explain why the ophiolite is approximately 40 Ma older than the southern Povungnituk and Chukotat Groups. This dilemma may be resolved with the following scenario (Figure 2): (1) the opening of a northern basin with formation of ancient oceanic crust (the Purtuniqu basin); and (2) the opening of a second, younger southern basin (the Povungnituk - Chukotat basin). The Parent Group, interpreted as calc-alkaline deposits of an arc (Picard *et al.*, in prep.), appears to be the key to explaining the present relationships

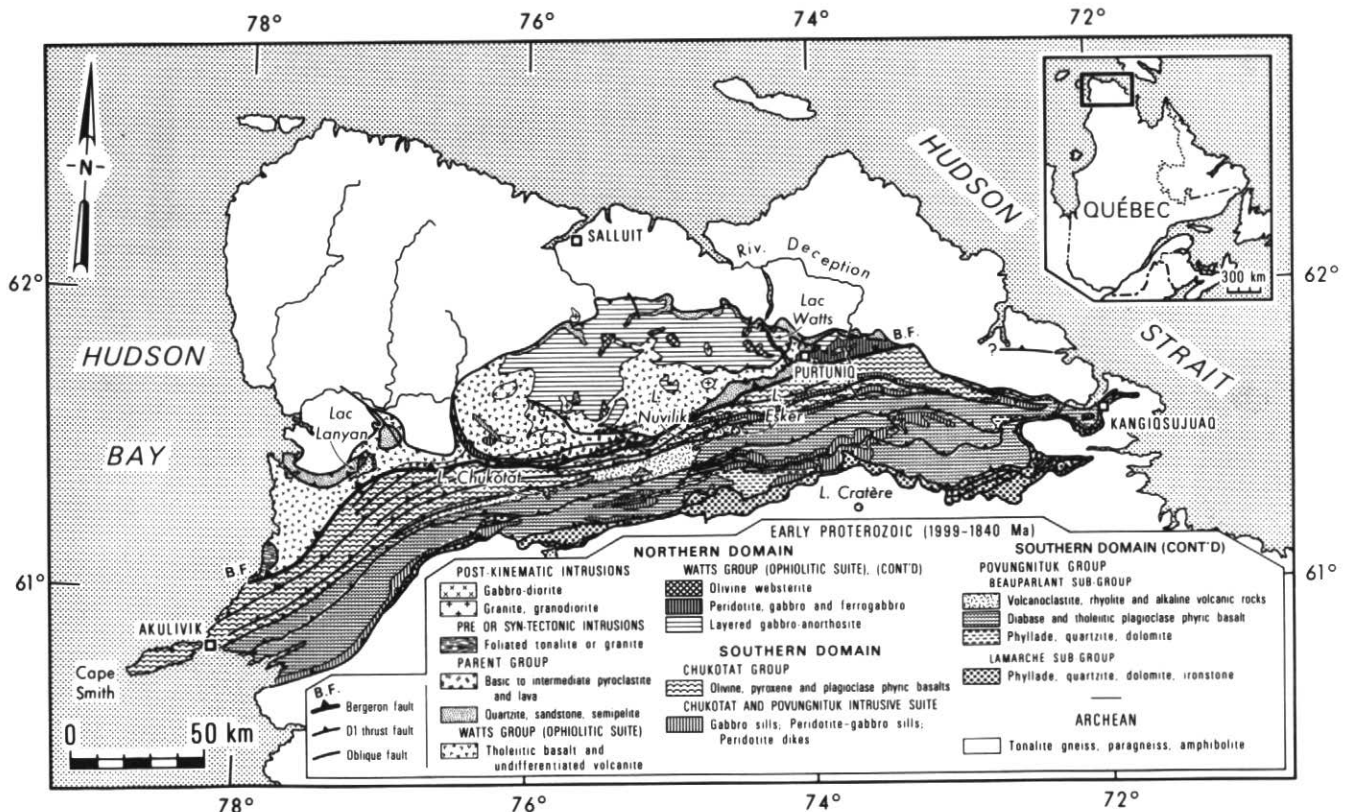


Figure 1 Geological map of the Cape Smith Belt. (Modified from Lamothe (1986) and St-Onge et al. (1988)).

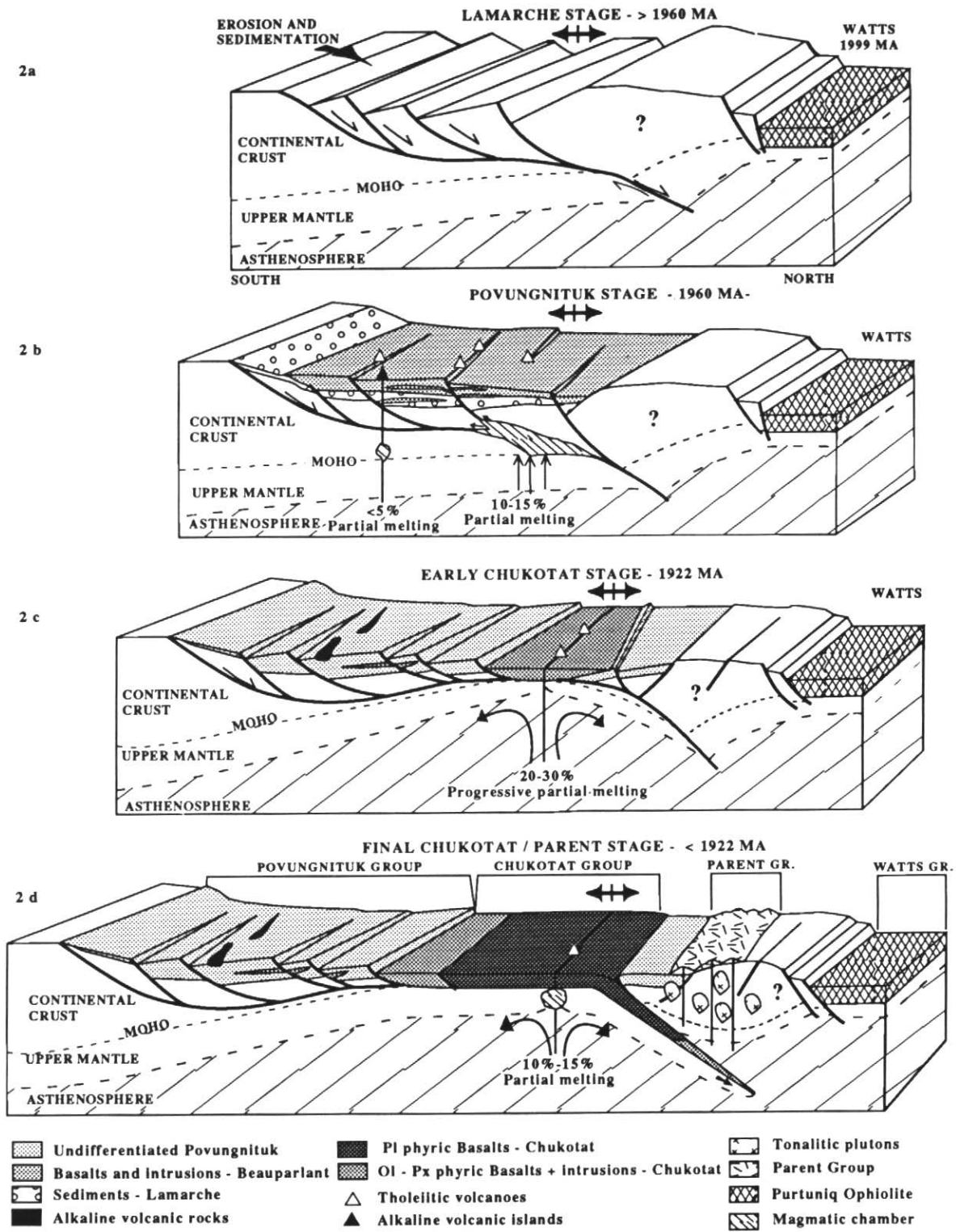


Figure 2 Proposed sequential evolution of the Cape Smith Belt.

between the two domains. The location of the Parent Group between the two domains (Figure 1), coupled with the structural work of St-Onge *et al.* (1987, 1988) and St-Onge and Lucas (in press), suggests that the Chukotat basalts were subducted below the northern domain forming a subduction-related magmatic arc on the overriding plate (Figure 2d). The hypothesis that the Parent Group represents a magmatic arc generated above a north-dipping subduction zone may provide a reasonable explanation for the post-rifting evolution of the continental margin system. This scenario appears to respect the chronology of the different events as revealed by the U-Pb ages (Parrish, 1989b - this issue, p. 126-130). It implies that a continental fragment separated the two oceanic domains prior to compressional deformation related to the Trans-Hudson Orogen (Figure 2a-d). However, no evidence for this crustal fragment is observed in the Cape Smith Belt, and in particular along the Parent Group. This missing fragment remains the biggest outstanding problem with the two-basin model. One possibility for explaining this missing fragment is that subduction of the southern crust occurred not directly below the continental crust, but in front of this crust, beneath a fragment of the Povungnituk crust (Povungnituk basalts and underlying continental crust, Figure 2d). The existence of low MgO and LREE-enriched tholeiitic basalts immediately to the north of the Bergeron fault in the region where we observe the Parent volcanics (Picard, 1989b) could argue for such a hypothesis. The absence of the continental crust could be also explained by obduction of the Purtuniqu ophiolite during the Trans-Hudson Orogen. Nevertheless, these two possibilities are speculative and more work is necessary in order to understand the relationships between southern and northern domains.

In the southern domain, it is clear that the Povungnituk and the Chukotat Groups have an asymmetric arrangement. If we apply the classic symmetric model for the formation of graben and rift, this implies that the subducted crust was equivalent in size and constitution to the Lamarche, Beauport and Chukotat units. Such a possibility is not out of the question, but the asymmetric arrangement of the Povungnituk and Chukotat Groups and the present structure of thrust faults invoke more an asymmetric model for rifting as proposed by Wernicke (1981), Wernicke and Burchfiel (1982) and Lister *et al.* (1986) as applied by Coleman and McGuire (1988) and Voggenreiter *et al.* (1988) to the Red Sea opening. Indeed, such a model implies an asymmetric distribution of the units, and favours a reduced size for the northern section of the crust, with subsequent subduction to the north.

Conclusion

According to petrographic, geochemical, structural and geochronological data, the Cape Smith Belt appears to result from a double rifting process, affecting the ancient Archean Superior craton. The first event (1998 ± 2 Ma) was responsible for the formation of an oceanic crust (the Purtuniqu ophiolite) in the northern domain (Figure 2a, St-Onge *et al.*, 1987, 1988; St-Onge and Lucas, in press; Scott *et al.*, 1988; Picard *et al.*, in prep.). Later, crustal extension south of the northern basin opened a second rift basin (Povungnituk - Chukotat basin) on the Superior craton (Figure 2a). An asymmetric model is proposed to account for the apparent asymmetric distribution of rift margin deposits. Lamarche subgroup sedimentation was followed by continental basaltic volcanism (after fractionation in a magma chamber) of the Beauport subgroup with lateral and local emissions of peralkaline volcanic rocks at ca. 1959 Ma (Parrish, 1989a, b - this issue, p. 126-130; Figure 2b). Further extension of the rift margin along the presumed low-angle normal fault may have induced the uplift and partial melting of the asthenosphere. This resulted in the eruption of komatiitic olivine and tholeiitic pyroxene-phyric basalts in a transitional continental-oceanic setting at 1918 Ma (Parrish, 1989a, b - this issue, p. 126-130 Figure 2c) and finally in the eruption of tholeiitic plagioclase-phyric basalts in an oceanic setting (Figure 2d). Following development of this younger oceanic basin, the Chukotat Group was apparently subducted to the north below the continental fragment separating the two basins (Figure 2d). The sediments and calc-alkaline volcanic rocks of the Parent Group may represent the deposits of a magmatic arc related to subduction of the Chukotat Group oceanic crust. Obduction of the Purtuniqu ophiolite apparently occurred during this period of north-dipping subduction (St-Onge and Lucas, in press), with the ophiolite eventually being thrust onto the Parent Group rocks. However, the geometry of subduction, the location of the continental fragment separating the two basins, and the location of the remainder of the arc deposits remain outstanding problems not solved by this tectonic scenario. Hopefully, further integrated studies will allow these problems to be understood.

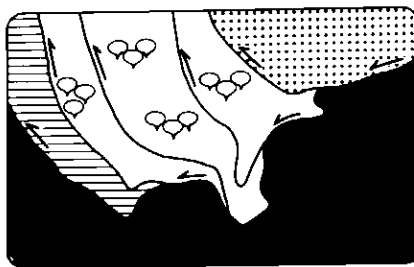
Acknowledgements

We thank the Ministère de l'Énergie et des Ressources du Québec (MERQ) and the NSERC for financing this work. We thank also Marc St-Onge and Stephen Lucas (Geological Survey of Canada, Ottawa) for their collaboration during fieldwork and their comments on this paper.

References

- Baragar, W.R.A. and Scoates, R.F.J., 1981, The Circum-Superior belt: a Proterozoic plate margin?, in Kröner, A., ed., *Precambrian Plate Tectonics*: Elsevier, Amsterdam, p. 297-330.
- Bergeron, R., 1957, Cape Smith-Wakeham Bay belt, New Quebec, Quebec: Department of Mines, Preliminary report 355 and preliminary maps 1090 and 1196, 8 p.
- Bergeron, R., 1959, Povungnituk range area, New Quebec: Quebec Department of Mines, Preliminary report 392 and preliminary map 1279, 9 p.
- Burke, K., Dewey, J.F. and Kidd, W.S.F., 1977, World distribution of sutures - the site of former oceans: *Tectonophysics*, v. 40, p. 489-499.
- Coleman, R.G. and McGuire, A.V., 1988, Magma systems related to the Red Sea Opening: *Tectonophysics*, v. 150, p. 77-100.
- Dimroth, E., Baragar, W.R.A., Bergeron, R. and Jackson, G.D., 1970, The filling of the Circum-Ungava geosyncline, in Baer, A.J., ed., *Symposium on basins and geosynclines of the Canadian Shield*: Geological Survey of Canada, Paper 70-40, p. 45-144.
- Francis, D.M., Hynes, A.J., Ludden, J.N. and Bédard, J., 1981, Crystal fractionation and partial melting in the petrogenesis of a Proterozoic high-MgO volcanic suite, Ungava, Quebec: *Contributions to Mineralogy and Petrology*, v. 78, p. 27-36.
- Francis, D.M., Ludden, J.N. and Hynes, A.J., 1983, Magma evolution in a Proterozoic rifting environment: *Journal of Petrology*, v. 24, p. 556-582.
- Gaonac'h, H., Picard, C., Ludden, J.N. and Francis, D., 1989, Alkaline rocks from a Proterozoic volcanic island in the Cape Smith Fold Belt, New Quebec: *Geoscience Canada*, v. 16, p. 137-139.
- Gibb, R.A. and Walcott, R.I., 1971, A Precambrian suture in the Canadian shield: *Earth and Planetary Science Letters*, v. 10, p. 413-422.
- Hoffman, P.F., 1985, Is the Cape Smith belt (northern Quebec) a klippe?: *Canadian Journal of Earth Sciences*, v. 22, p. 1361-1369.
- Hynes, A.J. and Francis, D.M., 1982, A transect of the early Proterozoic Cape Smith foldbelt, New Quebec: *Tectonophysics*, v. 88, p. 23-59.
- Lamothe, D., 1986, Développements récents dans la Fosse de l'Ungava, in Lamothe, D., Gagnon, R. and Clark, T., eds., *Exploration en Ungava, données récentes sur la géologie et la géologie*: Ministère de l'Énergie et des Ressources du Québec, DV 86-16, p. 1-6.
- Lister, G.S., Etheridge, M.A. and Symonds, P.A., 1986, Detachment faulting and the evolution of passive continental margins: *Geology*, v. 14, p. 246-250.
- Parrish, R.R., 1989a, Implications of U-Pb Geochronology of the Cape Smith Belt, Quebec: Geological Association of Canada - Mineralogical Association of Canada, Program with abstracts, v. 14, p. A57.
- Parrish, R.R., 1989b, U-Pb geochronology of the Cape Smith Belt and Sugluk block, northern Quebec: *Geoscience Canada*, v. 16, p. 126-130.
- Picard, C., 1986, Lithogéochimie de la partie centrale de la Fosse de l'Ungava, in Lamothe, D., Gagnon, R. and Clark, T., eds., *Exploration en Ungava, données récentes sur la géologie et la géologie*: Ministère de l'Énergie et des Ressources du Québec, DV 86-16, p. 57-72.

- Picard C., 1989a, Pétrologie et volcanologie des roches volcaniques de la partie centrale de la Fosse de l'Ungava: Ministère de l'Énergie et des Ressources du Québec, ET 87-07, 88 p.
- Picard, C., 1989b, Lithochimie des roches volcaniques protérozoïques de la partie occidentale de la Fosse de l'Ungava, région au sud du lac Lanyan: Ministère de l'Énergie et des Ressources du Québec, ET-87-14, 73 p.
- Picard, C., Lamothe, D., Piboule, M. and Oliver, R., in prep., Magmatic and geotectonic evolution of a proterozoic oceanic basin system: the Cape Smith Thrust Fold-Belt (New Quebec): submitted to *Precambrian Research*.
- Picard, C. and Giovenazzo, D., in press, Pétrographie, géochimie et géologie des roches plutoniques ultramafiques et mafiques protérozoïques de la partie centrale de la Fosse de l'Ungava: implications sur la distribution des éléments du groupe des platinoïdes: Ministère de l'Énergie et des Ressources du Québec.
- Scott, D.J., St-Onge, M.R., Lucas, S.B. and Helmstaedt, H., 1988, The 1999 Ma Purtuniqu ophiolite: imbricated oceanic crust obliquely exposed in the Cape Smith Thrust-Fold Belt, northern Quebec, Canada: *Geological Society of America, Abstracts with programs*, v. 20, no. 7, p. A158.
- Scott, D.J., St-Onge, M.R., Lucas, S.B. and Helmstaedt, H., 1989, The 1998 Ma Purtuniqu ophiolite: imbricated and metamorphosed oceanic crust in the Cape Smith Thrust-Fold Belt, northern Quebec: *Geoscience Canada*, v. 16, p. 144-147.
- St-Onge, M.R. and Lucas, S.B., in press, Evolution of the Cape Smith Belt: early Proterozoic continental underthrusting, ophiolite obduction and thick-skinned folding, in Lewry, J.F. and Stauffer, M.R., eds., *The Early Proterozoic Trans-Hudson Orogen: Lithotectonic Correlations and Evolution: Geological Association of Canada, Special Paper*, in press.
- St-Onge, M.R., Lucas, S.B., Scott, D.J. and Bégin, N.J., 1987, Tectono-stratigraphy and structure of the lac Watts-lac Cross-Rivière Déception area, central Cape Smith Belt, northern Québec: *Geological Survey of Canada, Paper 87-1A*, p. 619-632.
- St-Onge, M.R., Lucas, S.B., Scott, D.J., Bégin, N.J., Helmstaedt, H. and Carmichael, D.M., 1988, Thick-skinned imbrication and subsequent thick-skinned folding of rift-fill, transitional-crust, and ophiolite suites in the 1.9 Ga Cape Smith Belt, northern Quebec: *Geological Survey of Canada, Paper 88-1C*, p. 1-18.
- Thomas, M.D. and Gibb, R.A., 1977, Gravity anomalies and deep structure of the Cape Smith fold belt, northern Ungava, Quebec: *Geology*, v. 5, p. 169-172.
- Voggenreiter, W., Hötzl, H. and Mechie, J., 1988, Low-angle detachment origin for the Red Sea Rift System?: *Tectonophysics*, v. 150, p. 51-75.
- Wernicke, B., 1981, Low-angle normal faults in the Basin and Range Province: Nappe tectonics in an extending orogen. *Nature*, v. 291, p. 645-648.
- Wernicke, B. and Burchfiel, B.C., 1982, Modes of extensional tectonics in an extending orogen: *Journal of Structural Geology*, v. 4, p. 105-115.



Tectonic setting of Ni-Cu-PGE deposits in the central part of the Cape Smith Belt

D. Giovenazzo

*CERM/Université du Québec à Chicoutimi
Chicoutimi, Québec G7H 2B1*

C. Picard

IREM/MERI

École Polytechnique

C.P. 6079, Succ. 'A'

Montréal, Québec H3C 3A7

J. Guha

*CERM/Université du Québec à Chicoutimi
Chicoutimi, Québec G7H 2B1*

Summary

The Ni-Cu-PGE sulphide deposits in the central and eastern parts of the Cape Smith Belt are best developed near the contact between the Povungnituk and Chukotat Groups. The deposits are associated with differentiated sills and ultramafic intrusions forming part of the feeder system to the lower Chukotat Group which comprises alternating olivine and pyroxene-phyric basalts. The intrusions were emplaced near or at the axis of an oceanic proto-rift. The sulphide deposits are concentrated in two east-west trending horizons: (1) the Raglan horizon, containing deposits associated with sub-volcanic ultramafic intrusions (e.g., Lac Cross, Katinik and Donaldson sulphide deposits) and (2) the Delta horizon which contains deposits associated with differentiated sills (e.g., Delta region) and ultramafic intrusions (Méquillon dyke, Bravo Sills).

Résumé

Les gîtes Ni-Cu-EGP de la partie centrale de la bande du Cap Smith sont abondants près de la limite supérieure du Groupe du Povungnituk, immédiatement sous les premières coulées de basaltes à olivine et pyroxène du Groupe de Chukotat. Ils sont associés aux intrusions différenciées et ultramafiques qui forment une partie du système nourricier des premières séquences de basalte komatiitique du Groupe de Chukotat. Ces intrusions se sont mises en place près de la zone axiale d'un proto-rift en

domaine océanique. Les gîtes se concentrent le long de deux horizons est-ouest: (1) l'horizon de Raglan qui comprend des gîtes associés à des conduits sub-volcaniques de composition ultramafique (ex. Lac Cross, Katinik et Donaldson) et (2) l'horizon de Delta, qui comprend des minéralisations associées à des intrusions ultramafiques (ex. dyke de Méquillon) et à des filons-couches ultramafiques à mafiques différenciés (ex. filon-couche Delta).

Introduction

The geotectonic evolution of the southern part of the Cape Smith Belt (Povungnituk and Chukotat Groups, Figure 1) is described by the following sequence of events:

(1) Deposition of mainly shallow water sediments, followed by the extrusion of a volcanic sequence containing continental tholeiitic basalts with interdigitated clastic sediments and local rhyolites, basanites/nephelinites and phonolites (Picard *et al.*, 1989 - this issue, p. 130-134; Gaonac'h *et al.*, 1989 - this issue, p. 137-139). This environment is interpreted as a continental rift zone (Povungnituk Group; Francis *et al.*, 1981, 1983; Picard *et al.*, 1989 - this issue, p. 130-134).

(2) Eruption of komatiitic basalts that mark the beginning of the opening of a oceanic proto-rift (lower Chukotat Group; Picard *et al.*, 1989 - this issue, p. 130-134).

(3) Eruption of a monotonous plagioclase-phyric basalt sequence representing an oceanic floor (upper Chukotat Group; Francis *et al.*, 1983; Picard *et al.*, in press, 1989 - this issue, p. 130-134).

This sequence of events is recognized throughout the Cape Smith Belt, with the various tectonostratigraphic units preserved in east-west trending imbricated thrust-sheets (St-Onge and Lucas, in press).

The Povungnituk Group. The Povungnituk Group contains a lower, mostly sedimentary sequence of quartzites, shales, dolomites and a few iron formations structurally overlain by a volcanosedimentary package containing continental LREE-enriched tholeiitic basaltic sequences (Picard *et al.*, in press) with local alkali volcanic centres (Picard, 1986, in press; Gaonac'h *et al.*, 1989 - this issue, p. 137-139). A sedimentary unit terminates the Povungnituk Group and a local enrichment in LREE is observed (Giovenazzo *et al.*, in press). This transition zone between the Povungnituk and the Chukotat Groups is characterized by graphitic shales and siltstones, sulphidic shales, cherts and a few basaltic flows intruded by dioritic sills, differentiated sills and sub-volcanic ultramafic intrusions.

The Chukotat Group. This Group contains a volcanic sequence, with rare interflow sediments, composed of a basal series of alternating olivine and pyroxene-phyric basalts followed by an upper series composed of monotonous plagioclase-phyric