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Article abstract

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Hoffman, P.F., 1990, Dynamics of the tectonics assembly of northeast Laurentia in geon 18 (1.9–1.8 Ga): Geoscience Canada, v. 17, p. 222-226.

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.

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.

Moorhead, J., 1989, Tectonic history of the Renia basement-cover complex, Northern Québec, M.Sc. Thesis, McGill University, 194 p.

Moorhead, J. and Hynes, A., 1986, Structure and metamorphism of the eastern flank of the Renia gneiss dome: Geological Association of Canada — Mineralogical Association of Canada, Program with Abstracts, v. 11, p. A103.

Perreault, S., Machado, N. and Hynes, A., 1988, Timing of the tectonic evolution of the NE segment of the Labrador Trough, Kuujjuaq, Ungava, Northern Québec: Geological Association of Canada — Mineralogical Association of Canada — Canadian Society of Petroleum Geologists, Program with Abstracts, v. 13, p. A97.

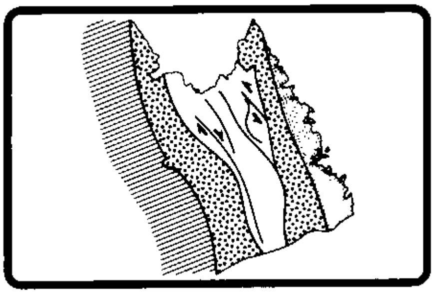
Poirier, G., Perreault, S. and Hynes, A., 1990, Nature of the eastern boundary of the Labrador Trough near Kuujjuaq, Québec, *in* Lewry, J.F. and Stauffer, M.R., eds., The Early Proterozoic Trans-Hudson Orogen of North America: Geological Association of Canada, Special Paper 37, p. 397-412.

Price, R.A. and Mountjoy, E.W., 1970, Geologic structure of the Canadian Rocky Mountains between Bow and Athabasca rivers — a progress report, *in* Wheeler, J.O., ed., Structure of the Southern Canadian Cordillera: Geological Association of Canada, Special Paper 6, p. 7-25.

Sauvé, P. and Bergeron, R., 1965, Région des lacs Gerido et Thévenet: Ministère des Richesses Naturelles du Québec, RG 104, 124 p.

Séguin, M., 1969, Configuration et nature du mode tectonique en bordure ouest de la partie centrale de la Fosse du Labrador: Canadian Journal of Earth Sciences, v. 6, p. 1365-1379.

St-Julien, P., Slivitsky, A. and Feininger, T., 1983, A deep structural profile across the Appalachians of southern Québec, *in* Hatcher, R.D., Williams, H. and Zietz, I., eds., Contributions to the Tectonics and Geophysics of Mountain Chains: Geological Society of America, Memoir 158, p. 103-112.



Deformational style in the foreland of the northern New Québec Orogen

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Summary

The northern segment of the New Québec Orogen is divided into 4 zones, based on lithostratigraphic assemblages and deformational style. The tectonic fabric is the result of WSW-SW transport during the third deformation event, which, in the foreland, consists of two stages. A basal décollement, low-angle thrust faults and bedding-parallel gliding in the western foreland are important features of the early D_3 stage. The bulk of crustal shortening occurred during the late D_3 ($D_{3'}$) stage, which is characterized by large-scale, high-angle out-of-sequence thrusts, and folds. The hinterland records more complex pre-$D_{3'}$ deformation, which cannot presently be correlated with early deformation in the foreland. The $D_{3'}$ out-of-sequence geometry is probably the result of syntectonic erosion of the orogenic wedge, but there is little geological evidence in the foreland supporting this premise. This apparent paradox can be explained by invoking a two-sided, double-wedge orogenic model, which links erosion and uplift in the hinterland to out-of-sequence thrusting in the foreland.

Résumé

La partie septentrionale de l'orogène du Nouveau-Québec se divise en quatre zones en fonction des assemblages lithostratigraphiques et du style structural. Le grain tectonique régional résulte d'un transport de ces zones vers le WSW-SW lors de la troisième phase de déformation qui comprend, dans l'avant-pays, deux phases. La phase précoce (D_3) est caractérisée par un décollement basal et des chevauchements en série dans la partie est de l'avant-pays et par des glissements parallèles aux strates dans la partie ouest. La phase tardive ($D_{3'}$), surtout responsable de l'épaississement crustal, est caractérisée par un ensemble généralisé de grands plis et de failles de chevauchement hors série abruptes. L'arrière-pays présente des structures pré-$D_{3'}$ plus complexes qui ne peuvent être corrélées avec celles de l'avant-pays. L'agencement hors-série $D_{3'}$ provient probablement de l'érosion syn-orogénique du prisme tectonique, mais on observe peu d'évidence de cette érosion dans l'avant-pays. Cette disparité correspond peut-être au modèle de double prismes tectoniques opposés, qui relie l'érosion et le soulèvement de l'arrière-pays aux chevauchements hors série de l'avant-pays.

Introduction

Most studies of the New Québec Orogen (NQO), previously known as the Labrador Trough Orogen (Hoffman, 1988), have focussed on the central (lat. 54°–57°N) and southern portions of the fold belt (*e.g.*, Dimroth, 1978, 1981; Dimroth and Dressler, 1978; Wardle and Bailey, 1981; LeGallais and Lavoie, 1982). Until recently, little attention had been paid to the northern segment of the orogen and, with few exceptions, existing maps were lithological in nature and had escaped detailed structural interpretation.

This paper summarizes field and compilation work begun in 1986 as part of a regional metallogenic synthesis of the northern NQO funded by the Ministère de l'Énergie et des Ressources du Québec (MERQ)(Wares *et al.*, 1988; Wares and Goutier, 1989, 1990). The project includes a 55 km by 100 km segment of the foreland of the orogen (Figure 1). Detailed mapping in selected sectors, compilation of MERQ geological maps and of data from Budkewitsch (1986), Goulet (1987) and Boone (1987), and integration of Landsat TM and airborne vertical magnetic gradient data (Rheault, 1989) has permitted resolution of the stratigraphy and structure of the area.

The NQO separates the Archean Superior Province to the southwest from the Archean/Proterozoic Rae Province to the northeast. The orogen comprises three NNW-trending volcano-sedimentary belts (Figure 1), defining the "Labrador Trough", and a broad, poorly defined metamorphic-plutonic hinterland within the Rae Province. The tripartite assemblage of rocks is Early Proterozoic in age (≈2145–1875 Ma; Clark and Thorpe, 1990; Machado *et al.*, 1989) and was deformed during the Hudsonian Orogeny (≈1845–1785 Ma; Machado *et al.*, 1989; Perreault *et al.*, 1988).

The foreland (Labrador Trough) assemblage consists of three cycles of sedimentation and/or volcanism separated by unconformities. The lower two cycles are widely interpreted as passive margin sequences thickening toward the east (Dimroth, 1981; Wardle and Bailey, 1981; LeGallais and Lavoie, 1982; Clark and Thorpe, 1990), while the upper cycle consists of a syntectonic fluvial molasse (Chioak Formation; Hoffman, 1987). The bulk of the supracrustal assemblage in the northern NQO is related to the second cycle of basin infilling.

Lithotectonic subdivisions

We have divided the northern segment of the NQO into 4 zones (Figure 1), based on lithostratigraphy and deformational style (Wares *et al.*, 1989). From west to east, these are the Chioak and Baby zones (foreland), and the Rachel and Kuujjuaq zones (hinterland).

The ***Chioak zone***, an autochthonous-parautochthonous belt resting unconformably on the Superior craton, is composed of a shallow water shelf sequence (Ferriman Subgroup) that is unconformably overlain by turbidites (Menihek Formation) and by syntectonic, immature continental clastic sediments (Chioak Formation; Figure 2). The ***Baby zone***, a central, strongly folded and thrust-faulted belt, comprises a rift-related volcano-sedimentary sequence, *i.e.*, the Abner dolomite, the Baby turbidites and iron formation and the Hellancourt tholeiitic basalt (Figure 2). This sequence is intruded by abundant tholeiitic gabbro sills. Meta-argillite and quartzite that are devoid of gabbro sills (Thévenet Formation) overlie the Hellancourt Formation and possibly represent syntectonic foredeep sediments. The ***Rachel zone*** marks the western edge of the hinterland. It is composed of an amphibolite-grade, thrust-imbricated package of Baby zone rocks, uncorrelated metasedimentary rocks, and Archean basement (Moorhead and Hynes, 1990; Poirier *et al.*, 1990). The ***Kuujjuaq zone*** is composed of remobilized Archean basement, amphibolite- to granulite-facies Early Proterozoic metasedimentary and metavolcanic rocks, syntectonic intrusions of continental arc affinity, and minor post-kinematic dykes. This zone may represent the root of a continental arc terrane (Machado *et al.*, 1989; Perreault and Hynes, 1990; Poirier *et al.*, 1990).

Three major faults separate the zones described above. The low-angle Garigue thrust separates the Chioak and Baby zones and represents the basal décollement of the latter (Budkewitsch, 1986; Clark and Thorpe, 1990). The Rachel fault separates the Baby and Rachel zones; it is a high-angle reverse fault (Moorhead and Hynes, 1990) that may also record a significant dextral strike-slip displacement (Goulet, 1987). The Turcotte fault separates the Rachel and Kuujjuaq zones (Perreault and Hynes, 1990).

The Baby zone is subdivided into three domains characterized by similar lithological assemblages but varying styles of deformation (Figures 3 and 4). From west to east, the amplitude and wavelength of folds increase, their interlimb angle decreases, and metamorphic grade increases from lower to upper greenschist. Folds plunge 0–30° (average 15°) to the SSE. The western portion (***Mélézes domain***) consists of thrust-imbricated Abner dolomite and Baby turbidites. Hellancourt basalt and tholeiitic gabbro sills are absent from this domain. Folds are isoclinal, overturned to recumbent near thrust faults, open and upright within allochthons, and are west-vergent with wavelengths rarely exceeding one kilometre. Deformation of the central volcano-sedimentary portion (***Gerido domain***) is characterized by imbricated synclines and duplexes and low- to high-angle reverse faults with dips increasing toward the east. Synclines are tight and overturned to the west; they have 2-4 km wavelengths, amplitudes reaching 3 km and are generally subhorizontal, extending over tens of kilometres. The eastern portion (***Thévenet domain***) is characterized by the same lithologies as in the Gerido domain. There are fewer high-angle reverse faults, as this domain is dominated by large-scale,

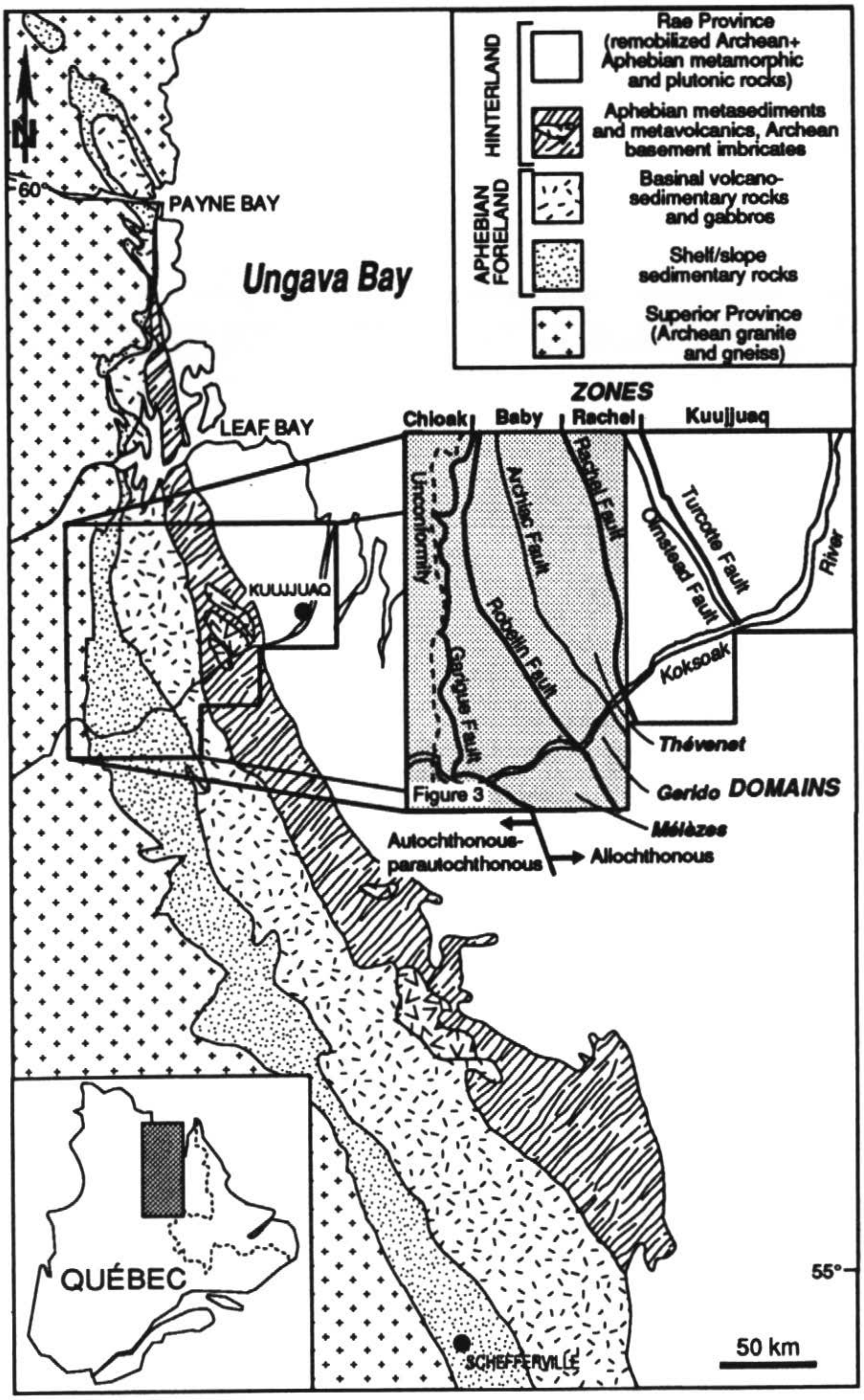

Figure 1 *Location of the study area, with inset of lithotectonic zones and domains. The three belts broadly define what was previously known as the Labrador Trough (Dimroth, 1978; Dimroth and Dressler, 1978; Hoffman, 1988).*

tight to open, inclined to upright anticlines and synclines. The folds have wavelengths of 6–12 km and amplitudes as high as 6 km.

Sequence of deformation

At least four phases of deformation are recognized in the northern NQO. The two earliest phases of deformation are best recorded in the Rachel zone (Moorhead and Hynes, 1990) where they correspond to the development of a basal décollement (D_1) and NW transport of basement-cored Pennine-style nappes (D_2).

The third deformational event encompasses the main stage of compression and is characterized by a SW to WSW transport direction. In the Baby zone, this event is preserved as two increments of deformation, *i.e.*, the D_3 (early) and $D_{3'}$ (late) stages. Only $D_{3'}$ is observed in the Rachel zone. In the foreland, D_3 was formerly referred to as D_1 (Goulet, 1987; Wares and Goutier, 1989), but the nomenclature was modified (Wares and Goutier, 1990) in an attempt to establish internal consistency with hinterland deformation. Furthermore, although $D_{3'}$ deforms D_3 structures, the foreland deformation is probably the result of continuous strain since the stages are coaxial and there is no evidence of temporally discrete events.

D_3 in the foreland is characterized by a penetrative schistosity, isoclinal folds and sheath folds that are limited to pelitic sedimentary units, except near the eastern limit of the Baby zone where folding involved the more competent gabbroic sills. In the Mélézes domain, these folds are limited to high-strain zones adjacent to thrust faults. D_3 folds trend NW to NNW and are overturned to the SW. D_3 thrust faults are mostly bedding-parallel in the Gerido and Thévenet domains, as indicated by a paucity of stratigraphic repetition within younger ($D_{3'}$) thrust slices and by a conspicuous D_3 shear zone located at the base of the Hellancourt Formation. In the Mélézes domain, where sills are absent, low-angle D_3 thrust faults imbricate the sedimentary sequence. The D_3 Garigue fault (basal décollement) thrusts Abner dolomite over the shelf sequence.

The main tectonic fabric of the orogen is the result of $D_{3'}$. This event is recorded in all four zones. In the Chioak zone, it generated NNW-trending, upright, open folds, whereas in the Baby and Rachel zones, it produced NW- to NNW-trending, open to tight, large-scale, upright to overturned folds with axial planar crenulation cleavages. D_3 faults, such as the bedding-parallel thrusts at the base of the Hellancourt Formation and the Garigue fault, are folded by $D_{3'}$ structures. $D_{3'}$ high-angle reverse faults are abundant, truncate $D_{3'}$ folds, and are limited to the Gerido and Thévenet domains, except south of the Mélézes River, where they extend into the Mélézes domain. The Robelin and Archiac faults are $D_{3'}$ structures that separate the Mélézes and Gerido and Gerido and Thévenet domains, respectively (Figures 3 and 4).

D_4 is observed in the Chioak and Baby zones; it resulted in NE-trending upright open folds that created local dome and basin patterns with $D_{3'}$ folds.

The chronology of faulting is complex, as illustrated in an oblique structural cross-section (unbalanced down- and up-plunge projections) across the foreland (Figure 4). In the Mélézes domain, D_3 faults apparently form an in-sequence imbricate fan (Boyer and Elliott, 1982), as suggested by regular, repeated imbrication of Abner dolomite over Baby turbidites and the fact that westerly faults do not truncate underlying faults to the east. The spacing and dip of faults increase toward the Gerido domain. D_3 faults are truncated by the Robelin fault, which represents the westernmost $D_{3'}$ fault ($D_{3'}$ basal décollement) in the northern half of this area. In the Gerido and Thévenet domains, $D_{3'}$ faults form a consistent trailing fan of break-back thrusts younging toward the hinterland, *i.e.*, the entire $D_{3'}$ fault system is out-of-sequence. The structures in lower (westerly) thrust slices are consistently truncated by faults at the base of the upper slices and, in some cases, the upper slices consist of stratigraphically higher lithologies than the lower ones (*e.g.*, Robelin fault). In Figure 4, it was assumed that the Robelin fault does not truncate the Garigue fault, although the true structural relationship between these faults is presently unknown. Out-of-sequence thrusts that truncate older décollements have been documented in many fold-thrust belts, including the Cape Smith Belt to the northwest (Lucas, 1989). At the eastern margin of the foreland, all $D_{3'}$ faults and folds are truncated by the Rachel fault, which may be syn-$D_{3'}$ or a late-tectonic feature.

Discussion

In the Baby zone, both D_3 and $D_{3'}$ reflect transport toward the WSW-SW, slightly oblique to the trend of the orogen. In the Rachel zone, however, D_2 reflects transport to the NW and $D_{3'}$ reflects transport to the SW. Whether D_2 in the Rachel zone reflects a true compression direction or local transport caused by a major lateral ramp structure is uncertain (Moorhead and Hynes, 1990). If the latter case is correct, early compression in the hinterland may have been toward the SW, in which case D_1 and D_2 would likely be coeval with D_3 in the foreland. However, the relations between the early stages of deformation in the Baby and Rachel zones remain speculative, since there is presently no convincing way to correlate the early deformations between these zones.

The out-of-sequence $D_{3'}$ event is related to the bulk of crustal shortening, given the associated degree of imbrication and juxtaposition of domains. We estimate the degree of shortening related to $D_{3'}$ at 78% in the Gerido domain and 50% in the Thévenet domain, based on deconvolution of the Hellancourt basalt. This is equivalent to a minimum 80 km southwestward displacement of the basalts at the eastern margin of the foreland, ignoring the D_3 displacement. These estimates are similar to the minimum 64% shortening calculated by Boone (1987) along a cross-section in the same area.

As in the case of the Cape Smith Belt (Lucas, 1989), out-of-sequence thrusting in the northern NQO seems to be the dominant mechanism responsible for crustal thickening, although the causes for such a deformational style are not clear. Widespread out-of-sequence high-angle thrusting in the foreland of an orogen is thought to be a consequence of maintaining critical taper during

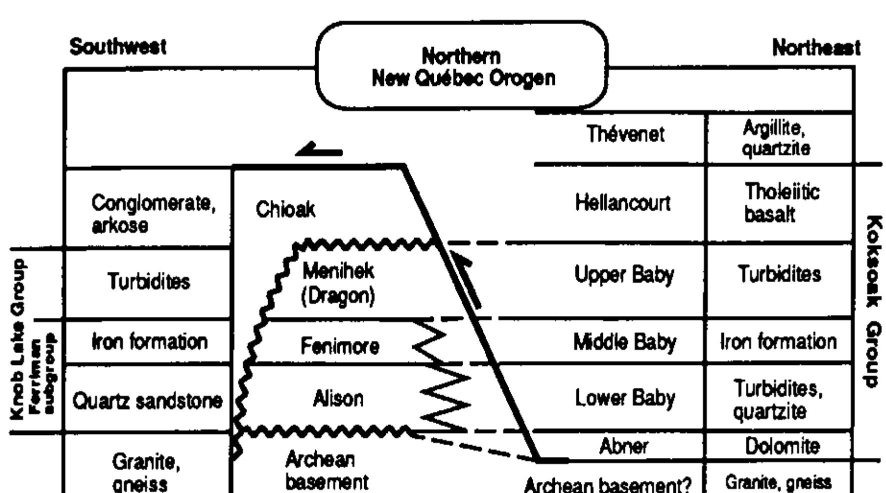

Figure 2 *Stratigraphy of the foreland (Chioak and Baby zones) of the northern New Québec Orogen, modified from Clark and Thorpe (1990).* ***Koksoak Group*** *is an informal name and includes the Abner-Baby-Hellancourt formations (Wares and Goutier, 1990). The Knob Lake and Koksoak groups are part of the second cycle sequence, with the possible exception of the Abner dolomite. The Chioak Formation is synorogenic and is related to the third cycle.*

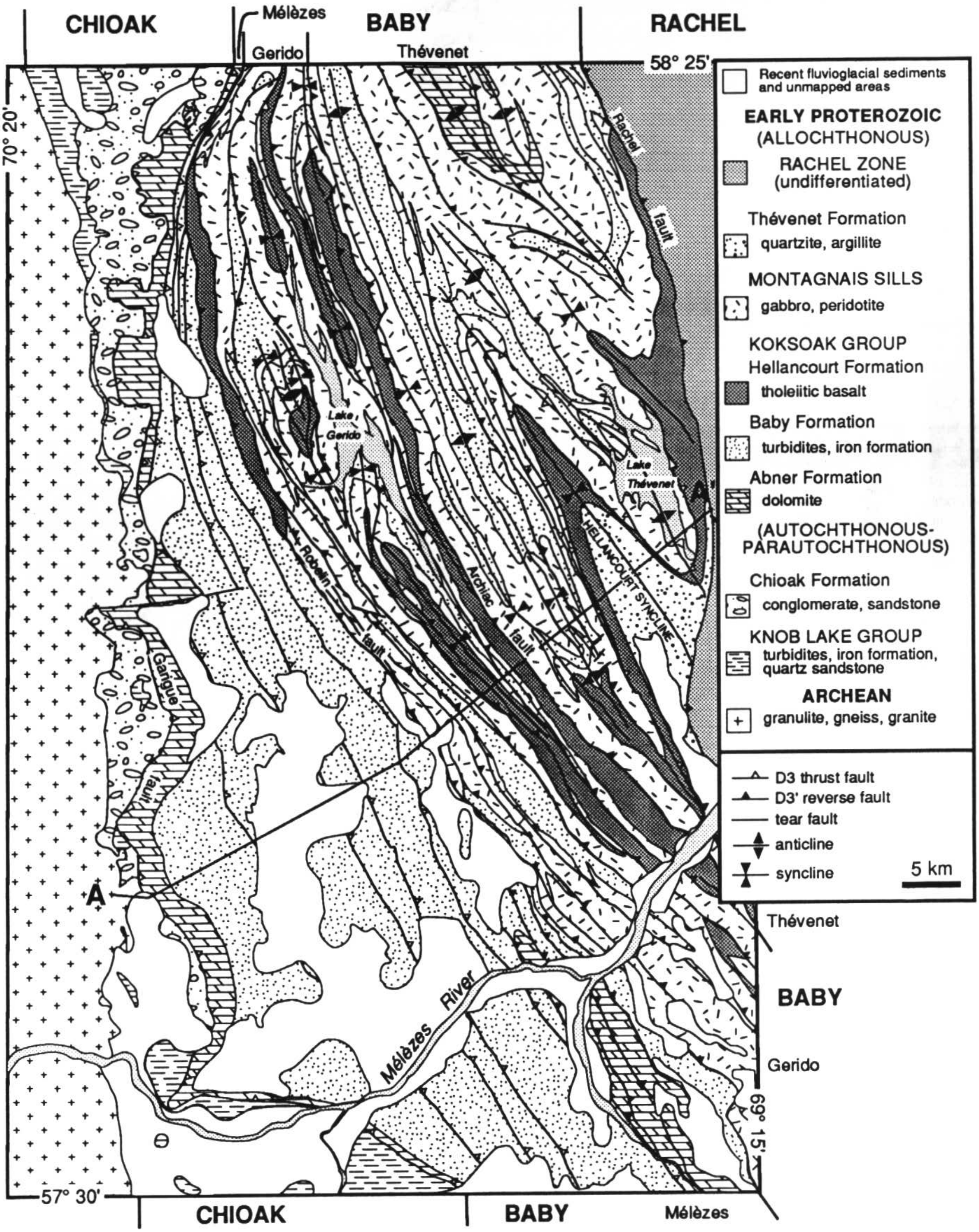

Figure 3 *Geological map of a segment of the foreland of the northern New Québec Orogen. The autochthonous/parautochthonous Chioak zone was deformed by $D_{3'}$ and D_4, and the allochthonous Baby zone (Koksoak Group) was deformed by D_3, $D_{3'}$ and D_4. Most large-scale structures are the result of $D_{3'}$.*

growth of the orogenic wedge, which invariably thins due to erosion and in-sequence forward thrust propagation (Davis *et al.*, 1983; Morley, 1988). If erosion of the wedge is the principal cause of the $D_{3'}$ out-of-sequence geometry, and one assumes the critical taper model of Davis *et al.* (1983) where a single uniform wedge faces the undisturbed craton, one would expect a high rate of uplift prior to and during $D_{3'}$, as well as the deposition of wedge-derived syntectonic foredeep sediments in the foreland. There is no evidence, however, for rapid uplift of the foreland assemblage, as it displays all the characteristics of upper crustal material. Furthermore, the presence of wedge-derived foredeep sequences in the foreland has yet to be convincingly demonstrated. Hoffman (1987) interpreted the entire second-cycle sequence of the northern NQO as a foredeep assemblage, but this is difficult to reconcile in view of the abundant tholeiitic magmatism and the fact that the youngest volcanic unit (Hellancourt Formation) is ≈25 m.y. older than $D_{3'}$ (Machado *et al.*, 1989). With the possible exception of the Thévenet Formation, we also interpret the second-cycle sequence as a passive margin sequence (*cf.* LeGallais and Lavoie, 1982; Clark and Thorpe, 1990).

The absence of syntectonic erosional features in the foreland can be reconciled by invoking a two-sided orogen (Koons, 1990), in which orogenic geometry is controlled by two mechanically coupled wedges, *i.e.*, a steep inboard wedge facing the indentor and a shallow outboard wedge facing the undisturbed craton. In such a scenario, the orogen perturbs prevailing winds and erosion concentrates at the toe of the inboard wedge facing the indentor, resulting in syntectonic sediment deposition on the indentor and uplift concentrated below the inboard wedge. Applying such a model to the NQO, erosion and uplift would have been focussed in the Rachel zone, and syntectonic wedge sediments deposited (but not necessarily preserved) east of the Kuujjuaq zone. Perreault *et al.* (1988) concluded that post-$D_{3'}$ rapid differential uplift of the Rachel zone juxtaposed the hinterland against the foreland along the Rachel fault. Perreault and Hynes (1990) have also demonstrated that the Kuujjuaq zone experienced deep late-tectonic burial, supporting the idea that the out-of-sequence geometry of the foreland may result from the erosion of a two-wedge orogen on the slope facing the indentor.

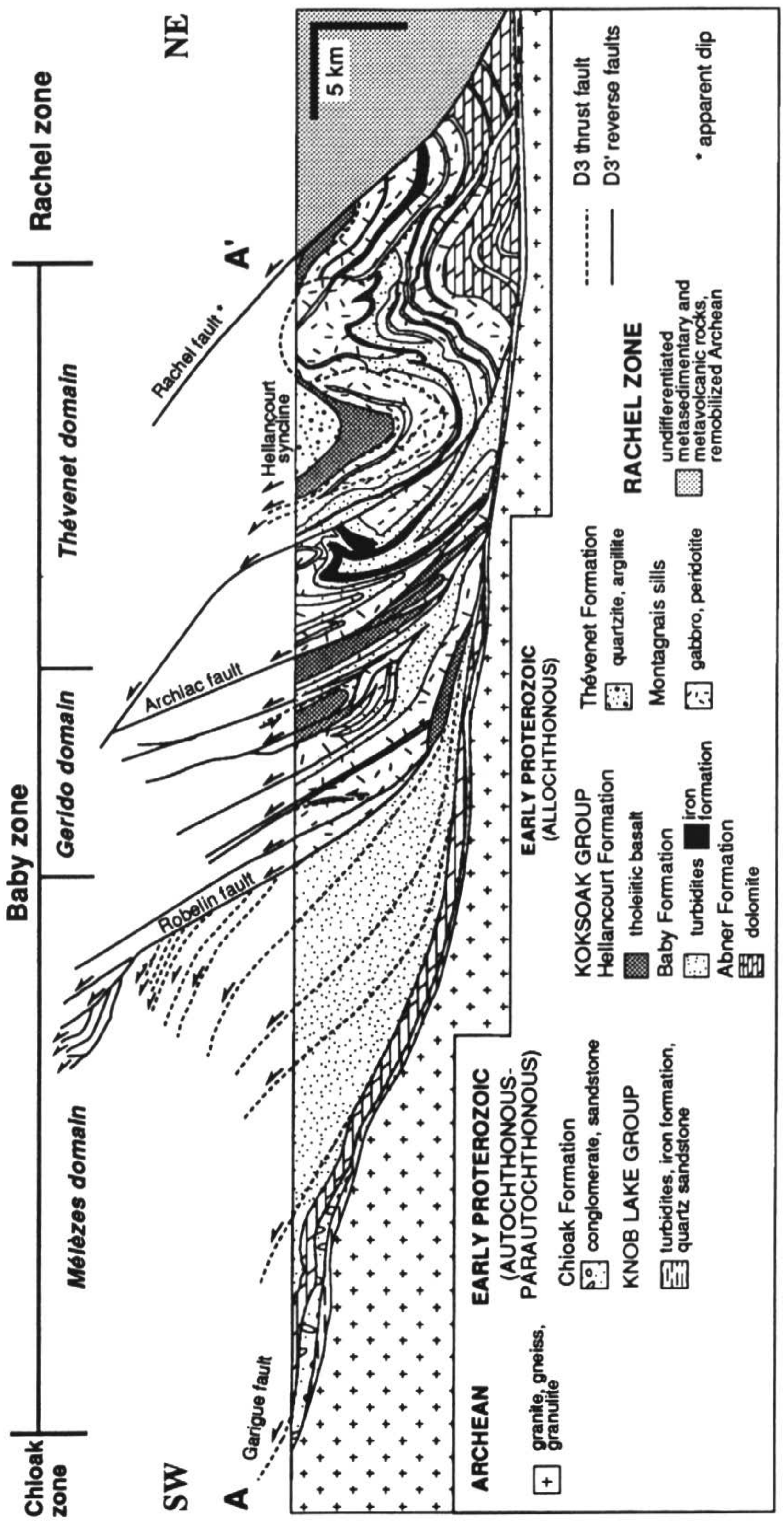

Figure 4 *Unbalanced structural cross-section (down- and up-plunge projections) along the transect indicated in Figure 3. D_3 faults in the Mélèzes domain are apparently in-sequence. $D_{3'}$ faults in the Gerido and Thévenet domains truncate $D_{3'}$ folds and are out-of-sequence.*

Conclusions

D_3 shortening in the foreland was accommodated by in-sequence "piggyback" thrusting and local isoclinal folding in the Mélèzes domain, and by isoclinal folding and bedding-parallel gliding (with little imbrication) in the Gerido and Thévenet domains. A thin-skin tectonic model is applicable to deformation in the foreland, and the style of deformation of the $D_{3'}$ stage is such that out-of-sequence reverse faults in the Gerido and Thévenet domains form a trailing imbricate fan that youngs toward the hinterland. Deformation in the hinterland was more complex, with involvement of the basement early in the tectonic history. Early hinterland deformation cannot presently be correlated with early deformation in the foreland.

The out-of-sequence geometry of the $D_{3'}$ stage of deformation is ubiquitous in the area studied and is the principal mechanism responsible for crustal thickening. In the New Québec Orogen and in other orogens where this is observed, rapid erosion of crustal material on the indentor (Rae Province) side of the inboard wedge may account for the absence of syntectonic, wedge-derived sediments in the foreland. Further investigations are required to establish the applicability, across the orogen, of the geometry observed in the north and the relative timing and coupling of events in the foreland and hinterland.

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References

Boone, E., 1987, Petrology and tectonic implications of the Hellancourt volcanics, northern Labrador Trough, Québec, unpublished M.Sc. Thesis, McGill University, Montréal, 95 p.

Boyer, S.E. and Elliott, D., 1982, Thrust Systems: American Association of Petroleum Geologists, Bulletin, v. 66, p. 1196-1230.

Budkewitsch, P., 1986, A structural study of the Chioak-Abner formation contact, northern part of the Labrador Trough, New Québec, unpublished B.Sc. Thesis, Concordia University, Montréal, 61 p.

Clark, T. and Thorpe, R.I., 1990, Model lead ages from the Labrador Trough and their stratigraphic implications, *in* Lewry, J.F. and Stauffer, M.R., eds., The Early Proterozoic Trans-Hudson Orogen of North America: Geological Association of Canada, Special Paper 37, p. 413-432.

Davis, D.M., Suppe, J. and Dahlen, F.A., 1983, Mechanics of fold-and-thrust belts and accretionary wedges: Journal of Geophysical Research, v. 88, p. 1153-1172.

Dimroth, E., 1978, Région de la fosse du Labrador: Ministère des Richesses Naturelles du Québec, Rapport Géologique 193, 396 p.

Dimroth, E., 1981, Labrador Geosyncline: type example of early Proterozoic cratonic reactivation, *in* Kröner, A., ed., Precambrian Plate Tectonics: Developments in Precambrian Geology 4: Elsevier Scientific, Amsterdam, p. 331-352.

Dimroth, E. and Dressler, B., 1978, Metamorphism of the Labrador Trough, *in* Fraser, J.A. and Heywood, W.W., eds., Metamorphism in the Canadian Shield: Geological Survey of Canada, Paper 78-10, p. 215-236.

Goulet, N., 1987, Étude tectonique de la partie nord de la Fosse du Labrador — Région à l'ouest de Kuujjuaq: Ministère de l'Énergie et des Ressources du Québec, MB 87-21, rapport intérimaire, 33 p.

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, Geodynamics Series, v. 17, p. 85-98.

Hoffman, P.F., 1988, United plates of America, the birth of a Craton: Early Proterozoic assembly and growth of Proto-Laurentia: Annual Reviews of Earth and Planetary Sciences, v. 16, p. 543-603.

Koons, P.O., 1990, Two-sided orogen: Collision and erosion from the sandbox to the Southern Alps, New Zealand: Geology, v. 18, p. 679-682.

LeGallais, C.J. and Lavoie, S., 1982, Basin evolution of the Lower Proterozoic Kaniapiskau Supergroup, central Labrador miogeocline (trough), Québec: Bulletin of Canadian Petroleum Geology, v. 30, p. 150-166.

Lucas, S.B, 1989, Structural evolution of the Cape Smith thrust belt and the role of out-of-sequence faulting in the thickening of mountain belts: Tectonics, v. 8, p. 655-676.

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.

Moorhead, J. and Hynes, A., 1990, Nappes in the internal zone of the northern Labrador Trough: Evidence for major early, NW-vergent basement transport: Geoscience Canada, v. 17, p. 241-244.

Morley, C.K., 1988, Out-of-sequence thrusts: Tectonics, v. 7, p. 539-561.

Perreault, S. and Hynes, A., 1990, Tectonic evolution of the Kuujjuaq terrane, New Québec Orogen: Geoscience Canada, v. 17, p. 238-240.

Perreault, S., Hynes, A. and Machado, N., 1988, Timing and tectonic evolution of the NE segment of the Labrador Trough, Kuujjuaq, northern Québec: Geological Association of Canada — Mineralogical Association of Canada — Canadian Society of Petroleum Geologists, Program with Abstracts, v. 13, p. A97.

Poirier, G., Perreault, S. and Hynes, A., 1990, Nature of the eastern boundary of the Labrador Trough near Kuujjuaq, Québec, *in* Lewry, J.F. and Stauffer, M.R., eds., The Early Proterozoic Trans-Hudson Orogen of North America: Geological Association of Canada, Special Paper 37, p. 397-412.

Rheault, M., 1989, Intégration des données Landsat, aéromagnétiques et géologiques, région du lac Gerido, Fosse du Labrador: Ministère de l'Énergie et des Ressources du Québec, MB 89-25, 23 p.

Wardle, R.J. and Bailey, D.G., 1981, Early Proterozoic sequences in Labrador, *in* Campbell, F.H.A., ed., Proterozoic Basins in Canada: Geological Survey of Canada, Paper 81-10, p. 331-358 (Supplement).

Wares, R.P., Berger, J. and St-Seymour, K., 1988, Synthèse métallogénique des indices de sulfures au nord du 57• parallèle, Fosse du Labrador: étape I: Ministère de l'Énergie et des Ressources du Québec, rapport intérimaire, MB 88-05, 186 p.

Wares, R. and Goutier, J., 1989, Synthèse métallogénique des indices de sulfures au nord du 57• parallèle, Fosse du Labrador: étape II: Ministère de l'Énergie et des Ressources du Québec, MB 89-38, rapport intérimaire, 114 p.

Wares, R. and Goutier, J., 1990, Synthèse métallogénique des indices de sulfures au nord du 57• parallèle, Fosse du Labrador: étape III: Ministère de l'Énergie et des Ressources du Québec, rapport intérimaire, MB 90-25, 96 p.

Wares, R.P., Perreault, S., Goutier, J. and Poirier, G., 1989, Lithotectonic zones of the northern Labrador fold belt, Québec: Geological Association of Canada — Mineralogical Association of Canada, Program with Abstracts, v. 14, p. A39.