GEOLOGICAL SURVEY OF CANADA
BULLETIN 574

GEOLOGY OF EASTERN PRINCE OF WALES ISLAND AND ADJACENT SMALLER ISLANDS, NUNAVUT

(parts of NTS 68D, Baring Channel and 68A, Fisher Lake)

U. Mayr, T.A. Brent, T. de Freitas,
T. Frisch, G.S. Nowlan, and A.V. Okulitch

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Cover Illustration
Oblique air photo of the mouth of Young Bay. View is to the west toward ice-covered Peel Sound. The small, unnamed peninsula is underlain by Precambrian intrusive rocks. The Precambrian rocks are thrusted over lower Paleozoic strata. The thrust fault runs across the neck of the peninsula. The lighter coloured ridges in the footwall consist of Cambrian to Silurian carbonate rocks, overturned in response to the thrusting. The flat area is underlain by horizontally bedded Siluro-Devonian sandstone and conglomerate. Oblique air photo T435L-175

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Foreword

This publication reports on the geology of the western margin of the Boothia Uplift in the south-central part of the Canadian Arctic Archipelago. In the past this area has been investigated only sparsely, but hydrocarbon exploration nevertheless took place. This bulletin illuminates the stratigraphy and structure through a multidisciplinary scientific approach which includes older unpublished information, the integration of new field data, and the presentation of newly reprocessed and interpreted seismic profiles. This has resulted in a comprehensive description of the area that stands as a new and important reference for explorationists. It is a goal of the Geological Survey of Canada and the Earth Sciences Sector to provide knowledge about the earth for sound economic, environmental and social decisions. Responding to the increased demand for information from both traditional and new users, Earth Sciences Sector has become a world leader in the generation and provision of on-demand, easily accessible and integrated earth science knowledge and advice using state-of-the-art technology.

ᓇᐃᓪᓕᒋᐊᖅᓯᒪᔪᖅ

ᐃᖃᓇᐃᔭᖃᑦᑕᖅᐳᒍᑦ ᒐᕙᒪᒃᑯᖏᓐᓂᑦ ᐋᑐᕚᑉ ᑖᓐᓇ ᐅᖃᓕᒫᓕᐊᕆᓚᐅᖅᐸᕗᑦ ᐅᔭᖃᑦ ᓇᓂᔭᕗᑦ ᐅᖃᐅᓯᕆᑉᓗᒋᑦ ᑭᓐᖓᐃᓚᖅᒥᑦ. ᑕᐃᑲᓃᓚᐅᖅᐳᒍᑦ ᐊᐅᔭᖓᓂ 1997. ᐊᑐᓚᐅᖅᐳᒍᑦ ᓯᑕᒪᓂᒃ ᐊᒃᓴᓗᐊᓕᖕᓂᒃ Hᐊᑕᓂᒃ ᕿᑭᖅᑕᐅᒐᖅᔪᐊᖅᓱᑕ ᐊᒻᒪ ᐊᑯᑦ ᐊᐅᓱᑦᑐᒥᐊᑕᖅ ᐅᖃᓇᓚᐅᖅᐳᖅ ᐱᓕᕆᐊᖃᖅᑎᓪᓗᑕ. ᐊᒥᓱᑦ ᑕᐃᑲᓃᓚᐅᖅᐳᑦ ᓯᕗᓂᐊᓂ ᕿᒥᖅᕈᔭᖅᑐᖅᓱᑎᒃ ᐅᔭᖃᓂᒃ ᐊᒪ ᐃᑰᑕᖅᓱᑎᒃ ᐅᖅᓱᐊᓗᒃᑕᖃᕆᐊᒃᓴᖅ ᖃᐅᔨᒋᐊᖅᓱᑎᒃ. ᐊᐃᑦᑖᖑᒐᓗᐊᖅ ᐅᖅᓱᐊᓗᒃᓯᐊᓚᐅᙱᒻᒪᑕ.

ᐅᔭᖃᓂᒃ ᐅᔭᖃᖕᓂᐊᓚᒃᓴᓂᒃ ᕿᓂᖅᑎᐅᙱᑦᑐᒍᑦ, ᑭᓯᐊᓂ ᖃᐅᔨᔪᒪᕗᒍᑦ ᖃᓄᐃᑦᑐᑦ ᐅᔭᖃᑦ ᓄᓇᕗᒦᒋᐊᒃᓴᖏᓐᓂᒃ, ᖃᑯᒍᓐᖑᒃᑲᓐᓂᖅᐸᑦ, ᖃᐅᔨᒪᑎᓪᓗᑕ, ᐅᔭᖃᑦ ᑕᐃᒪᐅᓂᖏᓂᒃ ᐃᑲᔪᕈᑕᐅᔪᓐᓇᖅᓂᐊᖅᒪᑕ ᓴᐳᒻᒥᔾᔪᑕᐅᓗᑎᒃ, ᐅᔭᖃᓂ ᓯᑏᓚᓂ ᐊᒻᒪ ᐅᖅᓱᐊᓗᒃᓯᐊᕈᑕᐅᓗᑎᒃ. ᑖᒃᑯᐊ ᓇᓂᔭᐅᒃᐸᑕ ᐅᔭᖃᓂᒃ ᐃᖃᓇᐃᔭᒐᒃᓴᖅᑖᖅᑎᑦᑎᓂᐊᖅᐳᑦ ᐃᓄᖕᓄᑦ ᓄᓇᕗᒥ. ᑖᓐᓇ ᐅᖃᓕᒫᖅ ᓇᓗᓇᐃᖅᓯᕗᖅ ᐅᓂᒃᑳᓕᖅᓱᓂ ᖃᓄᐃᑦᑑᓂᖏᓐᓂᒃ ᐅᔭᖃᑦ ᒪᓂᕋᐅᑉ ᖄᖓᓂᑦ ᕿᑭᖅᑕᐅᒐᒦᑦᑐᑦ, ᑕᑯᒃᓴᐅᑎᑦᕗᑦ ᐊᔾᔨᒌᙱᑦᑐᓂᒃ ᐅᔭᖃᓂᒃ ᖃᓕᓈᒃᑐᓂᒃ ᐅᕙᓈᓂᑦ ᓴᓂᓕᓈᒃᑐᓂᒃ, ᐊᒻᒪ ᖃᓄᐃᑦᑐᒋᐊᒃᓴᖏᓐᓂᒃ ᐋᑖᓂᑦᑐᑦ ᒪᓂᕋᐅᑉ. ᓄᓇᙳᐊᖃᕆᕗᖅ ᐊᖏᔪᒥᒃ ᑕᑯᒃᓴᐅᑎᑦᑎᔪᒥᒃ ᐊᔾᔨᒌᙱᑦᑐᓂᒃ ᐅᔭᖃᓂᒃ ᕿᑭᖅᑕᐅᒐᖅᒥ ᓇᓂᔭᐅᕙᒃᑐᓂᒃ.

ᓇᓂᓯᓚᐅᖅᐳᒍᑦ ᓯᑕᒪᒃᓂ ᐅᔭᖃᓂᒃ ᕿᑭᖅᑕᐅᒐᖅᒥ ᐊᔾᔨᒌᙱᑦᑐᓂᒃ. ᓯᕗᓪᓕᖅ ᐊᕿᑦᑑᕗᖅ ᑐᐊᐸᐅᑉᓗᓂ ᐊᒻᒪ ᒪᕋᐅᑉᓗᓂ ᐊᒻᒪ ᓄᓇᐅᑉᓗᓂ ᒪᓂᕋᐅᑉ ᖄᖓᓂ ᕿᑭᖅᑕᐅᒐᖅᒥ. ᑕᑯᓗᒍ ᓯᓇ ᐊᑖᓂᒥᐊᒃᓴᖕᓗᓂᒃ ᑖᒃᑯᐊ ᖄᓐᓂᑦᑐᑦ ᐅᔭᖃᑦ, ᐱᓯᓗᓚᐅᖅᐳᒍᑦ ᐊᒻᒪᓗ ᓄᓇᓯᐅᑎᒃᑯᑦ ᐃᖏᕐᕋᑉᓗᑕ ᑰᖕᓂ ᑐᐊᐸᒃ ᐃᒪᖅᒍᑦ ᐊᒃᑐᖅᑕᐅᑎᓗᒍ ᐊᑯᔪᒪᑉᓗᒋᑦ, ᓯᑎᓂᖅᓴᐃᑦ ᐅᔭᖃᑦ. ᐅᖅᑯᐊᓂ ᓯᔾᔭᐅᑉ ᓯᑎᔪᒻᒪᕆᐊᓗᐃᑦ ᕿᖅᓂᖅᑐᑦ ᐅᔭᖃᑦ ᑕᐃᒪᐅᕗᑦ ᑭᖓᖃᕈᑕᐅᔪᑦ ᖃᐃᖅᑐᖃᕈᑕᐅᔪᑦ ᓯᔾᔭᒥ. ᑖᒃᑯᐊ ᐅᔭᖃᑦ ᓴᕿᑦᑎᕗᑦ ᒪᓂᕋᐅᑉ ᐃᓕᖅᑯᓯᖓᓂᒃ, ᐅᑭᐅᑦ ᐊᒥᓱᒻᒪᕆᐊᓗᐃᑦ, ᐊᓂᒍᖅᑐᑦ ᐊᒻᒪ ᒪᓂᕋᖅᒍᑦ ᓴᕿᓪᓗᑎᒃ ᓄᐃᑉᓗᑎᒃ. ᑐᓪᓕᖓ ᐅᔭᕋᐅᑉ ᐊᑖᓂᑉᐳᖅ ᑕᓇᐅᑉ ᐊᒻᒪ ᓴᓇᔭᐅᓯᒪᕗᑦ ᐆᒪᔪᐃᑦ ᖄᖏᓇᓂᑦ. ᐃᓚᓐᓂ ᓇᓂᓯᖃᑦᑕᓚᐅᖅᐳᒍᑦ ᖄᕆᔭᐅᓂᑯᓂᖅᓂᒃ ᐱᐅᔪᓂᒃ ᓱᖅᓯᒪᙱᑦᑐᓂᒃ. ᐃᓗᐊᓂ ᐅᔭᖃᑦ ᑯᑭᒃᓴᐅᓚᐅᖅᐳᑦ. ᐃᓄᐃᑦ ᐱᑭᒃᓯᑦ ᖃᔪᖏᓐᓂᒃ ᓴᓇᖃᑦᑕᓚᐅᖅᐳᑦ ᑖᒃᑯᐊ ᐊᑐᖅᓗᒥᑦ ᑕᐃᑉᓱᒪᓂᒃᑲᓐᓂᖅ ᐊᒻᒪ ᓇᓂᓯᓚᐅᖅᐳᒍᑦ ᓇᑭᑦ ᐱᔭᐅᖃᑦᑕᓚᐅᕆᐊᒃᓴᖏᓐᓂᑦ. ᐅᔭᖃᑦ ᓇᓂᔭᕗᑦ ᐊᐅᐸᓗᒃᑑᓄᑦ ᐊᒻᒪ ᓯᐅᕋᒥᑦ ᑐᐊᐸᖕᒥᓪᓗ ᑰᑐᖃᖅᓂᑦ ᓴᕿᓇᓂᑰᓄᑦ.

ᐊᐅᐸᓗᒃᑐᖅ ᐅᔭᕋᒃ ᑰᖕᒥᑦ ᐊᒻᒪ ᐅᕐᓗᖃᐅᖅᑐᑦ ᐅᔭᖃᑦ ᖃᓖᓇᒃᐳᑦ ᑕᓂᒍᑦ ᑕᒪᐃᓐᓂᖃᔭᖅ ᐃᖏᕐᕋᖃᑦᑕᖅᐳᑦ, ᑲᑏᒋᔭᙱᓇᓂ, ᕿᖅᓂᖅᑐᑦ, ᑎᔪᑦ ᑭᖓᓂ ᐅᔭᖃᑦ ᐃᓗᐊᓂᐊᓐᓂᖅᓂᑯᓄᑦ ᒪᓂᕋᐅᑉ, ᖃᓇᑦᑐᑦ ᖁᒻᒍᑦ ᓇᐸᖅᑐᖅᓯᖅᐳᑦ. ᑕᐃᒪᓐᓇᐃᑉᐳᖅ, ᐅᔭᖃᑦ ᓯᑎᔪᑦ ᑭᓐᖓᓕᖅᓂ ᐅᔭᖃᑦ ᐊᔭᒃᓯᓚᐅᖅᒪᑕ ᖁᒻᒍᑦ ᒪᓂᕋᖅᒥᒃ ᐅᔭᖃᓂᑦ ᐅᕐᓗᖃᐅᖅᓂᐅᔪᓂ ᐊᒪ ᐊᐅᐸᓗᒃᑐᓂ ᐅᔭᖃᓂᑦ.

ᓇᓂᓯᓚᐅᙱᓚᒍᑦ ᓴᕕᒐᓂᒃ ᐅᕐᓗᖃᐅᖅᑐᓂ ᐅᔭᖃᓂ ᓇᓗᐊᖅᓇᖅ. ᓴᕕᑕᖃᐅᖅᐸᑦ ᐅᕐᓗᐊᓂᑦ ᐅᖅᓱᐊᓗᖅᐸᑦ ᑭᖓᐃᓕᖅᒥ, ᐅᕐᓗᖃᐅᖅᓗᑎᒃ ᐅᔭᖅᐅᓇᔭᖅᐳᑦ ᐊᑎᑦᑎᐊᖓᓂ ᕿᑭᖅᑕᐅᓚᐅᑉ.

GEOLOGY OF EASTERN PRINCE OF WALES ISLAND AND ADJACENT SMALLER ISLANDS, NUNAVUT

Abstract

The report area forms a narrow, north-oriented rectangle in the south-central part of the Arctic Islands. The area comprises the northeastern part of Prince of Wales Island and adjacent smaller islands. The western part of the area is underlain by very gently dipping lower Paleozoic formations of the Arctic Platform, and the eastern part by Proterozoic sedimentary rocks and intrusions and by Archean crystalline rocks of the Boothia Uplift. A major, west-directed thrust zone separates the two areas.

The Precambrian rocks comprise three assemblages: an Archean and/or lower Proterozoic basement of granulite grade metamorphic rocks (predominantly orthogneiss), its Mesoproterozoic cover of sedimentary rocks, and two suites of mafic igneous rocks of Meso- and Neoproterozoic ages. The Cambrian to mid-Silurian succession consists of minor sandstone and varied carbonate units. Upper Silurian and Lower Devonian rocks contain a large amount of terrigenous material in the vicinity of the Boothia Uplift, but they consist of carbonate deposits in the platform region.

The north-trending gneissic fabric of the basement controlled the overall form of the Boothia Uplift. The basement is cut by northwest-, west-, and northeast-trending faults and fractures, which influenced its subdivision into numerous small blocks that acted semi-independently of one another. As a result, the western frontal fold and thrust belt of the Boothia Uplift, although continuous for 500 km and with consistent west-verging geometry, is remarkably heterogeneous in detail. Blocks with their own consistent geometry rarely exceed 10 km in strike length; a few are as small as 2 km long.

Résumé

La région dont on traite dans le présent rapport forme un étroit rectangle allongé suivant un axe nord-sud dans la partie centre sud de l’archipel Arctique. Cette région englobe le nord-est de l’île Prince of Wales, ainsi que les petites îles avoisinantes. La partie occidentale de la région est occupée par des formations du Paléozoïque inférieur très faiblement inclinées qui appartiennent à la Plate-forme de l’Arctique. La partie orientale de la région comprend, pour sa part, des roches sédimentaires et des intrusions du Protérozoïque, ainsi que des roches cristallines de l’Archéen appartenant au soulèvement de Boothia. Ces deux parties de la région sont séparées par une importante zone de chevauchement à vergence ouest.

Les roches précambriennes se divisent en trois assemblages. Le premier forme le socle et se compose de roches métamorphiques (principalement des orthogneiss) du faciès des granulites datant de l’Archéen ou du Protérozoïque précoce. Le deuxième est constitué de roches sédimentaires du Mésoprotérozoïque qui composent la couverture du socle. Le dernier réunit deux suites de roches magmatiques de composition mafique du Mésoprotérozoïque et du Néoprotérozoïque. La succession du Cambrien au Silurien moyen est constituée d’un peu de grès et de diverses unités de roches carbonatées. La succession du Silurien supérieur et du Dévonien inférieur se compose de roches carbonatées dans le secteur de la plate-forme, mais de grandes quantités de matériaux terrigènes s’y ajoutent à proximité du soulèvement de Boothia.

La fabrique gneissique de direction nord observée dans les roches du socle a conditionné la forme générale du soulèvement de Boothia. Le socle est recoupé par des failles et des fractures de directions nord-ouest, ouest et nord-est qui ont participé à sa subdivision en de nombreux petits blocs partiellement indépendants les uns des autres. C’est pourquoi la partie frontale, à l’ouest, de la zone de plissement et de chevauchement du soulèvement de Boothia est remarquablement hétérogène à l’échelle locale, même si cette zone s’étend de manière continue sur 500 km en adoptant une géométrie uniforme à vergence ouest. Les blocs affichant une géométrie uniforme propre présentent rarement une dimension longitudinale supérieure à 10 km, et quelques blocs montrent une longueur de tout au plus 2 km.

Summary

The report area is situated in the south-central part of the Arctic Islands and comprises the northeastern part of Prince of Wales Island and smaller, adjacent islands. There are no occupied settlements in the area.

The land surface of Prince of Wales Island lies at various elevations and wide areas are characterized by glacial landforms and by marine strandlines. The highest elevation in the report area is about 410 m, part of a chain of summits that extends along the northeast coast of Prince of Wales Island. West of these summits are plateau and lowland areas with small lakes and extensive glacial drift.

The report area straddles the western margin of the Boothia Uplift and the adjacent part of the Arctic Platform. The eastern part is underlain by Proterozoic sedimentary rocks and by Archean and/or lower Proterozoic crystalline rocks. The western part is underlain by very gently west-dipping lower Paleozoic formations of the Arctic Platform. A major, west-directed thrust zone separates the two areas.

Two dry hydrocarbon exploration wells have been drilled and two seismic surveys shot within and immediately adjacent to the report area.

The present study is based on re-evaluation of unpublished data from earlier fieldwork conducted by the Geological Survey of Canada, recent fieldwork by some of the authors, and on interpretation of over 1000 kilometres of reprocessed seismic data.

The Precambrian rocks comprise three assemblages: an Archean and/or lower Proterozoic basement of granulite-grade metamorphic rocks, its Mesoproterozoic cover of sedimentary rocks, and two suites of mafic igneous rocks of Meso- and Neoproterozoic ages. The crystalline rocks comprise remnants of paragneiss and amphibolite of probable Archean age intruded by voluminous granitoids of Paleoproterozoic age, all of which were metamorphosed and deformed during several tectonomagmatic episodes up to about 1.9 Ga.

Predominantly clastic strata of the Aston Formation were deposited unconformably on the crystalline rocks prior to the Mackenzie Igneous Event at 1268 Ma. The Aston Formation occurs in isolated patches up to 900 m thick and appears to be locally derived from an ancestral Boothia Arch. Post-Mackenzie carbonate platform deposits of the Hunting Formation lie unconformably on the Aston Formation. The Hunting Formation is not exposed in the report area and was identified in the subsurface from seismic data in the northern part. Maximum thickness is estimated at 6280 m.

Lower Paleozoic rocks of the Canadian Arctic Archipelago form the Franklinian succession. In the report area the Franklinian succession is much thinner than elsewhere in the Archipelago, since it is situated near the southern, cratonal margin of the succession. Deposition of medium to coarse clastic rocks began in the Late Cambrian, followed by development of a carbonate shelf. Subsidence during the Ordovician was regionally uniform, but the area is situated near the southern continental margin of the evaporite-carbonate shelf. The strata are of marginal cratonic type and exhibit at least one major hiatus.

The Upper Silurian and Lower Devonian rocks contain a large amount of terrigenous material in the vicinity of the Boothia Uplift, but consist of carbonate in the platform region. This difference reflects the rise of the Boothia Uplift, folding and faulting of the cover rocks during the Late Silurian and Early Devonian, and erosional exposure of the crystalline core. Peneplanation and submergence of the core is recorded by a few outliers of Lower Devonian strata. All younger strata have been removed except for rare outliers of Upper Cretaceous and Tertiary units preserved in grabens. Formation thicknesses in the area increase from south to north.

Because of poor exposure, the Cambrian to Lower Silurian part of the succession has been mapped as an unnamed unit with two members, which are separated by a major unconformity. Individual formations known from islands north of the report area that are correlative with the unnamed unit can be distinguished in the two wells, but they are not recognizable in surface exposures. The lower member is between 231 and 660 m thick. It consists of variable dolostone and sandstone and is variably resistant to weathering. The upper member is between

284 and 600 m thick and comprises uniform, thick-bedded, resistant dolostone. The unnamed unit is overlain by the Cape Storm Formation, which is between 50 and 100 m thick and consists of interbedded silty dolostone and argillaceous and silty limestone. The highest formation of the carbonate platform along the immediate west side of the Boothia Uplift is the Douro Formation. It is between 178 and 276 m thick and consists of thick-bedded, mottled, fossiliferous limestone. The lower member of the Drake Bay Formation is a lateral equivalent of the upper part of the Douro Formation to the west. The member is present only in the northern part of the report area and consists of interbedded dolostone and limestone. No field exposures of the Drake Bay Formation were examined during this study.

Uniform subsidence and regionally extensive carbonate sedimentation were disrupted in Late Silurian and Early Devonian time during the Cornwallis Disturbance by substantial basement uplift and deformation of the sedimentary cover on the Boothia Uplift. Synorogenic detritus was shed onto areas adjacent to topographic-structural culminations in synorogenic basins, which in some cases developed on contemporary structures of the fold belt. Some of these synorogenic rocks form the Peel Sound Formation. The Peel Sound Formation has two members: a lower member of conglomeratic sandstone and an upper member of conglomerate. The Peel Sound Formation was not examined in detail during this investigation.

The north-trending gneissic fabric of the basement controlled the overall form of the uplift. The basement is cut by northwest-, west- and northeast-trending faults and fractures, which influenced its subdivision into numerous small blocks that acted semi-independently of one another. As a result, the frontal fold and thrust belt, although continuous for 500 km and with consistent west-verging geometry, is remarkably heterogeneous in detail. Blocks with their own consistent geometry rarely exceed 10 km in strike length; a few are as small as 2 km long.

The net displacement of the Boothia Uplift as a whole is small. Faults are predominantly steeply east-dipping, although some low-angle faults did develop during the multiple stages of movement. Displacements estimated from mapped relationships rarely exceed 3 km for individual faults; the maximum shortening across the belt of frontal structures is no more than 7 km. However, displacement that can be seen at the surface across the frontal belt is unlikely to be the total displacement. Most faults may be steep at the surface, however the level of exposure is the same throughout the study area and the limited seismic evidence suggests that most become listric at relatively shallow depths. Blind thrusts and ramp and flat geometry have also been interpreted from seismic data and would increase estimates. Moreover, the uplift contains internal thrusts. Although total, cummulative displacement doubtless varies along the strike of the segmented uplift, it seems plausible that it reaches a maximum of about 10 to 20 km in the central part of the report area and decreases to the north and south.

The Eocene–Oligocene Eurekan Orogeny primarily affected the northeastern part of the Arctic islands and reactivated structures in the older Ellesmerian and Late Silurian–Early Devonian fold belts.

The hydrocarbon potential of the report area and the area of seismic coverage does not currently look promising. However, the amount of subsurface stratigraphic control is poor. The metallic mineral potential of the report area is also considered poor.

Sommaire

La région dont on traite dans le présent rapport est située dans la partie centre sud de l’archipel Arctique et englobe la partie nord-est de l’île Prince of Wales, ainsi que les petites îles avoisinantes. Il n’existe aucune agglomération habitée dans la région.

L’île Prince of Wales présente un relief d’altitude variable et on y observe sur de grandes étendues des formes glaciaires et d’anciennes lignes de rivage. Le point le plus haut de la région s’élève à environ 410 m dans une chaîne de crêtes longeant la côte nord-est de l’île Prince of Wales. À l’ouest de cette chaîne s’étendent des plateaux et des basses terres ponctués de petits lacs et pourvus d’une couverture étendue de sédiments glaciaires.

La région à l’étude chevauche la marge ouest du soulèvement de Boothia et la partie adjacente de la Plate-forme de l’Arctique. La partie orientale de la région comprend des roches sédimentaires du Protérozoïque et

des roches cristallines de l'Archéen ou du Protérozoïque précoce. La partie occidentale est occupée, quant à elle, par des formations du Paléozoïque inférieur très faiblement inclinées vers l'ouest qui appartiennent à la Plate-forme de l'Arctique. Ces deux parties de la région sont séparées par une importante zone de chevauchement à vergence ouest.

Dans la région à l'étude et son voisinage immédiat, on a foré deux puits d'exploration à la recherche d'hydrocarbures, qui se sont avérés secs, et effectué deux levés sismiques.

La présente étude est basée sur une réévaluation de données non publiées recueillies lors de travaux antérieurs sur le terrain menés par la Commission géologique du Canada. Elle s'appuie également sur de récents travaux sur le terrain effectués par certains des auteurs, ainsi que sur l'interprétation de 1 000 km de profils sismiques issus d'un nouveau traitement des données.

Les roches précambriennes se divisent en trois assemblages. Le premier forme le socle et se compose de roches métamorphiques du faciès des granulites datant de l'Archéen ou du Protérozoïque précoce. Le deuxième est constitué de roches sédimentaires du Mésoprotérozoïque qui composent la couverture du socle. Le dernier réunit deux suites de roches magmatiques de composition mafique du Mésoprotérozoïque et du Néoprotérozoïque. Les roches cristallines comprennent des lambeaux de paragneiss et d'amphibolite datant probablement de l'Archéen, qui sont envahis par de volumineux granitoïdes du Paléoprotérozoïque. L'ensemble de ces roches a été métamorphisé et déformé au cours de plusieurs épisodes tectonomagmatiques qui se sont déroulés jusqu'à 1,9 Ga environ.

Les couches de caractère principalement clastique de la Formation d'Aston se sont déposées en discordance sur les roches cristallines avant l'événement magmatique de Mackenzie à 1 268 Ma. La Formation d'Aston, qui se présente en plaques isolées où elle affiche une épaisseur qui peut atteindre 900 m, serait formée de matériaux de source locale provenant probablement d'une proto-arche de Boothia. Après l'événement de Mackenzie, des dépôts carbonatés de plate-forme de la Formation de Hunting se sont accumulés en discordance sur la Formation d'Aston. La Formation de Hunting n'affleure pas dans la région à l'étude, mais des données sismiques nous ont permis de déduire sa présence en profondeur dans la partie nord de la région. On estime à 6 280 m son épaisseur maximale.

Les roches du Paléozoïque inférieur de l'archipel Arctique canadien forment la succession franklinienne. Dans la région à l'étude, la succession franklinienne est beaucoup plus mince qu'ailleurs dans l'archipel, car on se trouve près de sa bordure sud, à son contact avec le craton. Le dépôt, au Cambrien tardif, de sédiments clastiques à grain moyen ou grossier a été suivi de la formation d'une plate-forme carbonatée. La subsidence à l'Ordovicien a été uniforme à l'échelle régionale, mais cette région se trouve près de la bodure sud de la plate-forme d'évaporites-roches carbonatées, au contact de celle-ci avec le continent. Les couches sont de type margino-cratonique et on y relève au moins un hiatus majeur.

Les roches du Silurien supérieur et du Dévonien inférieur contiennent beaucoup de matériaux terrigènes aux environs du soulèvement de Boothia, mais elles sont essentiellement carbonatées dans la région de la plate-forme. Ces différences témoignent de la surrection du soulèvement de Boothia, du plissement et de la fracturation des roches de couverture au cours du Silurien tardif et du Dévonien précoce, ainsi que de la mise au jour par érosion du noyau de roches cristallines. Quelques lambeaux d'érosion constitués de couches du Dévonien inférieur témoignent de la pénéplanation et de la submersion de ce noyau. Toutes les couches plus récentes qui auraient pu se déposer ont été érodées, sauf dans quelques rares lambeaux d'érosion où ont été conservés dans des grabens des unités du Crétacé supérieur et du Tertiaire. Dans la région, l'épaisseur des formations s'accroît du sud vers le nord.

Puisqu'elle affleure peu, la partie de la succession couvrant l'intervalle du Cambrien au Silurien inférieur a été relevée comme une unité non dénommée qui se compose de deux membres séparés par une discordance majeure. Des formations distinctes identifiées dans des îles au nord de la région d'étude, qui seraient corrélatives de l'unité non différenciée peuvent être distinguées dans les deux puits, mais ne peuvent être reconnues en affleurement. Le membre inférieur montre une épaisseur comprise entre 231 et 660 m. Il est composé en proportions variables de dolomie et de grès, et sa résistance à la météorisation est inégale. Le membre supérieur, qui affiche une épaisseur comprise entre 284 et 600 m, est constitué d'épaisses couches de dolomie uniforme et résistante. L'unité non différenciée est surmontée de la Formation de Cape Storm, d'une épaisseur comprise entre 50 et 100 m, qui est constituée d'une interstratification de dolomie silteuse et de calcaire argileux et silteux. Le long de la bordure ouest du soulèvement de Boothia, au contact immédiat de celui-ci, la Formation de Douro est l'unité sommitale de la plate-forme carbonatée. Cette formation, épaisse de 178 à 276 m, est constituée de calcaire fossilifère tacheté, disposé en couches épaisses. À l'ouest, le membre inférieur de la Formation de Drake Bay est un équivalent latéral de la partie supérieure de la Formation de Douro. Ce membre, formé d'une interstratification de dolomie et de calcaire, n'est présent que dans la partie nord de la région d'étude. Aucun affleurement de la Formation de Drake Bay n'a été examiné dans le cadre de la présente étude.

Le déroulement de la subsidence uniforme et de la sédimentation carbonatée sur une vaste étendue a été perturbé au Silurien tardif et au Dévonien précoce par l'orogenèse de Cornwallis, qui s'est traduite par un important soulèvement du socle et la déformation de la couverture sédimentaire sur le soulèvement de Boothia. Des débris synorégéniques ont été déversés dans des bassins synorogéniques formés au voisinage immédiat de culminations topographiques-structurales. Dans certains cas, ces bassins se sont formés sur des structures de même âge de la zone de plissement. Une partie de ces roches synorogéniques constitue la Formation de Peel Sound. Celle-ci comporte un membre inférieur de grès conglomératique et un membre supérieur de conglomérat. La Formation de Peel Sound n'a pas été examinée en détail dans le cadre de la présente étude.

La fabrique gneissique de direction nord observée dans les roches du socle a conditionné la forme générale du soulèvement. Le socle est recoupé par des failles et des fractures de directions nord-ouest, ouest et nord-est, qui ont participé à sa subdivision en de nombreux petits blocs partiellement indépendants les uns des autres. C'est pourquoi la partie frontale de la zone de plissement et de chevauchement est remarquablement hétérogène à l'échelle locale, même si cette zone s'étend de manière continue sur 500 km en adoptant une géométrie uniforme à vergence ouest. Les blocs affichant une géométrie uniforme propre présentent rarement une dimension longitudinale supérieure à 10 km, et quelques blocs montrent une longueur de tout au plus 2 km.

Le déplacement net du soulèvement de Boothia est dans l'ensemble assez faible. La plupart des failles sont fortement inclinées vers l'est, mais certaines failles à faible pendage se sont formées pendant les nombreuses étapes où s'est produit un mouvement. Des corrélations établies à partir de données cartographiques indiquent que les déplacements associés à une faille donnée dépassent rarement plus de 3 km. Le raccourcissement maximal dans toute la bande de structures frontales ne dépasse pas plus de 7 km. Il est toutefois peu probable que le déplacement total déduit des observations de surface rendent compte fidèlement du déplacement total d'un côté à l'autre de la zone frontale. Bien que la plupart des failles présentent un fort pendage à la surface, il est possible que la majeure partie d'entre elles deviennent listriques à des profondeurs relativement faibles, selon ce que nous révèlent des indices sismiques limités, mais ce que ne nous permet pas de confirmer les observations de terrain puisque le niveau d'érosion est le même dans toute la région d'étude. Les données sismiques permettent aussi d'identifier la présence probable de chevauchements non affleurants, ainsi que l'existence d'une géométrie en rampes et plats, ce qui accroîtrait la valeur des estimations. En outre, le soulèvement comporte des chevauchements internes. Le déplacement cumulatif total varie sans doute le long du soulèvement segmenté, mais il apparaît probable qu'il puisse atteindre environ 10 à 20 km dans la partie centrale de la région d'étude et qu'il décroisse vers le nord et vers le sud.

L'orogenèse eurékienne de l'Éocène-Oligocène a touché surtout la partie nord-est de l'archipel Arctique et entraîné la réactivation de structures dans les zones de plissement du Silurien tardif et du Dévonien précoce de l'orogenèse ellesmérienne plus ancienne.

Le potentiel en hydrocarbures de la région d'étude et de la région couverte par les levés sismiques ne semble pas prometteur pour l'instant. Cependant, la quantité de données recueillies sur la stratigraphie en profondeur est limitée. Le potentiel en minéraux métalliques y serait également peu élevé.

INTRODUCTION

Description of report area

The report area is situated in the south-central part of the Arctic Islands (Fig. 1) and comprises the northeastern part of Prince of Wales Island and smaller, adjacent islands, six of which have been named. The largest of these are Russell, Prescott, and Pandora islands. The area covers the eastern parts of NTS map sheets 68D (Baring Channel) and 68A (Fisher Lake). The two partial map sheets are contained in the pocket of this report.

The seaways to the north and to the east of the report area are Barrow Strait and Peel Sound, respectively. There are no occupied settlements in the area. At Sherard Head (see Fig. 2 for locations) an abandoned Inuit village and a graded airstrip are present. Allen Lake to the northwest of Sherard Head is a popular fishing destination for Inuit from Resolute and Grise Fiord.

Most of the report area is part of the Banks-Victoria geomorphic region of the Arctic Platform (Dawes and Christie, 1991). The parts underlain by Precambrian rocks are included in the Boothia Upland, which is part of the Canadian Shield. The Banks-Victoria Region is an area of plateaus and low-lying land. The land surface lies at various elevations (Fig. 3) and wide areas are characterized by glacial landforms and by marine strandlines. The highest elevation in the area is about 410 m, southwest of Cape Hardy. It is part of a chain of summits that extends southward beyond Young Bay, where most elevations are in the range of 300 m. West of these summits is a plateau area ranging from 100 to 250 m in elevation (Fig. 4). West of the head of Browne Bay and south of Crooked Lake an extensive lowland area of small lakes and glacial drift is present.

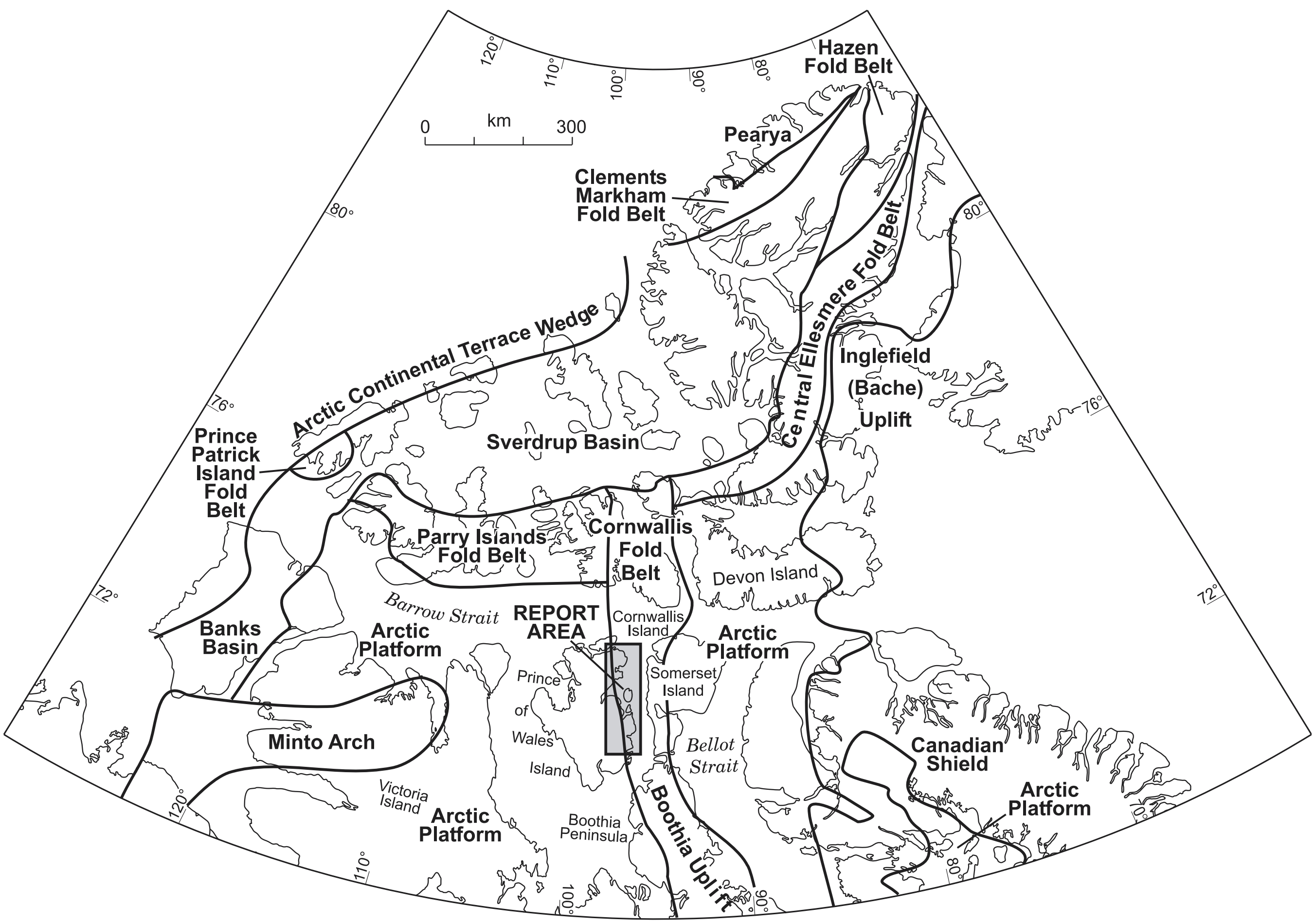


Figure 1. Index map of the Canadian Arctic Islands, showing the location of the report area and tectonic regions.

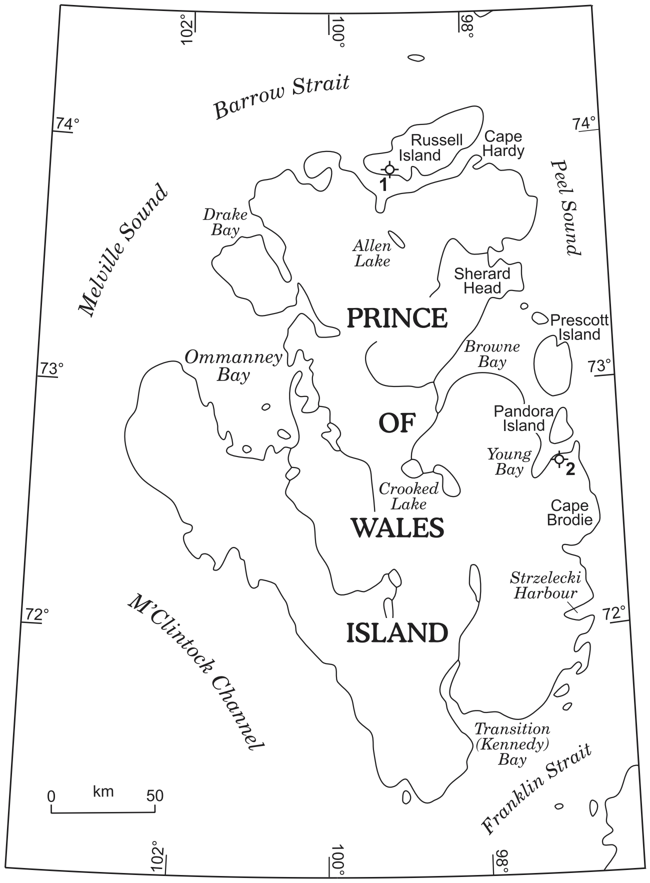


Figure 2. *Map of the Prince of Wales Island area showing well locations: Well location 1 on Russell Island is the Sun Panarctic Russell E-82 well; well location 2 at Young Bay (south of Pandora Island) is the KMG Decalta Young Bay F-62 well.*

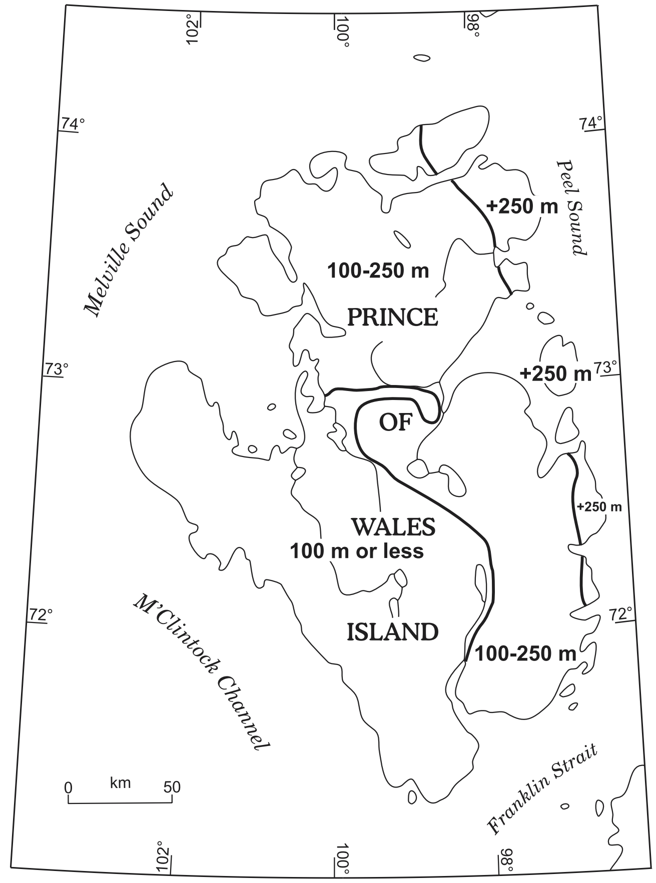


Figure 3. *Generalized map of maximum elevation ranges on Prince of Wales Island. The highest elevations are on the east side, where most of the area is underlain by the crystalline and intrusive rocks of the Boothia Uplift and resistant Peel Sound conglomerate facies.*

History of geographic and geological exploration

The coastlines of northern Prince of Wales and the adjacent smaller islands were mapped and explored by the crew of one of the Franklin search expeditions under the command of Captain H.T. Austin. Four ships wintered between Cornwallis and Griffith islands on the north side of Barrow Strait, and in the spring of 1851 the northern coast of Prince of Wales Island was examined for traces of the lost expedition. Travelling by sledge, Captain Erasmus Ommanney of the ship *Assistance* mapped the north coast of Russell Island and Prince of Wales Island as far west as Ommanney Bay (Ommanney, 1852), while Lieutnant W.H. Browne of the *Resolute* surveyed the western shore of Peel Sound as far south as Pandora Island (Browne, 1852). The coast south of Pandora Island was mapped by William Kennedy and Captain F.L. M'Clintock and their crews; both men were leading privately financed search expeditions.

Kennedy, after wintering with the *Prince Alber*t during 1851 and 1852 at Batty Bay on the east side of Somerset Island, crossed Peel Sound from Bellot Strait and mapped the area around Transition (Kennedy) Bay in the spring of 1852 (Kennedy, 1853). From there he crossed the island to the head of Ommanney Bay and back to Browne Bay.

Captain Leopold M'Clintock wintered with the *Fox* in Port Kennedy at the east side of Bellot Strait during 1858. During the spring of 1859 Captain Allan Young of the *Fox* surveyed all of southern Prince of Wales Island and connected with Browne's southernmost point on Pandora Island. As a result of the M'Clintock expedition, the questions revolving around the disappearance of the Franklin expedition were finally answered when written records were found in a cairn on northern King William Island (M'Clintock, 1859). The two ships of the Franklin expedition had come south through Peel Sound and were

Figure 4. *Photograph of coastal area, northeast Prince of Wales Island. View is to north from Cape Briggs. Stratigraphic Section 186 was measured in the hill slope facing the ocean in the distance (GSC photo no. 4738-1).*

abandoned by the crews in the spring of 1848, after having been beset in the ice since the fall of 1846 near the northern tip of King William Island.

M'Clintock's (1859) narrative contains, as an appendix, the first geological map and description of the Arctic Islands (Haughton, 1859), based on M'Clintock's collections and other information collected during the Franklin search. Prince of Wales Island was mapped as consisting of "granitoid rocks" along its eastern margin and of "Silurian limestone" on the rest of the island. Red sandstone (presumably the Peel Sound Formation) was reported to overlie the limestone. A fossil collection with long-ranging corals, probably from the Douro Formation, was collected by Captain Young at the head of Young Bay.

Geological exploration resumed about 100 years later, with Operation Franklin of the Geological Survey of Canada in 1955. However Prince of Wales Island was outside the main area of the operation, thus only a little fieldwork was done near Cape Hardy and, during a few helicopter landings, on other parts of the island (Thorsteinsson and Tozer, 1963). Operation Prince of Wales in 1962 was designed to fill the gap in reconnaissance mapping and covered a large area, which included Boothia Peninsula and Somerset, King William, and Prince of Wales islands. It resulted in a preliminary regional map and description (Blackadar and Christie, 1963), a description of the Precambrian geology (Blackadar, 1967), section descriptions and definition of new formations by Christie (1967, 1973), and a tectonic interpretation of the Boothia Uplift and the Cornwallis Fold Belt by Kerr and Christie (1965).

The next effort of the Geological Survey of Canada was in 1971, and was concentrated on the Prince of Wales area only (Christie et al., 1971a). Results of that fieldwork were an open file release of six geological maps (Christie et al., 1971b), and a regional correlation of Silurian and Devonian formations by Thorsteinsson and Uyeno (1980), which included several biostratigraphic logs for sections on Prince of Wales Island.

W.F. Fahrig of the Geological Survey of Canada, accompanied by D.L. Jones, sampled the diabase sill in the Aston Formation near Savage Point, Prince of Wales Island, for paleomagnetic analysis in 1976 (Jones and Fahrig, 1978).

Researchers from the University of Ottawa, who had been active in the Boothia Uplift area since 1964, started work on Prince of Wales Island in 1966 (Broad et al., 1968). Subsequently Miall produced a number of papers on the Peel Sound Formation (Miall, 1969, 1970a, b). Dixon, also from the University of Ottawa, examined the Cambrian to lower Silurian part of the succession (Dixon, 1973a, b, 1975, 1978) on the western and eastern sides of the Boothia Uplift. Work on the Precambrian rocks of eastern Prince of Wales Island by the University of Ottawa group was relatively detailed but confined to only two localities. Two structural traverses across the gneiss terrane of Somerset Island by R.L. Brown and I.W.D. Dalziel were extended in 1966 to the vicinity of Cape Brodie on Prince of Wales Island and to Prescott Island (Brown et al., 1969). In 1969, O.A. Dixon and associates discovered and mapped the exposures of the Aston Formation south of Savage Point (Dixon et al., 1971).

Other university-based research was by Ormiston (1967, 1969) and by Mortensen (1985; Mortensen and Jones, 1986, 1995), who examined in detail the upper Silurian and lower Devonian carbonate deposits. Ormiston (1967) described Lower and Middle Devonian trilobites in the Arctic Islands, including collections from the Drake Bay area on northwestern Prince of Wales Island. He also drew attention (Ormiston, 1969) to the presence of carbonate deposits equivalent or younger than the Peel Sound Formation exposed farther east. Mortensen (1985) described and interpreted in some detail the Upper Silurian carbonate exposed along the upturned edge of the Boothia Uplift. His unpublished thesis was also accompanied by a geological strip map at 1:100 000 scale for the area from Prescott Island in the north to just south of Strzelecki Harbour.

During the late 1960s and early 1970s there was a lot of interest in the Arctic Islands for oil and gas exploration, and most of Prince of Wales and Russell islands were covered by exploration permits. About half of these were held by Kerr McGee of Canada Northwest Ltd., who surrendered all acreage by 1977. The best parts of the other half of the acreage were eventually taken over by Panarctic and the Arctic Islands Exploration Group by 1976. Parts of this acreage were then selectively surrendered and the last permits were held in 1978 on northern Prince of Wales Island and on Russel Island. These were surrendered in 1979.

In the course of the hydrocarbon exploration a well was drilled on western Russell Island and another one at the head of Young Bay on Prince of Wales Island. Correlation of these wells was discussed by Mayr et al. (1980).

Present fieldwork and acknowledgments

The data used in this report come from a variety of sources – directly from fieldwork by Mayr, Frisch, de Freitas, and Okulitch, from interpretation of numerous seismic profiles by Brent, from examination of samples from the Russell Island and Young Bay wells, from unpublished field notes of J.Wm. Kerr, and from personal communications from R. Thorsteinsson.

During 1990 and 1992, while mapping the crystalline core of the Boothia Uplift, as exposed on northern Boothia Peninsula and southern Somerset Island, Frisch examined the Precambrian of the eastern coastal region of Prince of Wales Island (Frisch, 1993). In 1990, Frisch and his senior assistant, H.A.I. Sandeman, operating from a base camp on Somerset Island, conducted three one-day helicopter traverses along the coast. In parallel with one of these traverses, a foot traverse was run by Frisch on Prescott Island. In 1992, from July 8th to the 18th, Frisch worked the area, mainly on foot, between Savage Point and Flexure Bay on Prince of Wales Island and on Prescott Island. Additionally, aerial traverses were flown between Prescott Island and Strzelecki Harbour, Prince of Wales Island. Frisch acknowledges the assistance of H.A.I. Sandeman and junior assistants A. Sherman in 1990 and B. Paquin in 1992.

More recent fieldwork took place from July 19 to July 30, 1997 out of two small base camps at Cape Brodie and Sherard Head. The field crew consisted of geologists U. Mayr, T. de Freitas and A.V. Okulitch, with D. Beddell and R. Akeeagok as scientific assistants. Four all-terrain quadricycles were used for ground transportation. However the work was cut short by poor weather and injury to one of the participants. A critical section south of Cape Hardy, which might have provided information to substantiate statements in this report on the relationship between the Peel Sound, Drake Bay and Douro formations was briefly visited, but could not be examined in detail.

Invaluable logistical support was given by the Polar Continental Shelf Project in Resolute, and the authors thank base manager D. Malloley for his consistent help.

In addition to the fieldwork, the two wells in the area, on Russell Island and at Young Bay, were reexamined. The field data from 1997 are augmented with unpublished data of J. Wm. Kerr and G.S. Nowlan. The latter was supported for his thesis work in the field by J. Wm. Kerr in 1971.

In this bulletin the introduction was prepared by Mayr, the section on regional geology by Okulitch and Mayr and the lithostratigraphic part by Mayr, de Freitas, Frisch, and Brent. Conodont biostratigraphy was contributed by Nowlan and the structural part by Okulitch, Brent, and Frisch. The section on economic potential is by Mayr, Brent, and Okulitch.

Critical comments by D.G. Cook, J. Dixon, G.M. Ross and S. McCracken improved the geological interpretations considerably.

REGIONAL GEOLOGY

Introduction

The report area is situated in the south-central part of the Arctic Archipelago, straddling the western margin of the

Boothia Uplift and adjacent parts of the Arctic Platform (Fig. 1). The eastern part of the area is on the Boothia Uplift and is underlain by Proterozoic sedimentary rocks and Archean and/or lower Proterozoic crystalline rocks. The western part is underlain by very gently dipping lower Paleozoic formations of the Arctic Platform. A major, west-directed thrust zone separates the two areas. The term "Boothia Uplift" was originally used by Kerr and Christie (1965) for the crystalline rocks on Boothia Peninsula, Somerset Island, and the islands west of Peel Sound, and the term "Cornwallis Fold Belt" (op. cit.) was used for the folded cover rocks as far north as Grinnell Peninsula. In present usage (Trettin, 1991a and this report) "Boothia Uplift" includes both the crystalline rocks and the deformed cover rocks. The cover rocks occur as narrow belts east and west of the crystalline core and form all of the exposed northern part of the uplift.

The Precambrian rocks comprise three assemblages: an Archean and/or lower Proterozoic basement of granulite-grade metamorphic rocks (predominantly orthogneiss), its Mesoproterozoic cover of sedimentary rocks, and two suites of mafic igneous rocks of Meso-and Neoproterozoic ages. A distinct east-west change in the geophysical characteristics of the crystalline basement takes place across a line between the head of Le Feuvre Inlet and the centre part of Young Bay (referred to as the "Young Bay Line", see section on Precambrian structures). West of the line the basement appears to be characterized by a number of thrusted panels or other intense deformation. East of the line the basement appears as a mildly reflective panel dipping to the west no more than about 25°.

The Cambrian to mid-Silurian succession of the Boothia Uplift and Arctic Platform consists mostly of laterally uniform carbonate formations. The Upper Silurian and Lower Devonian rocks contain a large amount of terrigenous material in the vicinity of the Boothia Uplift, but consist of carbonate deposits in the platform region. This difference reflects the rise of the Boothia Uplift, folding and faulting of the cover rocks during the Late Silurian and Early Devonian, and erosional exposure of the crystalline core. Peneplanation and submergence of the core is recorded by a few outliers of Lower Devonian strata. All younger strata have been removed except rare outliers of Upper Cretaceous and Tertiary units preserved in grabens.

Summary of regional geological history

The crystalline core of the Boothia Uplift consists mainly of orthogneiss and paragneiss of Early Proterozoic and possibly older age, and of intrusive syenitic and granitic rocks. The bulk of the latter rocks was intruded during a major, high-grade, tectonothermal event at ca. 1.9 Ga (may be part of a northeastern extension of the Thelon Tectonic Zone, which bounds the eastern Slave Province, rocks of which are found in restricted amounts to the southwest on Victoria Island (Fig. 5).

Predominantly clastic strata of the Aston Formation were deposited unconformably on the crystalline rocks prior to the Mackenzie Igneous Event at 1268 Ma. The Aston Formation is correlated with the Fury and Hecla Group, the lower Bylot Supergroup and the lower Thule Supergroup. It may also be correlative with strata of the Elu, Thelon and Athabaska basins (ca. 1.7 and 1.27 Ga) and the Coppermine Homocline (sequence A of Young, 1979). Post-Mackenzie carbonate platform deposits of the Hunting Formation lie unconformably on the Aston and may correlate with middle carbonate deposits of the Bylot Supergroup and the uppermost group of the Thule Basin (sequence B of Young, 1979).

Given the poor constraints on the ages of units within these sequences, reliable correlations and reconstructions of an accurate and comprehensive geological history are premature. The Aston Formation appears to be locally derived from an ancestral Boothia Arch. Elsewhere, clastic rocks were deposited in several discrete basins at various times, possibly in response to distant orogenic events and then the doming and rifting that preceded the mantle plume of the Mackenzie Igneous Event. A western carbonate platform (Dismal Lakes Group) was disrupted by Mackenzie magmatism. Following that short-lived pulse, the platform, with local rift basins (e.g., Borden Basin, upper Thule Basin), was re-established over western Greenland, the Arctic Archipelago, and the northern mainland. Whether an ocean formed at the site of the plume after it subsided remains conjectural; all preserved later deposition was on continental crust. Subsequently (ca. 1.0–0.7 Ga), the westernmost Arctic (Shaler Supergroup) and possibly the Baffin Island and Boothia regions received detritus from the Grenville Orogen. The uppermost portion of the Hunting Formation on Somerset Island contains sandstone and siltstone, and major clastic components are interpreted from seismic data in the report area.

The Franklin Igneous Event (723 Ma), a second mantle plume that emplaced flows, sills, and dykes from the northern Cordillera to western Greenland marks the end of preserved Precambrian sedimentation. It was followed by regional uplift and peneplanation.

Lower Paleozoic rocks of the Canadian Arctic Archipelago form the Franklinian succession. In the report area the Franklinian succession is much thinner than elsewhere in the Archipelago, being situated near the southern, cratonal margin of the succession.

In contrast to to the Franklinian succession farther north, initial deposition took place as late as Late Cambrian with

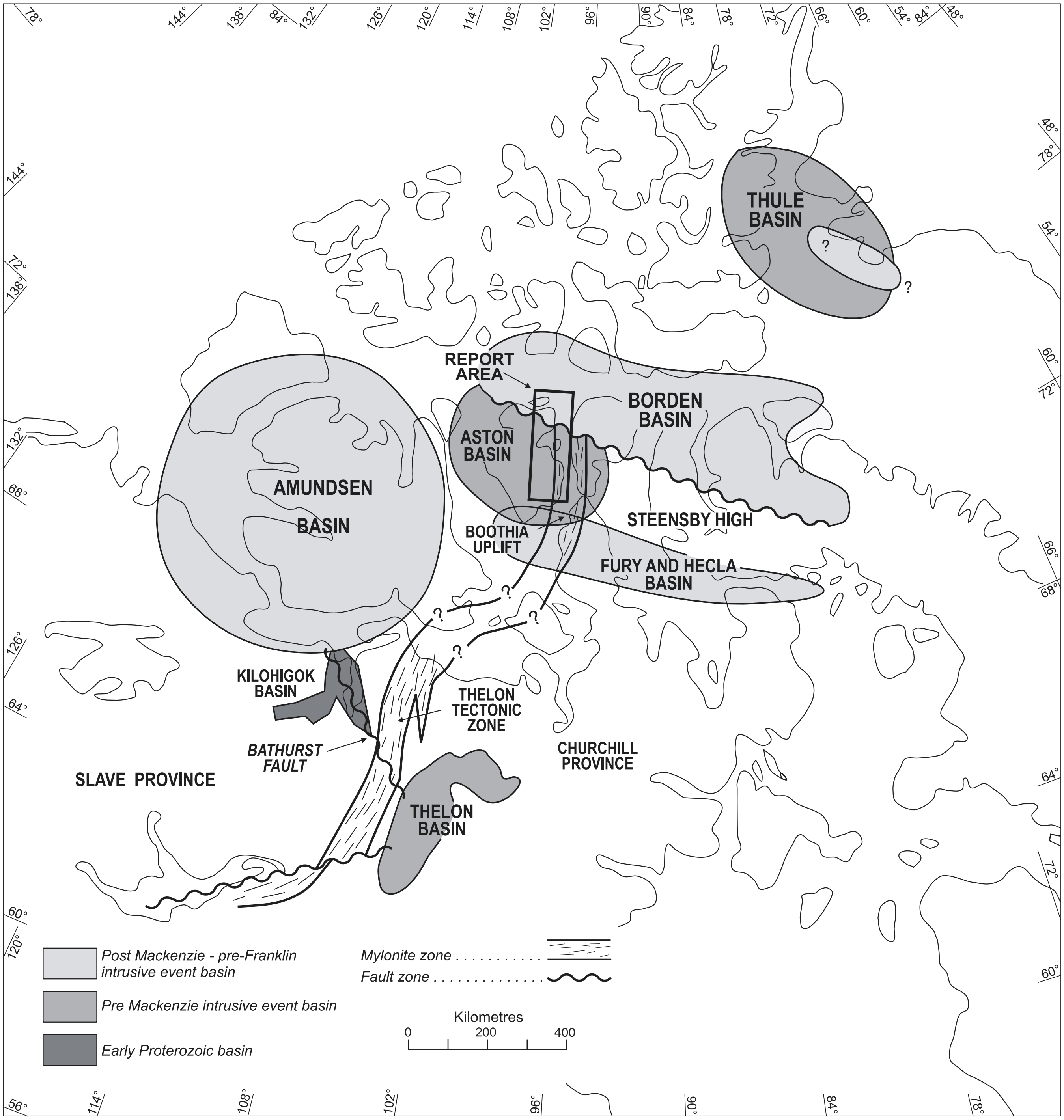


Figure 5. *Index map showing Proterozoic tectonostratigraphic elements of the Arctic Islands and adjacent mainland (modified from Campbell and Cecile, 1981; Jackson and Ianelli, 1981; Young, 1981; Hoffman, 1989; and Dawes, 1997).*

medium- and coarse-grained clastic rocks, followed by development of a carbonate shelf. Subsidence during the Ordovician was regionally uniform, and a thick salt-gypsum-carbonate sequence accumulated on a vast, highly restricted shelf. The report area is situated near the southward continental margin of this evaporite-carbonate shelf. The area retained its cratonic character throughout early and mid-Paleozoic time.

In Late Silurian and Early Devonian time uniform subsidence and regionally extensive carbonate sedimentation were disrupted locally by substantial basement uplift structures and deformation of the sedimentary cover in the south-central Arctic islands (Boothia Uplift) and on east-central Ellesmere Island (Inglefield Uplift; Smith and Okulitch, 1987; also known as the Bache Peninsula Arch). These tectonic events are called the Cornwallis Disturbance (Kerr, 1977). They may be linked kinematically to distant stresses generated by continent-continent collision and formation of the East Greenland Caledonides (Okulitch et al., 1986). In the central Arctic islands, intraplate compression caused folding and faulting, principally along northerly trends, to form the Boothia Uplift, including its northern part on Cornwallis Island and Grinnell Peninsula, the Cornwallis Fold Belt (Fig. 1). Synorogenic detritus was shed onto areas adjacent to topographic-structural culminations in several synorogenic basins, which in some cases developed on contemporary structures of the fold belt. The Cornwallis Disturbance affected only the Boothia and Bache Peninsula/Inglefield uplifts and immediately adjacent areas. Elsewhere in the Arctic Platform and the Franklinian Shelf and Basin, sedimentation was continuous and unaffected by these tectonic events.

Carbonate deposits continued to accumulate on a subsiding platform until about late Emsian time. The Franklinian succession was folded during the latest Devonian and earliest Carboniferous Ellesmerian Orogeny. Large, gentle, west-trending folds were formed north of the report area, but the preexisting, north-trending structures of the Cornwallis Fold Belt were only slightly cross-folded and the rocks in the report area were probably not affected.

The Eocene-Oligocene Eurekan Orogeny primarily affected the northeastern part of the Arctic islands, and reactivated structures in the older Ellesmerian and Late Silurian-Early Devonian fold belts. Although there are no obvious Eurekan structures in the report area, several grabens with Tertiary fill are preserved in the Boothia Uplift, the largest immediately east of the report area on Somerset Island. These are bounded by faults associated with regional extension in the eastern Arctic Archipelago (Okulitch and Trettin, 1991).

The rocks in the report area belong to three major successions separated by regional angular unconformities; the successions consist of Archean and Paleoproterozoic gneiss, of Proterozoic sandstone and dolostone, and of lower Paleozoic carbonate deposits, sandstone, and conglomerate (Table 1). The western margin of the Boothia Uplift is formed by a zone of west-directed thrusts and overturned folds and the majority of lower Paleozoic rocks are exposed in the upturned footwalls of these structures along river cuts. The Precambrian and basal lower Paleozoic rocks are variably well exposed in the hanging wall. The flat country immediately west of the upturned beds is covered mostly by glacial till (see Dyke et al., 1992) and void of any significant exposures.

Table 1
List of formations and stratigraphic units

Age	Formation	Thickness (m)	Lithology
Devonian	*PEEL SOUND FM: conglomerate facies*		*conglomerate (not examined)*
	unconformity		
	PEEL SOUND FM: sandstone facies	460	*sandstone, interbedded with carbonate and conglomerate*
	unconformity		
Silurian	*DRAKE BAY FM (lower member)*	0 - 500?	*dolostone and limestone (not examined)*
	DOURO FM	178 - 277	*mottled and argillaceous limestone*
	CAPE STORM FM	51 - 166	*silty dolostone and limestone*
Ordovician	*Unnamed unit: upper member*	315 - 402	*thick-bedded dolostone*
	unconformity		
Cambrian	*Unnamed unit: lower member*	231 - 316	*variable dolostone and dolomitic sandstone*
	unconformity		
Neoproterozoic/ Mesoproterozoic	Franklinian Igneous Event		
	HUNTING FM	0 - 6000*	*dolostone and sandstone*
	Mackenzie Igneous Event		
	ASTON FM	0 - 1300*	*sandstone*
	unconformity		
Archean and/or Early Proterozoic	*Crystalline basement*		*gneiss*

* Estimates of maximum thickness are based on seismic data

PRECAMBRIAN ROCKS

Exposures of the Precambrian in the study area are confined to the east coast of Prince of Wales Island and smaller islands between Back Bay and Transition Bay. The Precambrian rocks comprise two assemblages: Archean and/or lower Proterozoic metamorphic rocks, and Mesoproterozoic-Neoproterozoic sedimentary and mafic igneous rocks. The metamorphic rocks form a basement (not exposed north of Prescott Island) on which the sedimentary strata were deposited. Emplacement of dykes and sills of diabase followed.

The following account deals only with the Precambrian rocks between Prescott Island and Strzelecki Harbour (north of Transition Bay).

PRECAMBRIAN METAMORPHIC ROCKS

Rock types

The crystalline terrane consists predominantly of dark-weathering, granitoid gneiss metamorphosed in the granulite facies. The larger areas of gneiss, such as eastern Prescott Island and the tract between Flexure Bay and Cape Brodie on Prince of Wales Island, have been eroded to a rocky plateau dotted with small lakes and ponds and bordered by 200 m high seacliffs. The remarkably constant, northerly striking, steeply dipping gneissic foliation is reflected in the northerly trend of the coastline and of the thrust (high-angle reverse) faults that separate the Precambrian and Paleozoic rocks. The scarcity of distinctively coloured and weathered metasedimentary rocks renders the recognition of major structures (such as the large, plunging folds on Somerset Island) in the gneiss difficult. Certainly the gneiss terrane, from Prescott Island to Strzelecki Harbour, a distance of some 100 km, appears broadly uniform in both structure and lithology.

A typical outcrop comprises dark-weathering orthopyroxene tonalite-granodiorite gneiss (or its retrograde equivalent) containing layers, 1–2 m thick, of white- or pink-weathering granite gneiss. The light gneiss is greatly subordinate to the dark gneiss. Quartz lenticles, up to 1 cm long, characterize both rock types and define the gneissic foliation. The appearance of typical gneiss in outcrop is depicted in Figure 6a, b and c.

In thin section, both rock types display textures characteristic of highly strained granulite facies rocks. The rocks are markedly inequigranular. A few large (1–2 mm) grains of feldspar or a ferromagnesian mineral, with undulose extinction and curved twin lamellae, and abundant quartz lenticles or ribbons are set in a fine-grained granoblastic matrix containing trains of mineral grains paralleling the quartz lenticles and representing the comminuted remnants of the larger grains. The quartz lenticles themselves consist of chains of grains, differing in optical orientation. Although plagioclase is the predominant feldspar phase in the tonalitic gneiss, K-feldspar is invariably present and becomes the major feldspar mineral in granite gneiss. Even in the tonalite gneiss, microcline occurs commonly in fine-grained quartzofeldspathic aggregates that probably represent recrystallized mylonite or crush zones. Microcline content increases with increasing retrogression. In fresh tonalite gneiss, the major ferromagnesian mineral is orthopyroxene, weakly pleochroic in pink. It is commonly accompanied by minor amounts of nut-brown or reddish biotite (or phlogopite), less commonly by clinopyroxene, and rarely by garnet. Orthopyroxene (or its alteration products) is rarely present in the granite gneiss but locally, particularly in leucocratic varieties, garnet occurs and may be the only ferromagnesian silicate mineral.

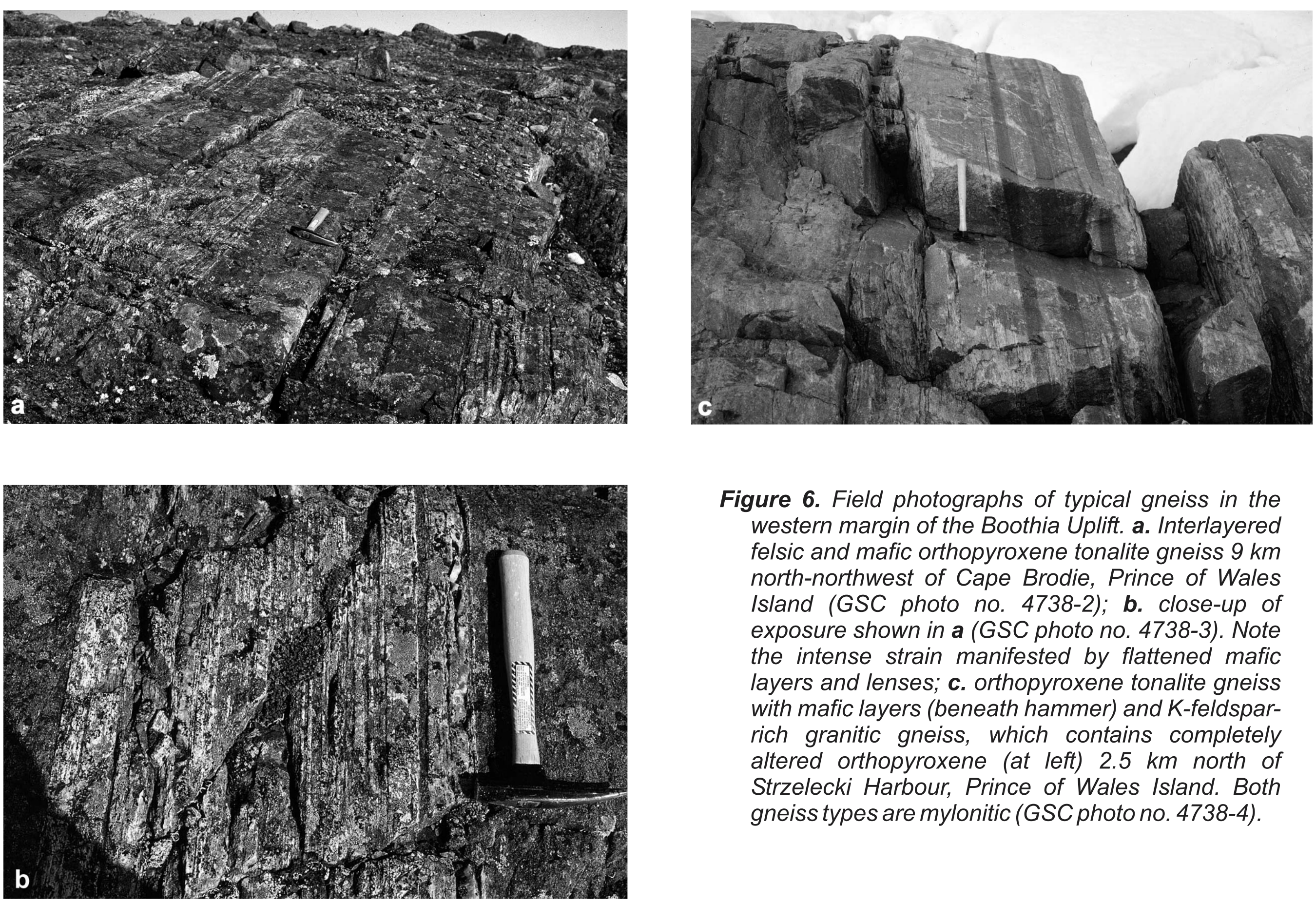


Figure 6. *Field photographs of typical gneiss in the western margin of the Boothia Uplift.* ***a.*** *Interlayered felsic and mafic orthopyroxene tonalite gneiss 9 km north-northwest of Cape Brodie, Prince of Wales Island (GSC photo no. 4738-2);* ***b.*** *close-up of exposure shown in* ***a*** *(GSC photo no. 4738-3). Note the intense strain manifested by flattened mafic layers and lenses;* ***c.*** *orthopyroxene tonalite gneiss with mafic layers (beneath hammer) and K-feldspar-rich granitic gneiss, which contains completely altered orthopyroxene (at left) 2.5 km north of Strzelecki Harbour, Prince of Wales Island. Both gneiss types are mylonitic (GSC photo no. 4738-4).*

In strongly retrograded tonalite and granodiorite gneisses, which are extensively developed, orthopyroxene has been completely replaced by a fine-grained intergrowth of indeterminate composition but probably consisting of mica and chlorite. In such rocks, plagioclase may be extensively sericitized but microcline and garnet have remained relatively fresh.

The relative ages of the tonalite and granite gneisses are unknown. Contacts are concordant, but this may be the result of deformation because both rock types clearly were deformed together, as is the case in the Boothia-Somerset terrane (Frisch and Hunt, 1993). Thin felsic veins extend from granitic layers and crosscut the tonalitic-granodioritic gneiss but still show at least a weak foliation. Although this may indicate that the granitic gneiss is younger than the tonalitic gneiss, the veins may simply represent mobilization of material during waning deformation and metamorphism.

Mafic tonalite gneiss and pyribolite (metabasaltic rock composed mainly of pyroxene, hornblende and plagioclase) occur locally as layers within the felsic gneisses, but no large mafic bodies and no ultramafic rocks were seen. The mafic rocks generally contain both ortho- and clinopyroxene and hornblende. The pyroxene generally appears fresh and evidence of retrogression is not as common as in the felsic gneisses. However, amphibolite bodies, present locally, presumably represent retrograded pyribolite.

Only minor amounts of metasedimentary rocks have been recognized but are widespread in the crystalline terrane, typically forming intercalations a few tens of metres wide in the granitoid gneiss. They are commonly migmatitic, locally rusty-weathering, garnet- and biotite-rich paragneiss; their counterparts occur in abundance on Somerset Island and Boothia Peninsula. Chief minerals are pink garnet, red-brown biotite, plagioclase, perthite, and quartz; needles of sillimanite and partly pinitized cordierite may also be present.

Retrogression of gneiss is particularly pronounced adjacent to the Precambrian-Paleozoic fault contact on Prescott Island. There, the gneiss is brick-red, as a result of extensive alteration of plagioclase and, to a lesser extent, perthite, to dusty hematite and sericite. The ferromagnesian minerals are completely altered to fine-grained sheet silicates (such as biotite and chlorite) but the former presence of orthopyroxene can be inferred from grain shape and outline. Where foliation is weak, the rock resembles a red granite.

Near the Precambrian-Paleozoic contact south of Flexure Bay, gneiss is relatively fresh (only pyroxene is totally altered) but flinty and conchoidally fractured. Thin sections show that even the quartz lenticles have been mylonitized and reduced to fine-grained aggregates that merge with the surrounding even finer-grained matrix.

The nonconformity between the crystalline basement and the sedimentary rocks of the Proterozoic Aston Formation is well exposed on the coast 10 km north of Flexure Bay, at the base of the measured stratigraphic section (1A) of the lower Aston Formation. The nonconformity is also preserved at several locations on Prescott Island. No change in appearance of the gneiss is apparent toward the base of the sedimentary succession, and no regolith is preserved. At the Prince of Wales Island locality, basal conglomerate-breccia of the Aston Formation rests directly on fractured and sheared garnet leucogneiss. The gneiss is chloritized and otherwise altered along fractures but has remained a cohesive rock.

Metamorphic conditions

The presence of orthopyroxene in quartzofeldspathic as well as mafic rocks throughout the crystalline terrane indicates granulite-grade metamorphism. The occurrence of cordierite in metapelitic rocks signifies relatively low pressure, but because this mineral typically is a secondary product, in that it has overgrown garnet and sillimanite, it reflects a retrograde stage of the metamorphism. Temperature and pressure estimates derived from the mineral assemblage garnet-orthopyroxene-plagioclase-quartz are likely to more closely approximate peak metamorphic conditions. Three samples of rocks with this assemblage from a locality 4 km northwest of Cape Brodie were evaluated; mineral analyses are tabulated in the Appendix (Table A1). Temperatures and pressures calculated with the geothermobarometry program of Fonarev et al. (1991) are approximately 750°C and 0.5–0.6 GPa. These values fall in the lower part of the pressure-temperature range determined for a larger suite of rocks from the central Boothia Uplift in the Boothia-Somerset terrane (Kitsul et al., 2000); that is, they are indicative of a similar crustal level.

Age

The only isotopic age available was determined on zircon from a mylonitic, two-pyroxene tonalite gneiss from Strzelecki Harbour, Prince of Wales Island (Frisch and Hunt, 1993), on the western side of the Boothia Uplift. The rock contained two distinct populations of zircon grains, low in uranium; nine zircon fractions were analyzed. Six fractions, with a range of discordance, define a discordia with an upper intercept at 2320 ± 30 Ma, which Frisch and Hunt (1993) tentatively interpreted as the time of protolith crystallization. The other three fractions are not collinear and two of them suggest the presence of an older component (Frisch and Hunt, 1993).

U-Pb isotopic data from the Boothia-Somerset terrane indicate crystallization of orthogneiss protoliths occurred in the Paleoproterozoic as early as 2.48 Ga and as late as ca. 2.2 Ga. Granulite-grade metamorphism and magmatism (probably related) took place in the interval between 1.94 and 1.92 Ga. Although some of the rocks undoubtedly have an Archean history, the gneissic core of the Boothia Uplift may represent a northern extension of the Thelon Tectonic Zone of the mainland (Frisch and Hunt, 1993).

Seismic expression

Seismic data from the Young Bay area (Fig. 19) reveal much coherent reflection energy arising from within the basement metamorphic complex. Velocity and density contrasts within this complex are assumed to exist along compositional layering (e.g., marble and mafic layers within the gneiss). The exact nature of the reflecting interfaces is not known. Surface exposures of the basement on eastern Prince of Wales Island do not exhibit such compositional layering. However, this is a relatively narrow outcrop belt parallel to regional strike, and is not necessarily representative of basement rocks farther west. Exposed basement complex in the Somerset-Boothia area includes rock types such as marble and to a lesser extent amphibolite and pyribolite. Rock densities of some closely related rock types elsewhere are known to vary significantly; for example, the orthopyroxene-free (2.73 gm/cc) and orthopyroxene-bearing (2.93 gm/cc) granulites in Lapland (Daly et al., 1966). The gneisses of the Boothia uplift are analogous. Seismic reflectivity is dependent on variables such as wave frequency, sharpness of contacts, and thickness of compositionally variable layers. The moderate reflectivity of the basement complex in the subsurface of Prince of Wales Island suggests reasonably sharp contacts between acoustically variable layers at least tens of metres thick.

PRECAMBRIAN SEDIMENTARY FORMATIONS

Aston Formation

Definition

Sandstone and minor dolostone and siltstone form the bulk of the Aston Formation, first described and named by Blackadar (1963) near Aston Bay on northern Somerset Island. No thickness was given in the original description. Subsequent reports give thicknesses in the order of 600 to 800 m (see Stewart, 1987).

The Aston Formation is overlain unconformably by the dolostone of the Hunting Formation.

Distribution, thickness, and contact relations

The formation occurs in isolated patches of variable size between Le Feuvre Inlet and Back Bay. The major occurrences are north of Flexure Bay and on Prescott Island. In the measured section (1A, 1B, Fig. 7, see Map 2016A for location), measured east of Young Bay on the coast of Prince of Wales Island, the Aston Formation rests nonconformably on gneiss, dips 30–35° SW, and is some 662 m thick. The measured section is described below and

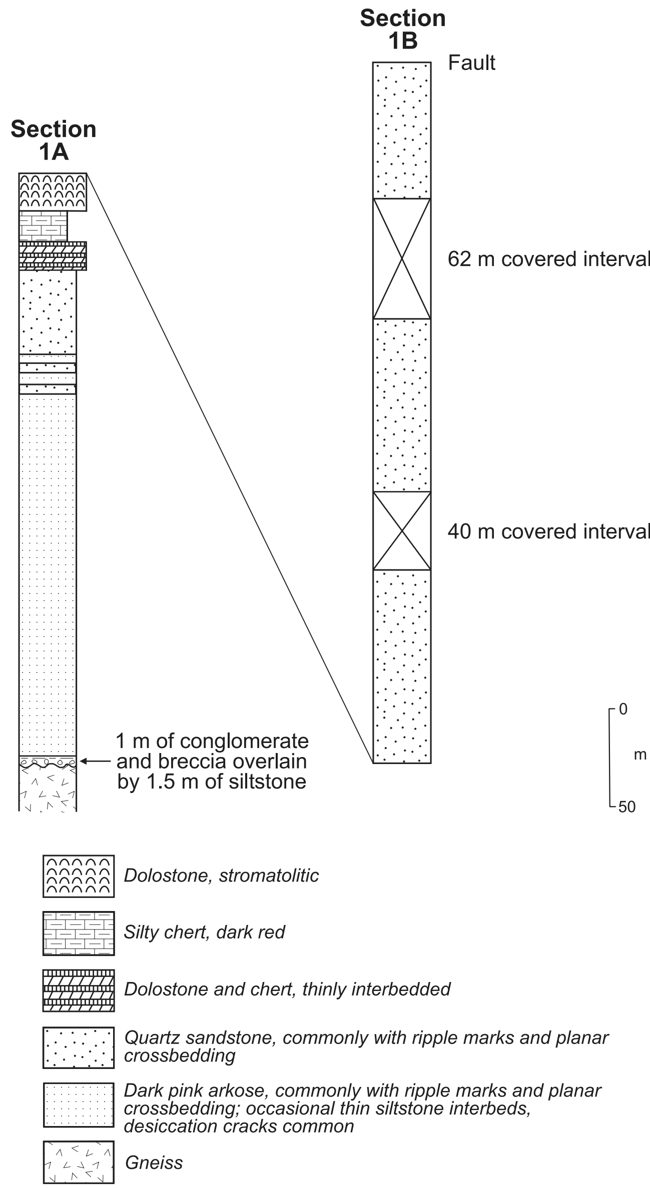


Figure 7. *Diagrammatic log of Aston Formation at stratigraphic sections 1A and 1B. See text for detailed description of rock types.*

further details of lithology may be found in Dixon et al. (1971), who described a section about 2 km along strike to the north and other occurrences of the Aston Formation south of Savage Point. Dixon et al. (1971) obtained a thickness of 798 m in the area of Section 1B; the greater thickness is attributable largely to a thicker succession below the dolostone-chert unit (364 m as against 251 m in Section 1A). Thus the formation appears to thicken northward.

The middle of the succession is occupied by a 200 m thick diabase sill. Originally considered to be a part of the formation (Blackadar, 1963); it is here considered a distinct unit.

Numerous exposures of conglomerate-breccia resting on gneiss on Prince of Wales and Prescott islands attest to the nonconformity between the Aston Formation and the crystalline basement. At or near the contact with the Paleozoic succession, as along the northern border of the Precambrian terrane on Prescott Island, the Aston Formation is faulted against gneiss. The upper part of the formation is in high-angle reverse fault contact with the Paleozoic strata and may be severely deformed. In central Prescott Island, Aston beds bordering the fault are overturned, dipping 30°E; farther south, the fault cuts through the sill, which intrudes the middle of the formation. At the southern end of the Precambrian-Paleozoic fault zone on Prescott Island, Aston strata and underlying gneiss are highly sheared and flattened. Indeed, the Aston sandstone and conglomerate is so deformed that locally it is not readily distinguished from the gneiss.

The Aston Formation density is measured as 2.65 gm/cc at the Young Bay F-62 well. Paleozoic rocks (density 2.90 gm/cc) overlie the Aston Formation there and provide a sharp acoustic contrast as illustrated on a synthetic seismogram (Fig. 8). Where the Aston is present in the subsurface it is underlain by gneiss of an expected density of 2.70 gm/cm**,** which suggests the Aston base will be a weak seismic reflector. Seismic data seem to bear this out; the base of the Aston Formation is not readily evident. Diabase sills (expected density 2.90 gm/cc) are known to be intruded into both the Aston Formation and basement gneiss, and could be expected to provide strong reflectors if hosted in either. Some strong discontinous and discordant reflectors have been interpreted as dykes and sills on seismic data (traverse K-K'; see Fig. 19 in section on structure and tectonics).

Seismic data at the Young Bay well show very weak reflections within the interpreted Aston Formation truncated beneath the Paleozoic cover, illustrating the sub-Paleozoic angular unconformity (traverse K-K'; see Fig. 19). The maximum Aston thickness interpreted in the subsurface is about 1300 m on line KM7234S sp. 50, traverse M-M', Figure 19. The reflectors within the Aston at this locality are interpreted to arise from the medial cherty dolostone marker and a sill possibly close to the base of the formation. If there is an appreciable sandstone unit below the interpreted sill, the Aston thickness could be up to several hundred metres greater. There is no obvious seismic expression of the Aston or its medial dolostone in the subsurface to the west or south of seismic line KM7234S (location map, see Fig. 19). If the Aston Formation does exist west or south under seismic coverage however, it is likely thin. Aston Formation has been speculatively interpreted on seismic data north of Browne Bay. A relatively thin unit of approximately 200 m (75 ms @ 5500 m/sec) thins to zero north and west along seismic traverse F-F' (Fig. 9, in pocket).

Rock types and internal stratigraphy

Section 1A has a total thickness of 301 m and begins at an elevation of 67 m above sea level, where a 2.5 m thick bed of reddish breccia and shaly siltstone rests on sheared and consequently weathered gneiss (Fig. 10a, b). The lower one metre of this unit comprises sedimentary breccia, in which the clasts are 5–10 cm across (the largest seen measured 20 cm) and consist of gneiss and white quartz. The matrix of the breccia is a brick-red, silty arkose with abundant millimetre-sized rock and quartz grains. Slightly more than one metre of brick-red, thin-bedded, shaly siltstone overlies the breccia. There follows a 206 m thick sequence of dark pink, flaggy arkose with occasional thin, silty interbeds and, near the top, some thin beds of yellow, more quartzose sandstone. In the measured section, the pink arkosic sequence is overlain directly by light-weathering, flaggy, quartz sandstone, 43 m thick. However, just north of the line of section, a resistant lens, less than 8 m thick, of pink, cherty-laminated dolostone, capped by 5 m of dusky pink siltstone, separates the arkosic and quartz sandstones. The dolostone weathers a pinkish grey and contains layers and laminae of dark red, argillaceous chert and cherty siltstone; the rock resembles some of that in the main dolostone-chert unit higher in the section.

The 43 m thick, light-coloured sandstone succession is divisible into four units of quartz sandstone, in order upward: very pale pink (4.5 m), pale yellow (14 m), very pale grey (7.5 m), and hematite-stained, yellowish pink (17 m). Ripple marks and planar crossbedding in sandstone and shrinkage cracks in silty and shaly rocks are seen throughout this 250 m thick succession.

At this point in the section the lithology changes abruptly with the appearance of a resistant, dolomitic-cherty unit, 45–50 m thick. The unit is better exposed 3 km along strike to the north and the following description is drawn from that locality. The unit may be divided into three parts: a resistant lower part, 16 m thick, comprising thinly interbedded pink to white dolostone and red chert (Fig. 11); a slightly

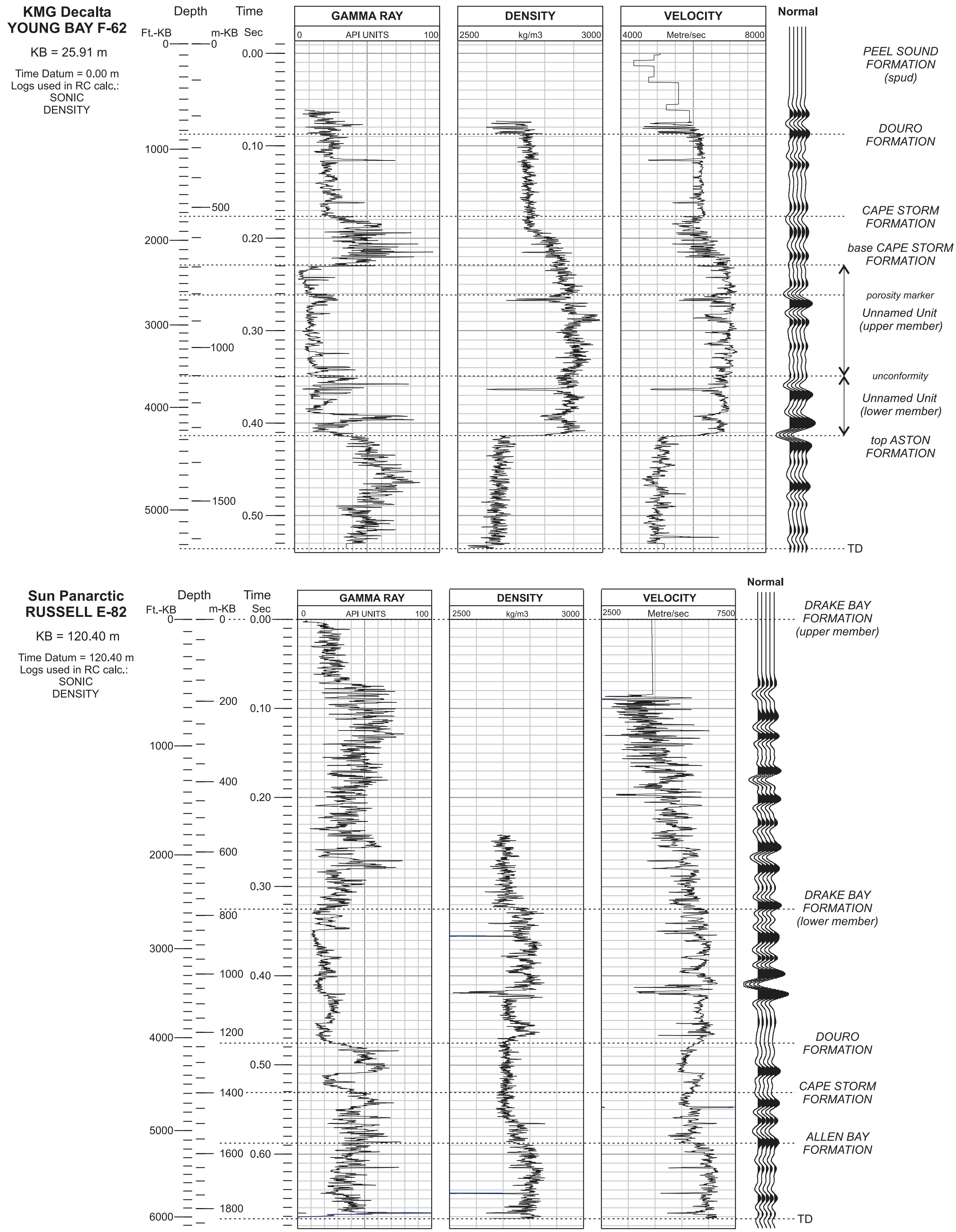


Figure 8. *Synthetic seismograms, gamma ray, density, and velocity logs of Young Bay F-62 and Russell E-82 wells.*

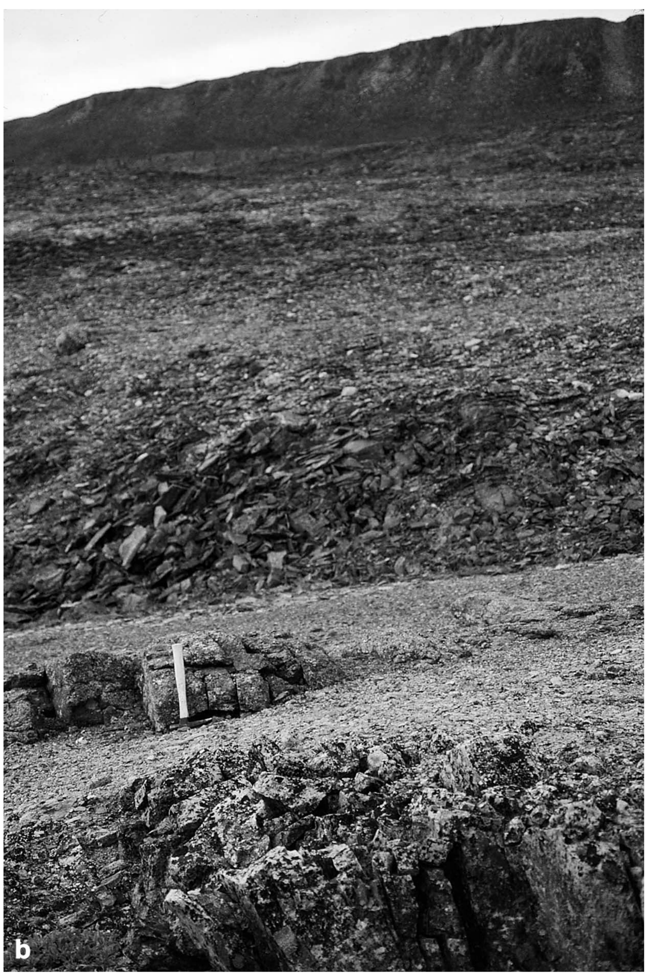


Figure 10. Field photographs of the Aston Formation 13.6 km south-southeast of Savage Point, Prince of Wales Island. Section 1A was measured at this location. ***a.*** *In the foreground, the unconformity at the base of the Aston Formation is visible as brick-red breccia-conglomerate overlying sheared gneiss just below the snow patches. The skyline is formed by the diabase sill that intrudes the middle of the formation; below lies the resistant dolostone-chert unit (GSC photo no. 4738-5).* ***b.*** *Close-up view of the unconformity. The head of the hammer rests on gneiss and the shaft leans against breccia-conglomerate, which is overlain by red, shaly siltstone. The slope beyond is underlain mainly by arkose and terminates in the resistant dolostone-chert unit. The diabase sill forms the cliff at the top (GSC photo 4738-6).*

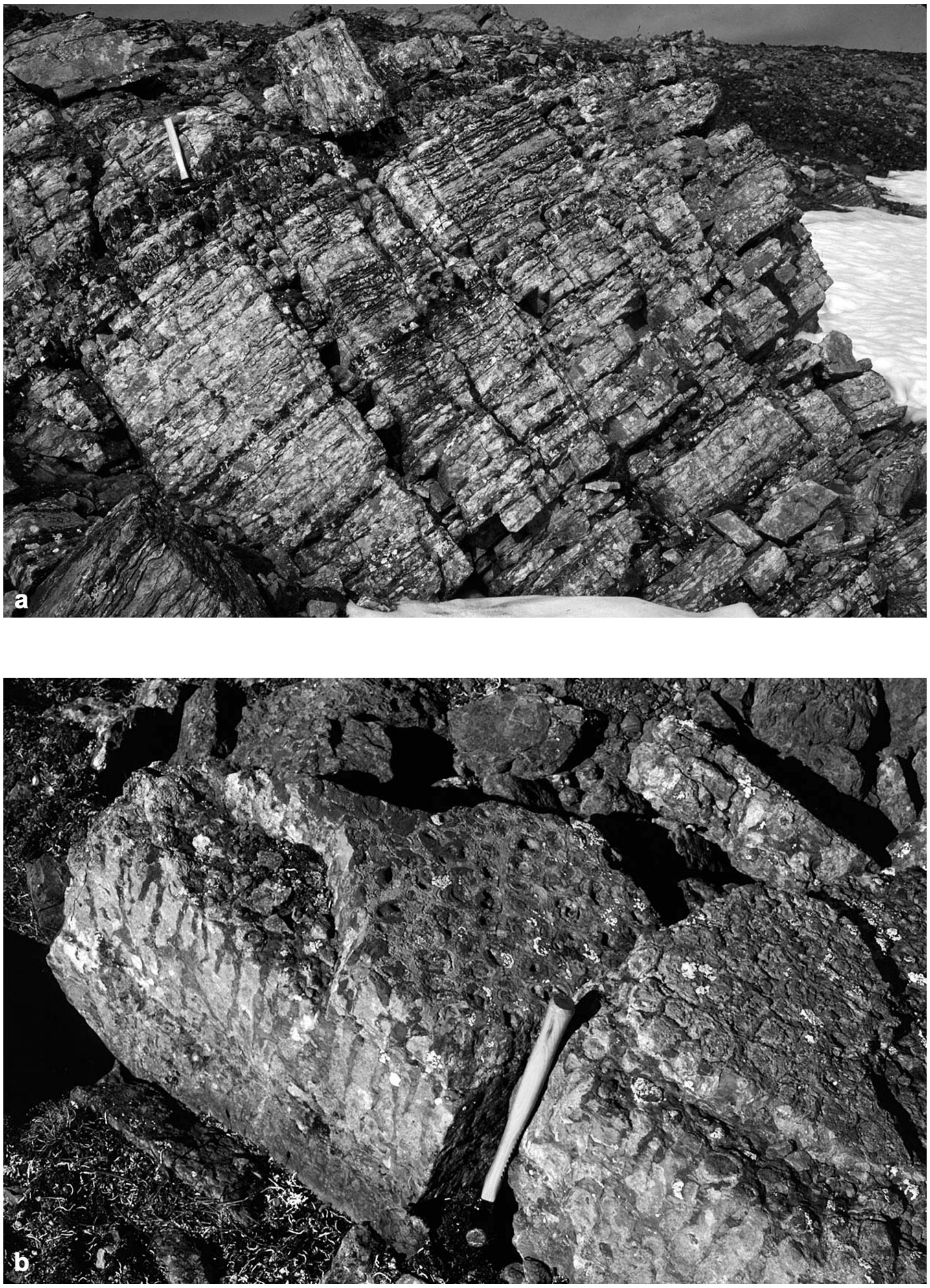


Figure 11. *Field photographs of the dolostone-chert unit in the Aston Formation, Prince of Wales Island.* ***a.*** *Interbedded dolostone and chert in the lower part of the unit, near the base of Section 1B, 10 km south of Savage Point (GSC photo no. 4738-7).* ***b.*** *Columnar stromatolites in the upper part of the unit, 2 km south of Savage Point (GSC photo no. 4738-8).*

recessive middle part, 15 m thick, consisting of dark red, silty chert; and an upper part, 18 m thick, consisting of resistant, pink and white, cherty-silty, stromatolitic dolostone. The stromatolites are the columnar type, forming both discrete and branching columns with circular to elliptical cross-sections and diameters typically of 3–7 cm, enclosed in silty dolostone (Fig. 11). The dolomitic unit and its stromatolites, as exposed at several localities north of the measured section (as far as Savage Point), have been described in some detail by Dixon et al. (1971). The unit can be traced, even if not well exposed everywhere, to the southern limit of the Aston Formation exposure on Prince of Wales Island. It also occurs on Prescott Island to the north and thus serves as an excellent marker bed in the Proterozoic sedimentary succession.

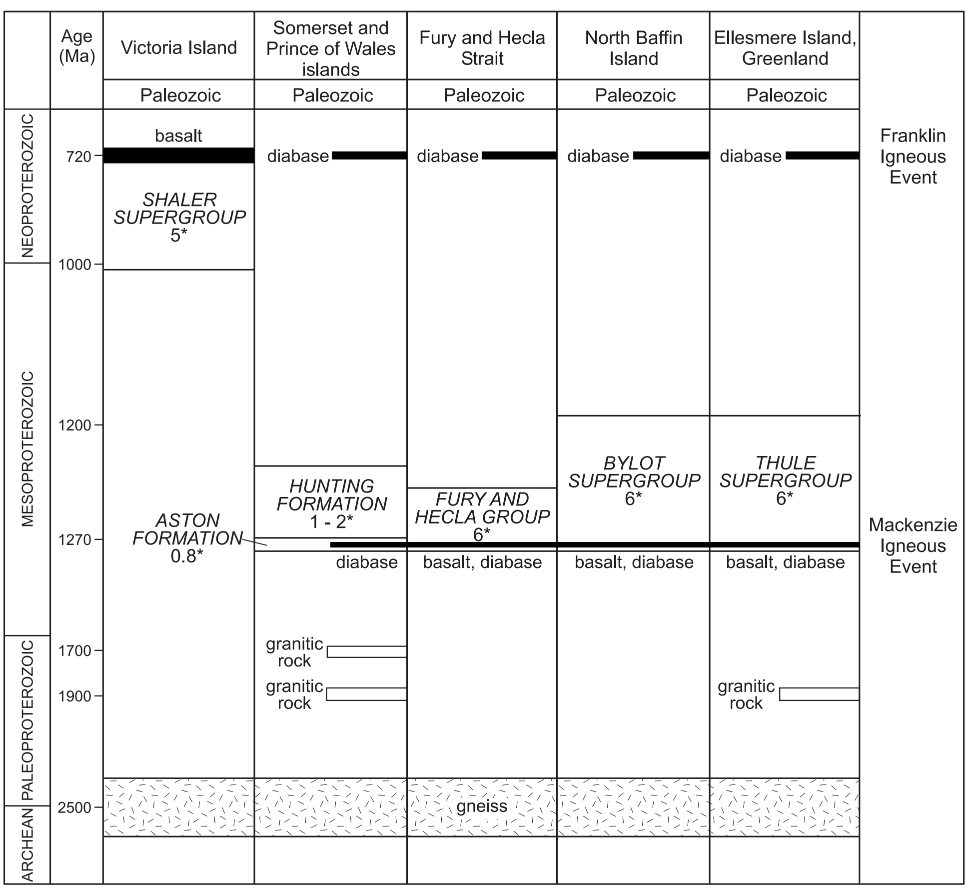
The line of the measured section was offset 3.2 km north and the section was continued (as Section 1B, Fig. 7) from the top of the dolostone-chert unit (at the locality described in the preceeding paragraph). The remainder of the succession is relatively poorly exposed (nearly one third is drift-covered) and consists of flaggy, medium-grained quartz sandstone, weathering pinkish yellow and locally ripple-marked and crossbedded. Its thickness of 361 m includes a 62 m thick covered interval formed by the drift-covered floor of the stream valley at the base of the Paleozoic succession. The stream essentially marks the trace of the high-angle reverse fault separating the Proterozoic and Paleozoic successions.

The Aston Formation was examined in central Prescott Island but exposure, topography and faulting are not favourable to accurate measurement of sections. What measurements were made indicate a thickness of sedimentary rock in excess of 1200 m, but this value must be considered very approximate. Nevertheless the Aston Formation apparently is thicker on Prescott Island than on Prince of Wales Island and the following evidence bears this out. A thickness of 6 m for the basal Aston conglomerate was measured at the base of the Aston Formation near the southernmost of the two east-west diabase dykes that cut the Precambrian rocks of Prescott Island. A thickness of approximately 450 m of sedimentary rock separates the basal conglomerate from the dolostone-chert unit. These thicknesses compare with 1 m and approximately 250 m, respectively, for the equivalent units in the measured section on Prince of Wales Island.

Age and correlation

The diabase sill in the Aston Formation intruded 1268 Ma ago during the Mackenzie Igneous Event (Table 2; see *Igneous Rocks* below) so the formation is at least middle Mesoproterozoic in age. The Aston Formation is correlated with unmetamorphosed, clastic, sedimentary successions, which include redbeds and basalt flows as well as sills of Mackenzie age, overlying crystalline basement on Baffin Island, southeast Ellesmere Island, and northwest Greenland (Frisch and Trettin, 1991). These are, on Baffin Island, the

Table 2
Correlation of Precambrian rocks in the Arctic Islands



*thicknesses in km

Nauyat and Adams Sound formations of the Bylot Supergroup (Jackson and Iannelli, 1981) and the lower units of the Fury and Hecla Group (Chandler, 1988), and, on Ellesmere Island and Greenland, the lower Thule Supergroup (Dawes, 1997). The maximum age of all these successions is considered to be Mesoproterozoic and unlikely to exceed ca. 1.3 Ga. The basal formations of the Bylot Supergroup, the Nauyat (basalt flows, subordinate sandstone and intrusive diabase) and the overlying Adams Sound (sandstone), have both yielded Mackenzie paleomagnetic poles and together record an episode of clastic sedimentation interrupted by basaltic volcanism around the time of the Mackenzie Igneous Event (Knight and Jackson, 1994). With a maximum thickness approaching 800 m, comparable to the approximately 1000 m aggregate thickness of the Nauyat and Adams Sound formations (Jackson and Iannelli, 1981), the Aston Formation is thought to have been deposited in approximately the same time interval.

Origin

Dixon et al. (1971) discussed the evidence for the Aston Formation’s derivation from a granitic terrain and its deposition in a shallow-marine environment. They further suggested that the deep red colour of many of the Aston rocks may be ascribed to iron oxide formed by postdepositional alteration of ferromagnesian minerals such as pyroxene, hornblende and biotite. These minerals are certainly abundant in the gneiss of the study area, and paleocurrent data suggest derivation from a local uplift (the margin of the Borden Basin or an ancestral Boothia Arch).

Hunting Formation

Definition

The name Hunting Formation was first used by Blackadar (1963) on northern Somerset Island for a succession of unfossiliferous dolostone, interbedded with minor shale and conglomerate. The Hunting Formation overlies the Aston Formation unconformably and is in turn overlain with angular unconformity by Cambro-Ordovician formations. Dixon (1974) provided a detailed description of the formation in the type area on northwest Somerset Island. It is between 1200 and 1400 m thick and comprises three members: a lower one (about 165 m thick) of variable sandy and dolomitic rocks; a middle one, about 600 m thick, of alternating dolostone and cherty dolostone; and an upper one, about 490 m thick, consisting of variable dolostone types.

During the 1997 fieldwork no surface exposures of the Hunting Formation were seen in the report area, and the term is here used for a thick subsurface unit, defined and subdivided on reflection seismic profiles.

Distribution, thickness, and contact relations

The Hunting Formation is not exposed on Prince of Wales and the adjacent smaller islands. The rocks in the outcrop reported by Miall (1969, p. 260, 261) north of Cape Brodie are assigned to the lower part of the Cambro-Ordovician unnamed unit. However, reflection seismic profiles indicate a substantial thickness of Hunting Formation in the subsurface and possibly other thin underlying and overlying units. These are present north of an approximately east-west directed line at the latitude of Sherard Head (73° 21'). An isochron map (Map 4, Fig. 9) illustrates the overall subsurface distribution of these strata which, below Russell Island, reach a maximum isochron of 2275 milliseconds. This converts to about 6200 m using an average velocity of 5.5 km/s. The faults shown on this map are largely of post-Proterozoic timing and are positioned at the base of the succession. To the south, the formation thins to a feather edge as a result of truncation below the Cambro-Ordovician unnamed unit (profile E-E', Fig. 9).

The lower contact is interpreted at a distinctive upward change from a generally unreflective and/or chaotic seismic character, to a reflective and coherent character. The stratigraphic nature of the contact is presumed to be an unconformity, with carbonate and minor sandstone resting on metamorphic basement rocks.

Internal stratigraphy, seismic character, and rock types

Three seismic stratigraphic subdivisions have been made in the Hunting Formation (profile F-F', Fig. 9): a lower unit, which is moderately to strongly reflective (PHs_1); a middle, generally unreflective unit (PHs_2); and an upper, variably reflective unit (PHs_3). The seismic expression of igneous intrusives are present in units PHs_1 and PHs_3, but generally absent from PHs_2.

Ten seismic velocity profiles shot using long receiver spreads in conjunction with the seismic acquisition (Appendix B), have provided average interval velocities used to estimate the thickness and constrain the dominant rock type of the three units described below.

The lower unit (PHs_1) is 675–1500 m thick at 6.3 km/s, and has strong internal reflectors. This reflective seismic character and relative high velocity is generally consistent with the stratigraphy of the exposed Hunting Formation described on Somerset Island by Dixon (1974). There, the lowest 1400 m are present, consisting mainly of various dolostones, interbedded with minor sandstone, conglomerate, shale and chert. This seismic unit is therefore correlated with that strata described on Somerset Island.

The middle unit (PHs$_2$) is generally a seismically unreflective unit, 756–1100 m thick at 5.5 km/s, and as such is though to be a relatively homogeneous rock type, probably a clastic lithology. This lithological interpretation is consistent with its relatively slow interval velocity and seismic character. The apparent lack of obvious intrusives in this sequence also supports the idea of homogeneity, in the sense that intrusives exist here largely as seismically unresolvable vertical dykes. This may be due to a lack of resistant bedding planes. The base of this unit appears to truncate the underlying unit (PHs$_1$), suggesting an unconformity (see Traverse F-F', Fig. 9).

The upper unit (PHs$_3$) has a maximum thickness of approximately 3600 m at 5.3 km/s. It appears moderately reflective but more so near its base and its uppermost portion and probably consists of various interbedded terrigenous clastic rocks. In contrast to the underlying sequence PHs$_2$, this unit displays a multitude of discontinuous and discordant strong reflections interpreted as igneous sills as illustrated on the northern part of profile E-E' (Fig. 9). The contact between this unit and the underlying unit (PHs$_2$) appears conformable and is based upon the upward change to a more reflective seismic character.

Age and correlation

On Somerset Island, the Hunting Formation rests unconformably on Aston Formation that is intruded by Mackenzie (1268 Ma) diabase and is itself cut by dykes intruded during the Franklin Igneous Event (723 Ma) (Stewart, 1987). Thus the formation's age is bracketed between 1268 Ma and 723 Ma. The geometry and nature of the sub-Hunting unconformity suggests that the time gap between the Hunting and Aston formations is not large (Dixon, 1974). Furthermore, the Hunting Formation can be closely correlated lithologically with the Society Cliffs Formation of the Bylot Supergroup in northwest Baffin Island, which, in turn, correlates with the Narssârssuk Group of the Thule Supergroup in northwest Greenland (Jackson and Iannelli, 1981; Dawes, 1997). All three units have disconformable lower contacts, but immediately underlying rocks in the Bylot and Thule supergroups have no equivalents in Somerset Island; presumably, they were removed by erosion (Stewart, 1987). The basal strata of both the Bylot and Thule supergroups are correlated with the Aston Formation (see above). The Hunting-Bylot-Thule correlation is also supported by carbon isotope data (Kah et al., 1999). The Bylot and Thule supergroups are believed, from isotopic, paleomagnetic and paleontological evidence, to have been deposited between ca. 1.3 and ca. 1.2 Ga (Samuelsson et al., 1999; Jackson, 2000; Sherman et al., 2000). Although correlation between the Hunting Formation and the Neoproterozoic Shaler Supergroup on Victoria Island cannot be ruled out, we consider it unlikely because of lithological dissimilarities and the probability that the Hunting is older than the Shaler, which has a maximum age of ca.1 Ga (Rainbird et al., 1997).

Origin

Dixon (1974) interpreted the Hunting Formation as a tidal flat complex.

PRECAMBRIAN IGNEOUS ROCKS

Unmetamorphosed igneous rocks in the study area consist of diabase, forming sills in the Aston Formation, and dykes that intrude both the Aston Formation and the crystalline basement. Two ages of diabase emplacement have been recognized in Somerset Island: Mesoproterozoic (Mackenzie Igneous Event) and Neoproterozoic (Franklin Igneous Event) (Stewart, 1987). The older intrusions cut the Aston Formation, the younger ones cut both the Aston and the overlying Hunting Formation (Stewart, 1987). It is not known if the sills and dykes west of Peel Sound are also of more than one age but the major sill in the Aston Formation on Prince of Wales Island has been dated at 1268 Ma (Mackenzie event; see below).

The sill intruding the middle of the Aston Formation on Prince of Wales Island is ca. 120–300 m thick (Dixon et al., 1971); along the line of Section 1A (Fig. 7) during the present work, a thickness of 203 m was measured. The sill is particularly well exposed south of Savage Point, where it forms a columnar-jointed cliff facing Peel Sound. Although generally concordant and lying above the dolostone-chert unit, the sill locally steps down through as much as 100 m of sedimentary strata to lie below the dolostone unit (as in the Savage Point peninsula). The petrography of the sill has not been examined in detail but the bulk of the body is an ophitic-textured, tholeiitic diabase consisting largely of clinopyroxene, orthopyroxene and plagioclase. The basal 8 m or so of the sill are ultramafic, consisting of heavily altered olivine, fresh orthopyroxene, a little brown biotite and a trace of interstitial plagioclase. Both the olivine and pyroxene appear to be cumulus crystals, the plagioclase is an intercumulus phase, and the biotite is probably a late deuteric mineral. In the course of their sampling for paleomagnetic studies, Jones and Fahrig (1978) collected not only from the ultramafic lower part of the sill but also from the upper part, which they found to be very coarse grained, hornblende-rich and granophyric at the southern end of the Savage Point peninsula. Interstitial, granophyric, red feldspar is conspicuous at the top of the diabase cliff south of Savage Point itself. Thus the sill is significantly differentiated.

The sill has caused considerable contact metamorphism in the Aston Formation, particularly in the dolostone-chert unit. North of measured section 1B (Fig. 7), where the sill cuts the carbonate unit, the dolostone and sandstone are strongly silicified over a distance of at least 90 m from the contact with the diabase. The siliceous dolostone in this contact zone contains layers and lenses of red chert and green andradite garnet (Dixon et al., 1971). On Prescott Island, ophicalcite, serpentinite veins and black aggregates of specularite are developed in the dolostone-chert unit near the igneous contact.

During the present work, diabase dykes were recognized on Prescott Island, on Prince of Wales Island south of Savage Point, and near Cape Brodie. The two easterly-trending dykes on Prescott Island are between 30 and 50 m thick and are bordered in the Aston Formation by baked zones approximately 10 m wide, in which the normally brick-red sandstone is purple, silicified and well cleaved. The diabase of the dykes is mineralogically and texturally indistinguishable from that forming the sill. The dykes on Prince of Wales Island to the south are generally similar but trend either northeast or northwest.

Baddeleyite from the sill south of Savage Point has given a U-Pb age of 1268 Ma, indicative of intrusion during the Mackenzie Igneous Event, which affected the entire northwestern Canadian Shield (Heaman and LeCheminant, 1993). Paleomagnetic results from the sill support a Mackenzie age (Jones and Fahrig, 1978). No isotopic data are available on the dykes but paleomagnetic data on northeast-trending, post-Hunting Formation dykes on Somerset Island (Jones and Fahrig, 1978) suggest they belong to the Franklin Igneous Event (723 Ma). The southern of the two easterly trending dykes on Prescott Island runs into the sill and could not be traced through and beyond it, so may be a feeder to it and thus of Mackenzie age. However, the ages of the dykes in the western margin of the Boothia Uplift remain to be determined.

LOWER PALEOZOIC FORMATIONS

Unnamed unit (Lang River and Allen Bay formations)

Definition

In the report area the Cape Storm Formation is the lowest unit within the lower Paleozoic succession that can be recognized and correlated with certainty with the succession north of Barrow Strait (Table 3). Some other units, in particular correlatives of the Cape Clay Formation, generally massive and resistant carbonate deposits, can be recognized locally in the Young Bay well (Fig. 12, Table 3) and in measured sections, but during the fieldwork for this report it was not possible to consistently map these units. Beds that could be correlated with the Irene Bay Formation, a thin, fossiliferous and usually very distinctive unit situated below the Allen Bay Formation, can be distinguished in the Young Bay well, but they were not recognized in exposures on Prince of Wales Island. For these reasons the entire Paleozoic succession below the Cape Storm Formation has been combined and mapped as a single, unnamed unit with two (upper and lower) members.

Table 3
Comparison of nomenclature for lower Paleozoic formations

<table>
<tr><th colspan="2">Dixon (1973b)</th><th colspan="2">Christie (1973)</th><th colspan="3">This report</th><th>N of Barrow Strait</th></tr>
<tr><td colspan="2" rowspan="2">READ BAY GROUP</td><td colspan="2" rowspan="2">READ BAY GROUP</td><td colspan="3">DOURO FORMATION</td><td>DOURO FORMATION</td></tr>
<tr><td colspan="3">CAPE STORM FORMTION</td><td>CAPE STORM FORMTION</td></tr>
<tr><td colspan="2" rowspan="2">ALLEN BAY FORMATION
?</td><td rowspan="7">FRANKLIN STRAIT FORMATION</td><td rowspan="3">Unit 12</td><td rowspan="9">Unnamed unit</td><td colspan="2" rowspan="3">Upper Member</td><td>ALLEN BAY FORMATION</td></tr>
<tr><td>IRENE BAY FORMATION</td></tr>
<tr><td rowspan="7">LANG RIVER FORMATION</td><td>Member 2</td><td>THUMB MOUNTAIN FORMATION</td></tr>
<tr><td rowspan="6">Member 1</td><td rowspan="3">Units 2 - 11</td><td rowspan="6">Lower member</td><td rowspan="3">Subdivision 3</td><td>BAY FIORD FORMATION</td></tr>
<tr><td>ELEANOR RIVER FORMATION</td></tr>
<tr><td>BLANLEY BAY FORMATION</td></tr>
<tr><td>Unit 1</td><td>Subdivision 2</td><td>CAPE CLAY FORMATION</td></tr>
<tr><td colspan="2">NETSILIK FORMATION</td><td rowspan="2">Subdivision 1</td><td rowspan="2">CASS FJORD FORMATION</td></tr>
<tr><td colspan="2">BOOTHIA FELIX FORMATION</td></tr>
</table>

The seismic stratigraphic facies of this unit is also consistent with a bifold division. The Kerr McGee Decalta Young Bay F-62 exploratory well provides seismic identification of the top and bottom of these two units as well as an intermediate level within the lower subdivision. These levels can be traced with reasonable confidence over most seismic data, from Russell Island to just north of Strzelecki Harbour and east as far as 100° 00' longitude (see Fig. 9, seismic stratigraphic profiles A-A', B-B', C-C', and D-D'). An upper, laterally consistent, generally reflection-free sequence is separated from a lower, more reflective sequence by an unconformity. This separating reflector generally cuts downsection to the south and correlates to the mid-Ordovician unconformity at the Young Bay well.

Distribution, thickness, and contact relations

The unnamed unit is present in a narrow band between Transition (Kennedy) Bay in the south and Lyons Point in the north (see Map 2016A). One nearly complete section of the unnamed unit was examined (stratigraphic section 185A; Appendix A). It is about 16 km north of Le Feuvre Inlet and there it is at least 600 m thick. In that section the lower member is about 316 m thick; 284 m of the upper member were examined. A complete section is also present in the Young Bay well between 698.0 m (2290 ft.) and 1331.4 m (4368 ft.), giving a thickness of 633.4 m. The lower member is 231.1 m thick, the upper one 402.3 m. Seismic line KM7239 on traverse C-C' (Fig. 9) shows an overall increase of more than 50 per cent in the thickness of the lower member as a result of basal thickening away from the Young Bay paleostructure. In stratigraphic section 7 (Appendix A) on the northern end of Prescott Island, about 540 m of the unnamed unit were examined. Here, the lower member is incomplete and measures 434 m. The upper member is apparently only 105 m thick.

A well-exposed section (about 445 m) of the lower member was examined about 5 km north of Cape Briggs. The nearest seismic data, 20 km away north of Back Bay on seismic line 1870 on traverse A-A' (Fig. 9), indicate there a thickness of about 660 m and 600 m for the lower and upper members, respectively. The uppermost 100 m or so of the upper member were examined in stratigraphic section 184 at Flexure Bay (Appendix A). Subsurface maps of estimated thickness in metres for both members are presented as maps 1 and 2 on Figure 9.

The unnamed unit rests unconformably on various Proterozoic rocks. Exposures of the lower contact were not seen during the fieldwork for this report, but the angular unconformity is clearly imaged in the subsurface on seismic data (Fig. 9), at the base of sequence ЄOl (for example line 1872a, traverse B-B').

The strength of the reflection at the interface between the members is variable. Seismic traverses B-B' and C-C' on Figure 9 are flattened at this level and illustrate the nature of the contact as an unconformity, particularly on the northern parts of the traverses.

Rock types and internal stratigraphy

Lower member. The lower member consists of yellow-grey weathering dolostone and dolomitic sandstone. The weathering profile of the succession varies from recessive, covered intervals to variably resistant intervals. This is in contrast to the upper member, which has a relatively uniform, resistant-weathering profile. Three poorly defined subdivisions can be distinguished in the lower member in sections 185A and 186 and in the Young Bay well (Appendix A). For descriptive purposes the three subdivisions are numbered 1 to 3 upward (Fig. 12).

Subdivision 1 ranges in thickness from 45 m in section 185A (Appendix A) to 85.1 m to the north in the Young Bay well. Most of subdivision 1 is not exposed in section 185A. In section 186 subdivision 1 consists of interbedded dolomitic sandstone and sandy dolostone. Dolostone is more common in the upper part of the subdivision. The sandstone is a yellow-orange, mature, fine- and medium-grained quartz arenite. It is thick bedded, with ripple marks and bioturbation in the lower part of the subdivision. The dolostone is grey to yellow-grey, mostly medium crystalline, with fine-crystalline intervals in the upper part. It is thick bedded, with intervals of vague, wavy lamination. Molar tooth structures and shrinkage cracks were observed in the upper part of the subdivision. Rock types of subdivision 1 are similar in the Young Bay well. The lower part consists of about 15 m of light grey sandstone, at least in part very coarse grained, conglomeratic and dolomitic, and interbedded dark grey, fine-crystalline dolostone. Dark grey, argillaceous partings were also seen in the well samples. Above that are about 27 m of light brown-grey dolostone. The dolostone varies from coarse to fine crystalline. Sandy intervals appear to be less common. The interval above the dolostone has an argillaceous gamma-ray log response and is 43 m thick. The main rock type is dark grey, fine-crystalline dolostone with interbedded light grey and light grey-brown, sandy dolostone and minor, brown, dolomitic shale.

Seismic data indicate the lower member increases in thickness on the downthrown side of the generally northeast-southwest-directed normal faults mapped at the base of the sequence (Map 2, Fig. 9). This growth appears to be limited to the basal part of this member, which generally correlates to subdivision 1 of the lower member of the unnamed unit (see seismic line 1871, traverse A-A' and line 1731, traverse C-C', Fig. 9). Seismic data also show this basal interval filling small-scale topographic relief on the sub-Cambrian unconformity (see line 1870, traverse A-A', Fig. 9).

Subdivision 2 ranges in thickness from 61.5 m in the south to a little over 100 m in the north. It consists entirely of dolostone, light grey to yellow-grey and mostly coarse crystalline, thick bedded and burrow-mottled. White and brown chert nodules are abundant (Fig. 13). In the Young Bay well the subdivision also consists entirely of dolostone, varying from light to dark brown and medium and coarse crystalline. Sandstone, if present at all, is very rare in the well.

Subdivision 3 thickens northward similar to the lower two subdivisions. In section 185A, its thickness is 178.5 m (Appendix A), in the Young Bay well, 62.8 m. In section 7 subdivision 3 is very poorly exposed and about 390 m of rock are assigned to it (Appendix A). At section 186

Figure 13. *Field photograph of lower member of unnamed unit. Felsenmeer of medium-bedded dolostone with white chert nodules (Stratigraphic Section 185A, unit 3) (GSC photo no. 4738-9).*

(Appendix A), 164 m were examined, but the total thickness is believed to be several times that value, because the upper contact of the member is present about 15 km west of the section in an apparently mostly west-dipping panel. The lithological composition of subdivision 3 is very heterogeneous and consists of variably interbedded carbonate, sandstone and shale. The four sections will be discussed from south to north.

In stratigraphic section 185A the lower part of subdivision 3 consists predominantly of sandy dolostone and sandstone (Appendix A). The dolostone is light grey and weathers yellow-brown. Bedding is medium and thick, with some minor platy beds. Vague wavy-parallel lamination is present locally. The dolostone is medium crystalline and contains quartz sand grains and chert granules. The sandstone is concentrated in a single unit and consists of fine-grained, mature quartz arenite. It is light grey and thick bedded and forms a conspicuous horizon that can be followed in the field for at least 10 km. The upper part of the subdivision consists of light grey dolostone with abundant chert nodules (Fig. 14). The dolostone is generally medium bedded, and crystal size varies from fine to coarse. Recognizable sedimentary features are planar-parallel lamination, shrinkage cracks and ripple marks.

In the Young Bay well the subdivision consists of a lower part, about 30 m thick, of dolostone intervals up to 10 m thick and minor arenaceous interbeds, and an upper part, about 33 m thick, of thinly interbedded rock types.

The dolostone at the base of the lower part is medium brown, coarse crystalline and contains abundant crinoid fragments. The dolostone above that is light grey and medium crystalline and appears to be interbedded with dark grey, fine-crystalline dolostone. The arenaceous intervals contain light grey siltstone, dolomitic sandstone with quartz granules, very dark grey, dolomitic shale, variably silty, and fine-crystalline, medium to light grey, silty dolostone. The sandstone may correlate with the sandstone interval in section 185A (Appendix A).

The dominant rock type in the upper part of the subdivision is dark grey and dark brown, fine-crystalline, variably argillaceous dolostone, interbedded with light brown, dolomitic siltstone and very dark grey shale.

In stratigraphic section 7 (Appendix A) only a few exposures of subdivision 3 are present. They consist of variably crystalline and variably bedded dolostone, in part with desiccation cracks or chert nodules.

In stratigraphic section 186 (Appendix A) only the lower part of the subdivision is exposed. The lower part of the exposed interval consists of limestone interbedded with shale overlain by dolostone interbedded with shale. The limestone is light grey, dolomitic lime mudstone, which is thick bedded and penetrated by burrow mottles. The dolostone is light grey, fine crystalline and medium bedded. Some poorly preserved flat-pebble conglomerate beds are present. The shale is light grey, siliceous, thin bedded and

Figure 14. *Field photograph of lower member of unnamed unit. Rare outcrop of medium-bedded, cherty dolostone. Mudcracks and ripple marks are found in this rock type (Stratigraphic Section 185A, unit 16) (GSC photo no. 4738-10).*

weathers fissile, with common grey and white chert nodules. The carbonate-shale succession is overlain by dolostone interbedded with sandstone. The sandstone weathers brown-reddish or orange and causes the plateau northwest of Cape Briggs to display a distinct red-brown striping when seen from a distance. The amount of interbedded sandstone increases upward. The dolostone is fine crystalline, grey-yellow and thin bedded. Upsection crystal size increases to coarse, bedding thickness to thick, and the dolostone becomes sandy. The dolostone is bioturbated. The sandstone is mature, medium grained, medium-bedded dolomitic quartz arenite.

The subsurface distribution of the lower member (ЄOl) of the unnamed unit is shown on an isopach map (Map 2, Fig. 9). Seismic traverse B-B' and C-C' are vertically exaggerated composites of seismic data flattened on the top of the unit. The suggestion is that the middle part of the lower member thins stratigraphically very gradually from north to south, while the upper part of the lower member thins much more from north to south, mainly because of erosion beneath the mid-Ordovician unconformity.

A very strong reflector appears beneath the mid-Ordovician unconformity north of an east-west line at about 73° 45', shown at the join of lines 1871 and 1873, traverse A-A' (Fig. 9). The presence of this reflector may attest to the northerly introduction of relatively low-velocity rocks, such as evaporitic rocks of the Baumann Fiord or Bay Fiord formations. Although Map 2, Figure 9 indicates a thickness of about 1600 m on Russell Island; this should be considered a maximum as conversion is based on an average velocity of 6.2 km/sec seen at Young Bay F-62, which is likely at the upper velocity range.

Upper member. The upper member was examined in stratigraphic sections 185A and 7 (Appendix A) and in the Young Bay well. In section 185A the member is 315 m thick and consists of yellow-grey to light grey weathering, thick-bedded dolostone. The dolostone is fine and medium crystalline and shows lamination and burrow mottling. Corals, stromatoporoids and cephalopods are present in the lower part of the member (Fig. 15).

In the Young Bay well the member is 402.3 m thick. It consists dominantly of light brown, medium-crystalline dolostone, which is slightly cherty in the upper part. Two intervals of dark brown, fine-crystalline dolostone interbedded with anhydrite are also present in the well, however no evaporitic deposits were observed in the field. Thin, shaly intervals are present at 3354 ft. (1022.3 m), 3507 ft. (1068.9 m) and 3534 ft. (1077.2 m).

In stratigraphic section 7 the member is 105 m thick and consists of medium- and thick-bedded, fossiliferous dolostone. The member here appears to be abnormally thin. Reasons for that are unknown but there could be an unrecognized fault or dip change in the section.

The seismic stratigraphy of this member (OSu) has been subdivided into distinct lower (OSu_1) and upper (OSu_2) members. These are illustrated on the four traverses the locations of which are shown on Map 3, Figure 9.

Figure 15. *Field photograph of upper member of unnamed unit. Felsenmeer of cherty and mottled, thick-bedded dolomite with orthocone cephalopod (Stratigraphic Section 185A, unit 18) (GSC photo no. 4738-11).*

The lower stratigraphic interval of this member (OSu_1) is characterized by a reflector at its top and a moderately reflective, parallel-bedded, internal appearance (see traverse A-A', Fig. 9). This interval has a maximum time thickness of about 105 ms (300 m at 5.7 km/sec) on Russell Island and thins to 25 ms or less southward (and may terminate).

The upper interval (OSu_2) is characterized by a generally uniform, weakly to mildly reflective, parallel-bedded seismic facies, which is consistent with the general description of rock types seen in outcrop. This seismic interval ranges in thickness from about 661 m (at 6.3 km/s) on Russell Island to 402 m at Young Bay F-62. The interval exhibits relatively short, discontinuous, strong to moderate amplitude reflectors within it (see line 1871, traverse A-A', Fig. 9). These "bright" reflectors are generally located on data nearer the Boothia Uplift rather than farther west and are thought to be the result of secondary processes that create porosity (further disscussion under *Economic Potential*). An isopach map of the entire OSu map unit is presented as Map 1 on Figure 9. The overall thickness range is from more than 1000 m at Russell Island to less than 350 m in the Young Bay vicinity. Part of the thickening of the isopachs north of about 73° 50' latitude is attributable to the development of the lower stratigraphic interval (OSu_1).

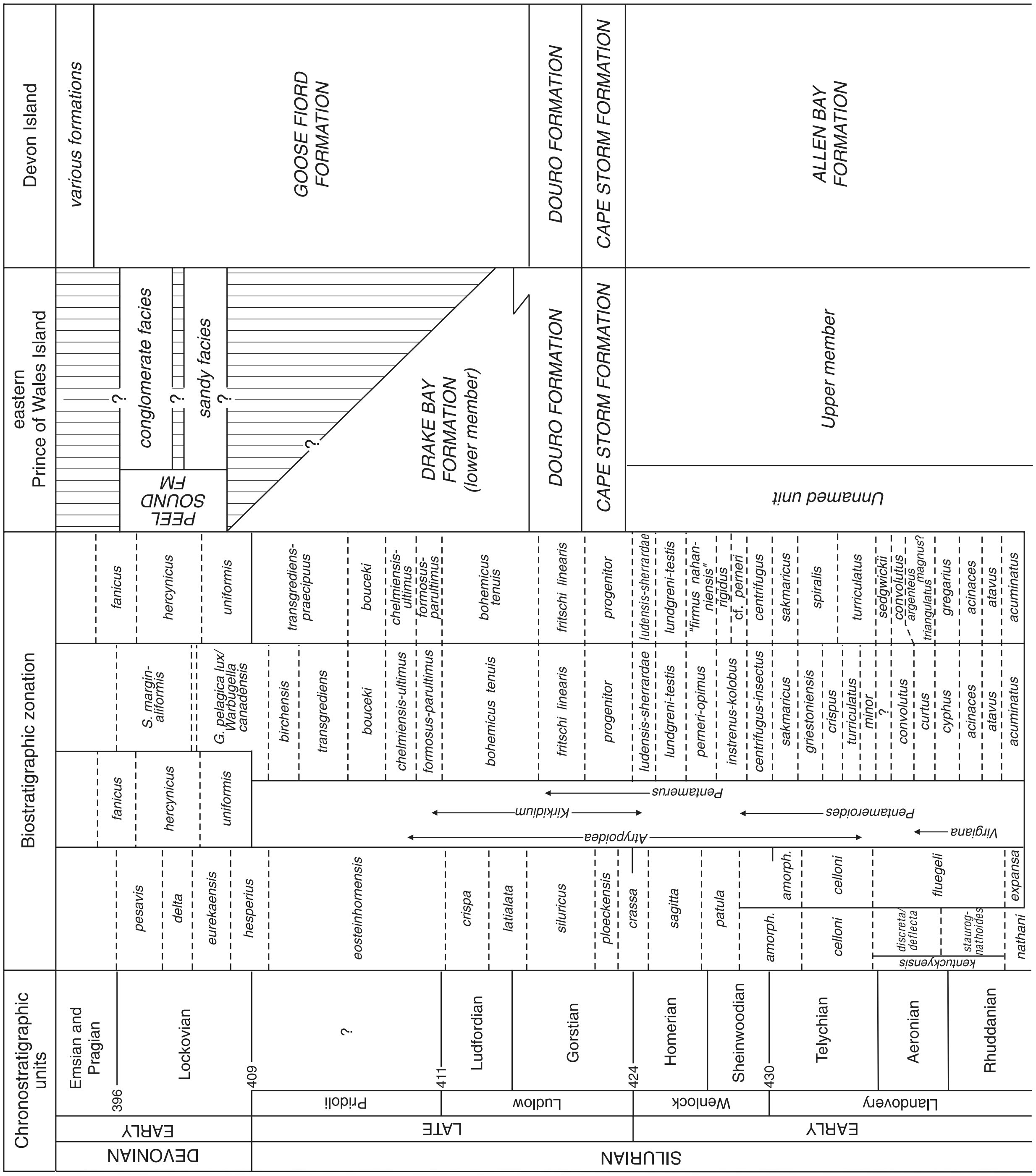
Age and correlation

General discussion. The age range and correlation of the unnamed unit is reasonably well established from published biostratigraphic data and from a number of new biostratigraphic collections made during the fieldwork for the present study. The oldest reported fossils are Upper Cambrian trilobites in the Boothia Felix Formation (Palmer et al., 1981); the youngest biostratigraphic samples from the upper part of the Franklin Strait Formation indicate Upper Ordovician and Silurian (Christie, 1973). The Boothia Felix and Franklin Strait formations are correlatives of the unnamed unit (see below). On lithological grounds the lower member can be correlated with the succession from the Cass Fjord to Bay Fiord formations and the upper member with the Thumb Mountain, Irene Bay and Allen Bay formations (Table 4, see discussion of member correlation below).

Dixon (1973b) defined the Lang River Formation on Somerset Island as all rocks in the interval between the Precambrian and the base of the Allen Bay Formation (Table 3). At the type section on southern Somerset Island the formation is about 450 m thick and consists of interbedded dolostone, sandy dolostone and sandstone.

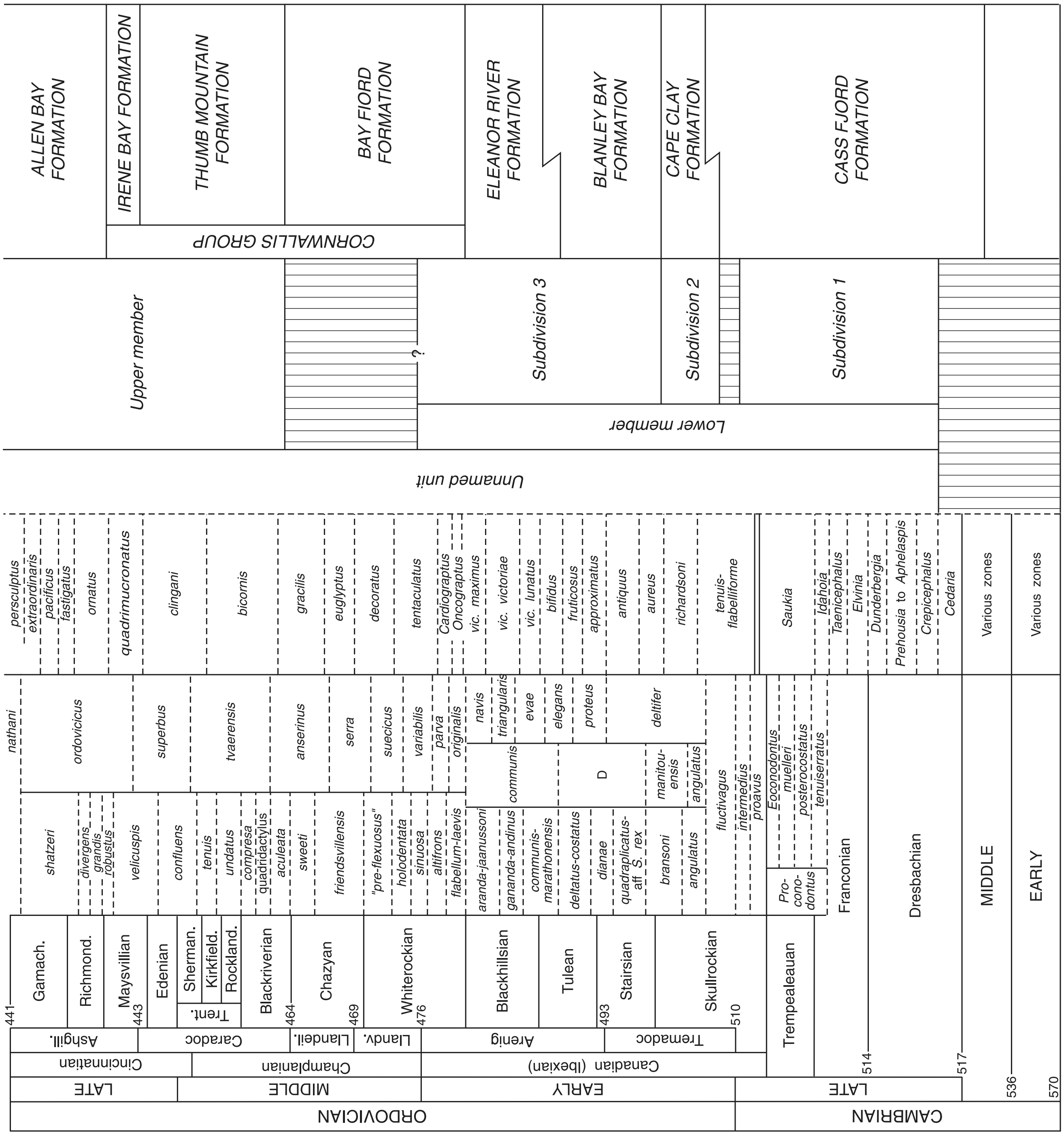
Christie (1973) defined three formations on the Boothia Peninsula for the interval below the Cape Storm Formation, which are, in ascending order, the Boothia Felix, Netsilik and Franklin Strait formations (Table 3). The Boothia Felix Formation is about 110 m thick at the west side of the Boothia Peninsula and consists of sandy dolostone and sandstone with thin beds of intraformational conglomerate. The Netsilik Formation is about 150 m thick on Boothia Peninsula and consists of thin bedded, dark grey to green-

Table 4
Correlation of Paleozoic units



grey weathering, sandy and shaly dolostone and minor intraformational conglomerate. The Franklin Strait Formation is “a sequence of dolomite and calcareous dolomite, at least 2200 feet (670 m) thick, that overlies the Netsilik Formation and underlies the Read Bay Formation ...”. The type section is on the west side of Boothia Peninsula, and Christie (1973) reported that there the formation is about 400 m thick. Since Christie’s definition of the Franklin Strait Formation, Kerr (1975) introduced the Cape Storm Formation between the Douro Formation (Read Bay Formation of Christie (1973), see Miall and Kerr, 1977 and Thorsteinsson and Uyeno (1980)) and the Allen Bay Formation.

With the Franklin Strait and Lang River formations, Christie and Dixon, respectively defined a single formation for the southern edge of the Stable Platform, which is correlative to at least eight formations farther north on the platform. Some features of the northern formations can be recognized south of Barrow Strait, particularly in the Young Bay well, but generally the northern formations are not mappable in the report area. Fieldwork during 1997 also



showed that the unnamed unit has a lower, variably resistant and recessive member and an upper, resistant member.

Reinterpretation of Christie's (1973) description of the type section of the Franklin Strait Formation indicates a bifold division similar to that of the unnamed unit. The lower subdivision, as interpreted in this report, is 236.8 m (777 ft.) thick and comprises Christie's units 1 to 11 (Table 3). The upper one is more than 154.8 m (508 ft.) thick and is formed by Christie's unit 12 (Table 3). The lower subdivision consists of variably sandy and silty, variably bedded dolostone with interbedded sandstone in the lower part. The upper subdivision consists of uniform, thick bedded dolostone. Similarly Dixon (1973a) distinguished two informal members in the type section of the Lang River Formation. Member 1 (lower) is 277 m thick and consists of varied dolostone interbedded with sandstone. Member 2 (upper) is 125 m thick and comprises fossiliferous dolostone and limestone with Arctic Ordovician fauna. The bifold subdivisions found in

Christie's and Dixon's stratigraphic schemes correspond in part to the upper and lower members of the unnamed unit (Table 3).

The seismic correlations within the report area with markers identified at the Young Bay well, and from seismic sequence analysis, encompass the base of Cape Storm Formation (top of OSu), mid-Ordovician unconformity (boundary between upper and lower members), a marker near the top of unit 1 of the lower member (contact between seismic units $\mathrm{\epsilon Ol_1}$ and $\mathrm{\epsilon Ol_2}$ in Fig. 9), and the sub-Cambrian angular unconformity.

Lower Member. Lithological similarities and age constraints indicate that subdivision 1 is equivalent to the combined Boothia Felix/Netsilik formations and the Cass Fjord Formation. The Boothia Felix/Netsilik (Christie, 1973) and the Cass Fjord formations on Devon Island (Thorsteinsson and Mayr, 1987; Mayr and de Freitas, 1998) are platformal units and consist of sandy and shaly carbonate and varying amounts of interbedded sandstone, microbial carbonate and flat-pebble conglomerate. This compares well with the sandstone and sandy dolostone encountered in subdivision 1. In the Central Dome well on Cornwallis Island, the Cass Fjord Formation appears to be depositionally more in a slope position, and comprises calcareous and dolomitic siltstone and sandstone, interbedded with shale and impure carbonate (Mayr, 1978).

The oldest fossils in the vicinity of the report area come from exposures on Boothia Peninsula, where trilobites from the lower and middle part of the Boothia Felix Formation were collected. These fossils were originally interpreted as Middle Cambrian in age (Christie, 1973), however they were subsequently reassigned to the Upper Cambrian, mid-Dresbachian *Cedaria-Crepicephalus* Zone (Palmer et al., 1981). In the Canadian Arctic Islands the Cass Fjord formation is no older than *Cedaria-Crepicephalus* Zone (de Freitas and Fritz, 1995; de Freitas, 1998) and is overlain by the Cape Clay Formation, a unit which is correlated with subdivision 2.

The Cape Clay Formation is very uniform in thickness and lithology and consists everywhere of resistant, medium- to thick-bedded burrow-mottled and microbial carbonate with varying amounts of chert (Thorsteinsson and Mayr, 1987; Packard and Mayr, 1994; Mayr and de Freitas, 1998). The dolostone of subdivision 2 is similar lithologically and yielded several conodont faunas in stratigraphic section 185A (Appendix A). Sample C-246399 is located at the base of the subdivision and is of earliest Ordovician age (*lindstromi* Zone). The remainder of the subdivision contained several Early Ordovician samples (GSC loc. C-246400, C-246402). Elsewhere (Packard and Mayr, 1994; Mayr and de Freitas, 1998), the Cape Clay Formation is of Tremadocian age (*lindstromi* to *manitouensis* zones).

Subdivision 3 correlates with the Blanley Bay, Eleanor River, and Bay Fiord formations; however poor lithological correlation and lack of biostratigraphic information make it difficult to know how much of the lower member has been removed during the development of the basal unconformity of the upper member. Probably only part of the Bay Fiord equivalent is missing (see biostratigraphic discussion in this section). The Blanley Bay Formation is the nonevaporitic equivalent of the Baumann Fiord Formation along the cratonal margin of the Ordovician restricted shelf. The closest known exposure is on southeastern Devon Island. There the predominant rock types are thin- to medium-bedded, silty and sandy dolostone, in part laminated, and with abundant sandstone interbeds in the upper part of the formation (Thorsteinsson and Mayr, 1987). Exposures of the Eleanor River Formation are present on Cornwallis and Devon islands and consist of thick-bedded, burrow-mottled limestone with thick intervals of thin-bedded, laminated carbonate (Thorsteinsson and Mayr, 1987; Mayr and de Freitas, 1998). The Bay Fiord Formation on Cornwallis and Devon islands comprises mostly thin-bedded carbonate units, variably silty and with variable amounts of shale partings and anhydrite. Except for the thick bedded, subtidal limestone of the Eleanor River Formation, the thin-bedded, impure carbonates of the three formations are similar to the rock types of subdivision 3. Presumably the reason for the absence of the subtidal limestone, common on the deeper part of the platform, is the fact that the succession on Prince of Wales Island is near the cratonal margin of the Ordovician platform where water depth was generally too shallow for deposition of the thick-bedded subtidal carbonate.

Several conodont samples were collected from subdivision 3. An Early Ordovician age is indicated at the base of the subdivision in stratigraphic section 186 (GSC locs. C-246422 and C-246423; Appendix A). Mayr et al. (1980) reported conodont fauna D from the 1127.8–1158.2 m (3700–3800 ft.) interval in the Young Bay well, which is approximately the middle part of subdivision 3. This is mid to late Ibexian, early Stairsian to early Blackhillsian age, encompassing the range of the Blanley Bay and Eleanor River formations. Also in the middle part of the subdivision is collection C-246405 in stratigraphic section 185A (Appendix A). This sample is of Stairsian/Tulean (mid-Ibexian) age, which is the same age as the Eleanor River Formation. Two samples from the upper part of the subdivision in section 7 (GSC locs. C-257794 and C-257795; Appendix A) likewise indicate a Tulean/Blackhillsian age, with a fauna typical of the lower and middle part of the Eleanor River Formation. The upper age of the subdivision is bracketed by a fauna of Middle or Late

Ordovician age from the base of the upper member (GSC loc. C-246406) in section 185A. Although this age not a definitive one, it is compatible with a correlation of the upper part of subdivision 3 with the Bay Fiord Formation.

Upper member. The upper member is lithologically similar to the Thumb Mountain Formation and the lower Allen Bay Formation. Both units consist of resistant, thick-bedded, mottled carbonate. During the present fieldwork no new age evidence, except the conodont sample mentioned (GSC loc. C-246406; Appendix A), was obtained. However section 7 yielded a date of Middle Ordovician or younger (GSC loc. C-257797) for the member. The presence of poorly preserved cephalopods and hylisitid corals in the lower part of the member implies the presence of Arctic Ordovician fauna and correlation with the upper part of the Thumb Mountain Formation, the Irene Bay Formation and the lowest part of the Allen Bay Formation. Dixon (1975) reported detailed Arctic Ordovician faunal lists from two locations on Prince of Wales Island near Strzelecki Harbour and Savage Point. The Irene Bay Formation, a regionally consistent, thin, shaly, recessive unit, could not be identified in section 185A or elsewhere in the report area. In the Young Bay well the Irene Bay Formation also cannot be picked with full confidence. A possible top for the Irene Bay Formation is at 3507 ft. (1068.9 m), which gives a combined thickness of 31.4 m for the Irene Bay and Thumb Mountain formations. A significant shale marker, however, is present at 3354 ft. (1022.3 m). This shale marker is easily correlated with a similar marker on the gamma ray log of the Garnier well on eastern Somerset Island (unit 4, Baillarge Formation B, Appendix b in Mayr, 1978). This shale marker indicates the Silurian-Ordovician boundary on Devon Island (Thorsteinsson and Mayr, 1987).

The upper member also correlates with the interval below 5128 ft. (1563.0 m) of the Sun Russell E-82 well on Russell Island.[1]

Origin

Lower member. Subdivision 1 represents deposition under a restricted nearshore-marine environment, as suggested by the common mudcracks. Siliciclastic deposits, like those of subdivision 3, were likely derived from the craton to the south and transported to this region by fluvial systems (not preserved). Active faulting during this time, as seen on seismic profiles, indicates some regional extension of the Franklinian passive margin. The extension was nowhere accompanied by volcanic activity, but extensional stresses affected a large part of the northern mainland and arctic archipelago of North America.

Subdivision 2 represents deposition under more open-marine conditions than those of subdivisions 1 and 3. The locally abundant chert probably had a biogenic source, perhaps from disarticulated siliceous sponges. The silica was likely mobilized in a shallow-burial diagenetic environment to form the present nodular chert fabric. Fabric-selective dolomitization of bioturbated lime mud has been used to explain the origin of the mottled dolostone (Morrow and Kerr, 1977). The observed high bioturbation indices of these strata imply open-marine depositional environments.

In subdivision 3 the nodular cherty shale is very similar to that observed in the Baumann Fiord Formation on Ellesmere and Devon islands, and elsewhere. In many of those exposures, the cherty shale occurs in association with common gypsiferous carbonate, mudcracks, and molar tooth structures and thus was deposited in a very restricted or periodically hypersaline depositional environment. Although the cherty carbonate of Prince of Wales Island lacks the associated restricted-marine and subaerial paleoenvironmental indicators, the lack of bioturbation and lithological similarity to the Baumann Fiord shale suggest a similar restricted-shelf marine depositional environment.

Strata overlying the cherty shale at section 186 (Appendix A) contain abundant red-weathering carbonate and siliciclastic deposits that represent deposition in nearshore and continental environments. That the units are closely interbedded suggests that section 186 was at or near the continental-to-marine transition. The source of the siliciclastic deposits was likely the exposed craton to the south, and they were transported to this area by large river systems (not preserved). The ancestral Boothia Uplift[2] may have provided some siliciclastic sediment to the area, but if present, it was likely a low-relief structure and thus a minor source.

Upper member. The common Arctic Ordovician fauna indicates largely open-marine depositional environments. However these were affected by high-order relative sea-level fluctuations, and gypsiferous carbonate was deposited locally (as observed in the Young Bay well).

1 The present study necessitated some revision of the stratigraphy in the lower part of the Sun Russell E-82, as interpreted by Mayr (1978). New formation tops, based on correlation with the Young Bay F-62 well by seismic markers, are: Allen Bay Formation at 5128 ft. (1563.0 m) and Cape Storm Formation at 4588 ft. (1348.4 m).

2 The Boothia Uplift was a positive feature predominantly during the Late Silurian and Early Devonian, but may have also have been positive during deposition of Ordovician and Cambrian strata (de Freitas and Mayr, 1993), as it had been in the Proterozoic during the time of deposition of the Aston Formation.

Cape Storm Formation

Definition

Kerr (1975) defined the Cape Storm Formation as a sequence of dolostone and limestone that was included previously in the upper part of the Allen Bay Formation. He recognized that these beds were mappable on a regional scale and thus warranted formational status. In the southern Ellesmere Island type section (*op. cit.*), two members comprising 197 m of strata are well exposed: the lower member is Llandovery to Wenlock age, coarse crystalline, thick-bedded dolostone, whereas the upper member is a Ludlow age, yellow-weathering, fine-crystalline, silty dolostone. However, subsequent field investigations demonstrated a disconformable contact between the lower and upper members (Thorsteinsson and Mayr, 1987; Mayr and Packard, 1994), and thus the lower boundary of the Cape Storm Formation was revised stratigraphically upward, and only Kerr's (1975) upper member is at present assigned to the Cape Storm Formation. The Cape Storm Formation attains a maximum thickness of 540 m on Griffith Island (Thorsteinsson and Uyeno, 1980), south of Cornwallis Island, while a minimum thickness of 123 m occurs on Somerset Island (Stewart, 1987). The Cape Storm Formation had been partially mapped as “transition beds” during fieldwork in 1970 by Kerr (unpublished field notes).

Distribution, thickness, and contact relations

The Cape Storm Formation is thin, and is present in a very narrow band between Transition (Kennedy) Bay in the south and Back Bay in the north. It is also exposed in the area south of Cape Hardy. The formation was examined in stratigraphic section 184 (Appendix A) near Flexure Bay, where it is 51 m thick. In the Young Bay well the formation is reported to be 166.4 m thick (Mayr et al., 1980). This large difference in thickness may represent some northward thickening, but is probably caused mostly by a different pick of the subsurface contacts, which are based on argillaceous content and not on weathering features. Mortensen and Jones (1986) reported a maximum thickness of 97 m and divided the formation into three informal, lithofacies-based and laterally interfingering members. The lower member consists of planar laminated, variable quartzose dolosiltite, the middle member of stromatolitic and algal-laminated dolostone, and the upper member of variably calcareous dolostone and planar-bedded, mottled, dolomitic limestone.

The lower contact is sharp (see stratigraphic section 184, unit 3, Appendix A) and drawn at an upward increase of silty material and thinner bedding in the dolostone.

The base of the Cape Storm Formation is the shallowest seismic level to be confidently correlated between wells. It provides a variable reflecting character and does not conclusively provide seismic evidence of being an unconformity or not. However it does appear to possibly cut downsection on the east side of traverse D-D' (Fig. 9). The top of the Cape Storm Formation was not correlated on seismic data but internal character appears to indicate a moderately reflective seismic appearance.

Rock types

In many parts of the report area the Cape Storm Formation is poorly exposed and underlies a poorly drained, shallow depression between the more resistant, westward-dipping to overturned, eastward-dipping unnamed map unit and the Douro Formation.

In stratigraphic section 184 (Appendix A) the formation consists of interbedded dolostone and limestone. The limestone interbeds increase in number upward. The dolostone is silty, light grey and weathers yellow-grey. It is medium to thin bedded with wavy, parallel lamination (Fig. 16). Shrinkage cracks and molar tooth structures are present in some beds. The limestone is a thin- to medium-bedded, light grey, skeletal wackestone. Atrypid brachiopods are common. In the Young Bay well the formation comprises dolostone and limestone interbedded with shale. Shale is most abundant in the middle part of the formation. The dolostone is present in the lower part of the formation and is generally fine crystalline and silty. The limestone is argillaceous and silty.

Age

Samples taken during fieldwork for conodonts proved barren. Mayr et al. (1980) reported *siluricus* Zone (mid-Ludlow) from the Young Bay well. Thorsteinsson and Uyeno (1980, fig. 21) published a biostratigraphic log for a section in the same location as stratigraphic section 184 in which a single conodont sample of *siluricus* Zone from the Cape Storm Formation is reported. North of Barrow Strait numerous *siluricus* Zone samples have been collected and the age is early to late Ludlow (Thorsteinsson and Uyeno, 1980; Packard and Mayr, 1994; de Freitas and Mayr, 1998).

Origin

Abundant wavy-parallel laminae, polygonal mudcracks, and molar tooth structures indicate generally restricted, periodically exposed nearshore-marine depositional

Figure 16. *Field photograph of Cape Storm Formation. Thin-bedded, silty and calcareous dolostone (Stratigraphic Section 184, unit 5) (GSC photo no. 4738-12).*

environments. The upper part of the formation, however, contains more evidence for continuous submergence and greater open-marine circulation, as indicated by common bioclastic beds containing atrypid brachiopods and other fossils. Some of these bioclasts are abraded and occur in grainstone beds, and may be interpreted as tempestites.

Douro Formation

Definition

Thorsteinsson (1963a, p. 227) originally described the Douro Formation as a sequence of "...light to medium light grey, light olive grey to olive grey, thin to medium bedded and aphanitic to fine grained..." limestone and argillaceous limestone. The type section is in the Douro Range on southern Grinnell Peninsula, where it is 270 m thick (de Freitas and Mayr, 1998). The Douro Formation has been widely recognized in the southern and eastern parts of the Arctic islands. In all areas, the formation is characterized by a remarkably uniform lithofacies, namely rubbly argillaceous limestone and mottled dolomitic limestone with atrypid brachiopods. The exception to this occurs on northeast Ellesmere Island, where abundant calcareous, fossiliferous sandstone occurs throughout the formation (de Freitas and Nowlan, 1998). On Somerset and Prince of Wales islands the term Read Bay Formation (Thorsteinsson and Fortier, 1954; see Thorsteinsson and Uyeno, 1980, for revisions of nomenclature) was used for rocks equivalent to the Douro Formation.

Distribution, thickness, and contact relations

The distribution of the Douro Formation is similar to that of the Cape Storm Formation. A complete section of the formation was examined in stratigraphic section 184, where it is about 178.3 m thick (Appendix A). In the Young Bay well the thickness is 276.8 m. The lower boundary is gradational and placed above the highest dolostone interval. Throughout most of the report area the Douro Formation is overlain by the Peel Sound Formation; north of Back Bay, in the northernmost part of the of the report area, the Douro Formation is overlain by a unit tentatively correlated with the lower member of the Drake Bay Formation.

The top of the Douro Formation has been identified on seismic data near both well locations but data quality did not allow a reasonable correlation between wells. The sense is, however, that the top of the Douro Formation at Russell E-82 correlates approximately 40 ms lower at the Young Bay F-62 well.

Rock types

The Douro Formation consists of light grey limestone, mostly skeletal wackestone and packstone, but with some grainstone and rudstone (Fig. 17). Most of the limestone is thick bedded and has dolomitic labyrinthine mottling. Intervals of the more typical, slightly argillaceous, rubbly weathering limestone are also present. The limestone has intervals of abundant, very well-preserved fossils: brachiopods, corals, stromatoporoids and megalodont bivalves. A 6 m thick interval of calcareous sandstone is present in the upper part of the formation. The sandstone is fine grained and well sorted, thick bedded with cross-stratification. Abundant disarticulated megalodont bivalves are present at the top of the interval. In the Young Bay well the formation consists of light and dark grey-brown lime mudstone and peloidal and skeletal wackestone and packstone. Dolomitic lamination or mottling appears to be present.

Age and correlation

During fieldwork a single conodont fauna of Ludlow age was recovered from the upper part of the formation in stratigraphic section 184 (GSC loc. C-246391, Appendix A). The *siluricus* Zone is also indicated on the biostratigraphic log of Thorsteinsson and Uyeno (1980, fig. 21) for the location of section 184. Regionally the age of the Douro Formation is entirely within the *siluricus* Zone, early to mid-Ludlow (de Freitas and Mayr, 1998). Within the report area the seismic and lithological (see next section on Drake Bay Formation) indications are that the upper part of the Douro Formation correlates with the lower member of the Drake Bay Formation.

Origin

The common, diverse fossils indicate deposition under a fully open-marine, periodically storm-influenced environment, as indicated by the alternation of lime mudstone and grainstone beds. During the storm-induced combined flows, the fossils were disarticulated and abraded. Megalodont bivalves are common in Ludlow shelf carbonate rocks throughout the Arctic islands and are indicative generally of a high-energy, shallow-shelf depositional environment (de Freitas et al., 1993). Overall, the number of fossils decreases upsection, indicating a gradual reduction in the degree of open-marine circulation. Mortensen and Jones (1995), in a detailed study of the fossil beds of the Douro, concluded a similar relative sea-level trend, but his interpretation also indicated several higher-order sea level fluctuations.

Figure 17. *Field photograph of Douro Formation. Dolomitic rudstone with large megalodontids (Stratigraphic Section 185B, unit 2) (GSC photo no. 4738-13).*

Drake Bay Formation

Definition

The name Drake Bay Formation was introduced by Mayr (1978) for a succession of marine carbonate rocks that are laterally equivalent to the fluvial and paralic, mostly terrigenous rocks of the Peel Sound Formation, and with part of the rubbly limestone of the Read Bay (now Douro) Formation. The formation underlies large parts of western Prince of Wales Island, but it is very poorly exposed. The Drake Bay Formation consists of Christie et al.'s (1971b) map units SD_3, SD_4, SD_5 on Prince of Wales Island, which were interpreted as facies of the Peel Sound Formation, and of map units Dd (Disappointment Bay Formation) and Ds (unnamed sandstone). The type section of the Drake Bay Formation (Fig. 12) is incomplete and is in the upper part of the Russell E-82 well on Russell Island. There the formation overlies the Douro (Read Bay) Formation, is 1238 m thick and forms the present land surface in the western part of the island. The formation is divided into two members. The lower member is 460 m thick and consists of white to light brown dolostone. The upper member is about 778 m thick and comprises silty limestone, calcareous and dolomitic siltstone and minor, very fine-grained, dolomitic and calcareous sandstone in the upper part. Higher parts of the formation are exposed in the Drake Bay and Smith Bay area, on the west side of Prince of Wales Island (Smith, 1976, 1980; Thorsteinsson and Uyeno, 1980).

Distribution, thickness, and contact relations

The lower member of the formation only is present south of Cape Hardy in the northernmost part of the report area. The maximum measured thickness of the unit is 460 m in the Russell E-82 well, but thickness may increase west from there; the formation disappears southward by grading laterally into the Douro Formation (see Map 2016A). The upper member is in lateral facies contact with the Peel Sound Formation farther west outside the mapped area. The lower contact is conformable and gradational.

The top of the lower member was identified on seismic at the Russell E-82 well but quickly becomes too shallow to be imaged over any distance.

Rock types

During the fieldwork for this project the stratigraphically significant section of the lower member south of Cape Hardy could not be examined. Unpublished notes of J.Wm. Kerr along this section indicate the presence of tan dolostone and light grey, fossiliferous, micritic limestone with colonial corals. In contrast to the underlying Douro limestone, this limestone is not nodular. This succession differs from that in the type section in the well, where only dolostone is present.

Age and correlation

The age of the lower member of the Drake Bay Formation is Ludlow to possibly lowest Devonian (Mayr, 1978; Thorsteinsson and Uyeno, 1980). No new information was obtained during the present fieldwork. The southeastward pinchout of the member is here interpreted as a combination of erosional removal below the Peel Sound Formation and lateral facies change with the underlying Douro Formation. Kerr's notes (referred to above), reporting close juxtaposition of dolostone and fossiliferous limestone, imply a transition between the Douro Formation and the lower member of the Drake Bay Formation.

Origin

Although a detailed interpretation of lithofacies is not possible because of the reconnaissance nature of the fieldwork, present data suggest that the formation was deposited in shallow-marine depositional settings.

Peel Sound Formation

Definition

The name Peel Sound Formation was given by Thorsteinsson and Tozer (1963) to a "... sequence of predominantly red beds, comprising siltstones, sandstones and conglomerates, with calcareous and dolomitic beds near the base, ...". The type section is on northwestern Somerset Island, where the formation is the youngest Paleozoic stratigraphic unit. The lower member consists of interbedded limestone, siltstone, sandstone and conglomerate, while the upper member is composed dominantly (>90%) of conglomerate. Subsequently, Miall et al. (1978) defined the Somerset Island Formation for about 390 m of beds between the Douro and Peel Sound formations and included part of the lower member of the Peel Sound Formation in the Somerset Island Formation. The Somerset Island Formation is a succession of interbedded, fine-grained, grey, planar-laminated dolostone and limestone, mottled nodular limestone and dolostone, red quartzose siltstone, and red dolosiltite on Somerset Island. Thorsteinsson and Tozer (1963) reported the Peel Sound Formation to be about 600 m thick in the type area, thus the remaining thickness of the revised type Peel Sound Formation should be in the order of 200 m.

Previous work on Prince of Wales Island

Christie (*in* Blackadar and Christie, 1963) and Christie et al. (1971b) showed that the Peel Sound Formation comprises a number of westward-fining terrigenous facies that grade farther westward into carbonate and minor graptolitic shale. Miall (1969, 1970a, b) defined upper and lower members and described and interpreted the upper member in detail. Thorsteinsson and Uyeno (1980) also discussed the Peel Sound Formation of Prince of Wales Island in some detail. According to Thorsteinsson, the lower member is in the order of 450 m thick and consists of sandstone and conglomerate, interbedded with limestone, dolostone and siltstone. The amount of carbonate decreases upward, and Thorsteinsson distinguished two subdivisions of the member. The lower subdivision consists mainly of sandstone and lesser amounts of limestone, dolostone and siltstone. The upper subdivision is made up mainly of conglomerate, conglomeratic sandstone, and minor amounts of limestone and dolostone (Table 5).

Thorsteinsson and Uyeno (1980) drew the lower contact of the member (= base of Peel Sound Formation) below the lowest sandstone bed. This is approximately in the same position as the base of the Somerset Island Formation as applied by Mortensen (1985). Mortensen (1985) used the first occurrence of crossbedded, red sandstone as the base of the Peel Sound Formation. Mortensen (1985) described and mapped as Somerset Island Formation a succession of planar-bedded, variably quartzose limestone and dolostone interbedded with quartzarenite and siltstone along the western margin of the Boothia Uplift. These rocks are assigned here to the sandy lithofacies (lower member) of the Peel Sound Formation. Presumably then the rocks assigned to the Somerset Island Formation by Mortensen (1985) are the same as those described by Thorsteinsson and Uyeno (1980) in the lower part of the lower member of the Peel Sound Formation. This is confirmed by Mortensen and Jones (1986).

Both Miall et al. (1978) and Mortensen (1985) drew the lower contact of the Peel Sound Formation at the base of the first crossbedded, red sandstone, which is a considerably higher position than the lower boundary used by Thorsteinsson and Uyeno (1980) and in this report.

Table 5
Comparison of nomenclature for the Peel Sound Formation

Thorsteinsson and Uyeno (1980)		Mortensen (1985)	This report
Upper Member conglomerate		*Upper member*	*Conglomerate facies*
Lower member	*conglomerate sandstone*	*Lower member*	*Sandstone facies*
	sandstone carbonates	*Somerset Island Fm*	

The upper member of the Peel Sound Formation consists almost entirely of conglomerate. According to Miall (1970a) the contact between the two members is gradational, whereas Thorsteinsson and Uyeno (1980) considered the contact an unconformity and the lower member to be absent on northern Prince of Wales Island. In stratigraphic section 185B (Appendix A) near Flexure Bay, clast size and composition change abruptly and the contact between the members is probably disconformable.

During the limited fieldwork for this report the complex stratigraphic and nomenclatural problems of the Peel Sound Formation were not investigated in any detail. We simply distinguished and mapped a sandy lithofacies in the lower part and a conglomerate lithofacies in the upper part of the Peel Sound Formation along the easternmost exposures of the formation. The boundary between the two lithofacies corresponds approximately to the contact between the upper and lower member. Mapping in terms of lithofacies is preferred here, because the conglomerate is presumed to grade westward into sandstone. Thus the "upper member " would grade laterally into the "lower member" and the distinguishing features of the members should disappear.

Distribution, thickness, and contact relations

The sandy lithofacies, as informally defined for this report, is present as a narrow strip along the thrust front in the foot- and hanging walls. It is 461.5 m thick in stratigraphic section 185B (Appendix A). The facies is also present extensively farther west but has not been examined there. The conglomerate facies is present in a broad strip west of the main fold-and-thrust zone.

The lower contact of the Peel Sound Formation is sharp and probably disconformable (see stratigraphic section 184, unit 14, Appendix A). During the course of this study the lower contact of the Peel Sound Formation, where it overlies the Douro Formation, was drawn below the lowest sandstone. The amount of interbedded carbonate decreases rapidly above the contact. The contact with the feather edge of Drake Bay Formation, north of Back Bay, is not exposed; south of Cape Hardy the Drake Bay-Peel Sound formational contact was not examined.

Seismic data does not image the Peel Sound Formation, or its base, very well, as a result of both its shallowness and its variable nature. This shallowness, however, places both the sandstone and conglomerate facies in the cryozone over much of the area of seismic data, which may produce apparent structure on deeper reflectors. The velocity of frozen Peel Sound Formation, relative to unfrozen, can create "velocity anomalies" on reflectors beneath a thinned permafrost zone. The magnitude of these anomalies depends upon the frozen/unfrozen velocity difference controlled by the porosity of the Peel Sound and the amount of permafrost thinning. An example of a suspected "velocity-sag" created by a permafrost thin, is centered at shot point 720, traverse Q-Q' (see Fig. 20 in section on structure and tectonics).

Rock types of the sandy lithofacies

Only the sandy lithofacies will be discussed in this report. A complete section of the lithofacies is present in stratigraphic section 185B (Appendix A). Approximately the lower half of the section consists of interbedded sandstone and carbonate rocks while the upper part consists of sandstone interbedded with conglomerate. Upward change is gradational. Red weathering colours start in the lower part of the facies and become more pronounced upward.

In the lower part the amount of interbedded sandstone increases upward. The carbonate rocks comprise dominantly dolostone; limestone is present only in a few intervals and is most common in the lowest part of the facies. The dolostone is sandy, fine crystalline and weathers to yellow or red. It is thick bedded, with wavy and planar lamination, desiccation cracks and molar tooth structures. The limestone is shaly or dolomitic and thick bedded. Burrow mottles, stromatoporoids and gastropods are common. The sandstone is mostly a dolomitic, fine-grained, yellow-grey quartz arenite. Grains are well sorted and rounded. It is thick bedded and shows some ripple marks and some planar lamination. Some of the lowest beds are bioturbated.

In the upper part of the sandstone facies barely any carbonate beds are present and the amount of interbedded conglomerate increases upwards (Fig. 18). The sandstone is variable, most commonly a fine- to medium-grained, dolomitic quartz arenite with chert and limestone granules. The coarser components also form local conglomerate lenses. The general weathering colour is yellow to pale red. Rare sandstone beds show bioturbation and contain fossil fragments.

The conglomerate is thick bedded and mostly of granule and pebble grade. Cobble grade intervals are rare. The lithoclasts are well rounded and moderately well sorted carbonate clasts. Clasts derived from the crystalline basement are rare and occur only in the uppermost part of the facies. The dominant carbonate composition and the granule and pebble grade are in contrast to the composition and lithoclast size of the overlying conglomerate facies, where the clasts are of metamorphic origin and of cobble and, less commonly, boulder grade. The conglomerate of the sandstone facies has a sand matrix and the clasts are locally imbricated. Weathering colour is moderately red and pale yellow-green.

Figure 18. *Field photograph of the Peel Sound Formation. Upper part of sandstone member is recessive weathering and consists of interbedded maroon sandstone and conglomerate. The resistant units are formed by the lower part of the conglomerate member (Stratigraphic Section 185B, unit 34 and above) (GSC photo no. 4738-14).*

Age and correlation

Along eastern Prince of Wales Island the age of the lower member of the Peel Sound Formation has been reported by Thorsteinsson and Uyeno (1980) as late Ludlow to early Pridoli; the upper member is late Lochkovian (Thorsteinsson and Uyeno, *ibid.*). The Peel Sound Formation correlates with the upper member of the Drake Bay Formation.

Origin

The sandy facies represents a progradational continental-to-marine syntectonic depositional system. As this system prograded, probably westward, open- to restricted-marine conditions in the lower part were replaced gradually by more continuously restricted-marine environments, then by fluvial environments. The latter conglomeratic facies were likely deposited in gravelly braided streams. Fully alluvial fan facies were not recognized in this study. Lithoclasts in conglomerate beds are mostly carbonate with rare basement-derived lithoclasts only in the upper part.

Lithoclasts in the overlying conglomerate facies consist predominantly of metamorphic rock fragments. This upward change in composition reflects a normal un-roofing history observed in uplifted cratonic blocks elsewhere. It reflects stream incision through the Phanerozoic cover into the underlying Precambrian intrusive, sedimentary and crystalline basement.

CONODONT BIOSTRATIGRAPHY

Introduction

A few samples were collected for conodonts from each measured section and some isolated localities in the map area were also sampled. A total of twenty-seven samples were processed from measured sections and an additional four from isolated localities on Traverse 9 (localities T9-2 and T9-4 north of Back Bay, Map 2016A). Twenty-three of these produced conodonts, but many of the productive samples are quite sparse (Table 6). However, the biostratigraphic ages derived from some of these faunas have been critical to understanding the stratigraphy of the region, commonly adjusting formational assignments that were based on fieldwork alone.

The results are described below for each section in order from north to south. No samples were available from Sun Panarctic Russell E-82 or Kerr McGee Young Bay F-62, but samples from these wells were reported on by Mayr et al. (1980).

Sections are dealt with in numerical order and are also presented in numerical order in Table 6. Selected conodonts are illustrated on Plates 1 to 3 and the figured specimens are stored in the National Type Collection of Invertebrate and Plant Fossils housed at the Geological Survey of Canada.

Biostratigraphy

Section 7. All five samples collected from this section of the unnamed unit on Prescott Island yielded conodonts, although three of the recovered faunas are extremely sparse. The lowest sample (GSC loc. C-257794 at 340.75 m) yielded a moderately diverse Early Ordovician fauna comprising mainly long-ranging species that collectively indicate a possible range from late Stairsian to Blackhillsian based on the ranges described in Ross et al. (1997). The taxa recovered include *Drepanoistodus*? *gracilis* (Branson and Mehl), *Eucharodus parallelus* (Branson and Mehl) and *Oneotodus costatus* (Ethington and Brand) as well as an Sa element that is probably part of a *Diaphorodus* apparatus (see Plate 1 for some illustrations of this fauna). This sample is from subdivision 3 of the lower member of the unnamed unit.

A sample of dolostone from the 381.25 m level in section 7 (GSC loc. C-257795), also within subdivision 3, yielded a moderately diverse conodont fauna. This includes an Sd element, probably assignable to a species of *Diaphorodus*, a specimen of *Dischidognathus* aff. *D. primus* Ethington and Clark, a few specimens of *Drepanoistodus*? *gracilis* (Branson and Mehl) and one specimen each of *Oneotodus costatus* Ethington and Brand and *Ulrichodina abnormalis* (Branson and Mehl) (see Plate 1 for some illustrations of this fauna). This fauna indicates an Early Ordovician (Ibexian, probably Tulean Stage or younger) age for the sample. The specimen assigned to *Dischidognathus* (Pl. 1, fig. 15) is similar to the described species *D. primus* Ethington and Clark, known from strata of Whiterockian age, but differs in some of the features outlined for a probable older species by Ethington and Clark (1981). Their analysis included consideration of material from the middle part of the Eleanor River Formation in the Arctic Islands that had been illustrated by Nowlan (1976). This unit is at least partly equivalent to the Eleanor River Formation elsewhere in the Canadian Arctic Islands.

A sample taken at 487.25 m in section 7 (GSC loc. C-257796) bears a single specimen of *Panderodus* (Pl. 2, fig. 10). This long-ranging genus makes its first appearance in the Whiterockian and therefore the sample is of Middle Ordovician or younger age. Another few specimens of *Panderodus* occur higher in GSC loc. C-257798 at 539.25 m above the base of Section 7. In between these two occurrences, a single prioniodiniform element occurs in

Table 6
Distribution of conodont species

Sections:	Section 7					Section 184					Section 185A								Section 185B			Section 186					Traverse 9				
Metres:	341	381	487	502	539	104	109	264	341	371	45	58.5	76.5	103	125	165	285	564	49	52	397	16.5	41	239	221	401					
Sample numbers:	C-257794	C-257795	C-257796	C-257797	C-257798	C-246388	C-246389	C-246391	C-246393	C-246394	C-246399	C-246400	C-246401	C-246402	C-246403	C-246405	C-246406	C-246407	C-246410	C-246411	C-246417	C-246420	C-246421A	C-246422	C-246423	C-246425	C-246429	C-246430	C-246431	C-246432	
ORDOVICIAN CONODONTS																															
Aloxoconus sp.	0	0	0	0	0						0	1	0	0	0	0	0	0				0	0	0	0	0	0	0			1
Belodina sp.	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	1			1
Clavohamulus sp.	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	1	0	0	0			1
Cordylodus drucei	0	0	0	0	0						8	0	0	0	0	0	0	0				0	0	0	0	0	0	0			8
Cordylodus lindstromi	0	0	0	0	0						16	0	0	0	0	0	0	0				0	0	0	0	0	0	0			16
Cordylodus sp.	0	0	0	0	0						0	1	0	0	0	0	0	0				0	0	0	0	0	0	0			1
Diaphorodus sp.	1	2	0	0	0						0	0	0	0	0	2	0	0				0	0	0	0	0	0	0			5
Dischidognathus aff. *D. primus*	0	1	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	0			1
Drepanoistodus? *gracilis*	3	9	0	0	0						0	0	0	0	0	2	0	0				0	0	0	0	0	0	0			14
Drepanoistodus suberectus	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	4			4
Eucharodus parallelus	3	0	0	0	0						0	0	0	0	0	2	0	0				0	0	0	0	0	0	0			5
Oneotodus costatus	6	1	0	0	0						0	0	0	0	0	3	0	0				0	0	0	0	0	0	0			10
Oulodus? sp.	0	0	0	0	0						0	0	0	0	0	0	5	0				0	0	0	0	0	0	0			5
Panderodus gracilis	0	0	0	0	0						0	0	0	0	0	0	9	0				0	0	0	0	0	2	26			37
Panderodus panderi	0	0	0	0	0						0	0	0	0	0	0	2	0				0	0	0	0	0	0	0			2
Panderodus sp.	0	0	1	0	0						0	0	0	0	0	0	0	1				0	0	0	0	0	0	0			2
Parapanderodus emarginatus	0	0	0	0	0						0	0	0	0	0	4	0	0				0	0	0	0	0	0	0			4
Paroistodus? sp.	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	2			2
Plegagnathus sp.	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	2			2
Pseudobelodina? *dispansa*	0	0	0	0	0						0	0	0	0	0	0	1	0				0	0	0	0	0	0	1			2
Teridontus gracillimus	0	0	0	0	0						3	0	0	0	0	0	0	0				0	0	0	0	0	0	0			3
Ulrichodina abnormalis	0	1	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	0			1
Variabiloconus bassleri	0	0	0	0	0						32	0	0	0	0	0	0	0				0	0	3	2	0	0	0			37
Variabiloconus sp.	0	0	0	0	0						0	0	0	2	0	0	0	0				0	0	0	0	0	0	0			2
Walliserodus sp.	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	0	0	3			3
acontiodontiform element indeterminate	0	0	0	0	0						0	0	0	0	0	0	0	0				0	0	0	0	1	0	0			1
prioniodiniform element indeterminate	0	0	0	1	1						0	0	0	0	0	0	0	0				0	0	0	0	0	0	0			2
polygnathid element	0	0	0	0	0						1	0	0	0	0	0	0	0				0	0	0	0	0	0	0			1
SILURIAN CONODONTS																															
Oulodus sp.						0	0	8	0	0									0	0	0								0	0	8
Ozarkodina douroensis						0	0	12	0	0									0	0	0								0	0	12
Ozarkodina excavata excavata						0	0	63	0	0									0	0	0								3	0	66
Ozarkodina n. sp. H (Uyeno, 1981)						0	0	0	19	9									0	22	0								0	0	50
Ozarkodina sp.						0	0	0	0	0									4	0	0								0	0	4
Panderodus gibber						0	0	5	0	0									0	0	0								0	0	5
Panderodus gracilis						0	0	168	0	0									0	0	2								1	0	171
Pedavis aff. *P. thorsteinssoni*						0	0	0	54	0									0	39	0								0	0	93
?*Pedavis* sp.						0	0	0	0	0									21	0	0								0	0	21
?*Peleksgnathus arcticus*						0	0	0	0	1									1	0	0								0	0	2
indeterminate icriodontid coniform elements						0	0	0	0	24									0	0	9								9	9	33
fish scales						10	0	0	0	0									0	0	0								0	0	10
TOTAL	13	14	1	1	1	10	0	256	73	34	60	2	0	2	0	13	17	1	26	61	11	0	0	3	3	1	2	2	2	2	648

GSC loc. C-257797 at 502.25 m. This element is not specifically identifiable, but may be part of an *Erismodus* type of apparatus (Pl. 2, fig. 8). Such an interpretation is supported by the shallow basal cavity, generally rounded cusp and denticles, and a darker hyaline appearance.

Section 184. Four of five samples from the unnamed unit and the Douro and Peel Sound formations in this section at Flexure Bay yielded phosphatic microfossils. One of the productive samples**,** from the 104 m level of this section (GSC loc. C-246388) in the upper member of the unnamed unit, produced some small phosphatic microfossils that may represent fish scales.

A sample from the lower part of the Cape Storm Formation (108.5 m, GSC loc. C-246389) proved to be barren of conodonts and other microfossils.

A sample from the Douro Formation (264 m; GSC loc. C-246391) produced an abundant conodont fauna of Late Silurian (Ludlow) age. The fauna is numerically dominated by simple cone elements assignable to *Panderodus*, but there are also moderately abundant elements assignable to *Ozarkodina*. A majority of these are identified as the long-ranging *O. excavata excavata* (Branson and Mehl), but the key diagnostic species is *O. douroensis* Uyeno, which was originally described by Uyeno (1981) based partly on material from Prince of Wales Island. A few specimens probably assignable to *Oulodus* are also present. For illustrations of the species present in this sample see Plate 2.

Two samples from the Peel Sound Formation in this section yielded conodonts. The lower sample (340.8 m, GSC loc. C-246393) yielded a fauna similar to that from samples of the basal part of the Peel Sound Formation in section 185B (GSC loc. C-246410, C-246411). The fauna comprises abundant specimens of *Ozarkodina* n. sp. H of Uyeno (1981) and *Pedavis* sp. aff. *P. thorsteinssoni* Uyeno. This fauna indicates a Late Silurian (late Ludlow) age for the unit. A similar fauna has been recovered from slightly higher in the section (370.8 m; GSC loc. C-246394) which includes numerous specimens of *Ozarkodina* n. sp. H of Uyeno (1981) and a single fragmentary specimen of *Pelekysgnathus arcticus* Uyeno. This fauna indicates a Late Silurian (late Ludlow) age for the sample.

Section 185A. A sample from this section just north of Le Feuvre Inlet, 45 m above the base of the section, just above the top of subdivision 1 of the lower member of the unnamed unit (GSC loc. C-246399) yielded an abundant and diverse fauna of earliest Ordovician age. The fauna comprises specimens of the diagnostic *Cordylodus lindstromi* Druce and Jones (Pl. 1, figs. 7–9) which indicates an earliest Ordovician age based on the newly defined base of the Ordovician (Cooper and Nowlan, 1999; Nicoll et al., 1999). The sample also yielded specimens of *C. drucei* Miller, *Teridontus gracillimus* Nowlan and *Variabiloconus bassleri* (Furnish) (Pl. 1). This part of subdivision 1 is clearly age equivalent to the Cape Clay Formation. This sample also produced a specimen of a juvenile polygnathid suggestive of a Devonian age (Pl. 2, fig. 25). It is assumed that this represents contamination in the sample, either from field collection or lab preparation.

A sample from subdivision 2 (58.5 m; GSC loc. C-246400) yielded two conodonts assignable to *Aloxoconus* sp. and *Cordylodus* sp. These also indicate an Early Ordovician (Ibexian; Skullrockian) age. A sample from slightly higher in subdivision 2 (76.5 m; GSC loc. C-246401) was barren of conodonts and other microfossils. A sample from the uppermost part of subdivision 2 (103.0 m; GSC loc. C-246402) yielded two fragmentary specimens of *Variabiloconus* sp. indicative of an Early Ordovician age.

A sample from the lower part of subdivision 3 proved barren of conodonts (124.5 m; GSC loc. C-246403). However, a sample from higher in the unit (165 m; GSC loc. C-246405) yielded biostratigraphically diagnostic conodonts. Specimens of an Sc element probably assignable to *Diaphorodus* are present together with *Drepanoistodus*? *gracilis* (Branson and Mehl), *Eucharodus parallelus* (Branson and Mehl), *Parapanderodus emarginatus* (Barnes and Tuke) and *Oneotodus costatus* Ethington and Brand. This fauna indicates an Early Ordovician (Ibexian; Stairsian to Blackhillsian) age and suggests that these strata are partly equivalent to the Eleanor River Formation. A number of specimens from this sample are illustrated in Plate 1.

A sample from the base of the upper member of the unnamed unit (285.0 m; GSC loc. C-246406) yields a markedly different and younger Ordovician conodont fauna. The fauna comprises long-ranging Middle to Late Ordovician species *Pseudobelodina*? *dispansa* (Glenister) and *Panderodus panderi* (Stauffer). Together, these species indicate a late Middle Ordovician (Kirkfieldian) to Late Ordovician (Gamachian) age for the sample. Specimens probably assignable to *Oulodus* (Pl. 2, fig. 11–14) are also present in this collection, however, only Sc, Sb, Sa? and M elements are available for study and a specific assignment is not possible. The Sc element bears a small lateral process with a single denticle and the M element has a broad, high cusp and is lacking an anterior denticle. The lack of identifiable P elements precludes a specific identification.

A sample from high in the section (564.0 m, GSC loc. C-246407), interpreted to be within the upper part of the upper member of the unnamed unit, yielded only long-ranging conodonts assignable to *Panderodus gracilis* (Branson and Mehl) and some denticulate fragments. This assemblage indicates a Middle Ordovician to Middle Devonian age.

Section 185B. Three samples from the Douro and Peel Sound formations in this section just north of Flexure Bay have been processed and all produced some conodonts. The lowest sample (GSC loc. 246410, 49 m) contains only fragmentary material from which can be identified some elements of *Ozarkodina* sp. and ?*Pedavis* sp. This material is suggestive of a Late Silurian age, but it is not diagnostic in the context of an overlying sample that constrains the age better.

A sample from 52 m (GSC loc. C-246411) within the basal part of the Peel Sound Formation yields the most diagnostic fauna from this section. Several specimens are assignable to *Ozarkodina* n. sp. H of Uyeno (1980) and several others to *Pedavis* aff. *P. thorsteinssoni* Uyeno (Pl. 3). This combination of taxa has been found before by Uyeno (1981; GSC locs. C-63587, C-63589) in the lower beds of the lower member of the Peel Sound Formation where it was assigned a Late Silurian, late Ludlow age. Some of the Pa elements assigned to *O.* n. sp. H of Uyeno (1980) show the shallow and narrow groove on the upper surface of the denticles (Pl. 3, fig. 2), a feature similar to that of the younger (Pragian) *Eognathodus sulcatus* Philip.

A higher sample, at 396.5 m in the section, from the Peel Sound Formation (GSC loc. C-246417) yields only a few specimens of *Panderodus gracilis* (Branson and Mehl) and a few icriodontid simple cone elements. The age range of this sample is Middle Ordovician to Middle Devonian.

Section 186. Five samples from this section yielded only a few conodonts; three of the samples were barren. A sample from the lower part of this section (GSC loc. C-246420 at 16.5 m) in subdivision 1 of the lower member of the unnamed unit was barren of conodonts and other microfossils. A sample from subdivision 2 (GSC loc. C-246421A) taken 41.0 m above the base of the section was also barren.

The lowest productive sample in this section was taken from the upper part of subdivision 2 (GSC loc. C-246422, 239.1 m). It yielded three fragmentary conodonts assignable to *Variabiloconus bassleri* (Furnish) which indicate an Early Ordovician (Ibexian, Skullrockian) age for the sample. This unit is probably equivalent to the Cass Fiord Formation. Another sample taken 221 m above the base of the section (GSC loc. C-246423) also yielded a couple of fragmentary specimens of *V. bassleri* as well as a single specimen of *Clavohamulus* sp. of the type assigned as an *a* element by Ji and Barnes (1994). This fauna is further evidence of the Early Ordovician (Ibexian, Skullrockian) age of the upper part of subdivision 2. Illustrations of some of this material are shown on Plate 1.

The highest sample from section 186, within subdivision 3 of the lower member of the unnamed unit (GSC loc. C-246425, 340.6 m), yielded a single, small, fragmentary simple cone conodont element. The fragment is acontiodiform and might represent part of a *Coelocerodontus* sp. apparatus, but it is too fragmentary to be identified with certainty. Therefore the age of this subdivision in section 186 is not known.

Isolated samples taken on field traverse 9. One sample from the upper member of the unnamed unit collected on traverse 9 in the vicinity of a small unnamed lake about 12 km north of Back Bay yielded the best collection of Late Ordovician conodonts from the area (GSC loc. C-246430; locality T9-2, see Map 2016A). Although numerically dominated by specimens of the long-ranging species *Panderodus gracilis* (Branson and Mehl), it also produced the biostratigraphically diagnostic form *Plegagnathus* sp. which indicates a Late Ordovician (Edenian to Gamachian) age for the sample. The sample also includes specimens of *Belodina* sp., *Drepanoistodus suberectus* (Branson and Mehl), *Panderodus gracilis* (Branson and Mehl), *Paroistodus*? sp., and *Walliserodus* sp. A number of specimens from this sample are illustrated on Plate 2.

Another sample from the upper member of the unnamed unit, collected on traverse 9 and stratigraphically above GSC loc. C-246430, produced conodonts of probable Silurian age (GSC loc. C-246431; locality T9-4, see Map 2016A) including ?*Ozarkodina excavata* (Branson and Mehl) and *Panderodus* sp.

The remainder of samples from this traverse were either barren (GSC loc. C-246432) or produced undiagnostic conodonts (GSC loc. C-246429).

Sun Panarctic Russell E-82 and Kerr McGee Young Bay F-62. No new samples have been collected from these wells. Previous data were reported by Mayr et al. (1980) and are briefly summarized below.

Silurian conodonts of the Late Silurian (Lulow to Pridoli) *Ancoradella ploeckensis*, *Polygnathoides siluricus*, and *Ozarkodina remscheidensis* zones were recovered from the Read Bay and Drake Bay formations of the Russell E-82 well. Early Devonian conodonts were recovered from high in the Drake Bay Formation in the Russell well.

A fauna was reported from the 1127.8–1158.2 m level in the Young Bay well that includes mainly long-ranging Early Ordovician species suggestive of an Early Ordovician (Ibexian, early Stairsian to early Blackhillsian) age. A fauna of Late Silurian (Ludlow, *siluricus* Zone) age was reported by Mayr et al. (1980) from the Cape Storm Formation in the Young Bay well.

Thermal Maturation

Conodonts from Section 7 generally display conodont colour alteration index values of 1 (CAI of Epstein et al., 1977; Rejebian et al., 1987) implying little or no thermal alteration. However a few samples higher in the section (GSC loc. C-257796–C-257798) may have CAI values of up to 2, but there are so few specimens this cannot be verified. CAI values of 2 indicate thermal alteration in the range of 60º to 140ºC.

Conodonts in all the other sections generally have CAI values of 1, indicating little or no thermal alteration; however, a few samples may have values in the CAI 1.5 range, but in such samples only some of the specimens indicate the higher levels and collectively these samples show no regional pattern of alteration. CAI values of 1.5 indicate thermal alteration in the range of 50º to 90ºC. It seems likely that there has been little or no regional thermal alteration, but some may have taken place locally, perhaps relating to local faults.

STRUCTURE AND TECTONICS

Introduction

The evolution of the Boothia Uplift has been described most recently by Okulitch et al. (1986, 1991) and de Freitas and Mayr (1993). Within the report area, the former synthesis was based largely on earlier mapping by Christie et al. (1971), gravity data from Berkout (1973) and interpretations by Kerr (1977). Unpublished field data collected by J. Wm. Kerr and others in 1970 on Prince of Wales Island were not utilized in that study. The latter paper focused on details of the stratigraphy and structure of the northernmost part of the uplift on Devon Island, which provided essential data that permitted clarification of the development of the entire uplift. Re-assessment of regional stratigraphic, structural and geophysical data resulted in an improved model, which bears on interpretation of features in the report area.

Five days of fieldwork with only ground transportation permitted examination of just a few localities in the frontal fold and thrust belt of the uplift between Le Feuvre Inlet and Flexure Bay. Major structures of the crystalline basement were not examined in the field, however seismic data provide some evidence for interpretation. Description and interpretation of the rest of the belt in the report area is based on earlier and newly gathered field data compiled by U. Mayr and geophysical data processed and interpreted by T. Brent (Fig. 19, 20).

The Boothia Uplift has been divided into southern and northern segments in recent reports (see above), based primarily on the differing structures developed in the thin platformal cover of the southern segment and those somewhat younger ones in the substantially thicker slope to basinal succession of the northern segment. Basement is not exposed in the north and its structures can only be inferred. The report area contains the westernmost part of the southern segment. Here both basement and cover are exposed, and therefore significant insights into the development and interaction of structures in both are provided.

The uplift was illustrated as a segmented, west-directed, intracratonic uplift that crossed a cratonic margin into a deep-water basin (Christie, et al. 1971; Okulitch, et al. 1986, 1991; de Freitas and Mayr, 1993). North-south gneissic fabric controlled the overall form of the uplift. The basement is cut by northwest, west, and northeast-trending faults and fractures that influenced its division into northern and southern segments and its subdivision into numerous small blocks that acted semi-independently of one another. As a result, the frontal fold and thrust belt, although continuous for 500 km along the southern segment and with consistent west-verging geometry, is remarkably heterogeneous in detail. Blocks with their own consistent geometry rarely exceed 10 km in strike length; a few are as small as 2 km long (see Map 2016A).

Estimates of crustal shortening on all structures and displacement on faults are generally not possible because, with few exceptions, the dips of faults both at the surface and, particularly at depth, are unknown. Stratigraphic throw and omission can be estimated in some instances. Overall shortening appears to increase from south to north on Prince of Wales Island, reaches a maximum in two blocks on Pandora and Prescott islands, and decreases northward. Descriptions of structures in the report area will be from south to north.

Description of structures

Precambrian structures

Paleoproterozoic. Seismic reflection data in the vicinity of Young Bay (Fig. 19) show primary energy interpreted as arising from within the pre-Mesoproterozoic basement complex of metamorphic and igneous rocks beneath the Paleozoic cover. Reflecting interfaces exist within the basement and provide seismic energy that suggests basic structural geometries (Fig. 19). Velocity and density contrasts within this complex are assumed to exist along compositional layering (e.g., marble and mafic layers within the gneiss). Surface exposures of the basement on eastern Prince of Wales Island do not exhibit such compositional layering, however, this is a relatively narrow outcrop belt parallel to regional strike, and is not necessarily representative of basement rocks farther west.

A fundamental change in geophysical characteristics occurs across a line between the head of Le Feuvre Inlet and the point on Prince of Wales Island adjacent to Prescott Island referred to as the “Young Bay Line” (Map 7, Fig. 19). This line coincides approximately with one of several north-trending reverse faults mapped in the subsurface and plotted at the sub-Cambrian unconformity (e.g. Traverse J-J', line KM7246, Shotpoint 10). A positive magnetic trend is roughly centred on this line and it also marks a west-to-east decrease in Bouguer gravity values (gravity and magnetic mapping is illustrated on Fig. 19, Maps 5 and 6, respectively). In general, the Young Bay Line is coincident with a seismic expression change from an apparent west-verging, Precambrian thrust belt to the west, to a more gently west-tilted block in the east, presumed to contain the steeply dipping tectonic fabric observed at the surface to the east of the main Boothia thrust mapped at surface.

Nine seismic traverses on Figure 19 illustrate the character of basement features. Map 7 (also on Fig. 19) shows tectonic elements. The shot point locations of individual lines that make up the traverses are also shown on Map 7. The aspect ratio of the seismic display is approximately 1:1 and has increased contrast to enhance major reflecting segments. The seismic interpretation (see basement structure seismic interpretation legend, Fig. 19) includes the highlighting of intra-basement reflectors (in blue) and is intended to illustrate a selection of apparent attitudes on seismic energy considered likely to be primary (real). These highlighted reflectors do not represent any particular stratigraphic level or all the primary energy. Some reflectors are interpreted as igneous intrusions, particularly on the eastern part of Map 7, where decreased Bouguer gravity values suggest the basement complex has relatively lower density and may provide a greater contrast with intrusions.

West of the Young Bay Line, the basement is characterized largely by a variety of north-trending thrust-like structures consisting of east-dipping (40°–60°) panels of rock, some of which appear to roll over above west-verging ramps with similar attitudes (e.g., west end of traverse I-I', Fig. 19). The structures are spaced approximately 6 km apart and are abruptly truncated by the sub-Cambrian or sub-Mesoproterozoic unconformities. Magnetic and gravity trends are roughly north-south and support the north-trending seismic interpretation. Elsewhere the seismic expression is characterized by reflective geometries exhibiting diverging dips (e.g., traverse M-M', line KM7231, shotpoint 28). Approximately 30 km west of, and parallel to the Young Bay Line, basement seismic expression becomes incoherent or chaotic beneath an otherwise well-imaged Palaeozoic cover, possibly indicating seismically unresolvable near-vertical dips or intense deformation (see Fig. 19, western parts of traverses M-M', N-N' and G-G'. This is accompanied by a westward change to lower magnetic and higher gravity values. This suggests another change in basement domain, possibly to a more compositionally homogeneous one.

East of the Young Bay Line, the basement structure appears as a mildly reflective panel of rock, dipping west no more than about 25° (see Fig. 19, east ends of traverses L-L', M-M' and K-K'). Strong discordant seismic energy is evident on traverse K-K', and is interpreted as igneous intrusives within both gneiss and the Aston Formation. Identification of the top of the gneiss beneath the Aston Formation is not easy as the gneiss and the sandstone of the Aston Formation likely have similar densities. The Young Bay Line may mark an ancient post-Aston down-to-the-east rift that allowed some preservation of the Aston Formation before inversion and the onset of Cambrian deposition. The relatively high magnetic signature of this feature suggests it was a zone of weakness that facilitated intrusion of both MacKenzie and Franklin magmas.

The main north-trending, high-angle reverse fault bordering eastern Prince of Wales Island (see Map 7, Fig. 19) crosses seismic traverse N-N' (Fig. 19) near the eastern end. The amount of throw calculated at that point is a minimum of 1.4 km. It is worth noting that this surface-mapped Boothia thrust directly corresponds to a relatively sharp change in magnetic mapping.

Bouguer anomaly and total residual magnetic field data are shown on Figure 19, Maps 5 and 6, respectively. Some qualitative observations of potential field trends can be made. In the southern part of Prince of Wales Island, generally north-south-trending magnetic highs and lows approximately coincide with similar-trending gravity lows and highs. This general coincidence of gravity high aligning with magnetic low and magnetic high aligning with gravity low, seems to persist some distance offshore to the south although the trend swings to a northeast-southwest strike. The Paleozoic cover, as imaged on seismic data, is generally uniformly thinning southward and intrusive-free and if assumed to continue south in this manner, would have very little potential field signature. It appears then, that relatively high-density basement terrains are less magnetic, while the relatively low-density terrains have relatively higher magnetic susceptibility. This may have arisen from increased amounts of magnetic minerals in low-density basement rock types or from an abundance of magnetic intrusive materials that might be concentrated in low-density basement but may not have invaded relatively higher density basement terrains.

The structural style of the gneissic rocks on Prince of Wales Island mirrors that of the Boothia-Somerset crystalline terrane. A north-trending structural grain reflects a compositional layering deformed by generally tight, upright folds. These folds are well seen in southern

Somerset Island and northern Boothia Peninsula, where they plunge gently to moderately north and south, but a lack of suitable marker units makes their recognition on Prince of Wales Island difficult. Brown et al. (1969) showed a number of north-south, moderately open to tight, megascopic folds in structural profiles along three east-west traverses on Prescott Island and near Cape Brodie, but in the absence of marker units and significant topographic relief, their profiles must be considered highly interpretative. Nonetheless, by analogy with the Boothia-Somerset terrane, the structural grain is a manifestation of regionally pervasive, north-south-oriented folds, recognized by Kerr and de Vries (1977) as having formed in a third major fold phase (F_3). Minor isoclinal folds with axial planes parallel to lithological contacts have been found in a few places in the study area and, again by analogy with the Boothia-Somerset terrane, are assigned to an early (F_1) fold phase. East-west-oriented folds related to an intermediate (F_2) event, recognized in the Boothia-Somerset terrane, have not been seen on Prince of Wales Island.

Mylonitic linear structure is widespread in the gneiss. It is most commonly marked by quartz grains, lenticles and ribbons but also by mafic schlieren and lenses. Measured lineations plunge 10–20° north and south. These features also characterize the gneiss on Boothia Peninsula and Somerset Island.

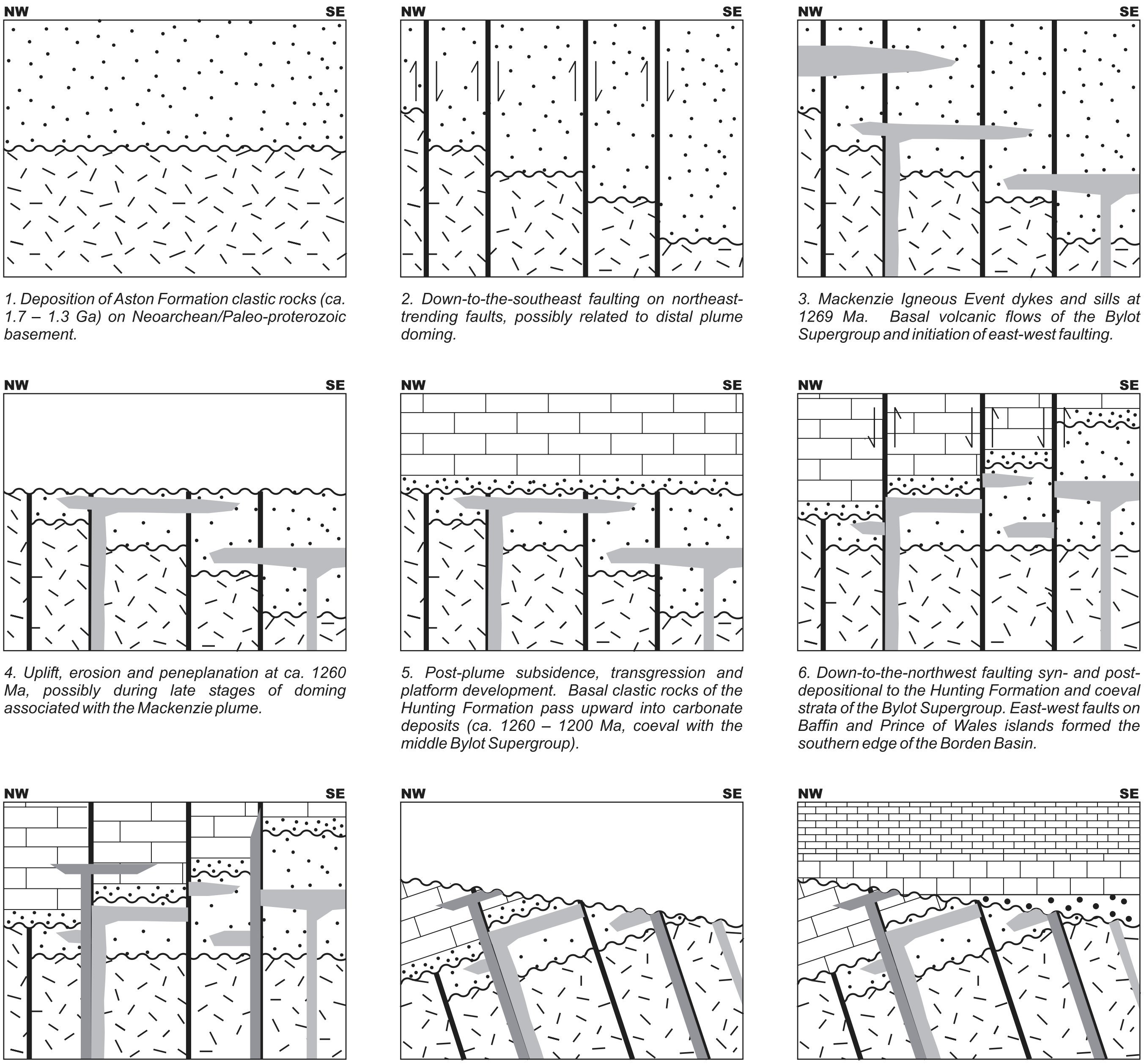
The consistency in structural style across the crystalline terrane of the Boothia Uplift from its eastern margin on Boothia Peninsula and Somerset Island to its western border on Prince of Wales Island suggests that the basement behaved as a rigid, albeit fractured**,** block during the entire tectonic history of the uplift.

Mesoproterozoic. Intrusion of the Aston Formation during the Mackenzie Igneous Event at 1268 Ma was accompanied by a regional rifting event (see section on tectonic evolution, below), followed by tilting, erosion and unconformable deposition of the Hunting Formation (Stewart, 1987). Syn- or post-Hunting faulting may have resulted in nondeposition or erosional stripping of the formation. This, combined with gentle folding and arching (Kerr and de Vries, 1977) during the Franklin Igneous Event (723 Ma), and uplift and peneplanation prior to the Paleozoic, removed the Hunting Formation from much of the report area except in the subsurface north of Browne Bay.

Along the southwest shore of Aston Bay on Somerset Island (Stewart, 1987, Map 1595A), the Aston Formation appears to thin discontinuously across northeast-trending normal faults that displace the Aston-Hunting unconformity, until it is entirely removed on northwesternmost Somerset Island (Cape Granite) where the Hunting Formation rests on crystalline basement (op cit., 1987). However, the contact between the Aston Formation and the crystalline basement does not appear to be significantly displaced. These relationships can be explained by the following scenario (Fig. 21): down-to-the-southeast faulting and erosion of the Aston, followed by deposition of the Hunting Formation, after or during which, faults were reactivated but with down-to-the-northwest displacement. In and north of the study area in the subsurface, the interpreted unconformity at the base of the Hunting Formation is displaced by several north-side-down normal faults, similar to those on Somerset Island but trending west-northwest. They may be responsible for the northward thickening and preservation of the Hunting Formation in the subsurface north of Prescott Island and are imaged on the seismic section P-P' (Fig. 20) on Russell Island northwest of the study area, and sections Q-Q' and R-R' (Fig. 20) north of Back Bay. This later episode may be related to faulting during deposition (circa 1240–1200 Ma) of carbonate rocks of the Uluksan Group in the Borden Basin to the east (Jackson and Iannelli, 1981; Sherman, et al., 2000). Fault zones on Somerset Island were subsequently intruded by Franklin dykes (Stewart, 1987). Northwest of the report area, Franklin sills have been interpreted on seismic section P-P' (Fig. 20).

Paleozoic structures

Strzelecki block. The fold and thrust belt begins north of Transition (Kennedy) Bay on Prince of Wales Island (Map 2016A). No distinct belt is present on Boothia Peninsula, projecting across Peel Sound to the southeast; only local structures that formed in response to limited displacements of small basement blocks are present. The belt is therefore first exposed south of Strzelecki Harbour. This southernmost block extends about 10 km in a northerly direction, ending at Le Feuvre Inlet, and has a width of about 2 km. In the south, basement is thrust southwestward against overturned, northeast-dipping Cambrian and younger strata. Absence of Paleozoic strata in the hanging wall indicates that displacement of the basement block on the fault plane is at least 500 m. The fault appears to be steeply east-dipping. Bedding becomes steeply southwest-dipping within the Douro and Peel Sound sandstone facies but is shallow in the Peel Sound conglomerate facies, suggesting unconformable relationships between the two units. A second, lower thrust begins in the Douro Formation at Strzelecki Harbour, cutting gently upsection and gaining displacement to Le Feuvre Inlet, where vertical to steeply overturned beds of the Peel Sound sandstone facies are thrust against gently west-dipping Peel Sound conglomerate facies strata. This fault is also steeply east-dipping and must have cut through an already folded, overturned and possibly overthrust succession along its axial surface and overturned bedding planes. This indicates



1. Deposition of Aston Formation clastic rocks (ca. 1.7 – 1.3 Ga) on Neoarchean/Paleo-proterozoic basement.

2. Down-to-the-southeast faulting on northeast-trending faults, possibly related to distal plume doming.

3. Mackenzie Igneous Event dykes and sills at 1269 Ma. Basal volcanic flows of the Bylot Supergroup and initiation of east-west faulting.

4. Uplift, erosion and peneplanation at ca. 1260 Ma, possibly during late stages of doming associated with the Mackenzie plume.

5. Post-plume subsidence, transgression and platform development. Basal clastic rocks of the Hunting Formation pass upward into carbonate deposits (ca. 1260 – 1200 Ma, coeval with the middle Bylot Supergroup).

6. Down-to-the-northwest faulting syn- and post-depositional to the Hunting Formation and coeval strata of the Bylot Supergroup. East-west faults on Baffin and Prince of Wales islands formed the southern edge of the Borden Basin.

7. Franklin Igneous Event (723 Ma) dykes largely followed older faults.

8. Arching, tilting and peneplanation, possibly related to doming associated with the Franklin plume or to younger events.

9. Transgression, deposition of Cambrian clastic rocks and development of the Paleozoic Arctic Platform.

Figure 21. *Possible sequence of events explaining the relationships between crystalline basement, overlying Proterozoic strata, Proterozoic intrusions, and Paleozoic strata on the northeastern flank of the Boothia Uplift at Aston Bay on Somerset Island, and their relationship to regional tectonostratigraphic and tectonomagmatic episodes of the northern mainland and the Arctic Archipelago.*

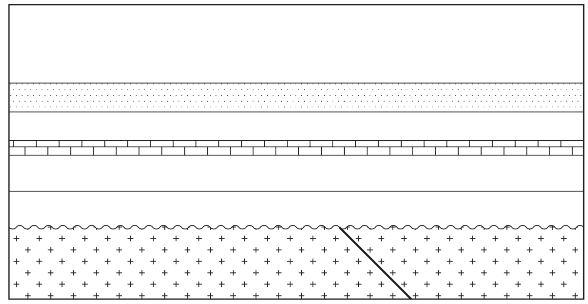
that two episodes of folding and thrusting occurred, or a continuum of deformation (Fig. 22). Displacement must equal the thickness of the Peel Sound sandstone facies – about 300 m. Displacement on the two faults in this block is therefore at least 1000 m and could be more if the thrusts become shallow at depth. The lower thrust does not extend across Le Feuvre Inlet, possibly dying away within the Peel Sound Formation north of the inlet.

Seismic section T-T' (Fig. 20) shows only minor, syndepositional or pre-Silurian faulting of basement and lowermost cover strata under the Peel Sound conglomerate facies well west of the fold and thrust belt. The basement surface is planar and very gently east-dipping. Near the eastern end of section T-T', a basement flexure and fault have propagated upward to form a vertical network of small faults almost to the surface. The east end of the seismic section T-T' extends into the fold and thrust belt, but no folded strata were clearly imaged, probably because of steep dips. Basement reflectors under the frontal structures were also not imaged.

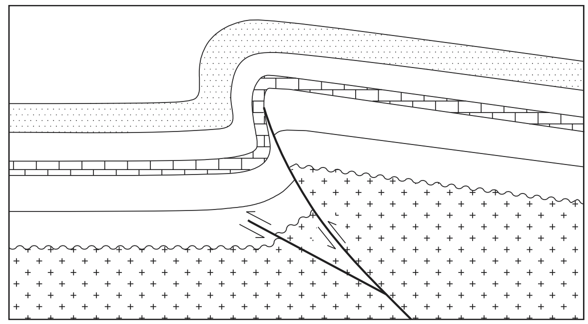
Le Feuvre-Brodie block. North of Le Feuvre Inlet to about the latitude of Cape Brodie, the belt follows a broad west-northwest-facing salient of moderately west-dipping strata displaying few thrust faults, but several sinistral and dextral strike-slip faults that segment the basement and cover into four sub-blocks. With the exception of its north and south ends, where there are faulted contacts, the Paleozoic succession lies unconformably on crystalline basement or its Proterozoic cover and diabase intrusions. The Proterozoic cover appears to have been preserved in a half-graben bounded on the south by a steep basement fault that later propagated into the Paleozoic strata. The Paleozoic strata cut downsection northward. The salient is interpreted as the result of two thrusts that carried a block of basement and its largely autochthonous Mesoproterozoic and Paleozoic cover, segmented by a central keystone sub-block. The sub-block south of the keystone is carried on the thrust from the Strzelecki block. The thrust below the keystone and in the sub-block north of the keystone is presumably blind. The broad expanse of gently dipping Cambro-Ordovician strata may be an original depositional feature relatively unaffected by Paleozoic deformation, which preserves some of the Proterozoic cover strata in local fault blocks. The minimal deformation and uplift of this block are also testified to by the absence of the Peel Sound conglomerate facies to the west of this part of the uplift.

The central part of seismic traverse N-N' (Fig. 19) extends from north of the west end of Le Feuvre Inlet westward. Little deformation is recorded in this section except two, very minor, west-directed thrust faults that displace basement and basal Cambro-Ordovician strata a few tens of metres. Faulting dies away in higher levels, likely through an array of smaller splays. Although small, the faults may be laterally continuous as similar features appear in other seismic traverses approximately along strike to the north.

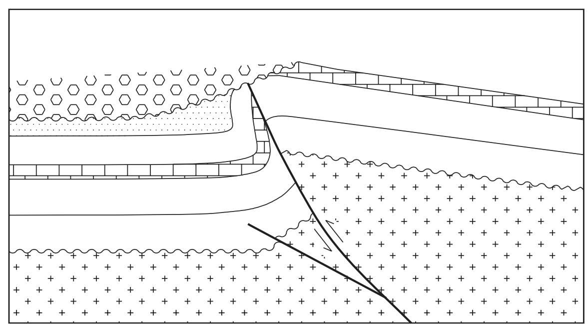
Brodie-Flexure block. The broad promontory between Cape Brodie and Flexure Bay is formed of two gneissic sub-blocks that impinge on several, small, imbricate thrust sheets in the Paleozoic cover. The fold and thrust belt begins with nearly zero displacement in the south but the main thrust fault cuts rapidly through a section overturned and faulted during initial stages of deformation until the inland gneissic sub-block rests against the Douro Formation at the middle of this block. Displacement decreases northward to where the belt turns nearly 90° at Flexure Bay and the



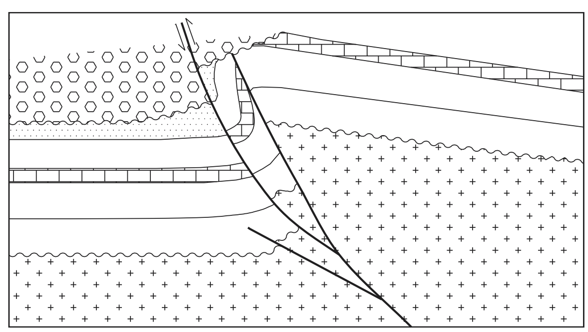
Initial stage. Platformal succession approximately 1 km thick over crystalline basement with incipient thrust fault. Patterned units are, from bottom to top: basement, Cape Storm Formation, and the sandstone facies of the Peel Sound Formation.



First stage of thrust faulting and overturned folding.



First stage of faulting and folding continues. Uplift and erosion produce deposition of the conglomeratic facies of the Peel Sound Formation (hexagon pattern).



Second stage of faulting carries the overturned fold limb against the Peel Sound conglomerate. Later tilting down to the west or arching of the crystalline core of the Boothia Uplift (not shown) brings the basement to the same elevation as the Peel Sound clastic wedge.

Figure 22. *Sequence of faulting and folding in Strzelecki structural block.*

inland gneissic sub-block ends. Maximum displacement on the fault on the west side of the inland gneiss sub-block is at least 800 m, depending on the length of the overthrust overturned fold limb, and is estimated from the thickness of the Paleozoic strata between the Douro Formation and the basement.

This thrust was examined where it is well exposed in an east-west gully near the middle of this block. The fault zone is about 5 to 10 m thick, dips steeply east and contains highly chloritized, sheared and brecciated gneiss (Fig. 23a) against overturned carbonate rocks of the Allan Bay Formation. Old gneissic foliation is somewhat variable. Most planes dip about 80° east, but some parallel later fractures and zones of shearing that dip 72°, indicating the influence of older anisotropy on faulting at this structural level. Another set of fractures and zones of chlorite breccia up to 1 m thick (Fig. 23b) dip 40–50° east but the relationship between the steeply and moderately dipping sets is unclear. Two episodes of faulting may be indicated. The carbonate rocks contain quartz-filled fractures and veinlets and are brecciated locally but otherwise appear undeformed. A few beds are offset on fractures that indicate top-to-west kinematics. The contrast in intensity of deformation between basement and cover supports overall control of the uplift by structures in the basement.

Immediately south of the flexure at Flexure Bay, east-west horizontal compression in overturned silty carbonate strata (probably Cape Storm Formation) is evidenced by top-to-the-west offset on gently north-dipping fractures (Fig. 24a) and conjugate fracture sets (Fig. 24b). Again, two episodes of movement or an evolving continuum of deformation are indicated (Fig. 25): initial folding and thrusting of cover by the adjacent basement block rising on a steep fault zone, followed by near-horizontal compression produced by either westward sliding of the top of the basement block against the overturned panel or compression of the horizontal limb of the cover on the basement block by another (coastal) block to the east moving up and westward.

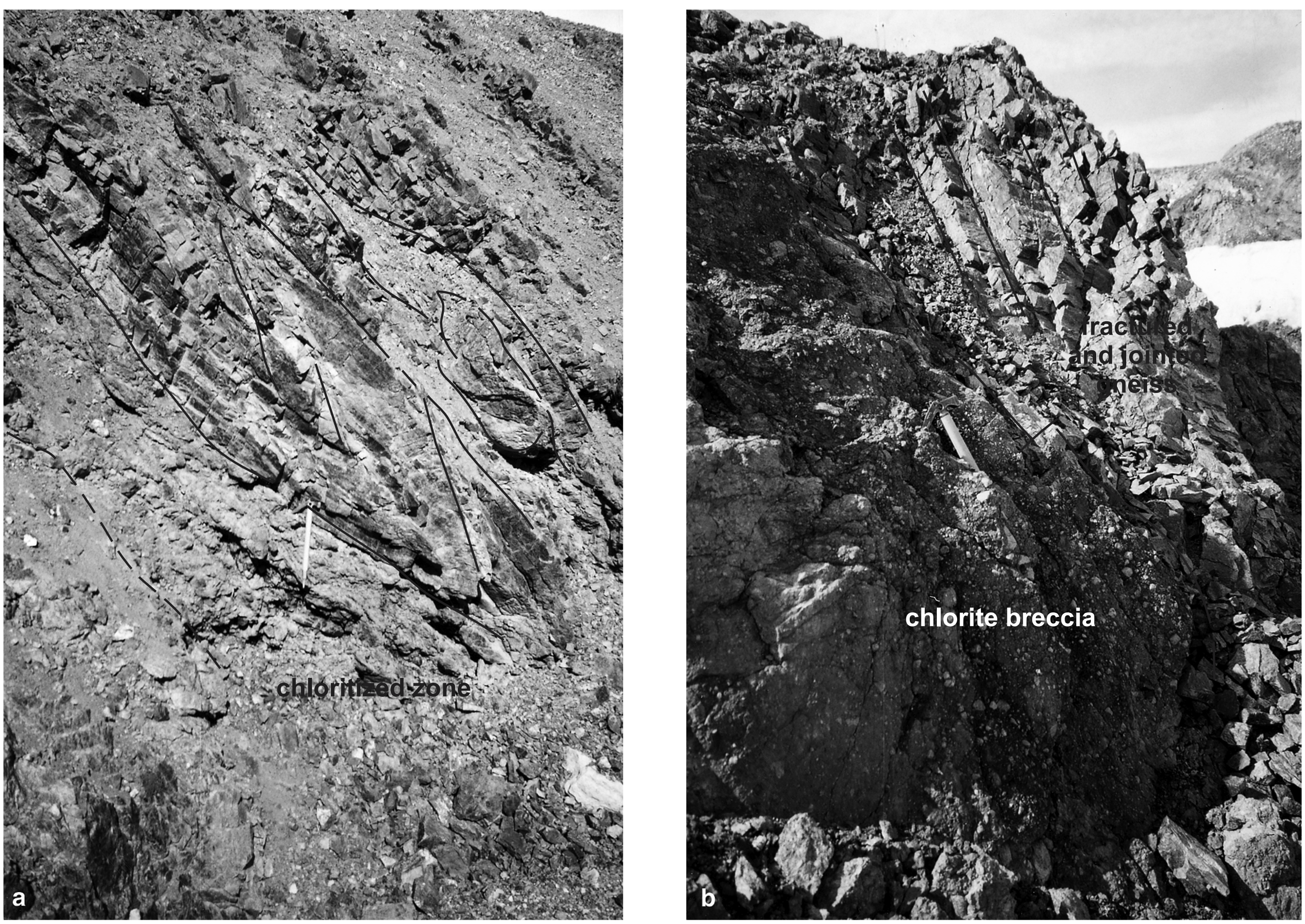


Figure 23. *Field photographs of main thrust.* ***a.*** *Chloritized shear zone between fractured basement gneiss (above and to the right) and Paleozoic platform strata (out of photograph to left). View is to north; hammer is about 45 cm long (GSC photo no. 4738-15).* ***b.*** *Chlorite breccia zone within fractured and jointed basement gneiss. Note minor normal fault that postdates overthrusting to right of hammer. View is to north (GSC photo no. 4738-16).*

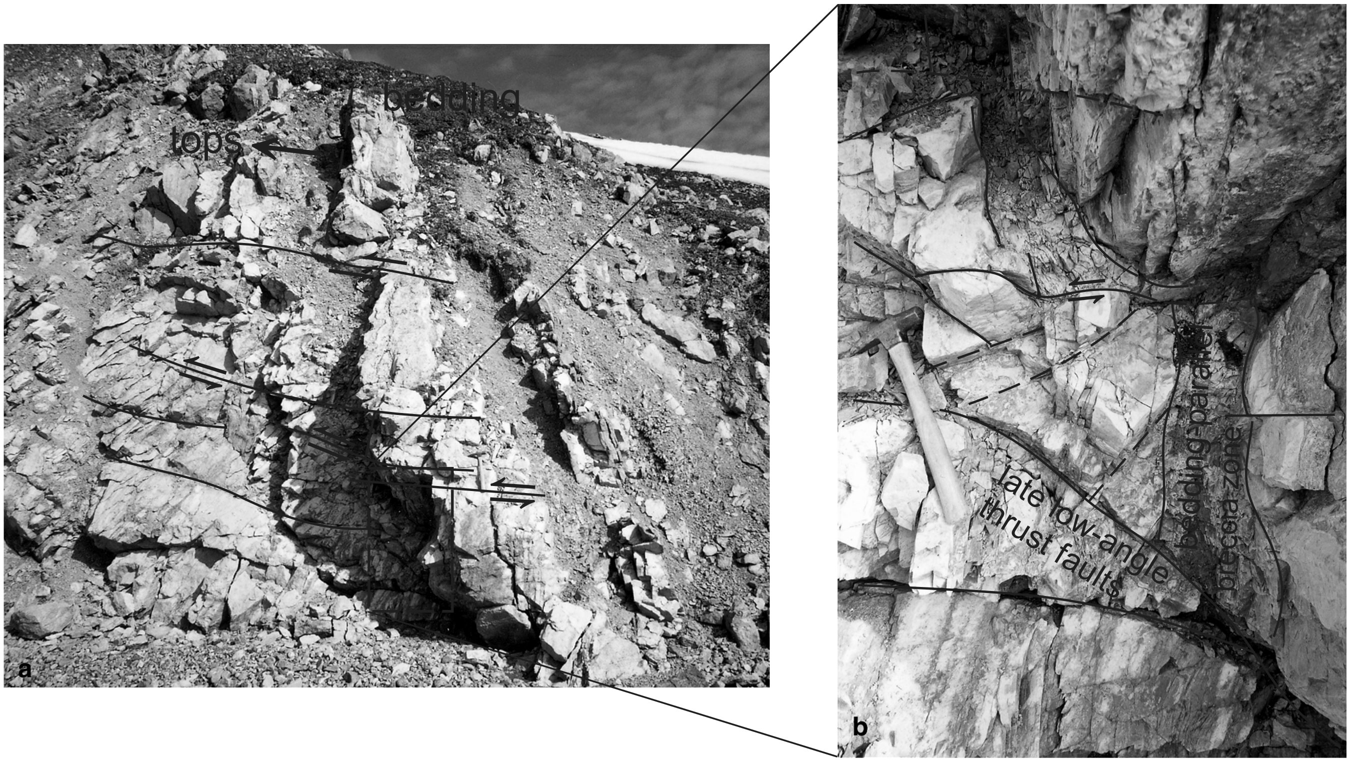


Figure 24. *Field photographs of main thrust.* ***a.*** *Vertical to overturned platform strata within 100 m of overthrust basement gneiss. Two episodes of deformation can be recognized: bedding-parallel brecciation developed during overthrusting and folding, followed by low-angle thrust faults. View is to north (GSC photo no. 4738-17).* ***b.*** *Enlarged part of* ***a*** *illustrates displacement of early breccia zone by later thrust faults (GSC photo no. 4738-18).*

The transverse portion of the thrust at Flexure Bay is not well exposed and it is possible that a strike-slip fault terminates the inland gneissic sub-block similar to the one postulated west of Cape Brodie. It is uncertain if thrusting on this portion was caused by a northerly component of basement displacement or the northern shoulder (lateral ramp) of a west-directed basement block. The north-trending thrust fault carrying the coastal gneissic block is marked by a prominent topographic lineament south of Flexure Bay but at the bay its displacement is sufficient only to overturn the cover strata.

Seismic section N-N' (Fig. 19) is the only one that passes from a gneissic block across the fold and thrust belt and westward under the synorogenic clastic deposits. The main frontal thrust is interpreted to lie within a transition zone that lacks reflectors between gently dipping strata to the west and rocks with poorly defined reflectors to the east. The belt itself is not imaged but can be located by surface mapping. Within 6 to 8 km to the west of the belt, open folds observed in the Peel Sound Formation can be traced into the subsurface and may be related to a small, steep thrust fault with less than 50 m westward displacement. About 10 km west of the belt a second, moderately east-dipping thrust appears to displace basement and basal cover strata about 100 m. Overlying strata take up the shortening through several open folds.

North Flexure block. North of Flexure Bay, the north-trending thrust fault brings basement up against the Cape Storm Formation at the coast and likely the Douro Formation offshore as displacement increases northward. Cover strata are imbricated on a small thrust at the bay and the deformation front lies within the Peel Sound conglomerate facies whose eastern edge forms the west limb of an overturned syncline. In the area of maximum displacement, basement presumably lies against the Douro Formation, a throw of at least 800 m.

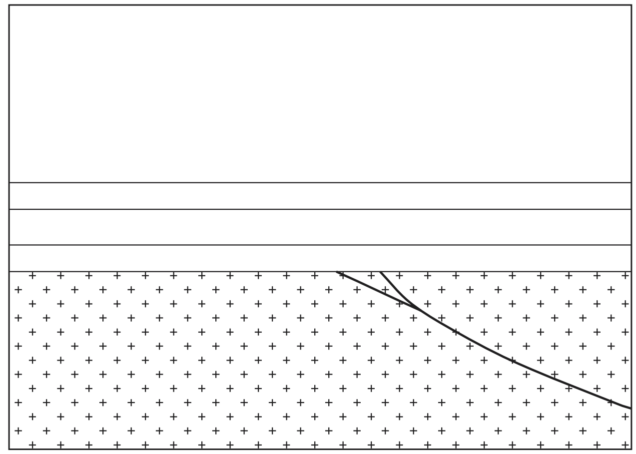
The eastern part of seismic section L-L' (Fig. 19) lies west of the deformation front. Paleozoic cover appears to lie on and infill a subdued topography of crystalline rocks and a prism of Aston Formation less than 500 m thick. The prism of Aston Formation caps a broad ridge about 100 m high that is apparently unrelated to basement structures.

Savage block. This block extends for 15 km along the coast south of Savage Point. Two broad promontories are underlain almost exclusively by Aston Formation and a large diabase sill of the Mackenzie Igneous Event. A narrow exposure of gneiss lies along the shore of the southern promontory. The Aston Formation and diabase are faulted against strata as high as the Douro Formation to the south, with two subsidiary faults at the top of the Douro. Apparent displacement decreases rapidly to the north to a minimum between the two promontories. Although such a decrease could be a result of deeper erosion levels at the northern promontory, the absence of basement suggests higher levels of erosion and less displacement compared to the southern promontory. West of Savage Point, the fold and thrust belt is arcuate over nearly 90° from northwest to northeast as it crosses the entrance to Young Bay onto Pandora Island. Strata as high as the Peel Sound sandstone facies remain overturned to the east, however, indicating that the frontal thrust still has significant displacement along the entire arc, and this fault is projected in the offshore parallel to it. As at Flexure Bay, the possibility of a northward component to the thrusting must be considered. Savage block is truncated by a presumably younger, northwest-trending thrust fault that cuts perpendicularly across the arcuate belt.

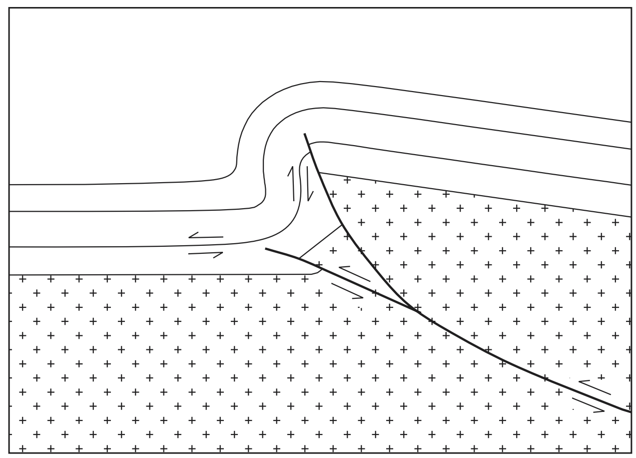
Seismic sections, L-L', J-J' and K-K' on Figure 19 (across the Young Bay well) illustrate structures west of the fold and thrust belt. Very minor high-angle reverse and normal faults cutting basement and basal cover strata occur about 4 and 6 km southwest of the belt and the southern promontory. Below the southeastern shore of Young Bay, two steep listric thrusts with displacements of less than 50 m flank a region of relatively rugged basement relief capped with lenses of Aston Formation. Basement/Aston depressions are infilled with lowermost Cambrian strata, and most of the Cambrian succession onlaps a ridge of Aston sandstone about 200 m high that was intersected by the Young Bay well (section K-K', Fig. 19). Compilation of contours of the sub-Cambrian unconformity (Map. 8, Fig. 20) indicates this ridge extends from south of Flexure Bay to the west coast of Prescott Island.

Pandora block. This block occupies the northern half of the east coast of Pandora Island and is distinctly different from all blocks to the south. An overturned and thrust-faulted panel of Proterozoic and Paleozoic strata, presumably the continuation of the fold and thrust belt in the Savage block, has been segmented and thrust westward by three keystone basement sub-blocks that point westward in map view. Apparent crosscutting relationships between faults and folds suggest that shortening occurred in five steps (Fig. 26) and brought about the greatest observed apparent displacement of the uplift. At one locality, gneiss and Aston Formation strata rest against synorogenic conglomerate of the Peel Sound conglomerate facies 400 m above its base, a throw of at least 1800 m.

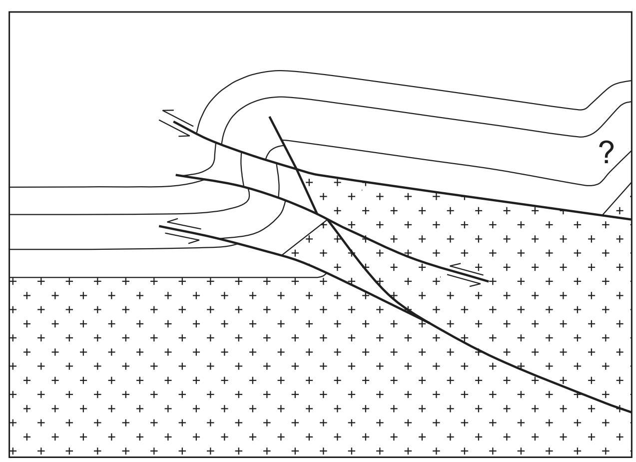
Steps 1 and 2 are represented by small thrusts southwest of Cape M'Clure and likely coincide with overturned folding of the Paleozoic section. Step 3 formed the large, central, keystone sub-block, bringing basement up against the Peel Sound Formation and likely overturning strata of the Aston Formation in the footwall. All faults formed



Initial stage. Incipient listric low-angle thrust fault in basement.



First compressional stage. Cover is folded and locally overturned. Bedding-parallel shearing occurs in response to tightening of the overturned syncline.



Second compressional stage. Low-angle thrust faulting predominates. Cover may have been affected by a higher basement block and become detached from the lower block.

Figure 25. *Sequence of folding and thrusting in Brodie-Flexure structural block.*

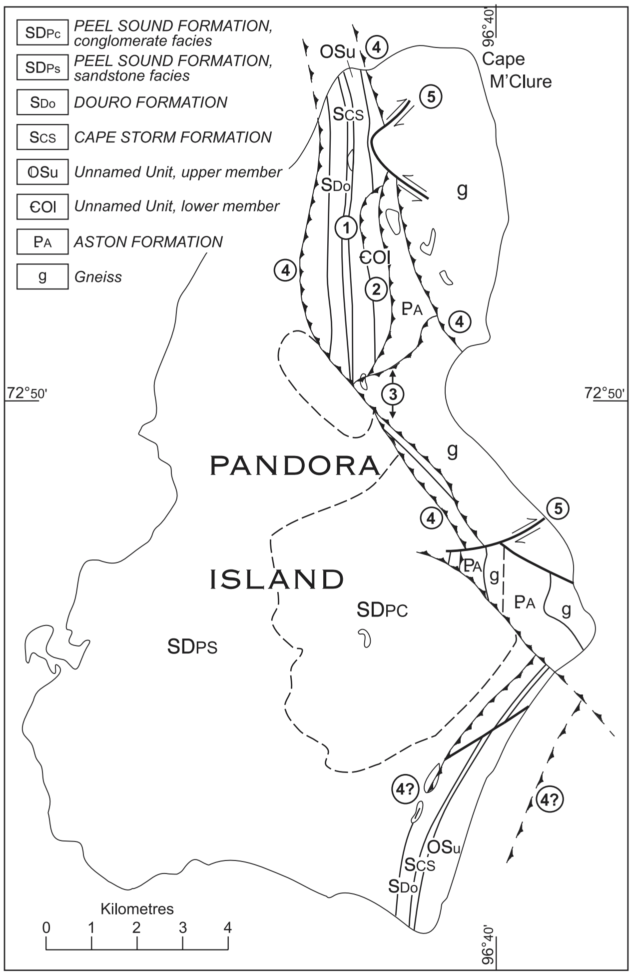


Figure 26. *Map of Pandora Island showing the sequence of thrusting and faulting in Pandora structural block.*

during these steps appear to have been steep. In step 4, two thrust faults with apparently moderate easterly dips caused basement to override faulted and overturned cover strata south of Cape M'Clure and created the frontal thrust of the whole block that carried the segmented panel formed during steps 1 to 3 a bit farther west. Step 5 resulted in the formation of the northern and southern small keystone sub-blocks on, in part, reactivated thrusts and tear faults. The southernmost thrust likely moved during steps 3 to 5 as it overrode the Savage block. The steeply west-dipping Aston-basement unconformity is repeated by an east-side-down normal fault in this keystone.

An estimate of the westward horizontal displacement during steps 3 to 5 is provided by restoring the continuity of the overturned folds and minor thrusts between their truncation at the north end of the Savage block, through a presumed arc east of the Pandora block, to join the belt on southeastern Prescott Island. Remnants of this belt on northern Pandora Island now lie as much as 6 km to the west. Taken as whole therefore, the uplift moved 2 km vertically and 6 km horizontally. The magnitude of a possible northwesterly component to the displacement on arcuate portions of the thrusts cannot be readily estimated. The overall geometry of thrusting is therefore listric, low-angle, with steep dips dominant at the exposed structural level.

Structures in the channel north of Pandora Island are conjectural but may be similar to those observed on land. Northerly trending, linear thrust and fold belt segments that pass northward into flexures that curve eastward to be truncated by other linear segments are common characteristics of other blocks and are thereby postulated to lie in this channel. West-northwest to west-southwest-trending strike-slip faults with small (< 1 km) displacements are subordinate elements elsewhere but may also be present.

Prescott block. Structures in the eastern half of Prescott Island are generally similar to those of the Pandora block. A relatively narrow (approximately 2 km wide) fold and thrust belt, forming another easterly concave arc, is indented and overthrust by a large, west-pointing keystone sub-block of crystalline basement, Aston strata, and diabase intrusions. Overturned folding and thrust faulting in the belt was not extreme – Aston strata lie against Cambro-Ordovician units – and resulted in shortening of perhaps 100 to 200 m. The sub-block, however, moved to juxtapose the Aston and the Peel Sound conglomerate facies, a throw of about 1 500 m. About 3 km of horizontal displacement along the northeast-trending tear or thrust fault that bounds the sub-block is evident from the map pattern. Some counterclockwise rotation of the sub-block is probable. At least two discrete stages to the deformation are evident.

East-northeast-trending faults restricted to Precambrian rocks are mostly down-to-the south, and some have been intruded by dykes of possible Mackenzie and/or Franklin ages. These relationships are similar to those described on western Somerset Island (see Mesoproterozoic structure section, above). The north end of the Prescott block is postulated to be truncated by thrust faults of the Whitehead block.

Whitehead block. The Whitehead block extends across the entrance to Browne Bay, sporadically exposed on several islands, north to Back Bay. The fold and thrust belt outcrops only along the east coast of Vivian Island and southwest of Whitehead Point. Shortening is minimal during the first stage of deformation and is therefore transitional between blocks to the south and the substantially different block to the north. A frontal thrust that formed during the second stage cuts through the overturned panel and places Douro strata against the basal Peel Sound conglomerate facies, a throw of about 500 m. A large panel or west-pointing keystone of Aston Formation, diabase and, presumably, crystalline basement offshore to the east, over-rode the fold and thrust belt, its hanging wall anticline near Sherard Head, and an overturned syncline at the south end of the bay west of Whitehead Point. Aston strata were placed on overturned strata of the sandstone facies of the Peel Sound Formation, an additional throw of at least 1000 m (disregarding the additional displacement needed to cut through an overturned fold limb). This displacement dwindles south-ward to Sherard Head, suggesting counterclockwise rotation of the sub-block, or a significant northwest component to the displacement, similar to that in the Prescott block.

The usual pattern of flexure and block truncation seen to the south does not appear to be present at the north end of the Whitehead block in Back Bay, possibly because the flexure has been entirely overridden by the large panel or keystone of Precambrian units. In addition, as noted below, the block to the north differs markedly from all others in that it is only mildly deformed and the main deformation occurs well to the east in the offshore. It seems probable that a northeast-trending dextral strike-slip fault, possibly with subordinate thrust component, lies in Back Bay.

Back-Birthday block. Structures of the Paleozoic cover between Back and Birthday bays on northeasternmost Prince of Wales Island are very different from those of southern blocks, and are only hinted at by the broad, west-verging anticline at Sherard Head. Only in the south at Back Bay are strata overturned although the accompanying thrust fault has minimal displacement; elsewhere dips rarely exceed 30°. This block preserves the cover as it may have been shortly after initiation of rise of the uplift. If so, then the arcuate form of the belt is likely an original feature, perhaps influenced by subdued paleo-highs of basement and its Mesoproterozoic cover. The broad expanse of gently folded Cambro-Ordovician strata may be attributed to the presence of the northerly thickening succession of the clastic and carbonate Hunting Formation, a thick (up to 6000 m), panel less easily deformed than the Paleozoic succession with its numerous lithological and rheological contrasts.

More typical and intense deformation of the western edge of the uplift has apparently stepped well to the east. At Birthday Bay, strata are steeply dipping to overturned and a thrust fault carrying a basement sub-block is inferred to lie just off the coast. Any connection between it and the strike-slip (and thrust?) fault in Back Bay remains uncertain.

Two seismic lines cross much of the deformed belt. The southern one (section R-R', Fig. 20) extends west-southwest just north of Back Bay. Although it fails to image the overturned beds of the Peel Sound sandstone facies just south of it, it illustrates an array of steep and gently dipping thrust faults with a combined displacement of about 1800 m. This is much more than expected from simple estimates of stratigraphic throw, and implies the faulting of an overturned fold limb and the possible presence of a blind thrust. As the faulting of overturned beds has been demonstrated in other blocks, it suggests that estimates of overall shortening may be excessively conservative and that significant horizontal movement has occurred on low-angle thrusts not evident at the surface. Also imaged on this line are two east-side-down normal faults that predate deposition of the Paleozoic succession and contribute to the increase of preserved thickness of the Hunting Formation. One lies near the head of Back Bay, the other about 5 km west of the report area.

The second line (section Q-Q', Fig. 20) crosses the whole block from Birthday Bay south-southwest to beyond the report area. Again, the overturned beds at its east end are not imaged, but the array of thrust faults described above is and again shows a displacement of about 1750 m. Most displacement seems to be along a nearly flat blind thrust within the Ordovician-Silurian succession, a level that contains minor evaporitic rock types that would favour detachment. The section also reveals a third east-side-down normal fault that primarily affects Precambrian strata by about 500 m, but it was reactivated to displace the Paleozoic section less than 100 m and create a small flexure. Detected on at least two seismic lines, it is interpreted to strike nearly east-west. Reactivation of this fault may have occurred in the Tertiary.

A third seismic line (section P-P', Fig. 20) extends south-southeast across Russell Island and is notable for a major, slightly reactivated, Precambrian normal fault of possible northwest to east-west trend that causes a drop of the Hunting Formation of about 1800 m on its northeast side. The basal Paleozoic succession is only slightly perturbed on this and associated steep faults. Upper parts of the succession are undisturbed. Prominent reflectors, interpreted to be Franklin-age sills because they intrude the post-Mackenzie Hunting Formation are also present.

TECTONIC EVOLUTION

Precambrian

It has been suggested that the tectonic setting of the crystalline basement is part of the Thelon Tectonic Zone (Fig. 5), the major tectonomagmatic belt bounding the eastern Slave province (Hoffman, 1989; Frisch and Hunt, 1993). The northernmost exposure of the belt lies about 400 km southwest of and along strike with the southernmost part of the Boothia Uplift. The Thelon Tectonic Zone (TTZ) contains sparse evidence of Archean deformation (Thompson, 1989), severely overprinted by its primary tectonomagmatic event(s) between 2.02 and 1.92 Ga. These carried granulite facies rocks up and northwestward, forming a fold and thrust belt in the Kilohigok Basin (Tirrul and Grotzinger, 1990). In the northern segment (north of the Bathurst Fault), K-Ar cooling ages are greater than 1.8 Ga. In the southern segment, Rb-Sr cooling ages average 1.74 Ga, in response to east-directed indentation of the TTZ by the Slave Province. Crustal flexure east of the indented and uplifted region may have formed a basin into which the Thelon Formation was deposited (Henderson et al., 1990).

The Boothia terrane shares some of the tectonomagmatic history of the TTZ (Table 2). Frisch and Hunt (1993) noted the presence of an Archean component in some units but found some protolith ages of igneous rocks that have not been observed in the TTZ. The age, grade and structural style of the culminating metamorphism and deformation in the Boothia terrane (1.94–1.92 Ga) are similar to although somewhat younger than the peak of metamorphism in the TTZ (1.98 Ga). Cooling ages in the Boothia terrane range from 1.74 to 1.59 Ga, more typical of the southern segment of the TTZ than the northern segment. A possible explanation for this is that a continental block akin to the Slave Province may have collided with the Boothia terrane and deflected the TTZ eastward. East-dipping features in the basement west of the Boothia Uplift (imaged on several seismic traverses, Fig. 19) may therefore be analogous to the northwest-directed structures described in and west of the TTZ. Similarly, resulting uplift and cooling, fracturing on northwest and southwest trends and crustal flexure, may have in turn given rise to deposition of the Aston Formation, a possible correlative of the Thelon Formation or the Hornby Bay or Dismal Lakes groups.

Despite such speculation, the age of the Aston Formation is too poorly constrained to place it in a specific tectonic setting. It is a part of one of several clastic basin units deposited on the craton after Hudsonian orogenesis (ca. 1.8 Ga) and before the Mackenzie Igneous Event (1268 Ma), and seems to have been unaffected by distant orogenesis elsewhere in the Canadian Shield in that interval.

The mantle plume that gave rise to the Mackenzie Igneous Event (Lecheminant and Heaman, 1989; Barager et al., 1996) caused doming, rifting and radial and concentric fracturing that altered the Mesoproterozoic (Mesohelikian in the terminology of Okulitch, 2001) depositional regime across much of the Canadian Shield and its northern extensions beneath the Arctic Platform and miogeocline. Intrusion of dykes and sills and faulting of basement and cover occurred in the report area (Fig. 27). Relaxation of the dome as the plume died and cooled, brought about resumption of platformal sedimentation in the Neohelikian (op cit., 2001), influenced by continuing instability and faulting during subsidence.

Faulting affected deposition and preservation of the Hunting Formation in the study area. Its northerly thickening can be plausibly linked to similar deposition and preservation patterns in the carbonate rocks of the Uluksan Group, Bylot Supergroup, and its east-west basin edge is likely the western extension of the Steensby High as originally proposed by Jackson and Iannelli (1981). Whether an ocean opened at the site of the plume head and along some northern margin (op cit., 1981) or not remains conjectural, but only shallow-marine and fluvial sediments were deposited and preserved over Mackenzie flows and intrusions in Thule, Borden and Amundsen basins, and in the study area, during the subsequent 550 Ma suggesting that the ocean, if it existed, lay much farther north.

Carbonate rocks of the Uluksan Group, and by extension, the Hunting Formation, were deposited at about 1200 Ma (Sherman et al., 2000). After deposition of the uppermost preserved Bylot Supergroup (circa 1190 Ma; Knight and Jackson, 1994), regional depositional patterns changed in response to the Grenville Orogeny. Uplift and erosion of that orogen shed clastic sediments across the shield from southeast to northwest into Amundsen Basin west of the Boothia Uplift (Rainbird, et al., 1992). Amundsen Basin deposition (Shaler Supergroup) culminated in the Franklin Igneous Event, which is postulated to be the product of another mantle plume at 723 Ma (Heaman et al., 1992). Franklin dykes cut the Hunting Formation on Somerset Island (Stewart, 1987) and Franklin sills are interpreted on several seismic sections on Prince of Wales Island. Franklin intrusions are also common on Baffin Island. Regional depositional patterns altered once more, but uplift and erosion prior to the Cambrian has erased any record of the 200 Ma interval between the Franklin Igneous Event and basal Cambrian strata adjacent to the Boothia Uplift.

Paleozoic

The Boothia Uplift is the largest Rocky Mountain Foreland-type uplift known, extending almost 1000 km across the Precambrian craton, from a Paleozoic cover of the Arctic Platform in the south to a thick succession of miogeoclinal and deep-water basinal successions in the north. As noted by de Freitas and Mayr (1993), the uplift differs from classic Laramide-age uplifts in its tectonic setting. The cover successions differ markedly, with Laramide uplifts rising through cratonal cover and foreland basin deposits in a continental setting, and the Boothia Uplift forming in a submerged craton covered with platformal strata and shelf and marine basin deposits. Laramide uplifts formed in close association with the Sevier foreland fold and thrust belt, whereas the Boothia Uplift formed in a stable craton far from the coeval Caledonian Orogen. Examination of structures in the basements of both the Laramide and Boothia uplifts, however, indicates that basement responses to compression were essentially identical and formed similar structures (Schmidt et al., 1993). The Laramide

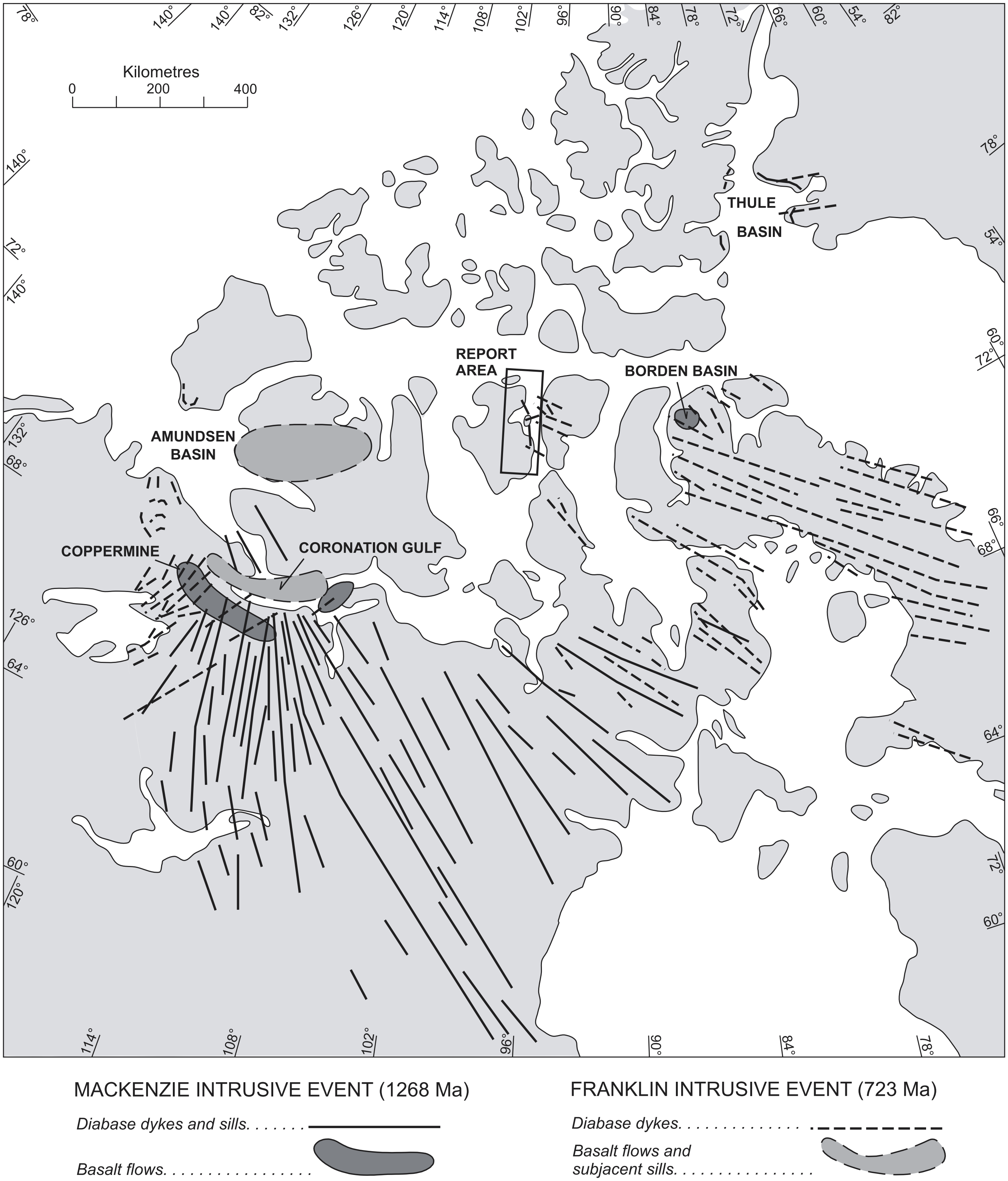


Figure 27. *Index map of Proterozoic mafic intrusion events in northern Canada (modified from Fahrig and West, 1986, and Dawes, 1997).*

uplifts formed in response to deep-seated compression aligned with northeast-directed plate convergence vectors (Erslev, 1993). Basement anisotropies controlled the location and orientation of uplifts and were utilized as reverse faults and lateral ramps with oblique slip that formed an anastomosing array (op. cit. 1993). Boothia-type uplifts are postulated to have also formed in response to plate convergence, but, being remote from their driving forces and suffering small displacements, only formed where basement anisotropies favoured reverse faulting and pre-existing fracture sets facilitated strike-slip or oblique motions.

The uplift developed from the Late Silurian to Early Devonian as a result of intracratonic compression likely related to late stages of the Caledonian Orogeny (Okulitch, 1986). Uplift was facilitated where structural trends of the basement were approximately orthogonal to far-field stresses, not only in the Boothia region but also to the northeast on southeastern Ellesmere Island (Inglefield or Bache Peninsula Uplift) (op. cit., 1986). The Boothia Uplift was not, however, a coherent tectonic element, but a highly segmented one. A primary break lies in Barrow Strait (Fig. 1), postulated to be one or more east- to northeast-trending reverse faults (Okulitch et al., 1986, fig. 3, 4; de Freitas and Mayr, 1993, fig, 4), which divides the uplift into northern and southern segments. Where exposed in the southern segment, the uplift is further broken up into numerous kilometre-scale blocks and sub-blocks, which are bounded by east-west, northwest, and northeast-trending faults and fractures. At least one similar basement fault has been inferred in the northern segment (op. cit., 1993, fig. 9, 11).

The primary break in Barrow Strait also separates segments of the uplift that were active at different times. The southern segment started to move at about 420 Ma (late Ludlow), shedding terrigenous mud of the lower Barlow Inlet Formation into the basin above the northern segment (Packard, 1985). Cyclic platform carbonate deposits of the upper Barlow Inlet, exceptionally sensitive to even minor tectonism, record the beginnings of instability in the northern segment at about 418 Ma (Pridoli) (op. cit., 1985). At the same time at the north end of the southern segment, the clastic component of peritidal carbonate rocks of the Somerset Island Formation (equivalent to the lowermost Peel Sound Formation of this report) changed from mature monocrystalline to strained metamorphic grains, indicating that parts of the Proterozoic core, presumably those to the south, were exposed during the latter half of Somerset Island deposition (Mortensen, 1985). As relief increased, the segment shed medium to coarse clastic sediments westward into a relatively restricted foreland basin, northward onto the northern segment, and eastward into 'piggy-back' basins to form the lower (sandy lithofacies) Peel Sound Formation. However clasts derived from cover strata predominate and metamorphic clasts do not appear in significant amounts until deposition of the upper (conglomerate facies) Peel Sound at about 415 Ma (late Lochovian). The youngest faults of the southern segment bring crystalline basement up against the upper Peel Sound strata, hence movement likely continued in this segment as tectonism began in the northern segment.

The northern segment, despite minor tectonism coeval with the main uplift of the southern segment, predominantly underwent subsidence recorded by platform progradation between 420 and 415 Ma. This may have been caused by tectonic loading by a crystalline thrust sheet to the south (de Freitas and Mayr, 1993). Uplift, tilting and syntectonic deposition of clastic sediments into several local basins occurred during the Pragian (about 413–409 Ma). The development of this segment of the Boothia Uplift has been documented in significant detail by de Freitas and Mayr (1993).

Post-uplift sedimentation transgressed the remnant relief of the northern segment from about 405 to 393 Ma (middle Emsian to early Eifelian). The extent of this transgression over the southern segment is not preserved. The Late Devonian–Carboniferous Ellesmerian Orogeny had only minimal effects on the northern segment of the uplift and Carboniferous rifting that formed the Sverdrup Basin also had no observed consequences.

Although the effects of intracratonic compression were manifested over a substantial area, the net displacement of the Boothia Uplift as a whole is small. Previous estimates ranged from about 30 km if thrust faults flatten at shallow depths (2–4 km) to dips of 5–15° as suggested by interpretations (Okulitch et al., 1986) of gravity data (Berkout, 1973), to less than 5 km if the faults remain steep to considerable depths (30–35 km) as suggested by de Freitas and Mayr (1993, fig. 3, 5, 10). Faults mapped in the study area are predominantly steeply east-dipping, although some low-angle faults did develop during the multiple stages of movement. Displacements estimated from mapped relationships rarely exceed 3 km for individual faults; the maximum across the belt of frontal structures is no more than 7 km. However, displacement that can be seen at the surface across the frontal belt is unlikely to be the total displacement. Most faults may be steep at the surface, however the level of exposure is the same throughout the study area and the limited seismic evidence suggests that most become listric at relatively shallow depths. Blind thrusts and ramp and flat geometry have also been interpreted from seismic data and would increase estimates. Moreover, the uplift contains internal thrusts. Many may lie in Peel Sound and several have been inferred from their effects on cover strata in the northern segment (Okulitch et al., 1986, fig. 4; de Freitas and Mayr, 1993, fig. 10). Although displacement doubtless varied along the strike of the segmented uplift, it seems plausible that it reached a maximum in the north part of the southern segment of about 10–20 km and decreased to the north and south.

The direction of transport remains a subject for future work. Overall, the crystalline core of the uplift appears to have moved up and westward; however several blocks and sub-blocks are bounded by west-southwest-trending faults and flexures which may have either thrust and strike-slip displacements or both. If strike-slip predominates on the west-southwest faults, then the movement of most blocks is to the west on the long north-northwest thrusts. If folding and thrusting predominates in the west-southwest-trending parts of the frontal deformation zone, then movement of at least the leading blocks of the uplift was to the northwest and a significant component of strike-slip, direct evidence for which was not observed in this study, is present in the long north-northwest thrusts.

Cenozoic

The Tertiary Eurekan Orogeny significantly affected the northern segment of the uplift (Eisbacher, 1992; de Freitas and Mayr, 1993, p. 616) but no evidence of this was found in the study area.

The preservation of Tertiary strata of the Eureka Sound Group in several grabens on Somerset Island and Boothia Peninsula (Stewart, 1987) testifies to tectonism related to widespread rifting events in the Arctic Archipelago. Many graben faults trend north-south and may be formed by normal faulting of basement structural trends or Siluro-Devonian reverse faults.

Some grabens may lie in Peel Sound, but none were noted in the study area. Gravity data do not support the presence of significant Tertiary strata in the sound.

ECONOMIC POTENTIAL

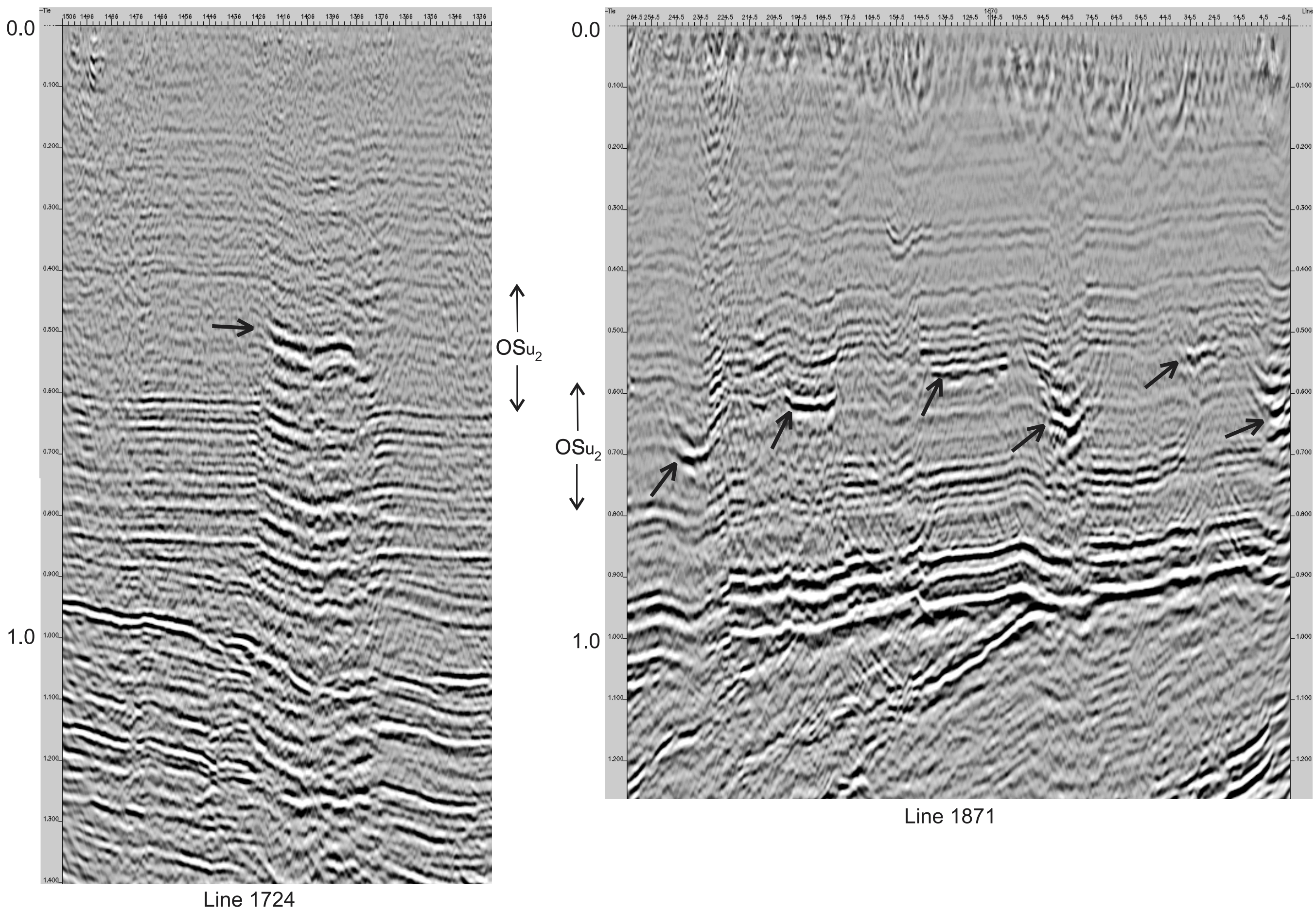
Hydrocarbon exploration

Prince of Wales Island lies within two of Canada's geological provinces: the Cambrian to Devonian strata of the Arctic Platform, and the Boothia Uplift (Fig. 1). These provinces and their contained offshore areas, encompass some 1 200 000 km^2, and are essentially unexplored. Only thirteen petroleum exploration wells were drilled between 1963 and 1979. Prince of Wales Island is roughly 30 000 km^2 and has two wells. In the late 1960s to early 1970s, exploration acreage on Prince of Wales Island was held mostly by Kerr-McGee of Canada Northwest Ltd. Smaller parcels in the northern part were held by Amoco Canada Petroleum Company and Panarctic Oils Ltd. Drilling commenced in 1972 with the Sun Panarctic Russell E-82 well on the southwest portion of Russell Island and then, in 1975, the Kerr McGee Decalta Young Bay F-62 well on the southeast side of Young Bay. The former well lies outside the area of surface mapping for this study, but its stratigraphy is important for the interpretation of the seismic and stratigraphic succession. The Russell E-82 well predates seismic shooting in the area by about three years and did not test a closed structural high.

The Young Bay well location was chosen by Kerr McGee after seismic evaluation indicated a closed structural high on a sub-Paleozoic unconformity and on overlying Paleozoic horizons. A seismic amplitude anomaly or "bright spot" exists on data at the crest of the structure and may have been an additional target. The well encountered Silurian through Cambrian strata and the Proterozoic Aston Formation below a sub-Cambrian unconformity. Petrophysical logs indicated porosity in the dolomite of the upper part of the upper member of the unnamed unit (OSu_2) coincident with the amplitude anomaly (see line KM7231–9649, Fig. 28). A drillstem test of this zone recovered watery drilling mud. Dead bitumen was reported from well samples in the upper member. In surface exposures the member exhibits vuggy porosity and a petroliferous smell. Conodont Colour Alteration indices for both wells indicate little or no thermal alteration. There are no other known thermal maturity data for these wells, or the next nearest wells, those on Somerset and Cornwallis islands.

The hydrocarbon potential of the report area and in the vicinity of seismic coverage is largely unknown. No obvious Paleozoic source rocks have been mapped at the surface. The nearest possible ones are exposed on Bathurst and Melville islands (fine-grained strata of the Weatherall and Bird Fiord formations and graptolitic shale of the Cape Phillips Formation, Embry et al., 1991). Facies changes in the Paleozoic succession appear to be very gradual. Seismic indicates that overall thickness of Paleozoic units gradually increases from south to north. Units of unknown facies, such as unit OSu_1 and the upper part of $ЄOl_2$, appear beneath unconformities in northern Prince of Wales and Russell islands.

The seismic amplitude anomaly within unit OSu_1 at the Young Bay well arose from variation in acoustic impedance caused by localized secondary porosity, which presumably developed during leaching and dolomitzation. Similiar seismic anomalies exist elsewhere within the OSu_1 unit and in many cases, are at precisely the same seismic stratigraphic level. Seismic line 1871 is located northwest of Whitehead Point, immediately west of the major Boothia thrust zone (see Map 3, Fig. 9 for location). It shows a number of amplitude anomalies (see line 1871, Fig. 28) while a parallel seismic profile 12 km to the east indicates no anomalies. The fact that the amplitude anomalies are



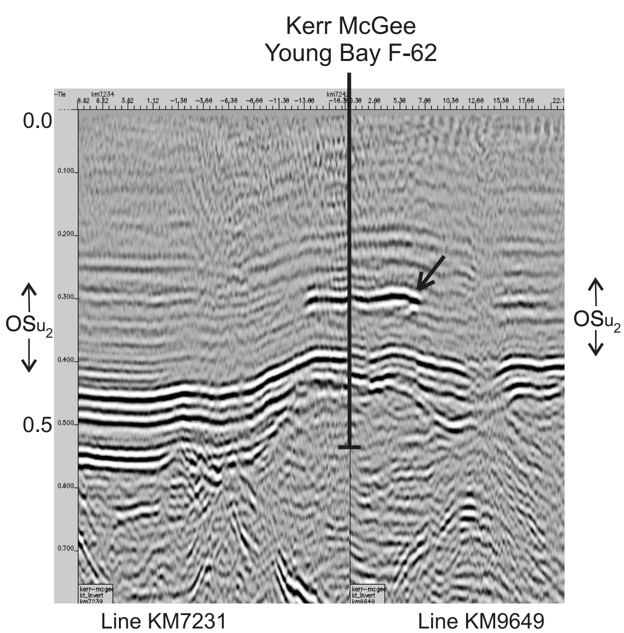


Figure 28. *Examples of seismic amplitude anomalies within seismic unit* OSu_2*. Profiles are migrated time structure data. Arrows indicate anomalies.*

more abundant in proximity of Boothia deformation gives the sense that the increased porosity suspected to be associated with these anomalies has been somehow faciltated by increased fluid movement linked to faults and fracturing.

Some seventy kilometres to the east of the uplift, a similar anomaly is seismically imaged at about 500 milliseconds on line 1724 (Fig. 28). This amplitude anomaly, and several others, (e.g. line 1871, Fig. 28) appear to occur exactly vertically coincident with what appears as local structural sagging. These sags are strongly suspected to be time-structure artifacts caused by lowered average velocities due to locally thinner or absent permafrost in the overlying porous Peel Sound Formation. Some anomalies also appear to contribute additional velocity sag beneath them, suggesting they are themselves low-velocity features. The explanation of these amplitude anomalies as being attributable to localized porosity is reasonable and exemplified at the Young Bay well. The curiosity however, is their precise coincidence in certain cases with apparent time-structure sags thought to be velocity-induced from overlying permafrost variation. One explanation of this coincidence involves the assumption that present geotherms are higher beneath a permafrost thin and the resulting increase in subsurface temperature is a factor. This can be rationalized with a qualitative explanation that has economic implications. Permafrost thicknesses in the high Arctic typically range from zero to 700 m (Brent and Harrison, 1998). The depth range of a potential porous, dolomitic zone in the area of anomalies is between about 1100 to 1700 m. These depths are within the hydrate stability range under typical arctic geothermal conditions (Majorowicz, 1998). If, however, a sharp local rise in isotherms was present, as might be expected beneath permafrost thins, the porous zone in the dolomites could be outside the gas hydrate stabilty field, dictating local free-gas conditions, laterally, between hydrated zones. In essence, the thermal condition that created the velocity sag in the seismic data would also be responsible for changing the physical nature of the contents of the dolomitic pore space at depth. The amplitude anomaly is explained by the high acoustic impedance of the relatively low-velocity free-gas bearing zone. If gas was sourced, and vertically migrated from the thick underlying Precambrian strata, the absence of this strata beneath the Young Bay well explains the absence of gas in its available dolomite trap. Other potential traps may exist from very gentle folding present west of the thrusted and overturned area giving rise to small structural closures.

Seismic data indicate in excess of 6 km of Proterozoic sediments in the subsurface of northern Prince of Wales Island. The oldest interpreted seismic unit, PHs_1, is correlated with the Hunting Formation on Somerset Island. The potential for economic hydrocarbons in these rocks is unclear, not so much because of age, but because of organic suitability. The nearest thermal maturation and petroleum source assessment of Canadian Proterozoic rocks used Cambrian and Proterozoic samples from 17 wells between 60 and 68°N in the Mackenzie Corridor (Snowdon and Williams, 1986). With few exceptions, samples had a total organic carbon content of less than 0.4 per cent. However, a 75 m thick Proterozoic shale section in Mobil Belot Hills M-63 contained up to 1.4 per cent organic carbon at a maturity level beyond the oil window but within the gas generation phase. Meyerhoff (1980) suggested the great thickness of unmetamorphosed marine Proterozoic section in the graben zone between Norman Wells and Coppermine, and on Victoria Island, may prove an important exploration objective after noting the similarity to the Siberian Proterozoic section (Lena-Tunguska region), which hosts hydrocarbon accumulations in the giant category. Major petroleum occurrences in the Precambrian worldwide are well documented and include the Arabian Shield (Oman), Sichuan Basin (southeastern China) and McArthur Group (Northern Territory, Australia). Multidisciplinary studies during the past twenty years have recognized controls on the distribution and composition of organic matter preserved in the Earth's Precambrian rocks and the window of suitable organic material for hydrocarbon generation back to the Archean (McKirdy and Imbus, 1992). When strata are unmetamorphosed, issues of source beds, structure at peak generation, tectonic stability, reservoirs and seals remain critical, not age. On northern Prince of Wales Island, the interpreted presence of intrusives within the seismically defined Hunting units implies early thermal influx and likely hydrocarbon expulsion. However, the lack of evidence suggesting that the burial of this entire sequence was even much deeper than present, which would have delayed or lengthened hydrocarbon generation times, means these unmetamorphosed Precambrian rocks should not necessarily be considered economic basement.

Metallic minerals

No visible indications of mineralization were found during fieldwork in the report area. Dyke et al. (1992) analyzed the clay fraction of tills for metals. High concentrations of copper were found on Prince of Wales Island just south of Back Bay and opposite the westernmost tip of Pandora Island, however the relationship of these anomalies to the bedrock is not known. At the time of writing, Cominco Ltd. was engaged in a multi-year drilling program on northwestern Somerset Island across Peel Sound. The stratigraphic succession there is comparable to that of eastern Prince of Wales Island, and it was rumoured that the company was prospecting along faults for copper in the Cape Storm Formation.

Other

A number of kimberlite diatremes have been identified on Somerset Island (Steward, 1987), but none are known from the report area.

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Appendix A
Stratigraphic sections

STRATIGRAPHIC SECTION 7 (northeastern Prescott Island)
72°32.37"N 96°26.16W

This section was described and collected for conodonts by G.S. Nowlan and C.R. Barnes during the summer of 1974. A tape was used for measuring. Base of section is at a fault with Precambrian Aston Formation.

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
	CAPE STORM FORMATION (Upper Silurian) (17.1 m, incomplete thickness)		
32	Dolostone: silty; pale grey-buff; thin bedded; brick shaped weathering pattern.	1.6	556.4
31	Covered interval	5.0	554.8
30	Dolostone: coarse sandy; medium grey; thin to medium bedded; interbedded with pale grey-buff, silty dolostone; vague ?brachiopod outlines	2.0	549.8
29	Covered interval	8.5	547.7
	UNNAMED UNIT (upper member) (Ordovician and Silurian) (105.0 m)[a]		
28	Dolostone: petroliferous; coarse crystalline; medium grey; massive bedding; GSC loc. C-257798 (conodonts, Middle Ordovician or younger)	10.0	539.3
27	Covered interval	12.0	529.3
26	Dolostone: coarse crystalline; medium grey; medium bedded	5.0	517.3
25	Covered interval	10.0	512.3
24	Dolostone: medium crystalline; pale buff to pale grey; vague ?brachiopod outlines; GSC loc. C-257797 (conodonts, Middle Ordovician)	5.0	502.3
23	Covered interval	10.0	497.3
22	Dolostone: medium crystalline; medium to dark grey; medium bedded; GSC loc. no C-257796, conodonts, Middle Ordovician or younger	2.5	497.3
21	Covered interval, thickness estimated	30.0	484.3
20	Dolostone: medium crystalline; pale to medium grey; thick bedded; solitary and colonial corals, locally abundant pentamerid-like brachiopods	3.0	454.8
19	Covered interval	15.0	451.8
18	Dolostone: medium grey-brown, weathers yellow-buff; thick bedded	2.5	436.8
	UNNAMED UNIT (lower member) (Cambrian and Ordovician) (434.3 m, incomplete thickness)		
Subdivision 3 (386.5 m)			
17	Covered interval	25.0	434.3
16	Dolostone: medium crystalline; pale grey to buff, pale grey weathering; large (10 cm diameter) chert nodules	3.0	409.3
15	Covered interval	25.0	406.3
14	Dolostone: medium crystalline; pale grey to buff, pale grey weathering; abundant large (10 cm diameter) chert nodules; GSC loc. C-257795 (conodonts, Early Ordovician, Tulean or younger)	3.5	381.3
13	Covered interval	37.0	377.8
12	Dolostone: medium to coarse crystalline; light grey to buff, pale grey weathering; weathers vuggy; GSC loc. C-257794 (conodonts, Early Ordovician, Stairsian to Blackhillsian)	3.0	340.8
11	Covered interval	73.0	337.8
10	Dolostone: medium to coarse crystalline; light buff, weathers pale grey; massive bedded	2.0	264.8
9	Covered interval; pale buff dolostone in scree	157.0	262.8
8	Dolostone: coarse crystalline; pale grey; thin bedded, locally laminated, dessication cracks, horizontal worm tracks; shale laminae	5.0	105.8
7	Covered interval	25.0	100.8

		Unit thickness (m)	Cumulative thickness (m)
6	Dolostone: coarse crystalline; pale grey; thin bedded, locally laminated, dessication cracks, horizontal worm tracks; shale laminae	3.0	75.8
5	Covered interval, thickness estimated	25.0	72.8
Subdivision 2? (47.8 m)			
4	Dolostone: pale to medium grey, weathers buff; locally laminated	15.0	47.8
3	Dolostone: pale grey; medium to thick bedded; minor interbeds of calcareous quartz sandstone units	15.0	32.8
2	Dolostone: pale grey; medium to thick bedded; local thin quartz sandstone units	15.0	17.8
1	Dolostone: pale grey; thick bedded; scattered quartz grains	2.8	2.8

[a] Outcrop in this section is very poor and measurement is complicated by folding and faulting. This thickness is probably too low.

STRATIGRAPHIC SECTION 184 (Flexure Bay)
72°32.37"N 96°26.16W

This section was measured and described by Russell Akeeagok and Tim de Freitas on July 21, 1997, in unusually warm sunny conditions. This locality is the same as location 6 illustrated by Thorsteinsson and Uyeno (1980, fig. 21). The described part of the section is overlain by the conglomerate facies of the Peel Sound Formation.

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
	PEEL SOUND FORMATION (sandstone facies) Upper Silurian (268.8 m)		
37	Conglomerate and sandstone (interbedded). Conglomerate (50%): orthoconglomerate; weathers yellow-grey; pebble grade: thick bedded; clast imbrication; moderately to well rounded carbonate lithoclasts; common clast imbrication; beds are lenticular and appear to be channel fill complexes; few conglomerate beds are poorly sorted and paraconglomeratic. Sandstone (50%): locally calcareous; weathers yellow-grey and locally pale red; fine grained; thick bedded, local chert granules; trough-cross-stratified, ripple marks; upper contact with the Peel Sound conglomerate facies is not exposed, but assumed to be disconformable	49.5	603.6
36	Conglomerate and sandstone (interbedded). Conglomerate (30%): paraconglomerate and orthoconglomerate; yellow-grey weathering; pebble grade; thick bedded; clast imbrication; moderately well rounded carbonate lithoclasts; common clast imbrication; beds are lenticular and appear to be channel fill complexes; few conglomerate beds are poorly sorted; fish fragments. Sandstone (70%): quartz arenite; locally calcareous; weathers yellow-grey and locally pale red; fine grained; thick bedded, common chert granules; trough-cross-stratified	64.5	554.1
35	Sandstone and dolostone (interbedded). Sandstone (80%): quartz arenite; dolomitic; weathers yellow-grey and locally pale red; fine grained; thick bedded, trough-cross-stratified, ripple marks. Dolostone (20%): sandy; weathers medium grey and pale red; thick bedded; wavy parallel lamination; sharp upper contact	22.5	489.6
34	Conglomerate: weathers yellow-grey; pebble grade; thick bedded; clast imbrication; carbonate lithoclasts	2.0	467.1
33	Sandstone: quartz arenite; calcareous; weathers yellow-grey and locally pale red; fine grained; thick bedded; sharp upper contact	24.0	465.1
32	Limestone: dolomitic; medium grey, weathers medium grey; fine crystalline; thin bedded; burrow-mottled at top (ichnofacies index of 3); disarticulated ostracods; gradational upper contact	1.5	441.1
31	Sandstone: calcareous; weathers yellow-grey and locally pale red; fine grained; thick bedded, local chert granules and carbonate intraclasts; large chert granules at top of unit; massive	25.5	439.6
30	Sandstone and dolostone (interbedded). Sandstone (80%): quartz arenite; dolomitic, weathers yellow-grey and locally medium red; fine grained; thick bedded, trough-cross-stratified. Dolostone (20%): sandy; weathers pale yellow-green; fine crystalline; thick bedded; wavy- and planar-parallel laminae, molar tooth structures	22.5	414.1
29	Sandstone: calcareous; weathers yellow-grey; fine grained; medium bedded; well sorted; some chert granules and carbonate intraclasts; gradational upper contact	15.0	391.6
28	Limestone and sandstone (interbedded). Limestone (80%): rudstone; silty, locally sandy; weathers medium grey; fine crystalline, thick bedded; bioturbated, some fossil fragments. Sandstone (20%): quartz arenite; occurs mostly in upper part of unit; calcareous and dolomitic; weathers yellow-grey; fine grained; thick bedded; trough-cross-stratified and bioturbated; few fossil fragments; sharp upper contact	22.5	376.6
27	Dolostone: calcareous; lower part of unit is gradational to dolomitic limestone; yellow-grey weathering; fine crystalline; thick, discontinuously bedded; massive, bioturbation structures	3.0	354.1
26	Sandstone: quartz arenite; calcareous, gradational to sandy limestone at top; weathers light grey; fine grained; well sorted, trough-cross-stratified and locally bioturbated	2.1	351.1
25	Limestone: mudstone and wackestone; silty, dolomitic; medium grey, weathers yellow-grey; fine crystalline; medium discontinuously bedded; faint bioturbation structures; burrow mottles (ichnofacies index of 2 to 5)[a]; gradational upper contact	15.0	349.0
24	Limestone: boundstone and rudstone; dolomitic; medium grey, weathers yellow-grey weathering; fine crystalline; medium, discontinuously bedded; stromatoporoids and solitary rugosan corals	3.0	334.0
23	Limestone and sandstone (interbedded). Sandstone (60%); calcareous, gradational to sandy limestone; fine grained; weathers light grey; well sorted, trough-cross-stratified and locally bioturbated. Limestone (40%): mudstone; silty, dolomitic; medium grey, weathers yellow-grey; fine crystalline; medium, discontinuously bedded; faint bioturbation structures; sharp upper contact	6.0	331.0

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
22	Limestone: rudstone; silty, locally sandy; weathers medium grey; fine crystalline; thick bedded; abundant *Coenites*, bryozoans, and rare atrypids	34.5	325.0
21	Limestone: mudstone; silty, dolomitic; yellow-grey, yellow-grey weathering; fine crystalline; medium, discontinuously bedded; faint bioturbation structures; gradational upper contact	1.5	290.5
20	Limestone: mudstone; locally sandy at base, dolomitic; medium grey, weathers yellow-brown; fine crystalline; thick bedded; sharp upper contact	18.2	289.0
19	Limestone: mudstone; locally sandy at base, dolomitic; yellow-brown weathering; fine crystalline; medium- to thick-bedded; gradational upper contact; GSC loc. no. C-246394 (conodont sample from the top of unit, Late Silurian, late Ludlow)	6.0	270.8
18	Limestone and sandstone (interbedded). Limestone (70%): mudstone and rudstone; locally sandy, dolomitic; light grey, weathers light grey; fine crystalline; medium, continuously bedded; oncolite rudstone; rare brachiopods, *Coenites,* and solitary rugosan corals. Sandstone (30%): calcareous; light grey, weathers light grey; medium to fine grained; thick bedded; well sorted, trough-cross-stratified	24.0	264.8
17	Limestone: mudstone and rudstone; locally sandy, silty, and dolomitic; light grey, weathers light grey; fine crystalline; medium, continuously bedded; *Coenites* rudstone bed; some *Coenites* forming nuclei for oncoids; gradational upper contact; GSC loc. no. C-246393, conodonts form top of unit, Late Silurian)	4.4	240.8
16	Sandstone: quartz arenite; calcareous, more calcareous up unit; medium grained; thick bedded; well sorted, well rounded quartz grains; gradational upper contact	0.9	236.4
15	Limestone: mudstone; silty and very sandy, dolomitic; very light grey, weathers very light grey; thin bedded; fine crystalline; gradational upper contact	0.7	235.5
	DOURO FORMATION Silurian (178.3 m)		
14	Limestone: wackestone and packstone, grainstone; dolomitic, locally argillaceous; weathers light grey; fine crystalline; thick bedded; poorly sorted bioclasts; burrow mottles; sparsely fossiliferous; sharp, possibly disconformable upper contact	3.8	334.8
13	Limestone: wackestone and packstone, grainstone; dolomitic, locally argillaceous; weathers light grey; fine crystalline; thick bedded; poorly sorted bioclasts, burrow mottles; abundant fragmentary brachiopods, crinoids, corals, and stromatoporoids; rare disarticulated megalodont bivalves; becoming less fossiliferous up unit; gradational upper contact	60.0	331.0
12	Sandstone: calcareous; light grey, weathers very light grey; fine grained, thick bedded, well rounded and sorted, cross-stratified; abundant disarticulated megalodont bivalves at top; sandstone is more calcareous gradational to sandstone-limestone at top	6.0	271.0
11	Limestone: rudstone and packstone; dolomitic, locally argillaceous; weathers light grey; fine crystalline; burrow mottles; thick bedded; poorly sorted bioclasts; about 20% of unit contains disarticulate megalodont bivalves; fragmentary crinoids, brachiopods and corals; 10 cm interval at top of unit contains abundant horn corals; gradational upper contact; GSC loc. no. C-246391 (conodont sample from top 1 m of unit, Late Silurian, Ludlow)	15.0	265.0
10	Limestone: grainstone; dolomitic, locally argillaceous; weathers light grey; fine crystalline; thick bedded; poorly sorted bioclasts; abundant fragmentary crinoids, corals, megalodont bivalves, and stromatoporoids; rare brachiopods	10.5	250.0
9	Limestone: wackestone; dolomitic, locally argillaceous; weathers light grey; fine crystalline; medium bedded; burrow-mottles; very abundant atrypids in some beds	34.5	239.5
8	Limestone: wackestone and rudstone, crinoidal grainstone in the top 2.0 m; dolomitic, locally argillaceous; weathers light grey; fine crystalline; medium bedded; slightly more resistant than unit 7; locally rubbly weathering; burrow-mottled with ichnofacies index of 5; very abundant atrypids in some beds; top 2.0 m is a rudstone containing abundant disarticulate megalodont valves	31.5	205.0
7	Limestone: mudstone and wackestone, local rudstone; silty, argillaceous, and dolomitic; light to medium grey, weathers yellowish grey; fine crystalline, medium bedded; locally rubbly weathering; bioturbated; abundant atrypids and high-spired gastropods; gradational upper contact	27.0	173.5
	CAPE STORM FORMATION Silurian (51.0 m)		
6	Dolostone and limestone (interbedded). Dolostone (30%): silty; light grey, weathers yellow-grey and locally pale yellow-green; fine crystalline; medium continuously bedded, locally thin bedded; abundant wavy-parallel laminae; dolostone mostly occurs in basal part of unit. Limestone (70%): wackestone; locally silty, weathers light grey and yellow-grey; fine crystalline; thin to medium continuously bedded; common brachiopods (atrypids) and other bioclasts. The contact between the Cape Storm and the Douro Formation is very gradational	18.0	156.5

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
5	Dolostone and limestone (interbedded). Dolostone (90%): silty; light grey, weathers yellow-grey and locally pale yellow-green; fine crystalline; medium continuously bedded, locally thin bedded; abundant wavy-parallel laminae; incomplete polygonal mudcracks, some molar tooth structures. Limestone (10%): wackestone; weathers light grey; fine crystalline; thin to medium continuously bedded; common brachiopods (atrypids) and other bioclasts; limestone occurs mainly in highest part of unit 5 and is a possible tempestite deposit	22.5	138.5
4	Dolostone: silty; light grey, weathers yellow-grey; fine crystalline; medium continuously bedded; GSC loc. no. C-246389 (3.0 m above base of unit)	10.5	116.0
	UNNAMED UNIT (upper member) Ordovician and Silurian (105.5 m, incomplete thickness)		
3	Dolostone: light grey, weathers light grey; fine crystalline; medium continuously bedded; 3% vuggy porosity; planar-parallel laminae; sharp (stylolitized) upper contact; GSC loc. no. C-246388 (1.0 m below top of unit)	22.5	105.0
2	Dolostone: light grey, weathers light grey; fine crystalline; thick bedded; 3% vuggy porosity; vague, wavy-parallel microbial laminae	69.0	82.5
1	Dolostone light grey; weathers light grey; fine crystalline; thick bedded; wavy, millimetre thick laminae; possible planar and wavy microbial laminae	13.5	13.5
Underlying beds were not investigated			

[a.] Quantitative estimates of ichnofabric were published by Droser and Bottjer (1986). An ichnofacies index of 1 indicates a rock with no disruption of lamination, while in a rock with an ichnofacies index of 5, lamination has been completely destroyed.

STRATIGRAPHIC SECTION 185A (south of Flexure Bay)
72°21.89'N 96°38.38'W

This section was measured and described by Russell Akeeagok and Tim de Freitas on July 22, 1997, under unusually warm and sunny conditions. The section is overlain by a recessive, poorly exposed interval assigned to the Cape Storm Formation.

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
	UNNAMED UNIT (upper member) Ordovician and Silurian (315.0 m)		
23	Dolostone: light grey, weathers yellow-grey and locally pale brown weathering; medium crystalline; thick bedded; massive; petroliferous; vague burrow-mottles; locally petroliferous; sporadic felsenmeer, abundant mud-covered areas; upper contact with the Cape Storm Formation is not exposed	36.0	600.0
22	Dolostone: as in unit 23; GSC loc. C-246407 (top of unit)	73.5	564.0
21	Dolostone: weathers yellow-grey, light grey; medium crystalline; thick bedded; massive; petroliferous; vague planar- and wavy-parallel lamination; locally petroliferous; sporadic felsenmeer, abundant mud-covered areas	60.0	490.5
20	Covered interval	97.5	430.5
19	Dolostone: very light grey, weathers very light grey; coarse crystalline; thick bedded; approximately 5% vuggy porosity; common silicified tabular stromatoporoids and favositid corals, rare chain corals (possible Silurian age macrofossils); rare white chert nodules at top of unit	16.5	333.0
18	Dolostone: cherty; light grey, weathers yellow-grey and locally pale brown; fine crystalline; thick bedded; rare white chert nodules at top of unit; 3% vuggy porosity; several largely orthoconic (possibly Upper Ordovician) cephalopods; felsenmeer; (texture appears to be dolomitized Thumb Mountain Formation); GSC loc. C-246406 (conodonts from base of unit, Middle or Late Ordovician)	31.5	316.5
	UNNAMED UNIT (lower member) Cambrian and Ordovician (285.0 m)		
Subdivision 3 (178.5 m)			
17	Covered interval; walked along strike and observed platy dolostone in the recent muds; these blocks were presumed to represent underlying bedrock	39.0	285.0
16	Dolostone: cherty; light grey, weathers light grey; coarse crystalline; medium bedded; abundant wavy-parallel laminae; some laminae are silicified; rare polygonal mudcracks and ripple marks; felsenmeer and sporadic outcrop	22.5	246.0
15	Dolostone: cherty; light grey, weathers greyish yellow; fine crystalline; medium bedded; abundant chert; some parts contain up to 5% chert; decrease in chert content up unit; single silicified intraclast bed was noted; felsenmeer	25.5	223.5
14	Covered interval	19.5	198.0
13	Dolostone: cherty; weathers pale brown; medium to coarse crystalline; <1% chert; petroliferous; vague planar-parallel lamination; outcrop and felsenmeer; GSC loc. C-246405 (conodonts from base of unit, Early Ordovician, mid-Ibexian, Stairsian or Tulean)	13.5	178.5
12	Dolostone: locally silty; slight increase in silt content up unit; light grey, weathers greyish yellow; fine crystalline; medium bedded; abundant planar-parallel lamination; felsenmeer	12.0	165.0
11	Covered interval	18.0	153.0
10	Sandstone: quartz arenite; light grey, weathers light grey; fine grained; thick bedded, well indurated, resistant; well-rounded quartz grains; poorly sorted; massive; unit is laterally continuous	4.5	135.0
9	Covered interval	6.0	130.5
8	Dolostone: cherty, sandy; light grey, weathers yellow-grey; medium crystalline, upper part with rare, coarse quartz sand grains, chert granules and carbonate intraclasts; chert granules and intraclasts are suspended in dolostone or in contact with other granules; medium to thick bedded, some platy (thin) beds; very minor (<1%) brown nodular chert; vague wavy-parallel lamination; felsenmeer; GSC loc. C-246403 (top of unit)	9.0	124.5
7	Dolostone: cherty; light grey, weathers yellow grey; medium crystalline; medium to thick bedded, some platy (thin) beds; very minor (<1%) black nodular chert; numerous intraclast beds; vague wavy-parallel lamination; felsenmeer	9.0	115.5

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
Subdivision 2 (61.5 m)			
6	Dolostone: light grey, weathers yellow-grey; medium to coarse crystalline; thick bedded; vaguely burrowed; wavy-parallel lamination; GSC loc. C-246402, 1.0 m above base of unit (conodonts, Early Ordovician)	4.5	106.5
5	Dolostone: cherty; medium light grey, weathers yellow-grey; medium crystalline; medium bedded; common nodular brown and white chert; less chert than in units 3 and 4; petroliferous; felsenmeer; unit is extensively covered	25.5	102.0
4	Dolostone: cherty; medium light grey, weathers yellow-grey; medium crystalline; medium bedded; common nodular brown and white chert (about 1–2% of unit); petroliferous; felsenmeer; GSC loc. C-246401 (top of unit)	18.0	76.5
3	Dolostone: cherty; medium light grey, weathers yellow grey; medium crystalline; medium bedded; common nodular brown and white chert (about 1–2% of unit); petroliferous; felsenmeer; GSC loc. C-246399 (conodonts, base of unit, earliest Ordovician); GSC loc. C-246400 (top of unit, Early Ordovician)	13.5	58.5
Subdivision 1 (45.0 m)			
2	Dolostone: locally sandy and silty; light grey, weathers yellow-grey; medium to fine crystalline; medium bedded, some platy (thin) bedded dolostone; some planar-parallel laminae; felsenmeer	6.0	45.0
1	Covered interval	39.0	39.0

Strata below unit 1 consist of Precambrian diabase.

STRATIGRAPHIC SECTION 185B (about 4 km north of Flexure Bay)
72°35.36'N 96°26.13'W

This section was measured and described by Russel Akeeagok and Tim de Freitas on July 23, 1997, under unusually warm and sunny conditions. This locality is the same as locality 7 logged by Thorsteinsson and Uyeno (1980, fig. 22). Beds overlying unit 35 were not examined.

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
	PEEL SOUND FORMATION (conglomerate facies) Silurian and Devonian (60.0 m, incomplete thickness)		
35	Conglomerate: weathers moderate red; cobble and local boulder grade; thick bedded; clast imbrication; basement lithoclasts >70% of clasts; boulders weather out of outcrop and occur as large, well rounded boulders and cobbles in the recent stream gravels; note abrupt change of clast size and composition across the Peel Sound facies contact	60.0	567.5
	PEEL SOUND FORMATION (sandstone facies) Silurian (461.5 m)		
34	Conglomerate and sandstone (interbedded) Conglomerate (60%): orthoconglomerate; weathers moderate red and locally pale yellow-green; pebble grade; thick bedded; clast imbrication; rare basement-derived lithoclasts; basement-derived lithoclasts tend to be more common at top of unit. Sandstone (40%): calcareous and dolomitic; weathers yellow-grey and locally pale red; common granule and pebble lithoclasts; medium bedded; bioturbated; upper contact with the Peel sound Formation conglomerate	55.5	507.5
33	Conglomerate and sandstone (interbedded). Conglomerate (60%): orthoconglomerate; weathers moderate red; granule and pebble grade; thick bedded; clast imbrication. Sandstone (40%): calcareous and dolomitic; weathers yellow-grey, locally pale red; common granule and pebble lithoclasts; common lenses of conglomerate in the sandstone; lowest occurrence of basement-derived lithoclasts	34.5	452.0
32	Conglomerate; orthoconglomerate; weathers pale red; pebble and local cobble grade; thick bedded; moderately well sorted; all carbonate lithoclasts; clast imbrication; unit fines upward	7.5	417.5
31	Sandstone: calcareous and dolomitic, about 20% of unit is sandy limestone; weathers yellow-grey, locally pale red, and pale yellow-green; fine grained; medium bedded; bioturbated; few fossil fragments; GSC loc. C-246417 (3.0 m above base of unit)	16.5	410.0
30	Conglomerate: orthoconglomerate; weathers moderate red and yellow-grey; granule and pebble grade; thick bedded; moderately well sorted; clast imbrication; pebbly, mostly granule grade; moderate well sorted carbonate lithoclasts; well rounded; unit fines upward	10.0	393.5
29	Sandstone: locally glauconitic; dark grey, weathers yellow-grey; medium grained; thick bedded; bioturbated; wavy-parallel laminae; recessive; felsenmeer and sporadic outcrop; upper contact not exposed	18.0	383.5
28	Conglomerate and sandstone (interbedded). Conglomerate (30%): mostly at base of unit; orthoconglomerate; weathering and bedding as in unit 30; Sandstone (70%): locally glauconitic; weathers moderate red and yellow-grey; medium to fine grained; thick bedded; poorly sorted; rare chert granules; gradational upper contact	15.0	365.5
27	Sandstone: quartz arenite; weathers moderate red; medium grained; thick bedded; granule-and pebble-size lithoclasts; poorly sorted; coarse grained lithoclasts more common at top; trough-cross-stratified; bioturbated locally; gradational upper contact	14.3	350.5
26	Limestone: wackestone; argillaceous, sandy; light grey, weathers yellow-grey; thick bedded; granule-size fossil lithoclasts; gradational upper contact	1.2	336.2
25	Sandstone: quartz arenite; locally calcareous; very calcareous at top of unit; variable to sandy limestone; moderate red, weathering and bedding as in unit 27; well-rounded quartz grains; gradational upper contact	3.0	335.0
24	Conglomerate: orthoconglomerate; weathers moderate red and yellow-grey; pebble and local cobble grade; thick bedded; poorly to moderately well sorted; well-rounded carbonate lithoclasts; sandstone matrix; clast imbrication; gradational upper contact	3.0	332.0
23	Sandstone: quartz arenite; light grey, weathers yellowish grey and locally moderate red; fine grained, minor granule-sized chert and limestone lithoclasts; thick bedded; well sorted; poorly sorted, felsenmeer	21.0	329.0
22	Conglomerate: orthoconglomerate; weathers moderate red and yellow-grey; thick bedded; poorly to moderately well sorted; well-rounded carbonate lithoclasts; sandstone matrix; sharp upper contact	3.5	308.0
21	Sandstone and Mudrock (interbedded). Sandstone (95%): quartz arenite; light grey, weathers yellowish grey and locally moderate red; fine grained, minor granule sized chert lithoclasts; thick bedded; well sorted. Mudrock (>5%): sandy; weathers pale yellow-green; recessive; sharp upper contact	13.0	304.5

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
20	Conglomerate: orthoconglomerate; weathers moderate red and yellow-grey; thick bedded; poorly to moderately well sorted; well-rounded carbonate lithoclasts; few chert lithoclasts; sandstone matrix; unit fines upward; clast imbrication; stratigraphically lowest conglomerate bed in this section; sharp upper contact	6.0	291.5
19	Dolostone and sandstone (interbedded). Dolostone (10%): sandy; weathers yellow-grey and locally moderate red; fine crystalline; thick bedded; vague wavy, parallel lamination; molar tooth structures. Sandstone (90%): quartz arenite, dolomitic; yellowish grey weathering and fresh surfaces; thick bedded; fine grained; well sorted, well rounded, well indurated quartz grains	28.5	285.5
18	Covered interval	19.5	257.0
17	Sandstone and dolostone (interbedded). Sandstone (80%): quartz arenite, dolomitic, locally calcareous; yellowish grey, weathers yellowish grey; thick bedded; fine grained; well sorted, well rounded, well indurated quartz grains. Dolostone (20%): weathers yellowish grey and locally moderate red; fine crystalline; thick bedded; bioturbated; ripple marks	16.8	237.5
16	Dolostone: sandy; weathers yellow-grey and locally moderate red; fine crystalline; thick bedded; vague wavy parallel lamination; polygonal mudcracks; gradational upper contact	1.2	220.7
15	Sandstone: as in unit 17; more dolomitic at top of unit; vague ripple marks and planar-parallel lamination; lowest red weathering unit in the section	12.0	219.5
14	Sandstone and limestone (interbedded). Sandstone (20%): quartz arenite; calcareous, as in unit 17. Limestone (80%): burrow-mottled; sparsely fossiliferous; gradational upper contact	7.0	207.5
13	Limestone: argillaceous; dolomitic; light grey, weathers yellow-grey; fine crystalline; burrow mottled (ichnofacies index of 2 to 3); locally rubbly weathering; sparse fossils; gradational upper contact	2.0	200.5
12	Sandstone: as in unit 17; ripple marks; planar-parallel lamination; gradational upper contact	14.8	198.5
11	Limestone: mudstone; sandy, dolomitic; light grey, weathers yellow-grey; thick bedded; branching stromatoporoids	1.2	183.7
10	Sandstone and Limestone (interbedded). Limestone (10%): sandy and dolomitic; light grey, weathers yellow-grey; fine crystalline; thick bedded; burrow mottled (ichnofacies index of about 2). Sandstone (90%): as in unit 6; gradational upper contact	28.5	182.5
9	Limestone: as in unit 11; stromatoporoid and *Coenites* fragments; gradational upper contact	12.0	154.0
8	Sandstone: quartz arenite; dolomitic; dark grey, weathers dark grey; thick bedded; fine grained; well sorted; gradational upper contact	10.5	152.5
7	Dolostone and sandstone(interbedded). As in unit 6, but unit 7 is extensively covered	22.5	142.0
6	Dolostone and sandstone (interbedded). Dolostone (40%): sandy; weathers yellow grey to greyish yellow; thick bedded; vague planar-parallel and wavy-parallel lamination; discontinuous mudcracks, molar tooth structures, and locally burrow-mottled. Sandstone (60%): quartz arenite, dolomitic, locally calcareous; yellowish grey, weathers yellowish grey; thick bedded; fine grained; well sorted, well rounded, well indurated quartz grains; gradational upper contact	24.0	119.5
5	Limestone: dolomitic; light grey, weathers light grey and yellow-grey; fine crystalline; thick bedded; burrow mottles (ichnofacies index of 1–2 at base and 5 at top of unit); high-spired gastropods and other fossils at top; unit contains features that suggest deepening upward; gradational upper contact	28.5	95.5
4	Dolostone and sandstone (interbedded). Dolostone (70%): sandy, gradational to dolomitic sandstone; light grey, weathers yellow-grey; fine crystalline; medium, discontinuously bedded; locally burrow mottled (ichnofacies index of about 2). Sandstone (30%, includes basal 10 cm of unit): quartz arenite; calcareous and dolomitic; yellow-grey, weathers yellow-grey; fine grained, poorly sorted; medium bedded; well rounded quartz sand grains, minor carbonate intraclasts; massive, bioturbated; minor burrow mottles; GSC loc. C-246411 (conodont sample from 6.0 m above base, Late Silurian, late Ludlow); GSC loc. C-246410 (3.0 m above base of unit)	21.0	67.0
	DOURO FORMATION Silurian (46.0 m, incomplete thickness)		
3	Limestone: rudstone; dolomitic; medium grey, weathers medium grey; fine crystalline; burrow mottles; thick bedded; colonial rugose corals and stromatoporoids less common than in unit 2, but abundant articulated and disarticulated atrypid brachiopods	16.5	46.0
2	Limestone: rudstone; dolomitic; medium grey, weathers medium grey; fine crystalline; thick bedded; colonial rugose corals encrusted by microbialites; top 2.0 m consist of a disarticulate, concave-up megalodont rudstone; tabular stromatoporoids, some corals are encrusted by stromatoporoids; stromatoporoids are 50 cm wide; very abundant fossils; gradational upper contact	28.5	29.5
1	Limestone: megalodont rudstone; dolomitic; medium grey, weathers medium grey; fine crystalline; thick bedded; disarticulate, concave-up megalodont valves; gradational upper contact	1.0	1.0

STRATIGRAPHIC SECTION 186 (northeastern Prince of Wales Island)

This section was measured and described by Russell Akeeagok and Tim de Freitas, July 25th, 1997, during a windy cool day, with patchy fog and a temperature of about 1 to 4° C. The base of the section is at the beach; the top is formed by the last major outcrop on the plateau.

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
	UNNAMED UNIT (lower member) Cambrian and Ordovician (545.1 m, incomplete thickness)		
	Subdivision 3 (227.0 m, incomplete thickness)		
30	Dolostone and sandstone (interbedded). Dolostone (60%): sandy; weathers light grey, yellow-grey, and pale yellowish orange; coarse crystalline; thick bedded; 5% vuggy porosity; massive; locally bioturbated. Sandstone (40%): quartz arenite; dolomitic; weathers pale brown and yellow-grey; medium grained; medium bedded; well rounded quartz grains; well sorted; mostly represented by felsenmeer; unit overlain by conglomerate; overlying beds poorly exposed and covered and were not investigated	25.5	445.1
29	Dolostone and sandstone (interbedded). Dolostone (60%): sandy; weathers light grey, yellow-grey, and pale yellowish orange; coarse crystalline; thick bedded; 5% vuggy porosity; massive; locally bioturbated. Sandstone (40%): quartz arenite; dolomitic; weathers pale brown and yellow-grey; medium grained; medium bedded; well rounded quartz grains; well sorted; mostly represented by felsenmeer; unit mostly represented by felsenmeer; GSC loc. C-246425 (2.0 m above base of unit)	81.0	419.6
28	Dolostone and sandstone (interbedded). Dolostone (90%): cherty; greyish yellow, weathers yellow-grey; medium to coarse crystalline; thick bedded; common white and brown chert nodules; common planar-parallel lamination; common replacement chert. Sandstone (10%): quartz arenite; dolomitic; weathers pale brown and yellow-grey; medium grained; medium bedded; well-rounded quartz grains; well sorted; mostly represented by felsenmeer	16.5	338.6
27	Dolostone and sandstone (interbedded). Dolostone (90%): as in unit 28; common replacement chert. Sandstone (10%): quartz arenite; dolomitic; pale brown and yellow-grey weathering; medium bedded; medium grained; well rounded quartz grains; well sorted; mostly represented by felsenmeer	19.5	322.1
26	Dolostone: silty; weathers yellow-grey and greyish yellow; fine crystalline; thin bedded (platy); planar-parallel lamination; felsenmeer	4.5	302.6
25	Covered interval	18.0	298.1
24	Dolostone: as in unit 28; felsenmeer and sporadic outcrop	21.0	280.1
23	Covered interval	10.5	269.1
22	Dolostone and mudrock (interbedded). Dolostone (75%): light grey, weathers very light grey; fine crystalline; medium bedded; 5% vuggy porosity; vague burrow mottles (ichnofacies index of about 5); poorly preserved intraclast beds. Mudrock (25%): cherty; light grey, weathers light grey; thin bedded; fissile; abundant grey and white chert nodules (see comments on nodular chert for unit 19); felsenmeer	12.0	258.6
21	Dolostone and mudrock (interbedded). Dolostone (75%): light grey, weathers very light grey; fine crystalline; thick bedded; vague burrow mottles (ichnofacies index of about 5). Mudrock (25%): cherty; light grey, weathers light grey; thin bedded; fissile	6.0	246.6
20	Limestone: mudstone; dolomitic; light grey, weathers yellow-grey to pale brown; fine crystalline; thick bedded; burrow mottled (ichnofacies index of about 5); gradational upper contact; GSC loc. C-246422 (conodonts from base of unit, earliest Ordovician, Ibexian, Skullrockian)	1.5	240.6
19	Limestone and mudrock (interbedded). Limestone (60%): mudstone; dolomitic; light grey, weathers yellow-grey to pale brown; fine crystalline; thick bedded; burrow-mottled (ichnofacies index of about 5). Mudrock (40%): cherty; light grey, weathers light grey; thin bedded; fissile; common light grey chert nodules; sharp upper contact (these chert nodules occur in abundance in raised beaches located about 3 km south of the base of the section; they occur in clusters adjacent to Tinuit dwellings; the chert appears to be dense and bears few structural imperfections, making an ideal raw material for stone tools and weapons)	3.0	239.1
18	Limestone and mudrock (interbedded). Limestone (70%): mudstone; dolomitic; light grey, weathers yellow-grey to pale brown; fine crystalline; thick bedded; burrow mottled (ichnofacies index of 5). Mudrock (30%): light grey, weathers light grey; thin bedded; fissile	7.5	236.1
17	Limestone: mudstone; dolomitic; yellow-grey to pale brown weathering; light grey fresh surface; thick bedded; fine crystalline; burrow mottled (ichnofacies index of 5)	2.0	228.6
16	Limestone: mudstone; argillaceous, dolomitic; fine crystalline; thick bedded; rubbly weathering	1.0	226.6

Unit	Description	Unit thickness (m)	Cumulative thickness (m)
15	Limestone: as in unit 17; GSC loc. C-246423 (conodonts from base of unit, earliest Ordovician, Ibexian, Skullrockian)	4.5	225.6
14	Covered interval	3.0	221.1
Subdivision 2 (102.5 m)			
13	Dolostone: cherty; weathers yellow-grey; thick bedded; medium to coarse crystalline; abundant brown and white amorphous chert nodules; locally petroliferous; vague burrow mottles; more calcareous at top.	13.5	218.1
12	Dolostone: as in unit 13	63.5	204.6
11	Dolostone: cherty; weathers yellow-grey; coarse crystalline; thick bedded; abundant white amorphous chert nodules	25.5	141.1
Subdivision 1 (115.6 m, incomplete thickness)			
10	Covered interval	24.0	115.6
9	Dolostone: locally sandy; light grey, weathers yellow-grey; medium crystalline; thick bedded; vague wavy-parallel lamination; 5% vuggy porosity; molar tooth structures	15.0	91.6
8	Dolostone: locally sandy; light grey, weathers yellow-grey; medium crystalline; thick bedded; planar-parallel lamination	20.0	76.6
7	Dolostone and sandstone (interbedded). Sandstone (90%): quartz arenite; dolomitic; light grey, weathers dark yellow-orange; medium grained; thick bedded; well-rounded quartz grains. Dolostone (10%): sandy; weathers yellow-grey; fine crystalline; medium and thin (platy) bedded; planar-parallel lamination; 5–10% vuggy porosity	7.0	56.6
6	Sandstone and dolostone (interbedded). Sandstone (30%): quartz arenite; dolomitic; light grey, weathers dark yellow-orange; medium grained; thick bedded; well-rounded quartz grains. Dolostone (70%): locally sandy; yellow-grey, weathers yellow-grey; medium crystalline; thick bedded; massive; local, vague, wavy-parallel laminae; 5% vuggy porosity; C-246421 lithological sample	6.0	49.6
5	Sandstone: quartz arenite; dolomitic; light grey, weathers dark yellowish orange; medium grained; thick bedded; well-rounded quartz grains; rare dolostone intraclasts	0.6	43.6
4	Dolostone: silty, locally sandy; weathers yellowish orange; medium crystalline; thick bedded; massive; local, vague, wavy-parallel laminae and burrows; 5% vuggy porosity; sharp upper contact; GSC loc. C-246421A (2.0 m below top of unit)	18.0	43.0
3	Dolostone and sandstone (interbedded). Dolostone (90%): sandy; light grey, weathers yellow-grey; fine crystalline; thick bedded; 5–10% vuggy porosity. Sandstone (10%): quartz arenite; dolomitic; light grey, weathers yellow-grey; fine grained; abundant ooids and coated grains, burrows filled with peloidal grainstone; thick bedded; well sorted; ripple marks; bioturbated; GSC loc. C-246420 (base of unit)	8.5	25.0
2	Sandstone and dolostone (interbedded). Sandstone (80%): quartz arenite; dolomitic; light grey, weathers yellow-grey; fine grained; thick bedded; well sorted; ripple marks; bioturbated. Dolostone (20%): sandy; weathers yellow-grey; fine crystalline; thick bedded; 5–10% vuggy porosity	13.5	16.5
1	Dolostone: very slightly silty; weathers yellow-grey; fine to medium crystalline; thick bedded; 5–10% vuggy porosity; some flat-pebble conglomerate; sharp upper contact	3.0	3.0

Appendix B
Geophysical data

Introduction

This appendix provides additional information regarding geophysical data presented in this bulletin. Although the report area is defined by the geological map sheets, the geophysical data covers a wider region, and provides both stratigraphic and structural information about the subsurface. Reflection seismic profiles, Bouguer gravity and total magnetic field maps have all been used and illustrated. In particular, the new versions of seismic profiles, enhanced, re-displayed, migrated, and re-interpreted, extract new information from legacy exploration data and provide a significant component of previously unpublished data.

Seismic surveys

Two industry-owned reflection seismic surveys, totalling 1 059 km, were completed on Prince of Wales and Russell islands. Line and shot point locations appear on Figure 9, Map 3; Figure 19, Map 7; and Figure 20, Map 8. Line listings for these surveys are shown in Table B-1.

A seismic survey was shot in 1972 by Kerr McGee of Canada Northwest Ltd. A report regarding this survey was submitted to the Canadian government (DINA # 551-06-09-008), and is available through the National Energy Board (NEB). This report however contains no actual seismic data. A six-fold subsurface reflection method was employed using 48 groups of geophones spread at 220-foot spacing with shot holes at 880-foot intervals. On sea ice, some coverage was obtained using the same configuration but with 110-foot geophone station intervals to provide three-fold subsurface coverage. The recording system was 48 channels using a DFS IV binary gain amplifier. Geophones were Mark L-10 14hz models on strings of nine at 25-foot intervals. Hole depths and charge sizes (presumably dynamite or equivalent) were varied but 20-pound charges at a 60 foot hole depth were used for most of the survey. R.B. Cruz and Associates Ltd. processed the field data using standard techniques of the day. A datum velocity of 16 000 ft./sec was used for structural static correction to a sea level datum. A horizontal survey inconsistency was reported in the above NEB report regarding line 7248, so its shot point locations are suspect.

The original moved-out trace gathers for this survey were supplied by Kerr McGee and were stacked, enhanced and migrated by the Geological Survey of Canada, Calgary for this project. A typical side label detailing the processing flow and parameterization for lines in this survey are shown in Figure B-3. The effective multiple suppression process here is the eigenvector filtering, which essentially decomposes the data based on dip criteria and reassembles it without generally flat-lying energy. This process was applied only to the sub-Palaeozoic basement complex through gating. A Kirchoff time-migration was then done. Figure B-1 illustrates the overall improvement of the seismic imaging of this survey achieved with this approach.

A second seismic survey, farther north with some lines on Russell Island, was shot by Panarctic Oils Limited in 1975. Paper copies of these original data reside at the NEB, DINA # 624-06-10-021. A six- or four-fold subsurface reflection method was employed using 48 groups of geophones spread at 220-foot spacing with shot holes of either 880- or 1320-foot intervals. The recording system was 48 channels using a Sercel 338-A system. Geophones were Mark L-10 14hz models on strings of nine at 37.5-foot intervals. Charge sizes of source explosives and hole depths were generally 50 pounds and 60 feet, respectively. Processing of original field data was done by Teledyne in 1975 and used a velocity of 16 000 ft./sec for structural statics correcting to a sea level datum. During the course of this survey, additional shots were acquired by using long spreads. These “velocity profiles” are used to establish velocity information at deeper levels than the regular receiver spread would allow. They are listed in Table B-1. An example is shown in Figure B-2.

The original Teledyne unfiltered structure stacks for this survey were supplied by Panarctic Oils and were enhanced and migrated by the GSCC for this project. A typical side label detailing the processing flow and parameterization for lines in this survey are shown in Figure B-3.

Gravity and aeromagnetic data

An aeromagnetic survey was flown for Kerr McGee in the year 1970 by Geoterrex Ltd. A report regarding this survey was submitted to the Canadian government (DINA # 551-07-09-005). This survey comprised 16 000 line km of profiling flown over the eastern half of Prince of Wales Island. A basic flight pattern of east-west lines one mile apart and north-south lines three miles apart was employed. This survey has been incorporated into the Canadian national aeromagnetic database maintained by the GSC’s Geophysical Data Center in Ottawa (GDC). The GDC provided grids for this project at a two-kilometre node spacing for both total magnetic field and Bouguer anomaly gravity data. These grids were contoured using optimized colour schemes but were otherwise unprocessed (Fig. 19, Maps 5 and 6). The CGD gravity data measurements on Prince of Wales Island have a very coarse spacing of approximately 16 km. The offshore area has a much greater frequency of gravity stations (see Fig. B-4). The Bouguer anomaly data shown on seismic traverses Q-Q', R-R' and S-S' on Figure 20 are not taken from the gravity values illustrated in Figure 19, Map 5, but come from separate gravity surveying done by Panarctic Oils Limited during their seismic acquisition of those lines. The frequency of these gravity measurements was every 1.34 km or less.

The authors would like to gratefully acknowledge Devon Canada and Talisman Energy Incorporated for providing original Kerr McGee seismic data and allowing its publication within this bulletin. Similarly we would like to thank PetroCanada for facilitating the inclusion of the original Panarctic Oils seismic data in this bulletin.

Table B-1
List of seismic lines and velocity profiles on Prince of Wales Island

Originally 100% Panarctic Oils Ltd. wholly owned data		
Line ID	Shotpoint Range	Length (km)
1872	0 - 942	62.9
1732	36 - 684	43.3
1724	930 - 1512	38.9
1730	-24 - 1660	112.3
1731	0 - 440	29.4
1734	0 - 1068	71.3
1826	0 - 772	51.5
1870	0 - 534	35.7
1871	0 - 582	38.9
1873	336 - 948	40.9
1875	-12 - 198	14.1
1875	0 - 138	9.3

Velocity/refraction profiles (Panarctic owned)		
Line ID	Shotpoint Range	Spread distance (ft.)
1870	534 -252	62040
1871	325 -419	52360
1872	73 -23	31680
1872	70 -29	31681
1872	85 -35	31682
1872	265 -215	41800
1872	271 -221	41800
1872	277 -227	41801
1872	342 -390	41802
1873	614 -707	52360

Originally 50% Kerr McGee, 50% Western Decalta owned data		
Line ID	Shotpoint Range	Length (km)
KM7212	0 - 142	38.1
KM7220	0 - 105	28.3
KM7224	0 - 120	32.3
KM7229	0 - 65	17.6
KM7231	0 - 200	53.6
KM7234	0 - 65	17.6
KM7234S	0 - 60	16.3
KM7238	0 - 27	7.5
KM7239	-29 - 80	29.3
KM7239S	0 - 44	12.0
KM7240	0 - 105	28.3
KM7242	0 - 24	6.7
KM7246	-36 - 100	36.5
KM7247	0 - 74	20.0
KM7248	0 - 60	16.3
KM7249	0 - 110	29.6
KM7254	0 - 98	26.4
KM7255	0 - 115	30.9
KM7303	0 - 51	13.9
KM7322	0 - 104	28.0
KM9649	0 - 40	10.9
KM9725	0 - 65	17.6

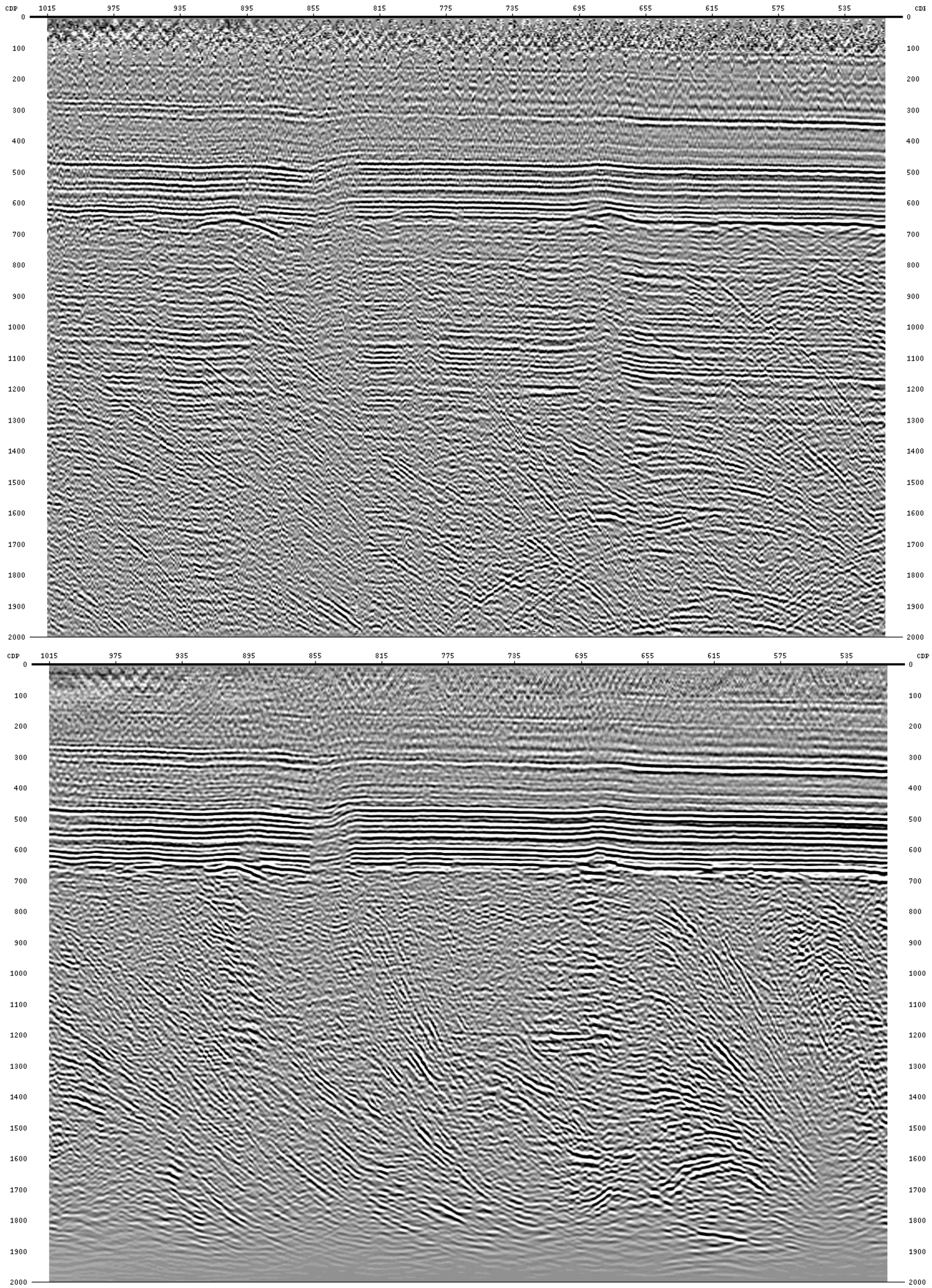


Figure B-1. *Comparison of an original unfiltered structure section created from stacking industry-provided NMO trace gathers (top), and GSCC's final migrated section (bottom). Data is part of reflection seismic line 7248 shot by Kerr McGee in 1972 (original data courtesy of Devon Canada and Talisman Energy Inc.).*

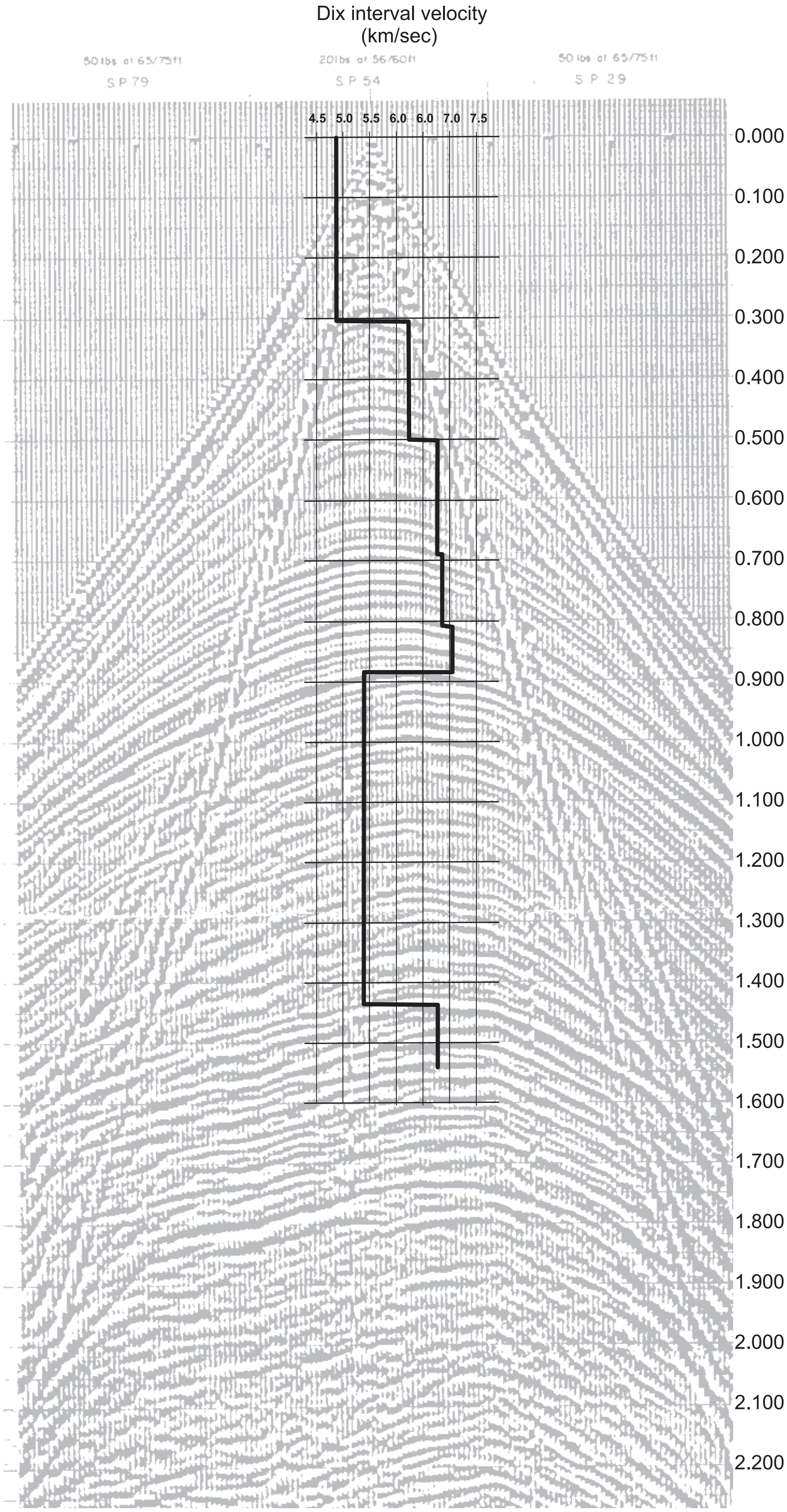
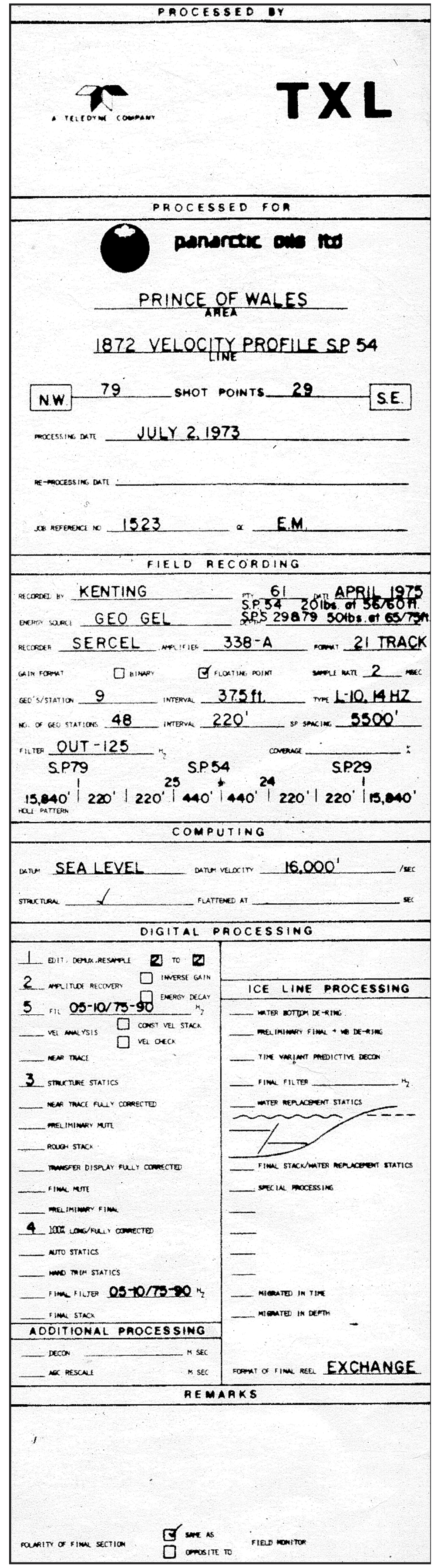


Figure B-2. *Shot record showing Dix interval velocities computed by Panarctic Oils. This is one of ten such velocity spreads listed in Table B-1. Side label is shown at right.*



PROCESSED BY

A TELEDYNE COMPANY TXL

PROCESSED FOR

panarctic oils ltd

AREA: PRINCE OF WALES

LINE: 1872 VELOCITY PROFILE SP 54

N.W. 79 SHOT POINTS 29 S.E.

PROCESSING DATE: JULY 2, 1973

RE-PROCESSING DATE:

JOB REFERENCE NO: 1523 QC: E.M.

FIELD RECORDING

RECORDED BY: KENTING   PTY: 61   DATE: APRIL 1975

ENERGY SOURCE: GEO GEL   DEPTH: S.P. 54 20lbs. at 56/60ft. S.P.S 29&79 50lbs. at 65/75ft.

RECORDER: SERCEL   AMPLIFIER: 338-A   FORMAT: 21 TRACK

GAIN FORMAT: ☐ BINARY ☑ FLOATING POINT   SAMPLE RATE: 2 MSEC

GEO'S/STATION: 9   INTERVAL: 37.5 ft.   TYPE: L-10, 14 HZ

NO. OF GEO STATIONS: 48   INTERVAL: 220'   SP SPACING: 5500'

FILTER: OUT-125 Hz   COVERAGE: %

S.P.79 S.P.54 S.P.29

25 24

15,840' | 220' | 220' | 440' | 440' | 220' | 220' | 15,840'

HOLE PATTERN

COMPUTING

DATUM: SEA LEVEL   DATUM VELOCITY: 16,000' /SEC

STRUCTURAL: ✓   FLATTENED AT: SEC

DIGITAL PROCESSING

1 EDIT, DEMUX, RESAMPLE ☑ TO ☑

2 AMPLITUDE RECOVERY ☐ INVERSE GAIN ☐ ENERGY DECAY

5 FIL 05-10/75-90 Hz

VEL ANALYSIS ☐ CONST VEL STACK ☐ VEL CHECK

NEAR TRACE

3 STRUCTURE STATICS

NEAR TRACE FULLY CORRECTED

PRELIMINARY MUTE

ROUGH STACK

TRANSFER DISPLAY FULLY CORRECTED

FINAL MUTE

PRELIMINARY FINAL

4 100% LONG/FULLY CORRECTED

AUTO STATICS

HAND TRIM STATICS

FINAL FILTER 05-10/75-90 Hz

FINAL STACK

ICE LINE PROCESSING

WATER BOTTOM DE-RING

PRELIMINARY FINAL + WB DE-RING

TIME VARIANT PREDICTIVE DECON

FINAL FILTER Hz

WATER REPLACEMENT STATICS

FINAL STACK/WATER REPLACEMENT STATICS

SPECIAL PROCESSING

MIGRATED IN TIME

MIGRATED IN DEPTH

ADDITIONAL PROCESSING

DECON M SEC

AGC RESCALE M SEC

FORMAT OF FINAL REEL: EXCHANGE

REMARKS

POLARITY OF FINAL SECTION: ☑ SAME AS ☐ OPPOSITE TO FIELD MONITOR

GSC Calgary
Prince of Wales Island
Line 1732
Kirchhoff Time Migrated

FIELD PARAMETERS

```
Date Recorded........ April, 1975
Source Type.......... Geo Gel, 20# @ 56/60'
Sample Rate.......... 2 ms
Record End Time...... 6 sec
Long Offset.......... 5500'
High Cut Filter...... 125 Hz
Instruments.......... SERCEL, 338-A, 21 Track
..................... L-10, 14 Hz phones
Format............... EXCHANGE
Number Data Chans.... 48
```

PROCESSING SEQUENCE

```
FLOW - get_sgy   Mon Aug 11 11:53:51 1997
  Output - 1732_data Add 1284 Over 0
 SEG-Y Input

FLOW - Stack     Tue Jul 13 10:12:05 1999
  Output - 1732_STK Add 1284 Over 0
 Header Statics
  Bulk shift static                         -300.
  What about previous statics?              Add to previous statics
  HOW to apply header statics               Add
 Database/Header Transfer
  Direction of transfer                     Load TO trace header FROM database
  First header entry                        Elevation of CDP
  Second header entry                       BOUGUER
  Third header entry                        XLINE
  Fourth header entry                       XSTN
  Fifth header entry                        STATIC

FLOW - Eigen Filter  Tue Jul 13 11:44:22 1999
  Output - 1732_EIGEN Add 1284 Over 0
 Eigenvector Filter
  Mode                                      Subtract Eigenimage of Zone
  Get matrix design gates from DATABASE?    No
    SELECT Primary header word              CDP
    SPECIFY design time gate parameters
    200:0-5700/600:0-5700/
  Get application gates from DATABASE?      No
    SELECT Primary header word              CDP
    SPECIFY application gate parameters
    52:0-5700/1335:0-5700/
  Get Subtraction gates from DATABASE?      No
    SELECT Primary header word              CDP
    SPECIFY subtraction gate parameters
    52:0-5700/1335:0-5700/
  Type of Computations ?                    Complex
  Horizontal window width                   200
  Start percent of eigenimage range         65.
  End percent of eigenimage range           100.

FLOW - FX-Decon  Tue Jul 13 13:33:08 1999
  Output - 1732_FX Add 1284 Over 0
 F-X Decon
  TYPE of filter                            Wiener Levinson
  Percentage of white noise                 0.1
  Horizontal window length                  8
  Number of filter samples                  7
  Time window length                        260.
  Time window overlap                       60.
  F-X filter start frequency                6.
  F-X filter end frequency                  90.

FLOW - KT-Migration  Tue Jul 13 14:17:19 1999
  Output - Current Flow Add 0 Over 0
 Bandpass Filter
  TYPE of filter                            Single Filter
  Type of filter specification              Ormsby bandpass
  PHASE of filter                           Zero
  Apply a notch filter?                     No
  Ormsby filter frequency values            0-0-80-90
 Kirchhoff Time Mig.
  Maximum frequency to migrate (in Hz)      80.
  Migration aperture (feet or meters)       3000.
  Maximum dip to migrate                    75.
  Avoid spatial aliasing?                   Yes
  Get RMS velocities from database?         Yes
    Select RMS vs.time velocity file        1732_rms2
  Re-apply trace mutes?                     Yes
```

DISPLAY PARAMETERS

```
Tue Jul 13 15:47:29 1999              Static Shift  = 0
Traces/Inches =                       Inches/Second  =
Bias Percent  = 0                     Clip Limit    = 6
Gain Set      = 0.75                  RMS Amplitude = 1330.95
Gain Constant = 0.563507
```

ADVANCE ProMAX

GSC Calgary
Prince of Wales Island
line KM7231
Kirchhoff Time Migrated

FIELD PARAMETERS

```
Date Recorded........ 1972
Source Type.......... Dynamite
Sample Rate.......... 2 ms
Record End Time...... 2 sec
Number Data Chans.... 48
```

PROCESSING SEQUENCE

```
FLOW - FX-Decon  Thu Jul  8 12:09:07 1999
  Output - 7231_FX Add 1624 Over 0
 Trace Header Math
  Select mode                               Fixed equation mode
    DEFINE trace header equation
    SOURCE=NINT(CDP/8)
 Database/Header Transfer
  Direction of transfer                     Load TO trace header FROM database
  First header entry                        Elevation of CDP
  Second header entry                       CROSLINE
  Third header entry                        TIEPOINT
  Fourth header entry                       STATIC
 Trace Header Math
  Select mode                               Fixed equation mode
    DEFINE trace header equation
    LINE=NINT(CROSLINE)
 Trace Header Math
  Select mode                               Fixed equation mode
    DEFINE trace header equation
    TIES=NINT(TIEPOINT)
 Header Delete
  Header entry                              CROSLINE
 Header Delete
  Header entry                              TIEPOINT
 Eigenvector Filter
  Mode                                      Subtract Eigenimage of Zone
  Get matrix design gates from DATABASE?    No
    SELECT Primary header word              CDP
    SPECIFY design time gate parameters
    100:0-2000/400:0-2000/
  Get application gates from DATABASE?      Yes
    SELECT application gate parameter       eigenlimit

  Get Subtraction gates from DATABASE?      Yes
    SELECT subtraction gate parameter       eigenlimit

  Type of Computations ?                    Complex
  Horizontal window width                   201
  Start percent of eigenimage range         0.
  End percent of eigenimage range           3.
 Eigenvector Filter
  Mode                                      Subtract Eigenimage of Zone
  Get matrix design gates from DATABASE?    No
    SELECT Primary header word              CDP
    SPECIFY design time gate parameters
    100:0-2000/300:0-2000/
  Get application gates from DATABASE?      No
    SELECT Primary header word              CDP
    SPECIFY application gate parameters
    1:0-2000/1624:0-2000/
  Get Subtraction gates from DATABASE?      No
    SELECT Primary header word              CDP
    SPECIFY subtraction gate parameters
    1:0-2000/1624:0-2000/
  Type of Computations ?                    Complex
  Horizontal window width                   201
  Start percent of eigenimage range         65.
  End percent of eigenimage range           100.
 F-X Decon
  TYPE of filter                            Wiener Levinson
  Percentage of white noise                 0.04
  Horizontal window length                  8
  Number of filter samples                  7
  Time window length                        260.
  Time window overlap                       60.
  F-X filter start frequency                6.
  F-X filter end frequency                  100.

FLOW - KT-Migration  Thu Jul  8 12:59:36 1999
  Output - Current Flow Add 0 Over 0

FLOW - display comparison    Sat Jun  7 16:33:59 1997
  Bandpass Filter
   TYPE of filter                            Single Filter
   Type of filter specification              Ormsby bandpass
   PHASE of filter                           Zero
   Apply a notch filter?                     No
   Ormsby filter frequency values            0-0-80-90
  Kirchhoff Time Mig.
   Maximum frequency to migrate (in Hz)      90.
   Migration aperture (feet or meters)       0.
   Maximum dip to migrate                    75.
   Avoid spatial aliasing?                   Yes
   Get RMS velocities from database?         Yes
     Select RMS vs.time velocity file        7231_rms
   Re-apply trace mutes?                     Yes
```

DISPLAY PARAMETERS

```
Thu Jul  8 13:17:27 1999              Static Shift  = 0
Traces/Inches =                       Inches/Second  =
Bias Percent  = 0                     Clip Limit    = 6
Gain Set      = 0.75                  RMS Amplitude = 2834.71
Gain Constant = 0.264577
```

ADVANCE ProMAX

Figure B-3. *Side labels representing the typical post-stack data processing flow and parameterization of Panarctic data (left) and Kerr McGee data (right).*

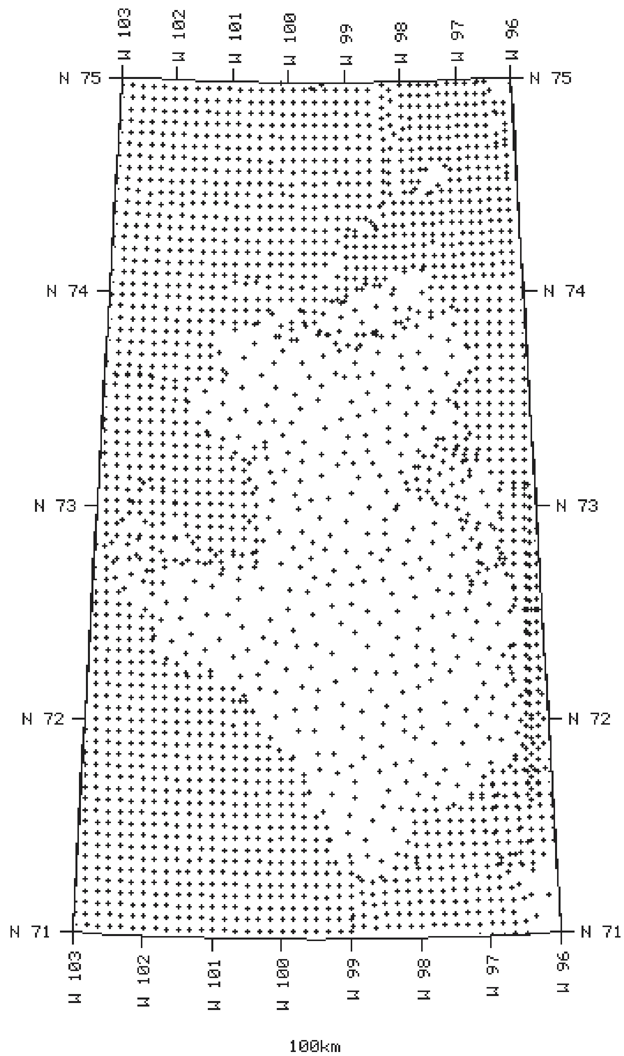


Figure B-4. *Spatial distribution of gravity stations used for gridded data in part of Map 5, Figure 19.*

Appendix C
Microprobe analyses of garnet, orthopyroxene and plagioclase in gneisses from a locality 4 km NW of Cape Brodie, Prince of Wales Island

Sample	FS-92-3C			FS-92-3D			FS-92-3E		
	Grt	Opx	Plg	Grt	Opx	Plg	Grt	Opx	Plg
SiO_2	38.73	49.04	60.58	38.03	49.12	62.54	37.30	49.14	58.75
TiO_2	0.04	0.11		0.05	0.12		0.03	0.11	
Al_2O_3	21.91	4.83	24.29	21.43	5.47	23.74	21.01	3.50	24.69
Cr_2O_3	0.10	0.14		0.13	0.17		0.19	0.19	
FeO_T	29.53	25.12	0.04	26.84	21.55	0.03	28.31	25.45	0.06
MnO	0.46	0.15		0.55	0.15		1.26	0.37	
MgO	9.18	20.00		10.05	20.95		7.57	18.59	
CaO	1.07	0.08	6.02	0.97	0.06	5.60	1.61	0.12	7.62
Na_2O	0.00	0.02	7.92	0.01	0.02	8.01	0.02	0.02	6.31
K_2O	0.00	0.00	0.16	0.01	0.00	0.19	0.00	0.01	0.24
Total	101.02	99.49	99.01	98.07	97.61	100.11	97.30	97.50	97.67
Temp., Pressure	760°C, 0.56 GPa			750°C, 0.62 GPa			750°C, 0.55 GPa		

Temperature and pressure of metamorphism are derived from the garnet-orthopyroxene-plagioclase-quartz assemblage and calculated using the TPF program of Fonarev et al. (1991). Temperature value is that recommended by Fonarev et al. (1991). Pressure is from the geobarometer of Newton and Perkins (1982).
UTM coordinates of sample locality: Grid Zone 14, 8039030m N, 588600m E

Plate 1

Figures 1–5. *Variabiloconus bassleri* (Furnish)

1. Lateral view, x137, GSC 117064, GSC loc. C-246399
2. Inner lateral view, x78, GSC 117065, GSC loc. C-246399
3. Lateral view, x105, GSC 117066, GSC loc. C-246399
4. Lateral view, x98, GSC 117067, GSC loc. C-246423
5. Inner lateral view, x165, GSC 117068, GSC loc. C-246422

Figure 6. *Aloxoconus* sp. Posterior view, x110, GSC 117069, GSC loc. C-246422

Figures 7–9. *Cordylodus lindstromi* Druce and Jones

7. Lateral view, Sc element, x200, GSC 117070, GSC loc. C-246399
8. Lateral view, Sb element, x106, GSC 117071, GSC loc. C-246399
9. Lateral view, Pb element, x178, GSC 117072, GSC loc. C-246399

Figure 10. *Cordylodus drucei* Miller. Lateral view, x85, GSC 117073; GSC loc. C-246399

Figure 11. *Clavohamulus* sp. Posterolateral view, x135, GSC 117074, GSC loc. C-246423

Figure 12. *Teridontus gracillimus* Nowlan. Lateral view, x203, GSC 117075, GSC loc. C-246399

Figures 13, 14. *Oneotodus costatus* Ethington and Brand

13. Lateral view, x153, GSC 117076, GSC loc. C-246405
14. Lateral view, x102, GSC 117077, GSC loc. C-257794

Figure 15. *Dischidognathus* aff. *D. primus* Ethington and Clark. Posterior view, x90, GSC 117078; GSC loc. C-257795

Figures 16, 17. *Parapanderodus emarginatus* (Barnes and Tuke)

16. Lateral view, x128, GSC 117079; GSC loc. C-246405
17. Oblique posterior view, x80, GSC 117080, GSC loc. C-246405

Figures 18, 19. *Drepanoistodus*? *gracilis* (Branson and Mehl)

18. Lateral view, drepanodontiform element, x105, GSC 117081, GSC loc. C-246405
19. Lateral view, oistodontiform element, x53, GSC 117082, GSC loc. C-246405

Figure 20. *Ulrichodina abnormalis* (Branson and Mehl). Lateral view, x76, GSC 117083, GSC loc. C-257795

Figures 21-23. *Diaphorodus* spp. Each specimen is from a different sample and may belong to separate species

21. Lateral view, Sc? element, x100, GSC 117084, GSC loc. C-246405
22. Oblique lateral view, Sd element, x70, GSC 117085, GSC loc. C-257795; 23, posterior view, Sa element, x100, GSC 117086, GSC loc. C-257794

Figures 24, 25. *Eucharodus parallelus* (Branson and Mehl)

24. Lateral view, drepanodontiform element, x45, GSC 117087, GSC loc. C-257794
25. Lateral view, drepanodontiform element, x40, GSC 117088, GSC loc. C-246405

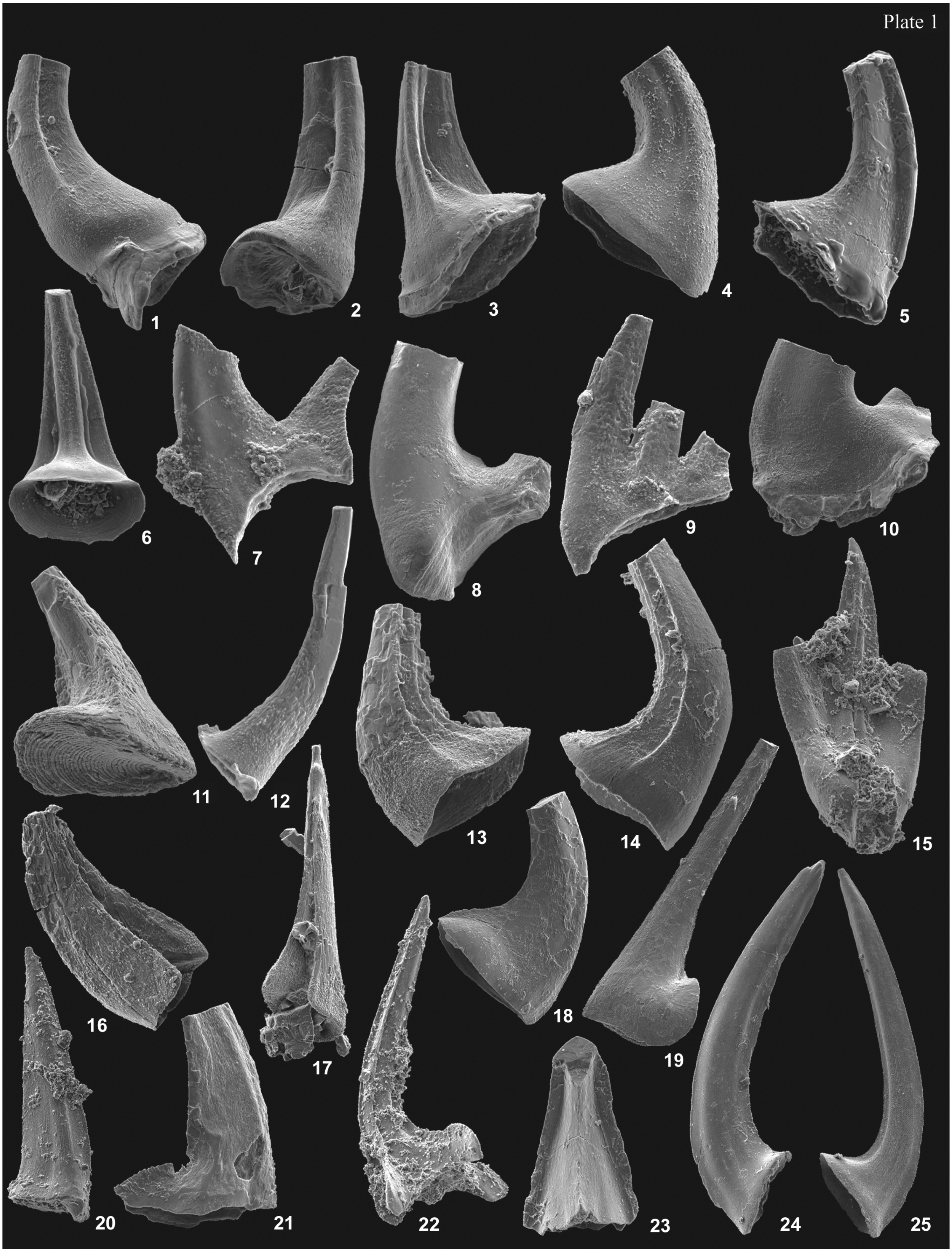

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Plate 2

Figures 1, 2. *Plegagnathus* sp.

1. Lateral view, cordylodontiform element, x66, GSC 117089, GSC loc. C-246430
2. Lateral view, plegagnathiform element, x105, GSC 117090, GSC loc. C-246430

Figures 3, 4. *Pseudobelodina*? *dispansa* (Glenister)

3. Inner lateral view, Sb element, x100, GSC 117091, GSC loc. C-246430
4. Lateral view, Sc? element, x75, GSC 117092; GSC loc. C-246406

Figures 5, 6. *Drepanoistodus suberectus* (Branson and Mehl)

5. Lateral view, drepanodontiform element, x32, GSC 117093, GSC loc. C-246430
6. Lateral view, suberectiform element, x35, GSC 117094, GSC loc. C-246430

Figure 7. *Belodina* sp. Lateral view, compressiform element?, x65, GSC 117095, GSC loc. C-246430

Figure 8. Prioniodiniform element indeterminate, inner lateral view, x49, GSC 117096, GSC loc. C-257797

Figures 9, 10. *Panderodus* sp.

9. Inner lateral view, x43, GSC 117097, GSC loc. C-257798
10. Inner lateral view, x63, GSC 117098, GSC loc. C-257796

Figures 11–14. *Oulodus*? sp.

11. Inner lateral view, Sc element, x70, GSC 117099
12. Posterior view, Sb element, x75, GSC 117100
13. Posterior view, Pb? element, x58, GSC 117101
14. Inner lateral view, M element, x49, GSC 117102; all specimens from GSC loc. C-246406

Figures 15–19. *Ozarkodina excavavta excavata* (Branson and Mehl)

15. Inner lateral view, Sc element, x83, GSC 117103
16. Posterior view, Sb element, x76, GSC l17104
17. Inner lateral view Pb? element, x103, GSC 117105
18. Lateral view, Pa element, x72, GSC 117106
19. Posterior view, M element, X95, GSC 117107; all specimens from GSC loc. C-246391

Figures 20–24. *Ozarkodina douroensis* Uyeno

20. Lateral view, Pa element, x62, GSC 117108
21. Inner lateral view, Sc? element, x68, GSC 117109
22. Inner lateral view, Sc element, x84, GSC 117110
23. Posterior view, M? element, x62, GSC 117111
24. Lateral view, ?juvenile Pa element, x102, GSC 117112; all specimens from GSC loc. C-246391

Figure 25. Polygnathid element indeterminate. Lateral view, x94, GSC 117113; probable contaminant specimen in GSC loc. C-246399

Figures 26, 27. *Oulodus* sp.

26. Posterior view, M? element, x61, GSC 117114
27. Posterior view, Pa? element, x45, GSC 117115; both specimens from GSC loc. C- 246391

Figure 28. *Ozarkodina excavavta excavata* (Branson and Mehl). Lateral view, Pa element, 80, GSC 117116, GSC loc. C-246431


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Plate 3

Figures 1–9. *Ozarkodina* n. sp. H of Uyeno (1982)

1. Lateral view, Pb element, x68, GSC 117117
2. Oral view, Pa element showing prominent groove, x56, GSC 117118
3. Lateral view, Pa element, x40, GSC 117119
4. Posterior view, Sa element, x90, GSC 117120
5. Lateral view, small Pa element, x90, GSC 117121
6. Posterior view, Sb element, x100, GSC 117122
7. Oral view, Pa element, x67, GSC 117123
8. Lateral view, Pa element, x85, GSC 117124
9. Lateral view, Pa element, x56, GSC 117125; Figures 1–4 from GSC loc. C-246393, figures 5, 6 from GSC loc. C-246394, and figures 7–9 from GSC loc. C-246411

Figures 10–13, 15–20. *Pedavis* aff. *P. thorsteinssoni* Uyeno

10. Lateral view, I element, x65, GSC 117126
11. Oral view, I element, x88, GSC 117127
12. Lateral view, I element, x50, GSC 117128
13. S element, x50, GSC 117129
15. Inner lateral view, weakly striate M_2 element with long cusp, x68, GSC 117130
16. Inner lateral view, strongly striate M_2 element, x100, GSC 117131
17. Inner lateral view, M_2 element with short cusp, x64, GSC 117132
18. Inner lateral view, M_2 element with short cusp, x64, GSC 117133
19. Inner lateral view, M_2 element with inwardly deflected cusp, x75, GSC 117134
20. Inner lateral view, strongly striate M_2 element with long cusp, x120, GSC 117135; Figures 10, 13, 16, 18 from GSC loc. C-246411, figures 11, 12, 15, 17,19 from GSC loc. C-246393 and figure 20 from GSC loc. C-246394

Figure 14. Plectospathodiform element indeterminate, x34, GSC 117136, GSC loc. C-246417

Figure 21. ?*Pelekysgnathus arcticus* Uyeno. Lateral view of fragmentary I element, x100, GSC 117137, GSC loc. C-246394

Figures 22–25. Unidentified thelodont scales

22. Dorsolateral view, x70, GSC 117138
23. Ventral view, x48, GSC 117139
24. Ventral view, x63, GSC 117140
25. Ventral view, small specimen, x81, GSC 117141; all specimens from GSC loc. C-246388

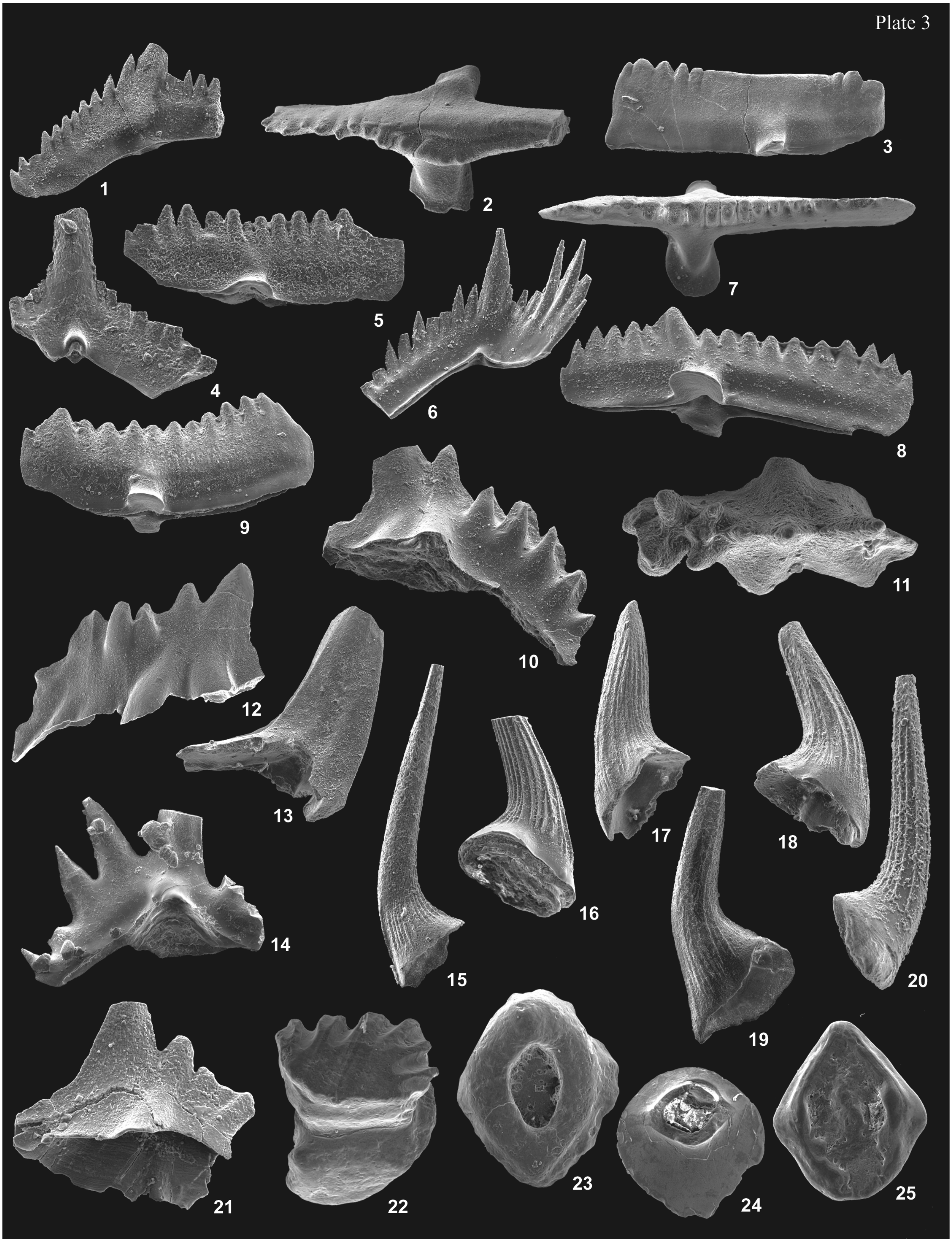
Plate 3
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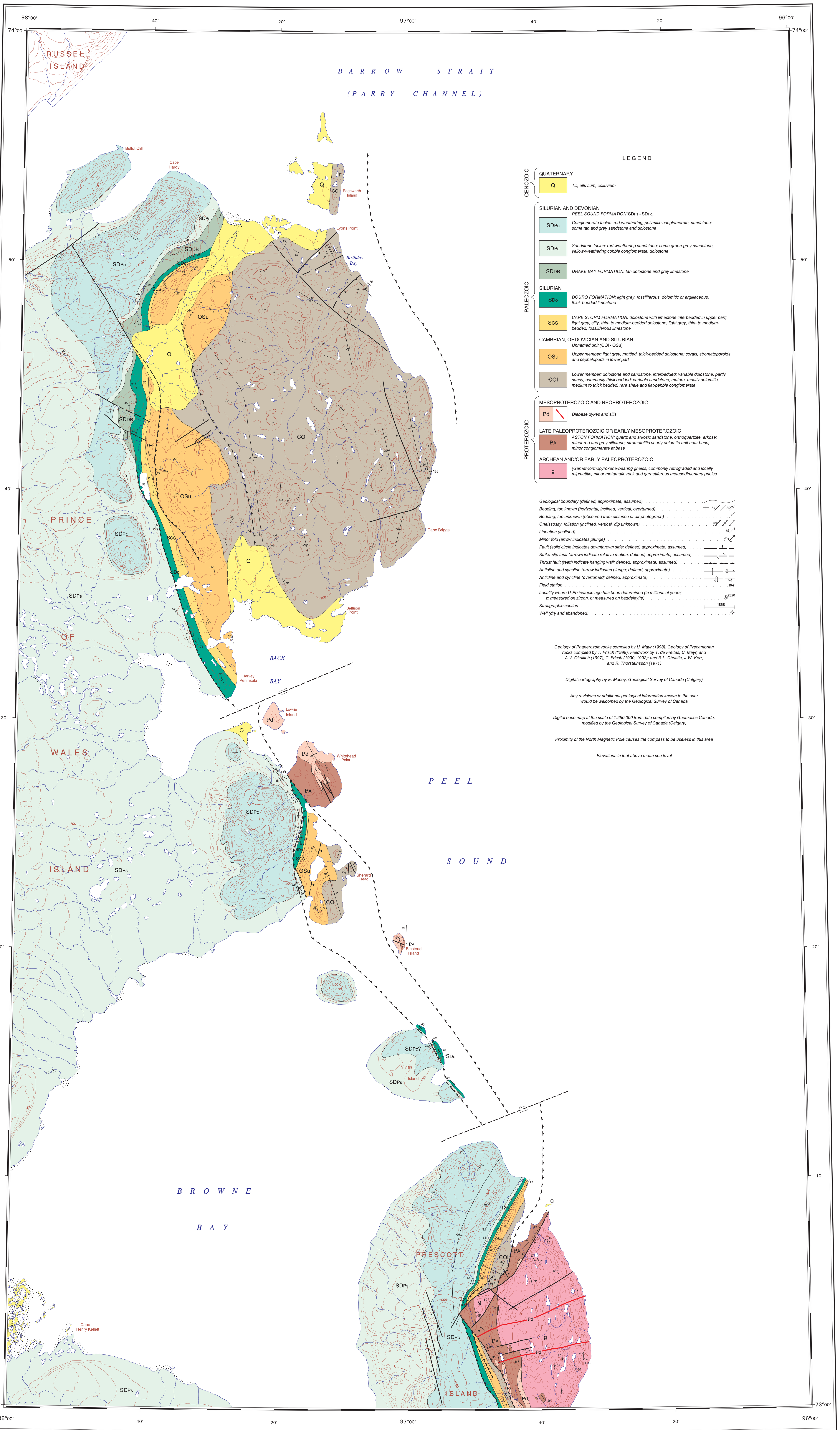


LEGEND

CENOZOIC

QUATERNARY

Q — Till, alluvium, colluvium

PALEOZOIC

SILURIAN AND DEVONIAN

PEEL SOUND FORMATION (SDPs - SDPc)

SDPc — *Conglomerate facies: red-weathering, polymitic conglomerate, sandstone; some tan and grey sandstone and dolostone*

SDPs — *Sandstone facies: red-weathering sandstone; some green-grey sandstone, yellow-weathering cobble conglomerate, dolostone*

SDDB — *DRAKE BAY FORMATION: tan dolostone and grey limestone*

SILURIAN

SDo — *DOURO FORMATION: light grey, fossiliferous, dolomitic or argillaceous, thick-bedded limestone*

Scs — *CAPE STORM FORMATION: dolostone with limestone interbedded in upper part; light grey, silty, thin- to medium-bedded dolostone; light grey, thin- to medium-bedded, fossiliferous limestone*

CAMBRIAN, ORDOVICIAN AND SILURIAN

Unnamed unit (ЄOl - OSu)

OSu — *Upper member: light grey, mottled, thick-bedded dolostone; corals, stromatoporoids and cephalopods in lower part*

ЄOl — *Lower member: dolostone and sandstone, interbedded; variable dolostone, partly sandy, commonly thick bedded; variable sandstone, mature, mostly dolomitic, medium to thick bedded; rare shale and flat-pebble conglomerate*

PROTEROZOIC

MESOPROTEROZOIC AND NEOPROTEROZOIC

Pd — *Diabase dykes and sills*

LATE PALEOPROTEROZOIC OR EARLY MESOPROTEROZOIC

PA — *ASTON FORMATION: quartz and arkosic sandstone, orthoquartzite, arkose; minor red and grey siltstone; stromatolitic cherty dolomite unit near base; minor conglomerate at base*

ARCHEAN AND/OR EARLY PALEOPROTEROZOIC

g — *(Garnet-)orthopyroxene-bearing gneiss, commonly retrograded and locally migmatitic; minor metamafic rock and garnetiferous metasedimentary gneiss*

Geological boundary (defined, approximate, assumed)
Bedding, top known (horizontal, inclined, vertical, overturned) — 54, 30
Bedding, top unknown (observed from distance or air photograph)
Gneissosity, foliation (inclined, vertical, dip unknown) — 30
Lineation (inclined) — 15
Minor fold (arrow indicates plunge) — 45
Fault (solid circle indicates downthrown side; defined, approximate, assumed)
Strike-slip fault (arrows indicate relative motion; defined, approximate, assumed)
Thrust fault (teeth indicate hanging wall; defined, approximate, assumed)
Anticline and syncline (arrow indicates plunge; defined, approximate)
Anticline and syncline (overturned; defined, approximate)
Field station — T9-2
Locality where U-Pb isotopic age has been determined (in millions of years; z: measured on zircon, b: measured on baddeleyite) — Ⓐ 2320
Stratigraphic section — 185B
Well (dry and abandoned)

Geology of Phanerozoic rocks compiled by U. Mayr (1998). Geology of Precambrian rocks compiled by T. Frisch (1998). Fieldwork by T. de Freitas, U. Mayr, and A.V. Okulitch (1997); T. Frisch (1990, 1992); and R.L. Christie, J.W. Kerr, and R. Thorsteinsson (1971)

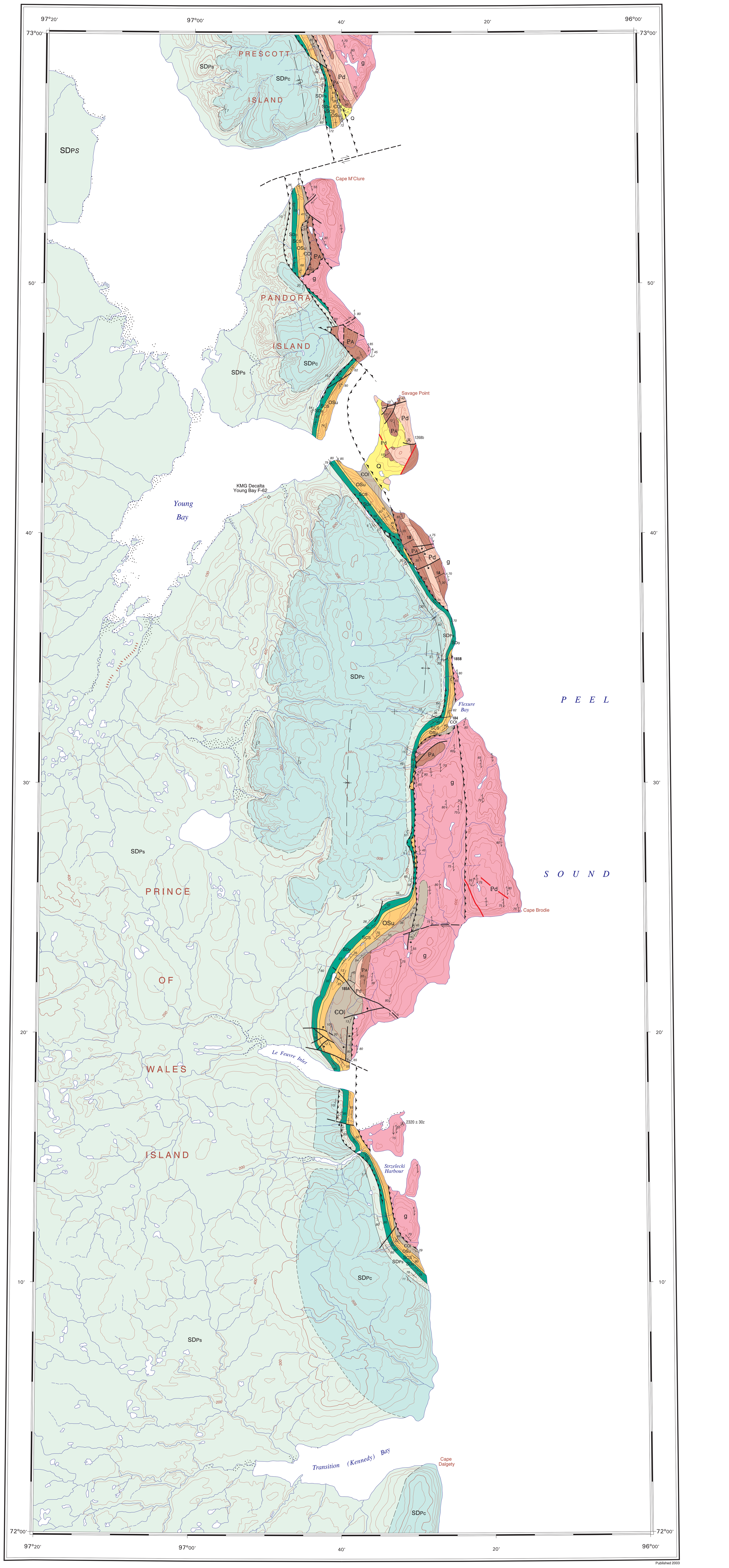
Digital cartography by E. Macey, Geological Survey of Canada (Calgary)

Any revisions or additional geological information known to the user would be welcomed by the Geological Survey of Canada

Digital base map at the scale of 1:250 000 from data compiled by Geomatics Canada, modified by the Geological Survey of Canada (Calgary)

Proximity of the North Magnetic Pole causes the compass to be useless in this area

Elevations in feet above mean sea level



Published 2003

Copies of this map may be obtained from the Geological Survey of Canada:
601 Booth Street, Ottawa, Ontario K1A 0E8
3303-33rd Street, N.W., Calgary, Alberta T2L 2A7
101-605 Robson Street, Vancouver, B.C. V6B 5J3

LOCATION MAP

MAP 2016A

GEOLOGY

EASTERN PRINCE OF WALES ISLAND AND ADJACENT SMALLER ISLANDS

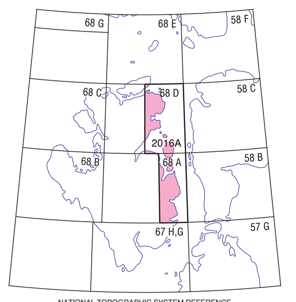
NUNAVUT

Scale 1:125 000/Échelle 1/125 000

kilometres 2 0 2 4 6 8 10 kilomètres

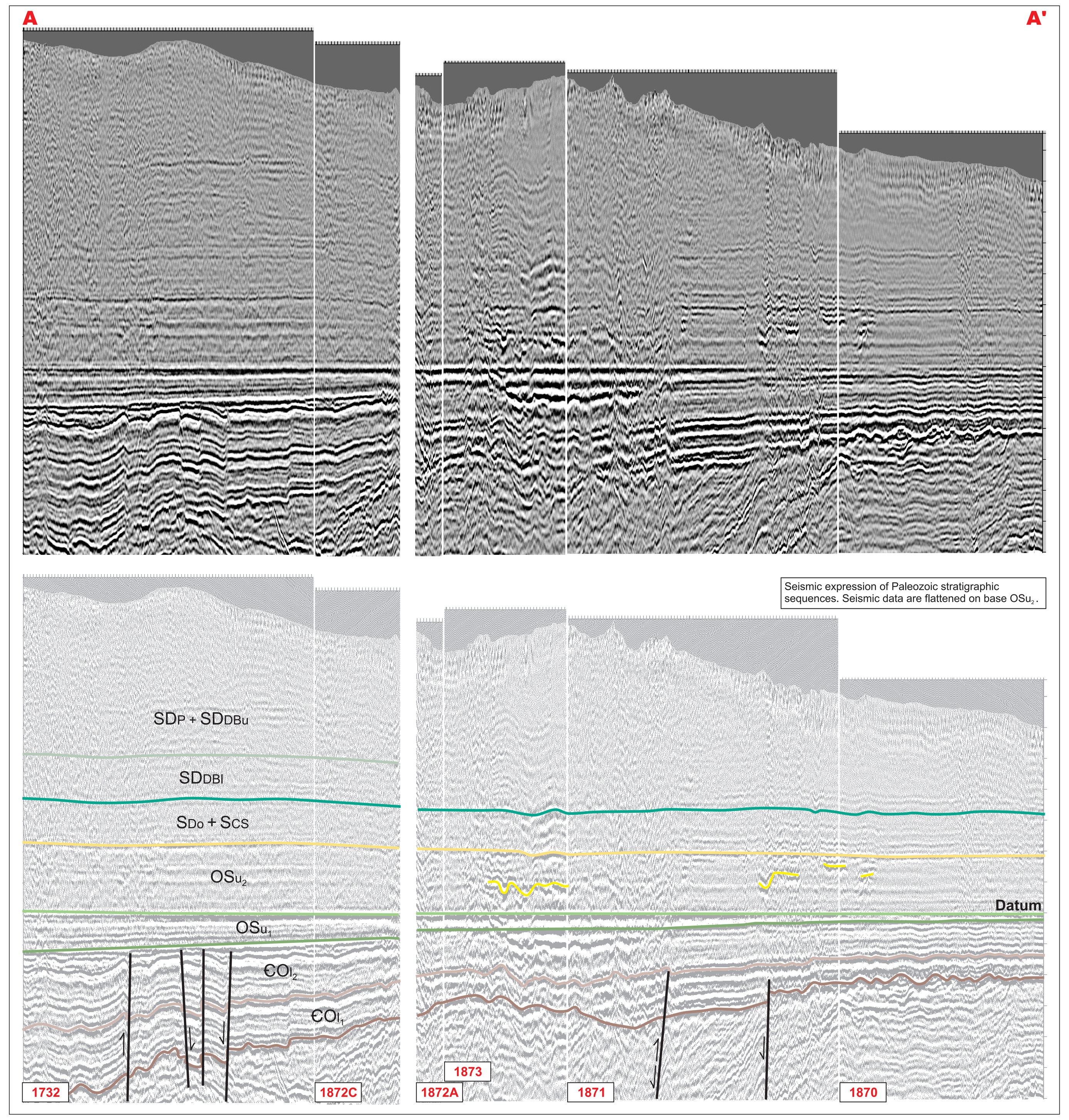
Universal Transverse Mercator Projection
North American Datum 1983

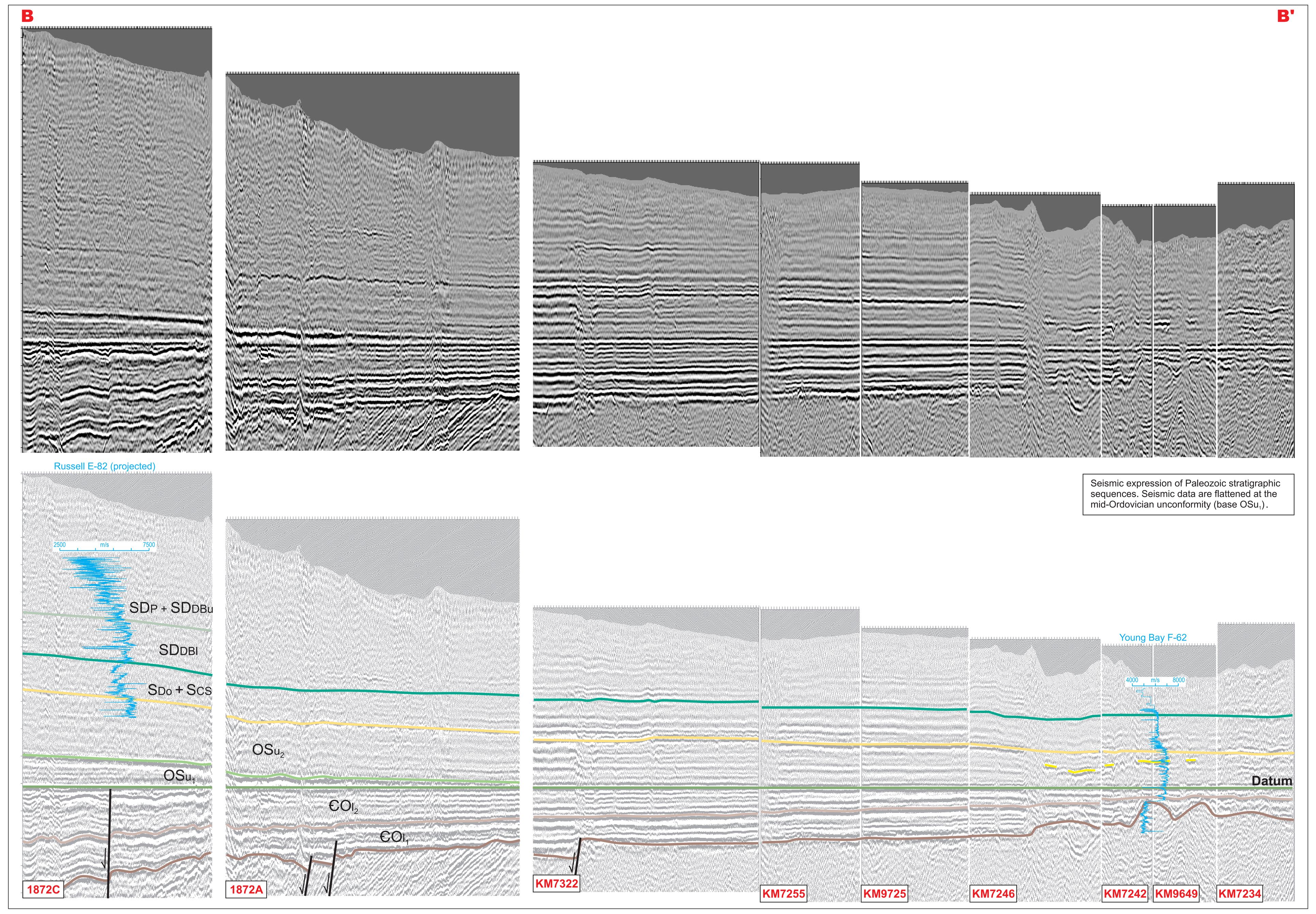
Projection transverse universelle de Mercator
Système de référence géodésique nord-américain, 1983

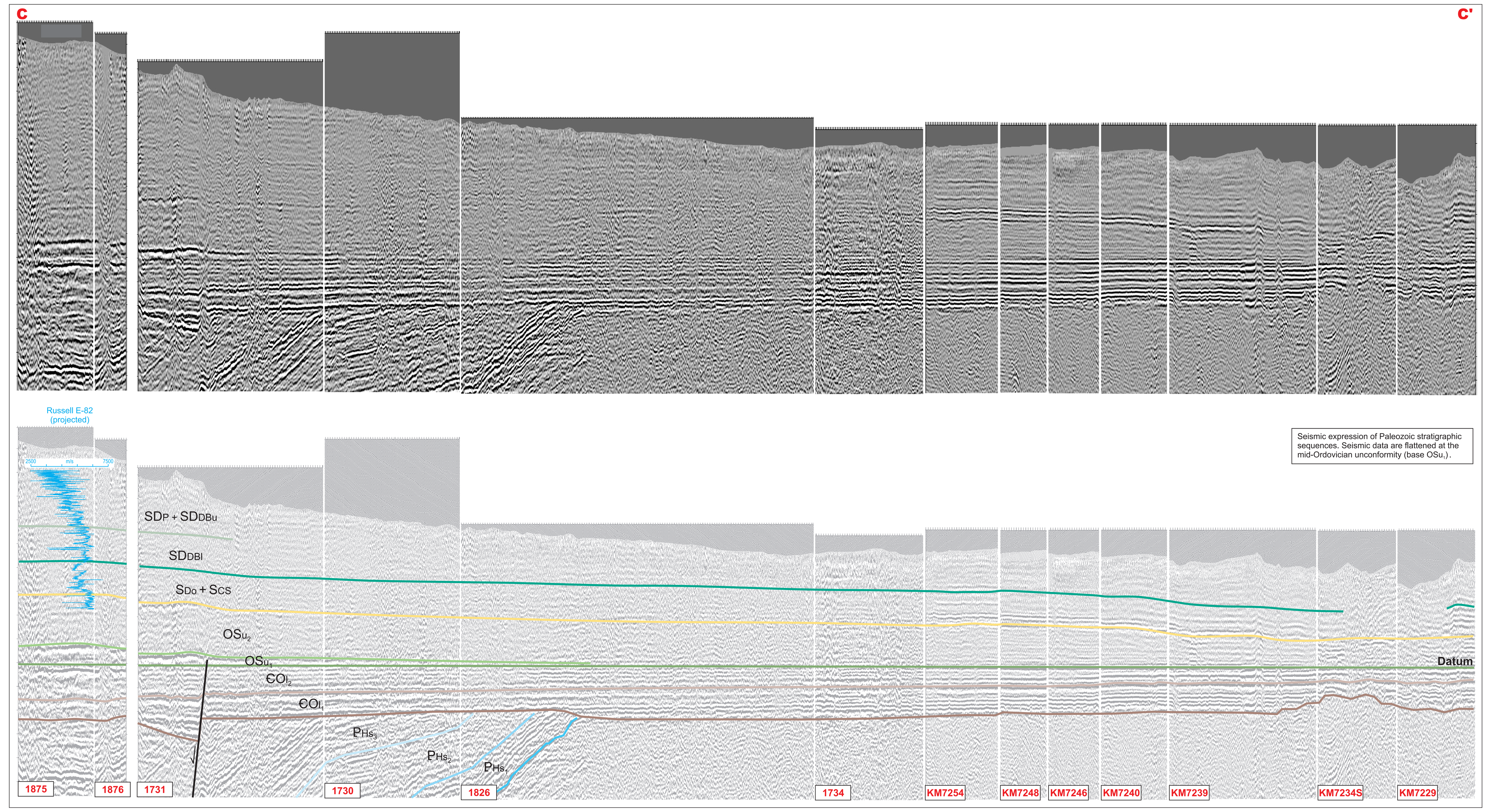


NATIONAL TOPOGRAPHIC SYSTEM REFERENCE

Recommended citation:
Mayr, U., Frisch, T., de Freitas, T., Okulitch, A.V., and Kerr, J.W.
2003: Geology, Eastern Prince of Wales Island and adjacent smaller islands, Nunavut; Geological Survey of Canada, Map 2016A, scale 1:125 000.







Seismic traverse legend

- Top, Drake Bay Formation, lower member (SDDBl)
- Top, Douro Formation (SDo)
- Base, Cape Storm Formation (Scs)
- Near base, Allen Bay Formation? (OSu)
- Mid-Ordovician unconformity (OSu)
- Near top, Cape Clay Formation (COl)
- Near base, Cass Fjord Formation (COl)
- Base, Hunting Formation, seismic unit 3 (PHs3)
- Base, Hunting Formation, seismic unit 2 (PHs2)
- Base, Hunting Formation, seismic unit 1 (PHs1)
- Base, Aston Formation? (PA)
- Possible igneous intrusives
- Reflection amplitude anomalies
- Fault

For complete unit descriptions refer to Map 2016A.

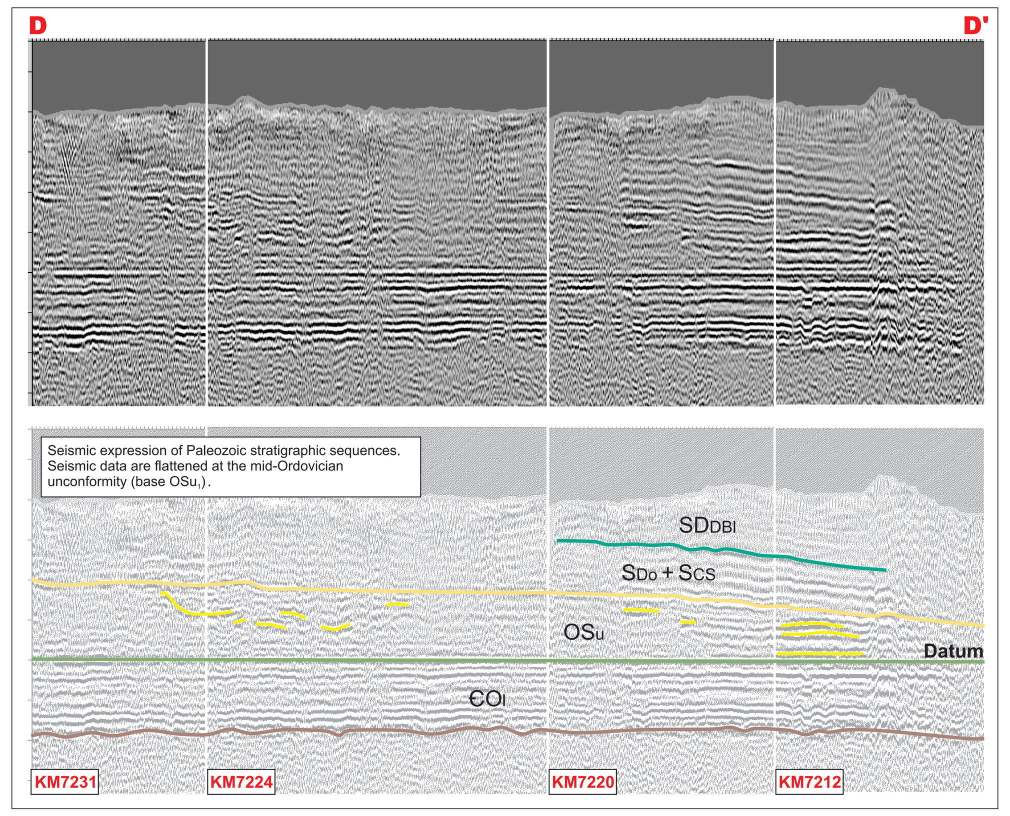
RELATIVE TIME SCALE

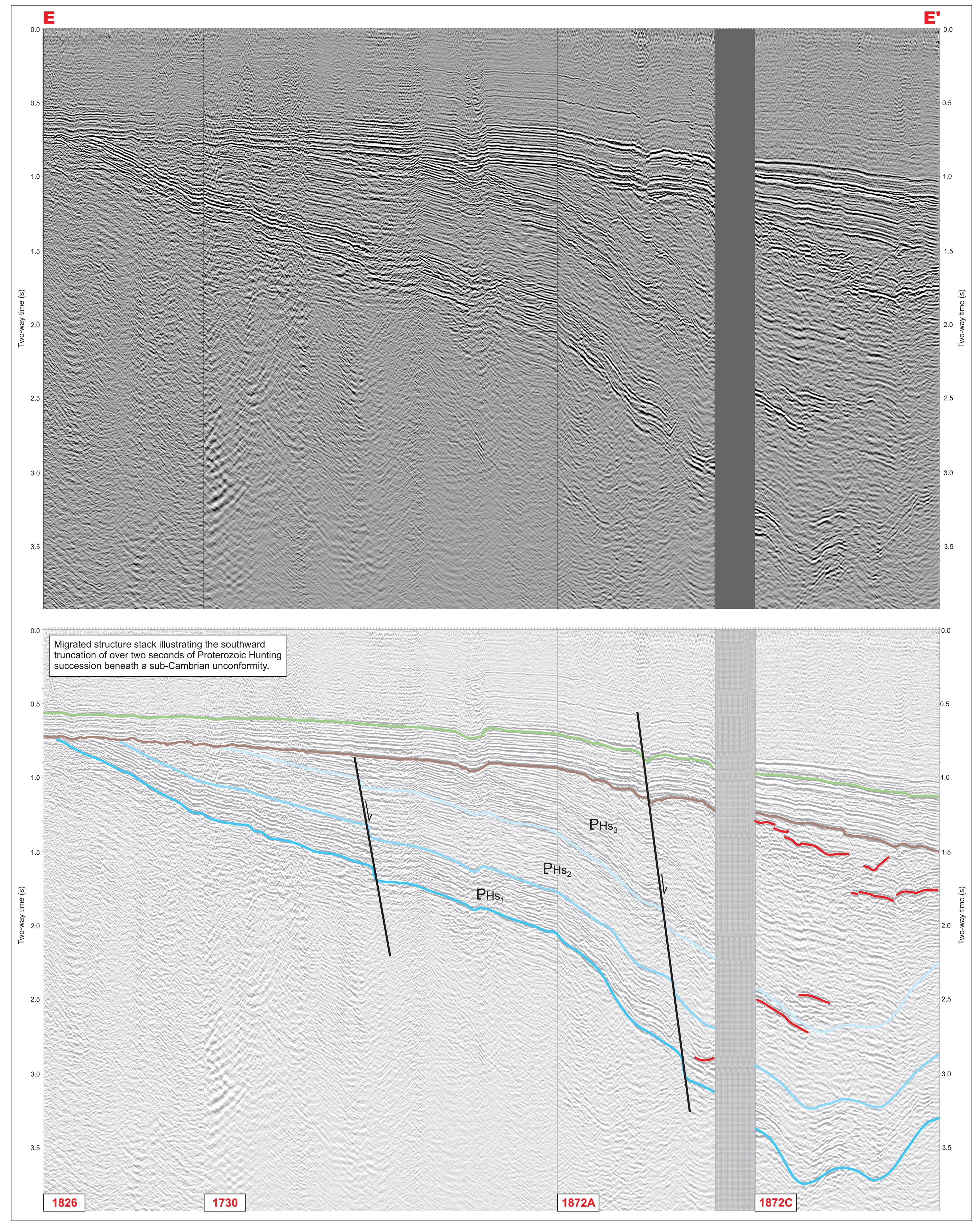
0.5 second two-way time (for flattened seismic)

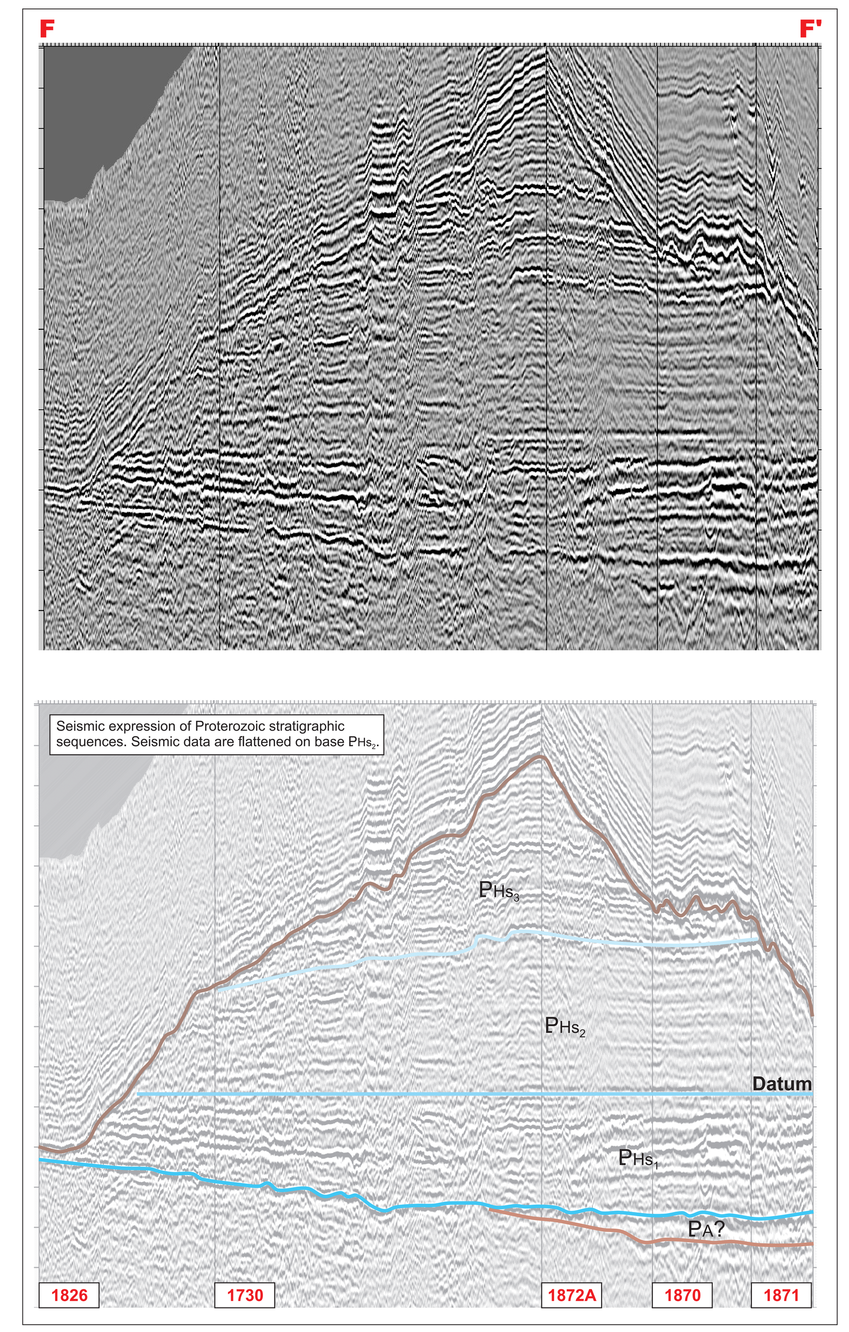
NOTES

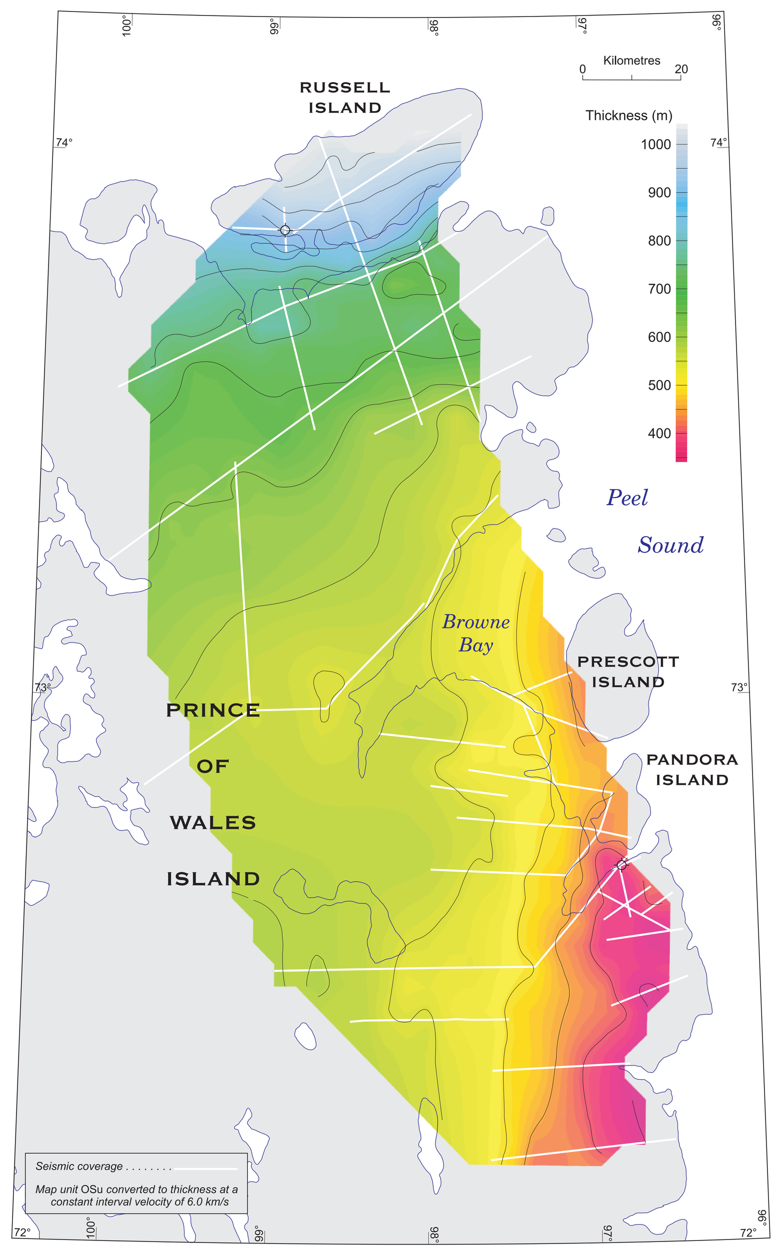
1. With the exception of seismic traverse E-E', all seismic are flattened on datum indicated. Relative time scale is shown at right. Seismic displays are vertically exaggerated by about 7:1. Uninterpreted data is also shown.
2. Gaps in traverses are omitted or reduced on seismic illustrations where they generally parallel isopach contours (indicated by white spaces).
3. See Appendix 2 for geophysical seismic processing details.
4. Original seismic data provided courtesy of PetroCanada, Devon Canada and Talisman Energy, Inc. Seismic reprocessing and interpretation by T.A. Brent, GSC-Calgary.

To accompany GSC Bulletin 574, by U. Mayr et al.

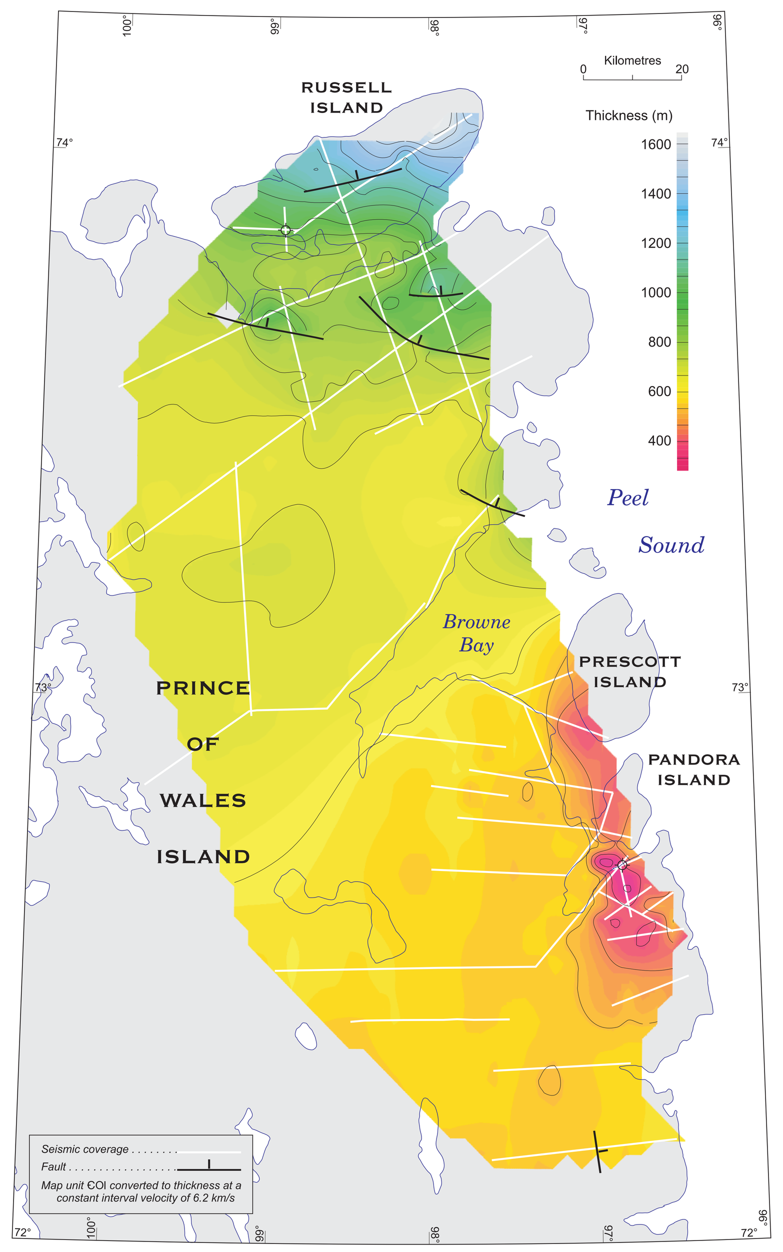




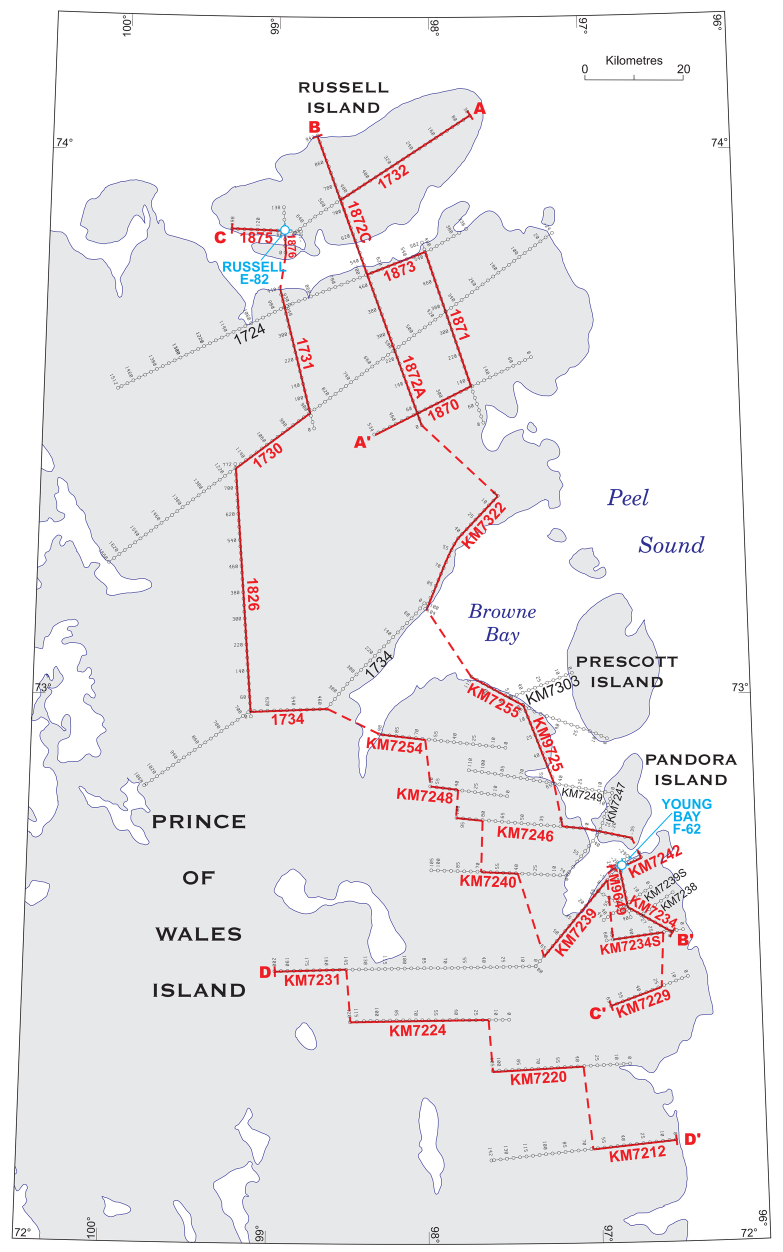




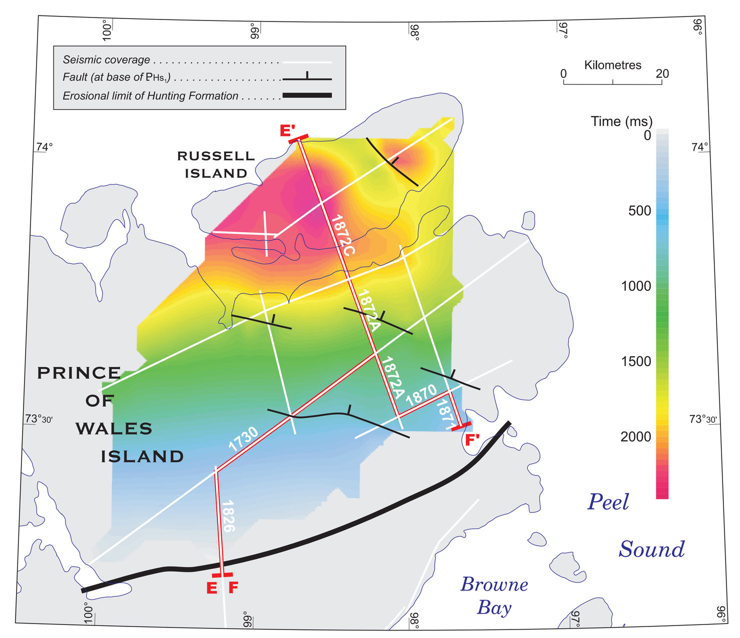
Map 1. Isopach of map unit OSu (upper member of unnamed unit).



Map 2. Isopach of map unit COl (lower member of unnamed unit).



Map 3. Location of seismic shotpoints, industry exploration wells and flattened seismic traverses.



Map 4. Isochron map of Hunting Formation and seismic traverse locations E-E' and F-F'.

Figure 9. Seismic stratigraphic cross-sections.

Published 2004

Published 2004

Figure 12. Columnar stratigraphic cross-section of lower Paleozoic formations between Russell Island and Le Feuvre Inlet, Prince of Wales Island. Detailed descriptions of sections in Appendix 1.

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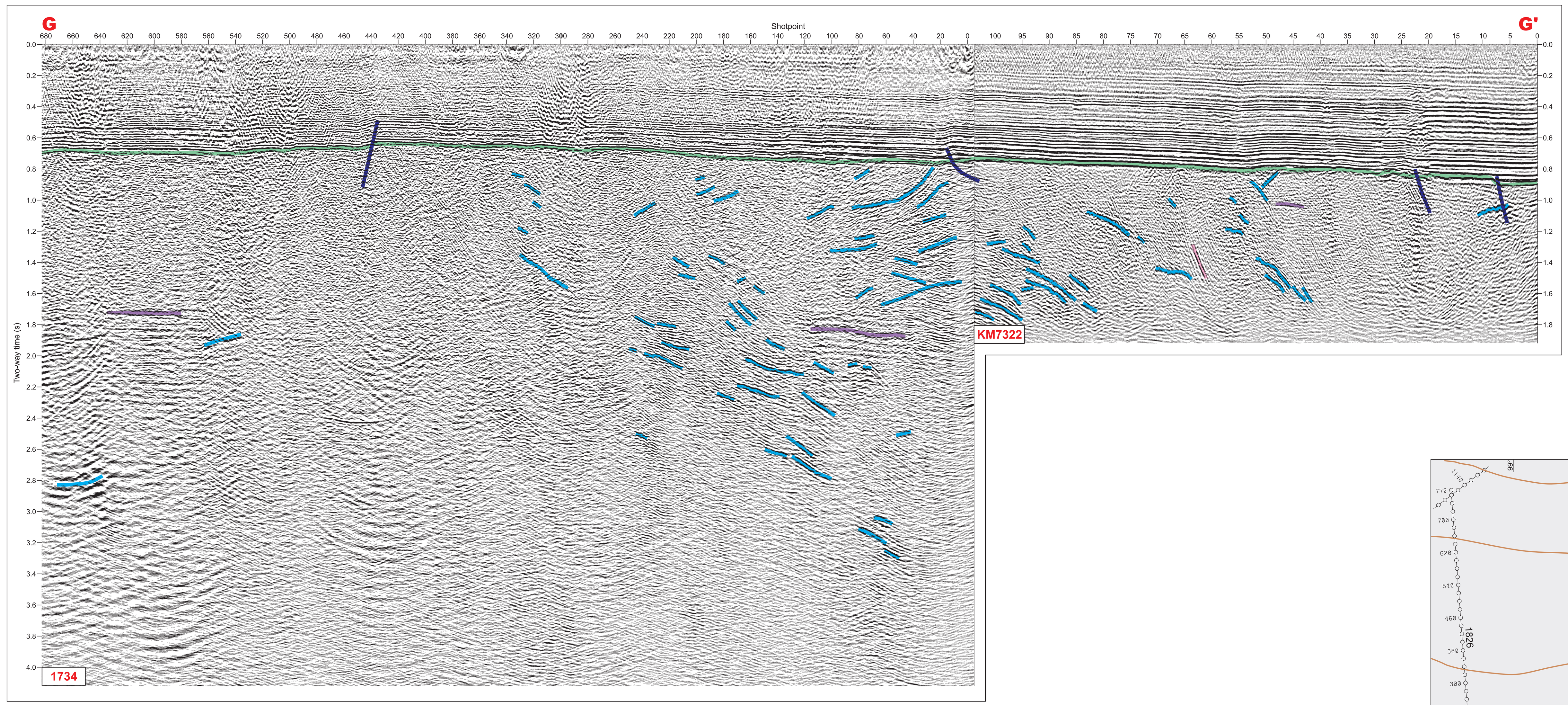
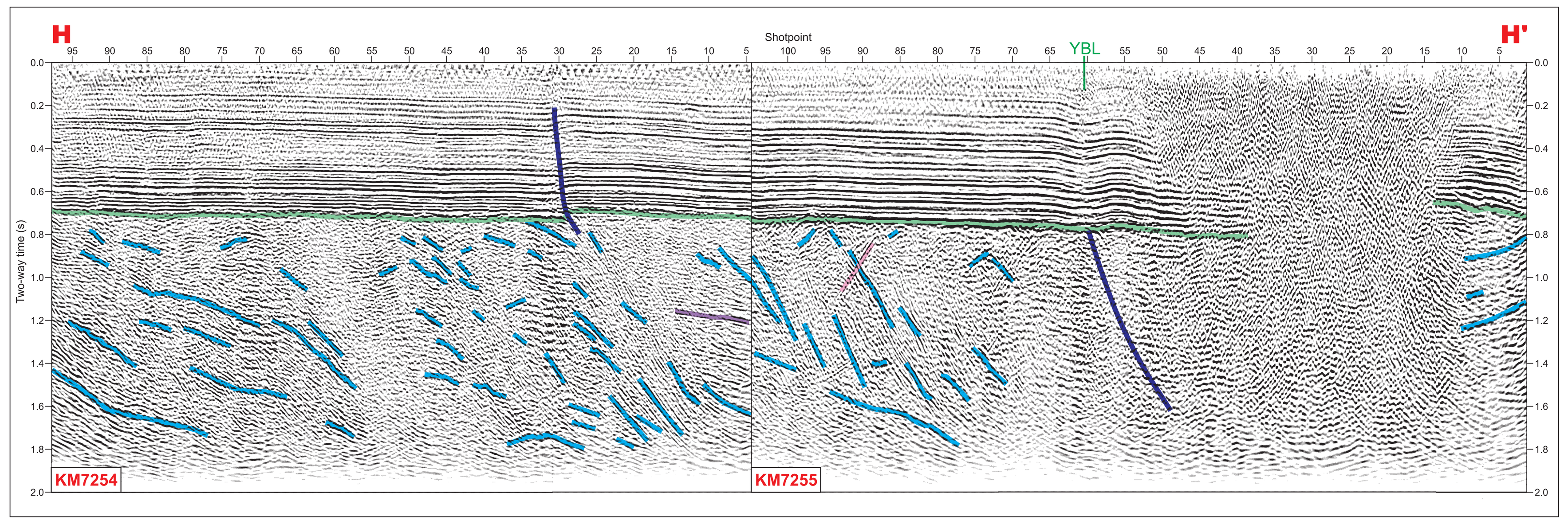
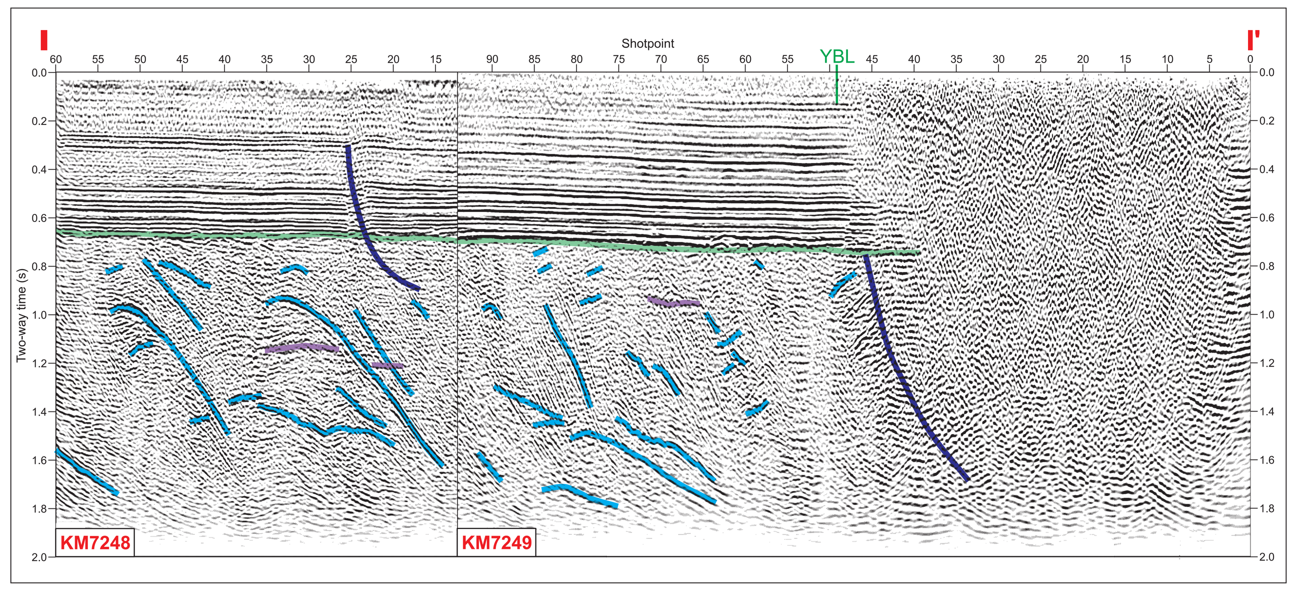
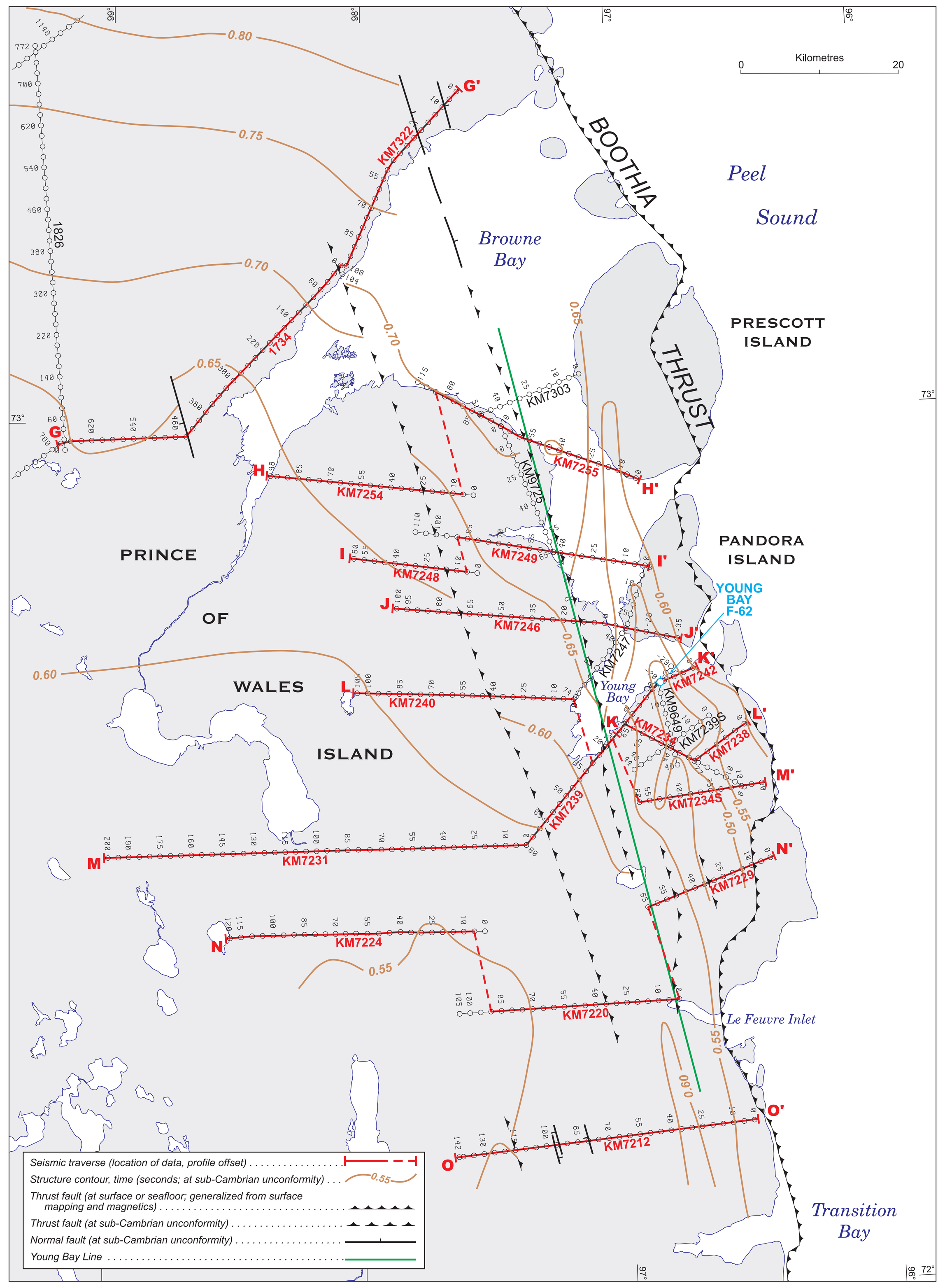
GEOLOGICAL SURVEY OF CANADA / COMMISSION GÉOLOGIQUE DU CANADA

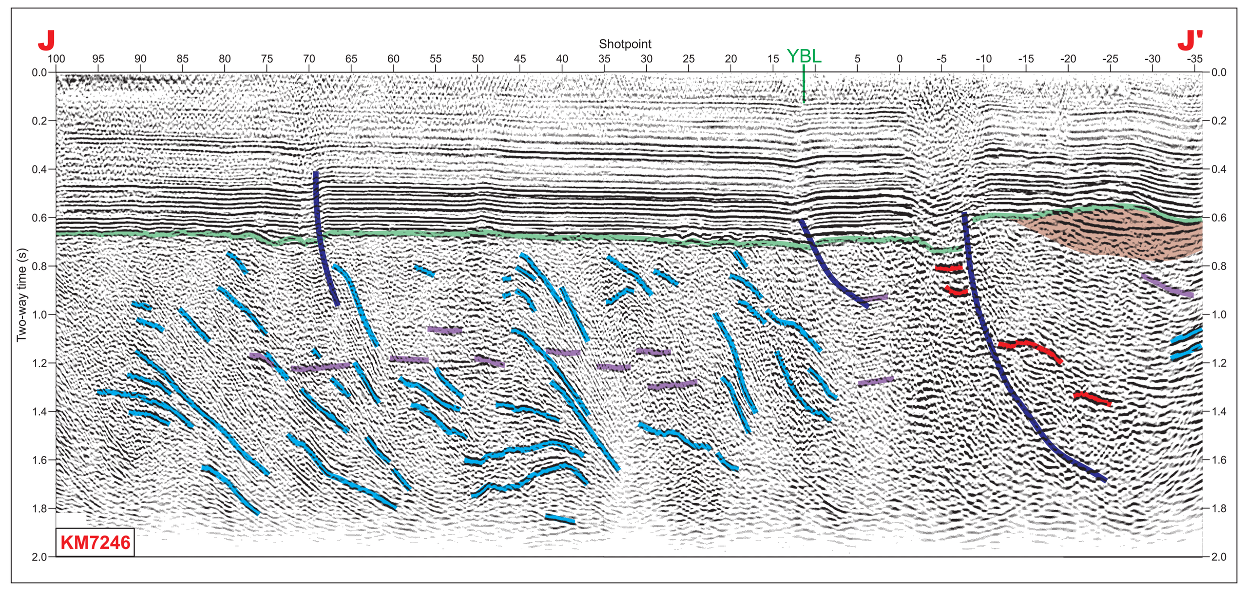


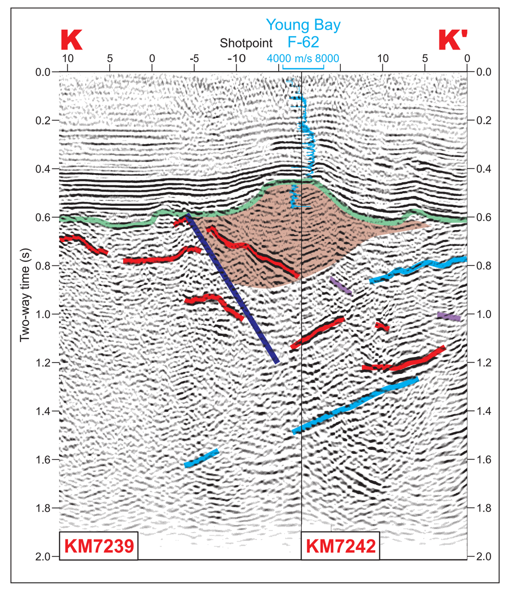


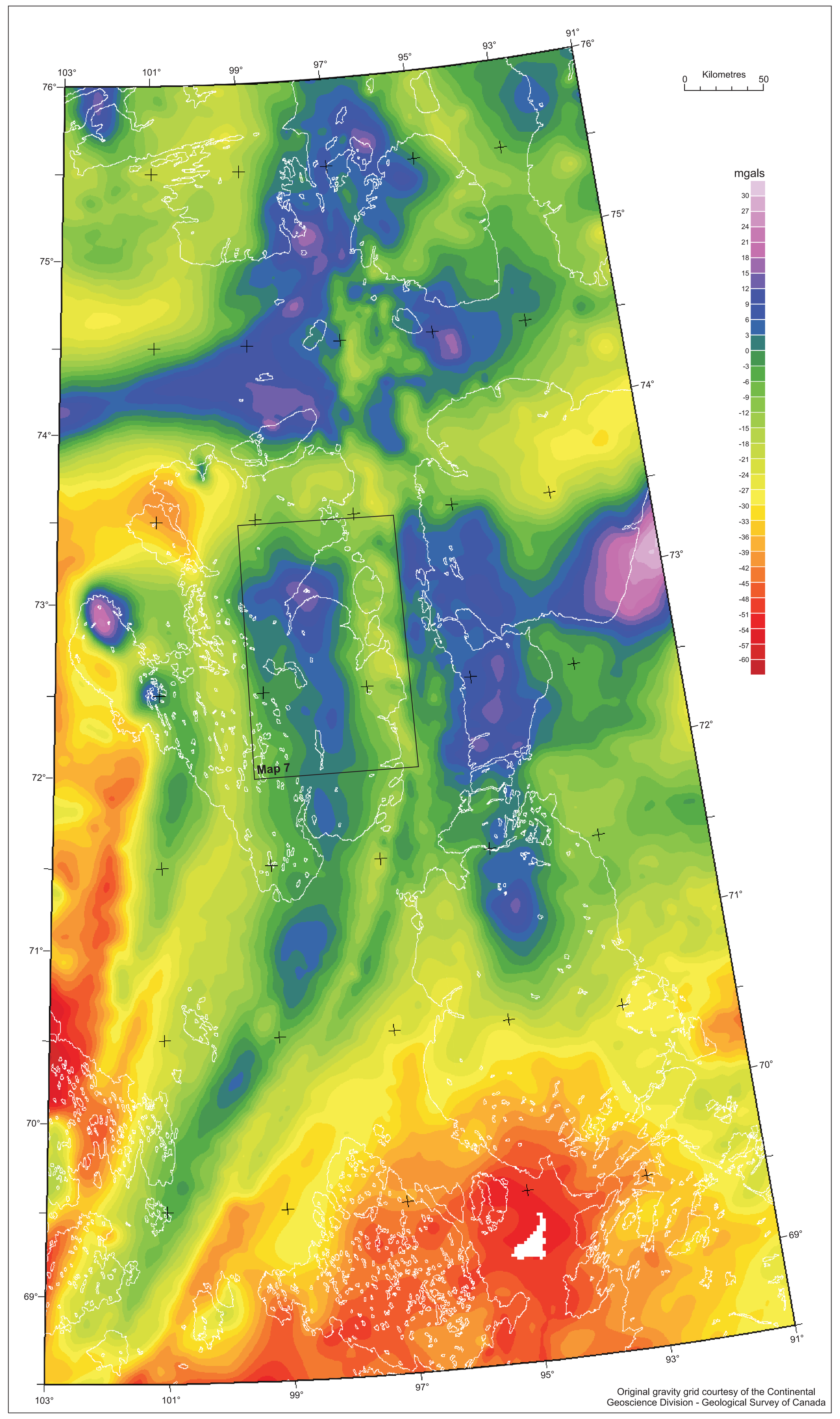




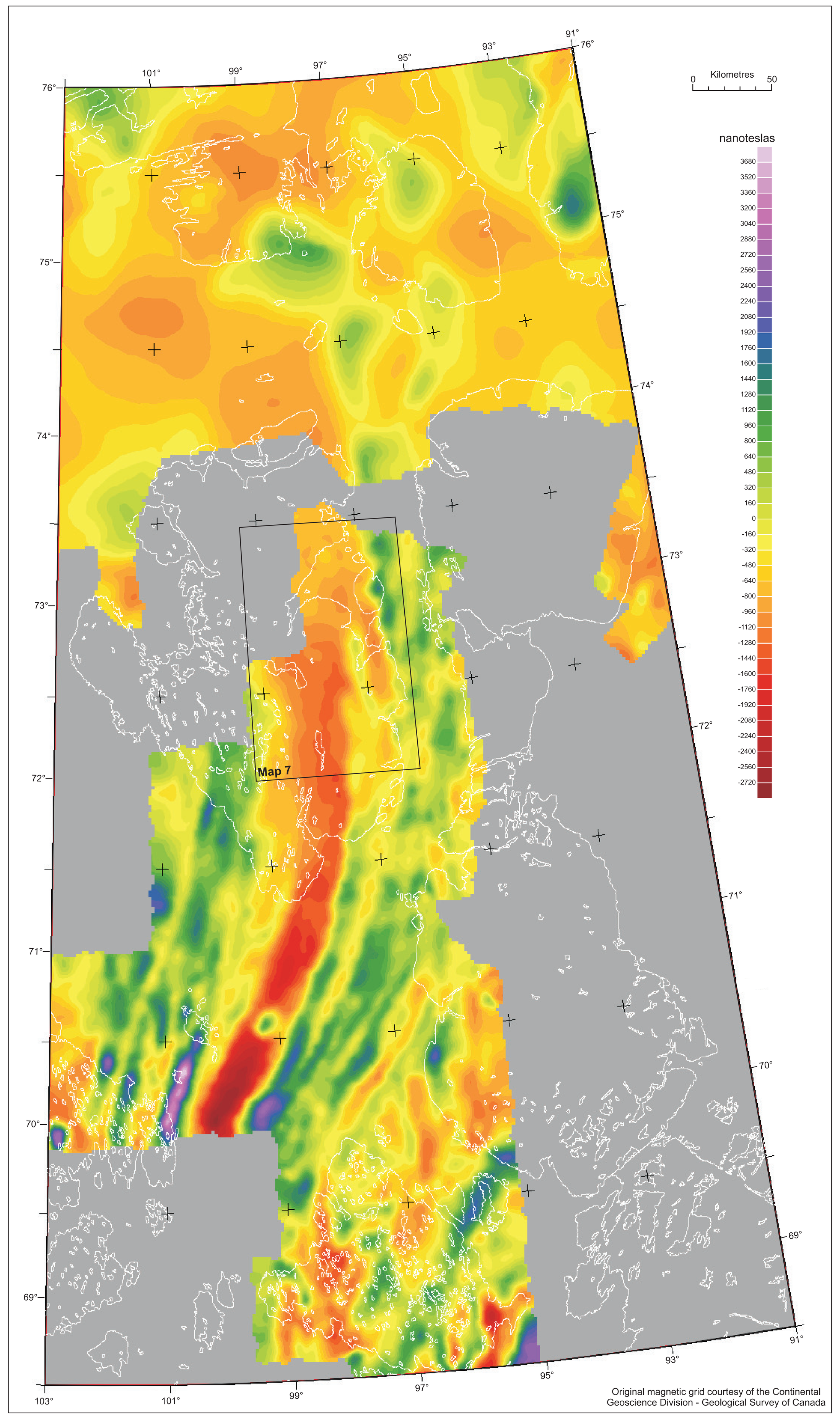
Map 7. Structural elements and seismic traverse locations.



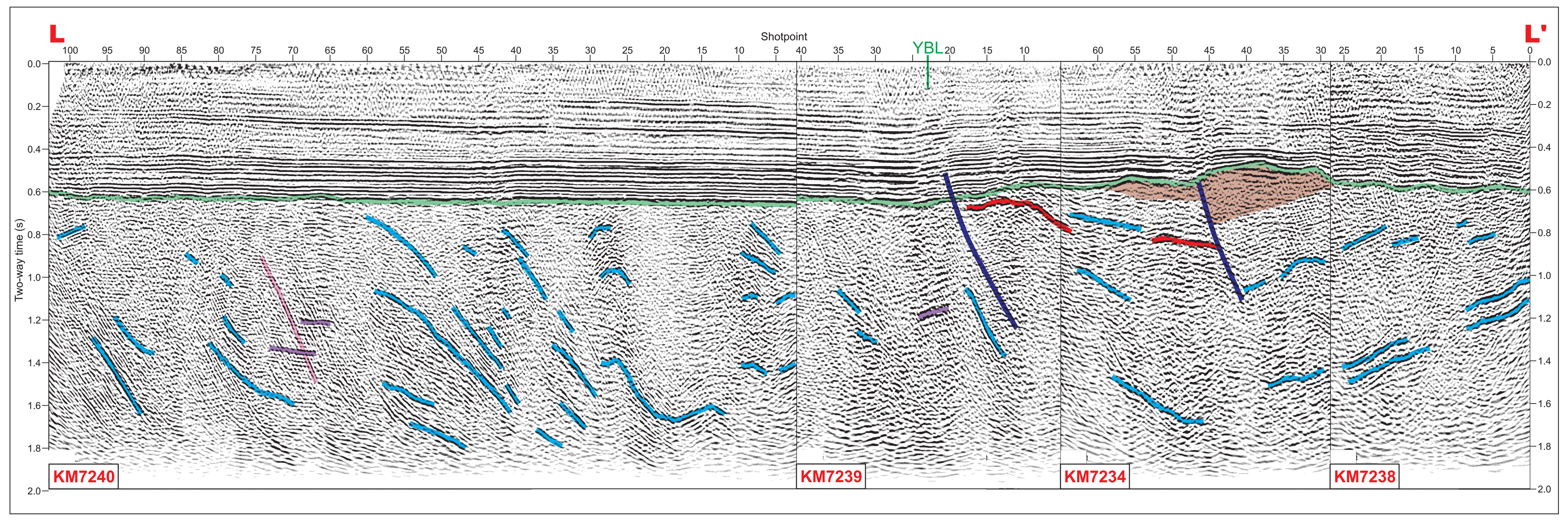


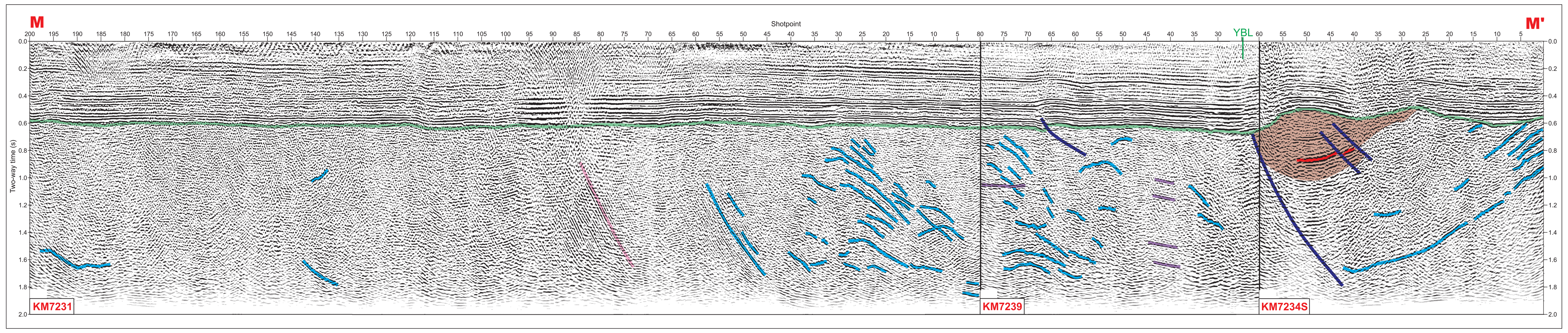


Map 5. Bouguer anomaly gravity.



Map 6. Total residual magnetic field.





Basement structure seismic traverse legend

Possible preserved Aston Formation
Sub-Cambrian unconformity
Intra-basement reflections
Possible intra-basement faults
Possible igneous intrusives
Probable linear noise
Probable multiples
Young Bay Line — YBL

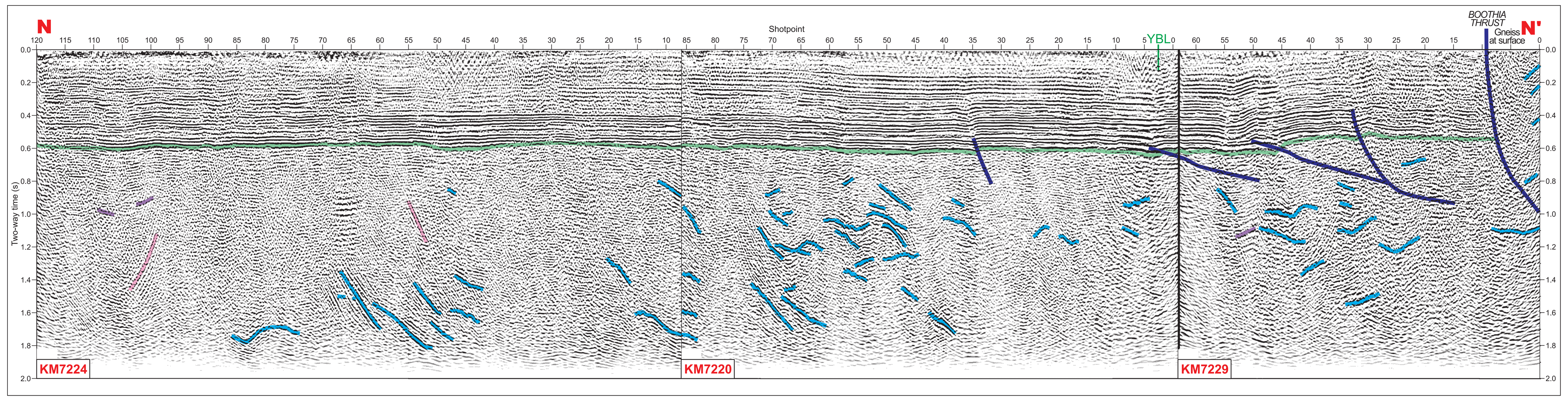
Kilometres 0 — 5

NOTES

1. The intra-basement reflectors (blue) are intended to show the reader a selection of apparent attitudes on seismic energy which are considered likely to be primary (real). This is in contrast to examples of multiple energy (purple) or steep linear noise trains (pink).
2. Seismic lines comprising traverses are migrated data displayed at an approximate 1:1 aspect ratio, assuming an average velocity of 6.2 km/s. Segments have been chosen to offset approximately along strike of the basement structure, therefore no space is shown between traverse segments.
3. See Appendix 2 for geophysical data processing details.
4. Original seismic data provided courtesy of PetroCanada, Devon Canada and Talisman Energy, Inc. Seismic reprocessing and interpretation by T.A. Brent, GSC-Calgary.

LOCATION MAP

To accompany GSC Bulletin 574, by U. Mayr, et al.



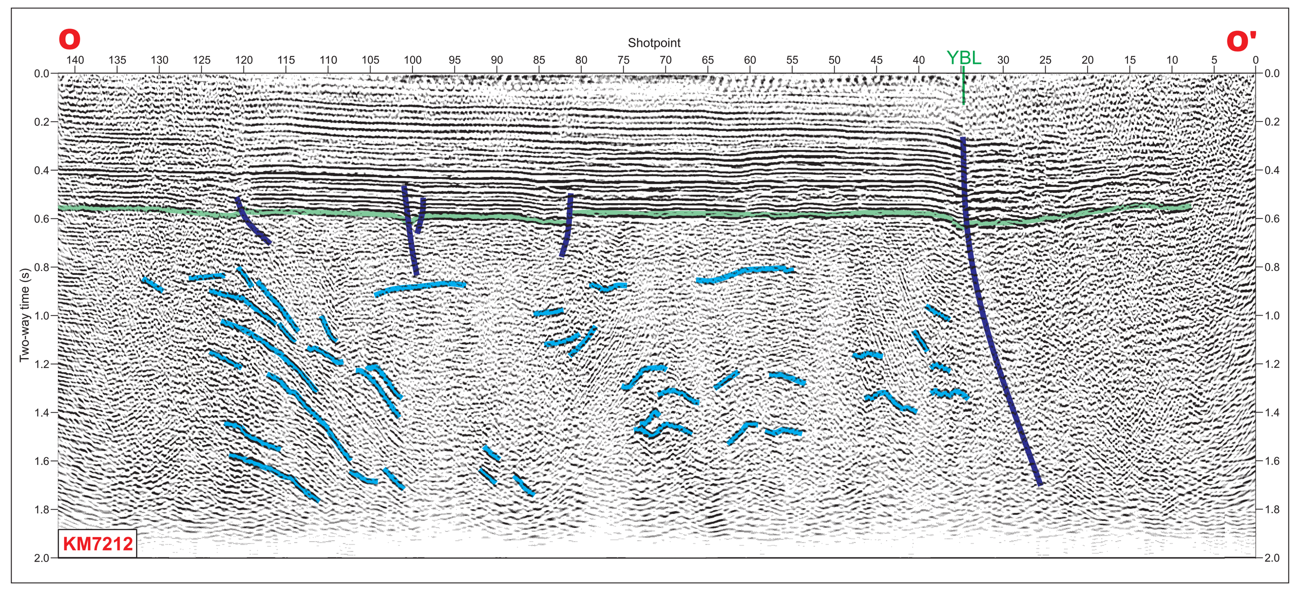


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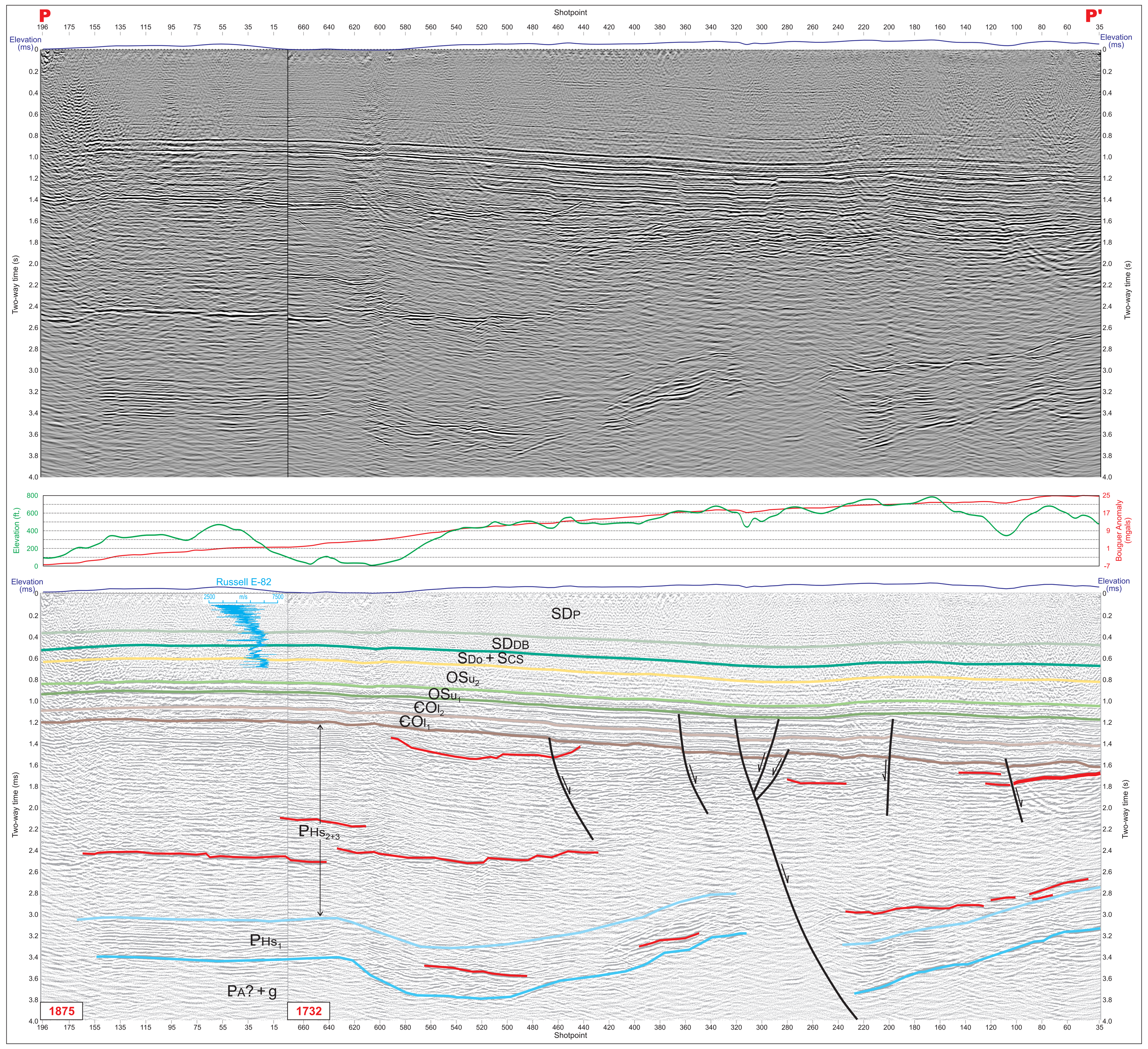
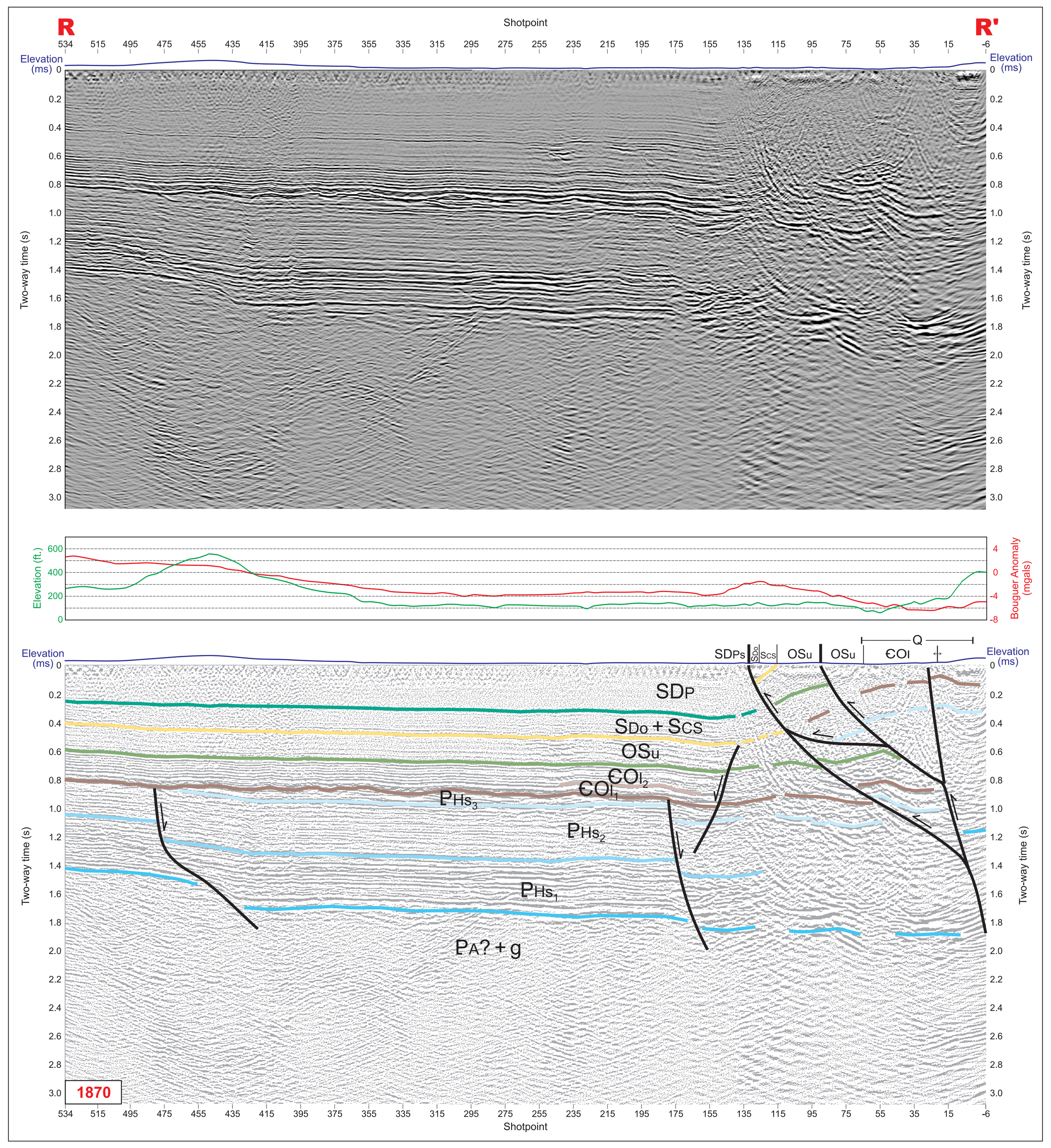
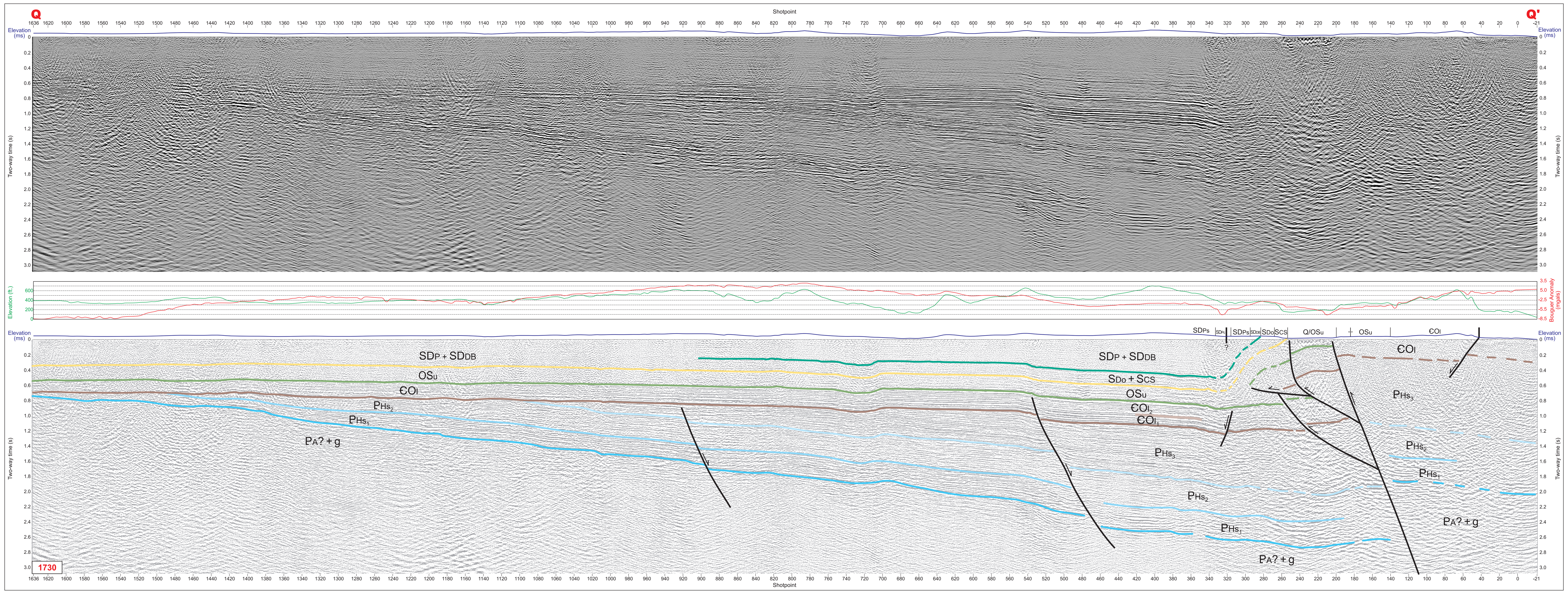
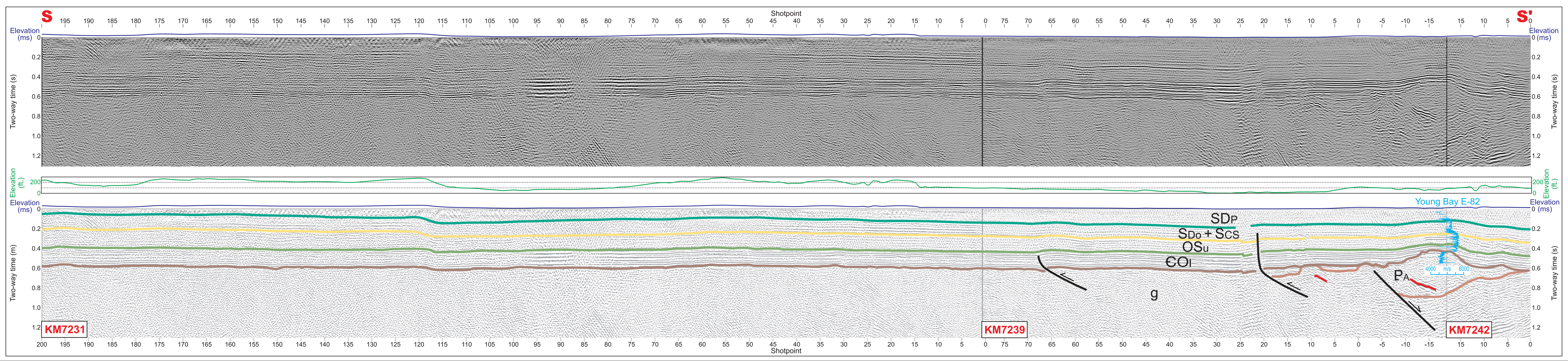
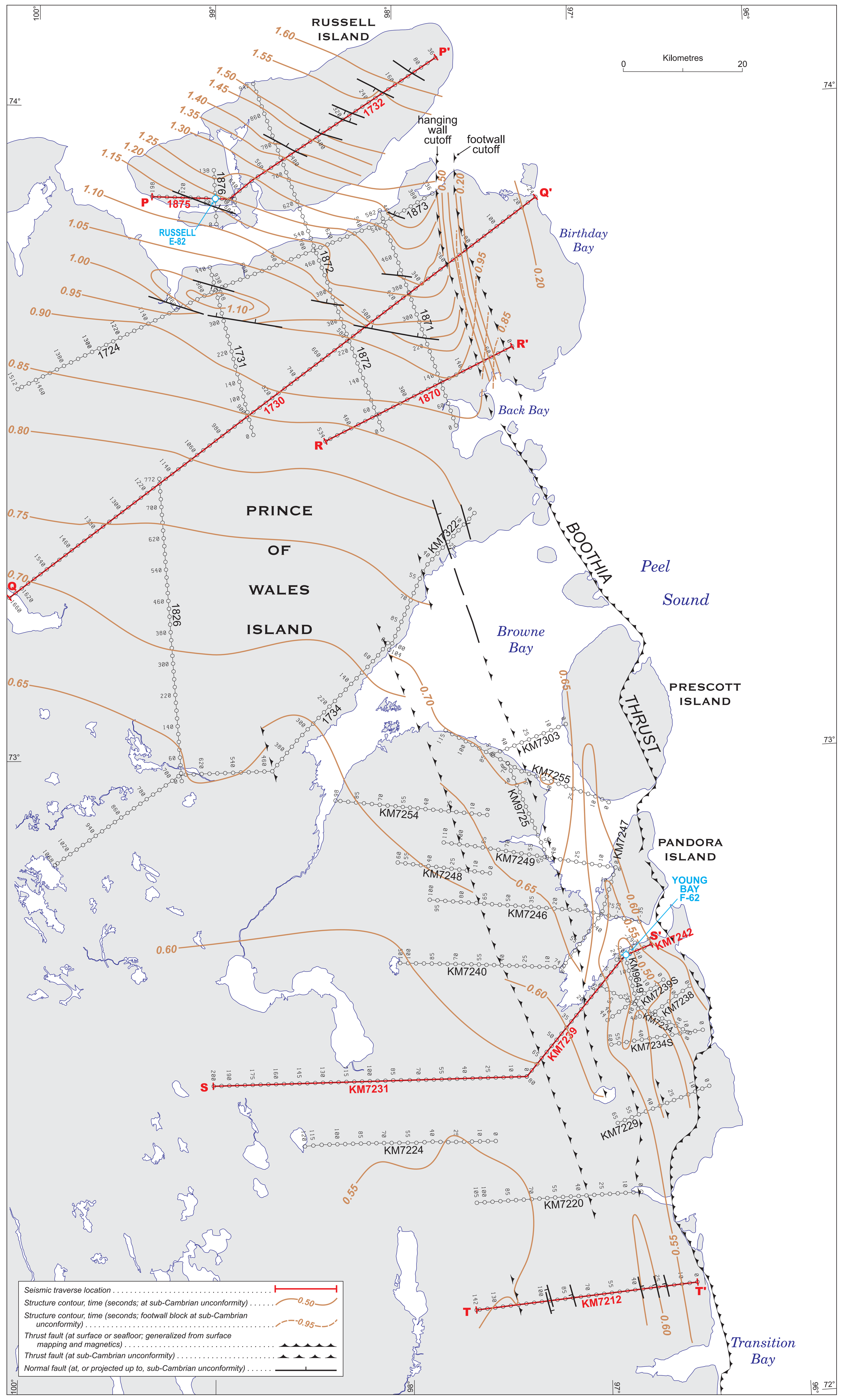
Figure 19. Seismic basement structure cross-sections.











Map 8. Sub-Cambrian surface contours and seismic traverse locations.

Seismic traverse legend

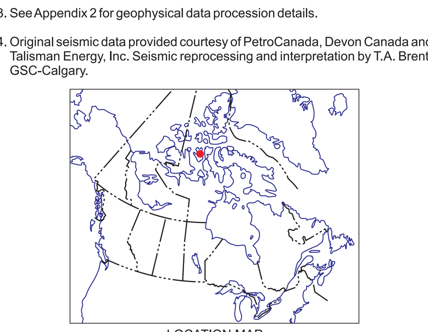
Kilometres 0–5

Top, Drake Bay Formation, lower member (SDDBl)	
Top, Douro Formation (SDo)	
Base, Cape Storm Formation (SCS)	
Near base, Allen Bay Formation? (OSu_2)	
Mid-Ordovician unconformity (OSu_1)	
Near top, Cape Clay Formation ($ЄOl_2$)	
Near base, Cass Fiord Formation ($ЄOl_1$)	
Base, Hunting Formation, seismic unit 3 (PHs_3)	
Base, Hunting Formation, seismic unit 2 (PHs_2)	
Base, Hunting Formation, seismic unit 1 (PHs_1)	
Base, Aston Formation? (PA)	
Possible igneous intrusives	
Fault	

For complete unit descriptions,refer to Map 2016A

NOTES

1. Seismic profiles are migrated data displayed at near 1:1 aspect ratio assuming an average velocity of 6.2 km/sec.
2. Bouguer gravity profiles shown on traverses P-P', Q-Q' and R-R' were acquired by Panarctic Oils at the time of seismic surveying. Bouguer gravity shown on Map 5, Figure 19, does not include this profile data.
3. See Appendix 2 for geophysical data procession details.
4. Original seismic data provided courtesy of PetroCanada, Devon Canada and Talisman Energy, Inc. Seismic reprocessing and interpretation by T.A. Brent, GSC-Calgary.



LOCATION MAP

To accompany GSC Bulletin 574, by U. Mayr, et al.

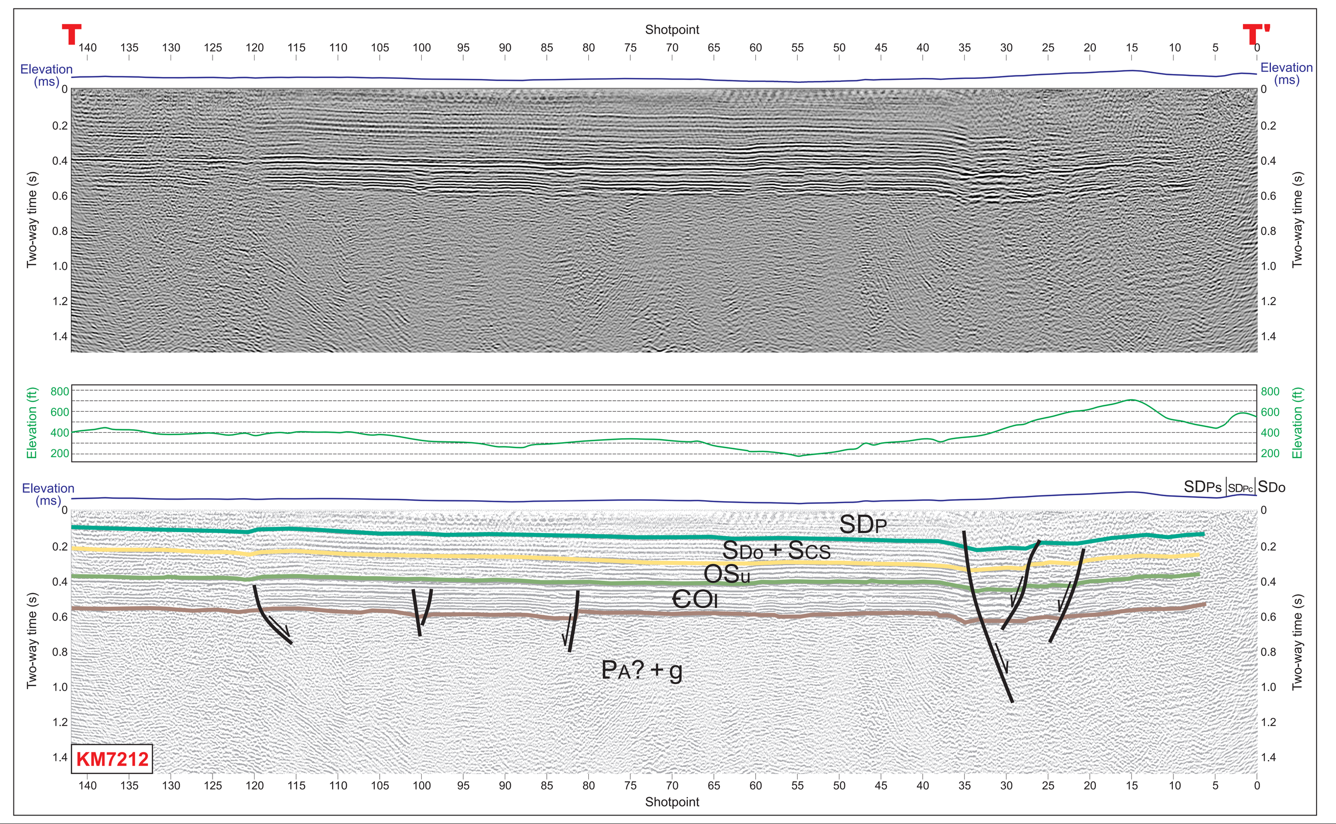


Figure 20. Seismic structure cross-sections.

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