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Geology of part of Kovik Bay map area (NTS 35-F)

W.R.A. Baragar

INTRODUCTION

Kovik Bay map area embraces the results of two studies separated by a dozen years. In 1973 three section lines, measured by tape and compass, were run across the Cape Smith Belt and each of the sections was mapped and systematically sampled for subsequent petrographic and chemical analyses. Partial results of that study were incorporated in a number of papers (Baragar, 1974, Baragar and Scoates, 1981, 1987) but the data in detail have not been available to date. The current report contains results from the western-most of the three trans-belt sections. Data from the other two lines will be provided in a separate report. The second study was launched in 1985 with the intent of mapping a broad band of 1 degree-longitude width across the Cape Smith belt from well south of it, north to the coast of Hudson Strait. The purpose was to study the belt within its tectonic context. Although originally planned as a two-year project, unfortunate events resulted in its cancellation after the first year and the results of that season's work have appeared only in preliminary form (Baragar et al., 1986). Accordingly, the current report attempts to make available detailed results (with some interpretation) of the two studies. Subsequent to this work, St-Onge and Lucas completed a major survey of the north Ungava region including parts of the Cape Smith Belt and all of the gneissic terrain north of it to Hudson Strait (Lucas and St-Onge, 1997a-c; St-Onge and Lucas, 1997a-c, and references contained therein). Some differences exist in the Kovik Bay area in both mapping and interpretation between the two sets of studies. In this report, maps and interpretations are based primarily on the observations of 1973 and 1985. Fortunately, such differences as do exist between the studies are probably not irreconcilable when applied on the regional scale represented by the work of St-Onge and Lucas.

The geology within the map area is grouped into three major divisions: the Archean basement south of the Cape Smith Belt, the Paleoproterozoic Cape Smith Belt itself, and the gneissic complex of Hudsonian affinity north of the Cape Smith Belt (Fig. 1 and 2). The southern Archean basement is barely represented in the geology mapped in this area but is covered in some detail in an accompanying report on the Povungnituk area to the south (Baragar, 2015). The Cape Smith Belt is represented only by the detailed section line that transects it from its southern contact with the Archean basement north to its boundary with the gneissic complex. The latter is mapped in varying detail to latitude 62 degrees north.

In this report an account of the Cape Smith Belt Kovik section will be given first (Map units 1-26) followed by a presentation of the geology of the various lithologies forming the hinterland north of the Cape Smith Belt (map units A1-A13, P1-P6).

KOVIK SECTION, CAPE SMITH BELT

The Cape Smith Belt is typically composed of the Povungnituk Group at its base structurally

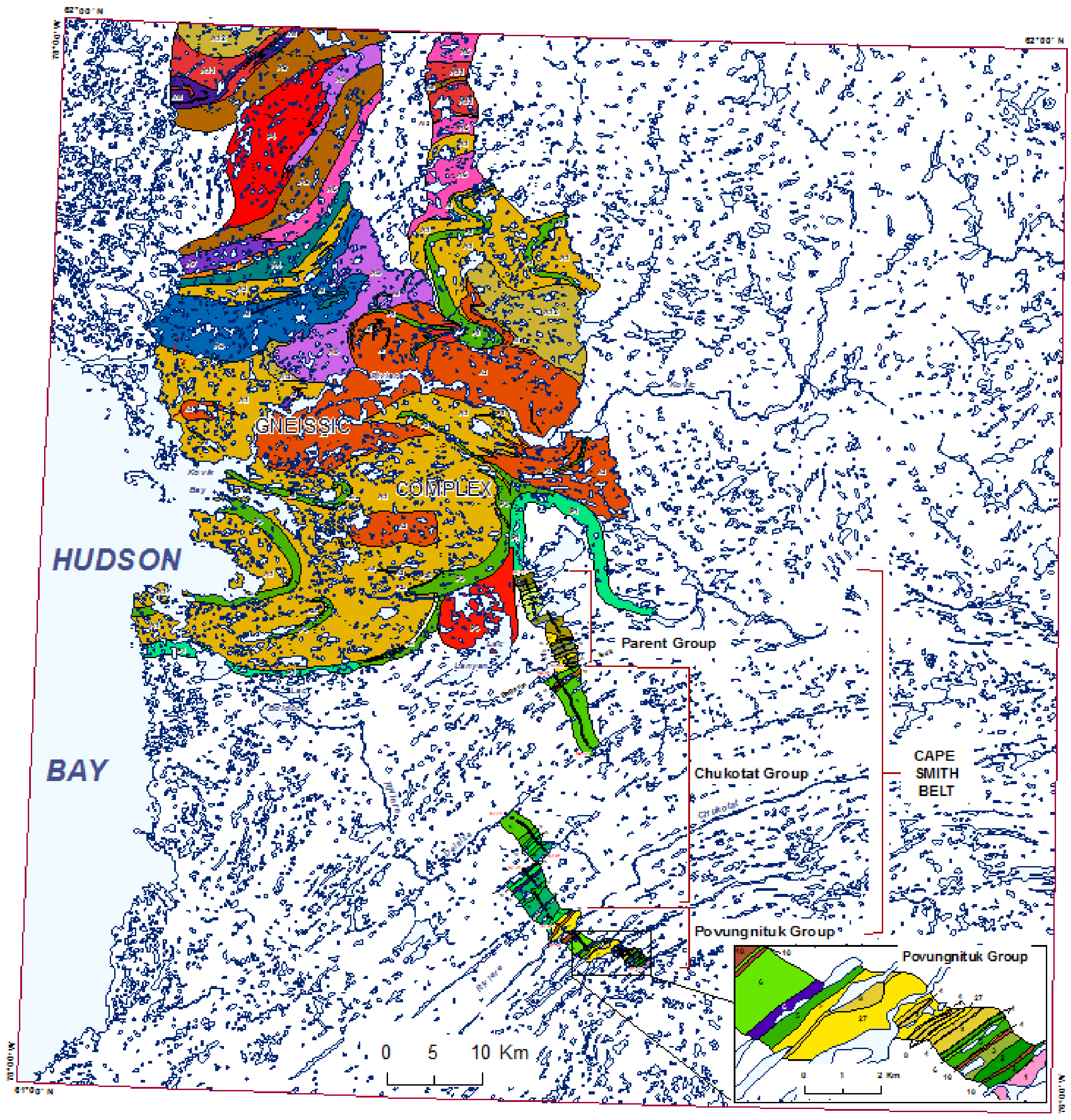

Figure 1. Kovik Bay Map Area (35F). For accompanying legend see Figure 2, this report. Downloadable pdf available in this Open File.

succeeded by, the Chukotat Group, and additionally, in the Kovik section, the Parent Group. The Povungnituk Group contains substantial sedimentary as well as mafic igneous rocks whereas the other two are predominantly igneous.

LEGEND

GNEISSIC COMPLEX NORTH OF CAPE SMITH BELT

PROTEROZOIC

P6	Late dolerite dykes.
P5	Late granite (undeformed).
P4	Pegmatite dykes (undeformed).
P3	Metabasalt, probably Povungnituk. Forms northern Cape Smith Belt boundary and infolds in the gneiss complex.
P2a, P2b	Metasediment, probably Povungnituk, mostly biotitic meta-pelite, in places garnetiferous: a) minor metaquartzite, particularly adjoining underlying basement gneiss and b) iron-formation.
P1	Cape Smith Belt rocks undifferentiated.

ARCHEAN AND/OR PROTEROZOIC

A13	Migmatite, mostly amphibolite blocks in a highly deformed quartz-feldspar-biotite matrix.
A12	Paragneiss. Mostly biotitic and garnetiferous quartzo-feldspathic, highly foliated gneiss, mafic to leucocratic in composition. In places cut by granitic veins and seams.
A11	Potash feldspar megacrystic quartzofeldspathic gneiss, augen gneiss. In places interlayered with brownish-weathering metagabbro.
A10	Mostly foliated metagabbro ranging to metadolerite and amphibolite; commonly yellow-brown weathering and locally garnetiferous.
A9	Undivided gneiss, partly supercrustal rocks. Quartzite with shaly interbeds, thick- to thin-layered quartz-feldspar-biotite gneiss, commonly garnetiferous, with interlayers of biotitic and amphibolitic seams.
A8	Intermediate gneiss. Mainly feldspar-biotite and feldspar-hornblende (clinopyroxene) gneiss, generally low in quartz.
A7	Metadiorite to metagabbro, mostly highly mafic ranging to coarse amphibolite. Hornblende-rich, lesser clinopyroxene and biotite. Generally highly foliated.
A6	Intermediate granitoid gneiss with generally 15 to 25% biotite and hornblende. Layered in places with alternating mafic and quartzofeldspathic layers.
A5	Biotite-rich, quartz-feldspar gneiss with significant potash feldspar locally.
A4	Mainly amphibolitic gneiss, garnetiferous in places, commonly with interlayered quartzofeldspathic and/or biotitic paragneiss.
A3	Mixed granodioritic and amphibolitic gneiss, commonly migmatitic, and garnetiferous in many places. Lit par lit structures.
A2	Leucocratic granitoid gneiss, probably a variant of the grey gneiss (unit A1). Generally pink in colour and with less than 15% mafic minerals, mostly biotite. Rare garnet.
A1	Leucocratic grey gneiss. Generally leucocratic, moderately foliated quartz-feldspar-biotite gneiss ranging to horn-blendic in places and commonly garnetiferous. Potash feldspar, varying from minor to major, usually present. Amphibolitic interlayers occur throughout the outcrop region.

KOVIK SECTION, CAPE SMITH BELT

PLEISTOCENE

27	Overburden

PALEOPROTEROZOIC

Parent Group

26	Dolerite / metadolerite.
25	Gabbro / metagabbro.
24	Hornblende-garnet schist.
23	Mixed metadolerite / metagabbro and schistose mafic volcanic rocks.
22	Hornblende - mica layered schists; in part metasediments.
21	Felsic to mafic lenticular schists ranging to fragmental volcanic rocks; felsic fragments in mafic matrix.
20	Mafic to felsic, garnet-bearing schists, ranging to block and lapilli tuff.
19	Block and lapilli tuff; mostly felsic blocks and particles in mafic matrix.

Chukotat Group

18	Dolerite sills
17	Mafic to ultramafic sills
16	Low Mg (<10% MgO), plagioclase- clinopyroxene-phyric, tholeiitic basalt.
15	Low Mg (<10% MgO), clinopyroxene- plagioclase-phyric, komatiitic basalt.
14	Low / medium Mg, clinopyroxene- olivine-phyric, komatiitic basalt.
13	Medium Mg (10-15% MgO), clinopyroxene- olivine-phyric, komatiitic basalt.
12	Medium / high Mg olivine- clinopyroxene-phyric, komatiitic basalt.
11	High Mg (> 15% MgO), olivine-phyric, komatiitic basalt.

Povungnituk Group

10	Dolerite sills
9	Mafic to ultramafic sills.
8	Interlayered dolerite sills and screens of shale or tuffaceous shale.
7	Grey to dark grey, highly cleaved, shale, siltstone, and greywacke.
6	Pillowed and massive tholeiitic basalt; may include some thin dolerite sills.
5	Massive tholeiitic basalt; possibly dolerite in part.
4	Grey to black shale or tuffaceous shale.
3	Sheared, finely layered mafic rock; tuff?
2	Mafic schist

ARCHEAN BASEMENT

1	Granitic gneiss

Figure 2. Legend to accompany Kovik Bay Map Area (35F). (Figure 1, this report). Downloadable pdf available in this Open File.

Povungnituk Group

Along the line of the mapped section the Povungnituk Group lies between the Chukotat River and the boundary of the Archean basement about 8 km to the southeast. Neither boundary outcrops. Hence, the stratigraphic relationship of the Povungnituk Group can only be interpreted by its relationships elsewhere. In the Povungnituk map area to the south the contact of the Povungnituk Group is clearly unconformable with the underlying Archean gneisses as evidenced by grits and pebbles of Archean derivation in sediments at the base of the Group (Baragar et al., 2001). Both basement and Povungnituk rocks are affected by thrust faulting which roughly parallels the unconformity and may, in places, take its place. The upper boundary of the Povungnituk Group is marked by the trace of a major thrust fault that is interpreted to lie along the course of the Chukotat River. Elsewhere, sills of Chukotat magma-type intrude the Povungnituk Group and are evidence that the structurally overlying Chukotat Group is, in fact, younger than the Povungnituk Group (Baragar, 2008).

This Group comprises interlayered black, shaly sediments, tuffaceous mafic volcanic rocks, pillowed metabasalts, massive basalt, and doleritic sills. The lower-most 700 or 800 m of the section are mostly mafic volcanic rocks with minor interbedded black shale. Near the lower contact the rocks are mafic schists showing in places vestiges of stretched pillows and in others probable tuffaceous and agglomeratic relics. Higher in the section the volcanic rocks alternate between massive basalts (or possibly dolerites), tuffs, lesser stretched pillow lavas and rare interlayers of black shale. This predominantly volcanic succession is overlain by about 1500 m of mainly dolerite sills of commonly 5 to 10 m thickness separated by black shaly interlayers ranging from a few cm to metres in thickness and this zone is succeeded in turn by about 1200 to 1500 m of mostly massive and, to lesser degree, pillow basalts intruded by major sills of gabbro and dolerite. The section is topped by a few tens of metres of highly contorted black shale adjoining the Chukotat River. These presumably are the rocks that accommodate the upper terminating thrust fault.

Igneous rocks of the Povungnituk Group are clearly of tholeiitic, basaltic magma-type with little variation in composition throughout the sequence. All rocks are of greenschist facies. The dolerites commonly preserve a vestige of igneous texture mainly in the distribution of the mafic minerals and feldspar and most have little or no foliation except adjoining their contacts with shales. The mineralogy is typically of greenschist type. Sodic plagioclase is intergrown with actinolite and chlorite, in roughly equal proportions, epidote is subordinate, and sphene, commonly enclosing relicts of opaque mineral, is accessary. Sparsely distributed rounded blebs of chlorite observed in some dolerite sills are interpreted as pseudomorphs of olivine. The volcanic rocks are of similar mineralogy and are commonly sparsely plagioclase -phyric and generally show varying degrees of foliation. The rocks interpreted as tuffs near the base of the section are invariably schistose to highly schistose indicative of the concentration of movements attendant upon folding in these comparatively weak strata adjoining the Archean basement.

The average composition with standard deviation of 31 igneous rock samples taken across the Povungnituk Group along the line of the section is given in Table 1. The generally low values for the standard deviations, particularly of MgO, are indicative of negligible differentiation of the parent magmas in the course of their emplacement.

TABLE 1

Average Analysis of Povungnituk Group, Kovik Section

		SiO_2%	Al_2O_3%	Fe_2O_3%	FeO%	MgO%	CaO%	Na_2O%	K_2O%	TiO_2%	P_2O_5%	MnO%	S%	CO_2%	H_2O%
Average	31 samples	47.54	12.66	3.36	10.13	6.84	10.53	2.02	0.26	1.42	0.15	0.24	0.09	0.73	3.76
Std Dev	31 samples	1.41	0.79	0.59	1.23	0.98	1.9	0.57	0.22	0.35	0.06	0.02	0.08	1.23	1.04

	Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm
Average	105	0.87	198	126	110	16.68	181	465	84	104	155	2.03	0.04
Std Dev	85	0.74	88	43	22	3.04	56	65	81	128	117	0.42	0.03

Chukotat Group

The Chukotat Group can be divided into a komatiitic lower segment and a tholeiitic upper segment. The nature of their boundary is unclear. It does not outcrop and no obvious topographic feature separates distinctive outcrops of each type but chemical, mineralogical, and lithological data from the mapped section indicates that the contact is abrupt.

Compositional and mineralogical variations throughout the Chukotat section are shown in the diagrams of Figures 3, 4 and 5. The abrupt transition from lower komatiitic to upper tholeiitic segments is particularly marked in Figure 3 by the MgO content which changes abruptly from a variable 8 to 24 per cent to a steady 5-6 per cent. The change in the alumina content is less abrupt but in the komatiitic part of the section it varies widely from about 8 to 16 per cent whereas in overlying tholeiites it rises fairly steadily from about 14 to 17 per cent then declines slightly near the upper boundary. Low titania (generally <1 per cent) together with high Cr (generally > 300 ppm) are characteristic markers of komatiitic affiliation even in rocks of otherwise tholeiitic-like compositions such as some of the low-Mg basalts of this section (cf. Baragar, 2007, 2008). Figures 4 and 5 illustrate the variations of titania and Cr respectively throughout the Chukotat succession. Both are marked by sharp changes upward in the sequence from the komatiitic segment, where the titania content is less than 1 per cent and the Cr content is highly variable but generally greater than 300 ppm, to the tholeiitic segment where titania ranges from 1.2 to 2.4 per cent and Cr is generally stable at 100 to 200 ppm.

Subdivision of the Chukotat Group in detail can be made on the basis of lithology as well as chemical composition. Following a classification established for the Ottawa Islands (Baragar, 2007) the komatiitic lavas are subdivided into Low, Medium and High Mg basalts on the basis of MgO contents of < 10 per cent, 10 to 15 per cent, and > 15 per cent respectively. Because of the influence of Mg content on lava fluidity and in consequence on flow characteristics, these subdivisions are evident in outcrop and can be mapped in the field. In the komatiitic part of the section several layers of High Mg basalts alternate with low and medium basalts with declining frequency of High Mg lavas upward. The overlying tholeiitic basalts are fairly uniform in composition and appearance and are not subdivided.

Chukotat Group rocks of the Kovik section are little altered and are virtually undeformed. They are of subgreenschist facies rocks. Plagioclase and clinopyroxene are commonly fresh or only slightly altered. Olivine is invariably pseudomorphed by serpentine or chlorite except in a peridotite layer at the base of a mafic-ultramafic sill within the komatiitic assemblage (station

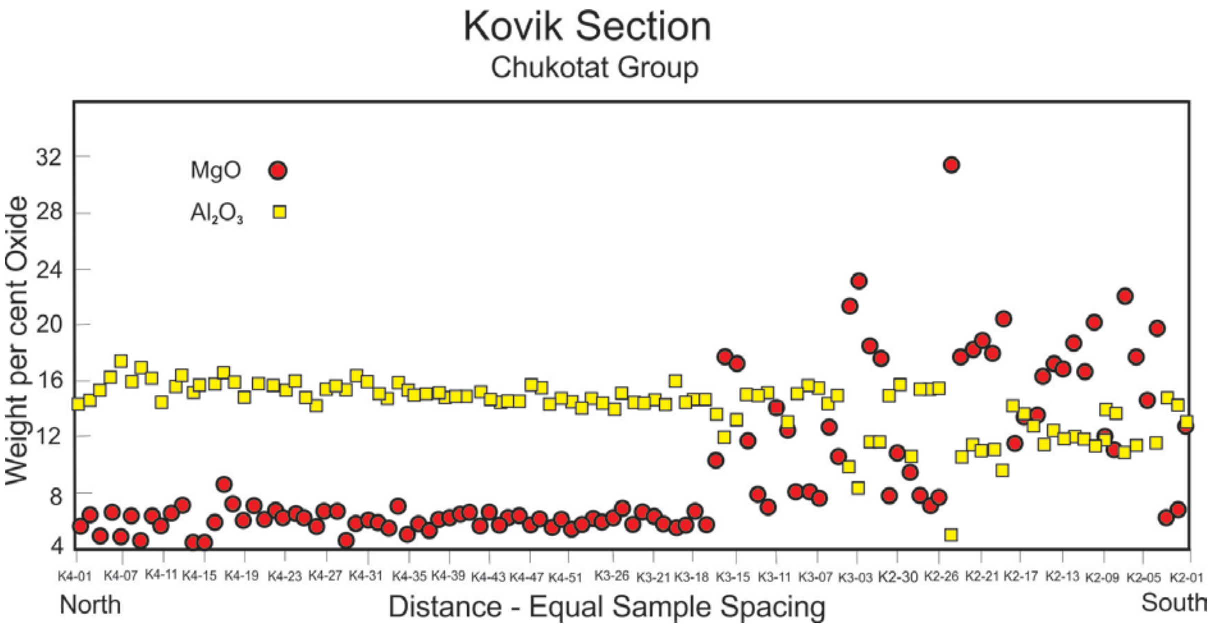

Figure 3. MgO and Al_2O_3 content variation of the Chukotat Group from samples taken systematically along the Kovik Section line.

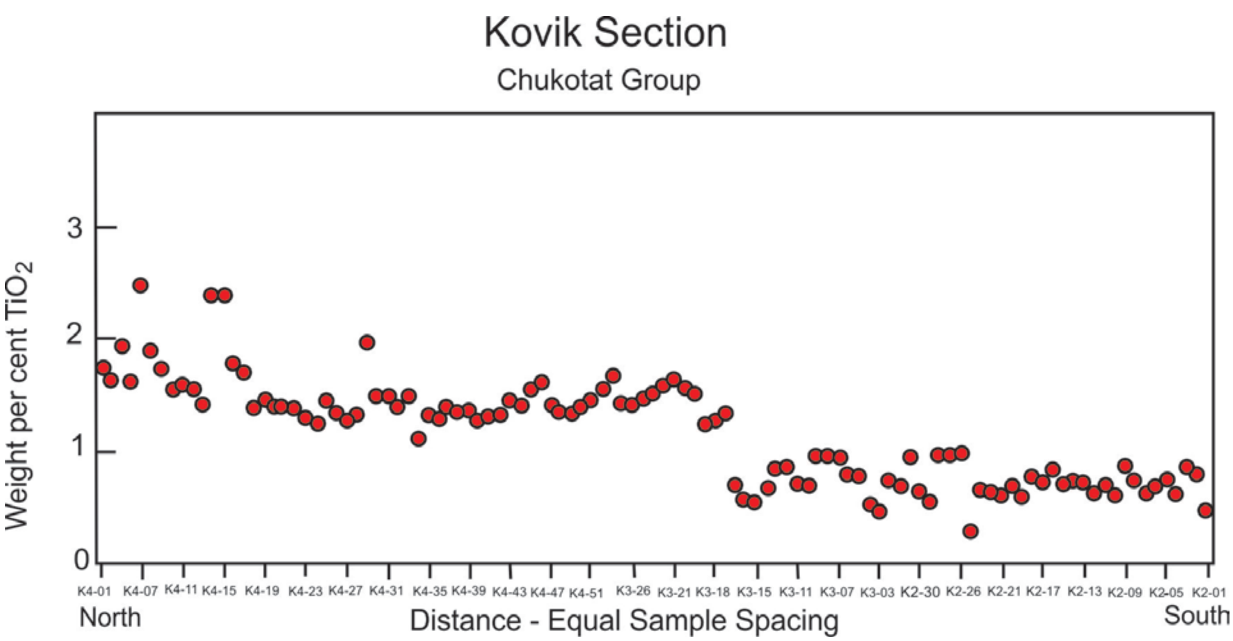

Figure 4. TiO_2 content variation of the Chukotat Group from samples taken systematically along Kovik Section line.

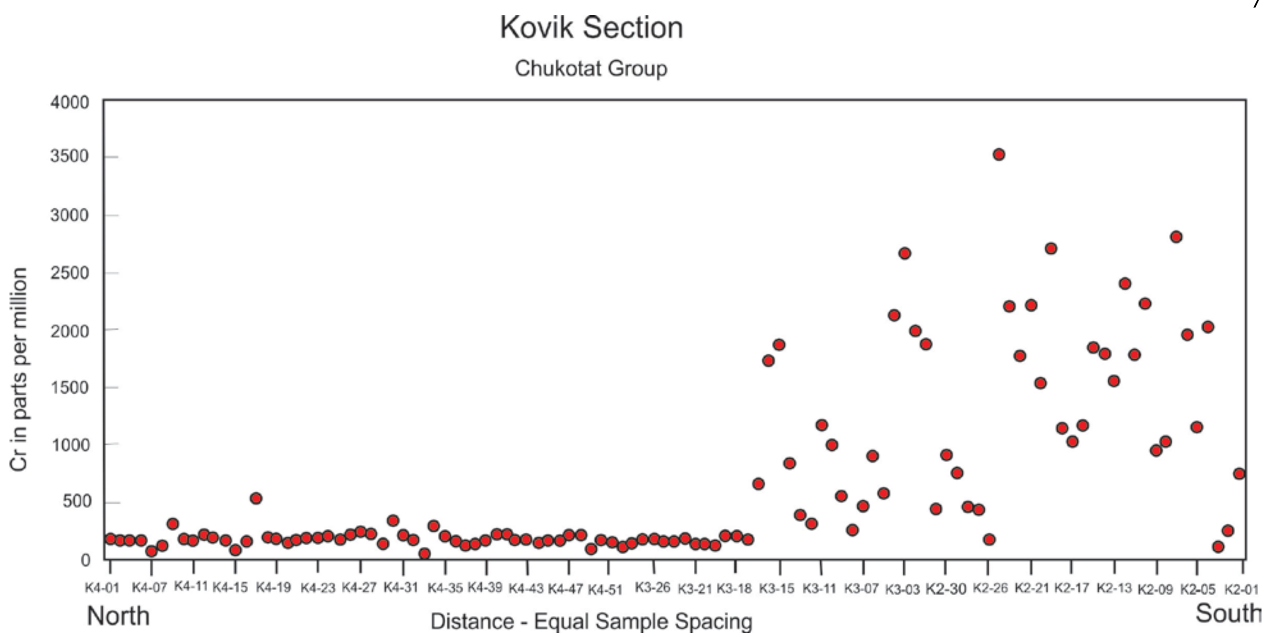

Figure 5. Cr content variation of the Chukotat Group from samples taken systematically along the Kovik Section line.

K2-25). There fresh olivine was determined as Fo80 - 83 (Baragar, 2007). Alteration minerals are commonly chlorite, sphene, and pumpellyite. Most of the rocks are microphenocrystic and the groundmasses are generally fine grained or even quenched.

Figure 6 shows the distribution of the types of phenocrysts throughout the section. These are olivine, clinopyroxene, and plagioclase. In the komatiitic segment olivine is the dominant phenocryst, commonly ranging from 15 to 30 percent of the rock in the High Mg flows, and less than 10 per cent in the Low Mg members. In the latter, clinopyroxene is generally a secondary phenocryst. The groundmass is mostly finely acicular clinopyroxene with, in the low Mg rocks, interleaved plagioclase. Magnetite, more or less altered to sphene, is a ubiquitous accessory mineral throughout the succession and is joined by chromite in the rocks of higher Mg content. In the latter, skeletal olivine are also characteristic of the groundmass. In the tholeiites plagioclase is invariably the dominant phenocryst but what appears to be olivine pseudomorphs are commonly a secondary phenocrystic phase. Plagioclase and clinopyroxene are the normal groundmass minerals but in places, pyroxene also forms ophitic masses of one to a few millimetres in diameter.

Plagioclase-phyric rocks within the Cape Smith Belt assemblages have been interpreted as differentiates of the same magma that produced the lower komatiitic sequence (e.g. Francis and Hynes, 1979; Baragar and Scoates, 1987). However, the abrupt change of compositions in this section between the komatiitic and tholeiitic (plagioclase-phyric) segments does pose the question as to whether this succession may not be simply upthrusted Povungnituk Group basalts. Table 2 compares the average composition of Upper Chukotat tholeiites with averages of Povungnituk basalts from this and from two other sections in the Nuvilik Lakes map-area to the east. It is obvious that the averages are generally a match within their standard deviation limits. The matter could be settled with an age determination on the tholeiitic succession but with the evidence at hand, it remains unresolved.

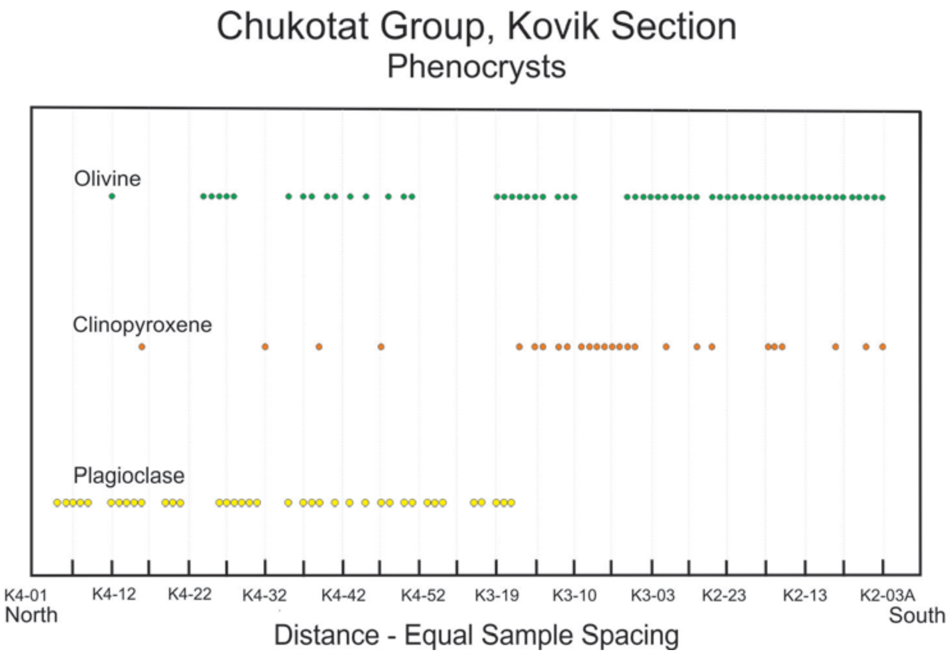

Figure 6. Showing the presence of phenocrysts and microphenocrysts in samples of the Chukotat Group taken systematically along the Kovik Section line.

TABLE 2
Comparison of average analysis of upper (tholeiitic) part of Chukotat Group in Kovik Section with averages of Povungnituk Group in Cape Smith Belt Sections 1 (Kovik), 2 (Nuvilik), and 3 (Nuvilik)

Kovik Section															
Upper Chukotat	Section 1	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S%	CO2%	H2O%
Average	62 samples	47.41	14.60	2.99	10.33	5.66	9.37	2.36	0.40	1.43	0.13	0.24	0.08	0.63	3.78
Std Dev	62 samples	1.28	0.65	0.82	1.02	0.69	1.38	0.46	0.47	0.25	0.05	0.02	0.05	1.02	0.78
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		105.05	0.43	162	199	96	15.21	208	519	71	93	186	1.68	0.029	
Std Dev		63	0.45	68	264	22	3.06	39	61	21	20	66	0.62	0.014	
Povungnituk Gp															
Kovik Bay	Section 1	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S%	CO2%	H2O%
Average	31 samples	47.54	12.66	3.36	10.13	6.84	10.53	2.02	0.26	1.42	0.15	0.24	0.09	0.73	3.76
Std Dev	31 samples	1.41	0.79	0.59	1.23	0.98	1.90	0.57	0.22	0.35	0.06	0.02	0.08	1.23	1.04
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		105	0.87	198	126	110	16.68	181	465	84	104	155	2.03	0.04	
Std Dev		85	0.74	88	43	22	3.04	56	65	81	128	117	0.42	0.03	
Nuvilik Lakes	Section 2	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S%	CO2%	H2O%
Average	14 samples	43.27	13.455	2.27	8.83	7.70	11.80	2.16	0.83	1.45	0.19	0.22	0.10	4.01	3.50
Std Dev	14 samples	9.12	3.00	0.85	1.25	2.36	6.37	1.22	0.71	0.82	0.13	0.05	0.17	7.84	0.43
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		482	0.31	306	130	67	9.75	117	411	69	221	402	2.47	0.03	
Std Dev		554	0.14	183	85	10	3.50	44	116	26	154	390	2.32	0.00	
Nuvilik Lakes	Section 3	SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S%	CO2%	H2O%
Average	40 samples	46.24	13.64	2.69	10.90	6.62	9.48	2.27	0.47	1.87	0.28	0.23	0.05	1.38	3.50
Std Dev	40 samples	3.18	1.08	0.84	1.77	1.41	1.83	0.69	0.36	0.54	0.17	0.05	0.07	1.97	1.13
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		135	0.88	203	187	96	11.51	96	528	65	73	119	2.65	0.03	
Std Dev		82	1.42	96	76	38	5.10	61	125	27	36	43	2.21	0.02	

Parent Group

The Parent Group structurally overlies the Chukotat Group from which it is presumably separated by a thrust fault parallel to the stratigraphy (the Bergeron Fault). It comprises an entirely different assemblage of rocks. Whereas the Chukotat volcanic rocks are little deformed, of mafic to ultramafic composition, and of subgreenschist metamorphic grade, the Parent assemblage is mainly schistose, mafic to felsic fragmental rocks of garnet-amphibolite metamorphic grade. Typically, the more felsic rocks contain block or lapilli fragments in a schistose mafic matrix but mafic schists, presumably derived from basaltic lavas and in one place showing relict pillow rims, are a subordinate part of the succession. Doleritic rocks, probably representing sills penecontemporaneous with the succession, occur at several levels.

The Parent Group has been subdivided into a number of units on the basis of broadly similar lithologies but unit contacts are not well defined and the make-up of units is somewhat arbitrary. At its base adjoining the contact with uppermost Chukotat volcanic rocks, Parent Group rocks are highly schistose mafic rocks with schistosity parallel to the contact and dipping steeply north. These schists presumably represent part of the zone associated with the thrust faulting interpreted as the contact. Even within this zone the mafic schists contain elongate lenses or streaks of more felsic composition that are probably deformed fragments. Northward the rocks become more typically fragmental and the schistosity decreases. The first unit (19) is most commonly a block and particle lapilli tuff with felsic fragments in a more mafic matrix. Fragments are mostly flattened lenses paralleling the prevailing schistosity and ranging up to as much as 40 centimetres long, but the majority are of lapilli size or less. This unit is succeeded on the north by a somewhat more mafic unit (20), still largely fragmental, but with a predominance of mafic matrix and associated doleritic and basaltic phases. In places, it grades into garnet-hornblende mafic schists. Other units include the largely metadoleritic and metagabbroic rocks with related hornblende-garnet schists and amphibolites (units 23 and 24) at the north end of the Kovik section and centrally, the more felsic, largely fragmental rocks, of Unit 21. These latter rocks range from mafic schists with felsic lenses to coarser (15 cm) only slightly lensoidal agglomerates. One generally well-layered unit (22) of mainly garnet-hornblende, and accompanying mafic and felsic schists is interpreted as being (at least in part) metasedimentary and/or metatuffaceous.

Rocks of the Parent Group are almost invariably schistose to varying degree and because of this, the unit trends are not generally apparent in outcrop. From the air photographs the trends can be judged to be generally east-northeastward with the dips (estimated in outcrop) 60 to 65^{o} northward throughout the southern leg (Stations K5-1 to K5-21) of the section line. In its northern leg (Stations K6-1 to K6-17) the foliation trends are predominantly north with steep (65 - 90^{o}) westward dips. This trend parallels the eastern margin of the adjoining, late or post-orogenic Lanyon Lake granitic intrusion and is probably related to its emplacement. It overprints what appears from the air photographs to be the northeastward strike of the rock units themselves.

The composition of the Parent Group rocks is roughly bimodal as shown in Figure 7 by the frequency distribution diagrams for SiO_2 and MgO. The modes of 52 and 58 per cent SiO_2 and 3 and 6 per cent MgO reflect the bimodality of many of the rocks which are so typically composed of felsic fragments in an andesitic or basaltic matrix. Variation of composition throughout the Parent Group succession is represented by the diagrams of Figure 8, 9, and 10 for the oxides of Si, Al, Mg, Ti, Na, and K. In general the more mafic rocks are at the south and north ends of the section with a broad band, roughly corresponding to parts of units 19 and 21 separating them. The average composition of the Parent Group along this section line is shown in Table 3 together with its standard deviation. Also shown are averages and standard deviations of the mafic and felsic fractions of these rocks as determined by the frequency distribution diagram for SiO_2. Note that the fractions would probably classify as basalt and dacite respectively whereas the overall average would be andesite.

TABLE 3
Average Analysis of Parent Group, Kovik Section

Parent Group															
		SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S %	CO2 %	H2O %
Average	25 samples	57.47	14.79	1.58	6.05	3.94	7.70	3.51	0.68	0.96	0.22	0.14	0.05	1.25	1.90
Std. Dev.	25 samples	6.24	1.20	0.82	3.77	1.75	2.72	1.12	0.43	0.54	0.07	0.06	0.10	1.84	0.68
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		244	2.7	265	155	68	15.04	76	278	28	54	95	1.70	0.03	
Std. Dev.		180	1.7	123	71	31	4.58	59	188	27	41	63	0.79	0.02	
Parent Group: Felsic fraction															
		SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S %	CO2 %	H2O %
Average	13 samples	62.36	14.98	1.41	4.10	2.84	6.15	4.26	0.72	0.67	0.21	0.10	0.01	0.95	1.59
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		264	2.9	268	135	59	14.77	42	200	14	53	66	1.63	0.03	
Parent Group: Mafic fraction															
		SiO2%	Al2O3%	Fe2O3%	FeO%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%	MnO%	S %	CO2 %	H2O %
Average	12 samples	52.17	14.57	1.77	8.16	5.13	9.38	2.70	0.64	1.27	0.23	0.18	0.09	1.59	2.23
		Ba ppm	Pb ppm	Sr ppm	Zr ppm	Zn ppm	Ga ppm	Cu ppm	V ppm	Co ppm	Ni ppm	Cr ppm	Sn ppm	Ag ppm	
Average		223	2.4	260	177	78	15.33	113	362	43	55	126	1.78	0.03	

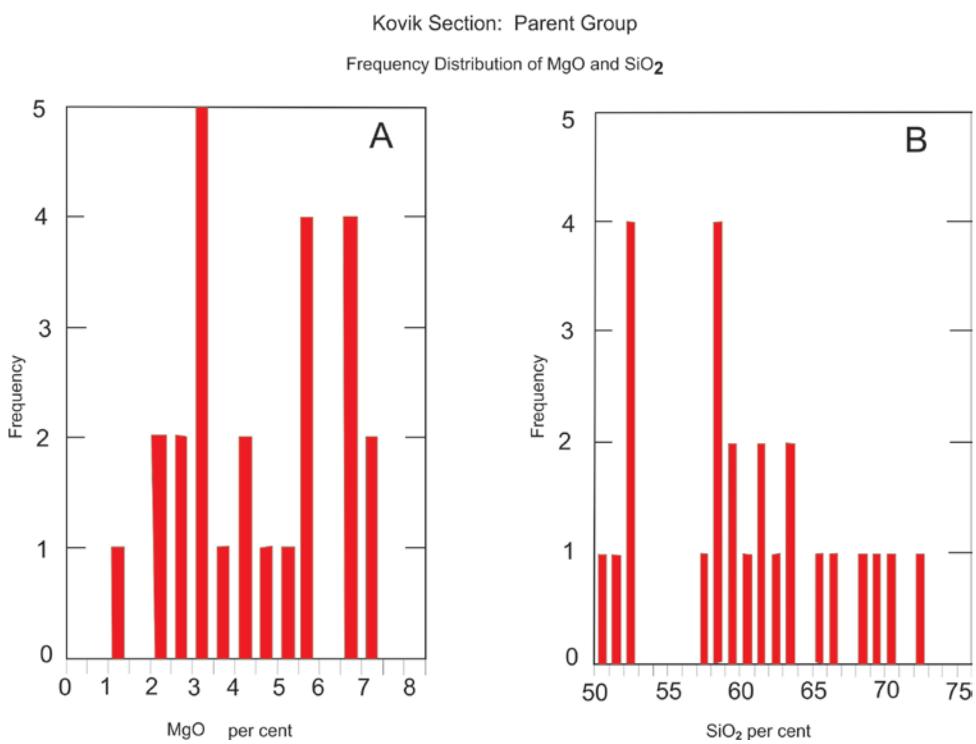

Figure 7A and B. Frequency distribution of (A) MgO content and (B) SiO_2 content in samples of the Parent Group taken systematically along the Kovik Section line.

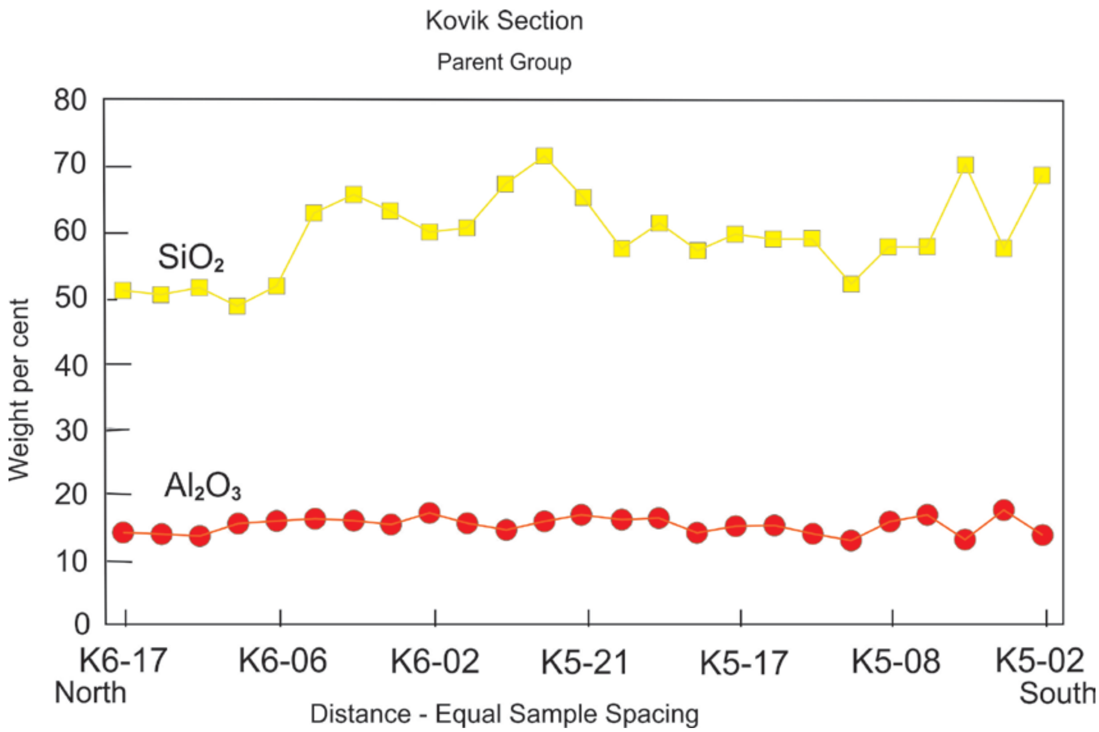

Figure 8. Variation of SiO_2 and MgO contents in samples of the Parent Group taken systematically along the Kovik Section line.

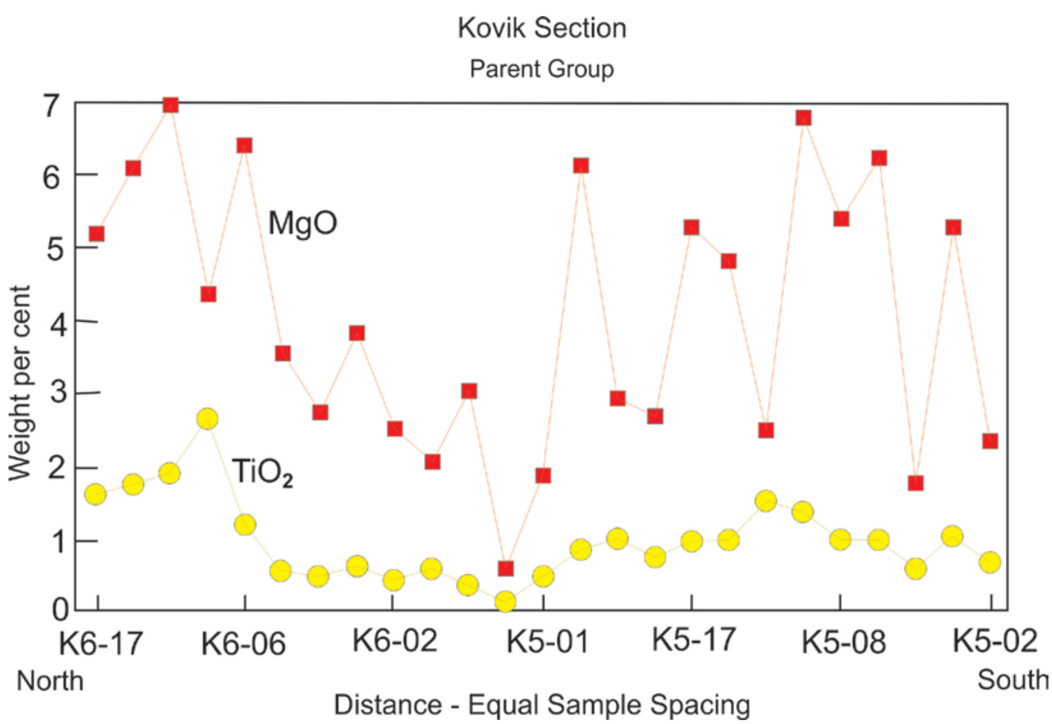

Figure 9. Variations of MgO and TiO_2 contents in samples of the Parent Group taken systematically along the Kovik Section line.

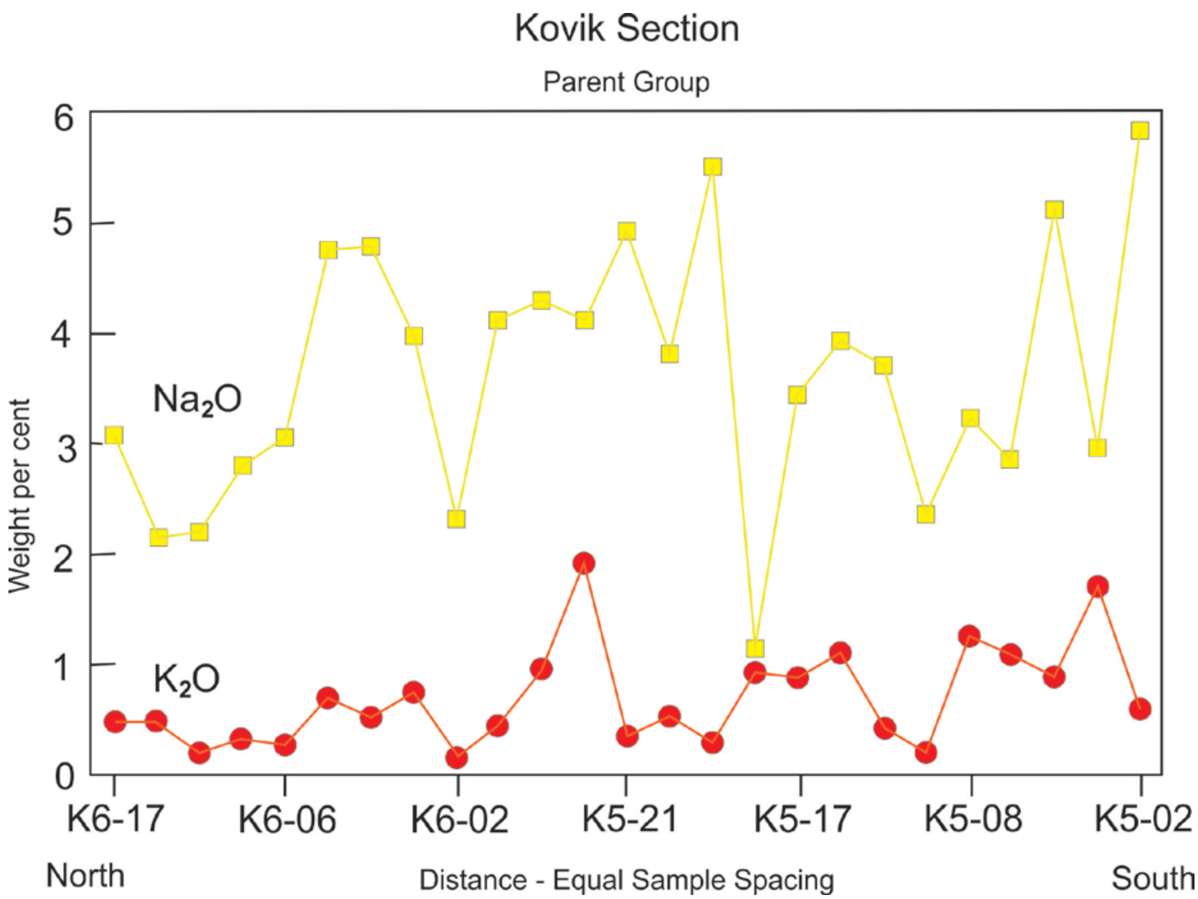

Figure 10. Variations of Na_2O and K_2O contents in samples of the Parent Group taken systematically along the Kovik Section line.

GNEISSIC COMPLEX NORTH OF THE CAPE SMITH BELT

Introduction

Within the Kovik Bay map area the northern boundary of the Cape Smith Belt is marked by a fringing belt of metabasalts and metasediments interpreted as being part of Povungnituk Group. The contact itself is invariably highly sheared and has been interpreted as a fault contact by Lucas and St-Onge (1997a). As will be discussed in a later section the contact can also be interpreted as an unconformity along which movement was concentrated during episodes of deformation. Further to this view, within the gneissic complex are a number of isolated belts of similar metabasalt and sediments which are interpreted as keels of Povungnituk Group rocks infolded into an Archean basement and refolded during the culminating Hudsonian deformation.

The relationship of the Parent Group to the seemingly underlying Povungnituk Group within the body of the Cape Smith Belt is not evident from the mapping done in this map-area but either overlies it unconformably or has been thrust into position as interpreted by Lucas and St-Onge (1997a).

The gneissic complex is a mixed assemblage of metamorphic rocks ranging from mafic to felsic compositions and from garnet-amphibolite to granulite facies. Subdivision into mapable units tends to be arbitrary and subjective (Fig. 2). Unit boundaries are rarely well-defined, rock types grade into one another along and across strike. However, some units which are fairly distinctive and may have special significance are as follows: 1) The grey gneisses (A1) and associated granitoid gneisses (A2) both interpreted as Archean basement, 2) paragneisses and undivided supercrustal rocks (A9), (A12); 3) metagabbro, foliated metagabbro/metadolerite, and amphibolite (A10); and 4) potash feldspar megacrystic granite and associated augen gneiss (A11). Other rocks of the complex are generally granodioritic gneisses commonly ranging without distinctive division into more mafic or more felsic phases.

Grey gneisses (A1 and A2)

The grey gneisses form a broad zone adjoining the north border of the Cape Smith Belt (Fig. 1). Their contact with the Cape Smith Belt is in all places observed, so badly sheared that its nature is indeterminant. Generally, metasedimentary rocks, mostly dark shales or schists and commonly quartzites, of presumed Povungnituk Group affiliation adjoin the contact on its south side. In one place just north of Lanyan Lake, iron formation is part of this assemblage. Hence, the northern boundary of the Cape Smith Belt has the appearance of a mirror image of its southern boundary with the grey gneisses the equivalent of the underlying Archean basement.

The southern part of the zone of grey gneisses comprises mostly light- to medium-grey quartz-feldspar-biotite gneiss with marked foliation. Interlayers of amphibolite and pinkish granodiorite are common. Typically these gneisses contain 15 to 35 per cent quartz, 25 to 50 per cent intermediate plagioclase and 10 to 25 per cent brown- to olive-green biotite and in places minor green hornblende. Potash feldspar, commonly microcline, is normally a minor (<10 per cent), interstitial constituent but in the pinkish layers and phases the gneisses may contain up to 30 to 40 per cent. Accessory minerals are opaques, sphene, and apatite. Interlayers of amphibolite are composed of as much as 50 to 55 per cent dark green to blue-green amphibole. Most of the grey gneiss classify as tonalite.

Granodioritic gneisses (A2) within and north of the main belt of grey gneisses are interpreted as a phase of the grey gneiss. Their boundaries are unclear, possibly gradational, and their relationship is uncertain but because similar pinkish granodiorite appears as poorly defined seams and patches within the grey gneiss they are assumed to be younger. Grey gneisses pass into the granodiorites of unit A2 with increases in quartz, and generally potash feldspar. Mafic minerals, mostly biotite, are not abundant. These rocks are commonly weakly foliated and in places, have the aspects of a granodiorite.

Metamorphism is marked in the more mafic phases of both the grey and granodioritic gneisses by chiefly amphibole and garnet but in some schistose interlayers of what may be metasediments, kyanite and sillimanite are present.

Both sets of gneisses, because of their apparent relationship to Povungnituk rocks of the Cape Smith Belt, are interpreted as reworked Archean basement.

Paragneisses and undivided mixed gneisses (A9 and A12)

Within these categories are rocks that range from indisputable supercrustal rocks such as quartzites and metabasalts through biotitic schists and amphibolites to highly foliated gneisses of more problematic supercrustal derivation. They are grouped into Units A9 of mixed gneisses and A12 of generally micaceous gneisses and quartzites.

The mixed gneisses (A9) occur in two belts similar in lithology but of uncertain relationship to one another. They are in common, well layered and typically composed of alternating felsic and mafic layers. The felsic component is generally a quartzofeldspathic gneiss with 10 to 30 per cent brown biotite, 15 to 20 per cent quartz, and 50 to 60 per cent clear, intermediate plagioclase with or without minor garnet, green hornblende and clinopyroxene. Commonly, the rocks are finely granular, friable, garnetiferous biotitic schists. In places the quartz content can be sufficiently high as to make it likely that the protolith was a quartzitic sediment. The mafic layers are dominated (40 - 60 per cent) by green hornblende with variable amounts of clinopyroxene and garnet. Clinopyroxene generally appears as relict grains presumably representing survivals from a basaltic/doleritic protolith.

The metasediments and associated schists and gneisses of unit A12 are found in three widely separated belts: near the northern border of the map area; just northeast of the hump of Kovik River; and as the core zone of what appears to be a folded gneissic assemblage in the eastern part of the map area. Within each of these regions the rocks are highly variable but generally have the appearance of metasediments. A common lithology is a thinly layered, finely granular garnetiferous quartzofeldspathic gneiss with variable, but mostly abundant, brown biotite and lesser green hornblende. In gneisses of the northern belt andalusite and possibly sillimanite have been identified. Quartz, both as fine granules and as lenticles and bands in the foliation plane, forms typically 10 to 25 per cent of these rocks and clear intermediate plagioclase 40 to 50 per cent.

Metagabbro/metadiorite, metadolerite, and amphibolites (A10)

The principal metagabbro belt in the northwestern part of the mapped area of gneisses forms the hanging wall of a major northeastward- to eastward-trending thrust fault evident on both topographic and aeromagnetic maps where the gabbro is marked by physiographical and magnetic highs. The southwestern part of this belt is composed generally of little foliated metagabbro except immediately adjoining the fault where it may be finer grained and both sheared and recrystallized. The unfoliated rocks (Station 33B-6) are coarse grained and composed of mainly intergrown augite (20 - 25 per cent), hypersthene (5 - 10 per cent), olive-green hornblende (20 - 35 per cent) and intermediate plagioclase (40 - 60 per cent) with variable but mostly minor biotite, apatite, and magnetite. Locally it is garnetiferous. Elsewhere in this belt the metagabbros show varying degrees of degradation to hornblendic and hornblendic-biotitic gneisses with generally increasingly pronounced foliation. Amphibolites comprising 50 to 60 per cent of olive-green amphibole are common to the unit and rarely ultramafic phases are present. In one place (Station 33B-7b) an ultramafic vein occurring within the metagabbro was observed to contain 70 per cent clinopyroxene, 10 per cent orthopyroxene, 10 per cent biotite, and 10 per cent cordierite (?) with minor magnetite. Typically, throughout the belt, the metagabbros themselves are medium-grained rocks with about 50 per cent mafic minerals, mostly hornblende with variable biotite but commonly showing clinopyroxene relicts. Characteristically the rocks have a brownish colour imparted by their plagioclase. Although classed here as metagabbros many phases of the unit have significant amounts of biotite and even minor potash feldspar, hence might in part be classed as metadiorites. Northeastward the metagabbro gneisses seem to grade into the intermediate gneisses of Unit 8. On the southeastern side of the fault the foliation and lineations in the highly friable metasediments of the adjoining Unit A9 are probably reflective of the southeastward upthrusting movement of the superincumbent metagabbro mass.

A northern belt of very similar metagabbros is intimately associated with augen gneisses of Unit 11. Their relationship is uncertain. They appear to be interlayered; no contacts were apparent but in one place (Station 27B-3) the metagabbro seems to fine towards a contact with coarse-grained augen gneiss. Hence, the metagabbro may be younger and intrusive into the augen gneiss.

Potash feldspar megacrystic gneiss, augen gneiss (A11)

These pink granitoid megacrystic and/or augen gneisses occur mainly in the northwestward part of the mapped gneissic region where they are interlayered with metagabbros (A 10) but their relationship to the metagabbros, as noted above, is unclear. Elsewhere in the region megacrystic or augen gneisses have been mapped but whether they are to be considered an equivalent lithology is uncertain.

The rocks of this unit are basically granites with sparse to moderately abundant megacrysts of pink potash feldspar, generally 1 to 2 cm in diameter. Mafic minerals are commonly biotite and/or amphibole and mostly sparse. However, lithologies can range widely from moderately to highly foliated and from leucocratic to markedly mafic. In the more gneissic rocks the potash feldspar megacrysts are generally represented by recrystallized feldspar augen. In thin sections megacrysts can be seen to be large perthitic crystals of orthoclase and the groundmass is generally composed of 10 to 25 per cent orthoclase, 25 to 40 per cent plagioclase (oligocene-andesine), 10 to 25 per cent quartz and 10 to 20 per cent of both brown biotite and/or dark green amphibole. Commonly the quartz appears as bulbous strings in the plain of foliation. Accessory minerals may be magnetite and apatite.

In the Archean basement south of the Cape Smith Belt similar megacrystic granites are a major lithology.

POVUNGNITUK GROUP: CAPE SMITH BELT NORTH BORDER AND OUTLIERS

The continuing belt of Povungnituk metasediments and metabasaltic volcanic rocks that form the northern border of the Cape Smith Belt is in highly sheared contact with the adjoining grey gneisses (A1). In consequence, the nature of the contact is indeterminable. At a number of places observed, Povungnituk metasediments of varying thickness adjoin the contact. Quartz-biotite and garnetiferous quartz-biotite schists are the most common of these but in places nearly pure quartzites are found immediately adjoining the contact. These tend to be slivers a metre or two thick that seem to thin into the shear zone as if abraded away by the attending movements. Southward and presumably up-section, the biotite schists are succeeded by fine-grained, variably-foliated metabasalts now represented mostly by amphibolites and garnetiferous amphibolites.

Primary structures such as pillows or fragmental features are rarely preserved. Within the metasedimentary assemblage north of Lanyan Lake occurs a rusty-weathering, silicate-carbonate iron formation a few metres thick that closely resembles iron formation in the Povungnituk Group at the southern boundary of the Cape Smith Belt.

If these rocks are correctly interpreted as belonging to the lower part of the Povungnituk Group it suggests an original basinal form for the Cape Smith Belt wherein the Povungnituk Group passes continuously beneath the assemblage of Cape Smith Belt rocks to reappear on its north side in a mirror image of the south margin. The underlying grey gneisses are interpreted as the re-emergent Archean basement which in turn merges northward into the younger metamorphosed terrain of mixed gneisses.

Within the region of grey gneisses (A1) and associated granodioritic gneisses (A2), rocks interpreted as reworked Archean basement, there are several outliers of Povungnituk - type metavolcanics and metasediments. These are thought to be the keels of a formerly continuous Povungnituk assemblage now preserved as infolds in what was Archean basement and refolded with subsequent deformation. Typically, each of these belts is composed of fine-grained metabasalts now mainly garnetiferous amphibolite, commonly with interlayered quartz-feldspar-biotite schists, interpretable as metapelites. In a number of places where the contact of an inlier with ‘basement’ was observed in outcrop it is marked by several metres of highly sheared quartzite and metapelite. Hence, like the northern contact of the Cape Smith Belt itself, quartzites marking the inlier contacts with basement may signify an original unconformity sheared out by subsequent deformation.

POST OROGENIC INTRUSIVE ROCKS

Granitic pegmatite dykes

In the western part of the region of mixed gneisses north of the Kovik River two swarms of granite pegmatite dykes intrude the local country rocks and are clearly post orogenic. The northern swarm is mainly in the area underlain by the metagabbro (A10), paragneisses (A9), and associated gneissic (A8) units north of latitude 61^{o} 50'. Here the dykes generally parallel the northwestward trend of the foliation but dips, where they can be measured, are moderately to steeply south, thus crosscutting the northward dipping foliation. The southern cluster lies in the region between Kovik River and the south limit of the northern swarm. In this region the dykes generally have a northward trend and, where it can be determined, mostly a moderate eastward dip, quite unrelated to foliation in the host rock. In both swarms the dykes are typically coarse-grained, pink granites and granitic pegmatites with thicknesses ranging from a few centimetres to several metres. Elsewhere in the region pegmatite dykes are rare. It is possible that these dykes are comagmatic with the Late Suite of granitic vein/dykes of the Sugluk area (Lucas and St-Onge, 1997b) dated by Parrish (1989) at 1758 Ma.

Dolerite dykes

Major dolerite dykes generally trending 350^{o} and traceable on air photographs for a few kilometres, crosscut the grey gneisses of units A1 and A2 just south of Kovik River near the east end of the mapped region (Station H21-2, UTMX 391300. UTMY 6831768). One of the dykes swings southeastward at its south end of exposure. Here, its attitude was measured as 145^o with a westward dip of 80^o. It has a thickness at this point of 15 m and both chilled contacts are exposed.

Dolerite or gabbro dykes with similar north-northeast trends are exposed at Stations H28-5 (UTMX 397918, UTMY 6830181) (dyke thickness 20 m) and 20B-1 (UTMX 353831, UTMY 6835240) near the east and western limits of mapping respectively. At the latter location the dyke cuts its migmatite host but seems to be itself deformed along its strike. Hence, it may not be equivalent to the other dykes.

SUMMATION AND DISCUSSION

Cape Smith Belt assemblages rest unconformably on little disturbed Archean basement along their southern margin. The contents, comprising Povungnituk Group shelf- to marine-sediments and tholeiitic volcanic rocks and tectonically overlying Chukotat deep-water komatiitic volcanic rocks, are mainly steeply north-dipping. Generally concordant, intermittent, south-vergent thrusting within the assemblage is responsible for juxtaposing the Chukotat Group over the Povungnituk Group and for emplacing Parent Group calcalkaline volcaniclastic rocks of markedly higher metamorphic grade in contact with upper levels of the Chukotat Group. The northern margin of the Cape Smith Belt, like its southern margin, is formed of Povungnituk sedimentary and volcanic rocks that reappear, seemingly, from beneath the Parent Group. Here, they are similarly in contact with what is interpreted as reworked Archean basement to the north but the nature of the contact is obscured by intense foliation. Like its counterpart at the southern margin the contact was probably unconformable but with deformation the contact became a locus of shearing movement. The Povungnituk Group itself can be interpreted as a continuing basal member that passes beneath the Cape Smith Belt and extends northward. Within the region of gneisses interpreted as reworked Archean to the north of the Belt are several folded outliers of Povungnituk rocks thought to be relict keels of a once continuous Povungnituk Group that blanketed the region.

Northward, the reworked Archean basement passes into a region of mixed gneisses of generally upper-amphibolite to granulite facies grade. These are a younger assemblage of varied lithologies that St-Onge and Lucas (1997a-c) identify in part as magmatic components of the Narsajuak Arc. The Parent Group is interpreted as a surface manifestation of a late phase of this activity, notably of those plutons intrusive into the Cape Smith Belt, termed the Cape Smith Suite by Dunphy and Ludden, 1998. The Lac Lanyon pluton, dated at 1845 Ma is an example of the latter. The ages of the Narsajuak event range generally from 1836 Ma to 1898 Ma (Parrish, 1989).

A major distinction between the Kovik Bay map presented here and that of Lucas and St-Onge (1997a) is the lack of closure in this map area of the Kovik Bay basement anticline by the Povungnituk Group. In Lucas and St-Onge's map the anticline of reworked Archean rocks is entirely enclosed by a thrust slice of Povungnituk volcanic and/or sedimentary rocks. This was not evident from the data upon which the map of this report is based. The interpretation here is that the Archean basement is either overridden from the north by the Narsajuak Arc or that the Narsajuak Arc is a continental arc formed over a south dipping subduction zone and deformed by subsequent continental collision. In the latter case the Cape Smith Belt and related volcanism in the Circum-Superior Belt would assume the nature of back-arc basins.

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REFERENCES

Baragar, W.R.A.

2015: Archean basement underlying Paleoproterozoic Cape Smith Belt: Part of Povungnituk map area NTS 35-C; Geological Survey of Canada, Open File 7847, 1 .zip file. doi:10.4095/296432

Baragar, W.R.A.

1974: Volcanic studies in the Cape Smith Wakeham Bay Belt, New Quebec; *in* Current Research, Part A, Geological Survey of Canada Paper 74 - 1A, p. 155-157.

Baragar, W.R.A. and Scoates, R.F.J.

1981: The Circum-Superior Belt: a Proterozoic Plate Margin? *in* Precambrian Plate Tectonics, (ed.) A. Kroner, Elsevier, Amsterdam, p. 297-330.

Baragar, W.R.A., Hervet, M., and Charland, M.

1986: Structural character and plutonic setting at the west end of the Ungava Trough; *in* Exploration en Ungava; Données récentes sur la géologie et la gîtologie, (ed.) Lamothe, D., Gagnon, R., and Clark, T. Séminaire d'information, Ministère de l'Energie et des Ressources, Québec. v. 86-16, p.41-43.

Baragar, W.R.A. and Scoates, R.F.J.

1987: Volcanic geochemistry of the northern segments of the Circum-Superior Belt of the Canadian Shield; *in* Geochemistry and mineralization of Proterozoic volcanic suites. (eds.) T.C. Pharaoh, R.D. Beckinsdale, and D. Rickard, Geological Society Special Publication v. 33**,** p.113-131.

Baragar, W.R.A., Mader, U., and LeCheminant, G.M.

2001: Paleoproterozoic carbonatitic ultrabasic volcanic rocks (meimechites?) of Cape Smith Belt, Quebec. Canadian Journal of Earth Sciences, v. 38, p. 1313-1334.

Baragar, W.R.A.,

2007: Geology, Ottawa Islands, eastern Hudson Bay, Nunavut; Geological Survey of Canada, Map 2113A with marginal notes, scale 1:75 000.

Baragar, W.R.A.
2008: Geology, Smith Island and adjoining mainland, eastern Hudson Bay, Nunavut - Quebec; Geological Survey of Canada, Map 2112A with marginal notes, scale 1:75 000.

Dunphy, J.M., and Ludden, J.N.
1998: Petrological and Geochemical characteristics of a Paleoproterozoic magmatic arc (Narsajuak terrane, Ungava Orogen, Canada) and comparisons to Superior Province granitoids; Precambrian Research, v. 91, p.109 - 142.

Francis, D. and Hynes, A.J.
1979: Komatiite-derived tholeiites in the Proterozoic of New Quebec; Earth and Planetary Science Letters, v. 44, 473 - 481.

Lucas, S.B. and St-Onge, M.R.
1997a: Geology, Montagne Pinguk, Quebec-Northwest Territories / Géologie, Montagne Pinguk, Québec-Territoires du Nord-Ouest; Geological Survey of Canada, Map 1912A, scale 1:100 000.

Lucas, S.B. and St-Onge, M.R.
1997b: Geology, Sugluk, Quebec-Northwest Territories / Géologie, Sugluk, Québec-Territoires du Nord-Ouest; Geological Survey of Canada, Map 1913A, scale 1:100 000.

Lucas, S.B. and St-Onge, M.R.
1997c: Geology, Foul Bay, Quebec-Northwest Territories / Géologie, Foul Bay, Québec-Territoires du Nord-Ouest; Geological Survey of Canada, Map 1915A, scale 1:100 000.

Parrish, R.R.
1989: U-Pb geochronology of the Cape Smith Belt and Sugluk block, northern Quebec. Geoscience Canada, v. 16, 126 - 130.

St-Onge, M.R. and Lucas, S.B.
1997a: Geology, Ivukivik, Quebec-Northwest Territories / Géologie, Ivujivik, Québec-Territoires du Nord-Ouest; Geological Survey of Canada, Map 1911A, scale 1:100 000.

St-Onge, M.R. and Lucas, S.B.
1997b: Geology, Pointe Rouge, Quebec-Northwest Territories / Géologie, Pointe Rouge, Québec -Territoires du Nord-Ouest; Geological Survey of Canada, Map 1914A, scale 1:100 000.

St-Onge, M.R. and Lucas, S.B.
1997c: Geology, Joy Bay, Quebec-Northwest Territories / Géologie, Joy Bay, Québec-Territoires du Nord-Ouest; Geological Survey of Canada, Map 1916A, scale 1:100 000.