Geological Survey of Canada

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2003

Natural Resources Canada
Ressources naturelles Canada

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CURRENT RESEARCH

ISSN 1701-4387
Catalogue No. M44-2003/C4E-IN
ISBN 0-662-33526-0

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Publication approved by Terrain Sciences Division

Ice-flow history and drift prospecting in the Committee Bay belt, central Nunavut: results from the Targeted Geoscience Initiative

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McMartin, I., Little, E.C., Ferbey, T., Ozyer, C.A., and Utting, D.J., 2003: Ice-flow history and drift prospecting in the Committee Bay belt, central Nunavut: results from the Targeted Geoscience Initiative; Geological Survey of Canada, Current Research 2003-C4, 11 p.

Abstract: Mapping of ice-flow indicators in the Committee Bay supracrustal belt (NTS 56 K, 56 J/9 to /16, 56-O/1 to /8, and 56 P) provides new evidence for a complicated ice-movement chronology during the Late Wisconsinan. Three main phases of ice movement have been identified at the regional scale. The oldest is northerly and is found throughout most of the area. This was followed early in the deglaciation sequence by northeastward flow in the eastern part of the area and northwesterly flow in the western part. Finally, there is a north-northwesterly flow south of the Chantrey moraines, associated with ice flow from the Keewatin Ice Divide. Results from drift-prospecting studies indicate that till geochemistry reflects a clear northerly direction of glacial transport. Most of the known gold showings are recognized in the gold-grain counts and/or the gold values in the till matrix, but at least two previously unknown, potentially gold-rich domains have been identified.

Résumé : Le relevé d'indicateurs d'écoulement glaciaire dans la ceinture de roches supracrustales de Committee Bay (SNRC 56K, 56 J/9 à 16, 56-O/1 à 8 et 56 P) fournit de nouveaux indices d'une chronologie complexe des mouvements de la glace au Wisconsinien supérieur. Trois principales phases de déplacement de la glace ont été identifiées à l'échelle régionale. La plus ancienne consiste en un écoulement vers le nord dont les traces sont observées dans la plus grande partie de la région. Elle a été suivie tôt à la déglaciation par un écoulement en direction du nord-est dans la partie orientale de la région et en direction du nord-ouest dans sa partie occidentale. Enfin, il y a eu un écoulement vers le nord–nord-ouest, au sud des moraines de Chantrey, associé à l'écoulement de la glace depuis la ligne de partage des glaces du Keewatin. Les résultats d'études de prospection glacio-sédimentaire indiquent que la géochimie du till reflète clairement un transport glaciaire vers le nord. La plupart des indices d'or connus sont repérables d'après les dénombrements de grains d'or ou par les valeurs en or dans la matrice du till, mais au moins deux domaines potentiellement riches en or, antérieurement non repérés, ont été identifiés.

INTRODUCTION

Through the 2000–2002 field seasons, Quaternary studies were carried out in the Committee Bay supracrustal belt, approximately 300 km northeast of Baker Lake, central mainland Nunavut (Fig. 1). These studies represent one component of the Committee Bay Multidisciplinary Geoscience Project, a three-year Geological Survey of Canada (GSC) Targeted Geoscience Initiative (TGI), the 2002 field season being the last year. This project is a collaboration between the Canada-Nunavut Geoscience Office, the Geological Survey of Canada, and several Canadian universities, designed to evaluate and highlight the exploration potential of this region. Objectives of the Quaternary component of this project were to 1) compile surficial-geology 1:100 000-scale maps for NTS areas 56 K, 56 J/9 to /16, 56-O/1 to /8, and 56 P; and 2) interpret the glacial history at local and regional scales. A second Quaternary-based TGI project, the Committee Bay Drift Prospecting Survey, was initiated in April 2001 and covers the same map areas mentioned above. The main objective of this two-year project was to initiate a reconnaissance-scale drift-prospecting program incorporating clast provenance, heavy-mineral (e.g. kimberlite-indicator suite, gold), and trace- and major-element geochemical studies.

This paper presents interpretations of ice-flow indicators observed in the field during the 2000–2002 seasons, as well as a discussion on selected till compositional datasets in NTS 56 K, 56 J, and 56-O. Follow-up work was conducted in these three map sheets during the 2002 season, so only partial datasets are available for discussion here (Fig. 1). Surficial mapping, till sampling and data collection were completed in 56 P during the 2002 field season. The complete till mineralogical and geochemical datasets collected prior to the 2002 field season were reported in McMartin et al. (2002). Surficial maps, kimberlite-indicator minerals from both till and esker samples (for all map areas), and data collected during the 2002 field season will be released in subsequent reports.

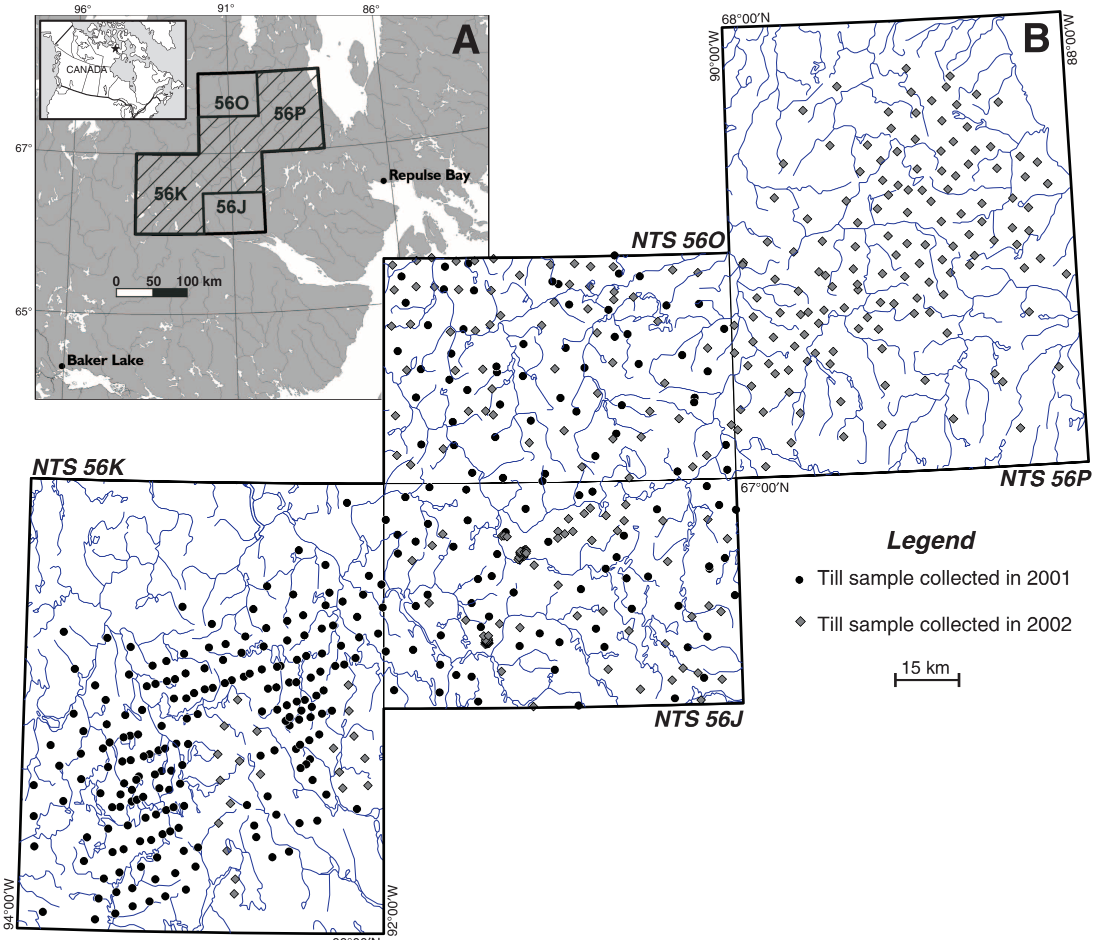

Figure 1. *A) Location of study area in Nunavut and* ***B****) locations of all till samples collected in 2001 and 2002. Only the results from samples collected in 2001 are discussed in this paper.*

REGIONAL SETTING

The study area is situated in the northern portion of the Wager Plateau, within the zone of continuous permafrost (Burgess et al., 2001). Regionally, topography is highly variable, with elevations ranging from approximately 122 m a.s.l. in NTS 56 K to 582 m a.s.l. at Kinngalugjuaq Mountain, the highest point in mainland Nunavut, in NTS 56 P.

Geomorphological features in the study area include large expanses of subhorizontal till plains; gently rolling hills; high-amplitude, hummocky till and glaciofluvial gravel; broad, sweeping, terraced valleys; deep, steep-walled gorges cut into bedrock; and, in NTS 56 P, marine-related features. Previously unidentified archeological sites, commonly observed on high ground in coastal and river-valley settings in NTS 56 P, add to this area's uniqueness. For a discussion on the distribution of surficial sediments and other features and processes, such as moraine systems and the influence of deglacial meltwater processes on sediment distribution, the reader is directed to Little et al. (2002), McMartin et al. (2002), Ozyer and Hicock (2002), and Utting et al. (2002). Giangioppi et al. (2003) discuss the proposed marine limit for the Ellice Hills area (NTS 56 P).

BEDROCK GEOLOGY

Exposed bedrock in the study area can be subdivided into three main lithological domains (Sandeman et al., 2001a, b; Skulski et al., 2002):

1. The Committee Bay belt (the main Archean supracrustal belt) is composed of Prince Albert Group rocks, dominantly semipelite and psammite with lesser iron-formation, quartzite, komatiite, komatiitic basalt, and felsic metavolcanic rocks that are intruded by cogenetic plutonic bodies consisting of quartz diorite, diorite, tonalite, granodiorite, and granite; these supracrustal rocks host a number of proven (gold) and possible commodities (nickel, copper, platinum-group elements).
2. Plutonic rocks to the south and east of this supracrustal belt consist primarily of K-feldspar augen–megacrystic, biotite granodiorite cut by variably foliated, biotite±fluorite monzogranite.
3. A higher metamorphic grade to the west and north of the supracrustal belt has resulted in the development of paragneiss and derived peraluminous granitic rocks.

Regionally, the study area has potential to host diamonds (Sandeman et al., 2001a; Skulski et al., 2002). A generalized bedrock-geology compilation for NTS 56 K, 56 J (north half), and 56-O (south half) was presented in McMartin et al. (2002).

PREVIOUS WORK

Previous Quaternary geological studies in or near the current study area have focused on such ideas and characteristics as ice-divide locations, ice-movement chronologies, and general glacial records of ice advance and retreat based on surficial-materials distribution and ice-movement indicators (cf. Wright, 1967; Dyke and Prest, 1987; Dyke and Dredge, 1989; McMartin and Henderson, 1999; Little, 2001). Much of the earlier debate regarding late Pleistocene glaciation was centred on opposing schools of thought: Tyrrell's (1897) work, which suggested ice-centre locations west of Hudson Bay and south of the Committee Bay study area; and the single ice-dome theory of Flint (1943). Detailed research (i.e. 1:250 000 scale and greater) conducted to date in and adjacent to the current study area has been predominantly reconnaissance-scale mapping (cf. Craig, 1961; Thomas, 1977), with the first surficial geology map of NTS 56 K produced by Thomas and Dyke (1981).

METHODS

Ice-flow indicator mapping

Ice-movement indicators used for determining the Quaternary history include both small-scale features (mainly erosional) and large-scale features (depositional). Small-scale features include striae, grooves, and chatter marks (bidirectional), and nail-head striae, lunate/crescentic fractures, crescentic gouges, and roches moutonnées (unidirectional). Large-scale features can be readily identified on 1:60 000-scale aerial photographs, and include flutes, drumlinoid features, and crag-and-tail landforms. The relative age of erosional ice-flow indicators was determined by crosscutting relationships (where available), comparing their azimuth relative to large-scale streamlined features and moraines, and the overall trend of regional ice flow.

Drift prospecting

Till and esker sediments were sampled for the TGI Committee Bay drift-prospecting survey. Till sampling and analytical methods are summarized below. For a detailed review of the field and laboratory methods used to generate the till compositional datasets, the reader is directed to Little et al. (2002) or McMartin et al. (2002).

Till-survey design was strongly influenced by such available datasets as ice-flow indicators (Little, 2001; Little et al., 2002; Ozyer and Hicock, 2002); the 1:250 000-scale map of surficial geology (Thomas and Dyke, 1981) and 1:100 000-scale bedrock geology (including geochemistry and assay results; Sandeman et al., 2001b); high resolution (400 m line spacing) aeromagnetic data; and the Northern Minerals Database (www.nwtgeoscience.ca/normin/). A sample spacing of 2.5 to 15 km was used, depending on available data. At each site, a 3 kg till sample was collected for analysis of grain size, carbonate content, and trace- and major-element geochemistry. At selected sites, a 10 kg till sample was collected for gold-grain counts, pebble lithology, and indicator-mineral analysis. Table 1 summarizes the number of till samples of the two types collected throughout the area.

Datasets discussed in this paper include 1) lithology of small pebbles (200 pebbles/sample from the 4–8 mm fraction); 2) trace- and major-element determinations on the less than 63 µm (silt+clay) fraction, using aqua-regia digestion followed by inductively coupled plasma–atomic emission spectrometry (ICP-AES); 3) gold in the silt+clay fraction, using instrumental neutron-activation analysis (INAA); 4) gold in the less than 2 mm fraction, using fire assay–ICP-AES; and 5) gold-grain counts in the nonferromagnetic heavy-mineral concentrates.

Table 1. Number of till samples collected in study area.

Sample size	NTS 56K	NTS 56J	NTS 56O	NTS 56P	Total
2001 field season:					
3 kg	193	60	56	-	309
10 kg	130	41	42	-	213
2002 field season:					
3 kg	20	84	61	139	304
10 kg	-	69	37	100	206
Total:					
3 kg	213	144	117	139	613
10 kg	130	110	79	100	419

ICE-FLOW EVENTS

Systematic mapping of ice-flow indicators in the Committee Bay study area provides new evidence for a complicated ice-movement chronology within the Keewatin Sector of the Laurentide Ice Sheet. Field measurements on small-scale ice-movement indicators have been recorded at 326 sites across the study area. Three main phases of ice movement have been identified at the regional scale. The following brief discussion presents a preliminary interpretation for the entire area, from the oldest recognized ice-flow event to the most recent pervasive flow(s) (Fig. 2). Minor, more local phases of

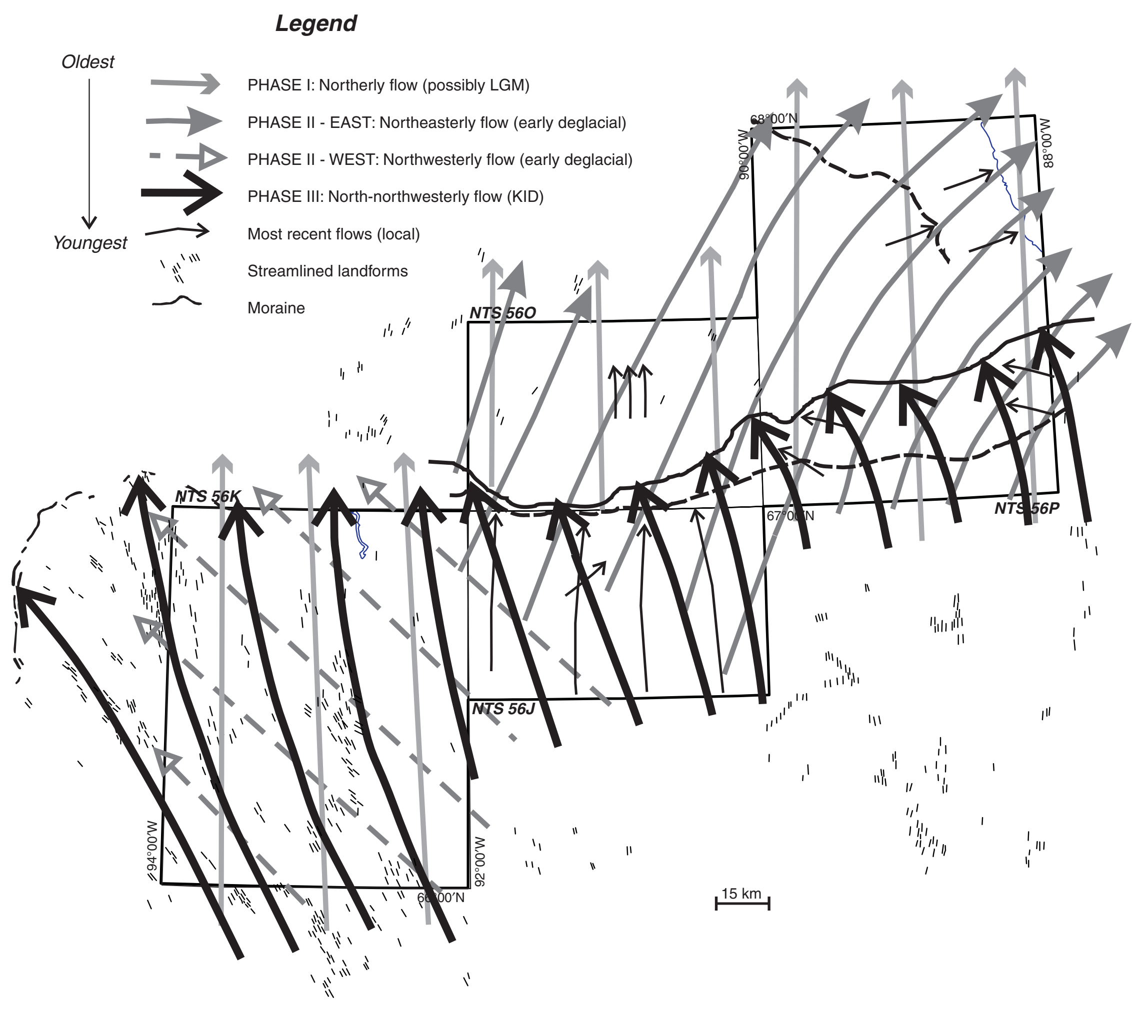

Figure 2. Generalized ice-flow and chronology interpreted from ice-movement indicators recorded in 2000-2002. Approximate positions of moraines in the study area are shown by thin continuous or broken lines. Morainal features outside the study area and all streamlined landforms are from the 1:1 000 000-scale compilation of Aylsworth and Shilts (1989).

ice flow that pre- and postdate the three main events have been identified throughout the area, but these are not presented in this brief overview.

Phase I

The oldest of the phases is characterized by a northward movement (*see* Little, 2001, his sequence 2). Phase I is tentatively associated with the last glacial maximum for several reasons: 1) associated ice-flow indicators are found throughout most of the Committee Bay study area, except in NTS 56 J where they may not have been differentiated from a more recent northerly flow in the area (Fig. 2); 2) Phase I data predate the other main ice-movement phases, although rare data across the area also suggest the possibility of southeasterly (NTS 56 P), northwesterly (NTS 56-O), and northeasterly-southwesterly (NTS 56 K) events that predate Phase I; 3) the direction is consistent over large areas, suggesting a relatively thick ice sheet that was not influenced by topographic controls; and 4) in areas that record Phases II and III, Phase I is only preserved at high elevations, where subsequent ice movements were greatly attenuated, particularly in NTS 56 P.

Phase II

Phase I was followed by a northeastward flow (Phase II – EAST) that dominates the eastern part of the project area (mainly in NTS 56-O/2 to /8, and 56 P/5 to /7 and /9 to /16), but is recorded sporadically as far south as NTS 56 J (Fig. 2). During the early stages of deglaciation, Baffin Sector ice became separated from Keewatin Sector ice by the paleo–Gulf of Boothia (Dredge, 1995; Giangioppi et al., 2003). During this time, ice movement had shifted from the northerly sense of Phase I to a more northeasterly direction, denoted as Phase II. With further retreat of the ice front, the bays and inlets were accentuated, eventually forming a paleo–Committee Bay. During this time, ice flow was nearly perpendicular to the present-day coastline. When the ice-sheet margin was close to the present-day Committee Bay coastline, deltas and beaches formed at nearly 250 m a.s.l. (*see* Giangioppi et al., 2003). As retreat of the ice margin continued inland however, the margin gradually reoriented into a general east-west configuration (*see* Phase III).

In the western part of the Committee Bay study area (NTS 56 K and parts of NTS 56 J), Phase I was followed by a northwesterly phase (Phase II – WEST; *see* Little, 2001, his sequence 3). This event may also have occurred early during deglaciation, when Keewatin Sector ice retreated progressively into Chantrey Inlet, located northwest of the study area, perhaps opening a bay in which the ice was pulled in a northwesterly direction. Some northwesterly streamlined landforms are preserved in NTS 56 K, adjacent to pervasive and more recent north-northwesterly landforms (Fig. 2). It is not clear whether this northwesterly flow predates or postdates the northeasterly flow in the eastern part of the area, because associated ice-flow indicators are rarely observed together.

Phase III

Finally, there is a north-northwesterly phase of ice movement that is confined to the southern two-thirds of the area (NTS 56 K, 56 J, 56-O/1 to /4, and 56 P/1 to /4 and /8). Ice-movement indicators associated with Phase III developed during the late deglaciation of the region, after the ice margin had been oriented into a general east-west configuration and the orienting influence of large water bodies (e.g. Committee Bay, Chantrey Inlet) was significantly reduced. This last phase of ice movement may be associated with flow from the Keewatin Ice Divide (*see* Little, 2001, his sequence 4), located southeast of NTS 56 K. Numerous end-moraine segments, likely part of the Chantrey moraine system (Dyke and Prest, 1987) occur throughout NTS 56-O and 56 P, and mark the northern limit of Phase III (Fig. 2). More recent ice flows that postdate Phase III (or Phase II north of the moraines) occur in all map sheets, in northerly, northwesterly, and northeasterly directions. These flows can be pervasive locally and are commonly controlled by local topography, ice streaming, or reorientation of the ice margin as the ice front retreated farther south.

DRIFT PROSPECTING

Pebble provenance

Preliminary results of lithological analysis of till in the Committee Bay belt are characterized by 1) an abundance of intrusive and high-grade metamorphic rocks ('granitoid+ gneiss') averaging 84% and ranging from 14 to 100%; 2) a variable but generally low abundance of low-grade metavolcanic and metasedimentary rocks ('greenstone'), averaging 14% and ranging from 0 to 86%; and 3) the absence of Dubawnt Supergroup clasts or Paleozoic carbonate clasts. Regional variations are significant and are primarily related to the areal extent, topographic exposure, and erodibility of the source bedrock, and ice-flow history and dynamics. For example, greenstone clasts are most abundant over and north of the Committee Bay belt, indicating a northerly direction of glacial transport (Fig. 3). The proportion of greenstone clasts is particularly high (up to 72%) in till collected over komatiitic rocks, which form particularly well exposed, high ridges on either side of the central tonalite in NTS 56 K. Greenstone-clast concentrations, however, do not decrease regularly with distance from the main belt; in NTS 56-O, for example, abundances in excess of 10% are observed as far as 40 km down-ice from the closest source. In general, the relatively low content of greenstone clasts in till collected throughout the belt indicates that till composition, including matrix geochemistry, may be suppressed by a significant load of metal-poor granitic and gneissic debris. South of the supracrustal belt, the background value for greenstone units is approximately 5%, and the source of these clasts probably lies in undifferentiated supracrustal rock units exposed immediately southeast of the study area, in NTS 56 J (Paul et al., 2002).

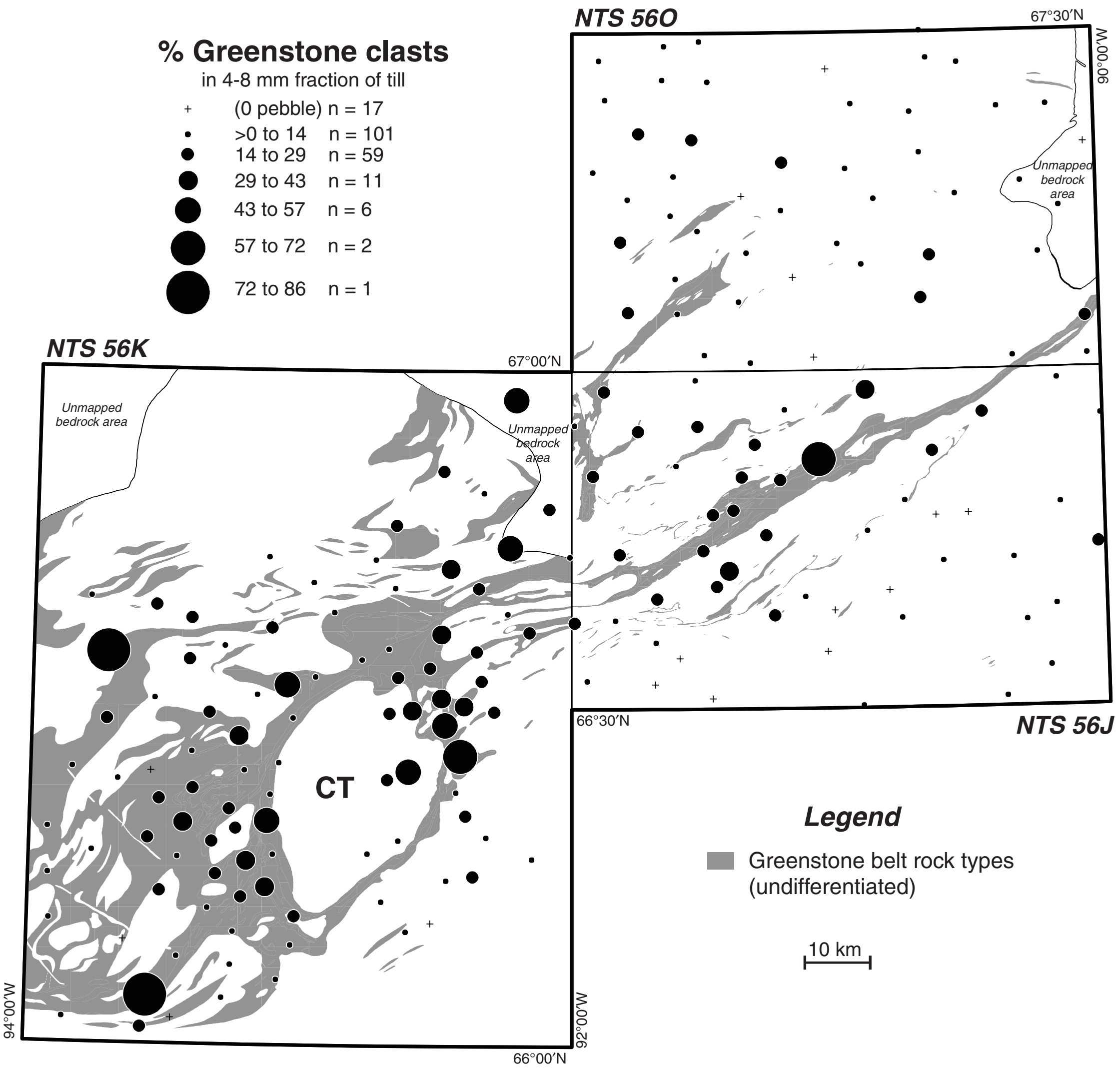

*Figure 3. Proportion of undifferentiated greenstone clasts in the pebble fraction of till samples, plotted as proportional dots; results are by weight % of the total pebble split. Potential bedrock sources for greenstone clasts in till, which consist of Prince Albert Group supracrustal rocks, are shown in grey (*adapted from *Sandeman et al., 2001b; Skulski et al., 2002). Abbreviation: CT, central tonalite intrusion.*

The absence of clasts from the Dubawnt Supergroup, a distinctive sequence of red Proterozoic volcanic and sedimentary rocks located more than 200 km to the southwest of the study area, is interpreted as a lack of evidence for northeasterly flow originating in the Baker Lake area (cf. Fig. 1). Further, the absence of Paleozoic carbonate clasts in till of the Committee Bay area indicates that the ice did not flow out of Hudson Bay, thereby refuting the idea of a long-term ice-sheet centre over Hudson Bay, as modelled by Flint (1943).

Till-matrix geochemistry

Data presented by McMartin et al. (2002) include several regional trends in the geochemistry of the silt+clay fraction of till. Two major glacial dispersal trains, in chromium, cobalt, and nickel, were noted down-ice of extensive outcrop of komatiite flows on either side of the central tonalite in NTS 56 K. On the northeastern margin of the central tonalite, a 12 km wide by 40 km long, ribbon-shaped dispersal train in chromium clearly extends to the north of well preserved and exposed komatiitic rocks (Fig. 4). The dispersal train extends north of the supracrustal belt for about 15 km down-ice from known outcrop of these rocks. It parallels the northerly Phase I found throughout most of the area. West of the central tonalite, a 5 to 20 km wide by 35 km long, fan-shaped dispersal train in chromium extends to the north-northwest of another set of well preserved komatiite outcrops (Fig. 4). This second well defined dispersal train extends more than 20 km down-ice from the last appearance of these rocks. The fan shape of the dispersal train most likely reflects glacial transport in two directions, first to the north and then to the

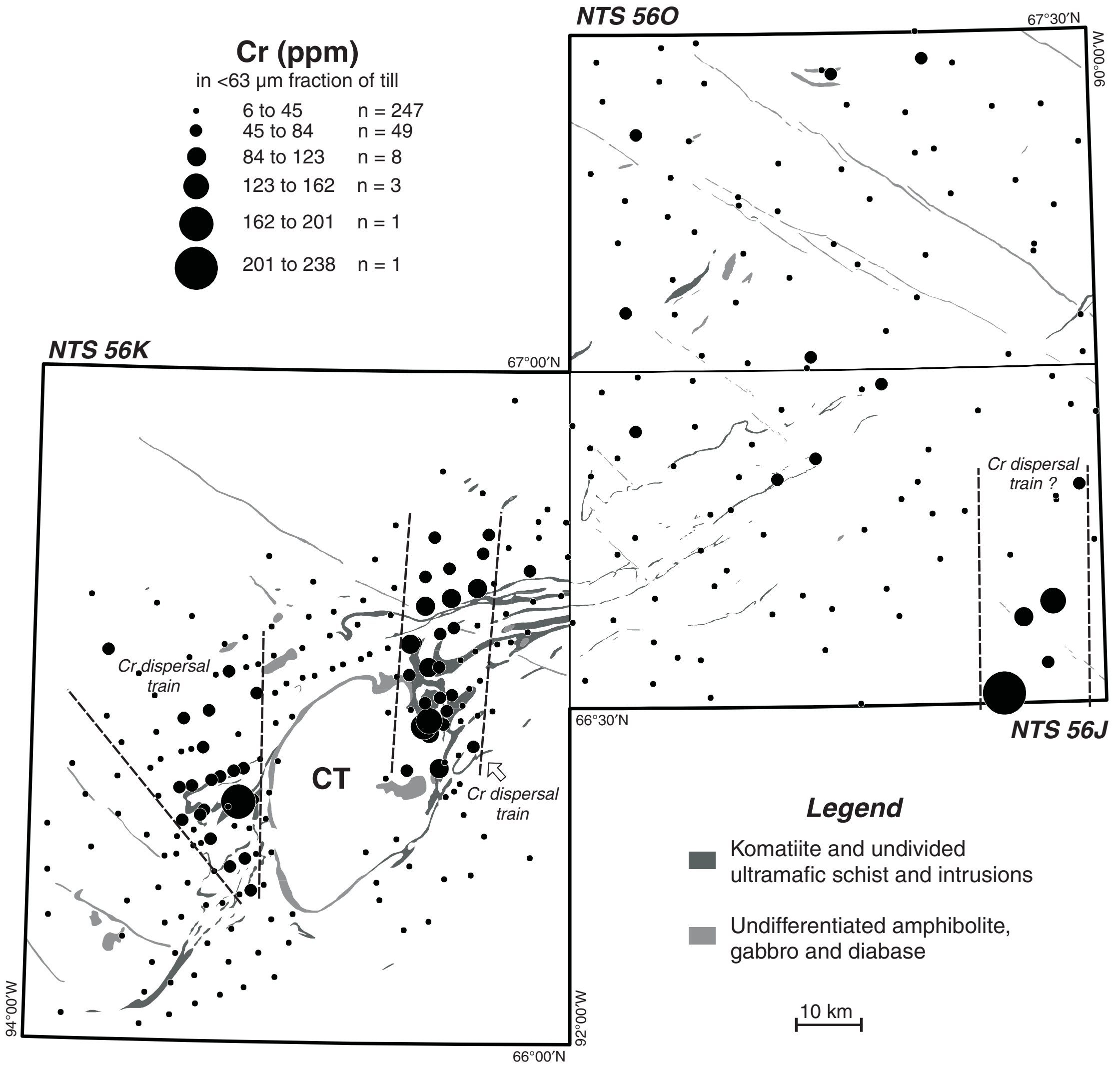

Figure 4. *Chromium in the silt+clay fraction of 3 kg till samples, plotted as proportional dots; analysis by aqua-regia digestion and ICP-AES. Potential bedrock sources for high Cr content in till are shown by different shades of grey (*adapted from *Sandeman et al., 2001b; Skulski et al., 2002). Abbreviation: CT, central tonalite intrusion.*

northwest or north-northwest, as indicated by the ice-flow chronology described earlier. In the southeastern part of NTS 56 J (Fig. 4), high chromium, nickel, and cobalt values may indicate glacial transport from possible ultramafic rocks exposed to the south (Paul et al., 2002).

Analysis of gold and associated pathfinder elements in till has direct implications for mineral exploration. Data for gold in the silt+clay fraction of till analyzed by either INAA or fire assay–ICP-AES show very poor reproducibility (McMartin et al., 2002). The gold analyses are imprecise because 1) values are close to the lower detection limit in more than half of the duplicate samples analyzed for quality control; and 2) of the particulate nature in which gold occurs, coupled with sample inhomogeneity (the ‘nugget’ effect). Gold ‘anomalies’ determined with these two methods should therefore be carefully evaluated; resampling is required in ‘anomalous’ areas prior to further interpretation. High gold values are noted, however, with both methods in at least one sample collected immediately east of the central tonalite, where concentrations are in excess of 30 ppb.

To better highlight potential gold-rich domains when drift prospecting, pathfinder elements such as arsenic have been used with success in some areas (e.g. in the Meliadine Trend near Rankin Inlet; McMartin, 2000). In the Committee Bay belt, results show that the till has particularly low arsenic concentrations, reflecting the very rare occurrence of arsenopyrite in mineralization (Sandeman et al., 2001a). Pyrite and pyrrhotite constitute the main sulphide minerals in the iron-formations, whereas quartz veins and other rocks containing sulphide mineralization are minor sources in the area.

Arsenic concentrations in till generally do not exceed 15 ppm in the silt+clay fraction, except west of the central tonalite in NTS 56 K, where arsenic values confirm the presence of known arsenopyrite-related gold showings (Fig. 5). In that area, relatively high arsenic values (>15 ppm) form a 45 km long, fan-shaped dispersal train extending to the north-northwest, down-ice from a series of overlapping potential sources. This arsenic 'anomalous' area is similar in size and orientation to the chromium dispersal train shown on Figure 4, suggesting again glacial transport in two distinct directions, to the north and to the north-northwest. In general, the poor association of arsenic with gold in the till matrix, and the lack of high arsenic values near known gold showings, prevent the direct use of arsenic in till as a pathfinder element for gold in the region.

Gold-grain counts

Data presented in McMartin et al. (2002) indicate that the majority of visible gold grains extracted from large bulk till samples are less than 60 µm in diameter (silt size), presumably mirroring the grain size of the bedrock mineralization. Averill (2001) has published on the dominance of silt-sized gold in till and ores in Canada. A mean of three gold grains (range of 0 to 52 grains) was recovered per till sample (data not normalized). Preliminary analysis suggests that the background value for visible gold grains in till is approximately four to five grains in 10 kg of till. The highest counts (>0.36 grains/gm of nonferromagnetic heavy-mineral concentrate) occur in two areas east of the central tonalite in NTS 56 K (Fig. 6). One sample with 52 grains (0.53 grain/gm of concentrate) is located about 16 km north-northeast of the

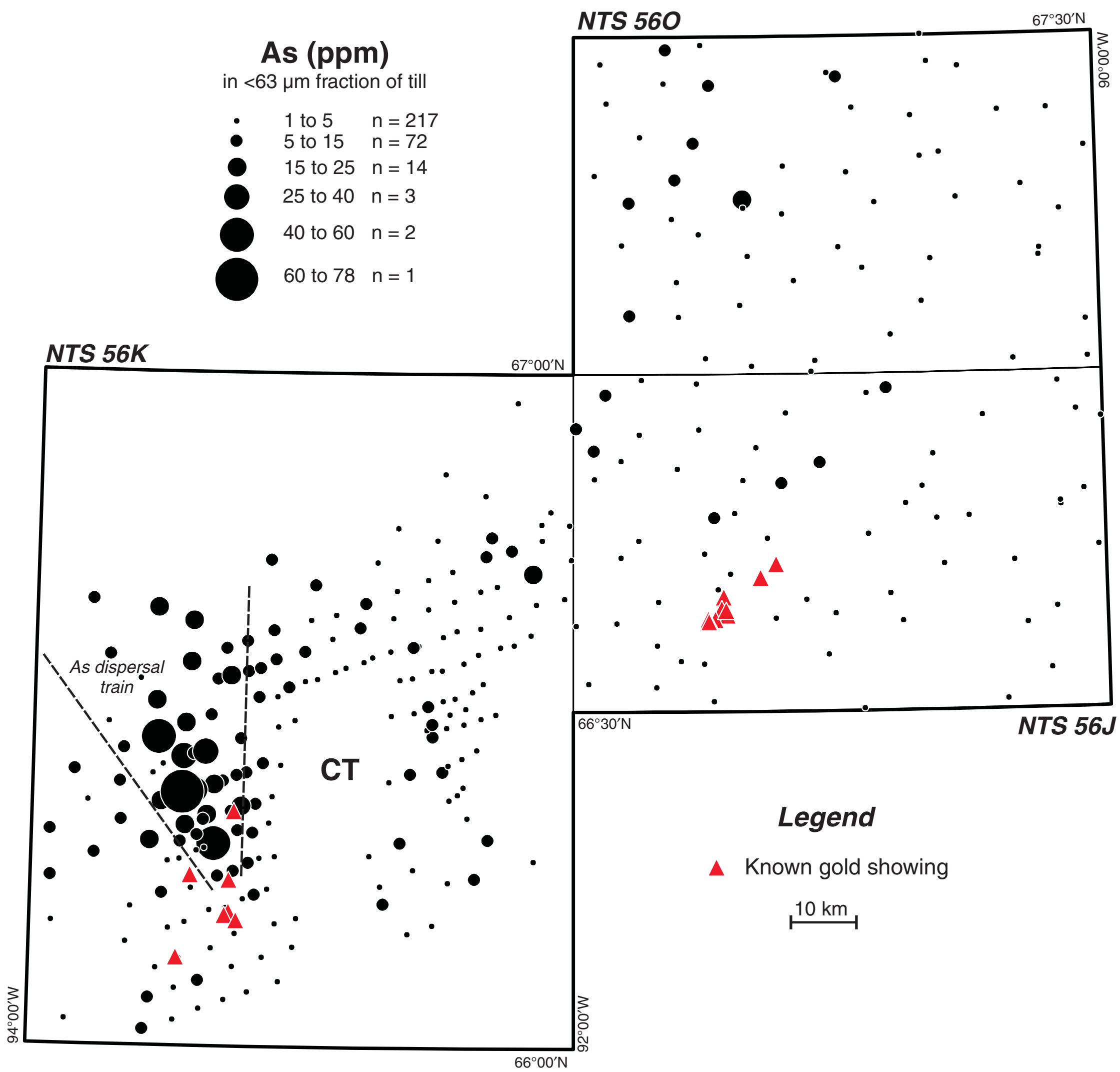

Figure 5. Arsenic concentrations in the silt+clay fraction of 3 kg till samples, plotted as proportional dots; analysis by aqua-regia digestion and ICP-AES. Known Au showings derived from the Northern Minerals Database (Oct. 10, 2002). Abbreviation: CT, central tonalite intrusion.

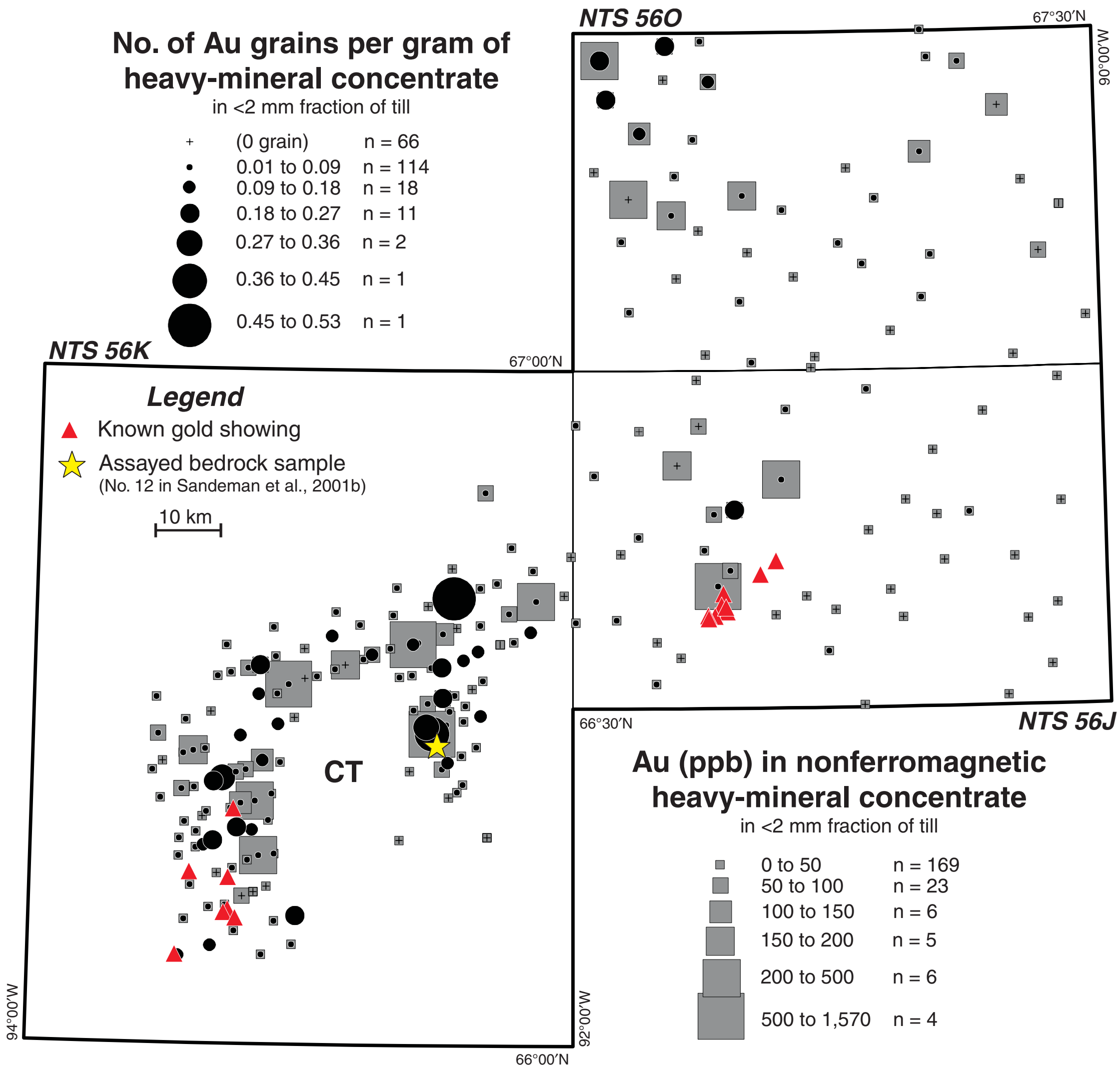

Figure 6. *Gold grains in less than 2 mm fraction of 10 kg till samples (normalized to the weight of the nonmagnetic heavy-mineral concentrates), plotted as proportional dots. Gold concentrations in less than 2 mm fraction of nonmagnetic heavy-mineral concentrates are plotted as proportional grey squares; analysis by fire assay–ICP-AES. Known Au showings derived from the Northern Minerals Database (Oct. 10, 2002). Abbreviation: CT, central tonalite intrusion.*

central tonalite. In this sample, several large grains, up to 175 µm in the long-axis dimension, have been observed. However, using the scheme of Dilabio (1990), only two grains were classified as pristine (indicating a close proximity to source). The source for these gold grains is unknown, but the sample lies within the eastern, komatiite-related dispersal train that indicated a clear northerly direction of glacial transport. The second main anomalous area inferred from gold-grain counts is located immediately down-ice (north) of an assayed bedrock sample that yielded significant gold values (135 ppb; *see* Fig. 6 for location; cf. No. 12 in Sandeman et al., 2001b). The bedrock sample was collected in a quartz vein containing sulphide and carbonate minerals hosted by mafic volcanic rocks. Two till samples, located 0.75 and 2 km north of the assayed sample, contained 26 and 23 gold grains (not normalized), respectively, of which almost half are pristine in nature, suggesting a short distance of glacial transport. The till sample located 0.75 km north of the assayed sample also contained relatively high gold concentrations (>30 ppb) in the silt+clay fraction (*see* previous discussion).

Some of the known gold showings, particularly in NTS 56 J, were not highlighted by the gold-grain counts in till. Gold dispersal based on regionally spaced samples (2–15 km) can be difficult to determine because most gold dispersal trains are known to be commonly short (<2 km; e.g. Nichol et al., 1992). On the other hand, the absence of free gold grains in till collected immediately down-ice from some gold showings may, in part, reflect the occurrence of gold as inclusions in sulphide grains (<2 mm) preserved in unoxidized till. At several sites in the area, high gold values in the less than 2 mm heavy-mineral concentrate fraction were found in till with zero or very few gold grains (Fig. 6), suggesting that some of the gold may be tied up in sulphide minerals. One area that has both relatively high grain counts and high gold values in the heavy-mineral concentrate fraction of till lies in the northwest corner of NTS 56-O, and defines a previously unknown, potentially gold-rich domain (Fig. 6).

SUMMARY

Small-scale ice-movement indicators were recorded on bedrock at 326 sites within the Committee Bay study area during the 2000–2002 field seasons. Together with large-scale oriented features, these data suggest a complicated ice-movement chronology. Three main phases of ice movement have been identified at the regional scale. The oldest of the phases is characterized by a northward movement that is ubiquitous throughout most of the area and is tentatively associated with the last glacial maximum (Phase I). This was followed by a northeastward phase that dominated the northeastern part of the project area, whereas a northwesterly phase dominated the western part of the area. Phase II may have occurred during the early deglaciation of the region, when Keewatin Sector ice, retreating progressively southward, was reoriented into large water bodies on either side of the study area (Committee Bay and Chantrey Inlet). As retreat of the ice margin continued inland, however, the ice margin gradually reoriented into a general east-west configuration and the flow shifted to a north-northwesterly direction (Phase III). Numerous end-moraine segments (Chantrey moraine system) delineate the northern limit of this last phase of regional ice movement. Minor, more local phases of ice flow that pre- and postdate the three main events have also been identified throughout the area.

A total of 309 till samples (3 kg each) were analyzed for trace- and major-element geochemistry on selected fractions; 213 till samples (10 kg each) were processed for lithological determinations and gold-grain counts. Results that have direct implications for mineral exploration include the following:

1. Till geochemistry reflects a clear northerly direction of glacial transport, forming ribbon- to fan-shaped dispersal trains (e.g. chromium, cobalt, and nickel from distinctive komatiitic rocks in NTS 56 K).
2. The poor association of arsenic with gold in till prevents the direct use of arsenic in till as a pathfinder element for gold in the region, as there are very rare occurrences of arsenopyrite, except west of the central tonalite in NTS 56 K, where arsenic values confirm the presence of known arsenopyrite-related gold showings.
3. The bulk of the gold occurs as free silt-size particles in till, although some of it appears to be present as inclusions in sulphide minerals (<2 mm).
4. Most of the known gold showings are reflected in the gold-grain counts and/or the gold values in till, but at least two previously unknown, potentially gold-rich domains have been identified in NTS 56 K and 56-O.

ACKNOWLEDGMENTS

Special thanks are due to Brent Ward (Simon Fraser University), Stephen Hicock (University of Western Ontario), and Jodi Di Menna (contractor) for their assistance in the field. We would also like to thank Hamish Sandeman (Canada-Nunavut Geoscience Office), Tom Skulski (GSC-Ottawa) and the entire bedrock crew for sharing logistics, mapping expertise, and field assistance. The Polar Continental Shelf Project, and Boris Kotelewitz (Baker Lake) and Bill Crawford (Repulse Bay), provided logistical support. The Committee Bay Project is jointly funded by a Targeted Geoscience Initiative to Tom Skulski and Isabelle McMartin, and by research funds from the Canada-Nunavut Geoscience Office. Special thanks to Dan Kerr and Ron Dilabio (GSC-Ottawa) for critically reviewing the manuscript.

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Geological Survey of Canada Project 010007