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FOREWORD

The Geo-mapping for Energy and Minerals (GEM) program is laying the foundation for sustainable economic development in the North. The Program provides modern public geoscience that will set the stage for long-term decision making related to investment in responsible resource development. Geoscience knowledge produced by GEM supports evidence-based exploration for new energy and mineral resources and enables northern communities to make informed decisions about their land, economy and society. Building upon the success of its first five-years, GEM has been renewed until 2020 to continue producing new, publically available, regional-scale geoscience knowledge in Canada's North.

During summer 2015, the GEM program has successfully carried out 17 research activities that include geological, geochemical and geophysical surveying. These activities have been undertaken in collaboration with provincial and territorial governments, northerners and their institutions, academia and the private sector. GEM will continue to work with these key collaborators as the program advances.

PROJECT SUMMARY

This report outlines the scope and objectives of the Banks Island kimberlite (diamond) indicator mineral studies project, and summarizes field work, sample collection, and data compilation carried out between September 2014 and August 2015. The principal objective of this study is to assess the potential for a local diamond-bearing kimberlite(s) source on Banks Island by undertaking stream sediment and drift surveys, geochemical and kimberlite indicator mineral (KIM) analyses, conducting field inspection of industry-derived aeromagnetic survey anomalies, applying significantly revised glacial history models for Banks Island to understanding drift origins and dispersal, and compiling and assessing all available seismic shothole drillers' log records as a means of further assessing regional stratigraphy. This research is designed to provide the insight necessary for mineral exploration stakeholders to either renew diamond exploration efforts in this area, or determine that Banks Island is not prospective for diamond-bearing kimberlites.

Fieldwork in July 2015 led to an improved understanding of the nature and distribution of glacial sediments in areas of industry stream sediment sample KIM recovery. Fieldwork also identified areas of previously undocumented bedrock outcrops, including extensive unconsolidated, gravelly-sands of the Beaufort Formation (an Upper Tertiary fluvial deposit). Samples of Beaufort Formation sands have been submitted for KIM processing to determine if they could be a potential source of inherited (Canadian Shield-origin) KIMs. Analytical results from KIM recovery and geochemical analysis being conducted this fall/winter will be used to determine sampling strategies and follow up field research to be conducted in 2016.

INTRODUCTION

To address knowledge gaps and facilitate decisions by mineral exploration stakeholders to either renew diamond-bearing kimberlite exploration efforts on Banks Island, or determine that this area is unlikely to host such mineral resources and thus focus exploration activities elsewhere, the Geological Survey of Canada (GSC) as part of the GEM 2 program is conducting targeted drift and bedrock sampling and analysis and other field geological studies on Banks Island (Fig. 1).

Kimberlite indicator minerals (KIMs) recovered and analyzed from these surveys, along with geological assessments of various terrains will produce new regional geoscience data that will increase knowledge on the potential provenance of Banks Island KIMs.

Diamond-bearing kimberlite and other mineral resource exploration in the Canadian western Arctic margins face many challenges in overcoming poorly to incompletely documented bedrock and surficial geology, glacial history and dispersal mechanisms, complications from periglacial reworking of sediments, and often prohibitive logistical costs and restricted access to remote and inhospitable localities. Historically, three diamond (kimberlite) exploration programs have been conducted on Banks Island: Monopros (1995-1997; northwest Banks Island aeromagnetic surveys), Diamonds North Resources Limited (2004-2007; northeast Banks Island, aeromagnetic and stream sediment surveys), and Rio Tinto Exploration Canada Incorporated (2010-2011; northeast Banks Island, aeromagnetic and stream sediment surveys; Fig. 2). The reconnaissance drift and stream sediment surveys and focussed aeromagnetic surveys have succeeded in recovering a diverse array of kimberlite indicator minerals (KIMs) and identifying a number of magnetic anomalies, but have been unable, as yet, to determine if any of these relate to a possible Banks Island kimberlite source(s), or represent redeposited KIMs from an extra-Banks Island source or non-kimberlitic magnetic anomalies. All mineral claims formerly established on Banks Island have lapsed, as have most prospecting permits. Only Rio Tinto Exploration Canada Inc. holds active prospecting permits on Banks Island (n=21; expiration dates 2016-01-31), all of which are situated on northeastern-most Banks Island (Fig. 2).

This report describes research and field activities initiated in the first year of this planned two year field research project, and includes summaries of three main activities: 1) reconstruction of regional drift stratigraphy based on the digital collation and GIS-based assessment of seismic shothole drillers' logs and lithogeochemical samples, 2) drift sampling, and 3) assessment by field inspection and remote predictive mapping (RPM) of surficial and bedrock geology in areas of identified magnetic anomalies and where Industry has documented the presence or absence of KIMs.

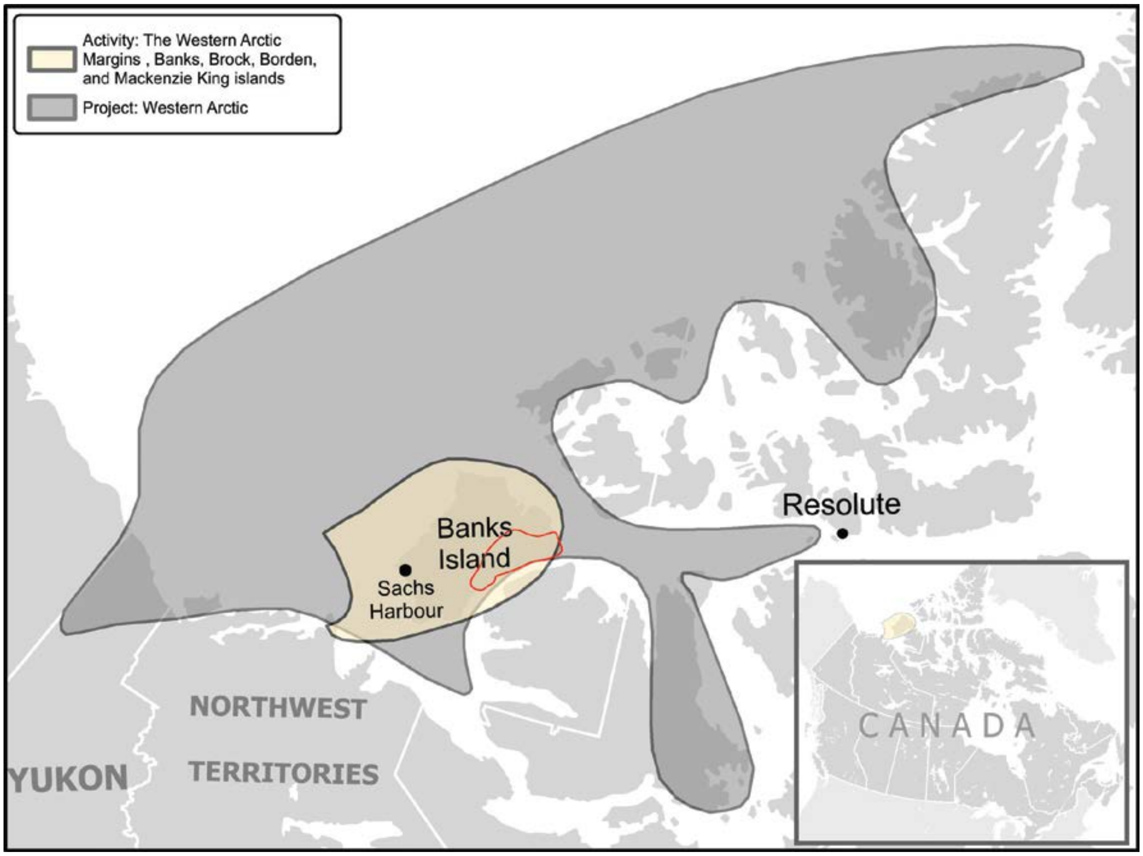

Figure 1. *Location of the Banks Island study area within the GEM 2 Western Arctic Margins project. Summer 2015 field investigations were conducted on northeastern Banks Island (outlined in red).*

Goals and Objectives

The overall objective of the Banks Island KIM study is to produce new regional geoscience data and knowledge that can be used to assess the probability of Banks Island hosting diamond-bearing kimberlite(s). Research activities undertaken to support this determination include:

- Determine the nature and extent of glacial and other drift materials within areas where KIMs have, and have not, been previously recovered by mineral exploration companies.
- Conduct field assessments of areas of magnetic anomalies identified in industry aeromagnetic surveys, and determine what if any relationship may occur between the anomalies and surficial materials/deposits.
- Employ ASTER multispectral satellite imagery and ground spectrometer surveys to characterize different terrains, identify anomalous terrains within areas of industry recovered KIMs and predictively delineate extents of terrain units such as Beaufort Formation sands and gravel.
- Test and apply new models of regional glacial history and ice flow as they pertain to potential sources of KIM-bearing sediments and dispersal patterns.
- Assess the potential for bedrock-inherited KIMs in the two prominent fluvial bedrock units on Banks Island – Upper Tertiary Beaufort Formation and Lower Cretaceous Isachsen Formation.
- Transfer surficial and geochemical data and knowledge derived from the study area to the mineral exploration industry and academia through GSC publications and conference posters and talks.

- Mentor and train highly qualified personnel (HQP) through support of a M.Sc. research project.

Scientific question to be addressed
The overall scientific question being addressed by these research activities is how can improved bedrock and surficial geology knowledge and indicator mineral sampling and geochemical analysis facilitate diamond-bearing kimberlite exploration and resource discovery in the western Arctic margins region?

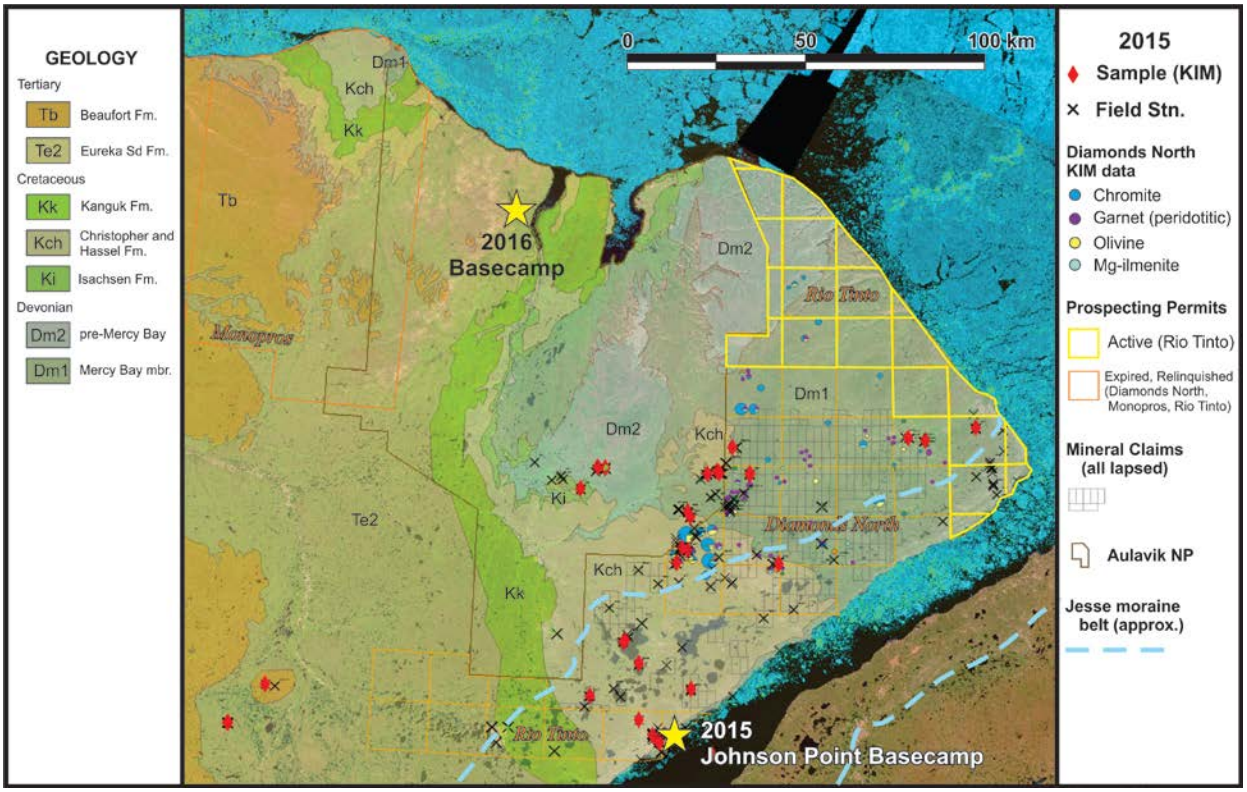

Figure 2. *Area of principal 2015 field operations on northeastern Banks Island, NT, working from a helicopter supported basecamp at Johnson Point. A transparency of Miall's (1979a) bedrock geology is shown atop a Landsat image basemap. Areas of former aeromagnetic survey and diamond exploration by Monopros, Diamonds North and Rio Tinto, and a plot of positive KIM samples (coloured circles) from Diamonds North are illustrated. Red diamonds identify 2015 KIM sample collection sites. Extents of the Jesse moraine belt on Banks and adjacent Victoria Island are delineated by the blue dashed line.*

METHODOLOGY

Seismic Shothole Drillers' Logs and Lithogeochemical Samples
A total of 13 107 seismic shothole drillers' logs and 1317 lithogeochemical sample records were recovered from Industry archives and rendered into databases and various thematic, interpretive GIS models, all of which were released in GSC Open File 7332 (Smith and Farineau, 2015). Analysis of these data were used to interpret aspects of the drift and near surface (<20 m deep) stratigraphy, including surficial and bedrock geology, sedimentology, lithology, and massive ice and ground ice distributions. This publication serves to provide base line geoscience knowledge

relevant to mineral exploration drift geochemistry surveys and reconstruction of past glacial histories.

Seismic shothole drillers' logs are recorded by drill operators during geotechnical seismic exploration programs when they auger, or air-rotary drill holes to set explosive charges. The drillers are not trained geologists or geotechnicians and thus material is logged at varying degrees of lithostratigraphic resolution and accuracy. Research by Smith (2011, 2012, 2015) had proven the utility and varied geoscience applications of seismic shothole drillers' log data in continental Northwest Territories and Yukon. Therefore, the decision was made to recover and digitally compile all available seismic shothole drillers' log records from Banks Island held in GSC and corporate archives as a means of recovering baseline, near-surface (<20 m) lithostratigraphic data that could then be used to further refine and focus field investigations. Drillers' log data from paper, fiche and microfilm archives was manually entered into a Microsoft Access database, and then a host of iterative and thematic geoscience layers were distilled and interpreted from the data (e.g., boulders, granite, massive ice, ground ice, log_mat1 (surface material) – gravel, sand, clay, sandstone, shale).

In addition to the actual seismic shothole drillers' log records, a paper file card archive of geological samples collected from seismic shotholes while they were being drilled was found in the basement of the GSC Calgary office. There is no documentation surrounding the creation of this archive, and only informal knowledge that collection of the actual seismic shothole drillers' logs were undertaken (at least in part) by Owen Hughes (GSC Calgary) in 1973-1975. The absence of documentation surrounding the shothole-derived samples is enigmatic, particularly in light of the amount of laboratory and microscope-based analyses they were subjected to, and their sheer number; 1317 on Banks Island, and over 7500 along the Mackenzie corridor (Smith, unpublished data). The only reference to collection and analysis of samples from seismic shotholes is made by Tucker (1975) and Miall (1979b). Tucker (1975) describes the collection of sediment samples during drilling of shotholes along 5 seismic lines in southwest Banks Island in order to obtain detailed textural and stratigraphic information of surficial unconsolidated deposits. Within the same report, Tucker (1975, p. 102) indicates that a similar project in the winter and spring of 1973-1974 collected samples from various other seismic operations on Banks Island, and that these samples were shipped frozen to ISPG [now GSC Calgary] for detailed laboratory work. It is assumed that these samples are the same as those noted by Miall (1979b) who describes seismic shothole samples contributed by Elf Oil Exploration and Production Canada Incorporated, as being of particular benefit to biostratigraphic studies in the northern part of Banks Island. Description of the shothole sample collection procedure is provided by Tucker (1975) and summarized in Smith and Farineau (2015). Descriptions and analyses performed on the seismic shothole samples include some or all of the following: 1) sample depth, 2) sediment/material type characterization (e.g., gravel, pebbly sand, argillaceous material, silty peat), 3) Munsell colour, 4) moisture content, 5) particle size (%gravel, sand, silt, clay), 6) lithic content of gravel and sand fractions – listed by main, lesser and trace constituents, 7) degree of sorting and grain roundness of gravel and sand fractions, 8) relative presence/absence of carbonate materials in gravel, sand, silt and clay fractions, 9) other lithic characteristics of silt and clay fractions (e.g., micaceous, argillaceous, pyrite presence), 10) organic material abundance and characteristics (e.g., peat, wood, carbonaceous material).

Kimberlite Indicator Mineral Drift Sampling

Drift sampling was undertaken to recover KIMs for geochemical analysis in the hopes of being able to discriminate those redeposited from different possible source areas/known kimberlites (e.g., Victoria Island), or to identify an unknown (possibly local Banks Island) kimberlite source. Stream sediment sample collection efforts were focussed in areas of previously documented KIM recovery (Fig. 2; Diamonds North Resources Limited, 2005, 2006, 2008). Sample sites were selected in areas of greatest reported KIM abundances and to reflect the diversity of individual indicator mineral types. Samples were also collected in areas peripheral to sites and within adjacent catchments to those previously sampled by diamond exploration companies as a means of testing different bedrock and unconsolidated (drift) source areas, and to further assess potential glacial dispersal patterns. These additional sample collection sites included areas within Aulavik National Park, a region that industry would have been excluded from operating.

Stream sediment sample locations were strategically chosen to maximize the potential for greatest KIM recovery, utilizing natural changes in stream flow velocity to preferentially trap the heavy mineral KIMs (cf., Prior et al., 2009) – these included the apex of mid-channel bars, boulder traps (both within open channels and on mid-channel bars), and prominent changes in channel width (narrow to wide; Fig. 3). Stream sediments from both active and dry ephemeral channels were shoveled directly into a two piece sieve nest consisting of coarse ½ inch (12.7 mm) and finer #8 mesh (2.38 mm) sieve sizes. Sediments were then washed through these two fractions, and the <2.38 mm size fraction was collected in a plastic bag-lined plastic 5 gallon bucket. Wet sample weights ranged from 18 – 30 kg.

Till samples were collected by digging holes 50-70 cm deep (base of active layer), and then collecting the lowermost sediments. Till samples were not sieved, and therefore represent bulk samples (only larger cobbles and boulders would have been excluded). In addition to collecting samples to characterize the regional surface till cover, 2 till samples were collected from the lower sections of Morgan Bluffs on east-central Banks Island (Fig. 4). The lower Morgan Bluffs till(s) is interpreted to represent a glacial deposit that dates >0.75 Ma (Bernard till of Vincent, 1983 and Barendregt et al., 1998; lithofacies 4.3 of Lakeman and England, 2014). Collection of these samples is designed to compare and contrast this older till with till deposited during the late Wisconsinan (last) glaciation that is now understood to have inundated all of Banks Island as well as the prominent late glacial (late Wisconsinan) Jesse moraine belt along the eastern margins of Banks Island where a number of Industry's KIM samples have been collected (Fig. 2; England et al., 2009; Lakeman and England, 2012, 2013). If the older till unit in the Morgan Bluffs section is found to contain KIMs, then this older till, of unknown aerial extent, represents a potential source of KIMs that could have been subsequently re-worked and re-deposited by late Wisconsinan glaciers, complicating any regional KIM dispersal history.

All KIM samples, along with spiked blanks and field sample duplicates, have been submitted to a commercial laboratory for heavy mineral separation and KIM picking. Results are anticipated by mid-winter, 2015-2016. Recovered KIMs will be geochemically analyzed and compared to known kimberlites in order to assess potential provenance.

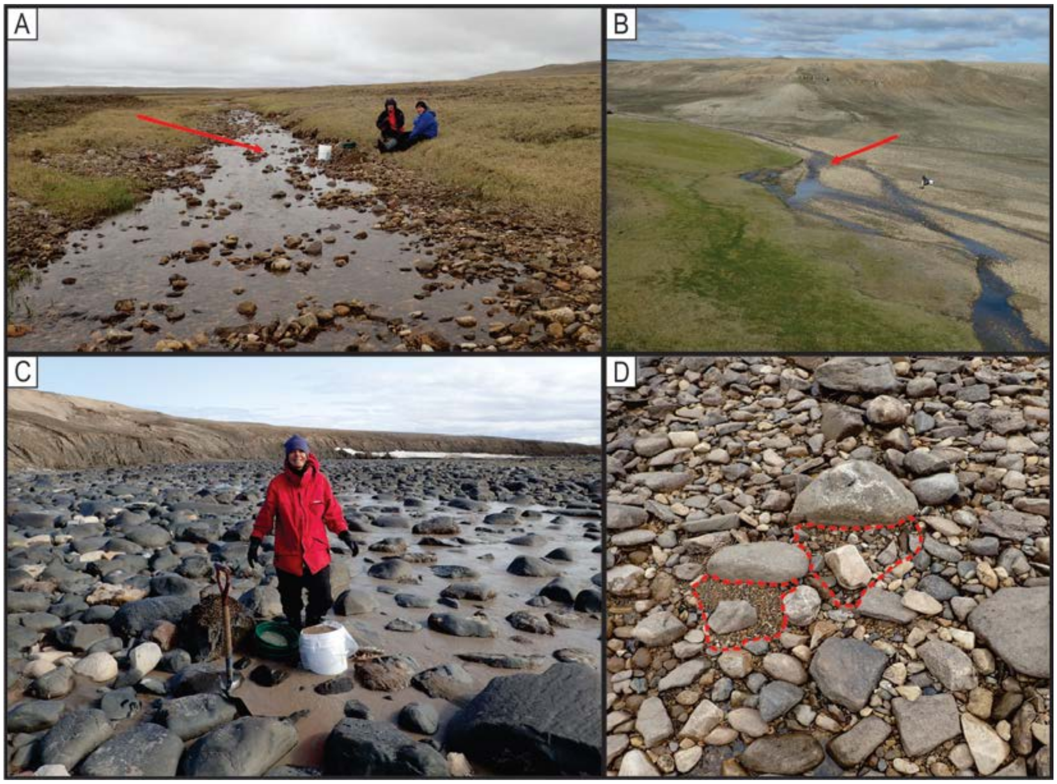

Figure 3. *Examples of kimberlite indicator mineral stream sediment sample sites. (A) 15SUV002; Mid-channel boulder traps at point of stream channel widening – flow towards the viewer, (B) 15SUV013; Mid-channel bar at apex of fan – flow towards the viewer, (C) 15SUV006; Sediment traps in large glaciofluvial boulder field, (D) 15SUV020; finer sediment apron accumulations on lee-side of boulders on mid-channel bar (outlined by red dashed lines) – flow towards the viewer.*

Figure 4. *(A) The interpreted old (>0.78 Ma) pink till exposed at Morgan Bluffs (outlined by white dashed line), enveloped by current-bedded and massive marine sediments with dropstones; (B) Excavated section of pink till. Visible pick handle length – 60 cm.*

The final targeted drift sampling included areas affected by active layer detachments and retrogressive thaw failures (Fig. 5). The Jesse moraine belt (Fyles, 1962; Lakeman and England, 2012) which parallels the length of eastern Banks Island from Nelson Head in the southeast to the northeast coast, and extends upwards of 60 km inland (Fig. 2), was found to be extensively underlain by buried ice. This ice is interpreted to be buried glacial ice because it exhibits prominent and often convoluted foliations and shear planes, and contains abundant debris lenses and striated clasts and boulders up to several metres in diameter. The ice is covered by a thin veneer (0.5-1.5 m thick) of what is deemed to be an ablation till, with thicker accumulations of colluviated sediments along lower slopes. Exposures of buried glacial ice in the Jesse moraine belt are seen in what are estimated to be >1000 active layer detachments and retrogressive thaw failures. The geographical association of exposures of this buried glacial ice with widespread, conspicuous rectilinear ice wedge polygons (Fig. 5) argues that a majority of the Jesse moraine belt may be glacial ice-cored (cf., Dyke et al., 1992; Dredge, 2002, McMartin et al., 2015). Preliminary investigations by researchers from Queen's University (Lamoureux, pers. comm. 2015; Rudy et al., 2015) suggest that the triggering (or reactivation) of these widespread failures largely post-dates 2011, and appear to be increasing in number annually. Thicknesses of buried glacial ice up to 35 m were observed, and in no location was the basal contact of ice with sediment/bedrock noted. The implications of this extensive buried glacial ice and pervasive thermokarst failures in some of the areas where diamond exploration companies have previously sampled for KIMs, is that it suggests that much of the surficial geology in the area relates to an ablation till derived from melt out of englacial, and possibly basally thrust debris (as opposed to basal lodgement/traction till). Thus, there may be prevalence for this sediment to be characterized by distally derived sediments, rather than reflecting proximal bedrock entrainment and deposition. Further, it also indicates that catchments containing active layer detachments and retrogressive thaw failures are receiving significant new inputs of glacial sediments, which may geochemically and lithologically differ from older, deglacial deposits.

Figure 5. *Prominent rectilinear ice wedge polygons in an area of the Jesse moraine belt extensively underlain by buried glacier ice. Ice is exposed in abundant active layer detachments and the headwalls of retrogressive thaw failures as seen in the central part of the image, and bordering the lake.*

Remote Predictive Mapping

Remote predictive mapping (RPM) has been an initiative of the GSC, and is used to both aide classification and preliminary bedrock and surficial geology mapping, and to identify anomalous terrain that can then become the focus of targeted field inspection and calibration (cf., Wityk et al., 2013; Harris et al., 2015). In this study, 13 ASTER multispectral images, and Landsat and SPOT imagery were acquired for northeastern Banks Island (Fig. 6). Of the 13 ASTER images acquired, only 9 were captured before 2007, which marks the time at which the ASTER satellite short wave infrared (SWIR) instrument failed. The central part of the study area did not have any pre-2007 ASTER imagery of acceptable quality (too much cloud or snow cover) and therefore application of ASTER-based RPM on northeastern Banks Island will have some limitations.

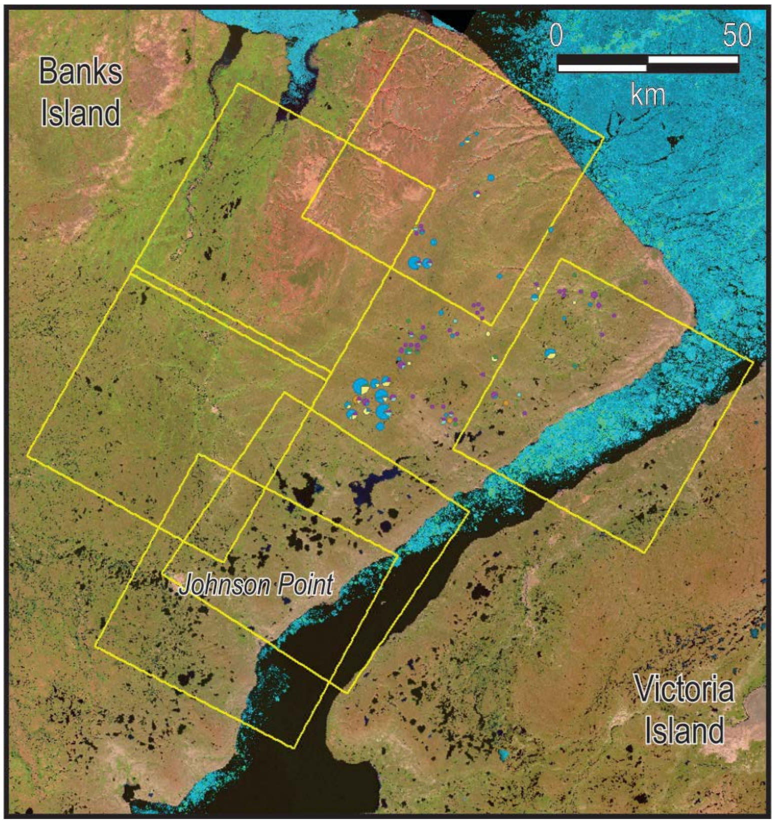

Figure 6. *Footprints (yellow boxes) of ASTER multispectral satellite images (containing SWIR and VNIR data) in northwestern Banks Island used for RPM studies. ASTER images from the central portion of the study area (not shown) only contain VNIR data and are therefore limited in their application. Coloured circles are sites where KIMs were previously recovered by Diamonds North (see Fig. 2 for KIM colour legend).*

The objectives of using RPM were three fold. First, the existing bedrock geology map of Banks Island (Miall, 1979a) depicts much of northeastern Banks Island as being comprised of Devonian Mercy Bay member, or lower Cretaceous Christopher and Hassel Formation bedrock, with "Numerous scattered outliers of Isachsen and Christopher Formations" (Fig. 2). As the Isachsen Formation is hypothesized to be a potential source of bedrock-inherited KIMs, it was hoped that RPM could be used to identify potential Isachsen Formation outcrops. Where such might occur within the catchments that industry had recovered KIMs from, then the outcropping bedrock itself could be targeted for potential KIM sampling during field operations. The second aspect of RPM undertaken by the project was to identify and discriminate anomalous terrain within each of the catchments, and glacially up-stream of where industry had recovered KIMs. This would provide an *a priori* assessment of surficial and bedrock materials that could then be subject to ground truthing and targeted for KIM field sampling.

The third objective of utilizing RPM was conceived while in the field, and involved identifying and delineating areas of proposed Beaufort Formation sand and gravel. An Analytical Spectral Device (ASD) Full Range Fieldspec Pro Spectroradiometer was brought into the field to ground truth representative vegetative, surficial and bedrock surface material covers. Results of the field spectroradiometer measurements are to be compared and contrasted to spectral signatures of different terrains on the ASTER satellite imagery and to catalogues of individual mineral and geological-based signatures as a means of validation and calibration. Because deployment and measurement by the field sprectroradiometer requires essentially ideal weather conditions (cloudless skies, low wind), it was anticipated that it's potential application was going to be limited, so focus was first put on testing and calibrating spectral signatures in a few distinct, largely homogeneous terrains with starkly different signatures (e.g., subaerially exposed glaciolacustrine sediments, vegetated wet sedge meadows, and Isachsen Formation bedrock outcrops). With the identification of provisional Beaufort Formation sand and gravel deposits on scattered uplands sites in northeast Banks Island, the spectroradiometer was also deployed to acquire a spectral signature from one such site. Locations of additional provisional Beaufort Formation sites were recorded, and these, in combination with the field spectral measurements are to be used to test whether the Beaufort Formation sites have a distinct spectral signature that enables them to be mapped throughout the extent of ASTER satellite imagery cover. Validation of this identification will include a determination of whether the RPM model can identify sites known to the field geologist, but unknown to the RPM modeller, and through subsequent ground inspection in the 2017 field season.

RESULTS

Seismic Shothole Drillers' Logs and Lithogeochemical Samples

A total of 13 107 seismic shothole drillers' logs and 1317 lithogeochemical sample records were recovered from GSC and industry archives and rendered into electronic databases and various thematic, interpretive GIS models (Fig. 7; Open File 7322 – Smith and Farineau, 2015). Analysis of these data were used to interpret aspects of the drift and near surface (<20 m deep) stratigraphy, including surficial and bedrock geology, sedimentology, lithology, and massive ice and ground ice distributions. Open File 7322 serves to provide base line geoscience knowledge relevant to mineral exploration drift geochemistry surveys and reconstruction of past glacial histories. Users of Open File 7322 can view, select, and query the lithostratigraphic records and thematic geoscience reconstructions using various database and GIS computer programs, or simply view the data and reconstructions in a freeware version of ArcReader®.

Individual shothole depths range from 3.0-54.9 m, and average 23.7 m. The drillers' logs provide lithostratigraphic data in two general formats. The majority (84.5%) have a single litholog record (log_mat 1) comprising either a single material (e.g., 0-20 m clay), or two or more materials which are not stratigraphically distinguished into individual units (e.g., 0-20 m clay, sand, shale). Lithological order is presumed to either reflect their stratigraphic position, or in the case of complex drift units (e.g., 0-20 m clay, sand, rocks), their diminishing relative proportion. Of the 84.5% single litholog records, ~60% are unconsolidated material, the rest are bedrock. The second type of drillers' log records (15.5%) display changes in lithostratigraphy in two and up to 6 distinct lithostratigraphic log records.

The 1317 lithogeochemical samples represent sediment and bedrock samples collected from 481 individual shotholes (Fig. 7). Any one of these 481 shotholes may have one to six samples collected from various depths and different materials. There are only 264 drillers' logs within former mineral claims areas, and 782 drillers' logs within former prospecting permit areas. The majority of these logs simply report some combination of sandstone, shale, and/or gravel – rare instances of clay and rocks (possibly till) are also found. There are only 8 lithogeochemical sample records within areas of former prospecting permits, and none within any of the mineral claim areas. While there historically has been extensive seismic exploration in this same area by Chevron, it has involved only vibroseis technologies, for which shotholes, and therefore drillers' logs are not required.

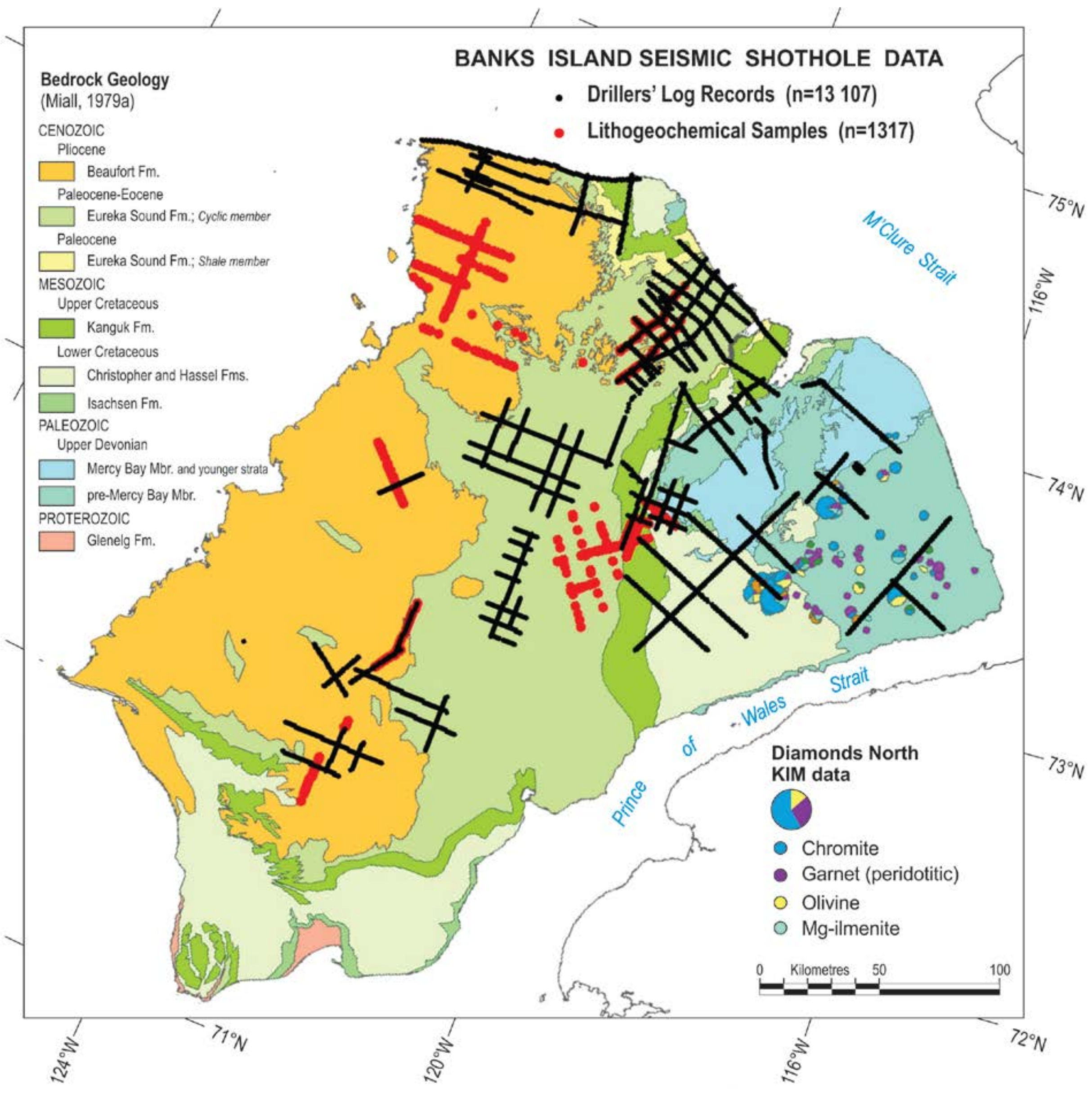

Figure 7. *Distribution of seismic shothole drillers' logs and shothole lithogeochemical samples on Banks Island, NT, illustrated in association with bedrock geology, and Diamonds North KIM data.*

Kimberlite Indicator Mineral Drift Sampling

Thirty-two large (18-30 kg) sediment samples were collected for KIM processing, comprising 22 stream sediment samples, 3 till samples, 1 glaciofluvial sample, and 6 samples collected from what is provisionally identified as Beaufort Formation gravelly-sands (Fig. 2).

Upland terraced surfaces covered by 4-10 m of gravelly-sand to sandy-gravel, with conspicuous bright orange-weathered (oxidized) surface sands (Munsell colour 10YR 7/4), and pebbles with thick weathering rinds, were found scattered throughout northeast Banks Island (Fig. 8). These sites are provisionally identified as belonging to the Pliocene Beaufort Formation (Tozer, 1956; Thorsteinsson and Tozer, 1962; Fyles 1990; Fyles et al., 1994), a fluvial braided river deposit derived from uplifted and eroded Phanerozoic basinal and fluvial/deltaic sedimentary bedrock and the Precambrian Canadian Shield, and often characterized by an abundance of unaltered wood and other plant materials. If confirmed, identification of remnant Beaufort Formation deposits throughout northeast Banks Island requires a substantial revision to previous geological reconstructions of Miall (1979a, b) and Vincent (1990; Fig. 8). Such revision is not without additional supporting geological evidence, as an area of interpreted Beaufort Formation sediments were found to unconformably overlie an extensive area of >40 m thickness of previously unidentified, upper Eureka Sound Formation bedrock outcrop (Site A, Fig. 8). The Eureka Sound Formation beds are comprised of a ferruginous, consolidated, bioturbated sandstone, and poorly consolidated sandstone, siltstone, mudstone and coal beds, geomorphically manifest in badlands type topography. A sample of a coal bed from this unit has been submitted for palynological analyses to confirm its age. A rare, scatter of glacial erratics (boulders) found on the surface of the Beaufort Formation units is considered to relate to deposition from a cold-based glacial cover (England et al., 2009; Lakeman and England 2012), rather than what previously may have been interpreted as reworking by glacial and glaciofluvial processes (cf., Fyles, 1962; Vincent (p. 55) in Miall, 1979b; Vincent, 1990). Pits dug with shovels 50-75 cm into the Beaufort Formation deposits did not encounter any of the larger clast or boulder material seen at surface, further suggesting this is a surface lag only. Because the Beaufort Formation strata has been reported to contain rare granites, and other lithologies derived from erosion of regional kimberlite-bearing strata (e.g., Victoria Island), it is hypothesized that the Beaufort Formation deposits could also contain kimberlite indicator minerals. Glacial and periglacial erosion and reworking of these provisional Beaufort Formation deposits could thus represent a compounding source of KIMs in many of the catchments from which Diamonds North Resources Ltd. has reported their presence (Fig. 8). Collection and processing of these samples will help to address this question of potential bedrock inherited KIMs.

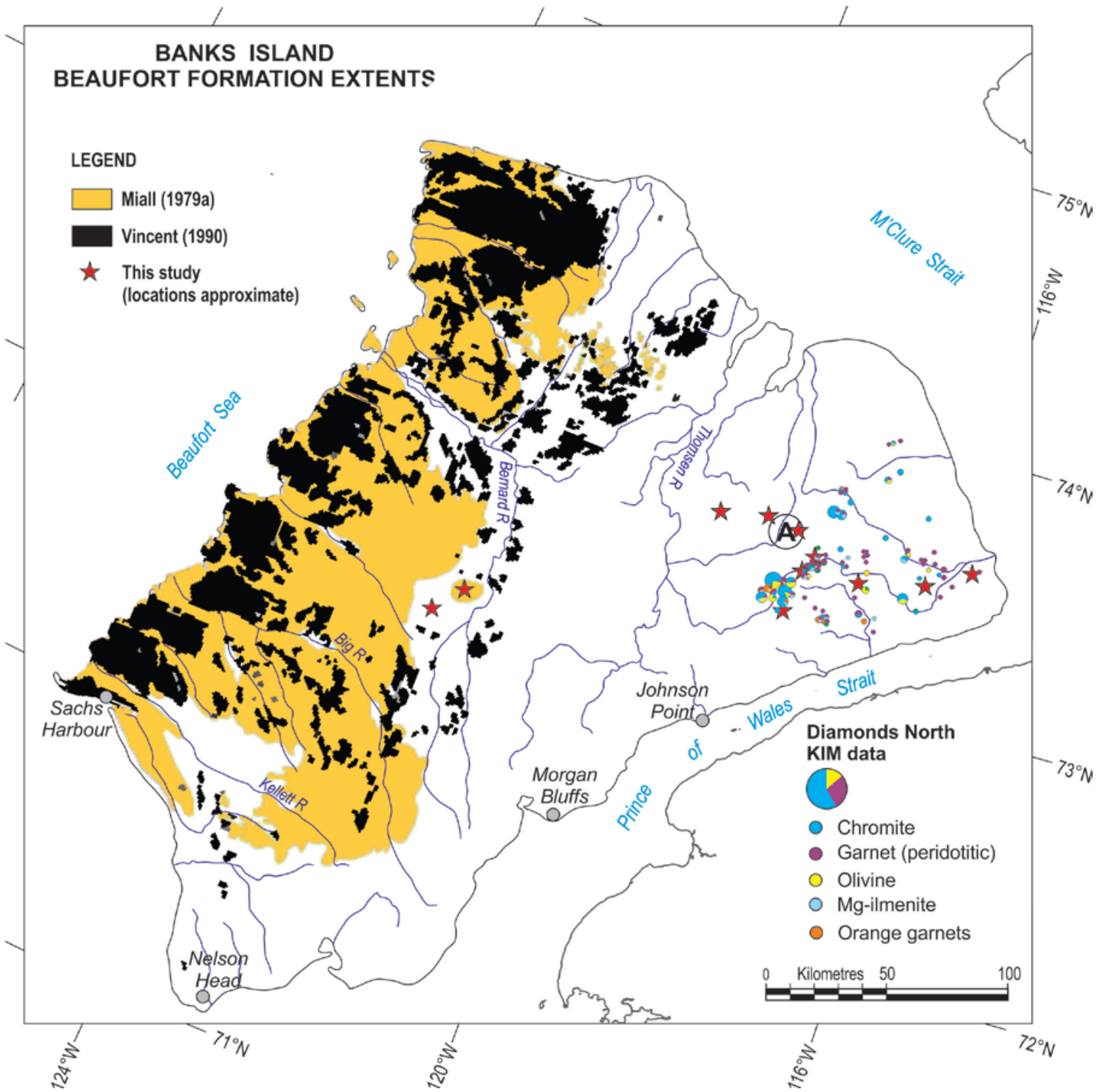

Figure 8. *Locations of provisionally identified Beaufort Formation upland, terraced deposits identified by this study (red stars) compared to extents of Beaufort Formation identified by Vincent (1990; black areas) as being situated at or near surface, and the regional bedrock geology Beaufort Formation distribution mapped by Miall (1979a, b; orange coloured areas). Site A marks the location of the newly discovered upper Eureka Sound Formation strata.*

Remote Predictive Mapping

Initial processing of the ASTER and Landsat images were combined with industry reported aeromagnetic survey data plots to identify and delineate anomalous terrain within the catchments from which KIMs had been recovered by Industry. These sites were then subjected to field inspection and ground truthing. The magnetic anomalies identified by Diamonds North were noted by them (Diamonds North, 2008) to be predominantly low priority, with 2 moderate, 2 moderate to high, and none high. The highest amplitudes of any of these magnetic anomalies did not exceed 5.5 nT which was further noted to be uncharacteristic of the >20 nT measures more commonly associated with kimberlites (Diamonds North, 2008). Field inspection of several sites revealed that the majority of the identified magnetic “anomalies” were coincident with large (up to and exceeding 10 m high), prominent pyramidal kame deposits. This form of kame deposit has been noted by the author to form along the near-vertical margins of cold-based or poly-thermal glaciers in the Canadian high arctic where supraglacial streams incise downward, intercepting thrust sheets of debris-rich ice, and then redepositing this material at the marginal wall of the glacier. As supraglacial channels shift, and the glacier retreats, these deposits are left as isolated pyramidal piles of generally coarse sand, gravel, and clast material. Several kames were noted to have inclined bedding planes (representing flow away from the glacier margin), and dissection of one kame by a retrogressive thaw failure revealed the entire deposit to be comprised of bedded sand and gravel. The association of kames with weak magnetic anomalies is considered to reflect the fluvial sorting and concentration of coarser, heavier magnetic particles, many of which are postulated to relate to abundant gabbroic boulders and sediments derived from glacial erosion of Proterozoic dikes and sills on Victoria Island. Continued development, testing and application of satellite and other imagery-based RPM activities is the focus of A. Farineau's M.Sc. research, and is anticipated to be completed by 2016.

CONCLUSIONS

Seismic Shothole Drillers' Logs and Lithogeochemical Samples

Lithological and sedimentological data from 13 107 shothole drillers' logs and 1307 lithogeochemical samples (particularly anomalous data) was useful in identifying potential field inspection and sample collection sites. The paucity of records within the main area of KIM recovery reported by Diamonds North however, limited the overall application of this data. A greater focus on bedrock mapping and the change of research areas to north-central Banks Island in 2016 will likely result in greater use of this shothole-derived data.

Kimberlite Indicator Mineral Sampling

Assessment of surficial geology within catchments from which industry had recovered KIMs does not conform to any simple or obvious model of glacial dispersal from a potential local (Banks Island) kimberlite source(s). Collection of 32 samples from various deposit types for KIM processing will be used to hopefully provide mineral samples that can be geochemically assessed. Comparison of these results with existing Industry KIM data from Banks Island and other known kimberlites beyond Banks Island will help to resolve the potential source of the Banks Island KIMs, including the potential for bedrock inheritance of KIMs from provisionally identified Beaufort Formation deposits.

Remote Predictive Mapping

RPM-based research is the focus of a M.Sc. student thesis. Field based use of satellite imagery and RPM methodologies were principally used to identify anomalous terrain for targeted KIM sampling within catchments that Industry had previously recovered KIMs. This research is now focussed on image processing and testing of different classification methodologies to discriminate terrain units identified in the field, including areas of provisionally identified Beaufort Formation sand and gravel deposits.

Future work 2015-2017

Geological samples collected during the summer 2015 field season will continue to be submitted for radiometric, palynological, and geochemical analysis. Results from these and analyses of recovered KIMs will be used to determine where follow-up and more detailed KIM sampling may be required in summer 2016 to further resolve issues of kimberlite source and dispersal.
In 2016, KIM research will move to areas of northeastern Banks Island prospected by Rio Tinto that were beyond the range of logistical operations in summer 2015. It is also hoped that the Rio

Tinto assessment reports from their 2010- 2011 activities will be publically released, and these can be used to further refine planned field operations.

The summer 2016 fieldwork will be based out of a central basecamp in northern Banks Island (Fig. 2; Polar Bear Cabin) that will support peripheral fly camp operations. An additional fly camp will be supported in southeastern Banks Island in the Nelson Head region. The principal focus of the 2016 field season will shift from the sole KIM study to predominantly involve researchers focussed on resolving the chronostratigraphic bedrock and tectonic history of Banks Island, particularly as it relates to understanding the stratigraphy and evolution of the offshore Canada Basin, as revealed through historical marine and terrestrial seismic data. Additional study of this year's newly discovered Tertiary Beaufort Formation outliers and upper Eureka Sound Formation outcrops in northeastern Banks Island will further resolve their stratigraphy, age, and significance to the overall tectonic framework of the island.

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