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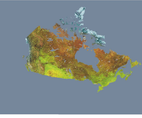
NEW BEDROCK MAP COMPILATIONS FOR THE CENTRAL MACKENZIE CORRIDOR, NORTHWEST TERRITORIES

Fallas, K.M.[1], MacLean, B.C.[1], MacNaughton, R.B.[1], and Hadlari, T.[1]



INTRODUCTION:

The Geo-mapping for Energy and Minerals (GEM) Program is funding activities by the Geological Survey of Canada (GSC), the Northwest Territories Geoscience Office (NTGO), and university scientists to improve the geoscience knowledge of Canada's northern regions. This knowledge will be made public to support decision making relating to energy and mineral exploration, as well as land use. As part of that effort, the Mackenzie Delta and Corridor Project of the GSC is leading bedrock mapping activities in the central Mackenzie Corridor (NTS map areas 96C, 96D, 96E, and 96F), an area known to have petroleum resources.

Due to the variable availability of bedrock exposures across the study area, efforts have been made to combine several lines of evidence. Traditional evidence, collected by visiting bedrock outcrops, includes: historical field observations from the GSC's reconnaissance-scale Operation Norman (Figure 1); recent field work in the Corridor (Figure 2); extensive new field observations made by participants in the Mackenzie Delta and Corridor Project (2009-2011); recent stratigraphic studies by government and university scientists; and biostratigraphic data on record with the GSC. In areas of sparse bedrock exposure, evidence from public domain reflection-seismic data and petroleum well logs has been used to constrain the location of structures and the distribution of map units (Figures 2 and 3). This poster presentation includes draft portions of several bedrock geology maps, concentrating on the geology of the Mackenzie Plain, showing compilation progress to date (Figure 4). As compilations are completed, 12 to 14 maps are planned for publication as GIS-enabled datasets, including field observations, with a functional scale of 1:100 000.

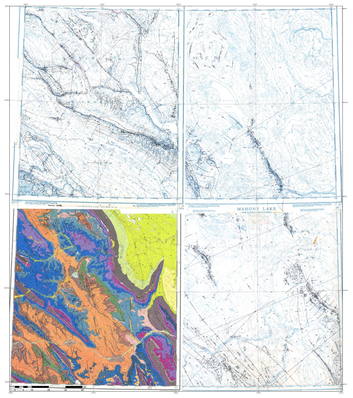


Figure 1. Published maps, in the current study area, from the GSC's Operation Norman project dating back to the mid-1970s. These three preliminary maps (black and white), and one A-series map (in colour) were based on reconnaissance-scale field observations.

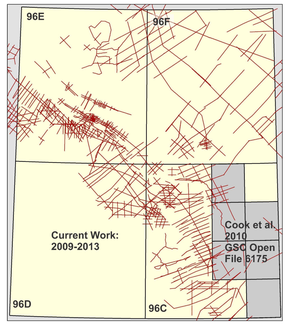


Figure 2. Map key showing the NTS map areas being studied by the Mackenzie Delta and Corridor Project, and the footprint of a recent map publication available for eastern 96C. Red lines indicate the location of seismic lines used in this study. Current map compilation also draws from recent field observations and historical data from Operation Norman.

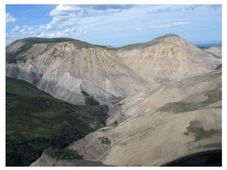


Figure 3a. Typically well exposed bedrock in the Mackenzie Mountains and parts of the Franklin Mountains allow for direct observation and sampling by geologists. Observations of rock type and measurements of structural orientations contribute directly to map compilation.

Figure 3b. View looking northeast across the Mackenzie Plain showing sparse bedrock exposure. Public domain reflection-seismic data and petroleum well-logs in the region help constrain the location of structures near the surface, and the distribution of rock types.

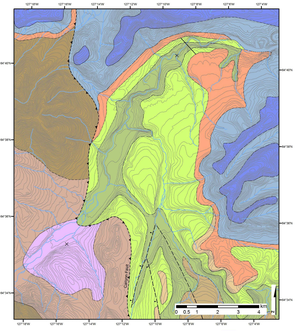


Figure 5a. Map compilation from Operation Norman (Aitken et al., 1974) showing limited recognition of Cambrian source rock (Mount Cap Fm) and no Cambrian reservoir (Mount Clark Fm). See the main map for location (Figure 4).

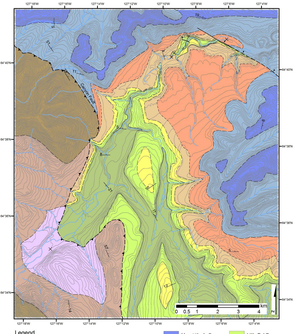


Figure 5b. The same area re-compiled based on new field observations from the Mackenzie Delta and Corridor Project (Fallas and MacNaughton, in press) showing improved recognition of Cambrian units.

FEATURES OF INTEREST:

- The new map compilation has documented more folding and faulting of Cretaceous strata within the Mackenzie Plain than was shown on Operation Norman maps.

- Variable structural trends are now more apparent throughout the Mackenzie Plain. In particular, there is evidence for the development of north-trending folds in pre-Late Cretaceous strata preserved northeast of the MacKay Range. Subsequent tightening of these folds involves Late Cretaceous and Paleocene strata. These relationships are constrained on seismic lines showing deeper erosion of Paleozoic strata on the crests of anticlines, with younger strata (typically Devonian) preserved in adjoining synclines beneath the Late Cretaceous (see MacLean and Cook, 1999 for seismic evidence). An example of one of these deeply eroded anticlines is exposed along the Mackenzie River east of the hamlet of Tulita where Slater River Formation overlies Franklin Mountain Formation (Figure 4). Variable preservation of Devonian and older strata in synclines will be of interest to petroleum exploration companies targeting Middle Devonian strata for exploration in the region.

- Mapping activities have improved our knowledge of the distribution of Cambrian reservoir (Mount Clark Formation sandstone), and source rock (Mount Cap Formation shale) in the eastern Mackenzie Mountains (Figure 5). The example of recent revisions shown in Figure 5 highlights the improvements that can be made in differentiating Proterozoic and Cambrian strata as a result of additional field observations.

ACKNOWLEDGEMENTS:

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We would also like to thank the communities and organizations of the Sahtu Region for their cooperation and guidance with respect to this work.

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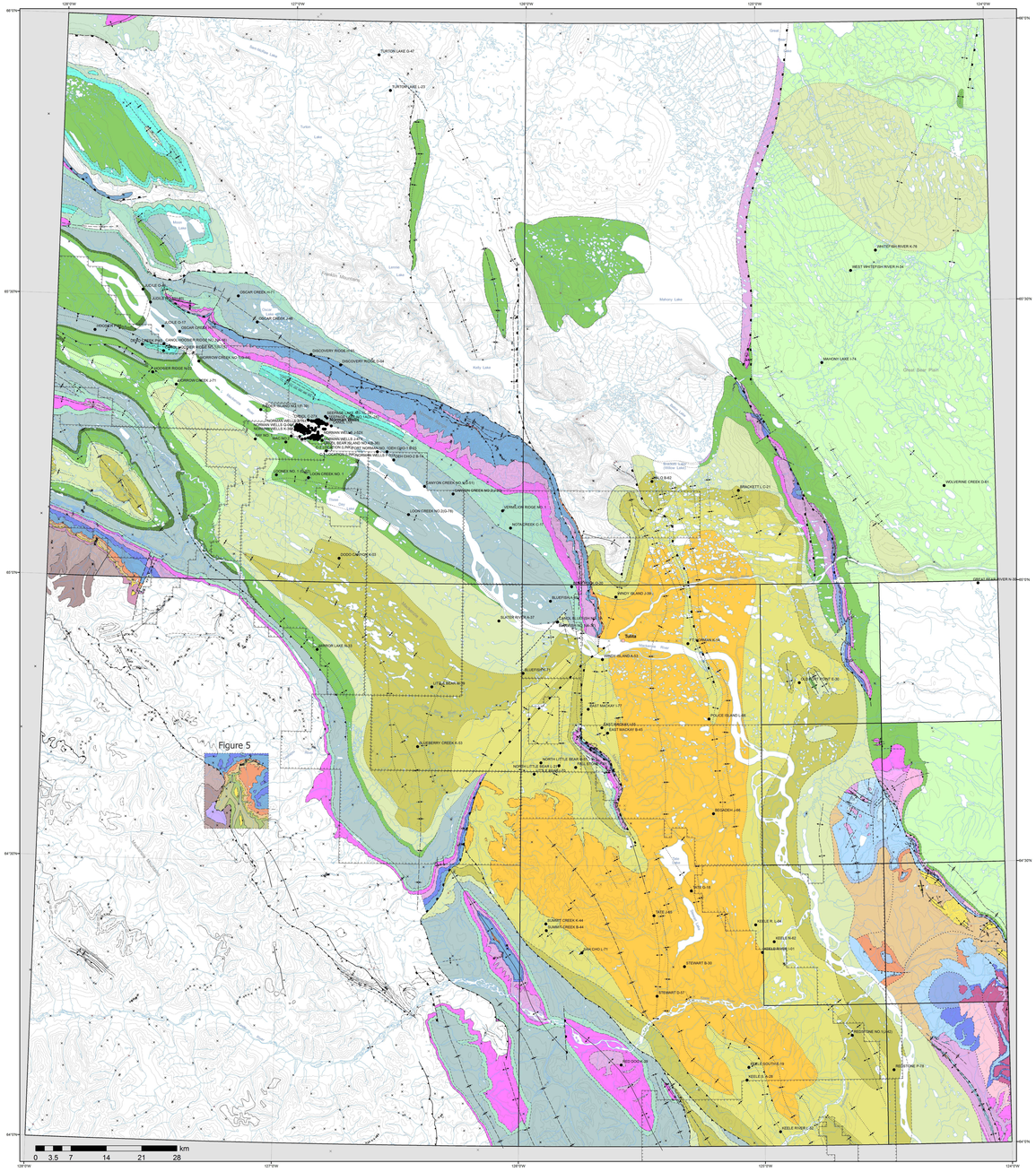

Figure 4. Draft bedrock geology for the central Mackenzie Corridor with accompanying legend.

Legend for DRAFT Bedrock Geology Map

Map Units

- not compiled

Cretaceous to Paleocene
- DPc-SC Summit Creek Fm

Cretaceous
- Cl-EF East Fork Fm
- Cl-LB Little Bear Fm
- Cl-SR Slater River Fm
- Cl-ML Mahony Lake Fm
- Cl-SS Sans Sault Mbr
- Cl-MA Martin House and Arctic Red fms
- Cl-AR Arctic Red Fm
- Cl-MH Martin House Fm

Devonian
- Dv-I Imperial Fm
- Dv-HR Horn River Gp
- Dv-C Canol Fm
- Dv-R Ramparts Fm
- Dv-HI Hare Indian Fm
- Dv-ls Devonian limestone
- Dv-Hu Hume Fm
- Dv-L Landry Fm
- Dv-BR Bear Rock Fm

Ordovician to Devonian
- DsDv-cd Ordovician to Devonian carbonate

Silurian to Devonian
- SlDv-TB Tsetso and Bear Rock fms
- SlDv-T Tsetso Fm

Cambrian to Silurian
- CmOs-FK Franklin Mountain and Mount Kindle fms

Ordovician to Silurian
- OsSl-MK Mount Kindle Fm

Cambrian to Ordovician
- CmOd-FM Franklin Mountain Fm
- Od-FMch Franklin Mountain Fm, Cherty mbr
- CmOd-FMr Franklin Mountain Fm, Rhythmic mbr
- Cm-FMc Franklin Mountain Fm, Cyclic mbr

Cambrian
- Cm-Cp6 Mount Cap and Saline River fms
- Cm-SR Saline River Fm
- Cm-Cp Mount Cap Fm
- Cm-Ck Mount Clark Fm

Proterozoic

Mackenzie Mountains Supergroup
- NPt-LDb2 Little Dal Gp, upper Basinal 2
- NPt-LDb1 Little Dal Gp, lower Basinal 2
- NPt-K-u Katherine Gp, upper part
- NPt-K-m Katherine Gp, middle part
- NPt-K-l Katherine Gp, lower part
- Pt-Tz Tsezotene Fm
- Pt-H1 H1

Stations
- visited outcrop [2009-2011]
- historical visited outcrop
- aerial observation

Contacts
- defined
- approximate
- inferred
- concealed

Other Boundaries
- limit of mapping
- nomenclature change
- map neat line

Folds
- anticline, upright, defined
- anticline, upright, approximate
- anticline, upright, inferred
- anticline, upright, concealed
- syncline, upright, defined
- syncline, upright, approximate
- syncline, upright, inferred
- syncline, upright, concealed
- monocline, anticlinal bend, defined
- monocline, anticlinal bend, concealed
- monocline, synclinal bend, defined
- monocline, synclinal bend, approximate
- monocline, synclinal bend, concealed

Faults
- normal, defined
- normal, approximate
- normal, inferred
- normal, concealed
- reverse, defined
- reverse, approximate
- reverse, inferred
- reverse, concealed
- thrust, defined
- thrust, approximate
- thrust, inferred
- thrust, concealed
- dextral, defined
- dextral, inferred
- sinistral, defined
- sinistral, inferred
- motion undefined, defined location
- motion undefined, approximate location
- motion undefined, inferred location

Petroleum features
- petroleum wells
- land parcel boundaries for July 2011 bidding cycle

Scale: 1:250,000
Projection: Lambert Conformal Conic, NAD83
Map Areas: NTS 96C, 96D, 96E, 96F

[1]Geological Survey of Canada, 3303 - 33rd Street N.W., Calgary, Alberta

For more information, please contact K.M. Fallas (Karen.Fallas@NRCan.gc.ca).

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