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Permanent link: https://doi.org/10.4095/328243

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Recommended citation
Fallas, K.M. and Finley, T.D., 2021. A GIS dataset of geological features from mineral exploration of the Gayna River property by Rio Tinto Canadian Exploration Ltd., 1975-1976, northern Mackenzie Mountains, Northwest Territories; Geological Survey of Canada, Open File 8791, 1. zip file. https://doi.org/10.4095/328243

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Abstract

Mineral exploration activity by Rio Tinto Canadian Exploration Ltd. in 1975 and 1976 generated good quality bedrock geological maps of the Gayna River Property, in the northern Mackenzie Mountains. These maps were included as part of mineral assessment reports submitted to the government of Northwest Territories. Geological features and observations illustrated in these maps have been digitally rendered into a GIS by the Geological Survey of Canada and are here provided as shapefiles and ArcGIS™ layer files for public use. Digitized geological features include: Rio Tinto informal map units, contacts, faults, areas of gypsum outcrop, areas of breccia outcrop, limits of mapping, structural cross-section locations, visited stations, lithologies, planar measurements, linear measurements, and significant mineral occurrences.

Introduction

In addition to the traditional regional mapping efforts of federal, provincial, and territorial geological surveys, exploration and assessment reports filed by mineral exploration companies working in Canada often provide useful geological information. Although the level of detail varies from report to report, in some cases companies do a careful and diligent job of documenting their observations. In such cases, these reports become a potentially valuable archive of geological information, and thus it is worth digitally rendering information from hardcopy reports and maps into reusable formats for public use. Techniques for digitally rendering historical geological information have been developed by the Geological Survey of Canada (GSC) to integrate historical bedrock data with modern, GIS-based observations (e.g. Fallas et al., 2015).

Following regional reconnaissance mapping in the northern Mackenzie Mountains, Northwest Territories (Aitken and Cook, 1974, 1979), mineral exploration companies became interested in the Pb-Zn mineral potential of carbonate units, including the Little Dal Group (see Ootes et al., 2011 for a review of mineral exploration activity in the region). In an area near the headwaters of Gayna River, in the core of the Shattered Range Anticline, Rio Tinto Canadian Exploration Ltd. (now Rio Tinto Exploration Canada Inc.) completed geological mapping in support of mineral exploration work on their Gayna River property (Fig. 1) from 1975 to 1976. The detailed work of Rio Tinto geologists resulted in good quality geological maps that were submitted to the Northwest Territories as part of Mineral Assessment Reports 080567 (Hewton, 1976) and 080568 (Sanguinetti et al., 1976). Copies of these assessment reports are available from the Northwest Territories Geological Survey at https://webapps.nwtgeoscience.ca/WebAppsV2/SearchHome.aspx.

The GSC, under the Geo-Mapping for Energy and Minerals (GEM) Program, recognized information from these reports as a useful complementary source of data for regional mapping activities (Fallas et al., 2016; MacNaughton et al., 2017, 2018). To make use of these data, geological features from the maps included in these reports were digitized for use in GIS software. The resulting files are provided with this report.

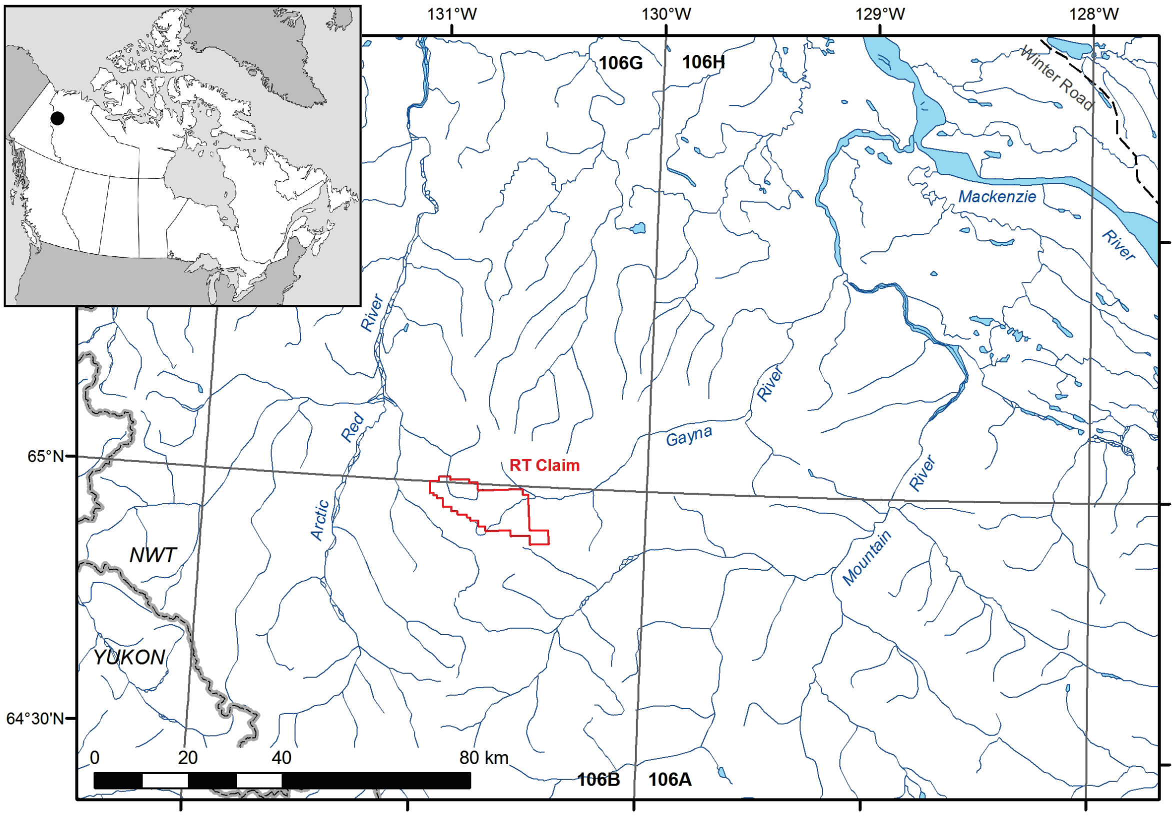

Figure 1. Location of Rio Tinto's Gayna River property (RT Claim) in northern Mackenzie Mountains. Mapped area captured in GIS files covers the RT Claim footprint and some adjacent areas.

Methods

Information presented on geological maps included in the mineral assessment reports was selected for data capture. As documented by Finley et al. (2017), these maps were first georeferenced in ArcGIS™ software using geographic features on high resolution satellite imagery of the claim area (e.g. by matching stream junctions), and then geological features and observations were digitized into a custom geodatabase. Features were organized into separate layers and files based on their representation as points, lines, or polygons, and by the type of geological feature (see list below). Observations and map interpretations from 7 maps were digitized, including the property map and geology maps 1 through 4 in Assessment Report 080568 (Sanguinetti et al., 1976), and geology maps 5 and 6 from Assessment Report 080567

(Hewton, 1976). An additional map from Assessment Report 080724 (Hewton, 1977), based on work conducted in 1977 at the northwest end of the claim area, was omitted from this work due to insufficient base map detail which did not provide enough reference points to match to a modern topographic base for reliable georeferencing. Features from the generalized property map (1:31 680 scale) were only digitized in areas not covered by the more detailed maps 1 through 6 (1:4800 scale for maps 1-4, 1:9600 scale for maps 5 and 6). Note that due to differences in mapping resolution in each set of maps, some geological features, such as faults or unit contacts, do not match across map boundaries. Geological features were digitized as shown on the original maps and no attempt was made to re-interpret these features to ensure along-strike continuity, or logical consistency.

Data

Data files provided in this report include:

- shapefiles for use in a wide variety of GIS software
- ArcGIS™ layer files using standard GSC symbols for bedrock geological features
- a spreadsheet of full text descriptions of map units from the original industry maps (Table 1)
- a style file of standard GSC geology symbols
- a set of fonts

The style file and fonts are provided for users who may wish to use standard GSC geology symbols (Geological Survey of Canada, 2020) in ArcGIS™. In order to display the standard GSC geology symbols correctly in ArcGIS™ the four font files (.tff) first need to be installed on a user's computer. The user may then choose to import the ArcGIS™ layer files with the embedded GSC symbols and appropriate legend descriptions already applied, or open the shapefiles and apply the symbols manually. This is done through the layer properties dialogue box (symbology tab) by matching the style file (.style) to the "symbol" field in each of the shapefiles. When applied manually, symbols will appear in the legend listed by symbol code rather than description. Note that there are no standard GSC symbols for lithology, so the symbol field is blank in the Lithologies shapefile. An illustration of a subset of geological features with applied GSC symbols is shown in Figure 2.

The shapefiles are provided in geographic coordinates, to facilitate accurate display in various projections, as desired by the user. Unprojected, the shapefiles may appear distorted in comparison to the projected files shown in Figure 2.

Spatial reference for shapefiles:

Projection: GCS_North_American_1983_CSRS

Datum: D_North_American_1983_CSRS

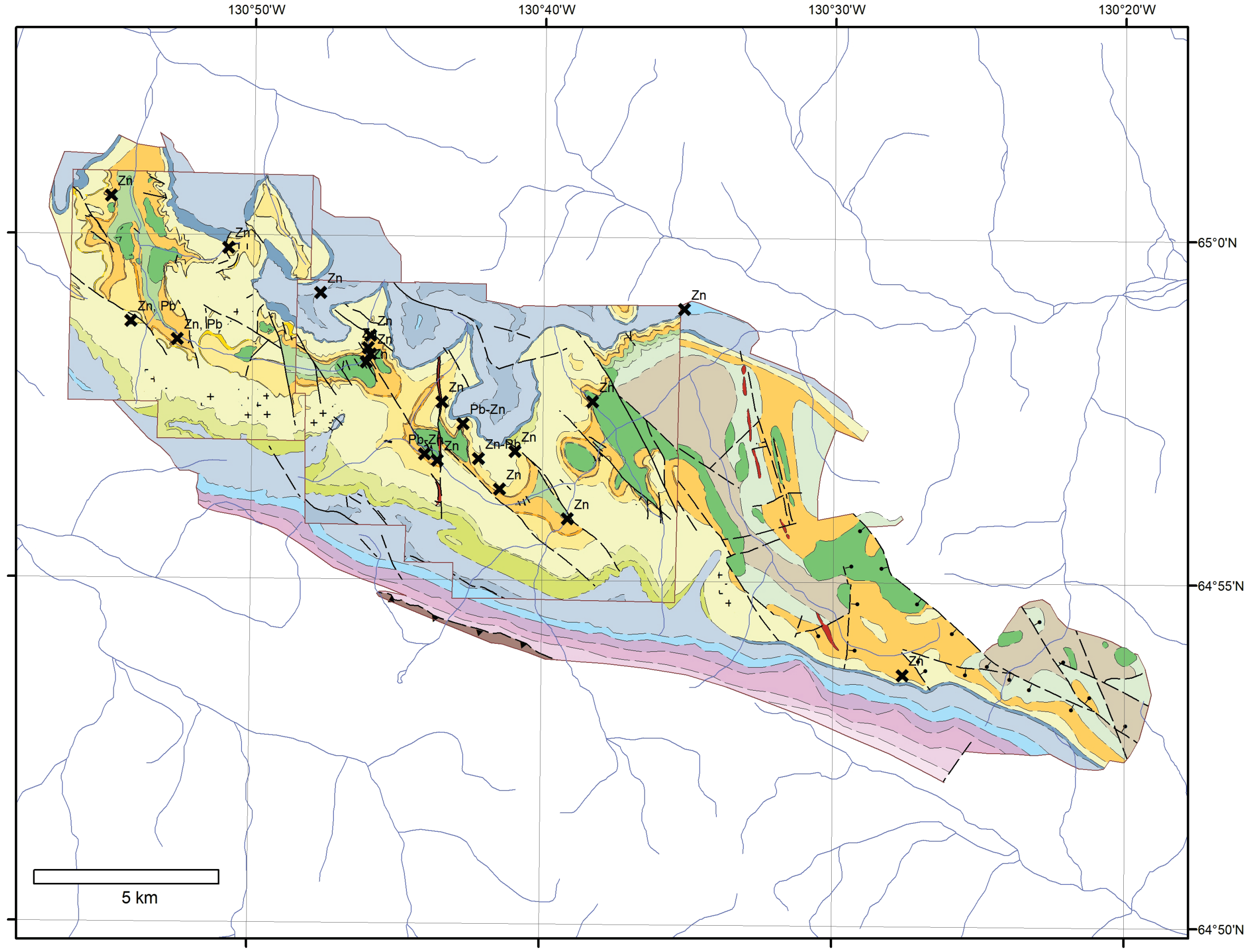

Figure 2. Illustration of digitized bedrock geological features (projected to UTM Zone 9) from Rio Tinto's property map and detailed maps 1 through 6 on the Gayna River property (RT Claim). For explanation of features, refer to the attribute tables in respective GIS files.

Geological features are organized into separate shapefiles (or layers) according to the type of feature, as follows:

- BrecciaZones: outcrop areas identified as breccia
- Contacts: depositional or intrusive boundaries between map units
- Faults: surface traces of faults
- GypsumOutcrop: outcrop areas identified as gypsum
- LinearMeasurements: outcrop measurements of any linear features (e.g. fold hinges)
- Lithologies: descriptions of outcrop lithologies, based on original Rio Tinto map unit descriptions
- MapLimits: limits of mapping from Rio Tinto maps
- MapUnits: areas where each bedrock map unit is exposed at the surface
- MineralOccurrences: major mineral occurrences as noted by Rio Tinto

- PlanarMeasurements: outcrop measurements of any planar features (e.g. bedding, joints)
- SectionLines: traces of structural cross-section lines.
- Stations: locations of outcrops examined by Rio Tinto geologists

Note that each lithology, linear measurement, and planar measurement has a corresponding station, and each station may have multiple measurement records. Although the locations of cross-section lines are provided in the data files, the cross-section illustrations submitted in the original mineral assessment reports have not been digitized, nor included in this report (but can be found in the original mineral assessment reports, available at the link cited).

Stratigraphy

As part of the process of integrating the industry data with mapping data of the GSC, informal stratigraphic terms used in the mineral assessment reports (Hewton, 1976; Sanguinetti et al., 1976) have been assessed for correlation with formalized stratigraphic nomenclature (Turner and Long, 2012; Long and Turner, 2014; MacNaughton and Fallas, 2014). Figure 3 shows a stratigraphic column from Assessment Report 080567 (Hewton, 1976) with the stratigraphic terminology used for the Rio Tinto maps and the interpreted correlation with the formal stratigraphic nomenclature of the Katherine Group (Long and Turner, 2014), Little Dal Group (Turner and Long, 2012), and the Nainlin Formation (MacNaughton and Fallas, 2014). In some cases, the correlation of unit boundaries is not exact, for example, the Silty Dolostone mapped by Rio Tinto corresponds to the upper part of the Gayna Formation, the entirety of the Ten Stone Formation, and the lower part of the Snail Spring Formation. Interpreted formal stratigraphic unit names are also included for individual outcrops in the Lithologies shape and layer files in the “Map_Unit” field. Original informal map unit assignments from the Rio Tinto maps appear in the “Field_Unit” and “SourceUnit” fields (as the full name of the unit and its map label abbreviation, respectively), facilitating direct comparison. Assessment of the appropriate formal stratigraphic term was supported by field observations collected by the GSC from 2016 to 2018 (unpublished data), interpretation of satellite imagery, and through field observations of E. Turner (unpublished data).

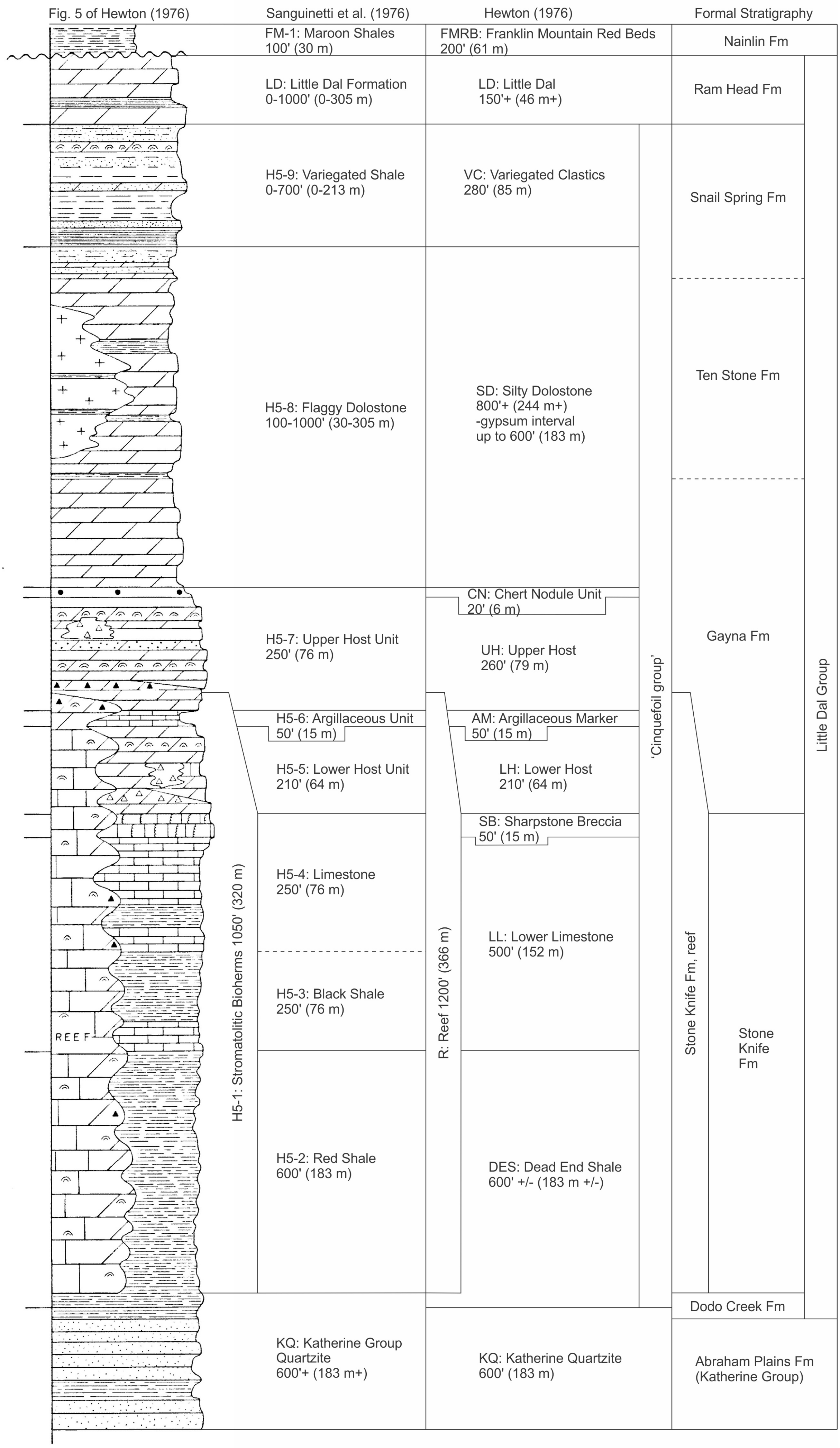

Figure 3. Comparison of stratigraphic terms used on Rio Tinto maps and formal stratigraphic nomenclature (Long and Turner, 2012; Turner and Long, 2012; MacNaughton and Fallas, 2014). Dashed lines indicate an approximate boundary.

Conclusions

Given the cost and logistical complexity of collecting geological data in remote regions of Canada, it is beneficial to Canadians that we use our resources as efficiently as possible. One aspect of that efficiency is avoiding duplication of work when relevant and reliable observations and interpretations are already available. Although the quality of the scientific information varies widely, mineral assessment reports and other exploration industry reports remain a potentially valuable resource for geological information.

In the case of Rio Tinto's Gayna River property, the quality of the mapping in the 1970's was good enough to clearly communicate what observations were made and where. It also provided a level of mapping detail beyond that which the GSC has been able to undertake. Taking the time to digitally render scans of hardcopy reports into GIS makes this data useful to the GSC, as well as other researchers, government agencies, and the general public. It also ensures that historical observations are available to be incorporated into new interpretations, rather than overlooked and forgotten.

Acknowledgements

This publication reports on work undertaken by the Geological Survey of Canada as part of the Geo-mapping for Energy and Minerals (GEM) Program from 2015 to 2020. Thanks are extended to Dr. E. Turner, Laurentian University, for guidance on relating informal stratigraphic units of the original Rio Tinto work to formalized stratigraphic terms of the Little Dal Group. An earlier draft of this publication was improved by a review from I.R. Smith.

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