

MINERAL INVENTORY PROJECT

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ABSTRACT

The primary mandate of the Mineral Inventory Project is to document all geological and mineral resource information on the Province's mineral occurrences and to make the information available to the public. Mineral Inventory personnel are also responsible for reviewing selected land-use applications and environmental assessment projects submitted to the Provincial Government, with the aim of minimizing their impact on the Province's documented mineral resources and areas of high mineral potential.

INTRODUCTION

The Mineral Inventory Project maintains the principal repository for geological information on the Province's mineral resources. The repository consists of the Mineral Occurrence Data System (MODS), which is a digital mineral occurrence database containing over 7000 records, supplemented by a collection of mineral occurrence maps (Stapleton *et al.*, 2000).

The MODS consists of summaries of data including location, geological descriptions, mineralogy, deposit type, work histories, resource and/or reserve statistics, analytical results and bibliography on known mineral occurrences. It is an important mineral exploration and research tool that offers fast and easy access to mineral occurrence information throughout all of Newfoundland and Labrador. The main delivery point for the MODS data is the Geological Survey of Newfoundland and Labrador website (<http://www.nr.gov.nl.ca/nr/mines/Geoscience/index.html>).

Clients can search the database using either the 'Mineral Deposit (MODS) Index Search Form' or the 'Geoscience Atlas'. It provides clients with a current, high-quality, online mineral deposit database that helps further define the Province's mineral potential and increase its prospectivity.

MINERAL OCCURRENCE DATA SYSTEM (MODS)

The MODS data are housed within an Oracle database management system; however, data entry is achieved using an application of the Microsoft-Access database software (Stapleton *et al.*, 2005). Microsoft-Access connects to the Oracle database using object database connectivity technology (ODBC).

The MODS data are obtained from three main sources; mineral industry assessment reports and press releases, government reports and academic reports (Figure 1). Data are reviewed to ensure compliance with the MODS coding standards before information is delivered to clients as occurrence specific, mineral inventory reports *via* the Geoscience Atlas or the MODS query form. Fields from the MODS database record (Table 1) can be downloaded from the Geoscience Atlas, which gives clients the ability to use the data in a GIS environment.

The MODS internet application is dynamically linked to the Oracle database, which serves as the common platform for all of the Geological Survey's databases. This enables efficient sharing of information between the databases giving clients same-day access to updated information.

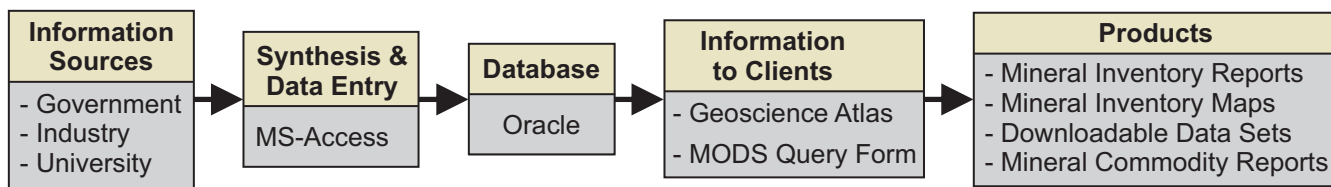


Figure 1. MODS flow chart.

Table 1. Fields and field descriptions from MODS for GIS record

Depname	Usual name
Altname	Alternate name
Recid	Record ID number
Nmino	National mineral inventory number
Comname	Major commodity present
Modslabel	Symbol for major commodity present
Commods	Secondary commodities present
Deptype	Deposit type; coded genetic classification of deposit
Desc	Description of deposit type
Status	Indicating amount of work done and hence the amount of information available on a deposit
	Producer - Commodity is extracted for sale
	Developed Prospect - Reserves or demonstrated resources of the commodity can be calculated, but the commodity has not yet been produced (<i>i.e.</i> , three dimensional data plus grade)
	Past Producer Dormant - The commodity is no longer produced, although there are known reserves or demonstrated resources
	Past Producer Exhausted - The commodity is no longer produced and there are no longer reserves or demonstrated resources
	Prospect - Two-dimensional data and grade are available, but not enough data to calculate reserves
	Showing - Mineralization exists in outcrop with little information known about its spatial extent; assay data exists
	Indication - An indication of the existence of the commodity (<i>i.e.</i> , field observation, map symbol)
Depchar	Deposit description
Geoprov	Geological province
Tectbelt	Tectono-stratigraphic zone
Strunit	Stratigraphic unit
Stratigrap	Stratigraphic age of the host unit
Rocks	Rock type(s) associated with deposit
Trench	Trenching? y = trenching done
DDH	Number of drillholes into the deposit
Working	Type of mine workings
	Underground - u,
	Open Pit or Quarry - o
	Underground and Open Pit - uo
Adit	Adit? y = adit present
Shaft	Shaft? y = shaft present
Utmeast	Easting coordinate
Utmnorth	Northing coordinate
Utmzone	UTM Zone

GENETIC CLASSIFICATION OF MINERAL MINERAL DEPOSITS FOR MODS

The MODS uses a hierarchical genetic classification system, illustrated using the “Hydrothermal, Structurally-Controlled Mineralization” classification in Table 2, to classify mineral occurrences. The model is based on the host rock type and the relationship between the mineralization and the host rock. The numerical codes, and code ranges for deposit types that are related, give the user the power to search MODS data using structured query language (SQL). The user can widen and narrow the scope of the search by using logic operators, *i.e.*, “<, >, =, and ”. The complete classification system is contained in Appendix B in the MODS Help File located at http://www.nr.gov.nl.ca/nr/mines/geo-science/mods_help.html.

The two broadest subdivisions in the classification system are 1) “Metallic (Ferrous and Non-ferrous) Rocks and Minerals”, Codes 000 to 499, and 2) “Industrial Rocks and Minerals”, Codes 500 to 799.

The Metallic occurrences are subdivided into four broad categories. These are, 1) Intrusive Associations, 2) Strata-bound Mineralization, 3) Hydrothermal, Structurally-Controlled Mineralization, and 4) Metamorphogenic Deposits. Each one can be further divided as illustrated in Table 2 to show sub-categories within a given category.

The user can select all “Hydrothermal, Structurally-Controlled Mineralization” using the SQL statement `Deptype >= 300` or `Deptype <= 331`, or the user can be very specific and select “Mesothermal Precious Metal Association” using the SQL statement `Deptype = 312`. “Deptype” is the name of the MODS database field that contains the code corresponding to the deposit type as per the classification system. The other three broad metallic classifications discussed above, as well as the Industrial Rocks and Minerals Classifications, are also subdivided in detail and can be queried using SQL.

DOWNLOADING MODS DATA

MODS data can be downloaded using the Tool icon on the Geoscience Atlas Map View. The process is “Tools/Download Data/Mineral Occurrences/Extract Data”. This method can be used to download all of the MODS database records or a subset. To download all of the records turn on the MODS layer, zoom to the full extent of the map and follow the process outlined above. A subset of the data can be downloaded by geographically zooming to an area of interest and following the process above, or one can first search the database and download the results of the search using the same method. The data fields included in the downloaded

Table 2. Genetic classification system for Hydrothermal, Structurally-Controlled Mineralization

300–399

HYDROTHERMAL, STRUCTURALLY-CONTROLLED MINERALIZATION

300	Undivided hydrothermal, structurally-controlled deposits
310–329	STRUCTURALLY-CONTROLLED VEIN SYSTEMS WITH BASE OR PRECIOUS METALS
310	Undivided hydrothermal vein systems
311–320	VEIN SYSTEMS ACCOMPANIED BY MINIMAL WALLROCK ALTERATION
311	Undivided vein systems accompanied by no or minimal wallrock alteration
312	Mesothermal precious-metal association (<i>e.g.</i> , the quartz vein type of Dubé, 1990, Deer Cove, Cape Ray) may include; Au, As, Sb, locally accompanied by base metals
321–329	VEIN SYSTEMS ACCOMPANIED BY SIGNIFICANT OR WIDESPREAD WALLROCK ALTERATION
320	Undivided vein systems accompanied by significant or widespread wallrock alteration
321	Precious-metal mineralization accompanied by aluminous alteration; includes most Newfoundland examples of epithermal-type mineralization, <i>e.g.</i> , Hickey's Pond, probably Hope Brook
322	Precious-metal mineralization accompanied by alkali-carbonate alteration; mesothermal examples include both broadly stratabound mesothermal mineralization in gabbroic sills (<i>e.g.</i> , Stog'er Tight) and alkali alteration and mineralization of granitoid rocks (<i>e.g.</i> , Rattling Brook, Western White Bay).
330–339	STRUCTURALLY-CONTROLLED MINERALIZATION NOT ASSOCIATED WITH VEINING
330	Undivided structurally-controlled deposits not associated with veining
331	Unconformity-related uranium deposits

record (Table 1) do not include the long text fields and are designed to be used in GIS programs.

QUERYING MODS DATA

The Geoscience Atlas is a very good application for cursory analysis and downloading of MODS data without the need for third party software. However, it is recommended that users import the data into other GIS programs for detailed analysis. There are four ways to search the database using the Geoscience Atlas, and the maximum number of hits that can be viewed in the Search Results dialogue box is 1000 per search.

Key Word Search

This is the simplest way to search the database. Choose the Search icon (magnifying glass) on the tool bar, set Location = Mineral Occurrences, enter a keyword(s), then search. All fields in the database are searched for the keyword(s) and a list of the results are displayed in the Search Results dialogue box and highlighted in the map view. The user can browse and download the results or link to the detailed MODS report.

Attribute Query

Using the “Attribute Query” option requires the construction of a “Boolean Expression”, which enables complex searches of the database.

An example would be to search the database for all “Hydrothermal, Structurally-Controlled Mineralization”. As discussed previously, mineral occurrences in the MODS are classified based on their genesis. The entire classification system is available in the MODS online Help File (http://www.nr.gov.nl.ca/nr/mines/geoscience/mods_help.html) and the classification system for “Hydrothermal, Structurally-Controlled Mineralization” is shown in Table 2. The Boolean expression, in this case, has two parts; Deposit ≥ 300 and Deposit Type ≤ 331 . To construct the Attribute Query to perform this search, choose the “Tools” option, then “Attribute Query” and “Layer = Mineral Occurrences”. Select the “Attribute” (database field) that you want to search using the “Attribute” drop-down box (in this case “DEPTYPE” (deposit type)). Select the operation using the “Operation” drop-down menu (in this case “Greater than or equal to”) and enter the Value “300” and “Add to Query Expression” and to construct the second part of the Boolean expression, repeat the above process choosing “Less than or equal to” as the Operation, select the Value “331”, “Add to Query Expression”, “Run Query”. All occurrences classified as “Hydrothermal, Structurally-Controlled Mineralization” will be highlighted on the map and appear in the Results Dialogue Box. The user can then turn on the Tectonic Contacts layer from the Bedrock Geology and the Lake Sediment sites (gold) from the Geochemistry layer and make some observations about the mineral potential of areas near major faults.

Spatial Search

A Spatial Search is used to query the database in relation to a feature on the map. The feature can be identified on the map using the cursor, hand-drawn on the map using the “Drawing Tool” or created by querying one of the databases available on the Geoscience Atlas and having the query results become the feature of interest.

As an example the question could be posed: What mineral occurrences are located on claims held by Red Moon Resources Inc? This is a two part process. First, identify the claims held by Red Moon using the “Attribute Query”, then search for the mineral occurrences located inside the claim boundaries.

Using the “Attribute Query”, choose the Map Staked Claims layer, set the Attribute (database field) “equal to” Red Moon Resources Inc., Add to Query Expression, Run Query. All of the claims held by Red Moon Resources are identified and become the feature of interest on the map.

Using the Tools icon, choose Spatial Search / Mineral Occurrences / Current Results / Buffer Distance = 0 (inside the claims boundary) / Search. The Search Result contains a list of all occurrences inside the highlighted claims and held by Red Moon Resources Inc. Using the same process, the user can search for the occurrences hosted by a particular rock type, geological unit or those within a defined distance (buffer) of a geological structure.

Custom Query

The “Custom Query” option is designed for users who want to search the data with a very easy to use, but less powerful application. The database can be searched by six attributes (data fields): NTS map sheet (1:50 000 and 1: 250 000 scales), Region (Newfoundland, Labrador), Major Commodity, Deposit Name Contains, and Status using a query form. All fields chosen in the search are, by default, linked together by the “AND” Boolean operator. The search results are displayed in the Search Results Dialogue Box and the features can be “zoomed to” in the map view. Links to

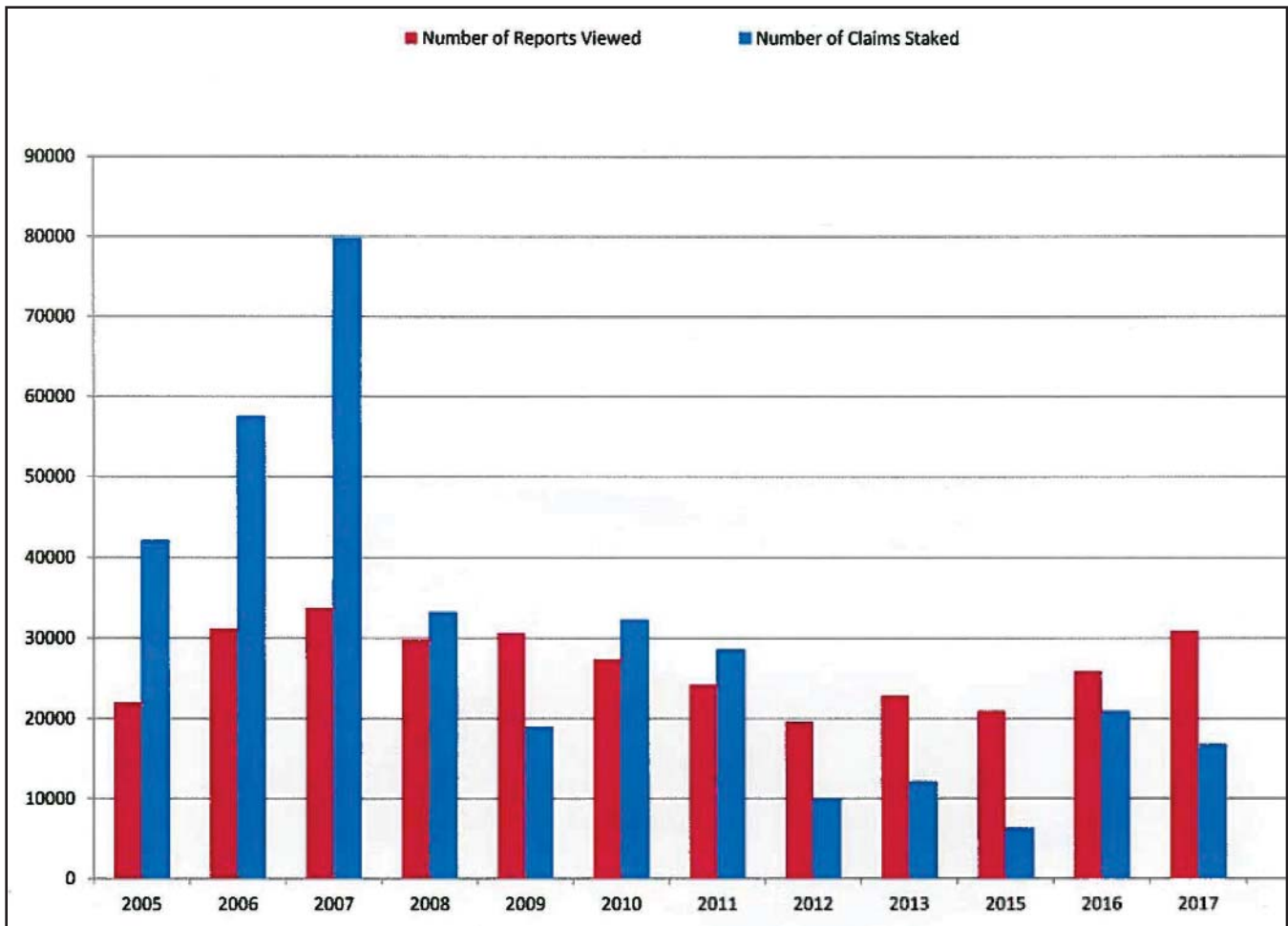


Figure 2. Number of reports viewed and claims staked per year 2005–2017 (data for 2014 unavailable).

Mineral Inventory reports can be followed and the data downloaded.

MODS END USER STATISTICS

The 2017 web server statistics for the Mineral Inventory Database indicate that it was accessed 30 892 times, representing an increase of approximately 19% over 2016 (Figure 2), and during the past eleven years it has been consistently used, averaging 26 578 hits per year. A hit is logged when the user opens a Mineral Inventory record. As illustrated in Figure 2, database usage strongly correlates with activity in the Province's mineral exploration sector with an increase in claim staking apparent during the years of greatest database access. A detailed study of the 2013 web server statistics (Stapleton *et al.*, 2015) indicated that the database has a global audience, being accessed from one hundred countries, representing approximately half of the countries of the world. It is accessed most frequently from Canada and the commodity of greatest interest is gold.

MODS CLIENTS

The MODS is used by mineral explorationists to help guide their exploration programs. It is used daily by government geologists in land-use planning. Advice is given to various government departments through the Interdepartmental Land Use Committee referral process and the environmental assessment registration process on establishing wilderness areas, hydro developments, provincial and national parks, cottage developments, water reservoirs, *etc.*, so that, where possible, these developments do not proceed in areas deemed to have high mineral potential.

Since the early 2000s, the Geological Survey has produced a series of Mineral Commodity Reports (Table 3). They are short summaries of mineral commodities with emphasis on their geological settings and exploration potential intended to act as a bridge between summary information of a promotional nature and the detailed information accessi-

Table 3. Published Mineral Commodity Reports

Zinc and Lead	Number 1, 2000, revised 2008
Nickel	Number 2, 2000, revised 2005, 2008
Copper	Number 3, 2000, revised 2005, 2007
Gold	Number 4, 2005, reprinted 2008
Uranium	Number 5, 2009
Rare-earth Elements	Number 6, 2011
Iron Ore	Number 7, 2012
Fluorite	Number 8, 2013
Barite	Number 9, 2014

ble through the MODS and the Geological Survey's Geofiles database. The MODS database is the critical reference for compiling these reports providing location data, occurrence descriptions, *etc.*

2017 UPDATES

Updates in 2017 were implemented on a Province-wide basis using data mainly taken from mineral industry assessment reports and press releases, and government reports. Areas updated include parts of NTS map sheets 1L, 1M, 2D, 2E, 2M, 12A, 12B, 12H and 12P (Newfoundland) (Figure 3), and 12P, 13A, 13B, 13M, 13N, 14C, 14D, 14E, 14L and 23J (Labrador) (Figure 4).

This year, we continued to achieve consistent delivery of information through both the database and the graphical interface, with both updated and new non-confidential records copied to the public domain on a 24 hour basis. This update provides the mineral exploration sector and other clients with a more current dataset that will help further define the Province's mineral potential and prospectivity. The data generated by the Mineral Inventory Project contributes toward longer term benefits evidenced by increased investment in the provincial mineral exploration and mining industries (Stapleton *et al.*, 2014).

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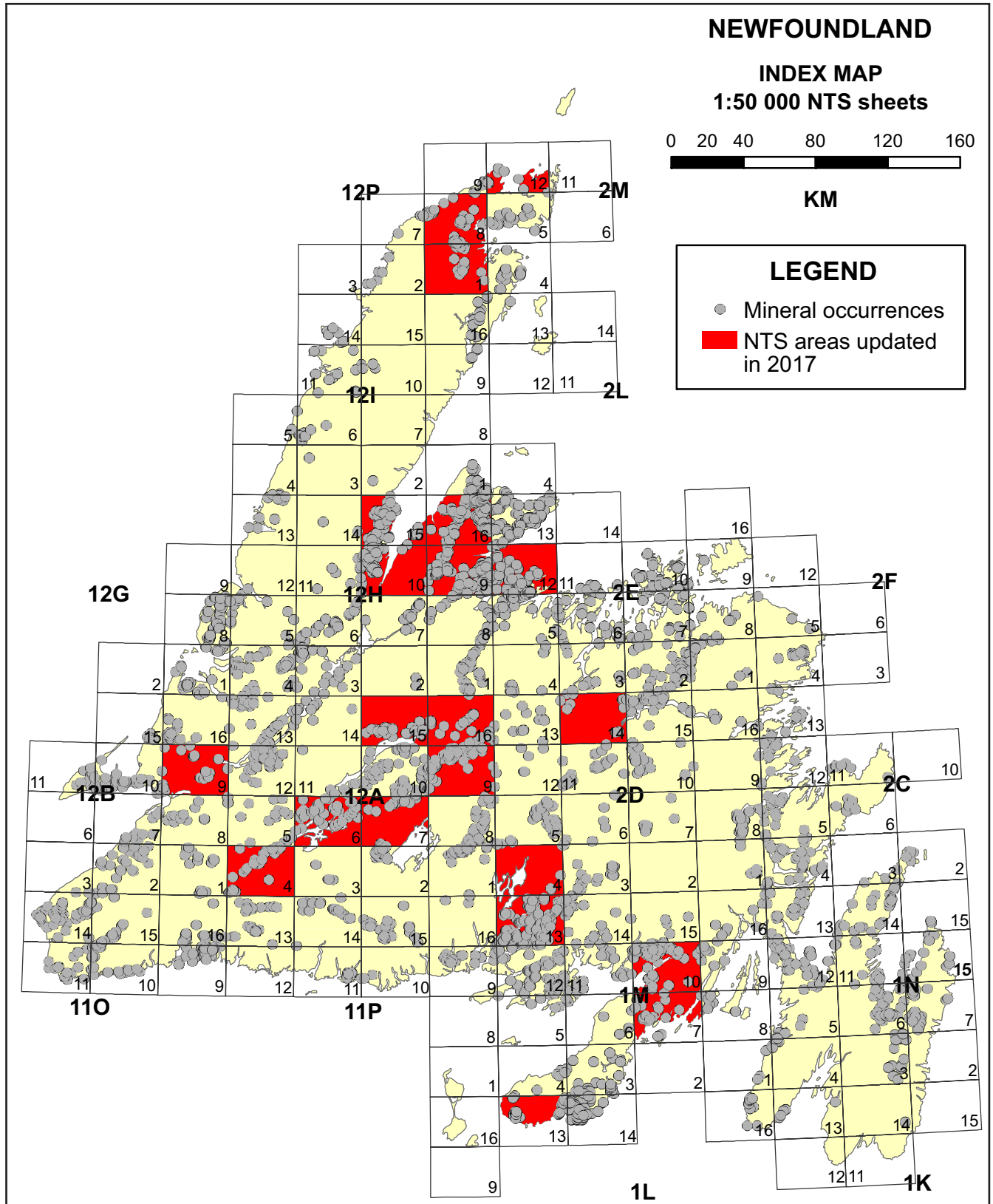


Figure 3. NTS areas updated, Newfoundland.

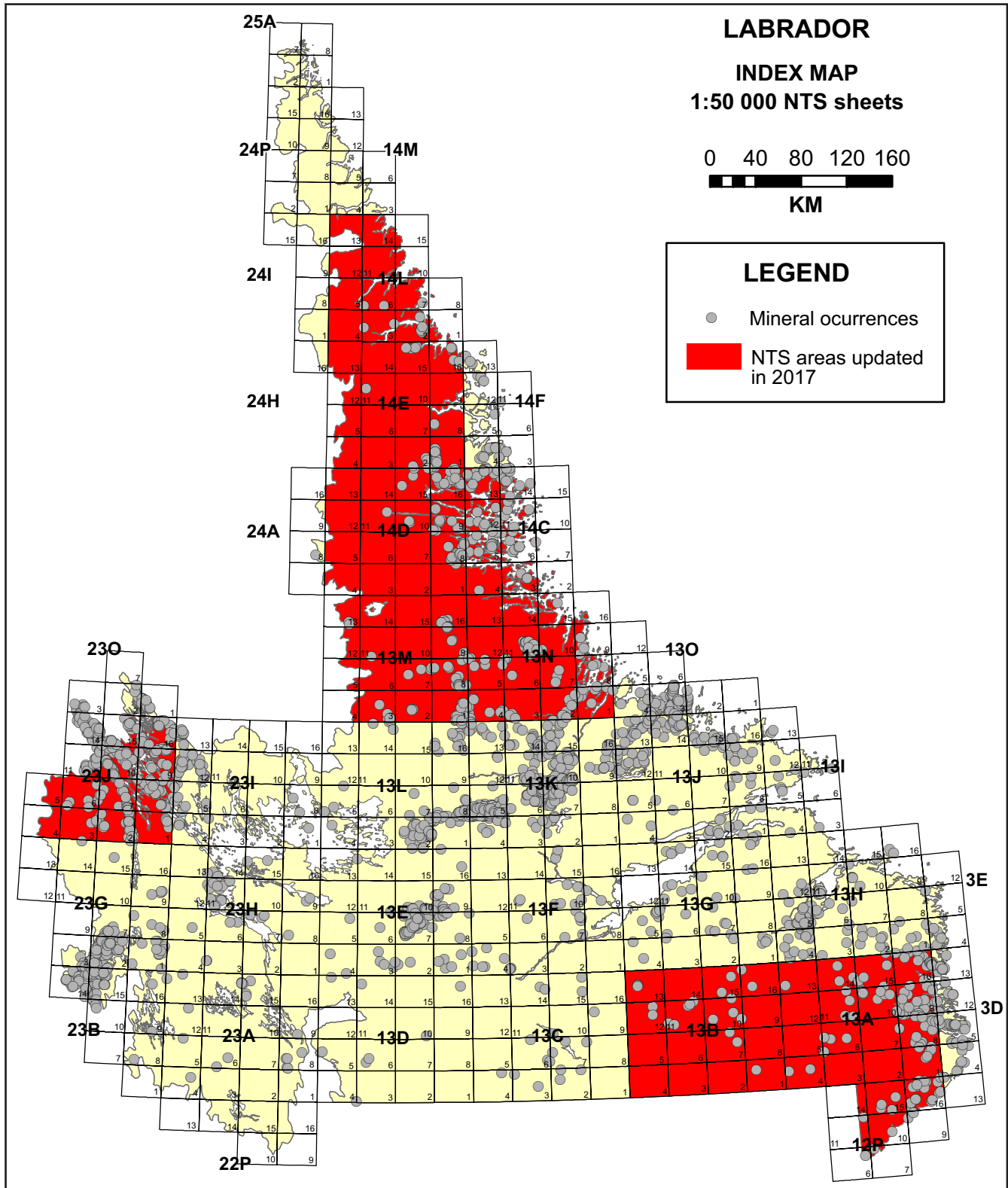


Figure 4. NTS areas updated, Labrador.

