Natural Resources Canada / Ressources naturelles Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8236

Surficial Data Model: the science language of the integrated Geological Survey of Canada data model for surficial geology maps

Version 2.4.0

C. Deblonde, R.B. Cocking, D.E. Kerr, J.E. Campbell, S. Eagles,
D. Everett, D.H. Huntley, E. Inglis, M. Parent, A. Plouffe,
L. Robertson, I.R. Smith, and A. Weatherston

2019

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 8236

Surficial Data Model: the science language of the integrated Geological Survey of Canada data model for surficial geology maps

Version 2.4.0

C. Deblonde, R.B. Cocking, D.E. Kerr, J.E. Campbell, S. Eagles, D. Everett, D.H. Huntley, E. Inglis, M. Parent, A. Plouffe, L. Robertson, I.R. Smith, and A. Weatherston

2019

Permanent link: https://doi.org/10.4095/315021

This publication is available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/).

Recommended citation
Deblonde, C., Cocking, R.B., Kerr, D.E., Campbell, J.E., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Parent, M., Plouffe, A., Robertson, L., Smith, I.R., and Weatherston, A., 2019. Surficial Data Model: the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 8236, ver. 2.4.0, 1 .zip file. https://doi.org/10.4095/315021

Publications in this series have not been edited; they are released as submitted by the author.

Table of Contents

Introduction

The Geological Survey of Canada (GSC) through the Geo-mapping for Energy and Minerals Program (GEM) has undertaken the Geological Map Flow project (GMF) to develop protocols for the collection, management (compilation, interpretation), and dissemination of surficial and bedrock geology data and map information. This document presents the version 2.4.0 of the science language implemented in the GIS data model and workflow for the production of surficial geology maps and datasets at the GSC. It represents an update by the GSC Surficial Geology Legend Committee to the Surficial Data Model (SDM) version 2.3.0 that was published by Deblonde et al., 2018.

Background and objective

The science language for surficial geology maps was designed with the aim of facilitating the transition from the traditional way of publishing paper maps to the production of standardized digital data sets with a structured database. Hence, the focus of this document is based on symbolization with an effort to standardize the scientific terminology used to describe the various entities present on a surficial geology map. The GIS data model and workflow are implemented using the ESRI™ ArcGIS™ geodatabase and software.

The science language originated from an extensive review of existing geological data models and map legends (Canadian and international). It was then refined by a small working group, known as the GSC Surficial Legend Review Committee, through iterative consultations with GSC surficial geology mappers. The first version of the surficial data model was published as version 1.2 (Deblonde et al., 2012). The working group consists of surficial geology mappers, science editors, and GIS experts.

Following the implementation of version 1.2 of the data model and workflow, all comments and change requests provided by the GSC surficial geology mappers and GIS users were evaluated by the GSC Surficial Legend Review Committee and when required were discussed with the submitters. This Open File presents the resulting updated version of the surficial data model: version 2.3.0. Table A briefly describes how the data model has evolved:

Table A-A brief history of the Surficial Data Model.

Version	Description
1.2	First version available for GSC use
2.0	Minor changes to the geodatabase schema and several additions and modifications to the geomorphological features and map units
2.0.1/2.0.2	Minor typographical edits
2.1.0	Minor additions of new features; addition of geological terms in French in documentation only
2.2.0	Minor additions of new features; removed redundant symbols between geomorphological points and field observations and measurements
2.3.0	Minor additions of new features; addition of new fields to support transferring data to FGP
2.3.14	Minor additions of new features

This Open File contains:

- a summary of additions and modifications (Appendix 1);
- a symbol chart for a succinct overview of the map units and geomorphological features symbology in legend order (Appendix 2);
- a detailed look at the attributes for the map units (Appendix 3) and geomorphological features (Appendix 4);
- a list of map units symbol and colour in legend order (Appendix 5) and list of map symbology and legend symbology for geormorphological features (Appendix 6);
- Cartographic Symbol Standard can be found in Open File 8572 (in press).

Submitting changes to the Surficial Data Model

The science language for surficial geology maps produced by the GSC will continue to evolve as per the requirements of surficial geology mappers. The science language will be annually updated if required. Submission for additions or changes by GSC mappers should be made using these editable PDF forms:

Surficial Feature Modification Form (English)	PDF	Use this form to submit suggestions for a symbol for a surficial geological feature.
Formulaire visant la modification d'entités superficielles (Français)	PDF	Utilisez ce formulaire pour soumettre des suggestions pour un symbole pour une structure géologique des dépôts meubles.

Completed forms should be sent to the "Surficial Geology Legend/Légende des formations superficielles" email available in the Natural Resources Canada internal email address list. Questions, comments, and suggested changes by collaborators outside the GSC are welcome. They can be sent to any of the authors of this publication. The annual deadline for submitting suggested changes or additions is November 1st.

All submissions will be reviewed by the Surficial Legend Review Committee by December 1st of that year, and approved changes will be implemented in the surficial data model by February 1st of the following year. Requested changes should be submitted as soon as they are identified by mappers to avoid a large number of review requests in November of each year.

Science language and symbolization

As an integral part of the data model, this document presents changes to the science language and data symbolization required to produce standardized surficial geology data and maps at a scale of 1:100 000; however, the same symbols and units are applicable for surficial geology maps at a range of scales.

The science language is divided into three components:

1. Map units (polygons and boundaries)
2. Geomorphological features (polygons, lines, and points)
3. Field observations and measurements (Field observations and measurements are digitally recorded using a field data collection tool (i.e. GanFeld).)

A summary of the additions and modifications are presented in Appendix 1.

Map Units

Map-unit definition

A map unit is defined as an area of ground distinguishable from surrounding areas by field observation and/or remotely sensed data (e.g. aerial photographs). Map units are based on the physical extent and geometry of the unconsolidated sediments lying between the bedrock and the surface, the sediment properties and characteristics (composition, stratigraphy, surface morphology, thickness, and other properties), and their relationship to other map units. Map units are delineated either in the field or on imagery based on, for example, morphology, thickness, tone, texture, patterns, landform association, vegetation, or feature orientation. These attributes are then used to infer environment of deposition, genesis, and relative geological age. Field sites show where the map unit has been verified with ground observations.

Map-unit designators

A map unit is defined as a combination of upper- and lower-case letters that constitute the map-unit designators (e.g. Cz, Ap) (Fig. 1). One or two upper-case letters defines the dominant primary genesis of the sediments, process and/or environment of deposition, for example:

GL = glaciolacustrine sediments

A = alluvial sediments.

The genesis is followed by one or two lower-case letters that define the category and reflect one of the following (Fig. 1a):

- morphology
- environment of deposition
- thickness of deposit
- secondary processes

If required, the category is followed by a number that defines the subcategory of the map unit (Fig. 1b). The subcategory reflects the following:

- a geological process
- a depositional environment
- the sediment composition
- the structure

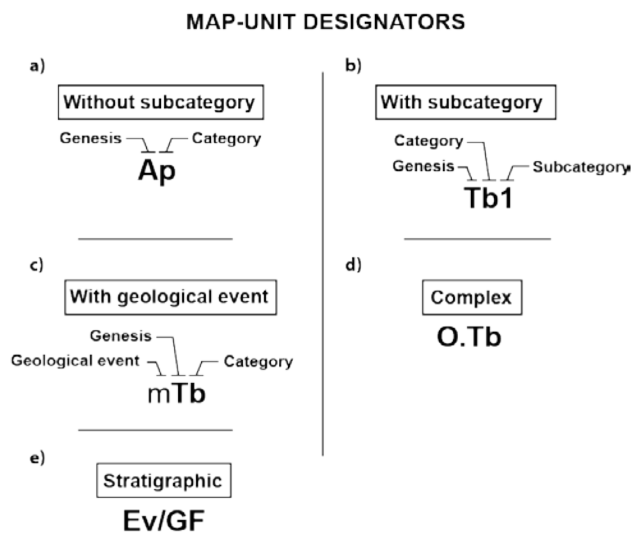

Figure 1 - Map-unit designators as labelled on maps.

If for a given map unit, there is only one subcategory present within the map area (for example, all landslides are retrogressive thaw flow, Cz3), the subcategory is not necessary for the map unit designator but is captured in the database.

In addition to subcategories, map units might need to be differentiated based on geological events. Geological events are defined based on time, provenance, depositional events, or erosional events, and can be divided according to one of the four following characteristics:

1. Chronostratigraphy (e.g. Late Wisconsinan versus Holocene)
2. Ice provenance (e.g. Laurentide versus Cordilleran ice sheets)
3. Glacial and nonglacial intervals of known or unknown absolute age (e.g. Amundsen glaciation and Liverpool Bay interglaciation)
4. Ice readvance (e.g. Tuk Phase ice advance)

The geological-event attribute can be depicted on a map as a prefix in front of the map-unit designator (Fig. 1c). The Appendix 3 presents the current list of geological-event prefixes for map-unit designators. Each prefix is unique.

If a single geological-event attribute is present within a map area, the prefix is not necessary for the map-unit designator but is captured in the database. A prefix is only used for maps with two or more identical map units with different geological-event attribute (e.g. Late Wisconsinan (lw) till versus Neoglacial (n) till). In such a case, the geological-event prefix is mandatory for at least one of the map-unit designators to permit differentiation on the map.

Using the example above, a map with abundant Late Wisconsinan till-blanket polygons and few Neoglacial till-blanket polygons will preferably depict the former as Tb and the latter as nTb. lwTb may not be preferable, as the Late Wisconsinan time and/or provenance attribute (lw) would be the dominant and default geological-event attribute on the map; however, the author has the option to include the attribute prefixes for both types of time and/or provenance polygons, although it is not generally recommended.

As a general principle, the use of a single map-unit designator per polygon is preferred. A maximum of two map-unit designators can be used in cases where the surficial cover forms a complex pattern and the map units are too small to be mapped individually, yet constitute a significant areal extent of the total polygon (e.g. O.Tb designates an area of organic deposits with numerous outcrops of till blanket). In such instances a dot ('.') is used to separate the map-unit designators (Fig. 1d).

Also, a stratigraphic relationship can be shown with a maximum of two map-unit designators separated by a slash ('/') (e.g. Ev/GF indicates Ev (eolian veneer) overlying GF (glaciofluvial sediments) (Fig. 1e). In both cases of using multiple map-unit designators, the first or the overlying designator determines the map-unit colour. The use of complex designators is not recommended where it is otherwise implicit (e.g. Tv.R or Tv/R). The second designator must also be included in the map legend. **Surficial geology mappers are encouraged to limit the use of complex designators and to avoid mapping large areas with complex designators.**

Map-unit legend description

In the legend, map-unit descriptions should be presented in the following order: map-unit name, grain size, structure, colour, minimum and maximum thickness, morphology, stratigraphic relationships, depositional environment, and other characteristic features.

Map-unit legend order

Map-units in the legend should generally follow a chronological order with the oldest at the bottom and youngest at the top. The order might need to be adapted specifically to a map area.

Map-unit boundaries

Five types of geological boundaries are available to mappers: **defined**, **approximate**, **inferred**, **concealed**, and **arbitrary** through water. Defined, approximate, and inferred boundaries are used, in decreasing order, to define the level of confidence of the location of a map-unit boundary. A concealed boundary can be used, for example, where a defined boundary is now under water since the area was flooded following the construction of a water reservoir. Arbitrary boundaries through water are used during map production to close all polygons under water bodies. This contact type is not shown on the final published map.

Geomorphological features (polygons, lines, and points)

Geomorphological feature definition

Geomorphological features are landforms, sediments, or locations where specific data were collected. Depending on the mapping scale and the size of the feature on the ground, the observation will be represented as a polygon, a line, or a point superimposed on the map-unit polygon. Appendices 5, 6, and 7 show the list of changes to the geomorphological features.

Like the map units, geomorphological features are characterized by the environment of deposition, genesis, and relative geological age. These characteristics may be identical or different from the underlying map unit. For example, drumlins (geomorphological feature) could have the same environment of deposition, genesis, and relative age as the underlying till unit, but an active dune field could have different characteristics than the underlying glaciofluvial map unit. Furthermore, for certain features (e.g. terrace scarp, beach crest) the environment of formation generally can be deduced from the underlying and surrounding polygons, but it is also specified in the database.

Similar to map polygons, geological events can be associated with points, lines, overlay polygons, and field observations. They are not labeled on the map but captured in the database in the ‘Geological event name’ field.

Field observations and measurements are separated from other point features in the database to maintain this supplemental data collected in the field.

Overlay Polygon (GEM_POLYS)

An overlay polygon feature can either delineate a grouping of common thematic features that are too small to be mapped individually or a feature that is large enough to be shown as an area. The outline of the feature is digitized to be represented as a patterned symbol.

Line (GEM_LINES)

Use a geomorphology line if the feature is too small to be shown as an area, but long enough to show its true length. The location, length, and orientation of the central axis are shown. The linear axis of the feature is digitized to be represented as a linear symbol. All line symbols are drawn to scale using the right-side rule: the arrow appears at the end of the line, and the ornamentation appears on the right side of the line as shown in Figure 2.

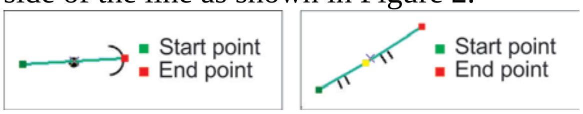

Figure 2 - Line digitizing direction.

Point (GEM_POINTS)

Use a geomorphology point if the feature is too small to be shown to scale as an area or a line. The centre location and orientation are shown. The centre location and direction of the feature are digitized to be represented as a point symbol. All point symbols are oriented with zero degrees pointing to the north and based at the centre of the symbol (Fig. 3).

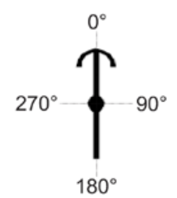

Figure 3 - Point digitizing direction

Field observations and measurements symbolized on maps

Field observations and measurement definition

Field observations and measurement information is recorded using a field data collection tool (i.e. GanFeld). Only the information that can be represented as a symbol on a map is shown in the field observations and measurements table. The central location of the field site is digitized to be represented as a point symbol. Figure 4 shows the different data-collection processes.
In previous versions of the surficial data model, features that can appear as both field observation points and as geomorphology points had different symbols. For example, a hummock was symbolized as 3.14.01.016 in F_STATIONS and 3.14.01.019 in GEM_POINTS despite using the same symbol. This version changes this so F_STATIONS and GEM_POINTS use the same symbol (3.14.01.019).

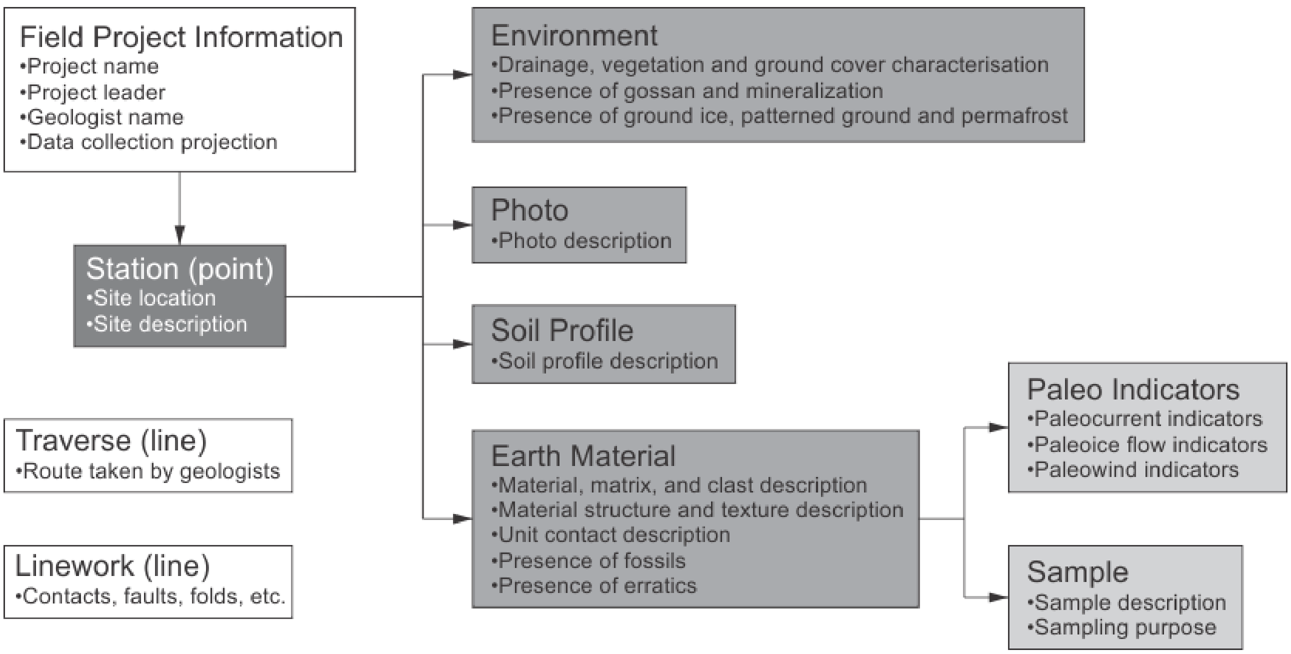

Figure 4 – Field data collection process.

Geomorphological feature order in the map legend

Line and point symbols should be placed below the map units. Like the map units, they should be listed in order of age with the youngest at the top. Generally, features on bedrock are assumed to be oldest. Features formed in subglacial settings are older than those associated with subaerial ice-contact processes, which are assumed to be older than features associated to proglacial sedimentation. Proglacial outwash features are assumed to be older than glacial-lake features. Items that do not have a geological time connotation (e.g. sampling site, gravel pit, field station) are placed at the bottom of the list.

References

Deblonde, C., Plouffe, A., Boisvert, E., Buller, G., Davenport, P., Everett, D., Huntley, D., Inglis, E., Kerr, D., Moore, A., Paradis, S. J., Parent, M., Smith, R., St-Onge, D., and Weatherston, A., 2012. Science language for an integrated Geological Survey of Canada data model for surficial maps, **version 1.2**; Geological Survey of Canada, Open File 7003, 238 p. doi:10.4095/290144

Deblonde, C., Plouffe, A., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Kerr, D.E., Moore, A., Parent, M., Robertson, L., Smith, I.R., St-Onge, D.A., and Weatherston, A., 2014. Science language for an integrated Geological Survey of Canada data model for surficial geology maps, **version 2.0**; Geological Survey of Canada, Open File 7631; 464 p. doi:10.4095/294225

Cocking, R., Deblonde, C., Kerr, D., Campbell, J., Eagles, S., Everett, D., Huntley, D., Inglis, E., Laviolette, A., Parent, M., Plouffe, A., Robertson, L., St-Onge, D., and Weatherston, A., 2015. Surficial Data Model, **version 2.1.0**: Revisions to the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 7741, 276 p. doi:10.4095/294225

Cocking, R.B., Deblonde, C., Kerr, D.E., Campbell, J.E., Eagles, S., Everett, D., Huntley, D.H., Inglis, E., Laviolette, A., Parent, M., Plouffe, A., Robertson, L., Smith, I.R., and Weatherston, A., 2016. Surficial Data Model, **version 2.2.0**: Revisions to the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 8041, 45 p. doi:10.4095/298767

Deblonde, C; Cocking, R B; Kerr, D E; Campbell, J E; Eagles, S; Everett, D; Huntley, D H; Inglis, E; Parent, M; Plouffe, A; Robertson, L; Smith, I R; Weatherston, A., 2018. Surficial Data Model: the science language of the integrated Geological Survey of Canada data model for surficial geology maps; Geological Survey of Canada, Open File 8236, (ed. version 2.3.14), 50 pages (2 sheets), doi.org/10.4095/308178

Acknowledgments

The science language presented here is the result of years of research and collaboration by many research scientists and GIS specialists across the GSC. The GMF project through the GEM program has been the catalyst for the accrued interest and involvement of the GSC community.

The first version of the model (1.2) was reviewed by I. McMartin and J. Bednarski. É. Boisvert, P. Davenport, and S.J. Paradis were major contributors to the initial version of the science language. At one time or another, many people have made a contribution to the model through discussions and comments including J.E. Campbell, A. Duk-Rodkin, A. Dyke, I. McMartin, R. Paulen, and D. Sharpe for the science language, and R. Boivin, M. Boutin, P. Brouillette, V. Dohar, É. Girard, G. Huot-Vézina, G. Lai, D. Lemay, L. MacDonald, K. Shimamura, and S. Williams for the data model.

The current surficial legend review committee includes the surficial geologists A. Plouffe, J.E. Campbell, D.H. Huntley, D.E. Kerr (committee chair), M. Parent, I.R. Smith, and D. St-Onge; the scientific editors E. Inglis, and A. Weatherston; the surficial data model developer C. Deblonde, documentation specialist R. Cocking; and the GIS specialists S. Eagles, D. Everett, and L. Robertson.

Comments and suggestions can be forwarded to any member of the surficial legend review committee.

Appendix 1. Changes between version 2.3.14 and version 2.4.0
OF_8236_appendix1.docx

Appendix 2. GSC Surficial Symbology Chart
OF_8236_appendix2.pdf

Appendix 3. Map Unit Polygon Attributs Poster
OF_8236_appendix3.pdf

Appendix 4. Geomorphological Feature Attributs Poster
OF_8236_appendix4.pdf

Appendix 5. Map Unit Polygon Symbols and Colours
OF_8236_appendix5.pdf

Appendix 6. Geomorphological Feature Map and Legend Symbols
OF_8236_appendix6.pdf