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OPEN FILE 7817**

**3D Drillhole Database of the Purcell Anticlinorium, British Columbia**

E.M. Schetselaar, E.A. de Kemp, P. Ransom, R. Buenviaje, K. Nguyen, R. Montsion  
and J. Joseph

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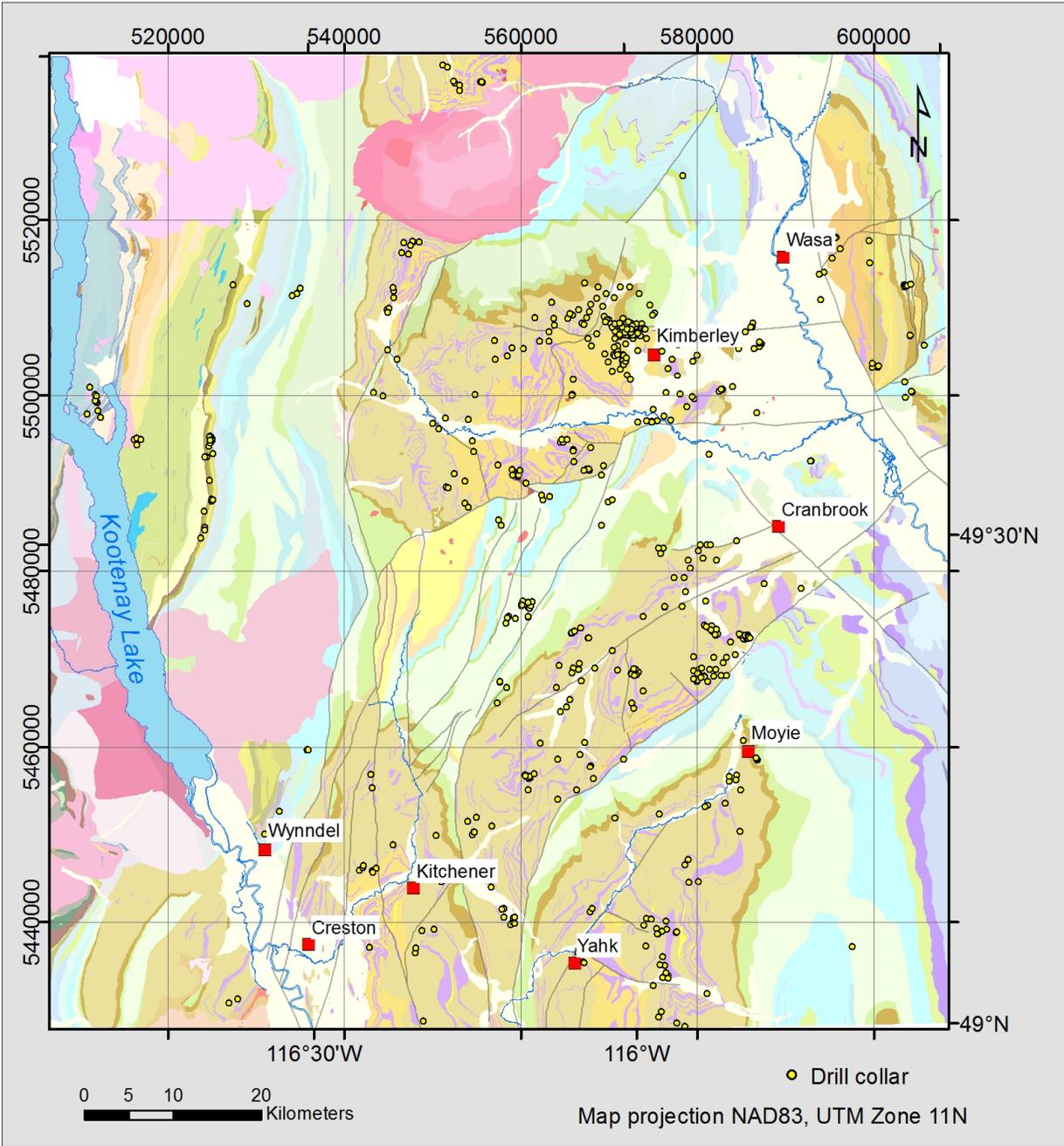
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## INTRODUCTION

A central objective of the Geological Survey of Canada fourth Targeted Geoscience Initiative Program (TGI4) is to develop knowledge and techniques to enhance the effectiveness of deep mineral exploration. Towards this objective a regional-scale 3D modelling initiative was undertaken to enhance insight into the subsurface geology of the Purcell anticlinorium, southeast British Columbia to support exploration for SEDEX deposits. This Open File publication presents a Microsoft-ACCESS<sup>®</sup> relational database populated with drillhole data acquired over several decades by industry exploring for SEDEX, carbonate-hosted Zn-Pb and gold deposits in the Purcell Anticlinorium. Because drillhole data provide essential lithostratigraphic constraints for generating 3D geological models (e.g. XYZ-referenced subsurface markers of formation contacts, alteration zones, mineralization occurrences and structural controls) this drillhole database is an essential resource for planning exploration projects and 3D modelling endeavours in the Purcell Anticlinorium. The reader is referred to an accompanying short paper published in the Open File publication on the Targeted Geoscience Initiative 4 SEDEX project (Schetselaar et al., 2015) for more details on the compilation methodology that was used to design and build the database and its applications.

The database archives 726 drillholes from exploration drilling programs conducted from 1912 to recent by operational firms exploring the 150 MT Sullivan SEDEX deposit and surrounding area, its satellites and other base metal and gold deposits in the Purcell anticlinorium (Figure 1). It contains lithologic and lithostratigraphic drill log descriptive data organized in eight thematic tables that are relationally linked to tables containing deviation log surveys and drill collar locations georeferenced in mine and UTM NAD83 coordinates. The MS Access<sup>®</sup> database also contains genetic lithofacies interpretations of the Sullivan horizon, assay data and structural observations, digitized mainly from legacy Cominco Ltd. archives. Many drillhole collar identifiers, their coordinates and metadata were obtained from a previous TGI3 publication of legacy drillhole archives (Joseph et al., 2011). All the tables of the MS Access<sup>®</sup> database are also provided in .CSV ASCII format stored in a separate folder, for users who want to inspect the drillhole data in spreadsheet format and/or import the data into 2D/3D GIS software. The Collar table is also stored in MS Excel<sup>®</sup> format to retain hyperlinks to the mineral exploration assessment reports on the BC government website.

3D visualization of the drillhole data is provided through the free downloadable Leapfrog<sup>®</sup> 3D viewer to accommodate users who do not have access to dedicated 3D GIS or 3D modelling software packages (see Appendix 1 for installation and instructions). Regional 3D views of the database show annotated drillhole lithology, lithostratigraphy, alteration and mineralization themes together with a seamless 3D compilation of the TGI3 geological map (Brown and MacLeod, 2011a, b, c, d; Brown et al.,

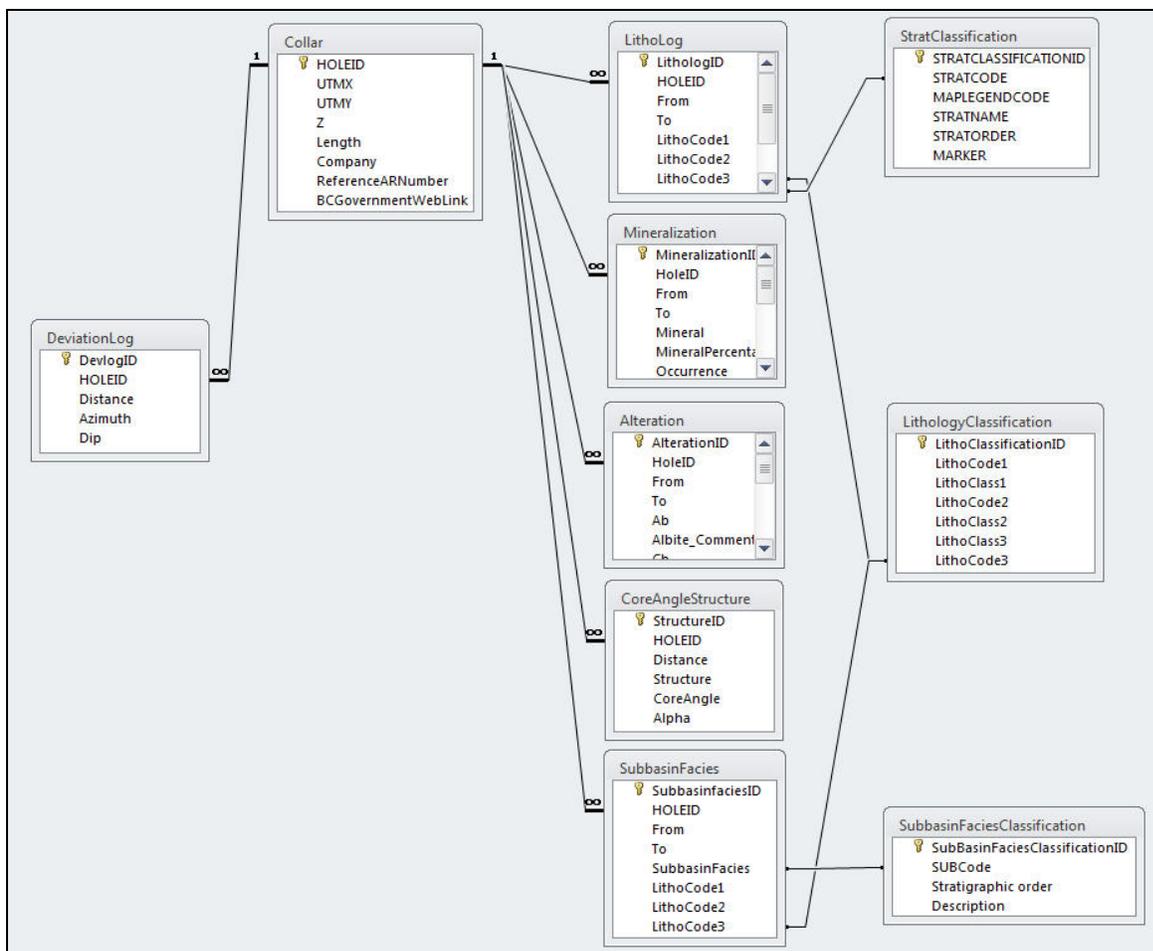


**Figure 1** Drillhole locations shown on geological map compilation of the Purcell Anticlinorium (after Brown and MacLeod, 2011a, b, c, d; Brown et al., 2011a, b, c, d, e, f; Glombick et al., 2011a, b).

2011a, b, c, d, e, f; Glombick et al., 2011a, b; Fig. 1). A more detailed 3D view of the Sullivan Sub-basin is provided as well that includes, in addition to the themes of the regional view, specific lithofacies drillhole intervals of the Sullivan time horizon.

## MS ACCESS® DRILLHOLE DATABASE STRUCTURE

The MS Access® database ‘PurcellDrillholeDatabase.mdb’ consists of ten tables including five thematic drill log tables (Fig. 1), describing: (1) lithology and lithostratigraphy (2) presence/absence of hydrothermal alteration and associated mineral species, (3) sulphide mineralization type (e.g. ‘massive’, ‘disseminated’) occurrence (e.g. ‘vein’, ‘bleb’) and mineral species (4) structures with their core-angle to the drill path and (5) descriptions of sedimentary facies found in the Sub-basin that hosted the now mined-out 150 MT Sullivan massive sulphide deposit. As shown in Figure 2, the records in the five thematic drill log tables are linked on their drillhole identifier ‘HoleID’ to the ‘Collar’ table and to the ‘DeviationLog’ table in many-to-one relationships. The ‘Litholog’, ‘DownholePoints’ and ‘SubbasinFacies’ are also linked to classification tables to facilitate translating database fields with abbreviated codes to full text descriptions. Full descriptions of the tables and database fields contained within them are provided in Appendix 2.



**Figure 2** Database structure of the MS Access® relational drillhole database of the Purcell anticlinorium.

## **LIMITATIONS OF THE DATABASE**

The drillhole data were compiled from a variety of sources some of which date back to the early 1900s. Starting in the 1960s exploration drilling became guided by structural and stratigraphic constraints in the search for SEDEX deposits. This compilation involved reconciling industry coding and lithologic descriptions of a large number of geologists from a variety of exploration firms that logged drill core in the Purcell Anticlinorium. Although the drill log records were checked against their original interval descriptions in the legacy archives, it is possible that data transcription errors, inconsistencies in rock classification and coding errors were propagated. Inconsistencies in lithologic and lithostratigraphic drill log coding may also be due to ambiguities in interpreting drill log interval descriptions, particularly for the most detailed interval descriptions, which are often composed of lithofacies mixtures, such as alternating intervals of mudstone, siltstone, wacke and subwacke. It should be noted that a significant proportion of the alteration and mineralization tables have overlapping FROM-TO intervals, as a result of parsing mineral species from text descriptions linked to different but overlapping intervals. Therefore it is recommended that separate queries be made for each mineral. Another significant limitation of this database is related to positioning of some of the drillhole collars that were carried out before the GPS era using topographic maps and/or air photographs. As a result, a few coordinates of, and shown drillhole collar locations may be tens to a maximum of a few hundreds of metres from their actual location.

## **ACKNOWLEDGEMENTS**

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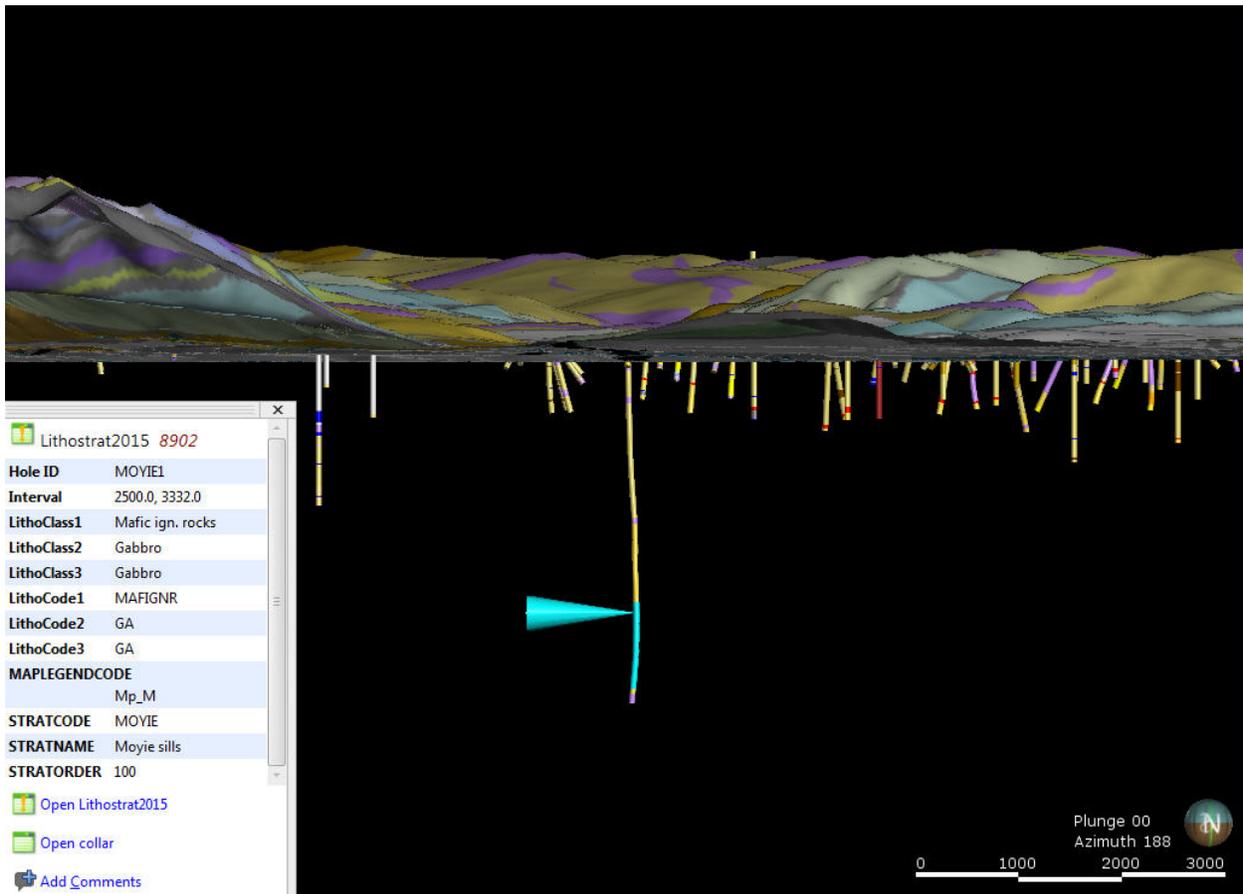
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## Appendix 1: 3D visualization of the drillhole database

This Open File publication contains Leapfrog® project files that can be inspected in 3 dimensions using the free downloadable Leapfrog® viewer: <http://www.leapfrog3d.com/products/Leapfrog-Viewer>. The project file 'PurcellRegional3D' provides a regional view of the database containing a seamless 3D compilation of the TGI3 geological map (Brown and MacLeod, 2011a, b, c, d; Brown et al., 2011a, b, c, d, e, f; Glombick et al., 2011a, b) lithostratigraphy, marker, alteration and mineralization drillhole themes. The file 'HallLakeBlock3D' provides a more detailed view of the same drillhole themes in the Hall Lake fault block that includes the Sullivan deposit. The geological map of this 3D visualization is based on the compilation of unpublished 1:25 000 scale geological map compiled by Cominco Ltd. and the previously published geological map of the St Mary Lake sheet (Brown and MacLeod, 2011a, b, c, d; Brown et al., 2011a, b, c, d, e, f; Glombick et al., 2011a, b).



**Figure A1** 3D scene of the Purcell drillhole database showing example of interactive query of lithostratigraphic information of a FROM-TO interval.

## Appendix 2: Description MS Access® database ‘PurcellDrillholeDatabase.mdb’

### **Collar**

This table contains 3D location information for each drillhole in UTM and mine coordinates.

**HOLEID** - Unique ID assigned to each drillhole (primary key)

**UTMX** - UTM, Zone 11, NAD83 (easting) x coordinate in metres of the drill collar/start location

**UTMY** - UTM, Zone 11, NAD83 (northing) y coordinate in metres of the drill collar/start location

**ZFIN** - Z elevation coordinate in metres computed from GPS survey or digital elevation model

**Length** - Length of the drillhole in metres

**Company** - Name of the company that acquired and/or logged the drillhole

**ReferenceARNumber** - Text field of the collar record containing the ARIS report number

**BCGovernmentWebLink** - Hyperlink field that when clicked links the collar database record to the Aris report source document stored on the BC Government ArisReports website

### **Deviation log**

This table contains the deviation log survey of each drillhole.

**DevlogID** - Unique identifier (Autonumber) for each deviation log record (primary key)

**HoleID** - Unique ID assigned to each drillhole (foreign key to Collar table)

**Distance** - Logged distance along the drillhole in metres

**Azimuth** - Logged azimuth angle (in degrees) of the drilling direction with respect to geographic north at each distance increment; drillholes without deviation log survey are assumed to be: (1) straight and (2) vertical (azimuth=0) when drill declination and inclination angles at surface are unknown

**Dip** - Logged dip angle (in degrees) of the drilling direction with respect to the horizontal at each distance increment; drillholes without deviation log survey are assumed to be: (1) straight and (2) vertical (dip = -90) when drill declination and inclination angles at surface are unknown

### **LithoLog**

This table contains the lithologic and lithostratigraphic codes assigned to logged drillhole intervals. The most detailed level of the lithology code ‘LithoCode3’ and ‘StratCode’ fields are linked to the LithologyClassification and StratClassification tables, respectively.

**LithoLogID** - Unique identifier (Autonumber) for each lithology log record (primary key)

**HoleID** - Unique ID assigned to each drillhole with a lithostratigraphic log (foreign key to Collar table)

**From** - Start of drillhole interval in metres

**To** - End of drillhole interval in metres

**LithoCode1** – Abbreviated character string to encode lithology at the first (most general) level of lithology classification

**LithoCode2** – Abbreviated character string to encode lithology at the second level of lithology classification

**LithoCode3** – Abbreviated character string to encode lithology at the third level of lithology classification (this field is linked to the **LithoCode3** field of the **LithologyClassification** table)

**STRATCODE** – Text string to describe the interpreted lithostratigraphic class assigned to a drillhole interval (this field is linked to the **STRATCODE** field of the **StratClassification** table)

**Marker** – Text string to describe the presence/absence of a ‘barcode’ siltstone marker

**Fault** – Text string to describe the presence/absence of a particular fault (e.g. ‘Kimberley Fault’)

### **LithologyClassification**

This table contains a three-level hierarchical lithology classification tailored to the description of clastic and carbonate sedimentary rocks of the Purcell Supergroup.

**LithoClassificationID** – Unique identifier (Autonumber) for each lithology classification record (primary key)

**LithoCode1** – Abbreviated character string to encode lithology at the first (most general) level of lithology classification

**LithoClass1** – Text description associated with LithoCode1 to describe lithology at the first (most general) level of lithology classification

**LithoCode2** – Abbreviated character string to encode lithology at the second level of lithology classification

**LithoClass2** – Text description associated with LithoCode2 to describe lithology at the second level of lithology classification

**LithoCode3** – Abbreviated character string to encode lithology at the third level of lithology classification

**LithoClass3** – Text description associated with LithoCode3 to describe lithology at the third level of lithology classification

### **StratClassification**

This table contains a lithostratigraphic classification with associated lithostratigraphic map legend codes based on the TGI3 geological map compilation of the Purcell Anticlinorium (Brown and MacLeod, 2011a, b, c, d; Brown et al., 2011a, b, c, d, e, f; Glombick et al., 2011a, b).

**StratClassificationID** – Unique identifier (Autonumber) for each stratigraphic classification record (primary key)

**StratCode** – Abbreviated character string to encode interpreted stratigraphic unit for each FROM TO interval (this field is linked to the **STRAT** field in the **Litholog** table)

**MapLegendCode** – Legend code of geological map corresponding to **StratCode** field

**StratName** – Text description associated with **StratCode** field containing full text description

**StratOrder** – Numeric code indicating stratigraphic order of lithostratigraphic unit (0 = unknown or non-applicable)

**Marker** – Binary field coding the presence (1) or absence (0) of ‘barcode’ siltstone marker of the Middle Aldridge Formation

### **Alteration**

This table contains identified drillhole intervals with altered rocks and a specification of the presence (1) / absence (0) of alteration mineral species or silicification

**AlterationID**– Numeric ID (Autonumber) to uniquely identify each altered drillhole interval record (primary key)

**HoleID** – Unique ID assigned to each drillhole interval in which alteration was identified (foreign key to Collar table)

**From** – Start of drillhole interval in metres

**To** – End of drillhole interval in metres

**Ab** – Binary field indicating presence/absence of albite

**Albite\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of albite alteration/mineralization

**Cb** – Binary field indicating presence/absence of carbonate

**Carbonate\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of carbonate alteration/mineralization

**Chl** – Binary field indicating presence/absence of chlorite

**Chlorite\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of chlorite alteration/mineralization

**Grt** – Binary field indicating presence/absence of garnet

**Garnet\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of garnet alteration/mineralization

**Ser** – Binary field indicating presence/absence of sericite

**Sericite\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of sericite alteration/mineralization

**Silcf** – Binary field indicating presence/absence of silicification

**Silicification\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of silicification

**Tur** – Binary field indicating presence/absence of tourmaline (ie. tourmalinite)

**Tourmaline\_Comment** – Text field describing (if this information is available in the legacy source archives) the intensity, occurrence or disposition of tourmaline alteration

## **Mineralization**

This table contains identified drillhole intervals with sulphide mineralization and a specification of the presence (1) / absence (0) of sulphide mineral species, hematite, limonite, manganese, siderite, tourmaline and garnet

**MineralizationID**– Numeric ID (Autonumber) to uniquely identify each mineralized drillhole interval record (primary key)

**HoleID** – Unique ID assigned to each drillhole interval in which mineralization was identified (foreign key to Collar table)

**From** – Start of drillhole interval in metres

**To** – End of drillhole interval in metres

**Mineral** – Text field indicating dominant mineral

**MineralPercentage** – Numeric field indicating percentage of dominant mineral (if information is available) 0 = no information available

**Occurrence** – Text field describing the occurrence of mineralization (if this information is available in the legacy source archives)

**Comment** – Text field providing additional description of the mineralization, including the intensity, occurrence or disposition of the mineralization (if this information is available in the legacy source archives)

**Po** – Binary field indicating presence/absence of pyrrhotite

**Py** – Binary field indicating presence/absence of pyrite

**Sp** – Binary field indicating presence/absence of sphalerite

**Ga** – Binary field indicating presence/absence of galena

**Ccp**– Binary field indicating presence/absence of chalcopyrite

**%Cu** – Numeric field indicating assay percentage of copper

**%Zn** – Numeric field indicating assay percentage of zinc

**%Pb** – Numeric field indicating assay percentage of lead

## **CoreAngleStructure**

This table contains core angle measurements of planar features such as bedding, cleavage, foliation, sills, dikes or veins

**StructureID** – Numeric ID (Autonumber) to uniquely identify each drill core angle measurement

**HoleID** – Unique ID assigned to each drillhole depth at which the planar feature was identified and the core angle was measured (foreign key to Collar table)

**Distance** – Drilled distance in metres along drill path at which the planar feature was identified and the core angle was measured (foreign key to Collar table)

**Structure** – Primary (e. g. bedding) tectonic planar feature or vein for which the core angle was measured

**CoreAngle** – Angle between core and planar feature measured in degrees

**Alpha** – Facing direction of bedding relative to cleavage measured or estimated in clockwise direction looking downhole (0 = cleavage is facing in same direction as bedding, 180 = cleavage is facing opposite with respect to bedding)

### **SubbasinFacies**

This table contains log descriptions of sedimentary facies specific to the Sullivan horizon in the Sub-basin hosting the Sullivan deposit

**SubbasinFaciesID** - Numeric ID (Autonumber) to uniquely identify each Sub-basin facies interval record (primary key)

**HoleID** – Unique ID assigned to each drillhole interval for which the Sub-basin facies was interpreted (foreign key to Collar table)

**From** – Start of drillhole interval in metres

**To** – End of drillhole interval in metres

**SubbasinFacies** – Abbreviated character string to encode the Sub-basin facies (this field is linked to the **SUBCode** field of the **SubbasinFaciesClassification** table)

**LithoCode1** – Abbreviated character string to encode lithology at the first (most general) level of lithology classification

**LithoCode2** – Abbreviated character string to encode lithology at the second level of lithology classification

**LithoCode3** – Abbreviated character string to encode lithology at the third level of lithology classification (this field is linked to the **LithoCode3** field of the **LithologyClassification** table)

### **SubbasinFaciesClassification**

This table contains log descriptions of sedimentary facies specific to the Sullivan horizon in the Sub-basin hosting the Sullivan deposit

**SubbasinFaciesClassificationID** - Numeric ID (Autonumber) to uniquely identify each Sub-basin facies classification record (primary key)

**SubbasinFacies** – Abbreviated character string to encode the Sub-basin facies class (this field is linked to the **SubbasinFacies** field of the **SubbasinFacies** table)

**StratigraphicOrder** – Numerical code providing the stratigraphic order of each Sub-basin lithofacies class

**Description** – Text description of each Sub-basin facies class

