Assessment report drillhole database: Development and initial data release

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Front cover:
Diamond drilling at the Woodjam project (Vizsla Copper Corp.). **Photo by Cary Pothorin.**

Back cover
Drilling site at Kemess North deposit (Centerra Gold Inc.). Photo by **Hassan Heidarian.**

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Abstract
ARIS (Assessment Report Index System) is a collection of more than 40,000 reports that detail results from mineral exploration and development programs. Submitted by the exploration and mining industry to comply with Mineral Tenure Act Regulations and maintain titles in good standing, the reports become an open resource after a one-year confidentiality period. Although containing a wealth of information, the assessment reports are typically submitted in a form (e.g., paper or PDF file) that makes working with the data cumbersome. To address this problem, we are developing databases that contain information extracted and digitized from assessment reports and releasing data in formats that are amenable to evaluation using geospatial and analytical software. This initial release of drillhole data from assessment reports includes collar information, lithological descriptions and assays from more than 400 reports.

Keywords: Geochemical data, assessment reports, drillhole samples, digitization, compilation, database, data access, analytical methods, chemical element abundance, ARIS

1. Introduction

The British Columbia Geological Survey (BCGS) Assessment Report Indexing System (ARIS) is a collection of reports documenting mineral exploration and development work in the province dating back to 1947. Assessment reports provide results of geological, geochemical and geophysical studies and become an open resource for planning mineral exploration, investment, research, land use, and resource management. To date, ARIS contains more than 40,000 reports representing nearly $4 billion of reported exploration expenditures. Newly available assessment reports are released through the BCGS website monthly.

Although containing a wealth of information, the assessment reports are typically submitted in a form (e.g., paper or PDF file) that renders working with the data cumbersome. Specific data, such as drillhole location, geometry, lithological descriptions, sampling parameters and analytical results, must be extracted into formats that are useable for detailed analysis and interpretation. To improve the usability of these data, the BCGS is creating open access databases by extracting and digitizing information from assessment reports. The first such database was presented in Norris and Fortin (2019), which included surface sediment geochemical data. Herein we present the initial release of the assessment report drillhole database, which includes drillhole location and geometry, core lithological descriptions, sampling parameters, and geochemical assay certificates and results (Fig. 1). The database contains information from more than 400 assessment reports, including results from more than 6,000 drillholes, 80,000 samples, with 3.8 million determinations from 1,300 assay certificates. We provide digital data as a GeoPackage (BCGS_GF2025-11.zip), which can be imported directly into most GIS.

2. Database structure

The data model, modified after Han et al. (2019), consists of eighteen tables (Fig. 2; Tables 1-18) containing drill hole data and is structured according to industry best practices. Tables are of two types: 1) those containing drill collar, lithologic and geochemical data extracted from assessment reports, which include discrete attributes following a standardized nomenclature; 2) those prefixed by 'code' containing expanded information and metadata regarding the various discrete attributes captured in the data tables.

The collars table (Table 1) is the central table of the database; it contains drill collar locations and metadata. The code_epsg table (Table 2) links to collars through the epsg_srid and contains details on the original geodetic datum. The code_drill_types table (Table 3) links to collars through the drilltype_code and contains details on the drilling method. The code_location_method table (Table 4) links to collars through the method_code and contains details on the method for determining drillhole surface location. The code_hole_diameter (Table 5) table links to collars through the diameter_code, which is connected in collars to both diameter_code and reduced_diameter_code, containing details on drill collar diameter. The code_north_reference table (Table 6) links to collars through the reference_

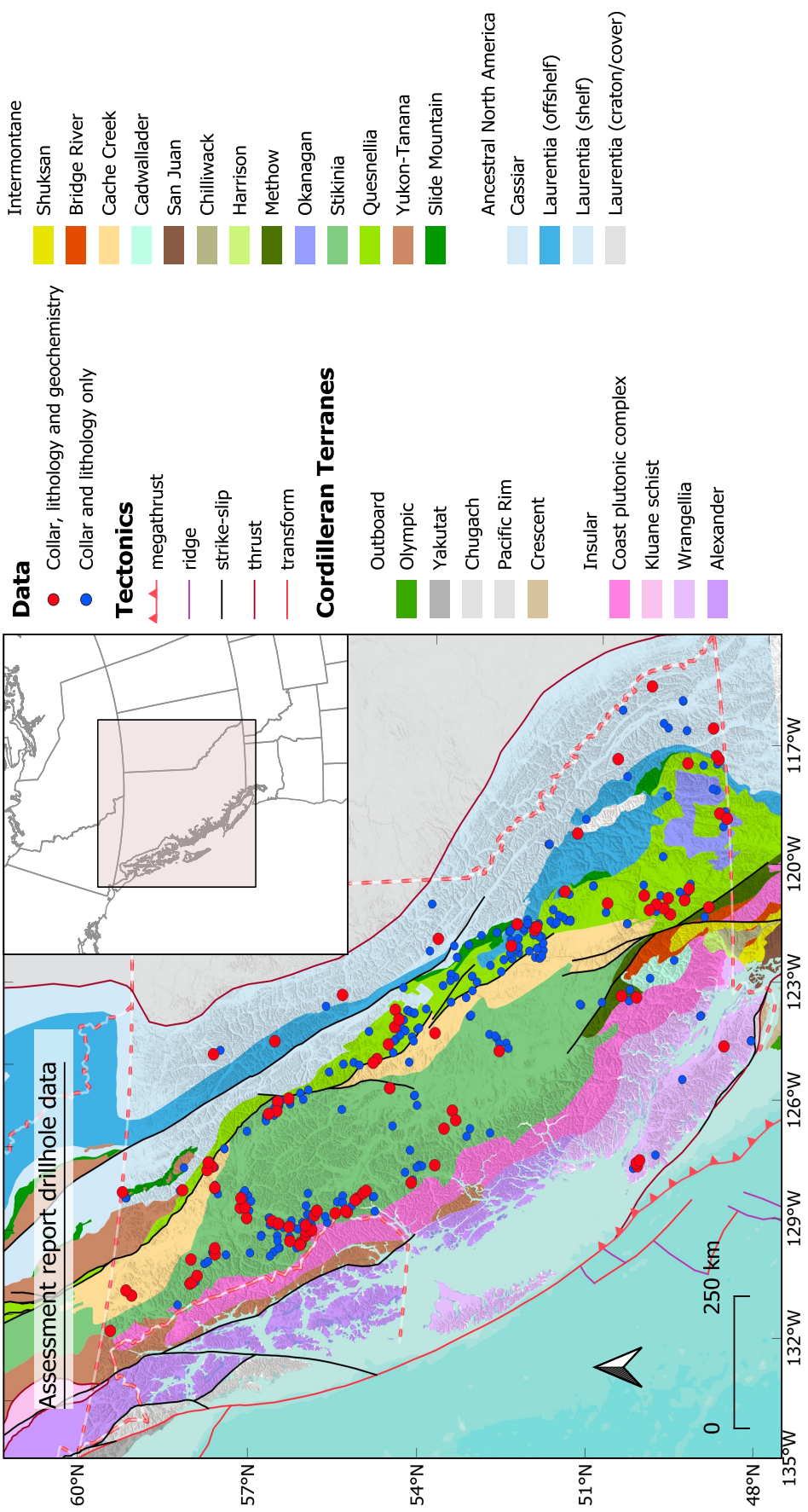

Fig.1. Assessment report drillhole data. Datum: WGS84

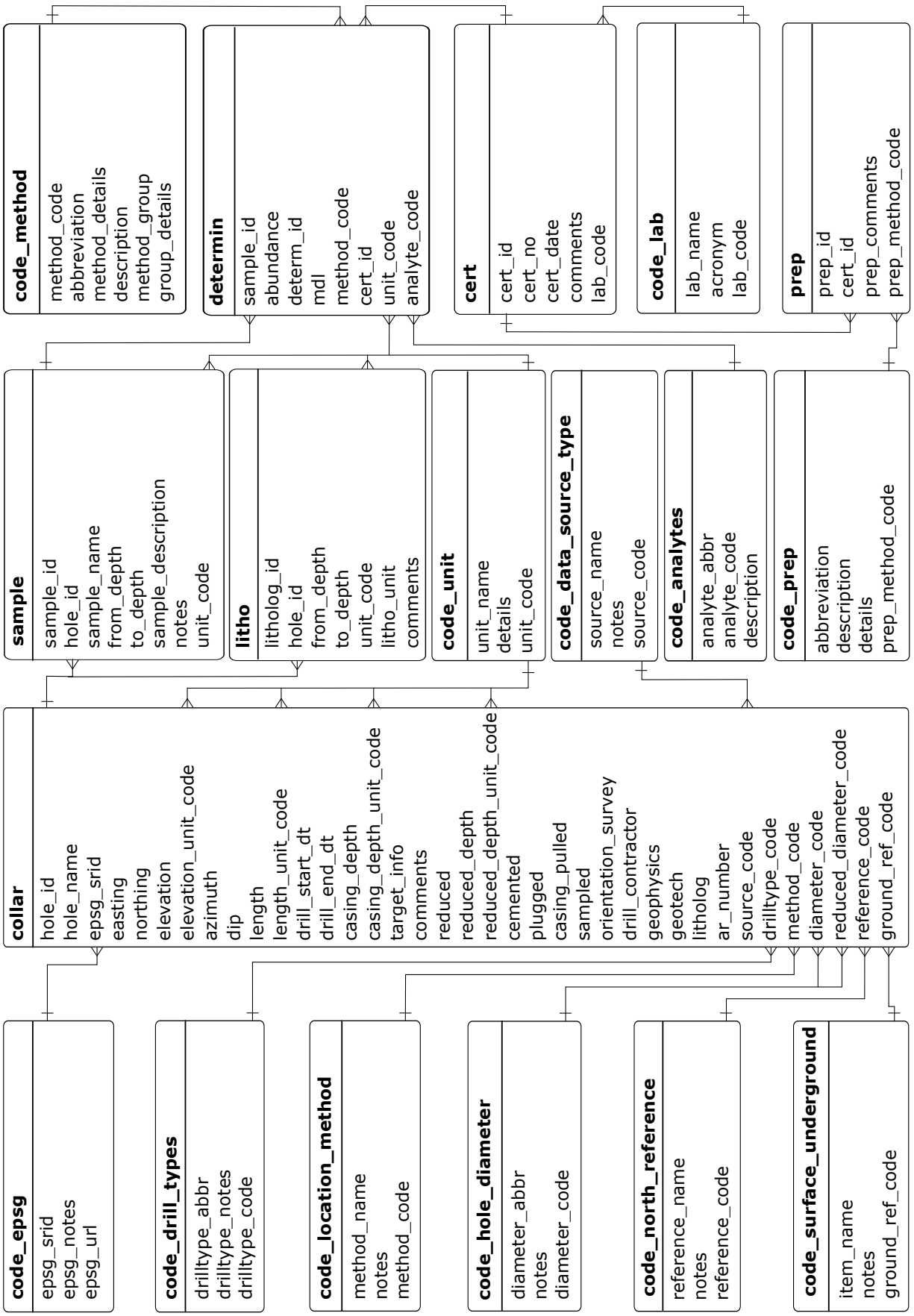

Fig.2. Database structure: ARDH data model using crowfoot's notation.

Field Name	Type	Description
hole_id	bigint	Sequential unique identifier for every drillhole
hole_name	text	Unique drillhole name within each assessment report
easting	numeric	Drillhole longitude in the original coordinate reference system of the assessment report
northing	numeric	Drillhole latitude in the original coordinate reference system of the assessment report
epsg_srid	bigint	Unique EPSG (European Petroleum Survey Group) code of geodetic datum for the drillhole location original coordinates
azimuth	numeric	Azimuth of drillholle direction relative to specified north reference
dip	numeric	Dip angle of drillhole relative to the horizontal plane
drill_start_dt	date	End date of drilling operations
drill_end_dt	date	Start date of drilling operations
target_info	text	Feature targeted by the drillhole
comments	text	Any additional remarks on the drillhole
drill_contractor	text	Name of drilling contractor responsible for the drilling of the drillhole
ar_number	text	Number of assessment report in ARIS to which drillhole belongs
source_code	bigint	Unique code for type of source for drillhole data
drilltype_code	bigint	Unique code for drilling method used in drillhole
method_code	bigint	Unique code for method of determining the drillhole surface location
diameter_code	bigint	Unique code for drillhole diameter
reference_code	bigint	Unique code for type of north reference of drillhole azimuth
ground_ref_code	bignit	Unique code for whether drillhole starts on the surface or underground
elevation	numeric	Elevation above mean sea level of drillhole surface location in specified unit
elevation_unit_code	bigint	Unique code for drillhole surface elevation above sea level unit type
length	numeric	Total length of the drillhole in specified unit
length_unit_code	bigint	Unique code for total hole depth/legth unit type
casing_depth	numeric	Depth of casing shoe in specified unit
casing_depth_unit_code	bigint	Unique code for casing shoe depth unit type
reduced_depth	numeric	Depth of diameter decrease if drillhole size was reduced during drilling
reduced_depth_unit_code	bigint	Unique code for hole diameter reduction depth unit type
sampled	bool	Availability of sample geochemical analyses in the drillhole
plugged	bool	Information on whether the drillhole was plugged after completion
casing_pulled	bool	Information on whether the casing string has been pulled out of the drillhole
orientation_survey	bool	Availability of dip angle and azimuth measurements along the drillhole
geophysics	bool	Availability of geophysical surveys associated with the drillhole
geotech	bool	Availability of geotehcnical surveys associated with the drillhole
litholog	bool	Availability of lithological description for the drillhole
reduced	bool	Information on whether the drillhole size was reduced during drilling
cemented	bool	Information on whether the drillhole has been cemented
reduced_diameter_code	bigint	Unique code for new drillhole diameter if drillhole size was reduced during drilling

Table 1. collar: location and metadata for each drillhole.

Field Name	Type	Description
epsg_srid	bigint	Unique EPSG (European Petroleum Survey Group) code of geodetic datum for the drillhole location original coordinates
epsg_notes	varchar	Name of EPSG (European Petroleum Survey Group) of geodetic datum for the drillhole location original coordinates
epsg_url	varchar	Spatial reference URL of EPSG (European Petroleum Survey Group) of geodetic datum for the drillhole location original coordinates

Table 2. code_epsg: drillhole location original geodetic datum list.

Field Name	Type	Description
drilltype_abbr	text	Abbreviation of drilling method used in drillhole
drilltype_code	bigint	Unique code for drilling method used in drillhole
drilltype_notes	text	Name of drilling method used in drillhole

Table 3. code_drill_types: drillhole drilling methods list.

Field Name	Type	Description
method_code	bigint	Unique code for method of determining the drillhole surface location
method_name	text	Method used for determining the drillhole surface location
notes	text	Additional remarks on the method for determining the drillhole surface location

Table 4. code_location_method: drillhole surface location methods list.

Field Name	Type	Description
diameter_abbr	text	Abbreviation of drillhole diameter
diameter_code	bigint	Unique code of drillhole diameter
notes	text	Description of drillhole diameter

Table 5. code_hole_diameter: drillhole diameters list.

Field Name	Type	Description
reference_name	text	Type of north reference of drillhole azimuth
notes	text	Additional remarks on the type of north reference of drillhole azimuth
reference_code	bigint	Unique code for type of north reference of drillhole azimuth

Table 6. code_north_reference: drillhole north reference types list.

Field Name	Type	Description
item_name	text	Description of whether the drillhole starting location is on the surface or underground
ground_ref_code	bigint	Unique code for whether the drillhole starting location is on the surface or underground
notes	text	Additional remarks on the drillhole starting location

Table 7. code_surface_underground: drillhole ground reference types list.

code and contains details on the type of north reference for directional surveying. The code_surface_underground table (Table 7) links to collars through the ground_ref_code and contains information on whether the drillhole starts on the surface or underground. The code_data_source_type table (Table 8) links to collars through the source_code and contains details on the type of source from which the data was obtained.

Both the litho (Table 9) and the sample (Table 10) tables link to collars through the hole_id. The litho table contains lithological depth logs, while the sample table contains sample information and their respective depth intervals. The determin (Table 11) table links to sample through the sample_id and contains the results of geochemical assays. The code_analytes table (Table 12) links to determin through the analytes_code and contains details on the measured analyte. The code_method table (Table 13) links to determinations through the method_code and contains details on the assaying method. The cert table (Table 14) links to determinations through the cert_id and contains details on the assay certificate. The code_lab table (Table 15) links to cert through the lab_code and contains details on the assay laboratory. The prep table (Table 16) links to cert through the cert_id and contains information about sample preparation methods. The code_prep table (Table 17) links to prep through the prep_method_code and contains details on sample preparation methods.

The code_unit table (Table 18) links to determinations through the unit_id and contains details on the measurement unit. The code_unit column in the code_unit table also links to the elevation_unit_code, length_unit_code, casing_depth_unit_code, reduced_depth_unit_code columns in the collars table.

3. Data compilation process description

Data compilation follows a similar process to that reported in Norris and Fortin (2019), consisting of three steps (Fig. 3): 1) data extraction; 2) data screening (QA/QC); and 3) data loading.

3.1. Data extraction

Data extraction can be broken down into three sub-steps: report selection; OCR (optical character recognition) or georeferencing; and data staging with visual checks. For the present release, we selected only assessment reports submitted since 2000 and included analyses only from those with a recognized laboratory certificate.

Because assessment reports are stored as PDF files, we use an OCR editor to extract tabular data (e.g., drillhole and sample names, location coordinates, sampling parameters, geochemical assay determinations) to create staging spreadsheet files. Low-confidence characters, as determined from the OCR editor, were compared against the original document, and mistakes were corrected manually. In addition, visual checks were made to ensure values were complete and in an appropriate numeric format. Most reports now in the database have tabulated GPS coordinates for drillhole locations. For a subset of drillholes, location coordinates were extracted by georeferencing the sample location map and then digitizing each point location.

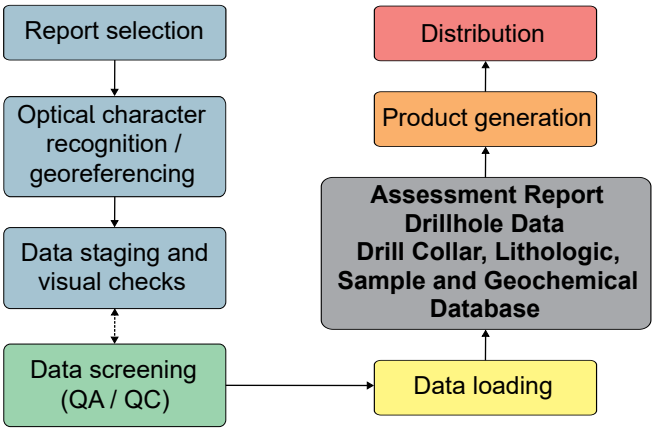

Fig. 3. Data flow diagram.

3.2. Data screening

We used Python scripts to check contents of the staging files for accuracy. As used herein, accuracy refers to ensuring the extracted data match what is in the report; it does not imply validation of sampling or analytical methods. More than 60 different verification checks (QA/QC; tables 19 to 23) were run during screening. If any discrepancies were identified, the spreadsheets were inspected and compared to the PDF original. In cases where an error was determined to have come from the original report (rather than the OCR process), changes were made only where both the error and the correction were clear in the report (e.g., reversal of easting and northing). During this stage, blanks, reference material and pulp duplicates were tagged and excluded from the database, so that only field drillhole samples and their respective determinations were present. Data were also standardized at this stage to ensure consistency between reports (e.g.; analyte names, units, laboratory names).

3.3. Data loading

Once data passed the screening phase, they were loaded into a spatial relational database (PostgreSQL/PostGIS) using Python scripts.

4. Data 'Product' Description

Data products were generated from the database using a combination of Python scripts and database views. The use of a spatial relational database to store the data made it simple to generate multiple products. Using record attributes or locations, samples could be linked to other BCGS databases.

Data from the ARIS drillhole database are made available in a GeoPackage database (see Norris and Fortin, 2019 GeoPackage details). In the GeoPackage, only the data_collars table is a spatial table. It can be brought directly into most GIS applications; sample information and results can then be joined to this layer as needed. Collar locations can also be viewed on MapPlace 2, the BCGS geospatial web service.

Field Name	Type	Description
source_code	bigint	Unique code for type of source for drillhole data
source_name	text	Type of source type for drillhole data
notes	text	Additional remarks on the source type of drillhole data

Table 8. code_data_source_type: data sources list.

Field Name	Type	Description
hole_id	bigint	Sequential unique identifier for every drillhole
litho_unit	text	Lithological description of the interval
litholog_id	bigint	Sequential unique identifier for every lithological interval logged in every drillhole
comments	text	Detailed lithological description and additional remarks of the interval
from_depth	numeric	Start depth of the lithological description interval
to_depth	numeric	End depth of the lithological description interval
unit_code	bigint	Unique code for interval depth unit type

Table 9. litho: lithological description for each drillhole.

Field Name	Type	Description
sample_id	bigint	Sequential unique identifier for every sample from every drillhole
sample_name	text	Unique sample name within each assessment report
to_depth	numeric	End depth of the sampled interval
from_depth	numeric	Start depth of the sampled interval
hole_id	bigint	Sequential unique identifier for every drillhole
notes	text	Additional remarks on the sample or interval
sample_description	text	Description of the sample or interval
unit_code	bigint	Unique code for sample depth unit type

Table 10. sample: sample information for each drillhole.

Field Name	Type	Description
determ_id	bigint	Sequential unique identifier for every assay determination from every drillhole
abundance	varchar	Concentration of analyte in specified unit
analyte_code	bigint	Unique code for analyte type
cert_id	bigint	Sequential unique identifier for every geochemical assay certificate from every drillhole
mdl	varchar	Minimum detection limit for the specified analyte and method
method_code	bigint	Unique code for every geochemical assay method
sample_id	bigint	Sequential unique identifier for every sample from every drillhole
unit_code	bigint	Unique code for determination unit type

Table 11. determin: geochemical assay determinations metadata.

Field Name	Type	Description
analyte_abbr	text	Abbreviation of analyte
analyte_code	bigint	Unique code for analyte type
description	text	Description of analyte

Table 12. code_analytes: geochemical assay analytes list.

Field Name	Type	Description
abbreviation	varchar	Abbreviation of geochemical assay method
description	varchar	Description of geochemical assay method
group_details	varchar	Geochemical assay method group description
method_details	text	Name of geochemical assay method
method_group	varchar	Geochemical assay method group abbreviation
method_code	bigint	Unique code for every geochemical assay method

Table 13. code_method: geochemical assay methods list.

Field Name	Type	Description
cert_id	bigint	Sequential unique identifier for every geochemical assay certificate from every assay certificate
cert_no	varchar	Certificate number of geochemical assay report
cert_date	date	Date of geochemical assay report certificate
comments	text	Remarks on the geochemical assay report certificate
lab_code	bigint	Unique code for geochemical assay laboratory

Table 14. cert: geochemical assay certificate metadata.

Field Name	Type	Description
lab_name	varchar	Name of geochemical assay laboratory
acronym	varchar	Acronym of geochemical assay laboratory
lab_code	bigint	Unique code for geochemical assay laboratory

Table 15. code_lab: geochemical assay laboratories list.

Field Name	Type	Description
prep_id	bigint	Sequential unique identifier for every sample preparation routine used
cert_id	bigint	Sequential unique identifier for every geochemical assay certificate from every assay report
prep_comments	text	Additional remarks on the method of sample preparation
prep_method_code	bigint	Unique code for type of sample preparation method

Table 16. prep: geochemical assay preparation method information.

Field Name	Type	Description
abbreviation	varchar	Abbreviation of sample preparation method
description	varchar	Additional notes on lab preparation method
details	text	Desciption of lab preparation method
prep_method_code	bigint	Unique code for type of sample preparation method

Table 17. code_prep: geochemical assay preparation methos list.

Field Name	Type	Description
unit_name	varchar	Abbreviation of measurement unit
details	text	Name of measurement unit
unit_code	bigint	Unique code for unit type

Table 18. code_unit: measurement units list.

Field(s)	Check
drill_start_dt, drill_end_dt, azimuth, dip, drill_type_code, ground_ref_code, hole_name, easting, northing, epsg_srid, reference_code, length, hole_diameter_code, source_code	Must not be null
azimuth	Must be more than or equal 0 and less than 360
dip	Must be less than 0 and more than or equal to -90 for drillholes drilled from the surface; and less than or equal to 90 and more than or equal to -90 for drillholes drilled from underground
hole_name	Must be unique for each assessment report
drill_type_code	Must be an acceptable drill type method
ground_ref_code	Must be either of the binary options, surface or underground
easting, northing	Must be numeric
epsg_srid	Must be an acceptable datum code
easting, northing, epsg_srid	Must fall within the provincial boundaries
easting, northing, epsg_srid	Generally, drillhole locations should be within a 10 km radius from the ARIS source report location, unless there is a documented reason for which this is not the case
elevation	Must be numeric, positive and be less than 5000 m
location_method	Must be an acceptable location method
reference_code	Must be an acceptable reference
length	Must be numeric and positive
diameter_code	Must be an acceptable drill collar code or equivalent diameter
reduced_diameter	Must be a boolean
source_code	Must be an acceptable source type

Table 19. collar data checks

Field(s)	Check
hole_name, from_depth, to_depth, litho_unit	Must not be null
hole_name	Must be a valid entry according to the drill collar table
from_depth, to_depth	Must be numeric
to_depth	Interval base depth must be greater than interval top depth
from_depth, to_depth	There must not be depth overlaps or gaps in sampling intervals, unless there is a valid reason stated in assessment report
to_depth	Base of last interval must be equal to total length of its respective drillhole
hole_name	Every drillhole name entry in drill collar table must have corresponding entries in lithology table

Table 20. litho data checks

Field(s)	Check
hole_name, sample_name, from_depth, to_depth	Must not be null
hole_name	Must be a valid entry according to the drill collar table
sample_name	Must be unique for each assessment report
from_depth, to_depth	Must be numeric
to_depth	Interval base depth must be greater than interval top depth
from_depth, to_depth	There must not be depth overlaps or gaps in sampling intervals, unless there is a valid reason stated in assessment report

Table 21. sample data checks

Field(s)	Check
cert_no	Table certificate number must match the value in the file name
analyte	Must be an acceptable analyte name
unit_code	Must be an acceptable unit
d_limit, method_code	Must not be null
d_limit	Must be numeric
method_code	Must be an acceptable method
abundance	Must be numeric and positive, except for less and greater than symbols
abundance	For less and greater than, value must be numeric, positive; for less than, value should be equal to detection limit
abundance	Must not amount to more than 100% in accordance with its respective measurement unit
sample_name	Must be unique for each assessment report, unless sample is split among more than one certificate

Table 22. determin data checks

Field(s)	Check
lab_code and prep_method code	Must be an acceptable laboratory and preparation method
cert_date	Certificate must have a date
cert_date	Certificate date must be valid
cert_no	Table certificate number must match the value in the file name

Table 23. cert and prep data checks

5. Conclusion

The assessment report drillhole database makes information locked in PDF or paper copy reports more accessible. Data extracted and digitized from these reports are released as a GeoPackage (BCGS_GF2025-11.zip), which can be imported directly into most GIS. The database continues to grow as more data from additional assessment reports are compiled and validated. The BCGS invites submission of data in raw and tabular format to ARIS.digital@gov.bc.ca. We would appreciate being notified of errors in the database.

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