Depth to bedrock dataset for the Interior Plateau

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Front cover: Bedrock outcrop looking west along the North Thompson River. **Photo by H. Arnold.**

The dataset for this paper can be downloaded from
https://www2.gov.bc.ca/gov/content/industry/mineral-exploration-mining/british-columbia-geological-survey/publications/geofiles#GF2021-13

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Abstract
This dataset contains both surface and subsurface locations of bedrock in the Interior Plateau. Observations were extracted from surficial and bedrock geology maps, sample locations for lithogeochemistry and geochronology, water well records, and assessment reports. These data were classified and compiled into consistent terminology and data structure while retaining original unit descriptions and publication information. These data that can be used as training data to produce or constrain spatial or geophysical predictions of the depth to bedrock.

Keywords: bedrock outcrop, depth to bedrock, surface sediment thickness, compilation, Interior Plateau

1. Introduction

Bedrock surfaces can be modified by chemical weathering, mechanical weathering, diverse erosional processes, and tectonic deformation. During the Late Pleistocene Fraser glaciation (29-10.5 ka), British Columbia was covered by the Cordilleran Ice Sheet, which resulted in bedrock surfaces being eroded, sculpted, and buried by variable thicknesses of glacial deposits (e.g., Clague and Ward, 2011; Hickin et al., 2017). Mineral exploration in regions with thick (locally up to ca. 400 m) glacial sediments, such as the Interior Plateau, has been hindered by a lack of knowledge of their thickness, distribution, and depositional history (e.g., Andrews et al., 2011; Caron et al., 2015), particularly where geochemical and geophysical methods have been used. Understanding these cover sediments is also valuable to disciplines such as agriculture, ecology, hydrology, and engineering (e.g., Shangguan et al., 2017).

The sediment-bedrock contact must be located to establish deposit thickness. This contact can be located through geophysical methods such as resistivity, electromagnetics, seismic refraction, and ground penetrating radar. It can also be located by direct measurement such as from diamond drilling or water well records (Hickin and Kerr, 2005; Gao et al., 2006; Paulen et al., 2006; Paradis et al., 2010; Slattery et al., 2010; Andrews et al., 2011; Benoit et al., 2015; Petrel Robertston Consulting Ltd., 2015; MacCormack et al., 2016; Rowins et al., 2018).

The primary objective of the present study is to present a sediment thickness and depth-to-bedrock dataset (BCGS_GF2021-13.zip) from an area in the Interior Plateau of past and current mineral exploration interest (Fig. 1). This area extends northwest from Williams Lake in the south to Mackenzie in the north and includes about 61,900 km^2. We integrate various data sources that use direct measurements to specify the location of the bedrock-sediment contact and bedrock outcrop. This dataset contains both surface and subsurface locations of bedrock that can be used as training data to produce or constrain spatial or geophysical predictions of the depth to bedrock.

2. Data types

The data we used fall into two categories, subsurface and surface. Subsurface data were derived from British Columbia Ministry of Environment water well records and British Columbia assessment report drillholes. Surface data were derived from surficial geology and bedrock geology maps and British Columbia Geological Survey lithogeochemistry, geochronology, and ice-flow indicator databases. Critical to the analysis of these data was evaluating a diverse set of textural descriptions and lithologic classifications to determine if a unit was a surficial sediment or bedrock. These data have been compiled from publicly available digital sources. Additional data are available in PDF format but need to be extracted into a usable format before incorporation. The following is a detailed description of the data types used.

2.1. Subsurface data

Water well records from the British Columbia Ministry of Environment's groundwater wells (GWELLS) database were used (British Columbia Ministry of Environment, 2021) in this dataset. The primary application of these data is to document groundwater wells in British Columbia, map aquifers, and monitor groundwater levels. Regardless, these data commonly contain textural and lithological descriptions that can be used to locate the bedrock-sediment interface. Although these data were useful, different well operators commonly used different

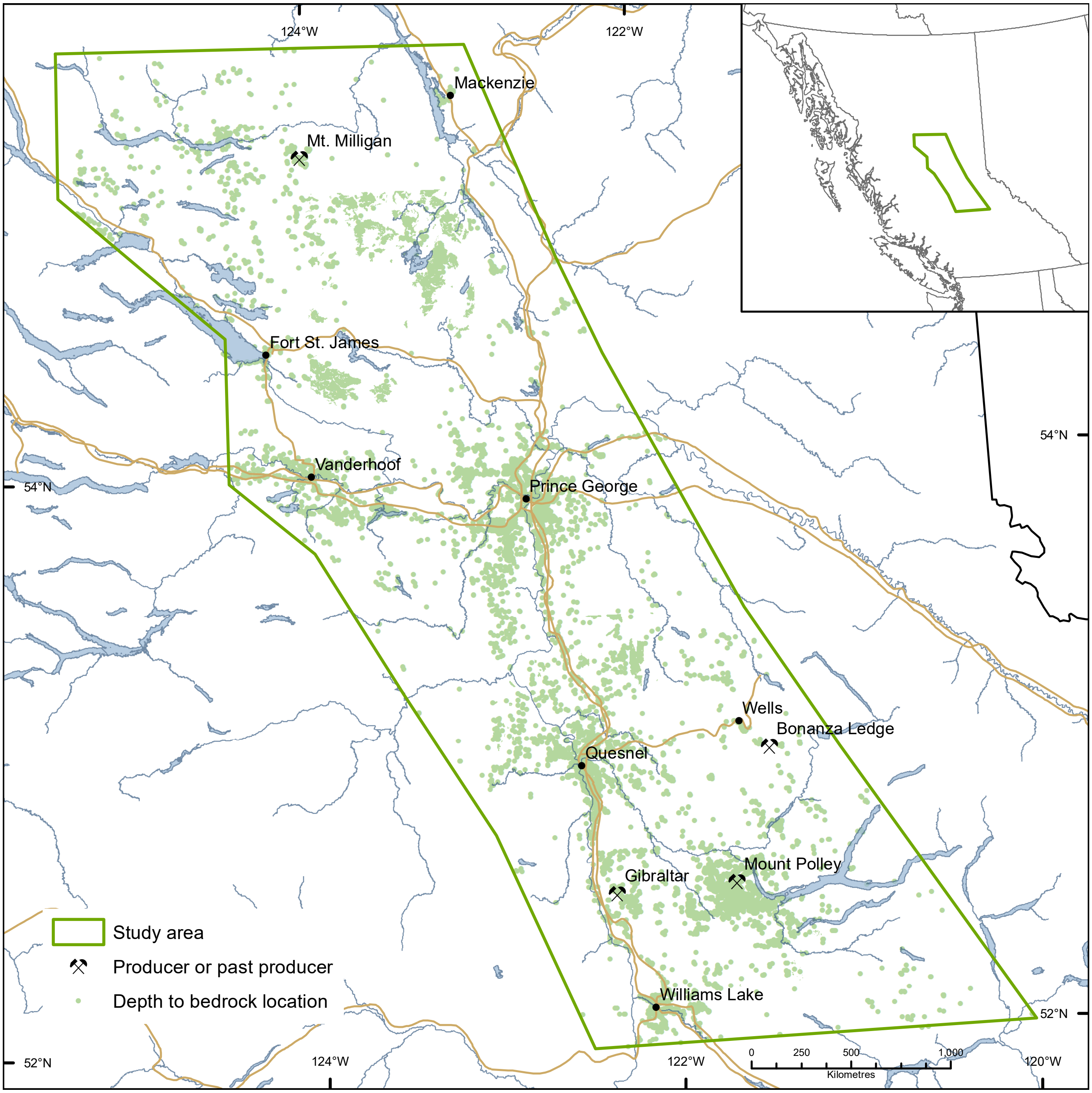

Fig. 1. Depth to bedrock measurement locations in the study area.

non-standard descriptive terms, which introduced ambiguities and uncertainties in what was identified in logs. Given these uncertainties, we assigned a data confidence qualifier when classifying these data (Table 1). A confidence value of 'high' was used for wells with textural descriptions and lithological classifications that seemed to confidently or reasonably be identifiable surficial sediment or bedrock, whereas a confidence value of 'low' was used in cases where identification was unclear. Spatially, water well data are highly clustered in urban areas and connecting corridors, leaving rural areas with sparse coverage or none of this data type. Although these data have limitations, they are a valuable publicly available source of subsurface textural and lithological descriptions.

Assessment reports in British Columbia are publicly available and accessed through the British Columbia Geological Survey's Assessment Report Indexing System (British Columbia Geological Survey ARIS, 2021). These reports document mineral exploration and development work and associated technical data (e.g., sample locations, geochemical analyses, drillhole parameters, geologial mapping, geophysical survey parameters and results). Drillhole data such as collar information (i.e. drill hole location, orientation coordinates)

Table 1. Data table structure and field descriptions for 'point_location' and 'area_location'

classification	Data have been classified as surficial sediment or bedrock	surficial; bedrock
qualifier	Used for data classified as surficial sediment to qualify where bedrock is located. Known indicates the sediment-bedrock interface is identified. Subcrop indicates bedrock is beneath at a relatively shallow depth. Below indicates bedrock is below at unknown depth. Nearby indicates bedrock outcrop has been identified nearby, but at an unknown distance. Above used for data classified as bedrock to qualify if sediment-bedrock contact is potentially located above.	known; subcrop; below; nearby; above
confidence	Estimate of data quality. High confidence for units with textural descriptions and lithological classifications that are easily determined to be surficial sediment or bedrock. Low confidence for units that are not easily classifiable as surficial sediment or bedrock.	high; low
elevation (m)	Elevation above sea level in metres if provided in original data.	695
depth (m)	Depth below surface in metres.	7
latitude (NAD 83)	Latitude of location in decimal degree, using NAD83 datum	54.776571
longitude (NAD 83)	Longitude of location in decimal degree, using NAD83 datum	-123.729537
category	If data originate from a subsurface or surface source. Subsurface data have been extracted from well water data or assessment report drillholes. Surface data have been extracted from surficial or bedrock mapping.	subsurface; surface
orig_type	Original description of unit.	extensional quartz vein; sandy loam
orig_code	Code used in source publication. Drillhole, sample number.	76053
comments	Comments included in original data.	pyroxene diorite; central volcanic rocks
pubno	Publication number that links to data_source_info table.	GF2020-02

and lithological information were used to determine the bedrock-sediment interface. Directed towards geological purposes and with a more standard terminology for descriptions of lithological units, a confidence value of 'high' was used for the ARIS-derived dataset (Table 1). A 'low' confidence value was not used as there were no cases where the identification of lithological units was unclear. Assessment report drillhole data are solely from rural areas. These data are available in small clusters but, at the scale of the entire study area, the concentration of the data is low.

2.2. Surface data

2.2.1. Surficial geology data

Surficial geology maps delineate both large areas of bedrock outcrop and locations of small, isolated outcrops. Large areas of bedrock outcrop are commonly mapped using aerial photography or satellite imagery. Small local bedrock exposures are mapped in the field. Site descriptions are commonly incorporated where bedrock outcrop is observed nearby. Surficial geology map coverage is incomplete across the study area but was incorporated where digitally available.

Surficial geology maps identify ice-flow indicators, some of which are bedrock based (e.g., striations, crag-and-tails, fluted bedrock). The British Columbia Geological Survey's ice-flow indicator database contains data derived from published and unpublished surficial geology, terrain, bedrock geology, and glacial feature maps (Arnold and Ferbey, 2020). Bedrock based ice-flow indicators were extracted and used to locate bedrock outcrop. We assigned data presented in surficial geology maps a confidence value of 'high' (Table 1) because these are known bedrock locations.

2.2.2. Bedrock geology data

Bedrock geology maps delineate areas of bedrock outcrop. The location of outcrop was determined using sample locations, structural measurement locations, and site descriptions. These data were incorporated where digitally available. The British Columbia Geological Survey's lithogeochemistry and geochronology databases contain province-wide locations of bedrock samples (Han and Rukhlov, 2020; Han et al., 2020). Sample site data from both these datasets were extracted for this study to use as locations of bedrock outcrop and we assign these data a 'high' confidence value.

3. Database structure

The depth-to-bedrock dataset presented here contains three components: 1) point locations of bedrock outcrop (point_location); 2) area locations of bedrock outcrop (area_location); and 3) a table of source publications (data_source_info). Both the point and area locations of outcrop contain the same table structure (Table 1). The data_source_info table links to point_location and area_location through the pubno field (Table 2).

4. Data table metadata

The dataset contains both classified and original data (Table 1) to allow the user to see how each data point and area location was classified. The following is a detailed description of the data table fields.

4.1. Classified data fields

The classification, qualifier, confidence, depth, location (latitude and longitude), and category fields (Table 1) contain data that were derived from the original dataset.

A classification of surficial or bedrock was applied to all the data in the dataset based on the textural and lithological descriptions in the source documents. Subsurface data were classified as either surficial sediment or bedrock. Given that finding water is the main purpose of drilling water wells, these drillholes commonly ended in surficial sediments rather than bedrock, thus providing only a minimum thickness of the surficial sediments. With a primary interest in bedrock geology, mineral exploration assessment report drillholes generally penetrate the bedrock-sediment contact. Most surface data have a 'bedrock' classification because they are locations of bedrock outcrop. In cases where surficial geology maps referred to subcrop or nearby bedrock outcrop, we used the 'surficial' classification with a qualifier of either 'subcrop' or 'nearby'.

The qualifier field was mostly used to indicate if the sediment-bedrock interface is known or unknown. A value of 'known' was used where the contact was identified. Qualifiers of 'below', 'subcrop', 'nearby', and 'above' were used where the contact is unknown, but its general location is indicated. Water wells commonly end in surficial sediments and, in these cases, 'below' was used to indicate the sediment-bedrock interface is below, at an unknown depth. If the site description

Table 2. data_source_info table attributes.

Column name	Description
pubno	Publication number that links to point_location and area_location tables
src_author	Author(s) of publication
src_year	Year of publication
src_title	Title of publication
src_org	Publishing organization
src_series	Publication series type
src_pubno	Publication number
src_scale	Scale of publication or page numbers
src_datum	Source datum of data
src_prj	Source projection of data

notes indicate that bedrock is beneath, but at a relatively shallow depth, the qualifier 'subcrop' was used. Similarly, if the description notes refer to nearby bedrock exposed nearby, the qualifier 'nearby' was used (although the distance may or may not be indicated). The 'above' qualifier was used where data are classified as bedrock, but the unit directly above cannot be confidently determined to be a surficial sediment or bedrock. For example, in some cases it was unclear if 'broken rocks' directly above bedrock were fragmented during drilling.

The confidence field is an estimate of how reliable the classification of the data is. We generally assigned 'high' confidence to data from published geological maps and reports and from mineral industry assessment reports. Because of ambiguities arising from inconsistent nomenclature by water well operators, water well data were given 'high' confidence in cases where the distinction between sediment and bedrock seemed reasonably clear; these data were given 'low' confidence in cases where this clarity was lacking.

The depth field contains the depth below surface. All the data were converted to metres. If the qualifier field has a value of 'known', then the depth is the location of the sediment-bedrock contact. If the data are classified as surficial with a qualifier value of 'below', then bedrock was not located, and the depth below surface is a minimum value of sediment thickness. If the data are classified as bedrock with an 'above' qualifier then the sediment-bedrock contact was unclear, but bedrock was located and the depth below surface is a maximum value of bedrock depth because the sediment-bedrock contact could occur above.

The latitude and longitude in decimal degree with NAD83 datum are provided for point data. Because original data were mapped in different datum and projections all the data were reprojected to NAD83 decimal degree. The original datum and projections can be found in Table 2 in the fields 'src_datum' and 'src_prj'.

The category field is used to enable easy extraction of subsurface or surface data from the dataset.

4.2. Original data fields

Original data are included to provide the lithological unit description and publication source information (Table 2). The elevation, orig_type, orig_code, comments, and pubno fields contain source data. Elevation is only provided if it was recorded in the original dataset. No derived elevations from a digital elevation model (DEM) are provided. Orig_type is the original description of unit. Orig_code is the code used in source publication, such as the drillhole collar or sample number. Comments contains any original comment made about the unit, commonly made to provide context or further unit descriptions. Pubno contains the original publication number, which contains the full reference of the source data.

5. Data limitations

These data were compiled from publicly available digital sources; we did not include data available in PDF format that needed to be extracted into a usable format. The spatial coverage of subsurface data across the entire study area is low and the data types are clustered. Water well logs commonly contain non-standard descriptive terms, which led to uncertainties is identifying what was being described. In many cases, water wells failed to penetrate the sediment-bedrock contact and only yielded minimum values for sediment thickness and depth to bedrock.

6. Summary

This dataset contains sediment thickness and location of bedrock data that can be used as training data to produce or constrain spatial or geophysical predictions of the depth to bedrock. These data were classified and compiled into consistent terminology and data structure while retaining original publication information.

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