

Development of a Database for Geoscience Field Observations, West-Central British Columbia (Part of NTS 093L)

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Introduction

The recording, analysis and publication of field observations, measurements and interpretations are an integral part of developing geoscience investigations. Historically, these field-acquired data and associated research materials were recorded, compiled and maintained in hard copy by individual scientists using various schemas. At the completion of the study, field maps and notebooks are archived in data repositories and libraries (Schumacher, 2002). To date, there are only a few programs, such as Natural Resources Canada's Consolidating Canada's Geoscience Knowledge Program (http://ess.nrcan.gc.ca/2002_2006/ccgk/index_e.php), that have been developed to specifically catalogue and digitize geological information previously available only in hard copy.

Although recent technological advancements now allow geological information to be directly inputted into digital databases from the field (e.g., Brodaric, 2004), there remains a requirement that these custom databases be designed to allow data to be queried, appended and edited by the geoscientist. Furthermore, the databases must also be compatible with corporate data structures and readily converted to other file formats.

To this end, a database was developed to store observations made in the field for the Geoscience BC-supported project, Surficial Geochemistry and Lithology of the Bulkley River Valley, Central British Columbia, which is currently only available from the author in hard copy. This database will assist users of the accompanying till geochemistry and clast lithology data to explore and query other information collected at each sampling site (e.g., location, drainage class, topographic position, character of sampled material, lithology of clasts in the material and bedrock lithology if observed at the sampling site). This paper is a preliminary guide to the structure of the database, which will be re-

leased as part of the final project report in early 2012 through Geoscience BC.

Field Data

Field observations were made at a total of 146 sampling sites for a study of the till geochemistry and clast lithology in west-central BC (Stumpf, 2011) in an area approximately 340 km east of Prince Rupert and 400 km west of Prince George (Figure 1). The project area is centred along the Bulkley River valley and adjacent areas (encompassing parts of NTS map areas 093L/07, /08, /09, /10, /11, /15; Figure 1) within the Geoscience BC's QUEST-West Project area and the Mountain Pine Beetle-Impacted Zone.

In a similar manner to the till geochemistry surveys conducted by Levson (2002) and Ferbey (2011), the selection of field sample sites for this project was undertaken to provide as complete coverage of the project area as possible using existing access routes. The sites were also selected to set the greatest density of samples along transects perpendicular to the regional ice-flow direction. Along transects paralleling the ice flow, less dense sampling was carried out. Samples of various geological materials—predominantly glacial till, but also silt and clay (glacial lake sediment) or diamicton reworked by water and gravity—were collected from natural and manmade exposures such as roadcuts, cuts along the shore of rivers and lakes, borrow pits and hand-dug holes. The average sampling depth below land surface ranged from 0.20 to 22 m.

At each sample site, a series of observations were made describing the site location and conditions, landscape position and vegetation, and properties of the geological materials (Table 1). The field sites were marked with metal tags and flagging tape, both labelled with site numbers that were assigned in sequential order. The location of sample sites were plotted on 1:50 000 NTS base maps with the aid of air photographs and a handheld GPS unit. The co-ordinates from the GPS for each sample site were recorded in the field on a hard-copy card similar to the form shown in Figure 2. The co-ordinates were recorded in the UTM projection, referenced to NAD 83, Zone 9.

Keywords: *database, geoscience, Quaternary geology, mineral exploration, QUEST-West*

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Sedimentological data including sediment descriptions, primary and secondary structures, matrix texture, presence of fissility, compactness, sediment genesis and thickness, total percentage and modal size, rounding and presence of striated clasts were also collected at each site (Table 1). This information was used to identify geological materials with different processes of transportation and deposition. For example, the information was used to distinguish diamicton that was classified as till from deposits of glaciogenic debris flows, colluvial processes, proximal

glaciofluvial meltwater or subaqueous debris flows or ice-rafted debris in glacial lakes. This information is very important to the understanding of associated anomaly patterns because variations in geochemistry from local sources are reflected in some materials whereas regional trends are observed in others. Additional information was collected describing the soil horizons, local slope, drainage class, dominant tree species, bedrock striae and bedrock lithology (Table 1).

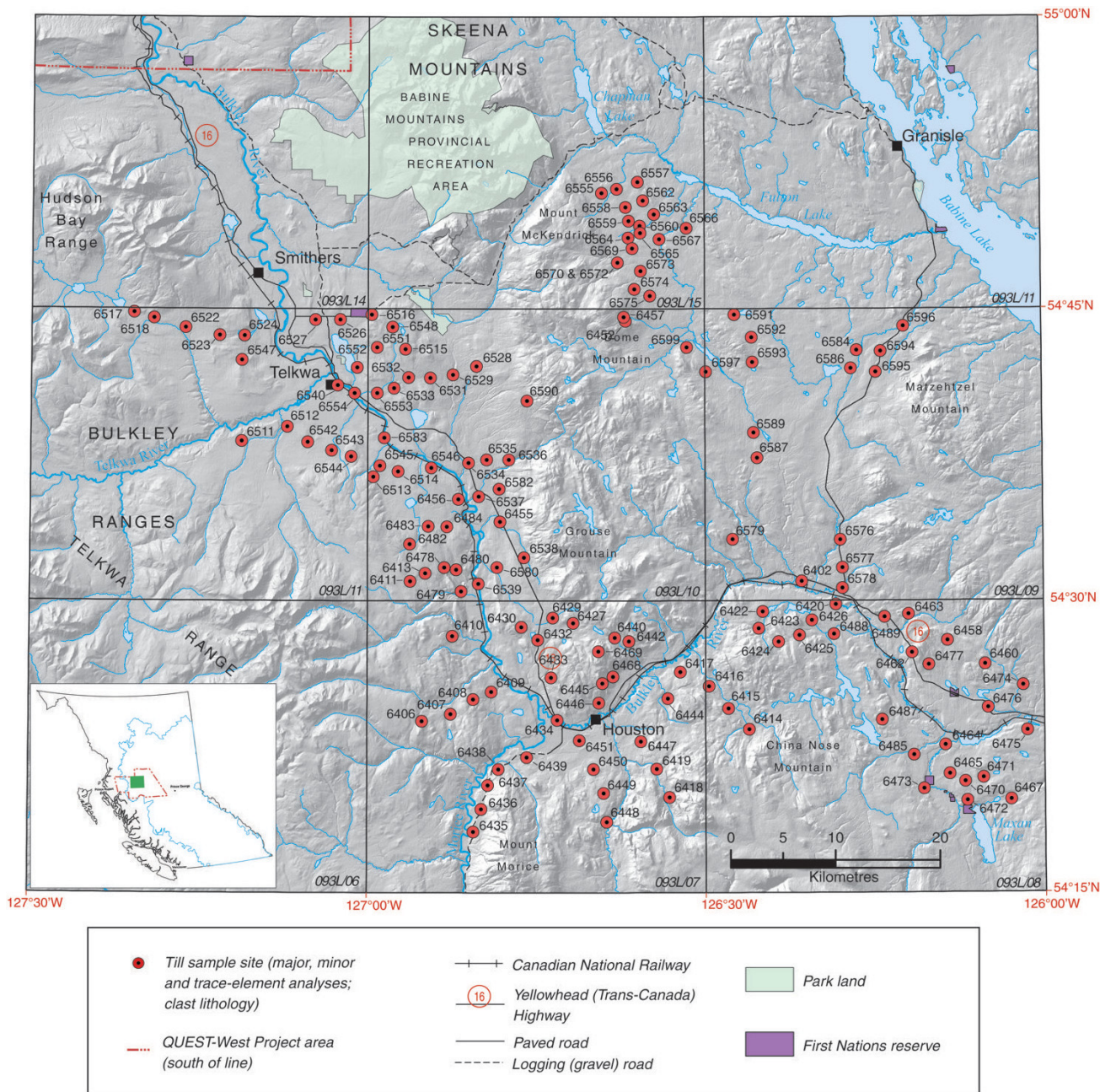


Table 1. Guide to field observations collected for the project along the Bulkley River valley (after Levson, 2002). The data is input into a relational database with a structure outlined in Tables 2–4. The 'Unit' field contains codes for deposit type, thickness and depositional processes (from Howes and Ken, 1997).

| Parameter | Description |
|----------------|---|
| Year | Year sample collected |
| Day_Month | Day and month sample collected |
| Type | Type of regional survey: LITH, clast lithology; TS, till |
| ID | Sample site number |
| Collector | Scientist(s) that collected the sample: AS, Andrew Stumpf; EB, Erin O'Brien; LV, Victor Levson; DM, Dan Meldrum; DH, David Huntley; CC, Craig |
| Map50 | NTS 1:50 000 scale map (in 093L) |
| Status | Identifies the collection of multiple samples from a single site. Quality control identifier: 00, routine sample; 10, first field duplicate; 20, second field duplicate |
| UTMZ | Site location UTM zone |
| UTME83 | Site location UTM easting (metres) referenced to NAD83 datum |
| UTMN83 | Site location UTM northing (metres) referenced to NAD83 datum |
| Lat | Latitude (decimal degrees) calculated from NAD83 UTM coordinates |
| Long | Longitude (decimal degrees) calculated from NAD83 UTM coordinates |
| Elev | Elevation of land surface (in feet above mean sea level) taken from BC TRIM map |
| Depth | Depth of sample from land surface (in metres) |
| Unit* | Surficial deposit type and thickness/depositional process: b, blanket; C, colluvial; FG, glaciofluvial sediments; LG, glaciolacustrine sediments; M, morainal; R, bedrock map symbol: b, blanket; r, redeposited; v, veneer; ^, overlying; (e.g., FG^Mb, glaciofluvial sediments over morainal blanket) |
| Material | Sample material type: C, clay; Dmm, diamicton (massive, matrix-supported); G, gravel; S, sand; Z, silt; prefix: c, clayey, g, gravelly, s, sandy, z, silty (e.g., szDmm, sandy to silty diamicton) |
| Exposure | Sample material exposed in: 1, roadcut; 2, shore of river or lake; 3, borrow pit; 4, hand-dug hole |
| Terrain | Position of site location on slope: 1, flat; 2, lower slope; 3, midslope; 4, upper slope; 5, ridgecrest |
| Terrain_Com | Topographic position (description) |
| Aspect | Azimuth (direction) that the land surface is sloping |
| Slope | Inclination of the land surface at the site location |
| Drainage | Drainage class: 1, poor; 2, moderate; 3, well Note: 0.5 is intermediate between any two classes |
| Vegetation | Dominant tree species at site location: al, alder; as, aspen; b, birch; bf, balsam fir; cc, clearcut; d, deciduous; f, fir; j, juniper; p, lodgepole pine; pop, poplar; s, spruce; saf, subalpine fir; sw, swamp; ws, white spruce |
| Soil | Thickness (m) of soil horizon(s); X, disturbed ground |
| Fissility | 0, none; 1, weak; 2, moderate; 3, strong |
| Density | 1, loose; 2, stiff; 3, hard |
| Oxidation | 0, none; 1, mild; 2, moderate; 3, high Note: 0.5 is intermediate between any two classes |
| Jointing | 0, none; 1, few; 2, some; 3, many |
| Matrix | Proportion of matrix material in bulk sample: 60, 70, 80, 90 |
| Matrix_Colour | Matrix colour: b, brown; bl, blue; bt, blue tinge; cb, chocolate brown; db, dark brown; dg, dark grey; dgr, dark green; dgb, dark greyish brown; dr, dark red; g, grey; gb, grey brown; gr, green; lb, light brown; lg, light grey; o, orange; ob, orange brown; ol, olive; p, purple; r, red; rb, reddish brown; y, yellow; t, tan; tb, tan brown |
| Matrix_Texture | Matrix texture: 1, sandy; 2, silty; 3, silty sand; 4, sandy silt; 5, other (see comments) |
| Clast_Mode | Size of pebbles: 1, small pebble; 2, medium pebble; 3, large pebble; Note: 0.5 is intermediate between any two mode classifications |
| Max_Clast_Size | Maximum clast size observed (b-axis dimension in cm) |
| Clast_Shape | Shape of clasts: 1, angular; 2, subangular; 3, subrounded; 4, rounded; 5, well rounded Note: 0.5 is an intermediate value between any two shape classifications |
| Clast_Striated | Proportion of striated clasts: 0, none; 1, rare (<1%); 2, common (1–10%); 3, abundant (>10%) |
| Bedrock_Lith | Bedrock lithology: n/v, not exposed; AND, andesite; B, basalt; CH, chert; COAL, coal; CONG, conglomerate; DIO, diorite; FP, feldspar porphyry; GR, granitic; GRD, granodiorite; GRN, greenstone; GW, greywacke; LAPT, lapilli tuff; LST, limestone; METSEDS, metasediments; MS, mudstone; RHY, rhyolite; SH, shale; SS, sandstone; SY, syenite; |
| Comments | Relevant information about the sedimentology, geology, location, or site characteristics |

Database Construction

A database was developed using Microsoft® Access® 2010 to input field data including site information, observations and interpretations. The database was designed to facilitate retrieval, interpretation and analysis of information associated with the collection of till and clast lithology samples, and is based on a relational database using Microsoft Access forms and tables developed at the Illinois State Geological Survey (Stiff, 2002).

The data is input via either a write-access form or three database tables that allow researchers to query, append to and edit the data housed in the database. Each field site has a unique identification code ('Sys_ID'). This identification code is used to establish a 1:1 relationship between the 'Field ID' table and the other two tables containing location information and geographic descriptions ('Header' table) and geological observations and interpretations ('Descriptions' tables).

The 'Field_ID' table contains identification codes that have been assigned to a particular site (Table 2). The ID is a unique number for each sample site assigned by the project geologist. The 'Master_Num' field was created to follow the file structure of geochemical databases maintained by Geoscience BC (Jackaman, 2007) and the BC Geological Survey (Lett, 2008). This field is also a unique identifier containing sample identification information, a compound of the fields 'Type', 'Map50', the last two characters of 'Year' and the 'ID'. The 'Type' indicates the type of survey

| | |
|---|------------------|
| DATE: 18-AUG-1996 | ID: 6458 |
| COLLECTOR: DM, AS | NTS MAP: 093L/08 |
| STATUS: <input checked="" type="checkbox"/> Routine <input type="checkbox"/> First duplicate <input type="checkbox"/> Second duplicate | |
| Easting: 685250 Northing: 6039200 | ELEV (ft.): 2523 |
| MAP UNIT: Mb^R | MATERIAL: czDmm |
| DEPTH: 1.2 m | |
| EXPOSURE: <input checked="" type="checkbox"/> Roadcut <input type="checkbox"/> Str./Lake cut <input type="checkbox"/> Bor. pit <input type="checkbox"/> Dug hole | |
| TOPO POSITION: <input type="checkbox"/> Flat <input checked="" type="checkbox"/> L.slope <input type="checkbox"/> M.slope <input type="checkbox"/> U.slope <input type="checkbox"/> Crest | |
| ASPECT: NW | SLOPE (deg.): 2 |
| DRAINAGE: <input checked="" type="checkbox"/> Poor <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Well | |
| VEGETATION: <input checked="" type="checkbox"/> Lodgepole Pine <input checked="" type="checkbox"/> Spruce <input type="checkbox"/> Other | |
| SOIL (cm): <input checked="" type="checkbox"/> Dist. <input type="checkbox"/> LFH <input type="checkbox"/> Ah <input type="checkbox"/> Ae <input type="checkbox"/> Bm <input type="checkbox"/> Bf <input type="checkbox"/> Bt | |
| FISSILITY: <input type="checkbox"/> None <input type="checkbox"/> Weak <input type="checkbox"/> Moderate <input checked="" type="checkbox"/> Strong | |
| DENSITY: <input type="checkbox"/> Loose <input type="checkbox"/> Stiff <input checked="" type="checkbox"/> Hard | |
| OXIDATION: <input type="checkbox"/> None <input checked="" type="checkbox"/> Mild <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> High | |
| JOINTING: <input type="checkbox"/> None <input type="checkbox"/> Weakly <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Well | |
| MATRIX %: <input type="checkbox"/> 60 <input type="checkbox"/> 70 <input checked="" type="checkbox"/> 80 <input checked="" type="checkbox"/> 90 <input type="checkbox"/> Other | |
| COLOUR: gb - grey brown | |
| TEXTURE: <input type="checkbox"/> S <input type="checkbox"/> Z <input type="checkbox"/> ZS <input type="checkbox"/> SZ <input checked="" type="checkbox"/> Other | |
| CLASTS %: Mode: <input type="checkbox"/> S <input type="checkbox"/> M <input checked="" type="checkbox"/> L <input type="checkbox"/> Pbl Max (cm): <input type="checkbox"/> | |
| SHAPE: <input type="checkbox"/> A <input type="checkbox"/> SA <input checked="" type="checkbox"/> SR <input type="checkbox"/> R <input checked="" type="checkbox"/> WR | |
| STRIATED: <input type="checkbox"/> none <input type="checkbox"/> <1 % <input type="checkbox"/> 1-10 % <input checked="" type="checkbox"/> >10 % | |
| BEDROCK: green- and maroon-coloured siltstone and sandstone | |
| COMMENTS: Site location at bottom of SE-trending (100°) fluted ridge; 50 m to east of site is exposed basalt (vesicular) with green amygdules and malachite staining; sampled bedrock | |

Figure 2. Example of the database input form.

Table 2. Structure of the 'Field ID' table (length in number of characters; abbreviations: CHAR, text field; NUM, numerical field).

| TABLE_FIELD | TYPE | LENGTH | FORM EXPLANATION |
|-------------|------|--------|---|
| SYS_ID | NUM | 12 | sequential, system-generated identifier |
| ID | CHAR | 4 | sample number in survey |
| YEAR | CHAR | 4 | year sample was collected |
| DAY_MONTH | CHAR | 4 | day and month sample was collected |
| MASTER_NUM | CHAR | 15 | unique samples identification combines type of regional sample, NTS map area, collection year and original sample site number (e.g., TILL93L09966402) |
| TYPE | CHAR | 7 | type of regional survey |
| STATUS | CHAR | 2 | sample quality control identifier |

Table 3. Structure of the 'Header' table (length in number of characters; abbreviations: CHAR, text field; NUM, numerical field).

| TABLE_FIELD | TYPE | LENGTH | FORM EXPLANATION |
|-------------|------|--------|--|
| SYS_ID | NUM | 12 | sequential, system-generated identifier |
| COLLECTOR | CHAR | 15 | initials of field scientist(s) collecting the sample |
| MAP50 | CHAR | 5 | NTS 1:50 000 scale map |
| UTME83 | NUM | 14 | site location UTM easting (6 decimal places) |
| UTMN83 | NUM | 14 | site location UTM northing (6 decimal places) |
| UTMZ | NUM | 2 | site location UTM zone |
| LAT | NUM | 10 | latitude in decimal degrees (6 decimal places) |
| LONG | NUM | 10 | longitude in decimal degrees (6 decimal places) |
| ELEV | NUM | 5 | elevation of site location (in feet) |
| DEPTH | NUM | 3 | depth of sample (m) (1 decimal place) |

Table 4. Structure of the ‘Descriptions’ table (length in number of characters; abbreviations: CHAR, text field; NUM, numerical field).

| TABLE_FIELD | TYPE | LENGTH | FORM EXPLANATION |
|----------------|------|--------|---|
| SYS_ID | NUM | 12 | sequential, system-generated identifier |
| UNIT | CHAR | 5 | deposit type and thickness/depositional process |
| MATERIAL | CHAR | 5 | sampled material type and texture |
| EXPOSURE | NUM | 1 | condition that material is exposed |
| TERRAIN | NUM | 1 | position of site location on slope |
| TERRAIN_COM | CHAR | 100 | topographic position (description) |
| ASPECT | NUM | 3 | azimuth of slope (degrees) |
| SLOPE | NUM | 2 | inclination of land surface (degrees) |
| DRAINAGE | NUM | 2 | drainage class |
| VEGETATION | CHAR | 10 | predominant tree species |
| SOIL | NUM | 3 | thickness of soil horizon (m) |
| FISSILITY | NUM | 1 | degree of fissility developed |
| DENSITY | NUM | 1 | field measure of density, consistency or compaction |
| OXIDATION | NUM | 1 | degree of oxidation |
| JOINTING | NUM | 1 | density of joints and fractures |
| MATRIX | NUM | 2 | proportion of matrix material (percent) |
| MATRIX_COLOUR | CHAR | 3 | primary color of matrix material |
| MATRIX_TEXTURE | CHAR | 15 | in field estimate of matrix texture |
| CLAST_MODE | NUM | 2 | average size of pebbles |
| MAX_CLAST_SIZE | NUM | 3 | maximum size of clasts (cm) |
| CLAST_SHAPE | NUM | 1 | dominant shape of clasts |
| CLAST_STRIATED | NUM | 3 | proportion of striated clasts in bulk sample (percent) |
| BEDROCK_LITH | CHAR | 8 | bedrock lithology at site location (if exposed) |
| COMMENTS | CHAR | 100 | descriptive details relating to sedimentology, geology, site location, etc. |

that was completed. For this project, only till geochemistry and clast lithology surveys were completed. The ‘Status’ is a unique quality-control identifier assigned to field duplicate samples sent for geochemical analyses. One field duplicate sample was collected for every 20 samples in the survey and the duplicate samples were collected at the same site of the preceding sample in the sampling sequence. This sampling protocol is adapted from similar QA-QC procedures used by Geoscience BC, the BC Geological Survey and the Geological Survey of Canada for geochemical surveys (e.g., Cook and Dunn, 2007). These duplicate samples were randomly submitted to the laboratory without any indication of their proximity.

The ‘Header’ table includes information about the site and its location (Table 3). A geoscientist can update fields in this table as more accurate or more complete data become available.

The ‘Descriptions’ table includes information describing the physical, chemical and engineering properties of the geological materials sampled, as well as the topography, drainage class, predominant tree species and soil formation at the land surface (Table 4). Additional detailed comments are included in the table describing specific aspects of sedimentology, geology and the site location that cannot be entered in the other fields (e.g., direction of glacier flow inferred from striated bedrock).

Conclusion

This digital database of descriptive sedimentology, geology and characteristics of the land surface, along with the associated geospatial information, will add to the functional data repositories available from Geoscience BC. The database structure will first be used to distribute the results of the Geoscience BC–supported project, Surficial Geochemistry and Lithology of the Bulkley River Valley, Central British Columbia, in early 2012. In addition, the database has a digital framework that is compatible with other data repositories maintained by Geoscience BC and the BC Geological Survey. The ‘open access’ structure permits database query and edit functions. Because the database was constructed using an industry-standard database system, data can easily be exported to other systems (e.g., Oracle[®], MySQL[®]) or linked with GIS software. This database will provide access to ancillary information collected as part of a geochemical survey that can be incorporated into a wide range of exploration and research activities and assist in the planning of detailed surveys and targeted studies.

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