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

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Stumpf, A.J. (2012): Development of a database for geological field observations, west-central British Columbia (part of NTS 093L); *in* Geoscience BC Summary of Activities 2011, Geoscience BC, Report 2012-1, p. 53–58.

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 released 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).

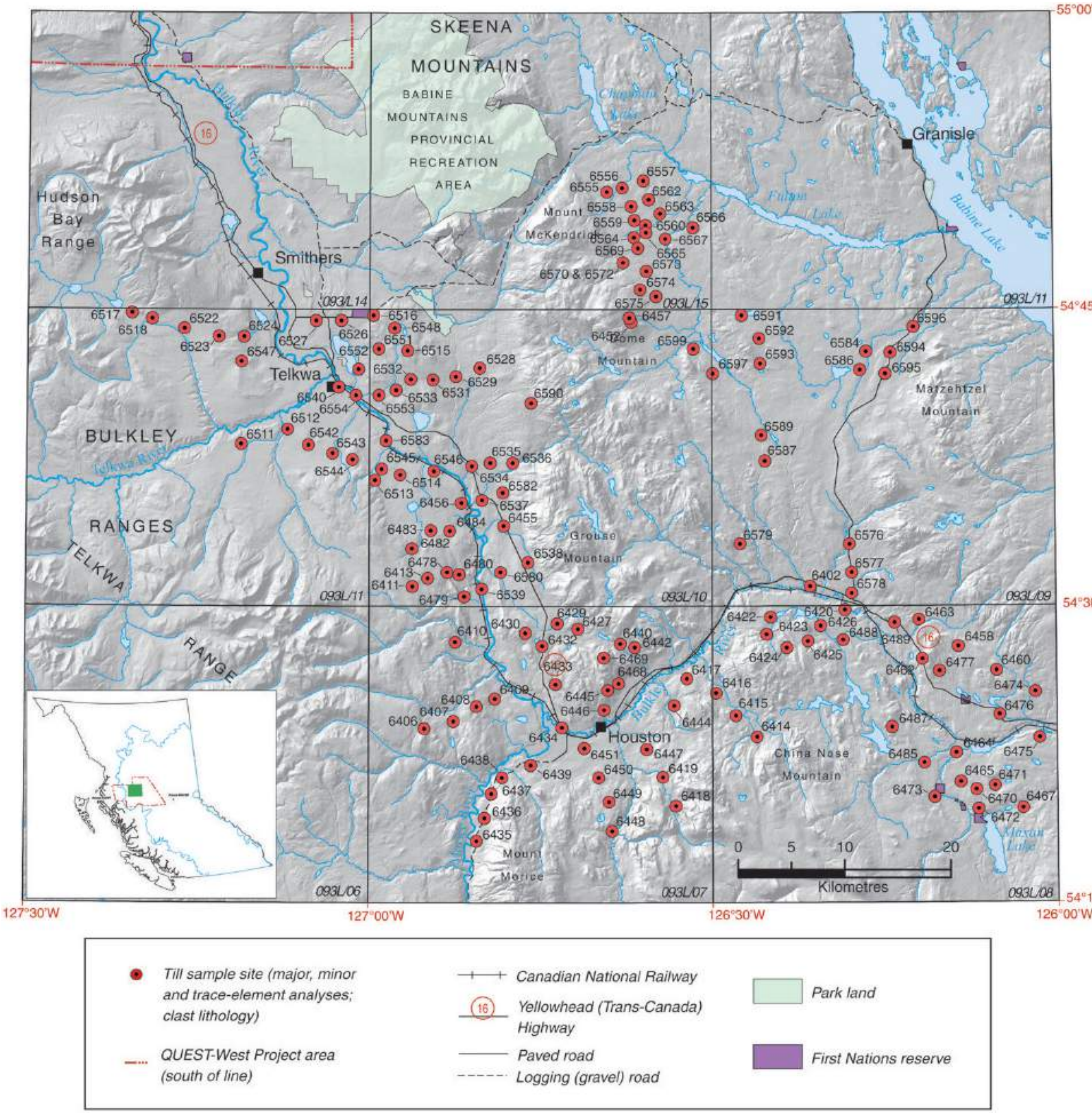

Figure 1. Location and till sample sites of the project area in west-central British Columbia (project area delineated by the green box on the inset map). Geoscience BC's QUEST-West Project area and the Mountain Pine Beetle–Impacted Zone are outlined by the red and light blue lines, respectively, on the inset map.

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 Kenk, 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

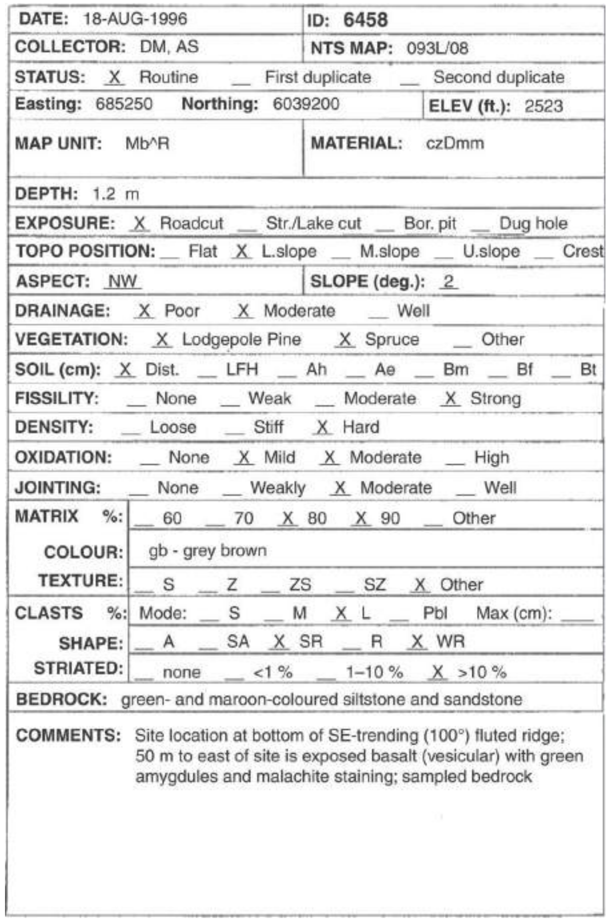
DATE: 18-AUG-1996 | ID: 6458
COLLECTOR: DM, AS | NTS MAP: 093L/08
STATUS: X Routine __ First duplicate __ Second duplicate
Easting: 685250 Northing: 6039200 | ELEV (ft.): 2523
MAP UNIT: Mb^R | MATERIAL: czDmm
DEPTH: 1.2 m
EXPOSURE: X Roadcut __ Str./Lake cut __ Bor. pit __ Dug hole
TOPO POSITION: __ Flat X L.slope __ M.slope __ U.slope __ Crest
ASPECT: NW | SLOPE (deg.): 2
DRAINAGE: X Poor X Moderate __ Well
VEGETATION: X Lodgepole Pine X Spruce __ Other
SOIL (cm): X Dist. __ LFH __ Ah __ Ae __ Bm __ Bf __ Bt
FISSILITY: __ None __ Weak __ Moderate X Strong
DENSITY: __ Loose __ Stiff X Hard
OXIDATION: __ None X Mild X Moderate __ High
JOINTING: __ None __ Weakly X Moderate __ Well
MATRIX %: __ 60 __ 70 X 80 X 90 __ Other
COLOUR: gb - grey brown
TEXTURE: __ S __ Z __ ZS __ SZ X Other
CLASTS %: Mode: __ S __ M X L __ Pbl Max (cm): __
SHAPE: __ A __ SA X SR __ R X WR
STRIATED: __ none __ <1 % __ 1–10 % X >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.

Acknowledgments

The project along the Bulkley River valley is being funded by Geoscience BC. The author thanks B. Stiff and S. Brown at the Illinois State Geological Survey for their insightful information about database structures. The author thanks B. Bauer and R. Klass for their thorough review of an earlier version of the manuscript.

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