PRELIMINARY INTEGRATED GEOLOGIC MAP DATABASES FOR THE UNITED STATES:

DIGITAL DATA FOR THE RECONNAISSANCE GEOLOGIC MAP FOR THE KODIAK ISLANDS, ALASKA

by

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INTRODUCTION

These digital files represent part of a systematic effort to release geologic map data for the United States in a uniform manner. Geologic data in this series has been compiled from a wide variety of sources, ranging from state and regional geologic maps to large-scale field mapping. It is presented for use at a nominal scale of 1:500,000, although individual datasets may contain data for use at larger scales. The metadata associated with each release will provide more detailed information on sources and appropriate scales for use. Associated attribute databases accompany the spatial database of the geology and are similarly uniformly structured for ease in developing regional- and national-scale maps.

The 1:500,000-scale reconnaissance geologic map of the Kodiak Islands, Alaska covers more than 4,900 square miles (12,800 square kilometers) of south central Alaska. The Kodiak Islands are located on the west side of the Gulf of Alaska and are one of the largest areas of exposure of the flysch and melange of the Chugach terrane of southern Alaska. However, in the past 25 years, only detailed mapping, covering small areas in the archipelago has been done.

The primary source for this map for Kodiak Island and south is the reconnaissance mapping of George W. Moore (1967) augmented with unit descriptions from George W. Moore (1969) and new mapping along the west coast of the islands by Connelly and J. Casey Moore (Connelly, 1978; Connelly and Moore, 1979) and on the east coast by Moore and others (1983). George Moore's map in turn is heavily based on Capps (1937), which is the major source for the Afognak Island part of the present map.

The digital datasets that form the basis for this product were compiled and created using existing published and unpublished data. The spatial and text databases here are linked through use of a field, called *nsaclass*, that is related to the age and lithology of the map units contained on each map. *Nsaclass* and the similar *qclass* field have been added to the polygon attribute table (PAT) of the spatial database and are also found in the text databases of supplemental attribute data. These fields store information that correlates individual map units between sources. *Nsaclass* is used to make regional unit assignments and generally reflects a known or an inferred correlation of map units. For example, all "Surficial deposits, undivided" are assigned an nsaclass code of 100. The schema for nsaclass was developed as regional maps throughout Alaska were compiled and therefore reflects an iterative process. As new or additional information becomes available, the nsaclass code for a particular map unit may be changed, either to reflect lumping or finer separation of map units. *Nsaclass* is used to cover the entire geologic time scale, whereas *qclass* is restricted to and provides finer detail for Quaternary map units. Fields called *source* and *nsamod* have also been added to the PAT. Source is a coded reference citation, indicating the manuscript or other source for the map information. The format for *source* is XX###, where XX is the two letter quadrangle code (CAPITAL letters) and ### is a three digit number (using leading zeros) to indicate a specific reference. *Nsamod* provides information with respect to hydrothermal alteration or contact metamorphism of a map unit, either for the entire unit or for an individual polygon. In this way, the *nsaclass* field needs to only store the primary map unit information. Fields also in the PAT are *class*, *label*, *min_age*, and *max_age* which are more fully described in the accompanying documentation. Finally, a field called *lith2* is in the PAT as a scratch field; no uniform schema has been developed for this field.

The arc attribute table (AAT) stores attributes indicating the type of line features in the coverages and shape files. Inherent in the coding is information defining the type of line shown, such as a stratigraphic or fault contact, and location (certain, approximate, inferred, or concealed). In addition, each arc within a spatial database has a source attribute.

The standardized supplemental attribute tables were generated by extracting information from the legends of the source maps and from unpublished data by the compilers of this regional map. Thus, the age and lithologic information in the attribute tables may, in some cases, conflict with the information on the legends of the original source maps. This reflects new information for maps that may have been compiled decades ago. The standardized supplemental attribute tables record an abstracted map unit description, lithologic and age information, and references.

The spatial databases are provided in the native UTM projection of the sources as well as geographic coordinates. The UTM projection parameters are described in the metadata, note that the datum is NAD ’27. Regional maps in Alaska are commonly presented using an Albers Equal-area projection and the parameters for this projection are as follows:

Projection: Albers Equal-area

Horizontal datum: NAD’27

Spheroid: Clarke, 1866

1st Standard parallel: 55 degrees North

2nd Standard parallel: 65 degrees North

Central meridian: 154 degrees West

Latitude of projection origin: 50 degrees North

Units: meters

False easting (meters): 0

False northing (meters): 0

ArcView files can be viewed with the free viewer, ArcExplorer, which can be downloaded from: http://www.esri.com/software/arcexplorer/.

These digital databases are the result of the compilation and reinterpretation of published and unpublished 1:250,000- and 1:63,360-scale mapping. The map area covers approximately 12,800 sq km (4,975 sq mi) in land area and encompasses parts of 5 1:250,000-scale quadrangles in south central Alaska. The compilation was done as part of the U.S. Geological Survey's National Surveys and Analysis project, whose goal is to compile geologic, geochemical, geophysical, and other data.

All geologic maps on which this compilation is based were published using the Universal Transverse Mercator projection (UTM; Zone 5). Because of the distortions use of the UTM projection would produce on a map of small scale and large area, regional-scale products derived from this data that cross UTM zones should be plotted using a more appropriate Albers Equal-area projection.

Kodiak Islands database tables

In order to manage the textural and coding information related to the Kodiak Islands (Kodiak) geologic map, we have created a series of related and interlinked databases. These databases are a subset of the databases being created and maintained statewide. As provided here, they include a runtime version of the primary databases, which are maintained using the commercial Filemaker Pro (version 5 or 6) database software. These databases are not directly connected to the ARC/INFO coverages; however the data can be linked through the .csv or .dbf files that accompany this report. However, these databases can used to guide searches of the coverages seeking particular sorts of information. By way of background the .PAT files of the coverages have 7 fields in them that correspond to fields in the FP5 databases. These fields are *class, nsaclass*, *qclass*, *label*, *min_ma, max_ma,* and *source*.

Nine database tables are included here. They are:

KODIAKUNITS: A subset of the statewide database containing abstracted geologic unit descriptions for each source map in the Kodiak Islands. The four .PAT fields, *class*, *nsaclass*, *qclass*, and *source*, mentioned above are duplicated in this database.

KODIAKREFS: A subset of the statewide database containing the references for the source maps of the Kodiak Islands. Linked to the KODIAKUNITS database through the *source* field.

NNSAKEY: The statewide database that shows the color symbol and label to be used for each *nsaclass* in the state. Note that these are **not** the colors and labels used on the KODIAK map (Wilson, in prep.). We have provided another key database (KODIAKLABELS) that shows the color symbols and labels appropriate for the Kodiak map. Linked to the KODIAKUNITS database through the *nsaclass* field. In both cases, the required ARC/INFO shadesets are not included with this report; please contact the senior author for information on obtaining this shadeset or the color definitions. Alternatively, the statewide shadeset can be downloaded from the following url in the arc-related files section: http://geopubs.wr.usgs.gov/open-file/of98-133-a/

KODIAKLABELS: This database contains the *nsaclass* and *qclass* codes tied to the map labels that are used on the Kodiak geologic map (Wilson, in prep.) and differ from the labels used in NNSAKEY, which are related to a statewide database assignment. Linked to KODIAKUNITS through *nsaclass* and *qclass* fields. This database table does not include labels from units within the included quadrangles but outside the Kodiak map area.

NSAAGE: The statewide database that provides information to assign specific ages to geologic units. Linked to the KODIAKUNITS database through the *nsaclass* field.

NASLITH: The statewide database that provides information to assign specific lithologies, lithologic form and importance to geologic units. Linked to the KODIAKUNITS database through the *nsaclass* field.

KODIAKDESCRIP: This database ties *nsaclass* numbers to the unit descriptions used on the Kodiak map (Wilson, in prep.) and the unit descriptions from the Central Alaska geologic map (Wilson and others, 1998) compilation for map units that do not appear within the Kodiak map area. Linked to the KODIAKUNITS database through the *nsaclass* field.

LITHLIST: Database containing all the lithologic terms used in the lithologic coding – duplicated here in Appendix 1 of this document. Linked to the NSALITH database.

LITHFORM: Database containing the lithologic form terms in lithologic coding of geologic units – duplicated here in Appendix 1 of this document. Linked to the NSALITH database.

TIME THESAURUS: Database containing the time terms used in age coding of geologic units. Linked to the NSAAGE database.

Database structures

KODIAKUNITS database

The main database for the project is called KODIAKUNITS. Entered into this database (Table 1) are brief abstracts of the unit descriptions from each source map, which are then *class*ified into regional or statewide units. This database is the root for correlations of units, although not necessarily the final word (more on this later). For example, Early Cretaceous granodiorite from various maps might get the same *nsaclass* and therefore be assigned to a single map unit, yet when drawn to produce particular map, it might be given the same symbol and color as granite and quartz monzonite of that age (only for that map). The standard view (called “GSA color”) of the database has portals to three other related databases, NNSAKEY, KODIAKREFS, and NSALITH, which show the related values in these databases. These databases are linked through either the *nsaclass* or *source* fields in the KODIAKUNITS database. The first 7 fields in the database come directly from the source, each of the other fields is assigned either at the time of entry into the database or later.

Table 1. KODIAKUNITS field definitions.

	Field name	Information type	Field type	Links
1	*Quadrangle*	1:250,000–scale quadrangle, with the name fully spelled out. If a map covers multiple quadrangles, each quadrangle will have a set of entries for the appropriate units from that map in the database.	Text	
2	*Map unit*	The label given on the source map for a geologic unit. Some maps do not use labels; hence a color or pattern might be entered here. In other cases, a unit might be subdivided using overprint patterns (such as limestone lenses in a clastic unit, or areas of significant lithologic variation). Where this happens, the variation is entered in the database as though it is another geologic unit.	Text	
3	*Unit name*	The unit name from the source map. If a map is divided in regions, terranes, or allocthons, etc., or the unit name explicitly mentions stratigraphic divisions, then this information is included in the unit name (for example, “Lisburne Group, Kuna Formation”, or “Greenstone of Venetie Subterrane of Arctic Alaska Terrane”. However, in general, we shy away from using terranes in this database.	Text	
4	*Age*	The geologic age of the unit as given in the source. (Note this is age and not stratigraphic position; convert Upper to Late and Lower to Early.) In some cases, the age assignment has been subsequently revised; nevertheless, the age from the source map is entered..	Text	

Table 1. KODIAKUNITS field definitions (cont.).

	Field name	Information type	Field type	Links
5	*Description*	An abstracted version of the unit description from the source map. Focuses on lithology and important relationships as described on the source map. Also includes any special notes regarding this unit from the source. This field, though of unlimited length is kept short.	Text	
6	*Fossil*	Brief notes on any fossil control mentioned on the source map.	Text	
7	*Radiometric age*	Brief notes on radiometric ages.	Text	
8	*Source*	A unique code assigned to each source; uses the 2-letter quadrangle code and a three digit number. By default, 001 is reserved for the topographic map for each quadrangle. Numbers above 100 indicate sources that were not captured digitally.	Text and number combined	KODIAKREFS, Arc coverage
9	*Rock class*	General classification: Igneous, Sedimentary, Metamorphic, Unconsolidated, or Melange. For mixed units, the dominant category.	Text, defined values	
10	*nsamod*	An item to indicate if unit is altered, contact metamorphosed, or a queried unit assignment (Tk? versus Tk). (Unit is given same *nsaclass* code as unmodified unit.). Some maps show contact metamorphosed areas as separate units, these would be assigned the *nsaclass* for the appropriate protolith and then “HFS” selected as the nsamod value. If only a few polygons of a unit are altered or hornfelsed, then the nsamod value will be set only for those specific polygons in the ARC coverage.	Text, defined values	Arc coverage
11	*Class*	A unique numeric code assigned to each source unit. (Unique only within a given quadrangle and specific to each source.)	Number	Arc coverage
12	*nsaclass*	A regional numeric code assigned to like units – the main key field in the database	Number	Arc coverage, NNSAKEY, NSALITH
13	*Maplabel*	This shows the label used on the Kodiak map. The alternate field below it shows the label assigned if the *nsaclass* value is less than 500.	Text	KODIAKLABELS

Table 1. KODIAKUNITS field definitions (cont.).

	Field name	Information type	Field type	Links
14	*qclass*	Similar to *nsaclass* that allows finer subdivision of Quaternary geologic units.	Number	Arc coverage, KODIAKLABELS

Using the KODIAKUNITS database, a user can determine the disposition of any geologic unit from any source map that is being used or even contemplated for use in the statewide database. As such it includes unit descriptions from maps used for differing purposes or at different stages of the project. An example is Nelson and other's 1985 geologic map of the Chugach National Forest, which included parts of the Cordova quadrangle. Initially, this map was the source for primary geologic data in the Central Alaska compilation. However, as the project and spatial database have evolved, the current compilation does not use any part of this map. Yet, it remains part of the database for archival reasons and because it is part of the "history" of the development of the present interpretation of the geology of that region. There is no attempt here to include every geologic map that has ever been done for the Kodiak Islands; however, many 1:63,360-scale maps are included because they are important to the regional story. Regional maps, such as the Beikman (1980) Geologic map of Alaska are not included. All recent 1:250,000-scale maps are included.

Each source map used in the compilation will have all of its geologic units entered in this database. If a source map covers more than one quadrangle, units are entered for all covered quadrangles; however, only the geologic units that actually appear in a quadrangle will be entered for a quadrangle. Typically, all units will be entered under the primary quadrangle and then once digital capture is complete and the digital file cut into quadrangle specific parts, the units appearing in each part with be copied to records for that quadrangle in the database. The reference record for the source map will have an entry for each quadrangle covered by the map.

Within the database itself, portals in the KODIAKUNITS database look into the NNSAKEY, NSALITH, NSAAGE, and KODIAKREFS databases, allowing the user to see the linked data applicable to any record.

NNSAKEY database

The second most used database is called NNSAKEY (Table 2). This is analogous to an ARC/INFO lookup table from which labels and colors are applied to the map. In fact, the primary lookup table used within ARC for the various Alaska products is derived directly from this database by importing it (NNSAKEY) into INFO. The primary field in this database is *nsaclass*, linking it to the KODIAKUNITS database and to the ARC coverages for each quadrangle. It is here that each unit gets assigned a symbol (color), overprint pattern, and tentative label to be used on geologic map products. This database allows control of the symbols and labels assigned to units and helps to eliminate duplication, except where desired. The database also includes a description field, which summarizes the regional unit in a sentence or less and lists the source maps that contain the unit. This database is not only exported to INFO to create the lookup table but is also exported to Word to assist in the classification of units. Portals in the NNSAKEY database look into KODIAKUNITS, NSAKEY (an old, obsolete database), and back into itself (NNSAKEY). The portal that looks inward is particularly useful because it allows a user see instantly what other units have been assigned a particular symbol. This is important, because although our shadeset ostensibly has 999 colors, in reality, only about 130 can be distinguished by eye on plots. (Different plotters have different capabilities). As a result, a color will get assigned to more than one unit and overprint patterns must be used to distinguish subsets. This database is also used to assign duplicate colors and labels to units to be lumped in map products, but need to be maintained as separate units in the database. Clearly, other lookup tables, such as KODIAKLABELS described below, could be and are used to lump units and label in different ways, depending on the need.

Table 2. NNSAKEY field definitions

	Field name	Information type	Field type	Links
1	*Symbol*	The color number used, derived from an ARC/INFO shadeset.	Number	NNSAKEY (self-linked)
2	*Overprnt*	The pattern number used, also derived from an ARC/INFO shadeset.	Number	
3	*Label*	The map label printed on map products.	Number	
4	*nsaclass*	A regional numeric code assigned to like units – the main key field in the database	Number	KODIAKUNITS, NSAKEY, Arc coverage
5	*Description*	Brief (5-10 words) summary of the unit on a regional basis, also shows applicable source maps and overprint pattern numbers.	Text	

KODIAKLABELS database

Related in concept to the NNSAKEY database, this database provides the labels and color symbols for units that occur with the Kodiak map area. The KODIAKUNITS database includes some geologic units that may not occur on the map, either because they come from source maps we did not use or the entire units lies outside the map area. These typically will not show a label in the Maplabel or alternative map label fields. The primary field in this database is *nsaclass*, linking it to the KODIAKUNITS database and to the ARC coverages for each quadrangle. This database also uses the *qclass* field to provide labels for units that have *nsaclass* codes of less that 500. It is here that each unit gets assigned a symbol (color), overprint pattern, and tentative label to be used on geologic map products. This database allows control of the symbols and labels assigned to units and helps to eliminate duplication, except where desired. As in the NNSAKEY database, this database is also used to assign duplicate colors and labels to units to be lumped in map products, but need to be maintained as separate units in the database.

Table 2a. KODIAKLABELS field definitions

	Field name	Information type	Field type	Links
1	*Symbol*	The color number used, derived from an ARC/INFO shadeset.	Number	NNSAKEY (self-linked)
2	*Overprint*	The pattern number used, also derived from an ARC/INFO shadeset.	Number	
3	*Label*	The map label printed on map products.	Number	

Table 2a. KODIAKLABELS field definitions (cont.)

	Field name	Information type	Field type	Links
4	*nsaclass*	A regional numeric code assigned to like units – the main key field in the database	Number	KODIAKUNITS, NSAKEY, Arc coverage
5	*qclass*	A numeric code assigned to allow finer subdivisions of Quaternary geologic units.	Number	KODIAKUNITS

KODIAKREFS database

The KODIAKREFS database (Table 3) contains the reference citation (as close to USGS style as possible) for each source map and other publication used. Included in the reference database will be maps that have been digitized, other publications that result in changes to the map (say a paper reassigning some rocks from one unit to another or giving age determinations). It will also list as "written communication" the source of unpublished information responsible for changes to particular bits of information. There can be up to 999 references for each quadrangle and if we need more, we have room to expand to over 40,000 per quadrangle. If a map covers multiple quadrangles, it will be assigned an id for each quadrangle. This database has a portal into KODIAKUNITS, showing the units from any given source that is in the KODIAKUNITS database.

Table 3. KODIAKREFS field definitions

	Field name	Information type	Field type	Links
1	*Source*	The unique code assigned to each source that uses the 2 letter quadrangle id and a 3 digit number. This field is forced to have unique entries by the database software.	Text and number	KODIAKUNITS, Arc coverage
2	*Refnum*	A unique tracking number assigned by the database to each reference.	Number, auto entry	
3	*Reference*	The USGS style reference citation. Also lists written communications where appropriate for modifications to maps.	Text	

NSALITH database

The NSALITH database (Table 4) will eventually contain lithologic coding for each *nsaclass* in the database. It uses a lithologic dictionary that is contained in special linked databases called LITHLIST and LITHFORM. It allows for the entry of as many lithologies for a unit as one desires. This database has a portal into the KODIAKUNITS database, showing which source maps contain that *nsaclass*.

A unique or special field in this database combines the values of 5 other fields in the database to allow searching of the database at any level of the lithologic hierarchy without need to be concerned about the level. Possible searches, for example are for any unit containing carbonate or for any unit where limestone is a major lithology

A data dictionary has been prepared for use with this database (Appendix 1 and 2, herein), showing the allowed terms in the data.

Table 4. NSALITH field definitions

	Field name	Information type	Field type	Links
1	*nsaclass*	A regional numeric code assigned to like units – the main key field in the database	Number	KODIAKUNITS
2	*Lith1*	The highest level lithologic *class*ification	Text, value list	
3	*Lith2*	Next level lithologic *class*ification, values are based on the value of *lith1* field	Text, value list	
4	*Lith3*	As above, based on the value of *lith2* field	Text, value list	
5	*Lith4*	As above, based on the value of *lith3* field	Text, value list	
6	*Lith5*	As above, based on the value of *lith4* field	Text, value list	
7	*Form*	Description of form of units, value list based on the value of *lith1* field.	Text, value list	
8	*Rank*	Values allowed are: Major, Minor, Incidental, and Indeterminate (major).	Text, value list	
9	*Lithology*	This is a field from an earlier lithologic classification and is generally not used.	Text	
10	*Percent*	Optional field containing an estimate of the percent of the unit that the given lithology represents. This information is rarely available in Alaska.	Number	
11	*Comment*	Free form comment field -- optional	Text	
12	*Record_no*	A unique tracking number assigned by the database to each record.	Number, auto entry	
13	*Totallith*	A text string that combines the information in all of the *lith* fields, allowing searches based on any aspect of the lithologic hierarchy.		

NSAAGE database

The NSAAGE database (Table 6) is used like NSALITH to assign a uniform age to each *nsaclass* unit. The fields in it are assigned using a data dictionary derived from the 1983 DNAG time scale to assigned maximum and minimum ages to geologic units. The database then creates a field that has the full definition of the minimum or maximum age of the unit, allowing searches bases on any part of the time scale. For example, you could search for units that are at least Paleozoic but no older than Devonian. Because minimum and maximum numeric ages are also populated in the databases, any unit can be searched based on a numeric maximum and minimum.

Note that the ages assigned in this database are for an *nsaclass* unit and may not necessarily match the assignments made on any given source map. The assignment of a geologic unit to an *nsaclass* controls the lithology and the age referenced to that unit by the database. For example, a source map may call a unit Paleozoic, yet current knowledge may indicate that unit is actually Permian in age. The KODIAKUNITS database will show the Paleozoic age as shown in the source whereas the NSAAGE database with most likely show the Permian age assignment, based on current knowledge.

Table 6. NSAAGE field definitions

	Field name	Information type	Field type	Links
1	*nsaclass*	The regional unit code as used above	Number	KODIAKUNITS, Arc coverage
2	*Unit_link*	This field is only used in the conterminous US and is similar in some respects to *nsaclass*	Text	(Conterminous US databases)
3	*Min_eon*	The minimum or youngest age assignment for the eon of the unit, based on geologic knowledge.	Text, value list	
4	*Min_era*	As above, for era	Text, value list	
5	*Min_period*	As above, for period	Text, value list	
6	*Min_epoch*	As above, for epoch	Text, value list	
7	*Min_age*	As above, for age	Text, value list	
8	*Full_min*	The complete, concatenated minimum age assignment.	Text, auto entry	
9	*Max_eon*	The maximum or oldest age assignment for the eon of the unit, based on geologic knowledge.	Text, value list	
10	*Max_era*	As above, for era	Text, value list	
11	*Max_period*	As above, for period	Text, value list	
12	*Max_epoch*	As above, for epoch	Text, value list	
13	*Max_age*	As above, for age	Text, value list	
14	*Full_max*	The complete, concatenated maximum age assignment.	Text, auto entry	
15	*Type*	Is the unit age assigned relatively (stratigraphic position or fossils) or absolutely (radiometric age).	Text, value list (Relative or Absolute)	

Table 6. NSAAGE field definitions (cont.)

	Field name	Information type	Field type	Links
16	*Minimum age*	Text, following the 1983 DNAG table for names. Based or stratigraphic position or fossil control.	Text, auto entry	
17	*Maximum age*	Text, as above.	Text, auto entry	
18	*Min_Ma*	Numeric, either from the DNAG table or radiometric determinations.	Number, auto entry	
19	*Ma_Ma*	Numeric, either from the DNAG table or radiometric determinations.	Number, auto entry	
20	*Age_comments*	Free form comment field -- optional	Text	

KODIAKDESCRIP database

This database ties *nsaclass* numbers to the unit descriptions used on the Kodiak map (Wilson, in prep.) and the unit description from the Central Alaska geologic map (Wilson and others, 1998) compilation for map unit that do not appear within the Kodiak map area.. Linked to the KODIAKUNITS database through the *nsaclass* field (Table 6). This database has portals into KODIAKUNITS and NNSAKEY databases.

Table 6. KODIAKDESCRIP field definitions

	Field name	Information type	Field type	Links
1	*Label*	Map unit label as published	Text	
2	*Name*	Map unit name from publication	Text	
3	*nsaclass*	A regional numeric code assigned to like units – the main key field in the database	Number	KODIAKUNITS, NNSAKEY
4	*Age*	Assigned age (range)	Text	
5	*Description*	Full text of unit description	Text	
6	*Sources*	Specific source for unit descriptions.	Text	

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Appendix 1. Lithologic Data Dictionary

Lith1	Lith2	Lith3	Lith4	Lith5
Unconsolidated				
	Coarse-detrital			
		Boulders		
		Gravel		
		Sand		
	Fine-detrital			
		Clay		
		Silt		
	Coral			
	Marl			
	Peat			
Sedimentary				
	Clastic			
		Mixed-clastic		
			Conglomerate-mudstone	
			Conglomerate-sandstone	
			Sandstone-mudstone	
			Siltstone-mudstone	
		Conglomerate		
		Sandstone		
			Arenite	
				Calcarenite
			Arkose	
			Graywacke	
		Siltstone		
		Mudstone		
			Claystone	
				Bentonite
			Shale	
				Black-shale
				Oil-shale
				Phosphatic-shale
		Sedimentary-breccia		
	Carbonate			
		Dolostone		
		Limestone		
			Chalk	
			Coquina	
		Marlstone		
	Chemical			
		Banded-iron-formation		
		Barite		
		Chert		
		Diatomite		

Appendix 1. Lithologic Data Dictionary (cont.)

Lith1	Lith2	Lith3	Lith4	Lith5
Sedimentary				
		Evaporite		
			Anhydrite	
			Gypsum	
			Salt	
		Novaculite		
		Phosphorite		
	Coal			
		Anthracite		
		Bituminous		
		Lignite		
		Sub-bituminous		
Igneous				
	Plutonic			
		Granitic		
			Alkalli-feldspar-granite	
				Alkali-granite
			Granite	
				Monzogranite
				Syenogranite
			Granodiorite	
			Leucocratic-granitic	
				Alaskite
				Aplite
				Pegmatite
				Quartz-rich-granitoid
			Tonalite	
				Trondhjemite
		Charnockite		
		Syenitic		
			Alkali-feldspar-syenite	
			Monzonite	
			Quartz-alkali-feldspar-syenite	
			Quartz-monzonite	
			Quartz-syenite	
			Syenite	
		Dioritic		
			Diorite	
			Monzodiorite	
			Quartz-monzodiorite	
			Quartz-diorite	

Appendix 1. Lithologic Data Dictionary (cont.)

Lith1	Lith2	Lith3	Lith4	Lith5
Igneous				
	Plutonic			
		Gabbroic		
			Gabbro	
				Gabbronorite
				Norite
				Troctolite
			Monzogabbro	
			Quartz-gabbro	
			Quartz-monzogabbro	
		Anorthosite		
		Ultramafic		
			Hornblendite	
			Peridotite	
				Dunite
				Kimberlite
			Pyroxenite	
		Foidal-syenitic		
			Foid-syenite	
			Cancrinite-syenite	
			Nepheline-syenite	
			Sodalite-syenite	
		Foidal-dioritic		
		Foidal-gabbroic		
		Foidolite		
		Melilitic		
		Intrusive-carbonatite		
	Hypabyssal			
		Felsic-hypabyssal		
			Hypabyssal-dacite	
			Hypabyssal-felsic-alkaline	
			Hypabyssal-latite	
			Hypabyssal-quartz-latite	
			Hypabyssal-quartz-trachyte	
			Hypabyssal-rhyolite	
			Hypabyssal-trachyte	
		Mafic-hypabyssal		
			Hypabyssal-andesite	
			Hypabyssal-basalt	
			Hypabyssal-basaltic-andesite	
			Hypabyssal-mafic-alkaline	
		Lamprophyre		

Appendix 1. Lithologic Data Dictionary (cont.)

Igneous				
	Volcanic			
		Alkalic-volcanic		
			Basanite	
			Foidite	
			Phonolite	
		Felsic-volcanic		
			Dacite	
			Latite	
			Quartz-latite	
			Quartz-trachyte	
			Rhyolite	
			Trachyte	
		Mafic-volcanic		
			Andesite	
			Basalt	
			Basaltic-andesite	
		Ultramafic		
			Komatiite	
			Picrite	
Metamorphic				
	Amphibolite			
	Argillite			
	Eclogite			
	Gneiss			
		Orthogneiss		
		Paragneiss		
	Granofels			
	Granulite			
	Greenstone			
	Hornfels			
	Marble			
	Metasedimentary			
	Metavolcanic			
	Migmatite			
	Phyllite			
	Quartzite			
	Schist			
	Serpentinite			
	Skarn			
	Slate			
Tectonite				
	Cataclastite			
	Mylonite			
		Phyllonite		
	Melange			
Water				
Ice				
Indeterminate				

Appendix 2. Lithform Data Dictionary

Lith1	Lithologic form		Lith1	Lithologic form
Unconsolidated			Igneous	
	Alluvial			Batholith
	Beach			Diabase
	Bed			Dike or sill
	Colluvial			Dome
	Eolian			Flow
	Eolian, loess			Flow, pillows
	Estuarine			Laccolith
	Flow, mass movement			Melange
	Fluvial			Pluton
	Glacial			Pyroclastic
	Glacial, drumlin			Pyroclastic, air fall
	Glacial, esker			Pyroclastic, ash-flow
	Glacial, outwash			Pyroclastic, cinder cone
	Glacial, rock glacier			Pyroclastic, tuff
	Glacial, till			Stock or pipe
	Lacustrine			Volcaniclastic
	Landslide			Volcaniclastic, lahar
	Mass wasting			Volcaniclastic, volcanic breccia
	Solifluction		Metamorphic	
	Swamp			Amphibolite
	Tailings			Amphibolite, epidote-amphibolite
	Terrace			Eclogite
	Terrace, marine			Glaucophane-schist
	Terrace, stream			Granulite
Sedimentary				Greenschist
	Bed			Hornfels
	Calcareous			Hornfels, biotite
	Carbonaceous			Hornfels, hornblende
	Coquina			Hornfels, pyroxene
	Deltaic			Hornfels, sanidine
	Dome			Pelitic
	Glauconitic			Zeolitic (prehnite-pumpellyite)
	Lens		Tectonite	
	Melange			Melange, blocks
	Olistrostrome			Melange, matrix
	Reef		Water	
	Tuffaceous			Lake, stream, or ocean
			Ice	
				Mass