PRELIMINARY INTEGRATED GEOLOGIC MAP DATABASES FOR THE UNITED STATES:

DIGITAL DATA FOR THE GEOLOGIC MAP FOR THE NORTHERN ALASKA PENINSULA AREA, SOUTHWEST ALASKA

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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 the individual datasets herein contain data suitable for use at larger scales. This regional map is the result of the compilation and reinterpretation of published and unpublished 1:250,000- and 1:63,360-scale mapping. The map area encompasses the land area of six 1:250,000-scale quadrangles in western Alaska. Associated attribute databases accompany the spatial databases of the geology and are uniformly structured for all maps in the series for ease in developing regional- and national-scale maps. This 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 mineral occurrence data for the United States.

This geologic map, showing an area nominally called the Northern Alaska Peninsula, is presented at a scale of 1:350,000, although the digital data presented here was compiled from 1:250,000- and 1:63,360-scale mapping. The map area lies on the west side of Cook Inlet in southcentral Alaska and consists of the parts of the Kenai and Seldovia 1:250,000-scale quadrangles that lie on the west side of Cook Inlet and the Lake Clark, Iliamna, Taylor Mountains, and Dillingham 1:250,000-scale quadrangles to the west of these (fig. 1). The map area is a region of transition from the classic magmatic arc geology of the Alaska Peninsula to the accretionary geology of southcentral and southwest Alaska, and to the poorly understood, tectonically complex sedimentary basins of southwest Alaska. A wide range of sources were used to construct this map, ranging from the published mapping of Robert Detterman and others in the Iliamna and Kenai quadrangles (Detterman and Hartsock, 1966; Detterman and Reed, 1980, Magoon and others, 1976) to unpublished mapping of J.N. Platt and E.H. Muller in the Taylor Mountains (J.N. Platt, 1957, unpub. data) and Dillingham quadrangles (J.N. Platt and E.H. Muller, 1958, unpub. data). Field notes of J.M. Hoare and W.H. Condon (1969-1970) were especially useful in the western Taylor Mountains and Dillingham quadrangles. Early mapping by J.B. Mertie and P.A. Davison in the 1930’s (Mertie, 1938) laid the general framework for the region; subsequent mapping by Cady and others (1955) filled in parts of that framework. Re-examination of the field notes of Mertie, Davison, Hoare, Condon, and W.L. Coonrad helped define a number of the map units in the western part of the area. Limited new field mapping was conducted as part of this compilation effort (for example, Blodgett and Wilson, 2001; Wilson and others, 2003) and extensive photo interpretative work has also contributed to this product. W.K. Wallace graciously provided field maps from his work in the region during the 1980’s. Papers on the plutonic rocks by B.L. Reed and his coworkers provided the basis for much of the map in the Alaska-Aleutian Range (Reed and Lanphere, 1969; 1972; 1973). Studies around Redoubt and Iliamna Volcanoes (Till and others, 1993; Waythomas and Miller, 1999) also contributed.

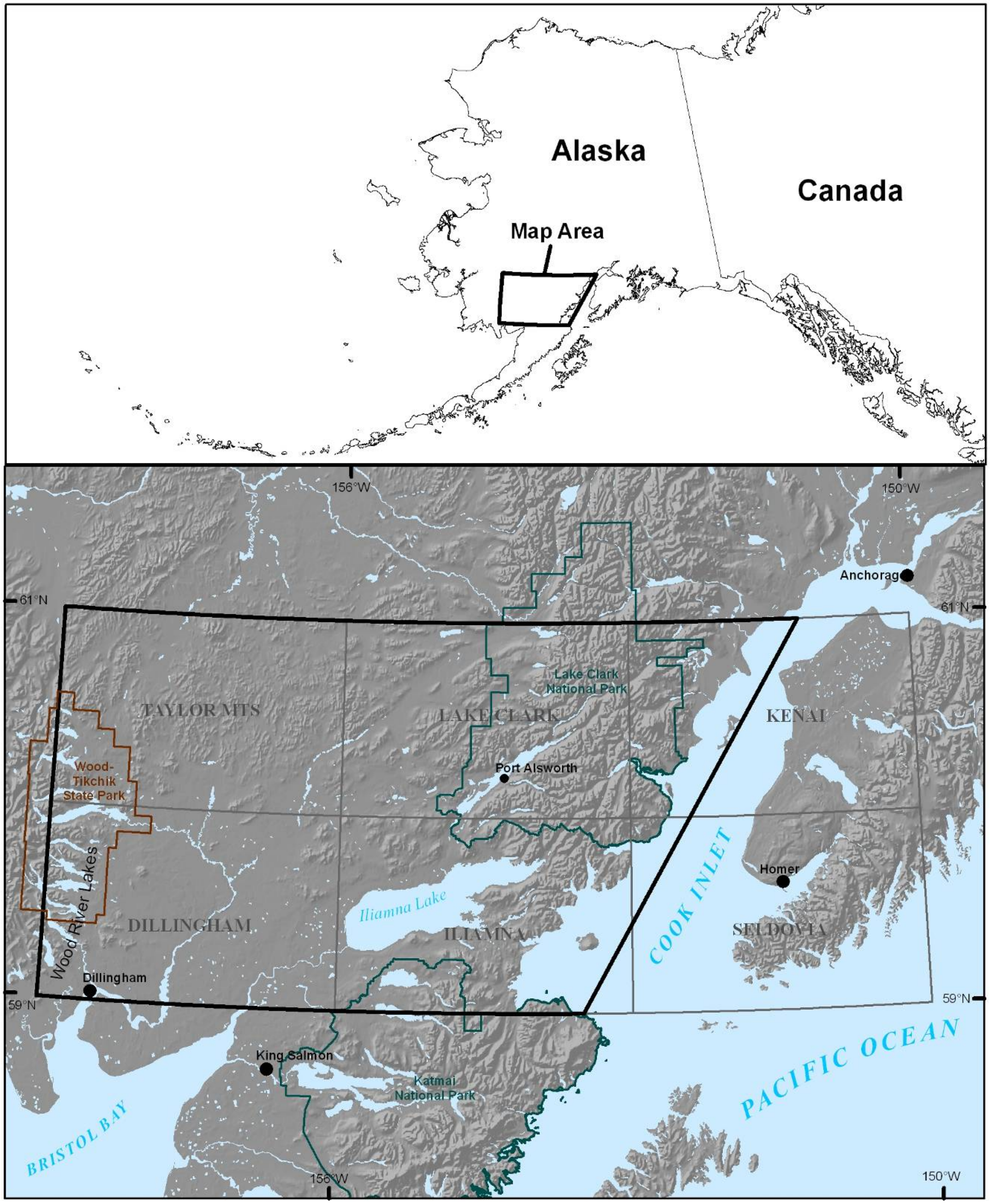

Figure 1. Location of the reconnaissance geologic map of the Northern Alaska Peninsula showing the geographic setting and associated 1:250,000 quadrangles.

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,* which 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 feature class or attribute table (PAT) of the spatial database (Geodatabase or shapefile) and can also be found in the text databases of supplemental attribute data. These fields represent the link 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, more generally, a finer separation of map units. The data for this map were originally released in 2006 and since that time, a statewide compilation has been created and released (Wilson and others, 2015); as such there may be slight variation in nsaclass assignments for some geologic units; these reassignments will primarily impact surficial deposits in the Taylor Mountains, Dillingham, and Lake Clark quadrangles.

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 only to store the primary map unit information. Fields also in the PAT are *class*, *nsasub*, *nsamod*, *tmp*, *symbol*, *label*, and *label2*, which are more fully described below. , Fields called *unitname* and *age_range* are in the PAT, which record the map unit name and the assigned age range of the map unit.

The line feature class or arc attribute table (AAT) stores attributes indicating the type of line features in the geodatabase 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 map areas for which maps may have been compiled decades ago. The standardized supplemental attribute tables record an abstracted map unit description, lithologic and age information, and references.

All geologic maps on which this compilation is based were published using the Universal Transverse Mercator projection (UTM; Zones 4 and 5), North American Datum 1927 (NAD-27). The quadrangle spatial databases (geodatabase and shapefiles) are provided in the native UTM projection of the sources as well as geographic coordinates. The UTM projection parameters are described in the metadata. 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. The supplied geodatabase and in general 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

DATABASE TABLES

In order to manage the textural and coding information related to the northern Alaska Peninsula geologic map, we created a series of related and interlinked databases. These databases are a subset of the databases being created and maintained statewide. As provided here, in addition to the native database format files (.fmp12), as well as “.dbf” and “.csv” (comma separated values) files, we also include a runtime version of the primary databases, which are maintained using the commercial Filemaker Pro (version 12 or higher) database software. These databases are not directly connected to the spatial databases; however, the data can be linked through the .csv or .dbf files that accompany this report and are linked in the geodatabase. In a standalone mode, these databases can be used to guide searches of the spatial databases seeking particular sorts of information.

Ten database tables are included here. They are:

NAPUNITS: A subset of the statewide database containing abstracted geologic unit descriptions for each source map in the Northern Alaska Peninsula map area.

NAPDESCRIP: This database ties *nsaclass* numbers to the more complete unit descriptions used on the Northern Alaska Peninsula map. Linked to the NAPUNITS database through the *nsaclass* field.

NAPREFS: A subset of the statewide database containing the references for the source maps of the Northern Alaska Peninsula map. Linked to the NAPUNITS database through the *source* field.

NAPKEY: The statewide database that shows a color symbol and label that can be used for each *nsaclass* in the state. Note that these are **not** the colors and labels used on the Northern Alaska Peninsula map. We have provided the color symbols and labels appropriate for the Northern Alaska Peninsula map in the NAPDESCRIP database. NAPKEY is linked to the NAPUNITS database through the *nsaclass* field. The required ArcGIS stylesheet is provided; 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 of (Wilson and others, 1998): http://pubs.usgs.gov/of/1998/of98-133-a/.

NAPQKEY: Database is similar to NAPKEY but it is used to subdivide the Quaternary surficial deposits by assigning color symbols and labels to only the Quaternary units. Linked to NAPUNITS through q*class*.

NSALITH: The statewide database that provides information to assign to geologic units specific rock types, lithologic form or mode of occurrence, and relative proportion of the unit that rock type represents. Linked to the NAPUNITS database through the *nsaclass* field.

LITHLIST: Database containing all the lithologic terms (rock types) 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 used for lithologic coding of geologic units – duplicated here in Appendix 1 of this document. Linked to the NSALITH database.

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

IUGSLIST: Database containing the minimum and maximum ages for every Eon, Era, Period, Epoch, and Age. Linked to the NSAAGE database through *Eon, Era, Period*, and *Epoch*.

RUNTIME APPLICATION

Included with this data release is a runtime application of the Filemaker Pro database tables. This application, which only functions under the Windows operating system, is provided as a zipped directory that contains the database tables and the necessary files to provide much of the functionality of the Filemaker Pro software. To use this application, unzip the supplied zip file, which will create a folder (directory) containing needed files. Within that folder will be a file named **NAP_Geology.exe**. Double click on this file to start the runtime application. The database tables can be scrolled by clicking on the “rolodex”-like icon in the upper left corner. Searches can be made by selecting the “Find mode”, found under the “View” tab and typing the desired search item in the appropriate field on the Find screen. A complete explanation of the software is not appropriate here, but experimentation will reveal many capabilities.

DATABASE STRUCTURES

NAPUNITS database

The main database for the project is called NAPUNITS. Entered into this database (table 1) are brief abstracts of the unit descriptions from each source map, which are then classified into regional or statewide units. This database is the root for correlations of units, although not necessarily the final word (more on this below). 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 a 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 in Filemaker Pro software has portals to three other related databases, NAPKEY, NAPREFS, and NSALITH, which show the related values in these databases. These databases are linked through either the *nsaclass* or *source* fields in the NAPUNITS database. The first seven 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.

Using the NAPUNITS database, a user can determine the disposition of any geologic unit from any source map for the map area that is in the statewide database. As such it includes unit descriptions from maps used for differing purposes or at different stages of the project.

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. The reference record for the source map will have an entry for each quadrangle covered by the map.

Within the database itself (see runtime version), portals in the NAPUNITS database provide views into the NAPDESCRIP, NAPKEY, NSALITH, NSAAGE, and NAPREFS database tables, allowing the user to see the linked data applicable to any record.

Table 1. NAPUNITS 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*	Label from the source map for a geologic unit. Some maps do not use labels; hence a color or pattern description would be entered here. In other cases, a unit subdivided using an overprint pattern (such as limestone lenses in a clastic unit) will have an entry for each variation.	Text	
3	*Unit name*	Map 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 terrane terminology is not used in this database.	Text	
4	*Age*	Geologic age of the unit as given in the source. (Note this is age and not stratigraphic position) In some cases, the age assignment has been subsequently revised; nevertheless, the age from the source map is entered here.	Text	
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.	Text	
6	*Fossil*	Brief notes on any fossil control mentioned on the source map.	Text	

Table 1. NAPUNITS field definitions (cont.)

	Field name	Information type	Field type	Links
7	*Radiometric age*	Brief notes on radiometric ages.	Text	
8	*Source*	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 may be significant, but not captured digitally.	Text and number combined	NAPREFS, Spatial database
9	*Rock class*	General classification of unit: 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 has a queried unit assignment. Some maps show contact metamorphosed areas as separate units; these units are assigned the *nsaclass* for the appropriate protolith and have "HFS" selected as *nsamod* value. If only a few polygons of a unit are altered or contact metamorphosed, then the *nsamod* value will be set for those polygons only in the spatial databases. Queried units, Tk? versus Tk for example, have the same *nsaclass* codes, but Tk? will have "Q" selected as *nsamod* value.	Text, defined values	Spatial database
11	*Class*	Unique numeric code assigned to each source unit. (Unique only within a given quadrangle and specific to each source.)	Number	Spatial database
12	*Nsaclass*	Regional numeric code assigned to like units – the main key field in the database.	Number	Spatial database, NAPKEY, NSALITH
13	*Label*	Label as used on the northern Alaska Peninsula map.	Text	NAPDESCRIP
14	*Qclass*	Similar to *nsaclass*; allows finer subdivision of Quaternary geologic units.	Number	Spatial database
15	*Source_class*	Concatenated field that uniquely identifies a given source map (*source*) geologic unit (*class*).	Text	Spatial database

NAPKEY database

The second most used database is called NAPKEY (table 2). This table is analogous to an INFO lookup table from which labels and colors are applied to the map. In fact, the primary lookup table used within ArcGIS for many derivative products is derived directly from this database by importing it (NAPKEY) into INFO or as a spreadsheet. The primary field in this database is *nsaclass*, linking it to the NAPUNITS, NSALITH, and NSAAGE databases and to the spatial database 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 it helps to eliminate undesired duplication. The database also includes a *description* field, which summarizes the regional unit in a sentence or less and may list the *source* maps that contain the unit. Portals in the NAPKEY database provide a view into NAPUNITS and back into itself (NAPKEY). The portal that looks inward is particularly useful because it allows a user to 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. As a result, a color will get assigned to more than one unit and on some maps overprint patterns have been used to distinguish subsets. The NAPKEY database is also used to assign duplicate colors and labels to units that are lumped in some map products, but otherwise need to be maintained as separate units in the database. Note, in the runtime version of the text databases, this table is accessed from the menu through the "Map unit key" button.

Table 2. NAPKEY field definitions

	Field name	Information type	Field type	Links
1	*Symbol*	Color number used, derived from an ARC/INFO shadeset or ArcGIS stylesheet.	Number	NAPKEY (self-linked)
2	*Overprnt*	Pattern, also derived from an ARC/INFO shadeset or ArcGIS stylesheet. Generally not used	Number	
3	*Label*	Map label printed on map products.	Text	
4	*Nsaclass*	Regional numeric code assigned to like units – the main key field in the database.	Number	NAPUNITS, Spatial database
5	*Description*	Brief summary of unit on a regional basis.	Text	

NAPQKEY database

The NAPQKEY database (table 3) is similar to NAPKEY but it is used to subdivide the Quaternary surficial deposits by assigning color symbols and labels to the Quaternary units. The table can also be used as a lookup table to assign the symbols, overprints, and labels to the surficial deposits. Within the FileMaker software, this database table contains a portal into the NSAUNITS database table, showing which map units or which sources are included in the qclass assignment.

Table 3. NAPQKEY field definitions

	Field name	Information type	Field type	Links
1	*Symbol*	Color number used, derived from an ArcGIS stylesheet.	Number	
2	*Overprnt*	Pattern, also derived from an ArcGIS stylesheet.	Number	
3	*Unit Label*	Map label printed on map products.	Text	
4	*Nsaclass*	Regional numeric code assigned to like units – the main key field in the database.	Number	
5	*Qclass*	Numeric code used to subdivide surficial deposits.	Number	NAPUNITS, Spatial database
6	*Geologic Unit*	Brief (5-10 words) summary of unit on a regional basis.	Text	
7	*Sources*	*Source* code for reference containing the unit and label of unit on original source map.	Text	

NAPDESCRIP database

This database (Table 4) ties *nsaclass* numbers to the more complete unit descriptions used on the northern Alaska Peninsula map and the unit descriptions from the Central Alaska geologic map (Wilson and others, 1998) compilation for map units that do not appear within the northern Alaska Peninsula map area. This table is linked to the NAPUNITS database through the *nsaclass* field and has portals into NAPUNITS and NAPKEY databases. Note, in the runtime version of the text databases, this table is accessed from the menu through the “Regional map unit descriptions” button.

Table 4. NAPDESCRIP field definitions

	Field name	Information type	Field type	Links
1	*Label*	Map unit label as used on the northern Alaska Peninsula map.	Text	
2	*Name*	Map unit name as used on the northern Alaska Peninsula map.	Text	
3	*Nsaclass*	Regional numeric code assigned to like units – the main key field in the database.	Number	NAPUNITS, NAPKEY
4	*Age*	Assigned age (range).	Text	
5	*Description*	Full text of unit description as used on the northern Alaska Peninsula map.	Text	
6	*Sources*	Source for unit descriptions (not the same form the “*source*” in other database tables).	Text	
7	*Color_symbol*	Color number used, derived from an ArcGIS stylesheet. Included here because a custom color assignment was used that differs from NAPKEY.	Number	

NAPREFS database

The NAPREFS database (table 5) contains the reference citation for each source map and other publication used. Included in the reference database will be maps that have been digitized, as well as other publications that result in changes to the map (for example, a paper reassigning some rocks from one unit to another or providing new age determinations). It will also list as "written commun." the source of unpublished information responsible for changes to particular aspects of the map. If a source map covers multiple quadrangles, it will be assigned an identification code for each quadrangle. This database has a portal into NAPUNITS, showing the units from any given source that have been entered in the NAPUNITS database. Note, in the runtime version of the text databases, this table is accessed from the menu through the “Map references” button.

Table 5. NAPREFS field definitions

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

NSALITH database

The NSALITH database (table 6) contains lithologic coding for each *nsaclass* in the database. It uses a lithologic dictionary that is contained in special linked database tables called LITHLIST and LITHFORM (listed in Appendices 1 and 2, herein). It allows for the entry of as many lithologies for a unit as needed and therefore has a many-to-one relationship through the *nsaclass* field. This database has a portal into the NAPUNITS database, showing which source maps contain that *nsaclass*.

One field, which is automatically generated, combines the values of five other fields in the database. This field allows searching of the database at any level of the lithologic hierarchy without the need to be concerned about the level of a given term. Possible searches, for example, are for any unit containing carbonate rocks or for any unit where limestone is a major lithology. Another field captures the information from the most specific part of the lithologic assignment; depending on the information about the map unit, this could be anything from the value in the lith1 to lith5 fields. The *rank* field has four defined values allowed; Major, meaning greater than or equal to 33 percent; Minor, between 10 and 33 percent; Incidental, less than 10 percent; and Indeterminate (major). Major is added to the indeterminate category to insure “fail safe” or inclusive searches for major rock types, as rock types listed in the indeterminate category could well be major components of a map unit. These can be eliminated from search results by explicitly omitting “Indeterminate” from the result. Note, in the runtime version of the text databases, this table is accessed from the menu through the “Map unit lithologies” button and the LITHLIST table is accessed through the “Lithologic data dictionary” button.

Table 6. NSALITH field definitions

	Field name	Information type	Field type	Links
1	*Nsaclass*	Regional numeric code assigned to like units – the main key field in the database.	Number	NAPUNITS
2	*Lith1*	Highest level lithologic classification.	Text, value list	
3	*Lith2*	Next level lithologic classification, 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, uses a 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	*Percent*	Optional field containing an estimate of percent of unit that given lithology represents. This information is rarely available in Alaska.	Number	
10	*Lith_comment*	Free form comment field – optional.	Text	
11	*Record_no*	Unique tracking number assigned by the database to each record.	Number, auto entry	
12	*Full name*	Text string that combines the information in all of the *lith* fields, allowing searches based on any aspect of the lithologic hierarchy.	Text, auto entry	
13	*Most detailed*	Calculated field that captures the most specific part of the lithologic assignment	Text, auto entry	

NSAAGE database

The NSAAGE database table (Table 7) is used like the NSALITH table to assign a uniform age to each *nsaclass* unit. The fields in it are assigned using a data dictionary (using the IUGSLIST database table) derived from a slightly modified (2006) version of the IUGS time scale (Gradstein and others, 2005) to assign maximum and minimum ages to geologic units. The database software then creates a field that has the full definition of the minimum or maximum age of the unit, allowing searches based on any part of the time scale, similar to the *full name* field described above for the NSALITH database. For example, searches could be for units that are 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 age as well.

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 NAPUNITS database will list the Paleozoic age as shown in the source whereas the NSAAGE database will most likely show the Permian age assignment, based on current knowledge and the assignment of an appropriate *nsaclass*. Note, in the runtime version of the text databases, this table is accessed from the menu through the “Map unit ages” button and the IUGSLIST table is accessed through the “Age data dictionary” button.

Table 7. NSAAGE field definitions

	Field name	Information type	Field type	Links
1	*Nsaclass*	Regional unit code as used above.	Number	NAPUNITS, Spatial database
2	*Unit_link*	Field only used in the conterminous US and is similar in some respects to *nsaclass* (included for compatibility with Conterminous US databases).	Text	(Conterminous US databases)
3	*Min_eon*	The minimum or youngest age assignment for the eon of the unit, based on geologic interpretation.	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*	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*	Complete, concatenated maximum age assignment.	Text, auto entry	

Table 7. NSAAGE field definitions (cont.)

	Field name	Information type	Field type	Links
15	*Type*	Unit age assigned relatively (stratigraphic position or fossils) or absolutely (radiometric age).	Text, value list (Relative or Absolute)	
16	*Cmin_age*	The most precise minimum age coded, derived from the *full_min* field.	Text, auto entry	
17	*Cmax_age*	The most precise maximum age coded, derived from the *full_max* field.	Text, auto entry	
18	*Min_Ma*	Numeric, either from the IUGS table or radiometric determinations.	Number, auto entry	
19	*Max_Ma*	Numeric, either from the IUGS table or radiometric determinations.	Number, auto entry	
20	*Age_comments*	Free form comment field – optional.	Text	

IUGSLIST database

This database table (table 8) provides the minimum and maximum ages for every Eon, Era, Period, Epoch, and Age. Linked to the NSAAGE database through *Eon*, *Era*, *Period*, and *Epoch*. The age assignments are based on the 2008 IUGS time scale (see Cohen and others, 2013).

Table 8. IUGSLIST field definitions

	Field name	Information type	Field type	Links
1	*Eon*	Eon	Text	
2	*Era*	Era	Text	
3	*Period*	Period	Text	
4	*Epoch*	Epoch	Text	
5	*Age*	Age	Text	
6	*Minimum_Ma*	Minimum age for the stratigraphic interval of the record in millions of years.	Number	
7	*Maixmum_Ma*	Maximum age for the stratigraphic interval of the record in millions of years.	Number	
8	*Rec_no*	Record number in database for sorting use.	Number	
9	*Concat*	Concatenated field including *Eon*, *Era*, *Period*, *Epoch*, and *Age* where defined in record.	Text	
10	*Far_right*	Right most term from *Concat* field	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
				Feldspathic-arenite
				Litharenite
				Quartz-arenite
			Arkose	
			Graywacke	
				Feldspathic-wacke
				Lithic-wacke
			Quartzose-sandstone	
		Siltstone		
		Mudstone		
			Claystone	
				Bentonite
			Shale	
				Black-shale
				Oil-shale
				Phosphatic-shale
		Sedimentary-breccia		
	Carbonate			
		Dolostone		
		Limestone		
			Boundstone	
			Chalk	
			Coquina	
			Floatstone	

APPENDIX 1. LITHOLOGIC DATA DICTIONARY (CONT.)

Lith1	Lith2	Lith3	Lith4	Lith5
Sedimentary	Carbonate	Limestone		
			Grainstone	
			Lime-mudstone	
			Packstone	
			Rudstone	
			Wackestone	
		Marlstone		
	Chemical			
		Banded-iron-formation		
		Barite		
		Chert		
		Diatomite		
		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	

APPENDIX 1. LITHOLOGIC DATA DICTIONARY (CONT.)

Lith1	Lith2	Lith3	Lith4	Lith5
Igneous	Plutonic	Syenitic	Syenite	
		Dioritic		
			Diorite	
			Monzodiorite	
			Quartz-monzodiorite	
			Quartz-diorite	
		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	

APPENDIX 1. LITHOLOGIC DATA DICTIONARY (CONT.)

Lith1	Lith2	Lith3	Lith4	Lith5
Igneous	Hypabyssal	Mafic-hypabyssal	Hypabyssal-basaltic-andesite	
			Hypabyssal-mafic-alkaline	
		Lamprophyre		
	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			
	Eclogite			
	Gneiss			
		Biotite-gneiss		
		Calc-silicate-gneiss		
		Hornblende-gneiss		
		Muscovite-gneiss		
	Granoblastic			
		Granofels		
		Hornfels		
	Granulite			
	Hydrothermally-altered			
		Greisen		
		Keratophyre		
		Skarn		
		Spilite		
	Metaigneous			
		Greenstone		
		Metaintrusive		
			Metaanorthosite	
			Metadiabase	
			Metadiorite	
			Metagabbro	

APPENDIX 1. LITHOLOGIC DATA DICTIONARY (CONT.)

Lith1	Lith2	Lith3	Lith4	Lith5
Metamorphic	Metaigneous	Metaintrusive	Metagranite	
			Metaultramafic	
				Metadunite
				Metaperidotite
				Metapyroxenite
		Metavolcanic		
			Metarhyolite	
			Metadacite	
			Metaandesite	
			Metabasalt	
		Orthogniess		
		Serpentinite		
	Metasedimentary			
		Calc-silicate-rock		
		Metacarbonate		
			Marble	
		Metaclastic		
			Argillite	
			Metaconglomerate	
			Metasandstone	
				Metagraywacke
			Metasiltstone	
			Pelitic-schist	
			Phyllite	
			Quartzite	
			Slate	
		Paragneiss		
	Migmatite			
	Schist			
		Amphibole-schist		
		Calc-silicate-schist		
		Mica-schist		
			Biotite-schist	
			Muscovite-schist	
		Quartz-feldspar-schist		
Tectonite				
	Cataclastite			
	Mylonite			
		Phyllonite		
	Mélange			
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			Mélange
	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			Blueschist
	Terrace, stream			Granulite
Sedimentary				Greenschist
	Bed			Hornfels
	Calcareous			Hornfels, biotite
	Carbonaceous			Hornfels, hornblende
	Coquina			Hornfels, pyroxene
	Deltaic			Hornfels, sanidine
	Dome			Zeolitic (prehnite-pumpellyite)
	Glauconitic		Tectonite	
	Lens			Mélange, blocks
	Mélange			Mélange, matrix
	Olistrostrome		Water	
	Reef			Lake, stream, or ocean
	Tuffaceous		Ice	
				Mass