

# PROPOSED NORTH AMERICAN GEOLOGIC-MAP DATA MODEL

## SCIENCE LANGUAGE TECHNICAL TEAM

### Examples of Geologic-map Data-base Queries, version 1.0

5 May, 2000

This document archives geologic-map data base queries submitted by Science Language Technical Team (SLTT) participants as of 5 May, 2000. For discussion purposes, the SLTT chair has unilaterally organized the queries into categories. A companion document (“20\_queries\_master\_1”) archives the submitted queries into a cumulative list without any organizational structure.

The organizational structure is not intended to be a definitive categorization of the geological-terminology universe. Rather, the categories are designed to do several things:

- Bring some organization and structure to the stream-of-consciousness archive of queries in the companion document “20\_queries\_master\_1”
- Identify some obvious query categories as a step toward our future discussions of classification hierarchies
- Identify some problem areas in classification hierarchies, including some false steps in distinguishing interpretive features from descriptive features
- Indicate the very clear and compelling linkage between lithologic nomenclature and structural nomenclature (as indicated by queries that cross-link between these features)
- Stimulate thinking about categories and hierarchies
- Indicate the frequency with which feature-level metadata plays a role in science-language queries
- Indicate the distinction between “data-base queries” and queries that use “data-base elements” to generate map plots or to evaluate and edit map plots
- To indicate that some of us may be equating “geologic maps” with “geologic-map data bases”. Is there an issue here?

The document has internal html links that allow you to use the Table of Contents to navigate to specific parts of the document. I have checked these links for their correctness, but if anything can go wrong, it must.

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## GENERAL QUERIES

- Select all bedrock geologic units
- Select all surficial geologic units
- Select bedrock geology after stripping off Quaternary cover
- Select all calderas in the western United States
- Select where I should not buy a house
- Select all basaltic units, irrespective of their specific petrologic classification based on modal analysis
- Select all sedimentary rocks
- Select all metamorphic rocks
- Select all igneous rocks
- Select all granites
- Select all gneissose rock, whether metamorphic or plutonic in origin
- Select all occurrences of Quaternary units
- Select Devonian rocks
- Select white rocks
- Select the distribution of Paleozoic and older rocks
- Select all Mesozoic igneous rocks (or all members of a similar broad age/rock class such as all Mesoproterozoic metasedimentary rocks)
- Select the distribution of glauconite-bearing rocks
- Select all rock units that include the Oxfordian Stage
- What stratigraphic units have been metamorphosed?
- Select all outcrops
- Select bedrock vs. alluvium
- Select all Mesoproterozoic rocks (or rocks having any given age range such as Triassic and Jurassic, Cretaceous and younger, or Quaternary)
- What rock in a particular region contains the most biotite?
- Select the locations of all sites with mineralogic data in section 8, T12N, R3E
- How many different rock types are present in a given area?
- Select all features related to the Acadian orogeny
- Select the distribution of unconsolidated, high-level Pliocene sediments flanking the Scioto River Valley from Columbus to Portsmouth in Ohio
- Select geologic units older than Mississippian

- Select wells that penetrate to the Precambrian and the type of rock
- Select a stratigraphic relationship of all the units exposed in the Grand Canyon and their textual descriptions
- Select all national parks in the US containing exposures of Cambrian rocks
- Select all sand deposits in California NPS units
- Select all oil well locations in Big Southfork NP
- Select all abandoned mines in Mojave NP awaiting reclamation
- Select an index map listing all the geologic quadrangles at Glen Canyon NRA at 1:24,000 scale
- Select all references and map notes that were cited to compile the geology of a certain park
- Select a map listing geologic hazard potential in all canyons of Zion NP

### **ALTERATION**

- Select all areas of altered rock
- How extensive is the hydrothermal alteration near \_\_\_\_?
- Select areas of sausseritic alteration
- Select areas of sericitic alteration
- Select areas of propylitic alteration
- Select areas of greissinization

### **ECOSYSTEM QUERIES**

- Select desert tortoise habitat and bedrock sand grain size
- Select forest-fire severity and bedrock moisture content
- Where are biota dependent on serpentine soils likely to be and with what probability?

### **ENERGY-RESOURCE QUERIES**

- Select all oil, gas or coal fields
- Select areas underlain by mined-out coal deposits greater than 4 feet in thickness
- Select all coal beds
- Select the location of all abandoned underground coal mines beneath the Interstate Route 70 corridor from Newark to St. Clairsville in Ohio

- Select the distribution of all Upper Freeport coal greater than 36 inches thick in Noble County, Ohio
- Select units containing coal seams thicker than one meter located on tribal lands
- Select all oil &/or gas wells
- Select all oil seeps
- identify all polygons that contain sample points with TOC (total organic carbon) attribute values in excess of 1%
- identify all polygons that contain sample points with apatite fission-track cooling age values between X and Y Ma
- Identify stream segments that cross polygons containing sample points with sulfur attribute values in excess of X%
- Identify stream segments that (a) cross formation polygons containing sample points with "oil-stained rock" attribute and (b) are within 0.5 km of topographic relief of at least 100 m
- Select rock units in which coal beds are interlayered with sandstone and organic mudrock beds
- Select rock units containing petroliferous blebs and (or) stringers
- Select all oil well locations in Big Southfork NP

## **FEATURE-LEVEL METADATA**

- Select polygons of unit X where the map-unit identification was made on the basis of outcrop examination
- Select polygons of unit X where the map-unit identification was made on the basis of extrapolation, and tell me the basis for the identification (binoculars, aerial photos, TM imagery, etc.)
- Select polygons of unit X where the map-unit identification is based on compiled sources, and identify the source
- Select polygons of unit X where the map-unit identification is little more than a guess
- How much field investigation was focused in this particular fault intersection?
- From what sources was this map element compiled?
- Select parts of the map compiled from the original mapping of Smith (1946)
- Who put these lines on the map? Are they reliable and at what scale?
- What is the reliability and or data density in various parts of the map area?
- How interpretive is this map, relative to "ground truth"?
- Who mapped this contact?

What is the definition of this map unit?

Exactly how is the contact between the Escabrosa Limestone and Horquilla Limestone defined on this map?

What is the statistical error in the data and how is it calculated?

At what scale is the data valid?

What is the useable scale range of the data?

Is the data sufficient to provide a user geographic reference to locate themselves?

Who has done geologic mapping in North Carolina?

Who has done paleontological studies in North Carolina?

Select all references and map notes that were cited to compile the geology of a certain park

## **GEOCHEMISTRY**

Select granites that contain more than 50 ppm whole-rock uranium

Select units with high acid-rock-drainage potential

Select polygons of rock units having acid neutralizing capacity, even if a minor lithology in the unit

Select locations of geochemical analyses of intrusive rocks that are ilmenite-bearing

Select all granitic rocks that have more K<sub>2</sub>O than Na<sub>2</sub>O

What is the geochemical signature of this unit?

How can I geochemically differentiate these two terranes?

Select bedrock units where nickel in lake sediments is between 60 and 75 ppm

Select rock units containing elevated rare-earth element abundances

Select rock units with Sr(initial) ratios greater than .706

## **GEO-ENGINEERING**

Select surficial deposits having average standard-penetration values less than N=20

Select surficial deposits with a shear-wave velocity less than 200 meters per second

Select all rock units denser than 2.67 g/cc

Select karst deposits underlying trailer parks

Select roads that overlie units with greater than 5% gypsum that are within 150 feet of the surface

Select Franciscan Formation where slope exceeds 20% and annual precipitation exceeds 25 inches

Select areas likely to have poor conditions for building

Is radon gas a problem in this area?

Permafrost is a problem here, how do I know where the safest place to put my pipeline would be?

Where are soils likely to exhibit shrink-swell?

Select liquefiable soils within the 100-year flood plain

What is under my house (or vacation property)? E.g., Rock type? Faults?  
Anything susceptible to landslides?

Where are slightly consolidated surficial deposits? Moderately consolidated?  
Well consolidated?

Select all sedimentary units with shear strengths (phi values) less than 35

Select all sedimentary units with cohesive strengths less than 500lb/square ft

Select all bentonite susceptible units that cross major roadways in National Parks  
(ie. Mancos Shale !!!)

Select rockfall potential in relation to specific map units

## **GEOMORPHOLOGY**

Select fault scarps that slope 15 to 25 degrees in playa deposits

Select late Pleistocene shorelines of Lake Bonneville

Select inner-gorges

Select areas underlain by shale where 30-m DEM data define a surface roughness value in excess of (some threshold value)

Select the location of all buried valleys in Shelby County that are filled with Pleistocene sand and gravel

Select the bedrock topography of Williams County, Ohio

Select the location of all probable karst areas of western Ohio

Select the location of all till bluffs over 15 feet high along the Lake Erie coastline

Select all terraces

What orientations are caves likely to have in carbonate deposits of XYZ mountains?

Where are biota dependent on serpentine soils likely to and with what probability?

- Select areas whose patterns resemble dunes along major east-west rivers of the High Plains
- Select sinkholes in section 12 and calculate the mean, median and mode of their diameters
- Select playas in Hale Co., Texas and fit them to a drainage pattern
- Select drainage patterns and fit to regional lineaments (or regional structural trends)
- Select all wetlands
- Select all occurrences of glacial striae superimposed on bedrock
- Select the location of slope-movement scarps where dips in the Reedsville Shale are greater than 25 percent
- Select all slope-movement scarps only on residual soil
- Select the location of slope-movement scarps on southwest-facing, treeless slopes
- Select all (certain, approximate, or concealed) (caldera boundaries, landslide scarps, etc.)
- Select all iceberg scours on the continental shelf and on the bed of Glacial Lake Agassiz
- Select all the eskers
- Select all the glacial striae and glacially streamlined landforms
- Select all sites with more than one set of glacial striae
- Select all the glacial lake and raised marine shorelines
- Select the all-time glacial limit in northwestern North America
- Select the location of all terraces > 3m above the flood plain
- Select areas having steep terrain
- Select spatial patterns of crestlines for Holocene barchan dunes
- Select recent shorelines to show dune migrations and beach erosion at North Carolina's Outer Banks
- Select all marine terraces 20 to 80 m above sea level that have reliable U-series dates < 130 ka
- Select areas where younger alluvial fans slope more steeply than older ones
- Select all calderas in the western United States

## **GEOPHYSICS AND PALEOMAGNETISM**

- Select all reversely-magnetized basalt flows that are younger than 10 Ma

- Select outcrops that correspond to magnetic anomalies with amplitudes of 100 nT and greater
- Select outcrops of turbidites that correspond to magnetic anomalies with amplitudes of 100 nT and greater
- Select all contacts and faults in white on top of this geophysical grid
- Select all aeromagnetic survey flight lines over the geologic map of this region. Code line colors according to survey altitude and/or survey date (or ID)
- What is the bulk mean density of map unit A? (bulk mean density could be replaced by any physical property)
- Produce a file of all gravity measurements from map unit A in the given region. This file must contain XYZ information as well as metadata
- Select contours of the Bouguer gravity anomaly map over this region of the geologic map
- Select aeromagnetic data of selected flight line centered on its flight line superimposed on the geologic map
- Select ground based magnetic survey location information. Select data projected to a straight line between selected endpoints. Calculate textural properties (fractal dimension) in the region overlain by map unit A
- Generate a map where wavelet (A) Selects a correlation of 0.75 or greater with the magnetic anomaly map. Overlay mapped faults. Overlay mapped intrusives, dikes, and sills with a magnetic susceptibility greater than 0.005
- Select reversely polarized early Pleistocene basalt
- Select where the geothermal gradient exceeds 4.0 degrees C when it intersects Pennsylvanian shales

## **HYDROGEOLOGIC QUERIES**

- Select all areas that have impermeable deposits within 2 m of the surface and slopes less than 3%
- Select all locations where the water table is within 20m
- Select all sedimentary rocks that are porous and permeable
- How deep do I have to drill my [water] well?
- Find all water wells that are found at the surface in "sequence A" of basin fill material
- Find all water wells that may intersect "sequence A" at 100m depth". What is the spatial variation (semi-variance?) in particle size distribution, cementation, (and possibly) porosity, and permeability of basin fill unit A?

## IGNEOUS ROCKS

### Age

Select all granites and granodiorites of Mississippian, Pennsylvanian, and Permian age, showing sample locations and references for U-Pb zircon dates by ion microprobe (from national geochronological database)

How was the age of this unit determined?

Select all Paleozoic intrusive rocks grouped according to age, as well as symbols distinguishing magmatic flow foliation and regional foliations

Select areas where 12 to 17 Ma old welded ashflow tuffs contain chloritized conglomeratic clastic dikes

### Rock type (classification)

Select all igneous rocks

Select areas where 12 to 17 Ma old welded ashflow tuffs contain chloritized conglomeratic clastic dikes

Select all charnockites and granulite-facies metamorphic rocks

Select all basaltic units, irrespective of their specific petrologic classification based on modal analysis

Select all granites

Select all hypersolvus granites

Select all andesitic and basaltic volcanic rocks

Select Neogene basalt units adjacent to rivers

Select rhyolite dikes

Select all hornblende-bearing plutonic rocks

Select all subvolcanic intrusive rocks

Select all syenitic rocks

Select all Proterozoic rock units that are part of a mangerite-jotunite complex

Select the location of all known kimberlites

### Outcrop geomorphology

Select plutonic rock units that have exfoliating structure

Select plutonic rock units that weather into tors

## **Lithology (physical description) and composition**

- Select units where basic igneous rocks dominate
- Select units with ultrabasic rocks as a component
- Select areas where 12 to 17 Ma old welded ashflow tuffs contain chloritized conglomeratic clastic dikes
- Select all occurrences of obsidian that are not devitrified
- Select calc-alkaline igneous rocks
- Select units with shear zones and silicic plutonic rocks
- Select Early Proterozoic bimodal volcanic rocks deposited in a backarc basin environment
- Select Early Proterozoic volcanic rocks and locate the massive sulfide deposits in them
- Select granites that contain more than 50 ppm whole-rock uranium
- Select volcanic deposits that are highly weathered and easily excavatable
- Select all intrusive rocks that are ilmenite-bearing
- Select all intrusive units that are inferred to be ilmenite-bearing
- Select all granitic rocks that have more K<sub>2</sub>O than Na<sub>2</sub>O
- Select Neogene basalt units adjacent to rivers
- Select rhyolite dikes
- Select all hornblende-bearing plutonic rocks
- Select all subvolcanic intrusive rocks
- Select all syenitic rocks
- Select all granitoid rocks that are stained brownish-red, whether or not the stain is understood in terms of its mineralogy or its geochemistry
- Select all basalt that has pillows
- Select granodiorite that contains inclusions of any kind
- Select granodiorite that contains equidimensional inclusions
- Select granodiorite that contains flattened and aligned inclusions
- Select all intrusive rocks that have schlieren
- Select all plutonic felsic rocks that have porphyritic textures with a fine-grained groundmass
- Select all plutonic felsic rocks with 2 micas
- Select all plutonic felsic plutons that are polyphase or zoned

Select all Phanerozoic mafic to ultramafic plutonic igneous rocks associated with calc-alkalic convergent margin magmatism that have cumulate textures

Select all Archean and Proterozoic mafic to ultramafic plutonic igneous rocks that have cumulus layering, particularly cyclic units or macrorhythmic layering

Select all tectonized harzburgites that are part of an ophiolite assemblage

Select all pillow lavas associated with the Coast Range ophiolite

Select all tuffs associated with the Thunder Mountain caldera in Idaho, distinguishing those that are intracaldera from those lying outside the caldera margin

### **Genetic structures**

Select all intrusive rocks that are flow-foliated

Select all Paleozoic intrusive rocks grouped according to symbols distinguishing magmatic flow foliation and regional foliations

Select all intrusive rocks that are flow-lineated

### **Petrography and mineralogy**

Select all intrusive igneous rock units that contain magmatic hornblende

Select all intrusive igneous rock units that contain magmatic muscovite

Select all extrusive igneous rock units that contain sanidine

Select all porphyritic plutonic rocks

Select all equigranular plutonic rocks of tonalitic composition

Select all rapakivi-textured hypabyssal and plutonic rocks

Select all rapakivi-textured plutonic rocks

Select all porphyritic plutonic rocks where K-spar is the phenocryst

Select all intrusive rocks with plagioclase composition An30-An40

Select all volcanic rocks having ophitic texture

### **Stratigraphic relations**

Select all intrusive contacts of late Cretaceous age

Select granitic intrusions into limestone

Select granitic intrusions into limestone that are associated with skarn occurrences

Select all intrusive contacts

### **Genesis and origin**

Select all intrusive igneous rock units

Select all intrusives/extrusives

Select all flood basalt

Select all intrusive rocks that are foliated

Select areas of plutonic intrusions, divided into mafic, felsic and intermediate

Select all volcanic deposits

Select all pumice deposits

Select all pyroclastic flow deposits

Select all lava flow deposits

Select all dome deposits

Select all recent volcanic eruptions and flows (< 2000 years ago)

Select all tuffs associated with the Thunder Mountain caldera in Idaho, distinguishing those that are intracaldera from those lying outside the caldera margin

### **Tectonic or paleogeographic setting**

Select Early Proterozoic bimodal volcanic rocks deposited in a backarc basin environment

Select volcanic rocks formed in island-arc settings

Select plutonic rocks formed in anorogenic continental-interior settings

Select synorogenic plutonic rocks

Select synorogenic plutonic rocks of Andean-margin type

Select synorogenic volcanic rocks in the upper plate of Tertiary detachment faults

Select synorogenic volcanic rocks in Miocene extensional nonmarine basins

### **ISOTOPE GEOLOGY AND THERMOCHRONOLOGY**

Select all intrusive igneous rock units with published U-Pb zircon ages

Select all intrusive igneous rock units with U-Pb zircon ages published after 1990

Select all extrusive igneous rock units with sanidine  $^{40}\text{Ar}/^{39}\text{Ar}$  ages published after 1985

Select all units having radiometric-age data

How was the isotopic age of this unit determined?

Who did the ages on the \_\_\_\_\_ pluton and are they any good?

What is the material investigated (rock type, mineral, liquid, gas)?

Where is the material from (lat. long.; range township, section, location map)? Is the age of the material known?

Were data generated in more than one laboratory (chemical lab, isotope lab, wet chemistry, dry chemistry, etc.)

What is the element(s) investigated?

What kind of isotope(s) is reported (radiogenic, stable)?

What techniques were used to determine elemental abundances?

What techniques were used to determine isotopic abundances or ratios?

Were initial isotopic ratios calculated for radiogenic isotopes?

How was age of material determined?

Are age determinations available from different techniques and/or isotope systems?

Are ages by different techniques the same or different?

if different, is it known why (geologic factors, analytical factors)?

What are the precisions of the measurements?

What are the accuracy's of the measurements?

when were initial radiogenic isotope ratios calculated (decay constants and isotopic abundances used)?

Who and/or what are the sources of data (references, written communication, rumor, guess, plagiarized)?

Are there other chemical or isotopic data elsewhere for materials in data base?

Where are additional data available (library, Internet, internal memo, rumor, etc.)

Why was the work done (is there a problem)?

Where are radiometric ages in "this" unit (and only this unit)?

Select locations of all samples dated by the U/Pb method using the mineral titanite and returning an age between 1345 and 1326 Ma

Select U/Pb age determinations performed at the Royal Ontario Museum geochronology lab

Identify all polygons that contain sample points with apatite fission track cooling age values between X and Y Ma

## DATA-BASE AND MAP-UNIT MANIPULATION

- Create a "lithologic map" by applying a standard or customized lithologic classification
- Create a "lithogeochemical map" (showing general lithologic and hydrogeochemical characteristics) by applying a standard or customized reclassification of rock units as in <http://water.usgs.gov/pubs/wri/wri994000>
- Create a "surface materials map," reclassifying surficial deposits (glacial, fluvial, etc.) and bedrock units where surficial deposits are thin or absent, according to material properties (as recently done for Connecticut)
- Create a "generalized geologic map" applying a standard or customized grouping of units
- Create separate "bedrock" and "surficial" geologic maps, plus a "complete" (combined bedrock + surficial) geologic map
- Remove all Cenozoic basin fill units, in their place Select depth to basement (contours or color)
- Remove all Cenozoic basin fill units, in their place Select depth estimates and trends based on magnetic and/or gravity analysis
- Superimpose all mapped faults, including dip information, in region where Cenozoic basin fill geology has been removed
- Find all water wells that are found at the surface in "sequence A" of basin fill material
- Find all water wells that may intersect "sequence A" at 100m depth". What is the spatial variation (semi-variance?) in particle size distribution, cementation, (and possibly) porosity, and permeability of basin fill unit A?
- What rocks in a give area are similar to a specified rock?
- What is the geologic description of this unit?
- If I specify groupings (e.g., sand + moldic limestone + gravel vs. clay + siltstone), will you draw a map of my groupings?
- Select the type section of the \_\_\_\_ unit?
- Select all polygons mapped as open water
- Select all map units that are mapped as lines only (for example, dikes)
- Select all map units that are mapped as both lines and polygons
- Select all (sample localities, mines, etc.)
- Select a cross section along the line A-A'
- Which stratigraphic units have analytical data
- Select all references
- Select all rock types in a list

Select all cross section index

Select all outcrops with measured sections and age dates

Can you print out the paleontological data for specific sites used in making a map?

Can you draw a marine/nonmarine map for a particular time slice or series of time slices (or limestone/sandstone map, etc.)

Anything to help overcome edge effects/state line faults. (Select all the nonmarine sand of late Paleocene age in Georgia and South Carolina, and when you do, tell the various formation names.)

Expand queries such as the one above (Ok, now Select early Eocene nonmarine sand, and any undated nonmarine sand, too)

Anything to help the user look for patterns in the data (do joints in one part of the map trend one way and in another part of the map trend a different way)

In maps where there is both surficial and bedrock coverage (or any maps where there is more than one coverage), anything to help look for similarities/differences that are related

Select all locations where map unit A has an aspect of 135-270 degrees and a slope of 10-60 degrees

Select all units for which a drainage line also acts as one of the unit's contacts

Select all cross-cutting relationships in streamlined glacial landforms

Select all the rock outcrops that are too small to show as polygons

Select all drill holes in the map area and link to their logs (so I can check a cross section)

Select all units that should have scratch boundaries shown for all or part of the unit

Select all contacts that are mapped as unconformities

Is there redundancy in the data and why?

What is the volume of basin fill unit A in this region?

Select a geologic cross section across the Black Canyon of the Gunnison River

## **LINEAR AND PLANAR GEOLOGIC FEATURES**

### **Broad structural queries**

Select stations at which multiple structural orientations are recorded

Select attitude symbols of nth generation

Select all strike & dips and other geologic symbols

Select all paleostress indicators within 20 degrees of east-west orientation

Select allochthonous rocks in the area

Select all faults and contacts that separate bedrock from basin fill

Select all locations where map unit A has an aspect of 135-270 degrees and a slope of 10-60 degrees

## Geologic Contacts

Select all (certain, approximate, inferred, concealed, or gradational) contacts

Select all contacts that are mapped as unconformities

Identify lines (including contacts and faults) that separate formation polygons that are not directly adjacent to one another in the map legend

Select all intrusive contacts with evidence of shearing and/or cataclasis

Identify all formation polygons whose contact with immediately younger formation polygons defines a closed line segment

Identify all contacts that meet the map-accuracy standard

Identify all sedimentary contacts

Identify all sedimentary contacts that overlap the XYZ granite

Identify all contacts where the geologist is not certain whether the linear feature is a contact or a fault

Identify all contacts whose location meets the stated map-accuracy standard

Identify all sedimentary contacts formed during the Kaskaskia onlap sequence

Identify all igneous contacts formed during the late Cretaceous part of the Laramide Orogeny

Select all gradational contacts separating marine and terrestrial sediments

## Geologic Structures

### Linear structures

#### Lineations (Selected as a point at the Earth's surface)

Select linear symbols that intersect with planar symbols

Select lineation and foliation measurements that were measured together as pairs on a single foliation surface

Select slickenside lineations

Select slickenside lineations trending between 045 and 115

Select slickenside lineations on low-angle normal dip-slip faults

Select lineations created by crushing and streaking of mineral grains

Select stretching lineations

Select L2 minor-fold lineations

Select paleocurrent lineations between 115 and 180

Select sole-mark lineations between 115 and 180

### **Planar structures**

Select all kinds of planar point features

Select planar symbols that intersect with other planar symbols

### **Bedding planes (Selected as a point at the Earth's surface)**

Select upright bedding attitudes with dips greater than 45 degrees

Select polygons of unit XYZ where sedimentary bedding is overturned beneath thrust faults of mid-Tertiary age

Select polygons in which the XYZ shale dips northwestward greater than 25 degrees on slopes steeper than 10 degrees

Select locations of shale where bedding dips greater than 30 degrees in the downhill direction

Identify pairs of strike/dip symbols for which the distance between symbols is less than 1 km and for which minimum difference in dip directions is at least 120 degrees

Select all strike & dips and other geologic symbols

Select bedding measurements for which tops are known

Create a 1 km buffer around strike/dip symbols characterized by dips greater than 45 degrees

Select overturned beds

Select linear symbols that intersect with planar symbols

Select units with sedimentary rocks that dip more than 25 degrees

Select units where the Tye Sandstone is dipping west

Select the attitude data for all sedimentary units that have a bed thickness less than 1 foot

Select areas where steeply dipping sedimentary rocks are buried beneath less than 3 m of unconsolidated sediments

Select all areas where reversal of dip direction within Pliocene sandstones occurs within 1 km

### **Fault planes (Selected as a line at the Earth's surface)**

- Select fault scarps that slope 15 to 25 degrees in playa deposits
- Select all historically active faults
- Select the location of all mapped faults with Holocene displacement
- Select thrust faults of the Penokean orogen
- Select thrust faults of the Penokean orogeny that were reactivated during the Mid-continent rift
- Select low-angle faults that are extensional in origin
- Select units with shear zones
- Select units with shear zones and silicic plutonic rocks
- Select maximum areal limits within which the surface trace of a specified fault could lie
- Select 90% confidence limits on the location of a specified fault
- Identify all faults whose location meets the stated map-accuracy standard
- Select reverse faults that cut Neogene deposits
- Select all areas of fault breccia
- Select faults of nth generation
- Select hanging-wall rock units where Mesozoic 2-mica granites intrude metacarbonate rock
- Select all (upright, overturned) (synclines, anticlines)
- Select all (certain, approximate, inferred, or concealed) faults(folds, )
- Select all Cretaceous and Cenozoic faults, classified according to relative movement (low-angle thrust, steep normal or reverse, sinistral or dextral strike-slip, etc.)
- Select all faults, shear zones, and rock units characterized by mylonitic fabrics
- Select all rock units in and adjacent to the Brevard and Mountain Run fault zones (or other named fault zones), or all faults of the Stafford fault system (or other named fault system)
- Select all Paleozoic thrust faults (or other faults of specified age and type)

Select all normal and reverse faults in contact with stratified units of Triassic or Jurassic age; or all faults that offset Cretaceous and younger units

Select thrust faults that overlie Mesozoic shale

Select faults of regional extent that have gold occurrences

Select strike-slip faults that have known sinistral movement between 450 and 423 Ma

What kind of fault rocks occur along this fault?

Select blind thrust faults that will produce a magnitude 6 or greater earthquake in the next 30 years

Select all faults that dip 60 degrees or greater

Select all listric faults

Select thrust faults that are reactivated Miocene normal faults

Select all inferred faults within Quaternary alluvium based on analysis of water levels

Select right-lateral strike-slip faults with 1 km or greater offset

Select right-lateral strike-slip faults with unknown amount of offset

Select all faults with evidence of movement during the Holocene

Select all faults that coincide with alignments of seismicity

Select faults having known or suspected Holocene and Pleistocene movement

Select faults younger than 28 Ma

Select surficial deposits younger than 250,000 years that are cut by thrust faults

Identify all thrust faults whose strike is between 80 and 110 degrees and whose vergence is south

Select all faults (by type)

Select faults having a NW-SE trend

Select fault scarps buried by < 3m of material

Select named faults

How much field investigation was focused in this particular fault intersection?

Select faults that perturb shallow ground-water flow enough to enhance vegetation

Select faults that perturb shallow ground-water flow enough to form springs

Select faults active during the middle Pleistocene

Is this site within 50 km of a Quaternary fault?

Select all [map] units for which faults act as unit boundaries

Select anywhere faults seem to have a circular pattern (or where clustered faults seem to have a lack of preferred orientation)

Identify lines (including contacts and faults) that separate formation polygons that are not directly adjacent to one another in the map legend

Select all low-angle faults, whether contractional or extensional

Select thrust faults that have been folded

Select Cretaceous thrust faults that were reactivated in Eocene time

Select segments of the Vincent-Orocopia-Chocolate Mountain thrust system that were re-activated by Oligocene-Miocene extension

Select all high-angle faults within 2 km of the Wasatch Mountain front that have a rake of 45 to 60 degrees

Select faults that offset only the youngest alluvium

Select all faults that truncate or offset faults of late Pliocene or younger origin.

Select all faults with damage zone wider than 2 m where the damage zone is not plugged

### **Fold-axial planes (Selected as a line at the Earth's surface)**

Select all (certain, approximate, inferred, or concealed) folds

Select named folds

Select all folds (by type)

Select folds of nth generation

Select fold-axial planes overturned to the SW

### **Foliation planes (Selected as a point at the Earth's surface)**

Select foliation within non-metamorphic units

Select foliation and lineation measurements that were measured together as pairs on a single foliation surface

Select all Paleozoic intrusive rocks grouped according to symbols distinguishing magmatic flow foliation and regional foliations

### **Fracture planes (Selected as a point at the Earth's surface)**

- Select units with joints or fractures with less than 2-meter spacing
- Select northeast-oriented fractures without calcite fill
- Select the location and orientation of all mapped bedrock fractures in Summit County, Ohio
- Where is fracture density of surface rocks great enough to significantly enhance hydraulic conductivity?
- Select all hard rocks with close fracture spacing
- Select surficial deposits having fractures that are partly closed by caliche
- Select surficial deposits having open fractures striking between 045 degrees and 090 degrees, with fracture spacing denser than 1 fracture per meter

### **Joint planes (Selected as a point at the Earth's surface)**

- Select units with joints or fractures with less than 2-meter spacing
- Select 20 to 30 Ma lacustrine limestones that have orthogonal joint sets

### **Non-Quantitative (annotation) point symbols**

- Select all symbols for overturned syncline
- Select all symbols for upright anticline
- Select all double-arrow symbols for right-lateral strike-slip faults
- Select all bar-and-ball fault symbols
- Select line-symbols for "contact, meets the map accuracy standard"
- Select all symbols for subsurface-boring locations

### **Geomorphic features**

- Select the location of slope-movement scarps where dips in the Reedsville Shale are greater than 25 percent
- Select all slope-movement scarps only on residual soil
- Select the location of slope-movement scarps on southwest-facing, treeless slopes

- Select all (certain, approximate, or concealed) (caldera boundaries, landslide scarps, etc.)
- Select late Pleistocene shorelines of Lake Bonneville
- Select spatial patterns of crestlines for Holocene barchan dunes
- Select spatial patterns of crests of Pleistocene terminal moraines
- Select spatial patterns of crests of Pleistocene lateral moraines
- Select ground fissures
- Select crown scarps for landslides
- Select recent shorelines to show dune migrations and beach erosion at North Carolina's Outer Banks

## **METAMORPHIC ROCKS**

### **Age**

#### **Metamorphic age**

How was the metamorphic age determined?

Select all greenschist-facies rocks metamorphosed in late Cretaceous-early Paleogene time

Select all rocks metamorphosed in late Proterozoic time

Select rocks having two prograde metamorphic ages

Select rocks having mid-Proterozoic prograde upper amphibolite metamorphism followed by late Proterozoic retrograde metamorphism to greenschist facies

#### **Protolith age**

How was the protolith age determined?

Select protoliths of late Proterozoic age

Select protoliths of Paleozoic age

### **Rock type (classification)**

#### **Metamorphic**

Select all metamorphic rocks

Select all granulite-facies metamorphic rocks and charnockites

Select all cataclastic rocks

Select orthogneisses that have mylonitic fabrics and are intruded by alkalic plutonic and hypabyssal rocks of Triassic age

Select all contact metamorphosed zones containing marble or talc in Death Valley NP

#### **Protolith**

Where are there carbonate rocks metamorphosed to amphibolite facies

## Outcrop Geomorphology

### Lithology and composition

#### Metamorphic lithology

Select orthogneisses that have mylonitic fabrics and are intruded by alkalic plutonic and hypabyssal rocks of Triassic age

Select biotite schist that is coarse grained

Select chlorite schist that is fine to medium grained

Select quartzose hornfels that contains <5% biotite

Select actinolite-chlorite schist interlayered with muscovitic quartzofeldspathic schist

#### Protolith lithology

Where are there carbonate rocks metamorphosed to amphibolite facies

Select marble that originally was chert-rich limestone

Select marble that originally was "pure" high-calcium limestone

Select marble that originally was high-magnesium dolostone

Select metaquartzite that originally was medium to coarse grained high-silica shore-face dune sand

### Petrography and mineralogy

#### Metamorphic

Select all occurrences of coexisting kyanite and sillimanite

Select biotite schist that is coarse grained

Select chlorite schist that is fine to medium grained

Select quartzose hornfels that contains <5% biotite

Select schist and gneiss containing porphyroblasts of cordierite

Select all metamorphic rocks that contain prograde hornblende

Select all metamorphic rocks that contain prograde muscovite

Select all metamorphic rocks that contain prograde garnet

## **Protolith**

Select Mesozoic orthogneiss containing porphyroclasts of potassium feldspar

## **Genetic structures**

### **Metamorphic structures**

Select orthogneisses that have mylonitic fabrics and are intruded by alkalic plutonic and hypabyssal rocks of Triassic age

Select rock units that have deformational fabrics transitional between brittle and ductile

Select rock units that have cataclastic deformational fabrics and are cut by low-angle listric faults

Select rock units that display S-C indicators

Select rock units that have mylonitic deformational fabrics and display S-C indicators

Select rock units that have mylonitic deformational fabrics and also have mullion structures

### **Protolith structures**

Select greenschist-facies metasedimentary rocks that contain original sedimentary structures

Select orthogneiss units that preserve porphyritic fabric

Select greenschist-facies metasedimentary rocks that contain original sedimentary structures

## **Stratigraphic relations**

Select areas where the XYZ orthogneiss cross-cuts the XRAY schist

Select areas where the XRAY schist and the PQR greenstone appear to be depositionally stacked rather than structurally stacked

## **Genesis and origin**

### **Metamorphic genesis**

Where are there carbonate rocks metamorphosed to amphibolite facies?

Select areas of the granulite facies metamorphic terrane that have been affected by greenschist facies retrogressive metamorphism

Where are rocks metamorphosed to at least greenschist facies  
between 125 and 140 Ma?

Where are rocks metamorphosed to upper greenschist facies and  
higher?

Select metasedimentary rocks metamorphosed adjacent to plutonic  
intrusions

### **Protolith genesis**

Select orthogneisses that originated as monzogranitic high-level  
plutons

Select metagraywacke that originated as turbidite sands

Select argillite that originated as basin-plain siliceous mudrock

Select metachert

Select greenstone that originated as basalt flows

Select gneiss units that have sedimentary protoliths

Select all metamorphic rocks derived from felsic, igneous plutonic  
protoliths

Select all metamorphic rocks that have relict sedimentary structures

### **Tectonic or paleogeographic setting**

#### **Metamorphic**

Select metasedimentary terranes metamorphosed to blueschist  
conditions in subduction zones

Select metamorphic rocks formed in continental-collision zones

Where do metamorphic rocks occur beneath the XYZ thrust plate?

#### **Protolith**

### **MINERALIZATION**

Select all units containing sulfide mineralization

### **MINERAL-RESOURCE QUERIES**

Where should I target surface materials for federal highway-grade concrete  
aggregate?

What playa deposits lie within 50 km of Cenozoic epithermal gold systems?

Select mines in Miocene silicic volcanic rocks

Select gold mines in Jurassic rocks

Select all geologic units known to contain past or present sources of crushed stone (from mineral resource database) plus other units having similar characteristics

Select all greenschist-facies mafic volcanic rocks known to contain abandoned copper mines (from mineral resource database)

Select all granitic units that contain traces of molybdenite or molybdenite prospects (from mineral resource database)

What potential rip-rap sources lie within 20 km of a railroad?

Select abandoned surface mining sites in Pike Co., Kentucky

Select mine tailings within 3 m of a stream

Select all mines

Select phosphate deposits located upstream from cities greater than 50,000 population

Select Quaternary units having active sand and gravel quarries

Where can I find gold?

I'm a recreational gold panner, where can I go and be successful (and legal)?

Select gravel pits in southeastern Virginia and tell me the formation that is being mined

Select all the aggregate deposits within 100 km of a deepwater port

Select all abandoned mines in Mojave NP awaiting reclamation

Select all contact metamorphosed zones containing marble or talc in Death Valley NP

Select economic mineral potential locations of the commodity selenite in Capitol Reef NP

Select all active mines and/or wells in Nevada

## **PALEONTOLOGY AND STRATIGRAPHY**

Select fossil localities that conflict with age assignments of units

Select conodont localities in the Conococheague Limestone

Select all units containing Ordovician fossil localities

Select all faunal assemblages of Celtic faunal provinciality

Select all units of black shale whose known or suspected age coincides with some part of the *Nemagraptus gracilis* graptolite zone

Where is the best place to find fossils that I can get to?

Where are fossil locations (or radiometric ages) in "this" unit (and only this unit)?

Select all occurrences of the trilobite, *Paradoxides davidis*

Select Paleozoic rock units that contain fossils having Appalachian provincial affinities

Select Paleozoic rock units that contain fossils having Hercynian provincial affinities

Select Tertiary rock units that contain fossils having Tethyan provincial affinities

Select rock units containing trilobite faunas of the XYZ trilobite biomere of Palmer

Select marine sedimentary rocks containing benthic foraminiferal faunas of the Mohnian Stage

Select all NPS units in Utah containing Pennsylvanian rocks with fossils

Select all NPS units in Utah containing Pennsylvanian rocks with fossil clams

Select all sedimentary rocks which contain abundant, well preserved trilobite fossils

## QUATERNARY SURFICIAL MATERIALS

### Age

Select all occurrences of Quaternary units

Select surficial deposits younger than 250,000 years that are cut by thrust faults

Select Holocene eolian silt deposits

Select Holocene bog or peat deposits

Select Holocene landslide deposits

Select all lacustrine beds that contain Lava Creek B tephra

### Deposit Type

Select all lacustrine beds that contain Lava Creek B tephra

Select all alluvial deposits except for alluvial-fan deposits

Select all hillslope materials and colluvium except those formed by sheet-wash processes

Select colluvial materials but not those formed by sheet-wash processes

Select all eolian deposits

Select loess deposits that are greater than 2 m thick

Select Holocene eolian silt deposits

What is under my house (or vacation property)? E.g., Rock type? Faults?  
Anything susceptible to landslides?

Select all landslide deposits

Select all the landslide deposits

Select all deep-seated landslides within a separately specified perimeter,  
such as a city boundary

Select Holocene landslide deposits

Select landslides in Clearwater Co., Idaho and separate by originating parent  
rock type

Select Holocene bog or peat deposits

Select where there is peat in Florida

Select organic-rich peat deposits in areas other than permafrost locations

Select all lacustrine deposits

Select the location of all Pleistocene lacustrine deposits in Muskingum  
County, Ohio

What playa deposits lie within 50 km of Cenozoic epithermal gold systems?

Select the distribution and thickness of colluvium derived from Pennsylvanian  
red claystones in Athens County, Ohio

Select all the debris flows with north aspects

Select all deposits related to glacial activity

Select all sandy glacial deposits

Select the location of all glacial bog deposits greater than 10 feet thick in  
Franklin County, Ohio

Where are the oldest glacial deposits?

Select the distribution of eskers greater than 2 km in length

Select all the areas of lodgement till, both at surface and below other surficial  
cover

Were there Pleistocene lakes in the area and where? Through which route  
did they drain?

Select all the organic terrane that is within the zone of discontinuous  
permafrost

Select all recent slope movements that occurred in areas mapped as ancient  
debris-fan deposits

Select all slope movements in the Potomac River drainage basin

Select the map polygons that are till

Select all areas of thick till  
Select all clay-rich till  
Select all end moraines and large recessional moraines  
Select all the calcareous till  
Select all glacial deposits  
Select all till deposits  
Select all outwash deposits  
Select all drift deposits  
Select all stream deposits  
Select all fluvial deposits  
Select all levee deposits  
Select all flood deposits  
Select all lacustrine deposits  
Select all lake deposits  
Select all gravel deposits  
Select all sand deposits  
Select all clay deposits  
Select all debris flow deposits  
Select all moraine deposits  
Select Holocene lahars  
Select Late Pliocene terrace deposits  
Select all polygons mapped as landslides in the Simi Valley East 7.5 minute quadrangle prior to the 1994 Northridge earthquake  
Select all polygons mapped as landslides in the Simi Valley East 7.5 minute quadrangle that were triggered by the 1994 Northridge earthquake  
Select all terrace alluvium with calcrete soil > stage IV  
Select all terrace alluvium deposits with upper surface between 10 and 20 m above stream level.  
Select all eolian deposits more than 1 m thick that lack significant soil development  
Select all areas that are within 2 km of and lower than landslide deposits having documented movement within the last 100 years

## Geomorphology

Select slope-movement scarps only in residual soil or colluvium developed over limestone

Select surficial deposits that have well-developed surface armor

Select surficial deposits that have depositional morphology preserved

Select surficial deposits that have no depositional morphology preserved

Select areas where younger alluvial fans slope more steeply than older ones

## Pedogenic soils

What surficial materials have weak Av horizons?

Select all residual soil developed on southeast-facing slopes

Select all cryptogamic soils in this region

Select alluvial deposits that have buried soils

Select alluvial deposits having well developed argillic horizons

Select alluvial deposits having moderately developed K horizons

Select alluvial deposits having a strong K-IV horizon within 3 m of the surface

Select all terrace alluvium with calcrete soil > stage IV

Select all eolian deposits more than 1 m thick that lack significant soil development

## Lithology (physical description) and composition

Select all surficial material with particle-size distributions of more than 20% sand

Select all sandy glacial deposits

Select all units composed of clayey lodgement till

Select slope-movement scarps only in residual soil or colluvium developed over limestone

Select surficial deposits having fractures that are partly closed by caliche

Select surficial deposits that have clast populations dominated by carbonate rock, whether dolostone or limestone

Select all sand-and-gravel units that have greater than 7% silt

Select surficial deposits having average standard-penetration values less than N=20

Select surficial deposits with a shear-wave velocity less than 200 meters per second

Select all soils (and/or surficial sediments) with carbon contents > 3% in the upper 10 cm

Where are biota dependent on serpentine soils likely to and with what probability?

Select map units containing gravel in their upper part

Select all unconsolidated deposits that contain sand

What is the percent gravel in all surficial materials, incremented by 10%, between 25% and 75%?

Select the location of all sand deposits greater than 15 feet thick within 10 feet of the surface in Hamilton County, Ohio

Select all gravel deposits larger than 0.5 ha

Where will I likely encounter caliche within 1.5 m of the surface? 6 m?

Select unconsolidated sand and gravel deposits that overlie granitic rock

Select unconsolidated sand and gravel deposits located within 20 miles of cities greater than 50,000

Select all the locations where caliche (indurated carbonate or calcrete -here's an example of needing a common term) is within 3 m of the surface

In what surficial materials is silt>5% and eolian sand<5%?

Select all locations where the composition of surficial unit A (or all surficial units) is >50% quartz

Where are slightly consolidated surficial deposits? Moderately consolidated? Well consolidated?

Select sand and gravel units where the gravel:sand ratio exceeds 2:1

Select sand and gravel units where the average clast size is <5 cm

Select sand and gravel units where the gravel:sand ratio exceeds 2:1 and where the average clast size is <5 cm

Select sand and gravel units where the clasts consist of unweathered metavolcanics

Select sand and gravel units where the clasts are highly weathered granitic and metamorphic rocks

Select areas where steeply dipping sedimentary rocks are buried beneath less than 3 m of unconsolidated sediments

Select areas where diamictons less than 2 m thick overlie well bedded, well sorted deposits

## Genesis

- Select alluvial-fan deposits where debris-flow deposition dominates over stream-flow deposition
- Select lacustrine near-shore and bar deposits
- Distinguish deposits of alpine glaciers from those of continental glaciers
- Distinguish outwash-plain deposits from morainal deposits
- Distinguish proximal alluvial-fan deposits from distal alluvial-fan deposits
- Distinguish alluvial-valley deposits from alluvial-fan deposits
- Distinguish braided-stream deposits from meander-belt deposits
- Distinguish pro-delta deposits from delta-front deposits
- Select all catastrophic flood deposits
- Select the location of outwash deposits of the Chippewa lobe
- Select ice flow directions within the Green Bay lobe
- Select slope-failure deposits that consist of earthflows
- Select slope-failure deposits that consist of slump blocks
- Select slope-failure deposits of late Holocene age, irrespective of origin
- What is the transport direction of eolian sand?
- In what areas will I likely find a debris-flow deposit within 2 m of the surface?
- Select Wisconsin moraines in Iowa and fit to a soil moisture map of Iowa
- Select provenances of sand sources of the Arkansas River
- Select all the marine clay
- Select channels on alluvial fans active in the last 12,000 years

## Stratigraphy

- Select where well data indicate alluvial thicknesses of 500 ft and greater;
- Select the thickness of alluvium in the Red River reach from point A to point B (assuming these points could be digitally located)
- What map units contain gravel in their upper part?
- Select alluvial deposits more than 10 meters thick
- Select units with less than 2 meters of unconsolidated surficial material
- Select units with more than 5 meters of unconsolidated surficial material
- Select the terminal moraine of the Miller Creek Formation

- Select where there is less than 50 feet of glacial deposits on Middle Proterozoic mafic intrusive rocks
- Select all landslide contacts
- Select where there is peat in contact with Pleistocene limestone in Florida
- In what areas will I likely find a debris-flow deposit within 2 m of the surface?
- Select the location of all sand deposits greater than 15 feet thick within 10 feet of the surface in Hamilton County, Ohio
- Select the distribution of Quaternary alluvium greater than 20 feet thick in Adams County, Ohio
- Select the location of all gravel deposits greater than 15 feet thick that are more than 100 feet from the high water mark of the Great Miami River in Ohio
- Select loess deposits that are greater than 2 m thick
- Select the location of all glacial bog deposits greater than 10 feet thick in Franklin County, Ohio

## **ROCK-STRATIGRAPHIC NOMENCLATURE**

- Select units underlain by Tyee Sandstone
- Select units where the Tyee Sandstone is dipping west
- Select units underlain by the Tertiary White River Group
- Select all rocks of the Marquette Range Supergroup
- Select all rocks of the Baraga Group
- Select all rocks of the Michigamme Formation
- Select all volcanic rocks of the Michigamme Formation
- Select all mafic volcanic rocks of the Michigamme Formation
- Select all volcanic rocks of Michigamme Formation that were deposited during continental breakup
- Select the distribution of the Kope Formation in Butler and Hamilton Counties, Ohio
- Select the distribution of the Black Hand Sandstone in Hocking County, Ohio
- Select the location of all Columbus Limestone in Ohio that has 25 feet or less of glacial cover
- Select the location of all abandoned Berea Sandstone quarries in Cuyahoga County, Ohio
- Select all formations in the \_\_\_\_\_ Group
- Select all members in the \_\_\_\_\_ Formation

- Select all map units that consist of two or more units mapped undivided
- Select conodont localities in the Conococheague Limestone
- Select the maximum seaward extent of lower-shoreface units in the Ferron sandstone
- Select names of all Eocene units
- Select all occurrences of unit Tvb
- Select all units and subdivisions of one or more named stratigraphic units (such as the Newark Supergroup, Great Smoky Group, or Ashe Metamorphic Suite)
- Select the distribution of Formation Y and all its stratigraphic equivalents
- Select the rock units in the map set, generalized at stratigraphic Group level or equivalent
- Select the distribution of formation x, including all its members
- I define the "Wasted" terrane as having these characteristics; Select where these criteria are met in this map area
- Select map units in the area of (name of geographic feature)
- Select all polygons mapped as (each map unit symbol in turn)
- Select map units in the (northeast or other area of the map)
- Select locations of the Hayden Lake stock
- Generalize the map so that it shows undivided Supergroups or Groups, but break out as a separate unit the felsic volcanic breccia in the Bimodal Member of the Volcano Formation of the Volcandseds Group
- Select all units assigned to a given regional geologic "province," "belt," "zone," or "terrane" (such as Atlantic Coastal Plain Province, Kiokee belts, Carolina terrane, Avalon zone), adding symbols for mineral elongation and stretching lineations
- Select the type section locality for the Anakeesta Formation
- Select all map units that change rank term (for example, from Formation to Member) within the map area
- Select the outcrop pattern of the Olentangy Shale in Delaware County, Ohio
- Where is the Ashley Formation of shallow marine origin?
- What percent of the Ashley is shallow marine?
- Select some outcrops of the Gosport Sand in Alabama
- Select a stratigraphic relationship of all the units exposed in the Grand Canyon and their textual descriptions
- Select a picture of an outcrop of the shaly facies of the Brushy Basin Member of the Morrison Formation at Capitol Reef NP

## SEDIMENTARY ROCKS

### Age

How was the age of this unit determined?

Select all units of black shale whose known or suspected age coincides with some part of the *Nemagraptus gracilis* graptolite zone

Select all sedimentary units that are less than 10,000 yrs old

### Rock type (classification)

Select all sedimentary rocks

Select sedimentary rocks classified according to Folk (1968)

Select sedimentary rocks classified according to Pettijohn ()

Select all Paleozoic sedimentary units that are predominantly composed of dolomite

Select all Paleozoic sedimentary units that are predominantly composed of dolostone

Select all limestones

Select all sandstones, etc. (make a list of primary rock types)

Select the location of all economic crushed-sandstone aggregate resources in Wayne National Forest in Ohio

Select all Tertiary deposits, marine or nonmarine, that consist mainly of sandstone, and re-select for those deposits dominated by well-sorted, clean sandstone

Select all Cretaceous sandstone deposits that have information about primary porosities

Select polygons of nonmarine sedimentary deposits where pebbly conglomeratic sandstone constitutes more than 50% of the map unit

Select shale that lies stratigraphically above Pennsylvanian limestone

Select units with Mesozoic sedimentary rocks at the surface

Select limestone units in areas that receive more than 20 inches annual precipitation

Select all limestone and marble units, as well as mapped sinkholes

Select granitic intrusions into limestone

Select limestone units adjacent to plutons

Select contacts between Laramide plutons and Mississippian Limestone

Select all Cambrian units that contain limestone

Select the felsic intrusive rocks younger than 65 Ma

Select Late Pliocene volcanic rocks (or sources)

Select map units consisting mainly of ironstone

### **Outcrop geomorphology**

What units have combined ledge-forming and slope-forming weathering profiles?

What crop out as recessive slope-formers?

What units crop out as prominent hogbacks?

What units crop out as resistant ledge- or cliff-forming units?

What units form badlands geomorphology?

### **Lithology (physical description) and composition**

Select areas where diamictites less than 2 m thick overlie well bedded, well sorted deposits

Select where there is peat in contact with Pleistocene limestone in Florida

Select units with high-calcium limestone

Select all units of black shale whose known or suspected age coincides with some part of the *Nemagraptus gracilis* graptolite zone

Where do Cambrian sections contain more than 50% carbonate rock

In what units are chert and shale combined?

Select all units that contain fine-grained quartzite

Select sandstone outcrops with permeabilities over 1 md in aquifer recharge areas

Where does coarse sandstone underlie basalt lava flows of Miocene age

Select polygons where smectite-bearing mudrock dips steeper than 15 degrees

Select all white, coarsely crystalline limestone

Select thick-bedded sandstone that is reddish colored

Select units of thinly laminated to thin-bedded limestone interlayered with lenses of fissile shale

Select units consisting homogeneously of lenticular thick- to very thick-bedded sandstone and pebbly sandstone

- Select units containing varved mudrock
- Select units consisting mainly of bioclastic limestone
- Select map units having containing conglomeratic sandstone containing mud chips
- Select all sedimentary units with shear strengths (phi values) less than 35
- Select all sedimentary units with cohesive strengths less than 500lb/square ft
- Select all sedimentary units with bedding thickness less than 6 inches
- Select all sedimentary units for which the dominant lithology (> 50%) is sand
- Select all sedimentary units with more than 15% clay
- Select the attitude data for all sedimentary units that have a bed thickness less than 1 foot
- Select a picture of an outcrop of the shaly facies of the Brushy Basin Member of the Morrison Formation at Capitol Reef NP
- Select areas where basaltic cobbles have been observed in the conglomerates of the Muddy Creek Formation
- Select all fine-grained siliciclastic sedimentary rocks that are organic-rich
- Select all sedimentary rocks which contain abundant, well preserved trilobite fossils
- Select all sedimentary rocks deposited in intertidal depositional environments
- Select all sedimentary rocks that are made up of turbidites
- Select all sedimentary rocks that show evidence for syndepositional deformation
- Select all sedimentary rocks that form massive, cliff forming units
- Select all sedimentary rocks that are porous and permeable

### **Petrography and mineralogy**

- Select all units with sandstone containing more than trace amounts of glauconite
- Select all sedimentary rocks that contain garnet
- Select Tertiary nonmarine deposits of lacustrine origin that have gypsum or anhydrite greater than 5% by volume
- Select polygons where smectite-bearing mudrock dips steeper than 15 degrees
- Select all units containing arkosic wackes
- Select all units that contain arkose

Select sandstones classified according to Folk (1968)

Select sandstones classified according to Pettijohn ()

Select sandstones classified according to McBride ()

Select sandstones classified according to Friedman ()

Select sandstones classified according to Dickinson ()

Select carbonate rocks classified according to Dunham (1962)

Select carbonate rocks classified according to Bathurst

Select carbonate rocks classified according to Friedman

Select carbonate rocks classified according to Folk (1968)

Select map units containing limestones dominated by mud-supported  
depositional fabrics

Select map units containing limestones dominated by grain-supported  
depositional fabrics

Select map units dominated by sandstone having between-grain argillaceous  
“matrix”

Select all sand deposits in California NPS units

### **Genetic structures**

Select map units containing sandstones having eolian cross bedding

Select map units containing sandstones having graded bedding

Select map units containing sandstones having graded bedding and  
dominated by base-truncated Bouma BCD intervals

Select map units dominated by matrix-supported pebbly conglomerate and  
sandstones having graded bedding and Bouma AB intervals

Select map units containing sandstones having sole marks

Select map units containing conglomerate having matrix-supported  
depositional framework

Select map units containing sandstones having cross-laminations classified  
according to Allen ()

Select map units containing mudrock and fine sandstone displaying  
mudcracks

Select all turbidite units exhibiting groove casts

## Stratigraphic relations

- Select map units containing sedimentary fining-upward cycles
- Select map units containing sedimentary coarsening-upward cycles
- Select formation-rank map units in which coarse-sandstone dominated facies pass laterally into sandstone-and-mudrock facies without changing formation name
- Select depositional contacts that overlie angular unconformities
- Select units with sedimentary rocks that dip more than 25 degrees
- Select shale that lies stratigraphically above Pennsylvanian limestone
- Where does coarse sandstone underlie basalt lava flows of Miocene age
- Select Tertiary nonmarine deposits where the mudrock:grainrock ratio is greater than 2:1
- Select rock units in which the prevailing sandstone-body geometry is shoe-string sands
- Select rock units in which the prevailing sandstone-body geometry is sheet sands

## Genesis and origin

- Select 20 to 30 Ma lacustrine limestones that have orthogonal joint sets
- Select all lacustrine beds that contain Lava Creek B tephra
- Select map units consisting of turbidite deposits
- Select evaporite deposits adjacent to modern rivers or lakes
- Select geologic-map units that have middle Devonian limestone deposited in platform-margin environments
- Select Cretaceous sandstone-mudrock sequences deposited in foreland high-sinuosity river plains
- Select all marine mudrock deposits that accumulated in oxygen-deficient environments
- Select the maximum seaward extent of lower-shoreface units in the Ferron sandstone
- Select Tertiary nonmarine deposits of lacustrine origin that have gypsum or anhydrite greater than 5% by volume
- Select marine deposits that formed in strand-plain or barrier-bar environments
- Select Tertiary alluvial-fan deposits dominated by debris-flow depositional processes
- Where is the Ashley Formation of shallow marine origin?

What percent of the Ashley Formation is shallow marine?

Select all debris-avalanche deposits

Select all tsunami deposits

Select all lahar deposits

Where can I find nonmarine Cretaceous rocks in South Carolina?

Where can I find shallow marine rocks in South Carolina?

Select Late Pliocene lacustrine beds

Select Neogene lacustrine deposits located east of the Sierra Nevada

Select the maximum extent of ejecta blankets associated with buried meteor impacts

Select all gradational contacts separating marine and terrestrial sediments

### **Tectonic or paleogeographic setting**

Select Cretaceous sandstone-mudrock sequences deposited in foreland high-sinuosity river plains

Select pull-apart basin deposits that accumulated within the San Andreas transform-fault system

Select Miocene submarine-fan deposits of Tertiary marine basins in the California Coast Ranges

Select Miocene submarine-fan deposits of Tertiary marine basins in the California Coast Ranges, but restrict the search to proximal-fan facies

Select Miocene submarine-fan deposits of Tertiary marine basins in the California Coast Ranges, but restrict the search to mid-fan facies

Select Mesozoic forearc nonmarine sedimentary deposits

Select Mesozoic forearc marine sedimentary deposits

Select Mesozoic back-arc deposits containing gravity-slide blocks

Select nonmarine flysch deposits

Select nonmarine molasse deposits

### **STRATIGRAPHIC-SEQUENCING RELATIONS**

Select all units that are described as stacked (for example, silt over sand over gravel)

Select formation-rank map units in which coarse-sandstone dominated facies pass laterally into sandstone-and-mudrock facies without changing formation name

Select units underlain by Tyee Sandstone

Select all volcanic rocks of Michigamme Formation that were deposited during continental breakup

Select all intrusive contacts of late Cretaceous age

Select all landslide contacts

Select all depositional contacts that overlie angular unconformities

Select contacts separating non-intrusive bedrock units that are not in stratigraphic order

Select all unconformable contacts

Where does coarse sandstone underlie basalt lava flows of Miocene age

What map units contain gravel in their upper part

Select the unconformity separating Jurassic/Cretaceous from the Miocene units

What rock bodies (map units) overlie a particular angular unconformity

Select all polygons of the Right Formation and the Wrong Formation, where the two formations are in stratigraphic contact with each other

Select areas where the XYZ orthogneiss cross-cuts the XRAY schist

Select areas where the XRAY schist and the PQR greenstone appear to be depositionally stacked rather than structurally stacked

## **TIME-STRATIGRAPHIC RELATIONS**

Select all lacustrine beds that contain Lava Creek B tephra

Select all occurrences of Quaternary units

Select all Precambrian rocks

Select all Proterozoic rocks

Select all Early Proterozoic rocks

Select all (Quaternary, Pleistocene, Archean, etc.) map units

Select all sedimentary units that are less than 10,000 yrs old

Select all NPS units in Utah containing Pennsylvanian rocks

Select all NPS units in Utah containing Pennsylvanian rocks with fossils

Select all NPS units in Utah containing Pennsylvanian rocks with fossil clams

Select all national parks in the US containing exposures of Cambrian rocks

How does the result of Q #11 compare to locations of skarn deposits?

reasonably close and show the occurrences

Select where the transition mentioned in #3 above occurs