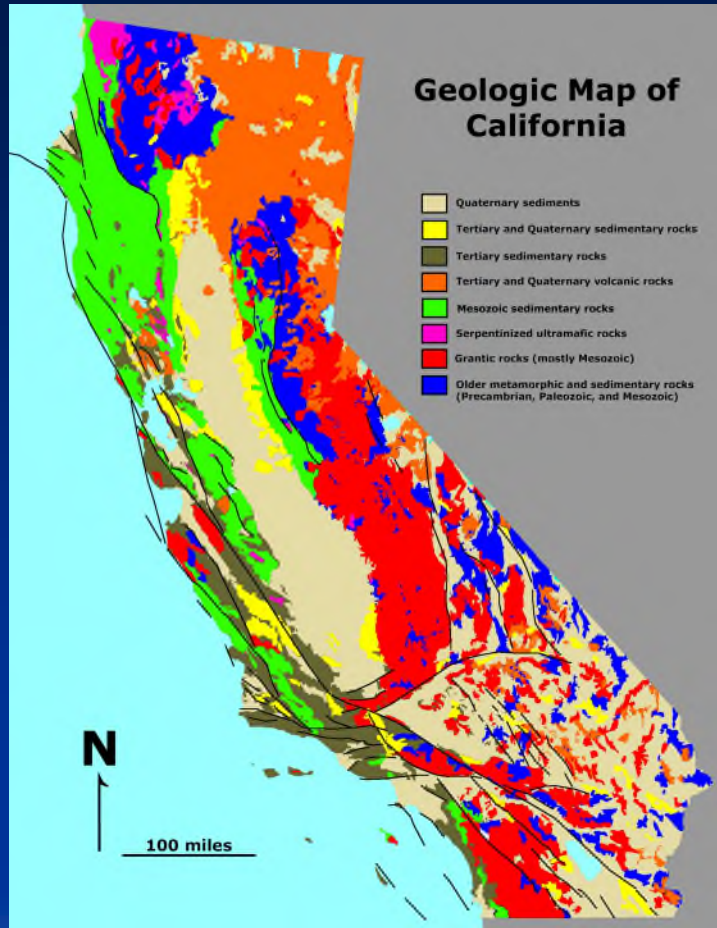


# Geology Map Laboratory



**Geology 101 Lab**  
**San Diego Mesa College**

**Ray Rector: Instructor**



# Geologic Map Lab Learning Objectives

The student should understand and know:

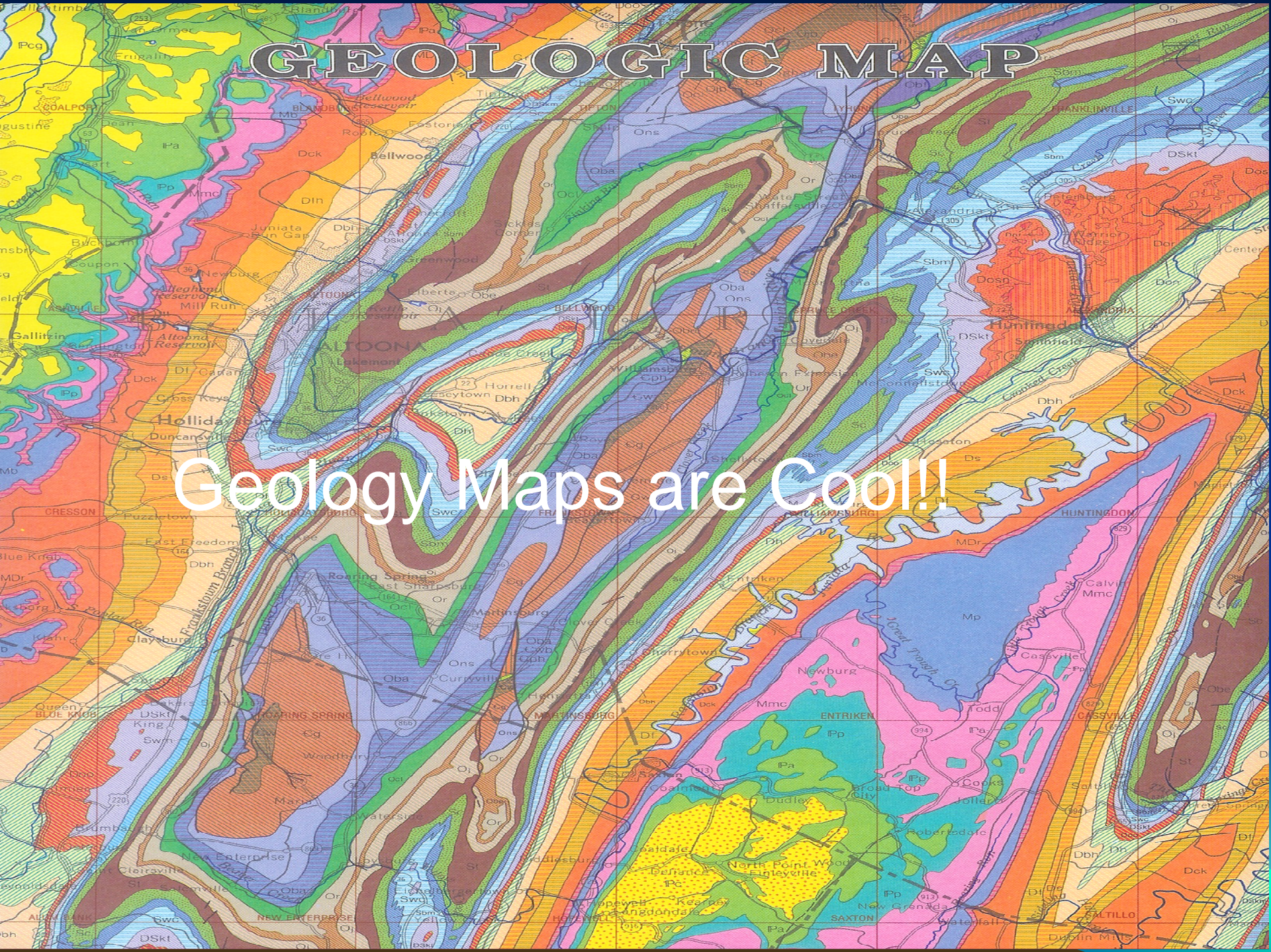
- 1) The terminology and basic symbols of geology maps
- 2) How to read and understand a geology map legend
- 3) The general concepts and field methods used in making a geology map
- 4) How to successfully recognize structures on a geology map such as contacts, bedding orientation, folds and faults
- 5) How to reconstruct the geologic history of the mapped region based on the geologic map information.





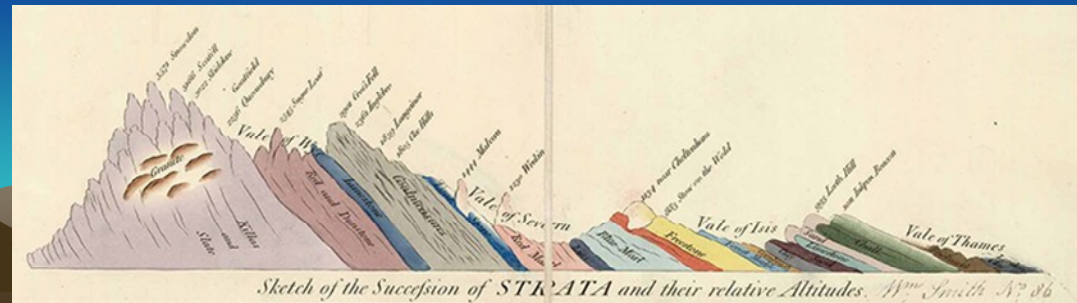
# GEOLOGIC MAP

Geology Maps are Cool!!





Geology of England and Wales  
Made by William Smith in 1815  
Included geologic cross sections



*Sketch of the Succession of STRATA and their relative Altitudes. W<sup>m</sup> Smith N<sup>o</sup> 86*



# 1875 Geology Map of Europe



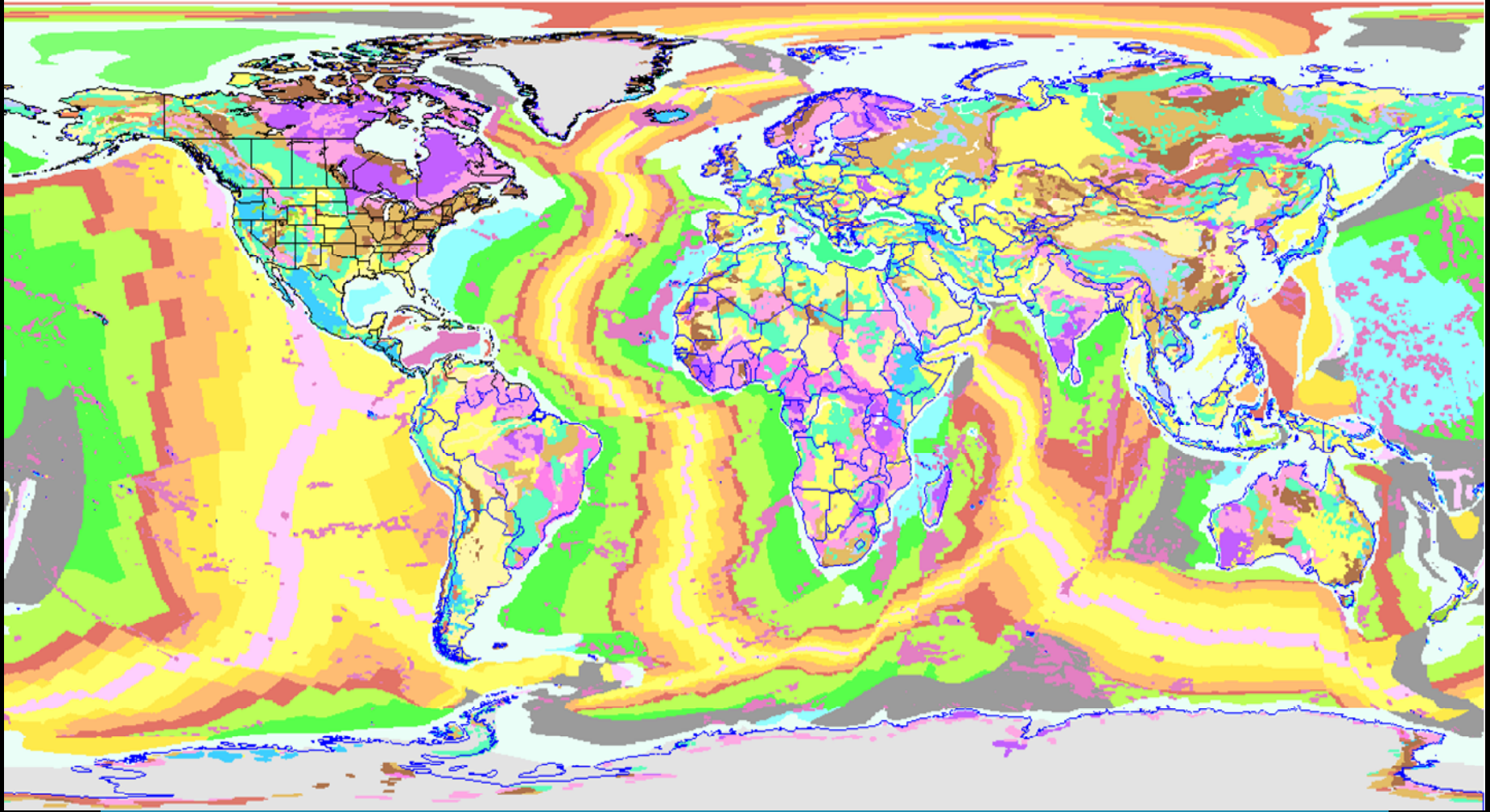


# Geologic Map of North America

U.S. DEPARTMENT OF THE INTERIOR  
U.S. GEOLOGICAL SURVEY

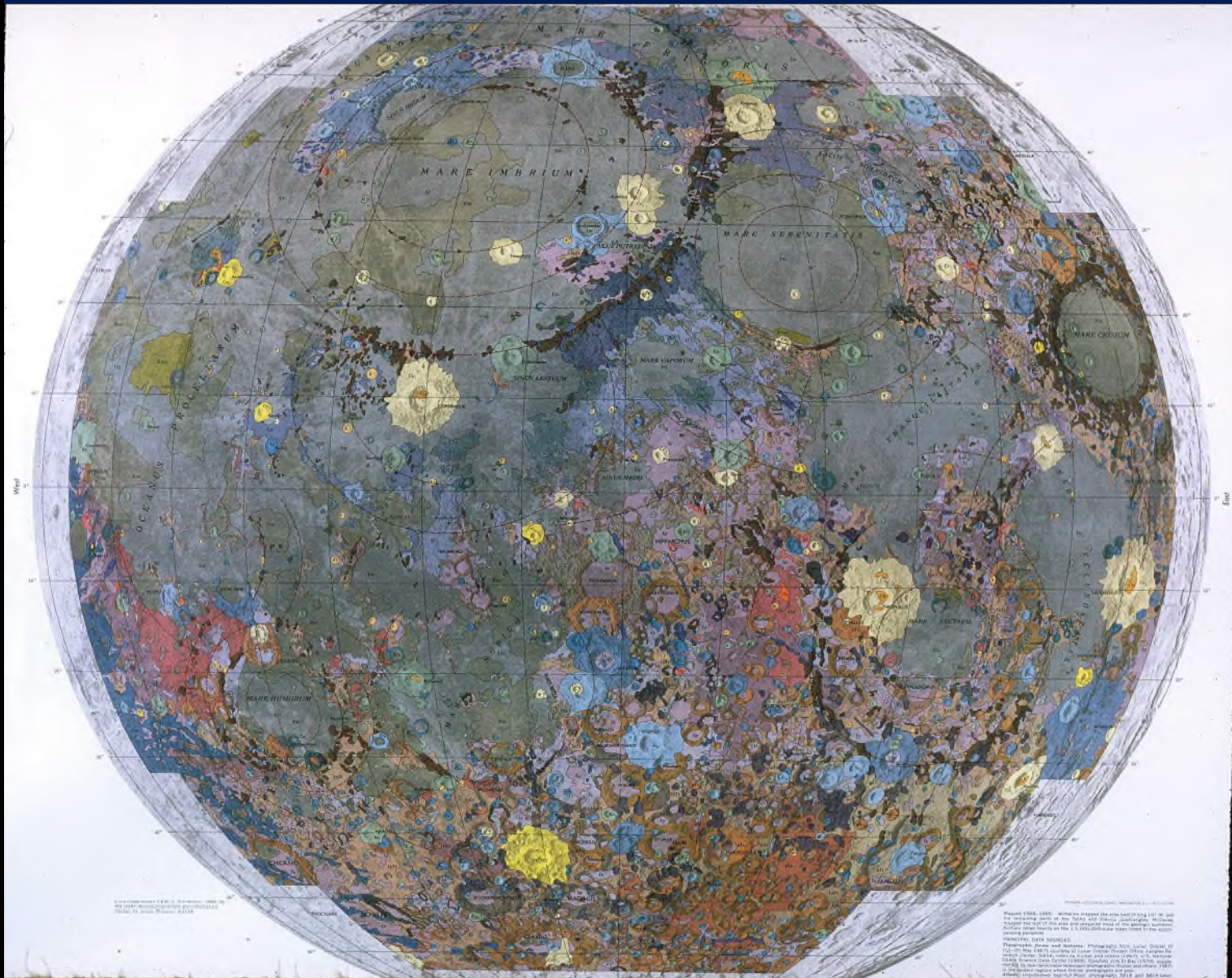


# Geologic Map of Earth



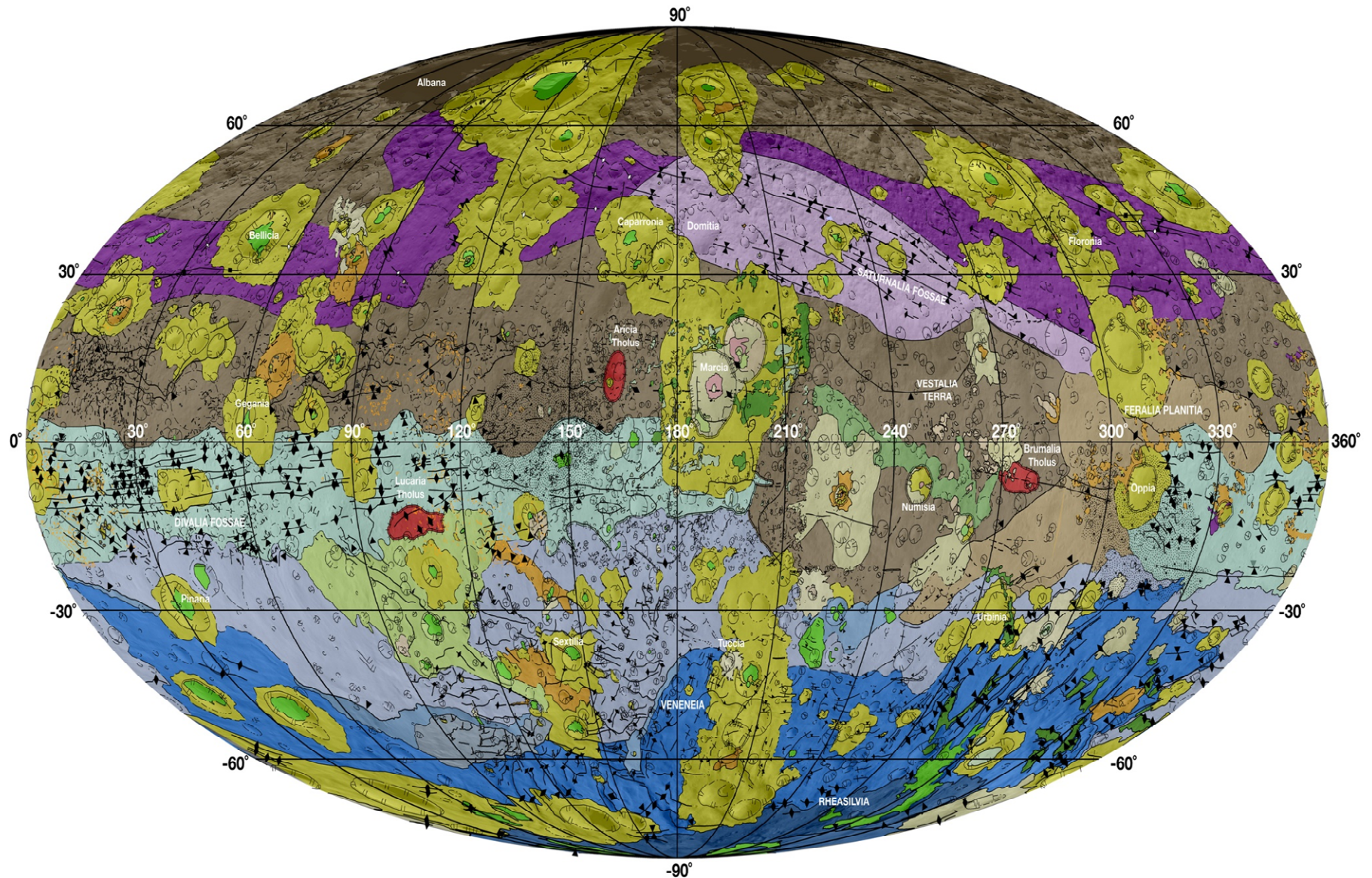


# Geologic Map of Moon



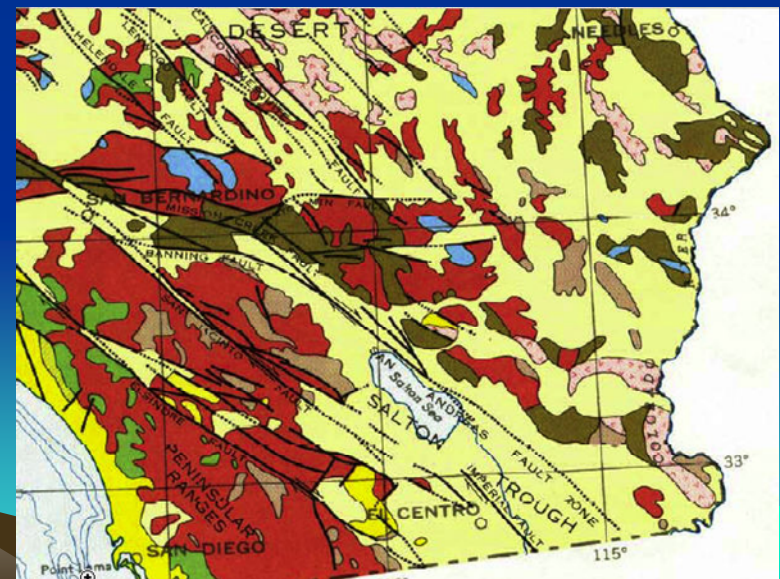
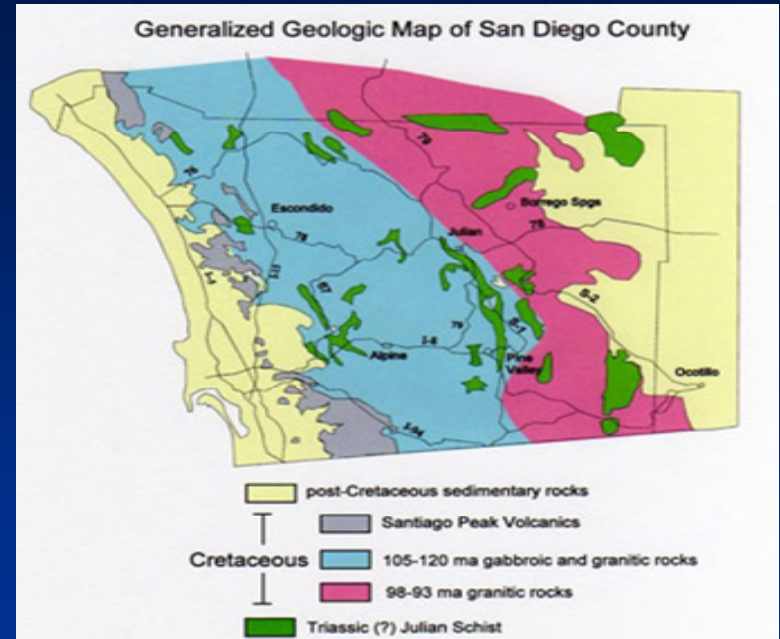
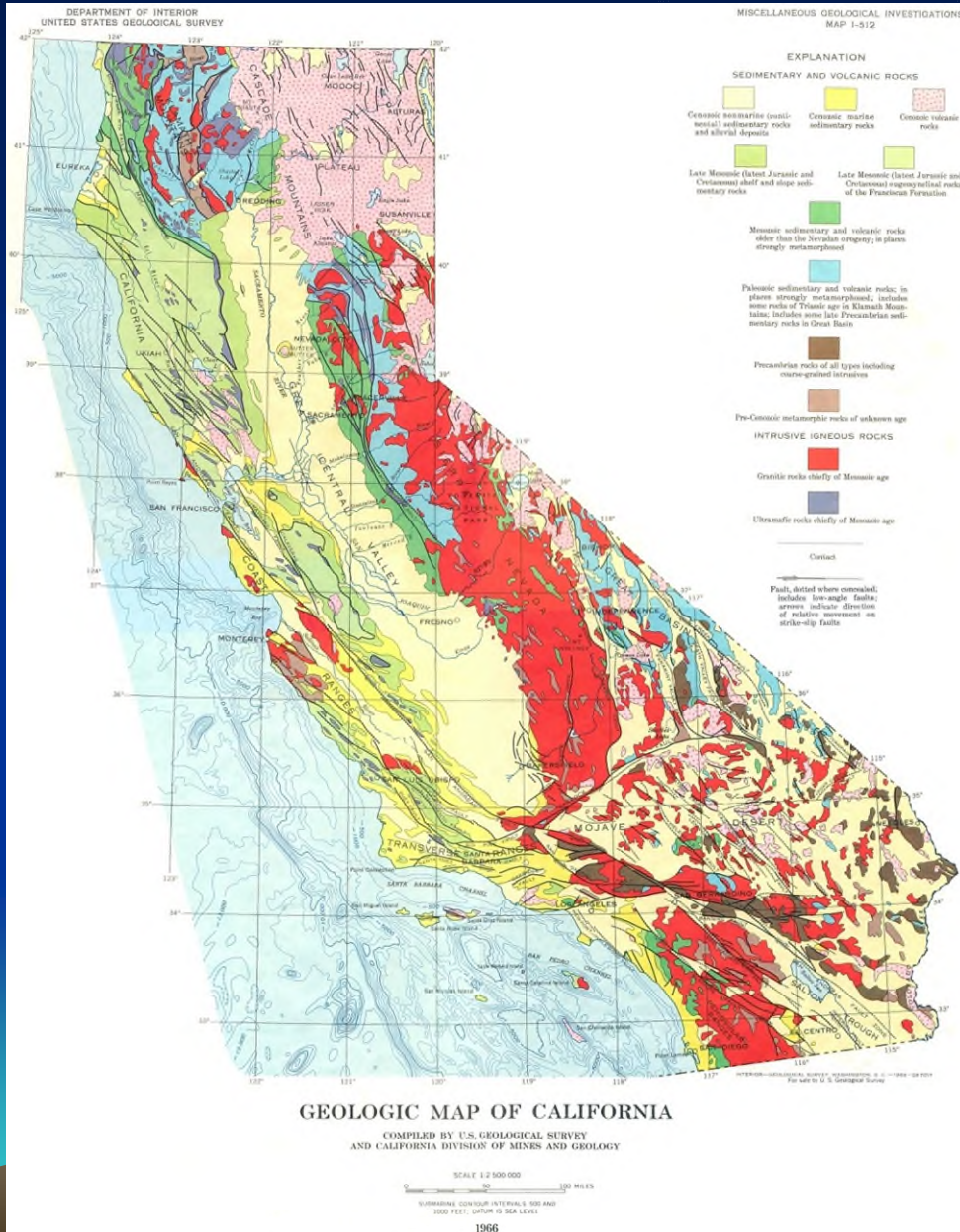


# Geologic Map of Mars





# Geologic Map of California



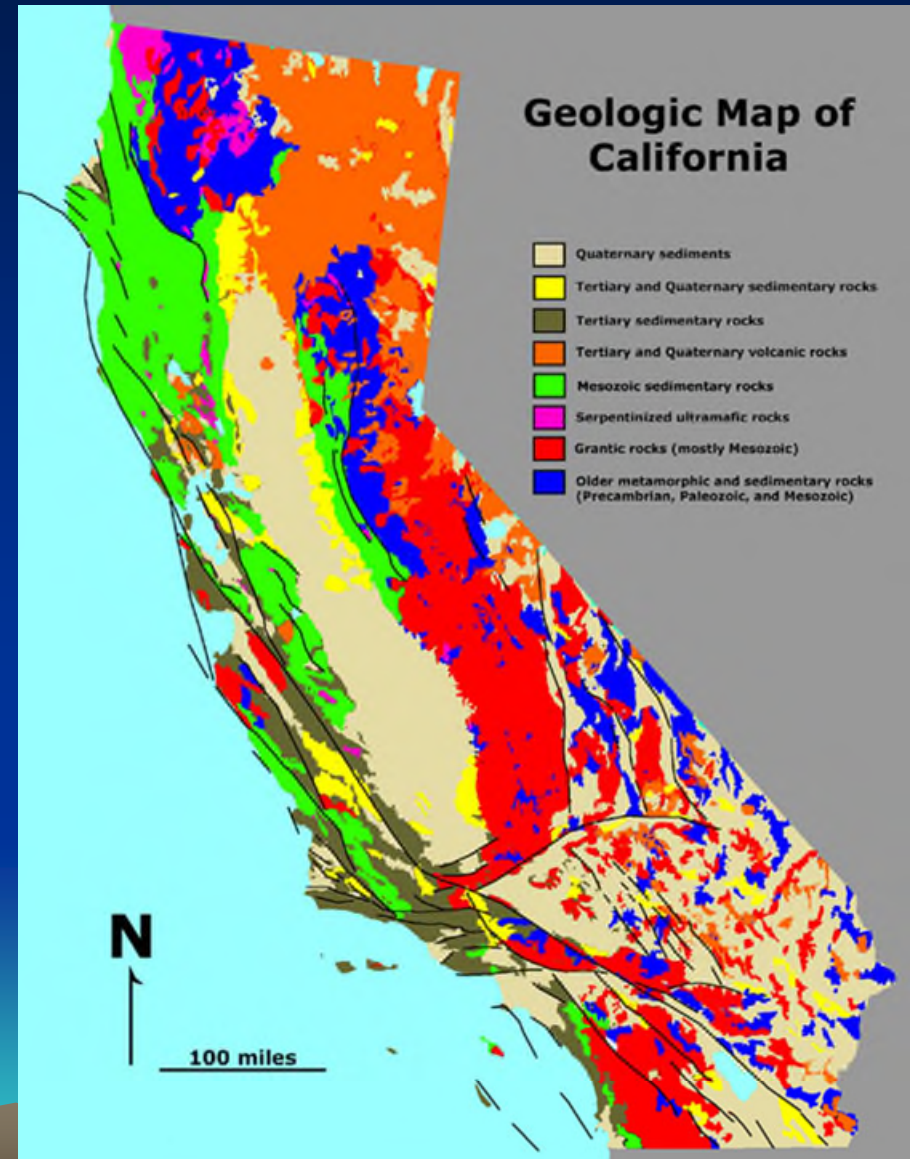


# Usefulness of Geology Maps

1) Geology maps have many vital uses:

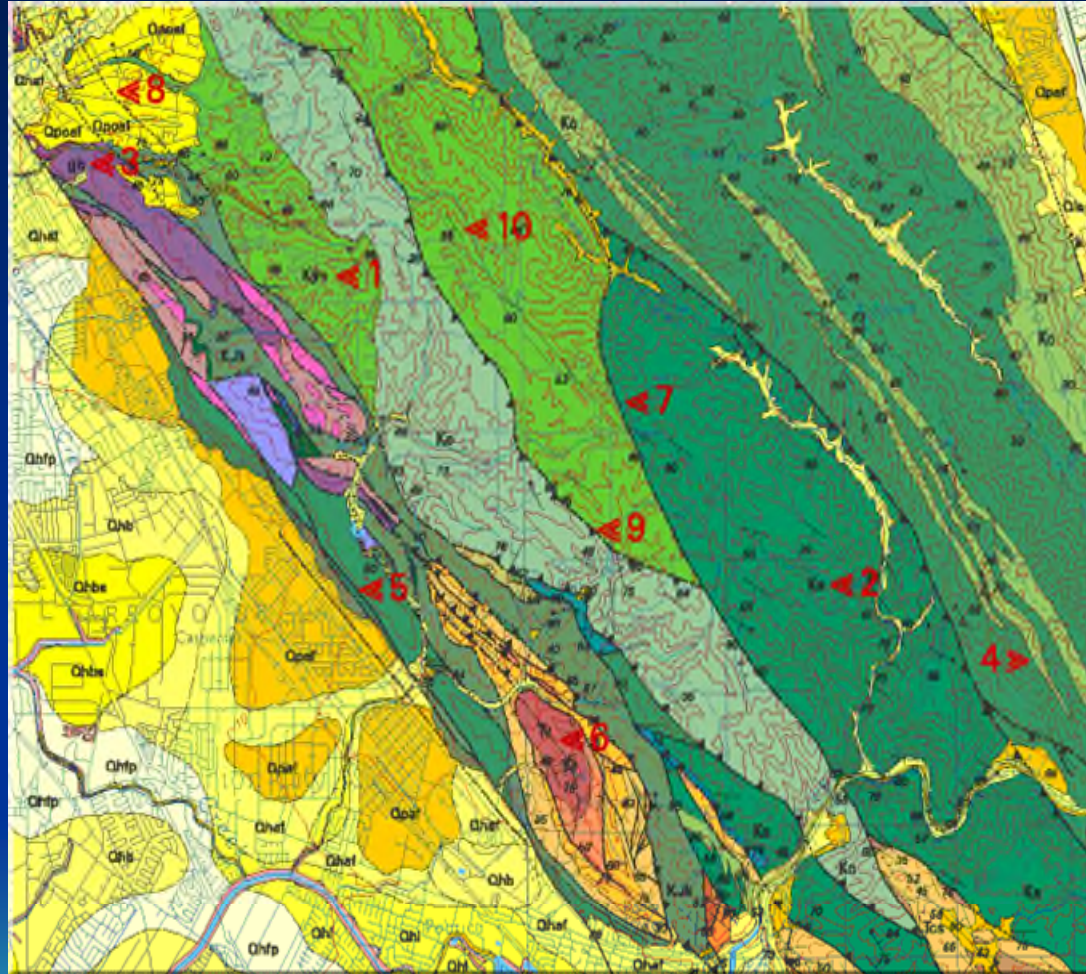
- ✓ Mineral Prospecting
- ✓ Engineering
- ✓ Earthquakes
- ✓ Historical geology
- ✓ Landform studies
- ✓ Soil development
- ✓ Biological studies

2) Geology maps are even useful when buying a home. Why?



# What is a Geology Map

- 1) A map that displays the types of rocks and sediment exposed at the surface
- 2) Displays the spatial orientation of rock units and rock structures like folds and faults.
- 3) Geology information is typically overlain on a topographic base map
- 4) Various map symbols are used to convey structural information





# Use Rules of Structure To Interpret Geology Maps

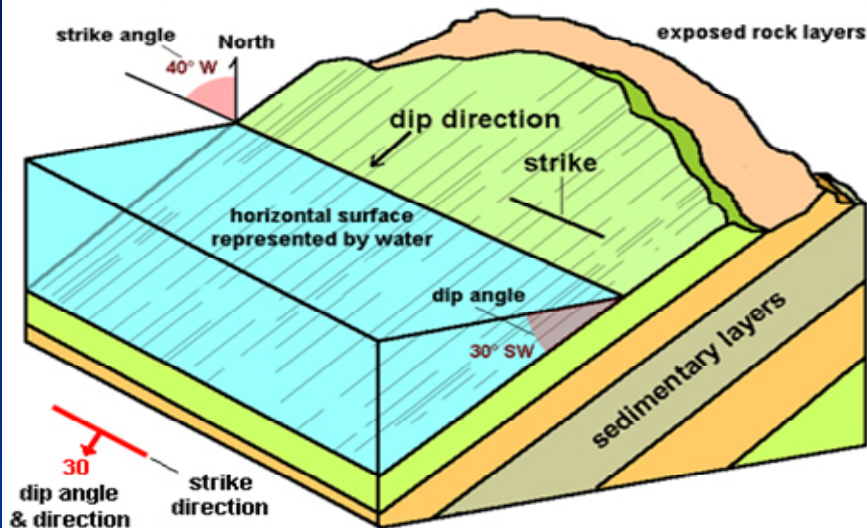
- 1) Strike of beds is always parallel to the direction of the contacts.
- 2) Rock layers dip towards the youngest exposed rock layers.
- 3) Oldest rocks exposed in the center of eroded anticlines and domes.
- 4) Youngest rocks exposed in the center of eroded synclines and basins.
- 5) Horizontal folds form parallel sets of belt-like outcrop patterns.
- 6) Plunging synclines form "V" or "U" shaped, belt-like outcrop patterns.
  - ✓ Fold plunges toward *open* end of "U" pattern.
- 7) Plunging anticlines form "V" or "U" shaped, belt-like outcrop patterns.
  - ✓ Fold plunges toward *closed* end of "V" or "U" pattern.
- 8) Steeper the dip of the layer, the more narrow the width of its outcrop.
- 9) Hanging wall *moves up* relative to foot wall in reverse and thrust faults.
- 10) Hanging wall *moves down* relative to foot wall in normal faults.
- 11) Vertical slickenside grooving indicates dip-slip fault movement
- 12) Horizontal slickenside grooving indicates slip-slip fault movement



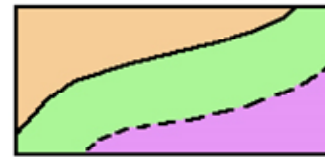
# Common Geology Map Symbols

## Common Geologic Map Symbols

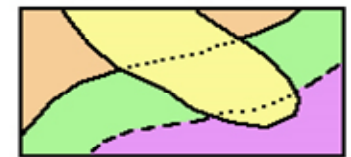
Describing orientation of geologic features with strike and dip



Rock Unit Boundaries - contacts between rock units of different age and/or different composition



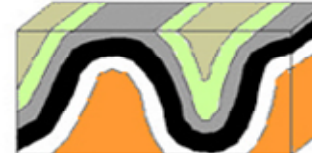
—— contact certain  
----- contact inferred



..... contacts inferred beneath sedimentary cover

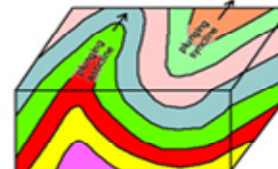
## FOLDS

anticline syncline



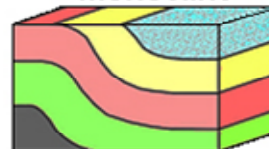
anticline syncline

plunging folds



plunging anticline plunging syncline

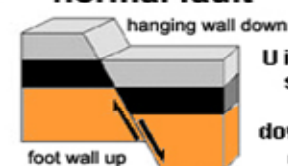
monocline



arrow points in fold dip direction

## FAULTS

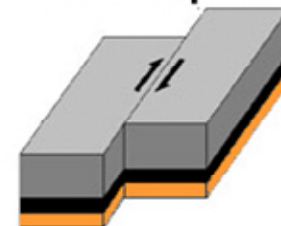
normal fault



U  
D

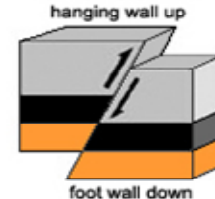
U is on the uplifted side (foot wall)  
D is on the down-dropped side (hanging wall)

strike-slip fault



half arrows show direction of fault motion

reverse fault



triangles on upper plate (hanging wall)

thrust fault



triangles on upper plate

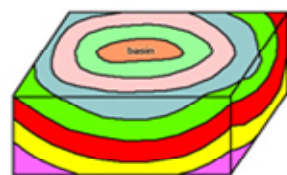
vertical beds dipping beds horizontal beds



beds inclined straight up strata inclined at an angle flat-lying strata



dome



basin




































# Geology Map Key or Legend

1) The map key lists and explains the geologic rock formations and the structural symbols

- ✓ Rock Names
- ✓ Rock Types
- ✓ Rock Ages
- ✓ Contacts
- ✓ Strike and Dip
- ✓ Faults and Folds

# MAP KEY

	af - Artificial Fill (Historic)		Contact
	all - Artificial Levee Fill (Historic)		Contact, approximately located
	Qhaf - Alluvial Fan Deposits (Holocene)		Contact, inferred
	Qhfp - Floodplain Deposits (Holocene)		Contact, concealed
	Qhfb - Flood Basin Deposits (Holocene)		Fault
	Qhbs - Salt Affected Flood Basin Deposits (Holocene)		Fault, approximately located
	Qhl - Natural Levee Deposits (Holocene)		Fault, inferred
	Qpal - Alluvial Fan Deposits (Pleistocene)		Fault, uncertain
	Qpold - Older Alluvial Fan Deposits (Pleistocene)		Fault, concealed
	Tv - Unnamed volcanic rocks (Miocene)		Fault, concealed and uncertain
	Tor - Orinda conglomerate (Miocene)		Oblique fault with thrust or reverse component
	Tbr - Briones sandstone (Miocene)		Oblique fault with thrust or reverse component, approximately located
	Tt - Tice shale (Miocene)		Oblique fault with thrust or reverse component, inferred
	Tcs - Claremont shale (Miocene)		Oblique fault with thrust or reverse component, uncertain
	Ts - Sobrante sandstone (Miocene)		Strike and dip of bedding
	Tsh - Unnamed shale and sandstone (Miocene)		Strike and dip of overturned bedding
			Strike and dip of vertical bedding

2) Each rock unit has a unique letter symbol and is color-coded

3) Map key is vital to understanding the accompanying geology map in terms of rock formations and structural elements









# Geologic Map Explanation

Series	Stage	Stratigraphic Units	Description
Devonian	Mississippian	Osagean	Pocono Group (Rockwell and Purslane Formations, Undifferentiated (Mip))
		Kinderhook	Pocono Group (Rockwell and Purslane Formations, Undifferentiated, 700-900 ft.) Light gray to dark gray, medium-grained, quartz sandstone with minor conglomerates, iron stained sandstone in lower part. Upper part consists of light gray to white quartz sandstone with minor quartz pebble conglomerate zones.
	Famennian	Hampshire Formation (Dhs)	Hampshire Formation (2300-2800 ft.) Non-marine, fine-grained, red and reddish gray sandstone and shale with minor tan and light green shale and sandstone beds present; unfossiliferous, except for rare terrestrial plant fossils such as <i>Archaeopteris</i> . Formation thins to west side of Town Hill syncline.
		Foreknobs Formation	Foreknobs Formation, Red Lick Member (1400-1550 ft.) Very fine to fine-grained sandstone with interbedded brownish gray to red shale, siltstone, occasional conglomerates and marine fossils. Upper contact placed at last occurrence of marine fossils. Prominent quartz and mudstone conglomerate at approximate contact with Hampshire Formation. Formation is thickest on west limb of Whip Cove syncline.
		Pound Member (Dggfp)	Foreknobs Formation, Pound Member (85-220 ft.) Massive, coarse to medium-grained light gray to white sandstone. Planar wedge-shaped cross beds and conglomeratic zones are common. Formation thins to the north and east in the quadrangle. Serves as a ridge-forming unit.
		Blizzard Member (Dggfb)	Foreknobs Formation, Blizzard Member (625-670 ft.) Gray interbedded thin-to-medium-bedded sandstone and siltstone with some shale. Thickness tends to be constant throughout the quadrangle. Tends to form topographic lows between the ridge-forming Pound and Blurry Gap members.
		Briery Gap Member (Dggfbg)	Foreknobs Formation, Briery Gap Member (80-130 ft.) Massive, medium-to-coarse grained light gray to white sandstone. Ripple marks, planar wedge-shaped cross beds and conglomeratic zones are common. Formation thins to the north and east in the quadrangle. Serves as a ridge-forming unit.
		Mallow Member (Dggfm)	Foreknobs Formation, Mallow Member (1250-1400 ft.) Medium-gray siltstones, thin-bedded fine-to-medium-grained sandstone, alternating with shale. Lowest strata consist of 25-30 ft. interval of mainly siltstones and fine-to-medium-grained sandstones, which serve as contact with underlying Schen Formation. Formation thins to the north and east in the quadrangle. Lowest Mallow unit serves as a low ridge-former.
		Schen Formation (Dggs)	Schen Formation (775-800 ft.) Mainly siltstone and shale, with some fine-grained sandstone, all light olive gray. Siltstones may reach 2-2.5 feet in thickness. Siltstones and sandstones less abundant than in overlying Mallow Member. Basal member is Minnehaha Springs.
		Minnehaha Springs Member (Dggsms)	Schen Formation, Minnehaha Springs Member (25-30 ft.) Lowest member of the Schen Formation. Sequence of olive gray coarse siltstone at the base of the Schen. Serves as boundary between underlying Brallier Formation and Greenland Gap Group. Locally may form a slight topographic high.
		Brallier Formation (Db)	Brallier Formation (1450-1600 ft.) Medium dark gray shales, interbedded with thin-bedded siltstones, most commonly not exceeding 6-8 inches in thickness. Back Creek Siltstones Member 100-125 feet above base is 25-30' sequence of thick siltstones, with some sandstones. Not present north of Moorefield. Upper contact with Schen Formation at Minnehaha Springs Member.
		Harrell Shale (Dh)	Harrell Shale (250-300 ft.) Dark gray, thinly laminated platy weathering shale. Lower member is the Burkert, a black shale sequence which is atop the Polejey Limestone Member of the Martinsburg. Upper contact of formation is gradational and placed at first siltstone of the Brallier Formation.
	Grv.	Mahantango Formation (Dmt)	Mahantango Formation (1600-1800 ft.) Dark gray siltstone and non fossiliferous shale, minor fine-grained sandstone; spheroidal weathering common. Upper contact placed at top of Polejey Limestone below the Burkert Member of the Harrell Shale.
	Eif.	Marcellus-Needmore Shales (Dnn)	Marcellus-Needmore Shale (500-600 ft.) Black to dark gray, mainly fossiliferous shale of the Marcellus overlies medium to dark gray and greenish gray to brownish black shale of the Needmore, 25-30 ft. thick, argillaceous limestone (i.e. Purcell Member) in middle of Marcellus; dark gray limestone nodules and beds near base of Needmore.
	Ems.	Oriskany Sandstone (Do)	Oriskany Sandstone (100-140 ft.) White to light gray, medium to coarse-grained, quartz sandstone with quartz conglomeratic zones; crossbedded, abundant marine fossils (brachiopods), carbonate and silica cement.
	Steg.	Helderberg Group (Dhh)	Helderberg Group (400-500 ft.) Massive-bedded, coarse-grained, gray limestone; abundant marine fossils; dark and light colored chert layers in upper one-third; minor karst development; lower part is Silurian.
	Gedin.	Tonoloway Limestone (Sto)	Tonoloway Limestone (400-500 ft.) Fine-grained, laminated, gray argillaceous marine limestone; minor shale layers; mudcracks common on bedding surfaces; fossiliferous.
Silur.	Pridol.		

RM/BB 04/03

Units listed below do not outcrop	
Swc	Will's Creek (300-375 ft.)
Sb	Bloomsburg (25-40 ft.)
Smc	McKenzie Formation (300-325 ft.)
Sk	Keefer Sandstone (20-30 ft.)
Sh	Rose Hill Formation (400-450 ft.)
St	Tuscarora Sandstone (150-250 ft.)
Ordovician System	
Oj	Juniata Formation (300-400 ft.)
Oo	Oswego Formation (350-450 ft.)
Om	Martinsburg Formation (1,500-2000 ft.)
Omu	Middle Ordovician
Oi	Lower Ordovician

## Explanation of Symbols

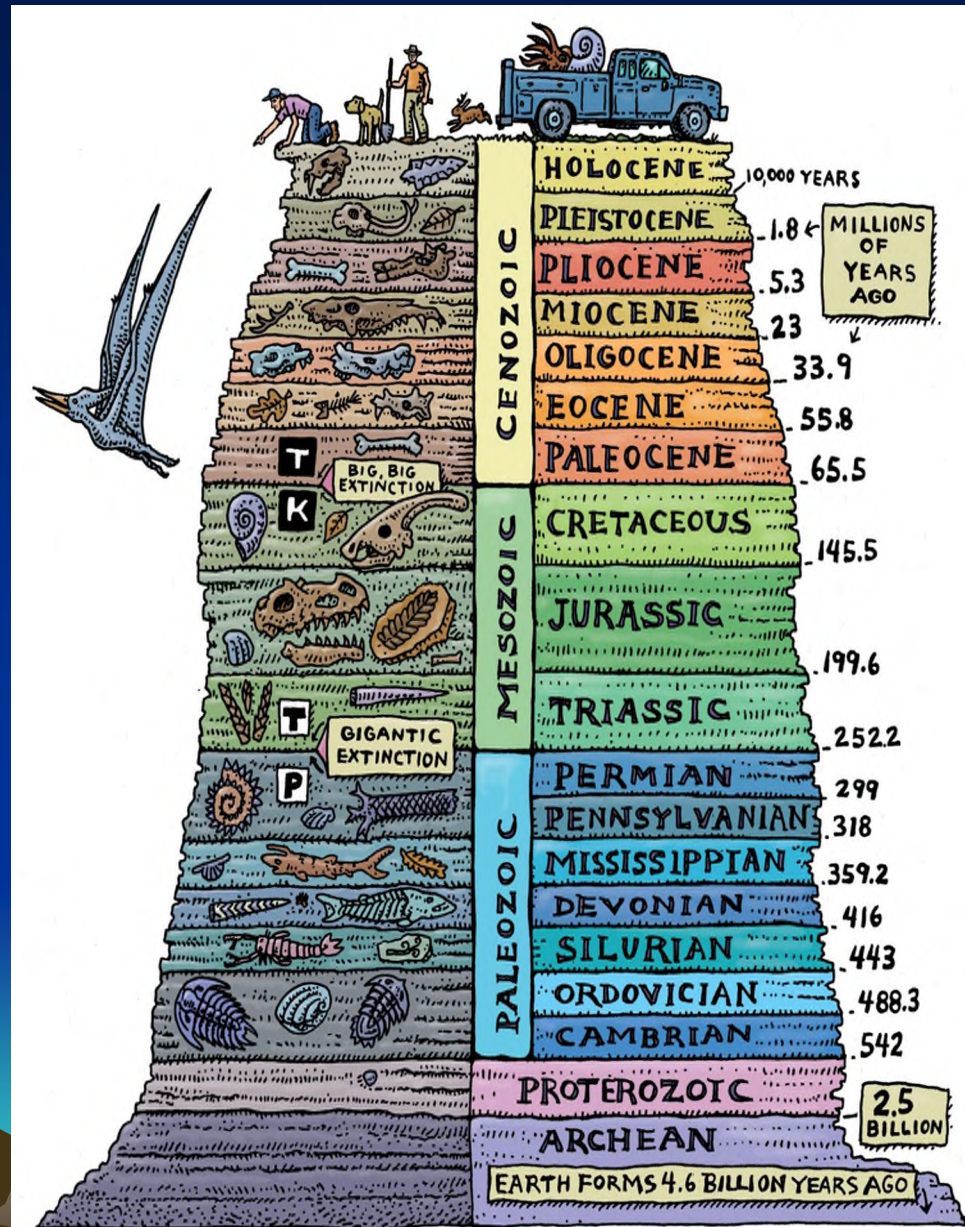
-  Anticline
-  Syncline
-  Overturned Anticline
-  Overturned Syncline
-  Reverse Fault (teeth on upper plate)
-  Bedding Orientation Observation

## Moorefield Quadrangle, Hardy County, West Virginia



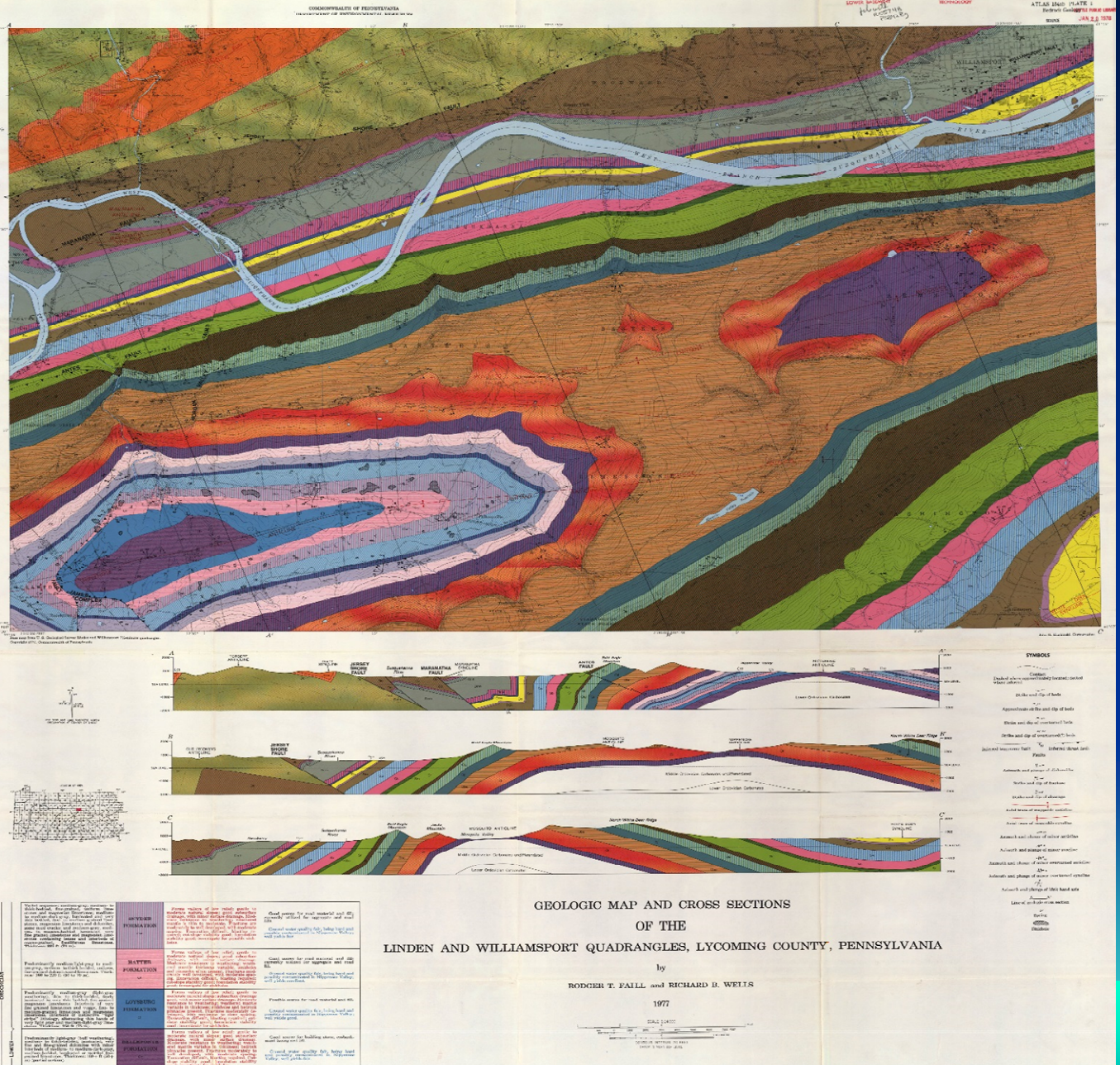
# Rock Formations and Geologic Time

- 1) All rock formations on a geologic map have a specific assigned age
- 2) Rock formations are listed in an ordered sequence in a geologic map explanation according to age
- 3) The geologic ages of rock formations are assigned by geologic period
- 4) Geologic periods are further divided into lower (older), middle, and upper (younger)





# A Complete Geologic Map

[illegible]

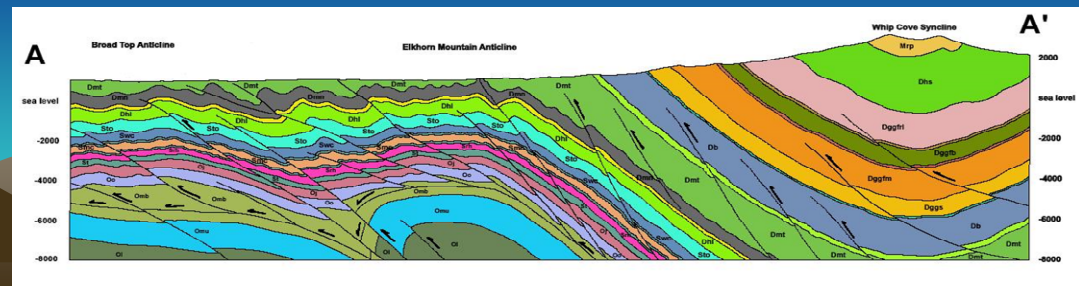
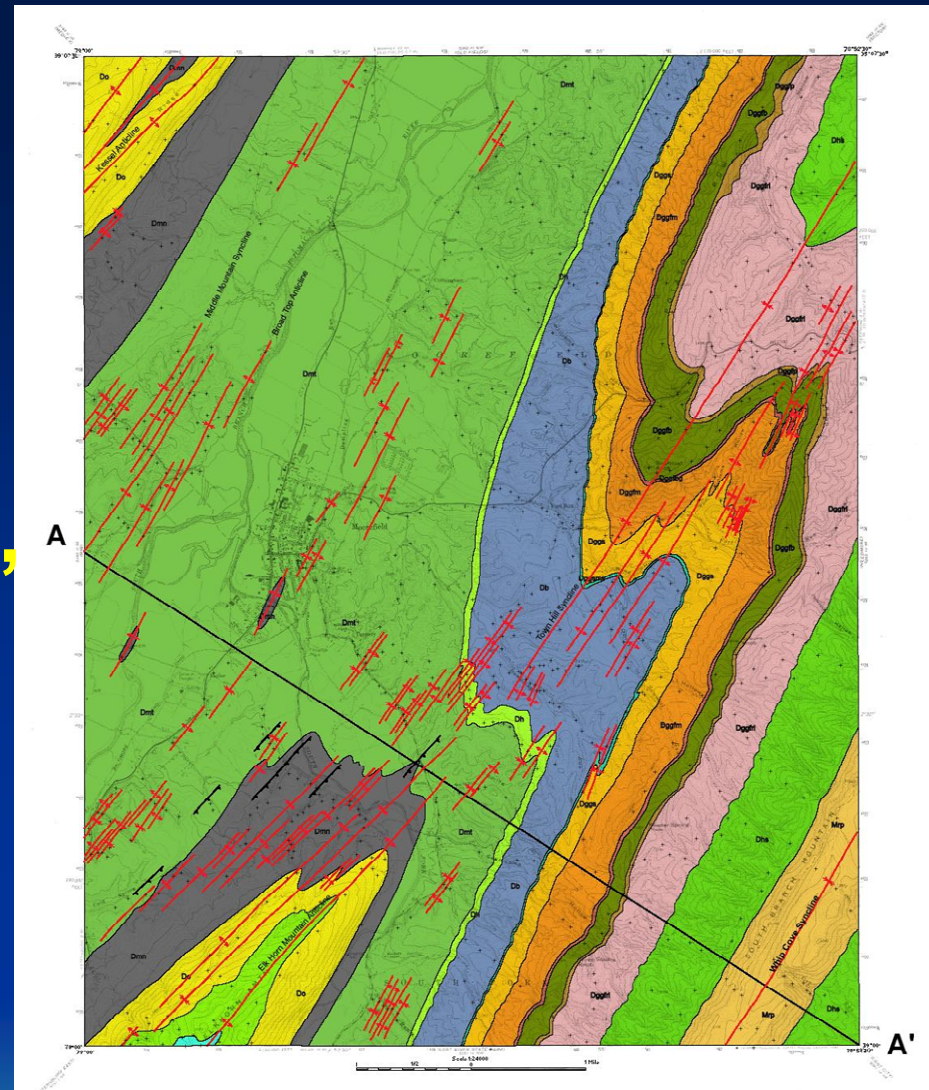






# Geologic Map with Cross Section

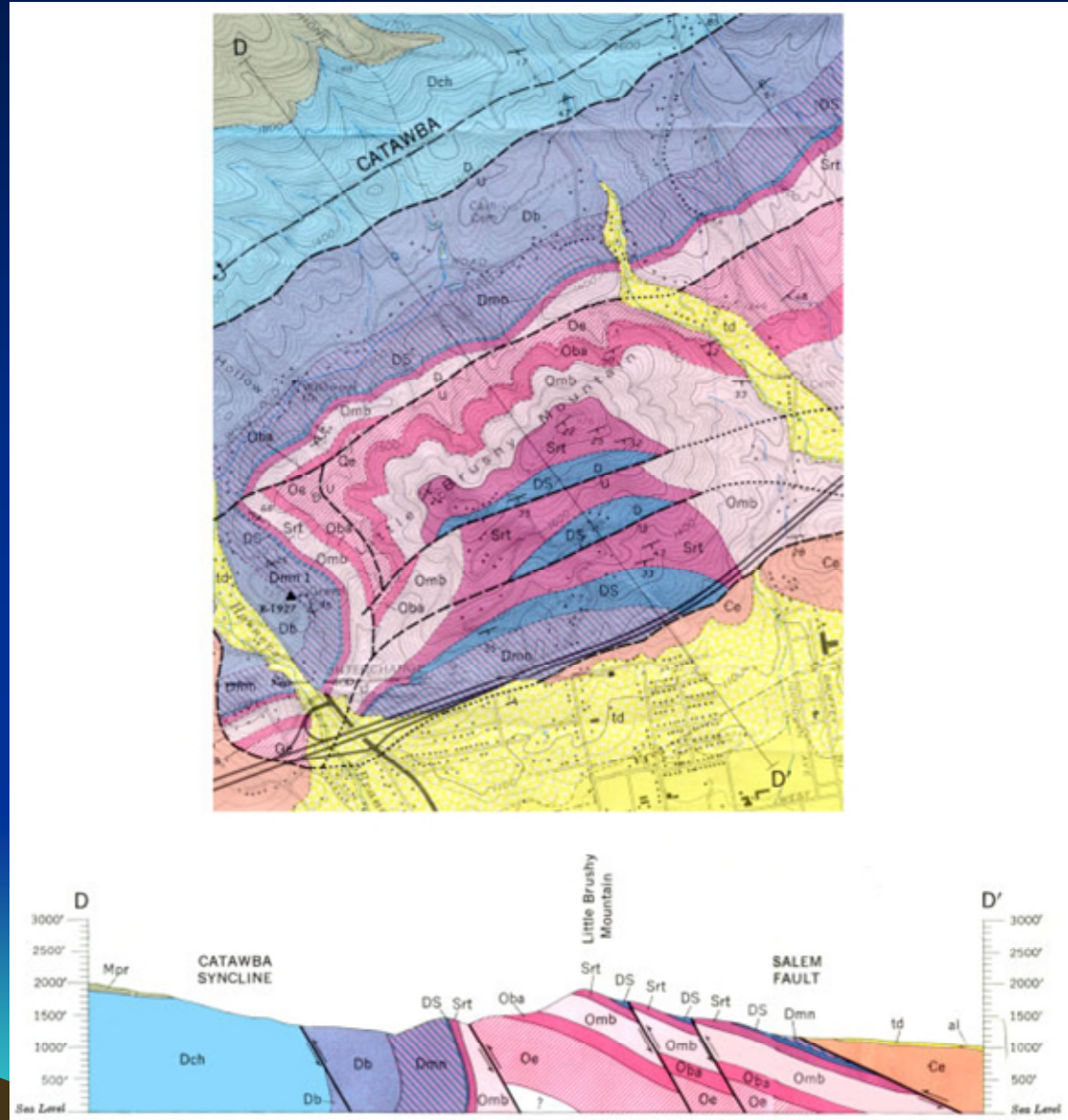
## Moorefield Quadrangle, Hardy County, West Virginia





# Geologic Map with Cross Section

- 1) A geologic cross section depicts a scale-balanced side profile of a specific transect across a geology map
- 2) The cross section includes rock formations and structural elements
- 3) Geology depicted in a cross section is an interpretation based on map view field data





# Use Rules of Structure To Interpret Geology Maps

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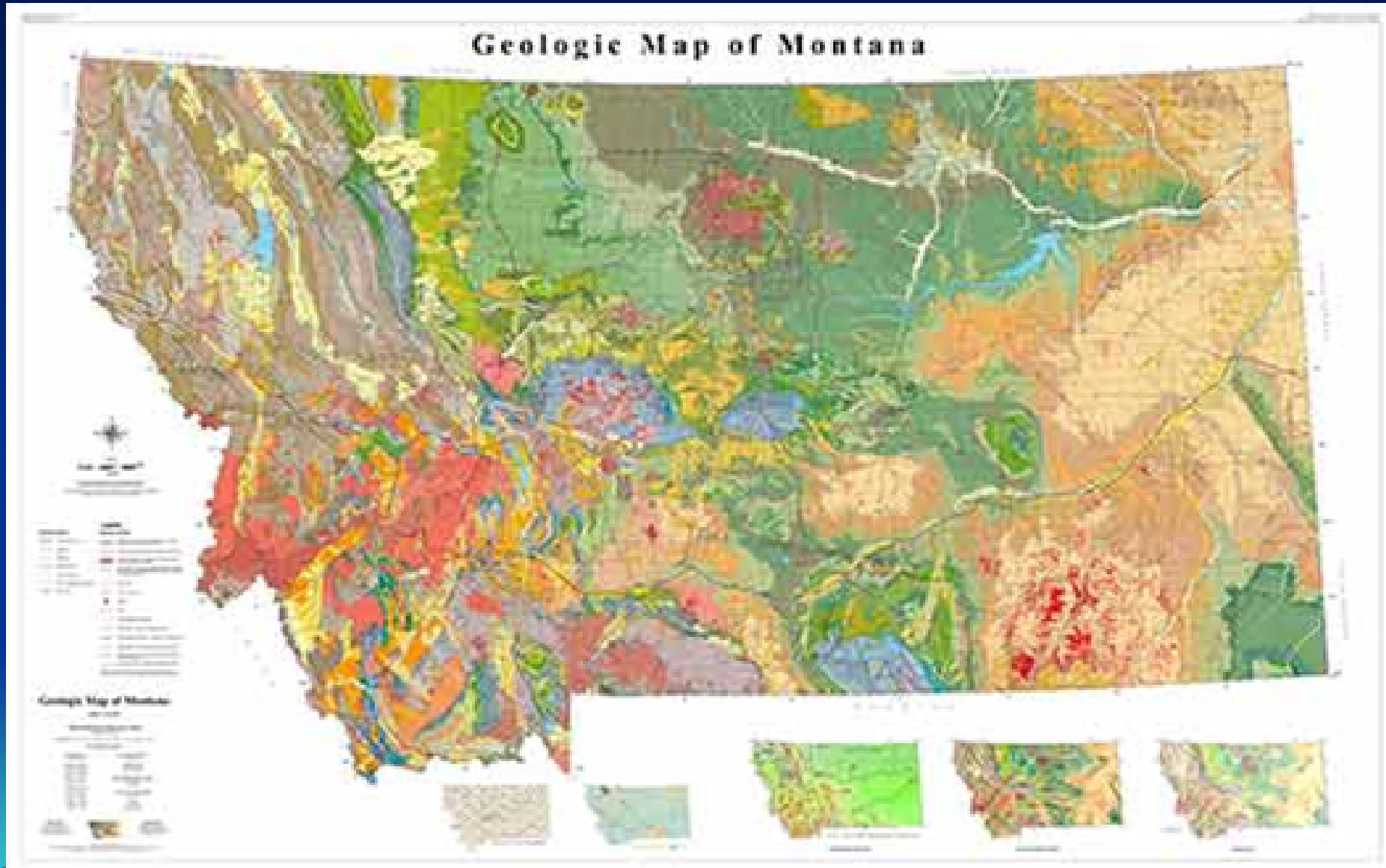


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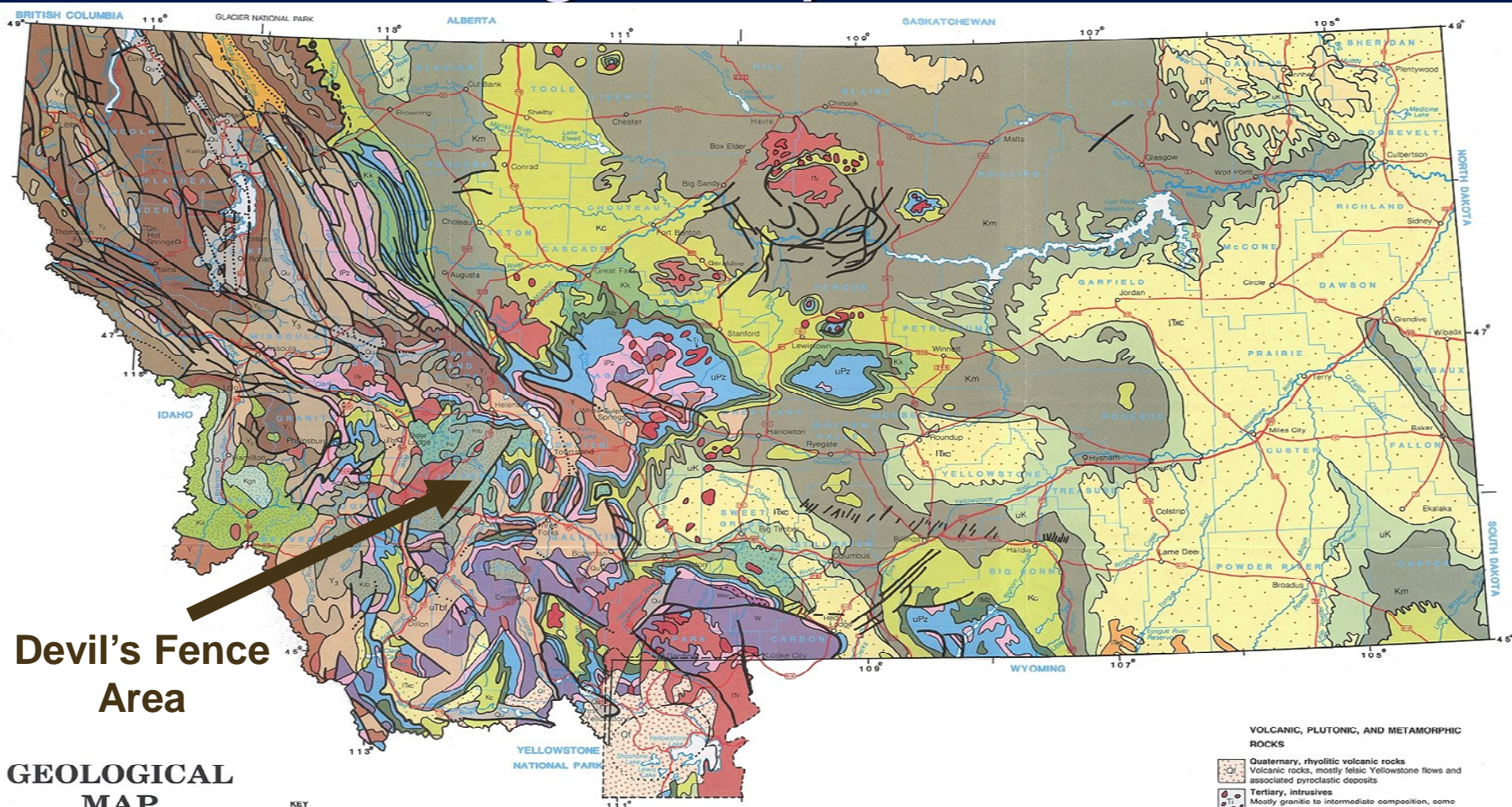


# Geologic Map of Montana



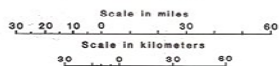


# Geologic Map of Montana



**Devil's Fence  
Area**

## GEOLOGICAL MAP of MONTANA and Yellowstone National Park



**KEY**  
Fault, sense of motion not indicated  
Contact

### CONTINENTAL AND MARINE DEPOSITS

- Quaternary, extensive**  
Stream, glacial, and lake deposits
- Tertiary, fluvial gravels**  
Gravel and sand with some silt, volcanic ash, and marl
- Tertiary, basin fill**  
Oligocene through Pliocene basin fill composed of a heterogeneous mixture of gravel, sand, silt, and clay deposited by streams and in lakes
- Eocene, continental deposits**  
Includes fine to coarse-grained clastic rocks
- Paleocene, continental deposits**  
Including stream-deposited sediments of coal-bearing Fort Union Fm. in the east, Willow Creek Fm. in the north central, and Beaverhead conglomerate in the southwest

- Upper Cretaceous, undifferentiated**  
Hell Creek sandstone and shale, St. Mary River mudstone, and volcanoclastic Livingston Gp. in southern Montana
- Montana Group**  
Bearpaw shale, Judith River sandstone, siltstone, and shale, Claggett shale, Eagle sandstone, and Telegraph Creek sandy shale. Includes Fox Hills sandstone and Pierre shale in the extreme east
- Colorado Group**  
Includes mainly shale of the Niobrara, Belle Fourche, Mowry, and Thermopolis Formations
- Kootenai Formation**  
Conglomerate, sandstone, shale, and mudstone
- Lower Mesozoic**  
Includes calcareous fossiliferous sandstone, shale, and limestone of the Ellis Group in the central and south central, and the Dinwoody and Thayne Formations in the southwest as well as the Morrison shale, sandstone, and marl in the west

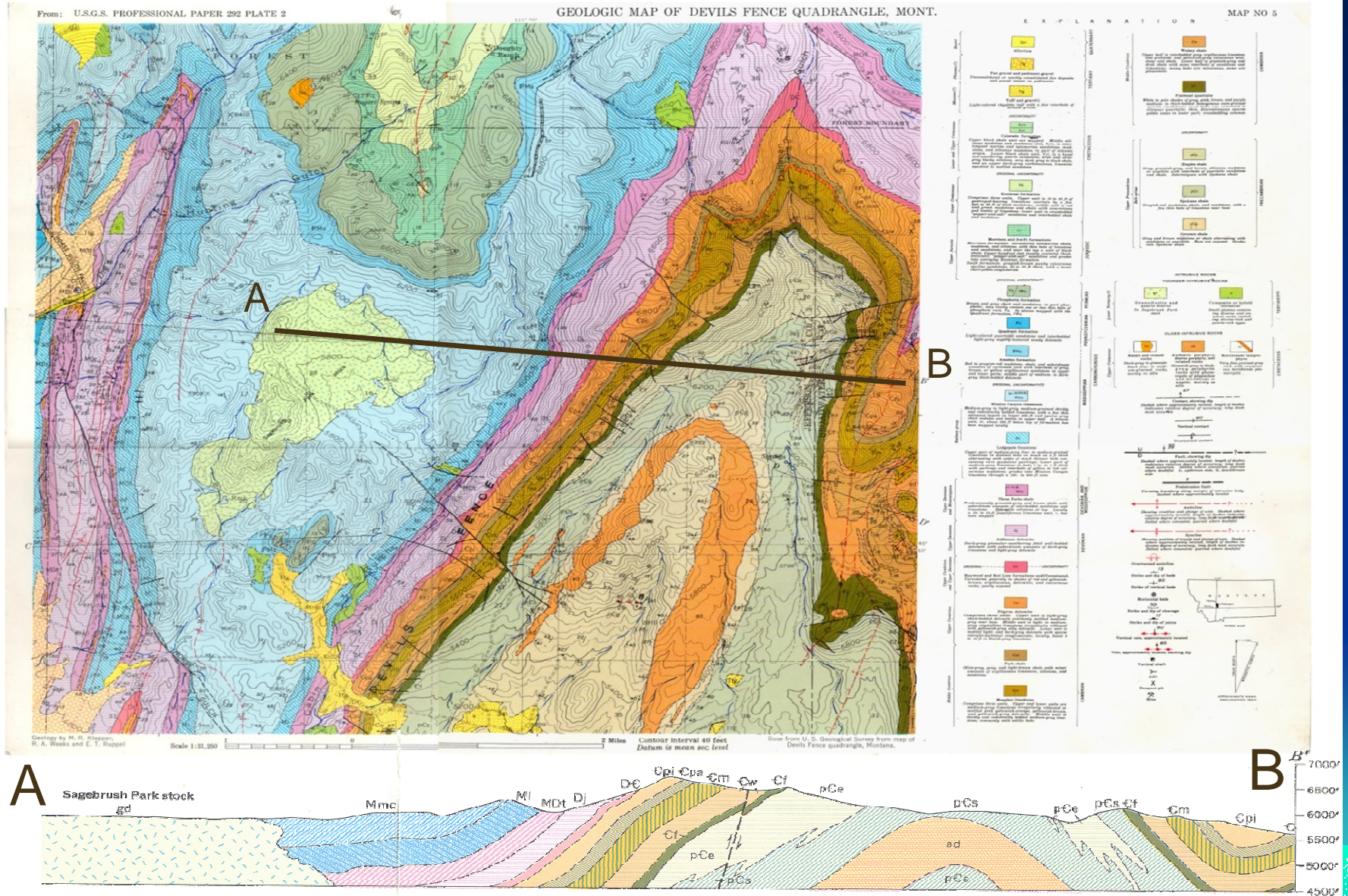
- Mississippian, Pennsylvanian, Permian**  
Includes Madison limestone, Big Snowy dolomite and limestone, and Quadrant sandstone
- Devonian and Cambrian**  
Consists of Three Forks shale, Jefferson limestone, Pilgrim and Mesagher limestone, Park and Wolsey shale, and Fishhead sandstone
- Upper Belt-Missoula and Piegian Groups**  
Chiefly red, maroon, and purple argillites and impure quartzite and limestone
- Middle Belt-Wallace, Slieth, Helena Fms.**  
Heterogeneous Wallace Fm. including argillite, limestone, sandstone, shale, and quartzite; Slieth and Helena limestones
- Lower Belt-Ravalli and Prichard Fms.**  
Ravalli Fm. includes siliceous and sandy quartzite, argillite, and shale; Prichard Fm. consists of banded slate with interbedded sandstone
- Undivided Belt Supergroup**

### VOLCANIC, PLUTONIC, AND METAMORPHIC ROCKS

- Quaternary, rhyolitic volcanic rocks**  
Volcanic rocks, mostly felsic Yellowstone flows and associated pyroclastic deposits
- Tertiary, intrusives**  
Mostly granitic to intermediate composition, some alkaline especially in north-central Montana
- Lower Tertiary, volcanic rocks**  
Flows and associated pyroclastic deposits; latite, andesite, with some rhyolite and basalt and associated intrusive dikes and necks
- Younger Cretaceous, granitic rocks**  
Boulder Batholith and related rocks; predominantly quartz monzonite
- Cretaceous, volcanic rocks**  
Mafic to intermediate composition lava flows, ash flows, and other pyroclastic rocks with interbedded sedimentary rocks including Eikhorn Mountains volcanic rocks
- Older Cretaceous, volcanic rocks**  
Idaho Batholith and associated masses; monzonite and granodiorite
- Border Zone of Idaho Batholith**  
Metasedimentary rocks of Belt age intruded by granitic rocks
- Stillwater Complex**  
Layered mafic-ultramafic intrusive complex, includes anorthositic; associated with hornfels aureole
- Archean, undifferentiated**  
High-grade metamorphic rocks derived from igneous and sedimentary parent rocks. Lithologies include quartzite, feldspathic gneiss, granulite, amphibolite, quartzite, and marble

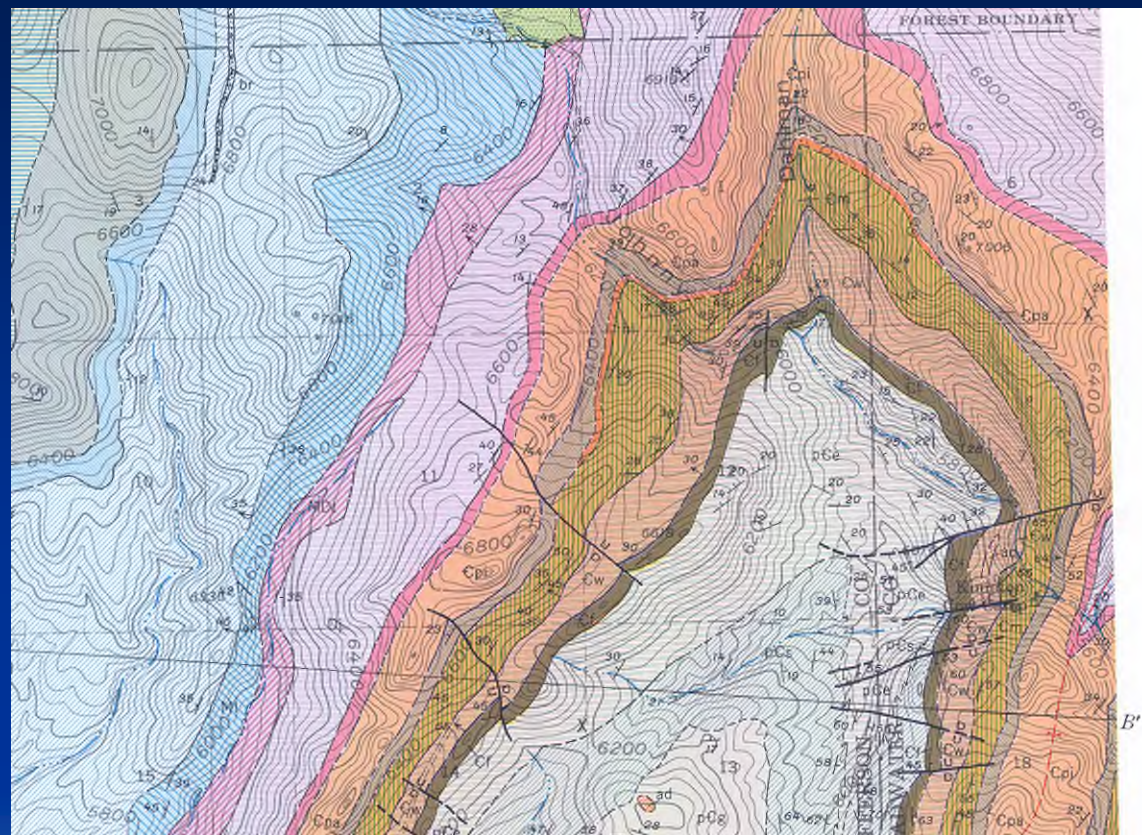


# Geologic Maps – Devil's Fence Quad





# Devil's Fence Geology Map with Explanation



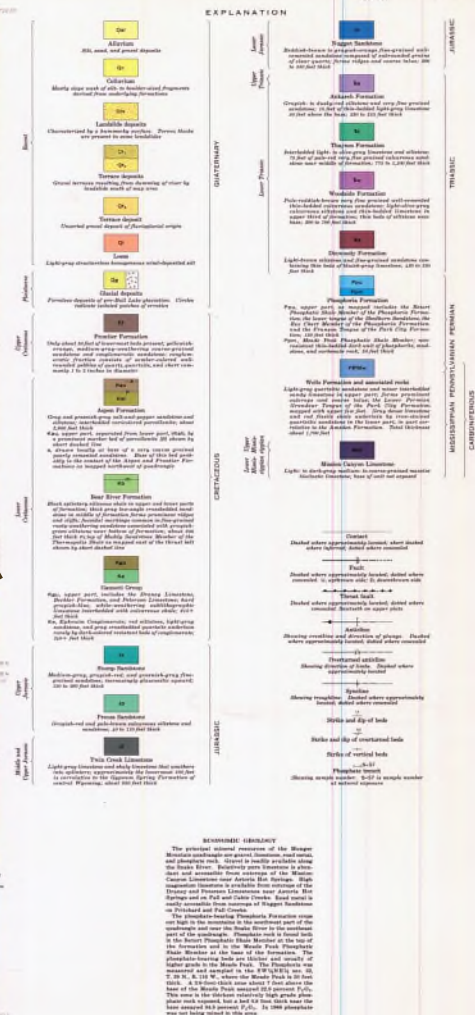
Recent		Pliocene (?)		Miocene (?)		Lower and Upper Cretaceous		Lower Cretaceous		Upper Jurassic		Lower Jurassic		Upper Permian		Lower Permian		Upper Carboniferous		Lower Carboniferous		Upper Devonian and Mississippian		Lower Devonian									
Qal Alluvium		T <sub>3</sub> Fan gravel and pediment gravel Unconsolidated or weakly consolidated fan deposits and gravel veneer on pediments		T <sub>2</sub> Tuff and gravel Light-colored rhyolite tuff with a few interbeds of stream gravel		UNCONFORMITY		K <sub>1</sub> K <sub>2</sub> Colorado formation Upper black shale unit not mapped. Middle silty mudstone and sandstone unit, K <sub>1</sub> , is interbedded marine and nonmarine sandstone, mudstone, and siliceous sandstone, in part of volcanic origin. Lower black shale unit, K <sub>2</sub> , is a basal fine-grained quartz sandstone, dark and olive-gray blocky siltstone, very dark gray to black shale, and an upper dark-gray carbonaceous, laminitic speckled to mottled sandstone		UNCONFORMITY		K <sub>1</sub> K <sub>2</sub> Kootenai formation Comprises three units. Upper unit is 10 to 25 ft of pebbly sandstone, middle unit is red and green mudstone and shale with concretions and lenses of limestone, lower unit is crossbedded "pepper-and-salt" sandstone and interbedded shale and mudstone		J <sub>1</sub> Morrison and Swift formations Morrison formation, varicolored nonmarine shale, mudstone, and siltstone, with thin beds of limestone and sandstone, and near the top a unit of black shale. Upper hundred feet locally contains thick, lenticular "pepper-and-salt" sandstone and grades into overlying Kootenai formation. Swift formation, grayish-brown blocky carbonaceous marine sandstone, 20 to 25 ft thick, with a basal chert-pebble conglomerate		P <sub>1</sub> P <sub>2</sub> Phosphoria formation Brown and gray chert and sandstone, in part phosphatic, may locally contain one or two thin beds of Quadrant formation, P <sub>1</sub> , in places mapped with the Quadrant formation, P <sub>2</sub>		P <sub>1</sub> Quadrant formation Light-colored quartzitic sandstone and interbedded light-gray sugary-textured sandy dolomite		P <sub>1</sub> P <sub>2</sub> Asenden formation Red to grayish-red mudstone, shale, and subordinate amounts of carbonaceous rock with interbeds of gray, brown, or yellow argillaceous sandstone in upper and lower parts; middle part of medium- to dark-gray thick-bedded dolomite		UNCONFORMITY		M <sub>1</sub> M <sub>2</sub> Mission Canyon limestone Medium-gray to light-gray medium-grained thickly and indistinctly bedded limestone, with a few thin siliceous layers in lower 200 ft and sparse gray chert nodules and lenses in upper half. A breccia unit, br, about 200 ft below top of formation has been mapped locally		L <sub>1</sub> L <sub>2</sub> Lodgepole limestone Upper part of medium-gray fine- to medium-grained limestone in distinct beds as much as 2 ft thick alternating with zones of much thinner beds containing rare mudstone and sandstone; lower part of medium-gray limestone in beds 1 in. to 1 ft thick with partings and interbeds of yellow to red calcareous mudstone, grades into Mission Canyon limestone through a 150- to 200-ft zone		C <sub>1</sub> C <sub>2</sub> Three Forks shale Predominantly greenish-gray and brown shale with subordinate amounts of interbedded sandstone and limestone. Dolomitic siltstone at top. Locally a 10- to 25-ft fossiliferous limestone unit, li, has been mapped		D <sub>1</sub> Jefferson dolomite Dark-gray granular-weathering feld well-bedded dolomite with subordinate amounts of dark-gray limestone and light-gray dolomite		D <sub>2</sub> Jefferson dolomite Dark-gray granular-weathering feld well-bedded dolomite with subordinate amounts of dark-gray limestone and light-gray dolomite	
QUATERNARY		TERTIARY		CRETACEOUS		JURASSIC		PERMIAN		PENNSYLVANIAN		CARBONIFEROUS		MISSISSIPPIAN		DEVONIAN AND MISSISSIPPIAN		DEVONIAN															
Upper Cretaceous and Upper Devonian		Upper Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous		Middle Cretaceous									
EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY		EROSIONAL UNCONFORMITY									
Maywood and Red Lion formations undifferentiated, varicolored, generally in shades of red and yellowish-brown, argillaceous dolomite, and calcareous rocks; poorly exposed		Pilegrimage dolomite Comprises three units. Upper unit is light-gray thick-bedded dolomite commonly mottled medium-gray near base. Middle unit is light- to medium-gray crystalline limestone irregularly ribbed with yellowish-gray silt dolomite. Lower unit is mottled light- and dark-gray dolomite with sparse intraformational conglomerate; locally, basal 8 to 10 ft is blackish-gray limestone		Park shale Olive-gray, gray, and light-brown shale with minor amounts of argillaceous limestone, siltstone, and sandstone		Meagher limestone Comprises three units. Upper and lower units are medium-gray limestone irregularly ribbed or mottled with yellowish-orange, yellowish-brown, and yellowish-gray dolomite. Middle unit is thickly and indistinctly bedded medium-gray limestone, commonly with oolitic beds		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.		Shale (Yash) Shale (Yash) is a dark gray to black shale, locally containing thin beds of limestone and sandstone. It is a member of the Morrison formation and is characterized by its dark color and by the presence of thin beds of limestone and sandstone.									



# Devil's Fence Topographic Feature







GEOLOGIC MAP OF THE MUNGER MOUNTAIN QUADRANGLE, TETON AND LINCOLN COUNTIES, WYOMING

Howard F. Albee  
1963

*Wyoming (Munger Mountain quad)  
map 1.*

U.S. GEOLOGICAL SURVEY

U.S. GEOLOGICAL SURVEY

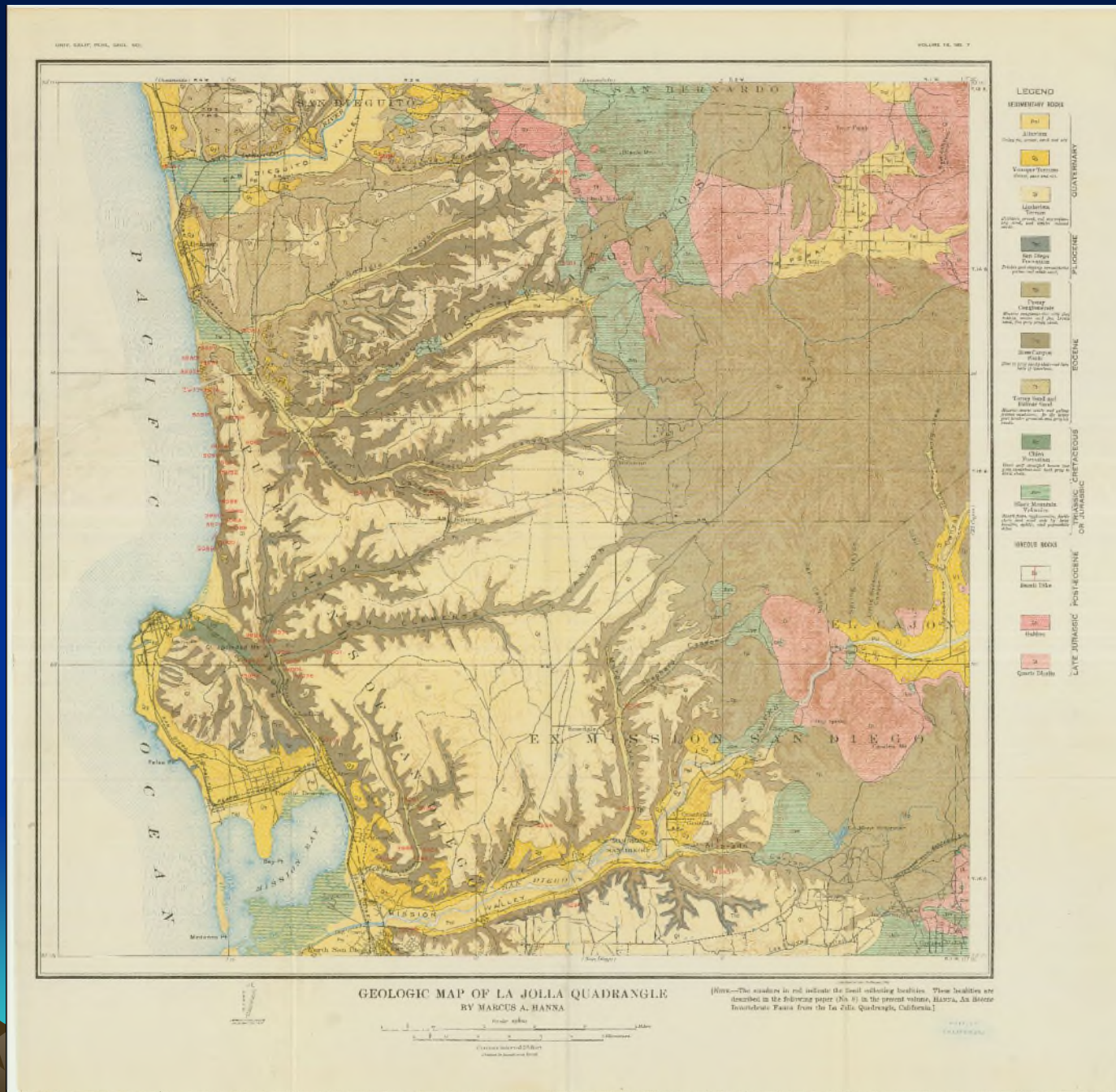
# Mungar Mountain Geology Map



M(200)  
599  
702



# Geology Map La Jolla Quad



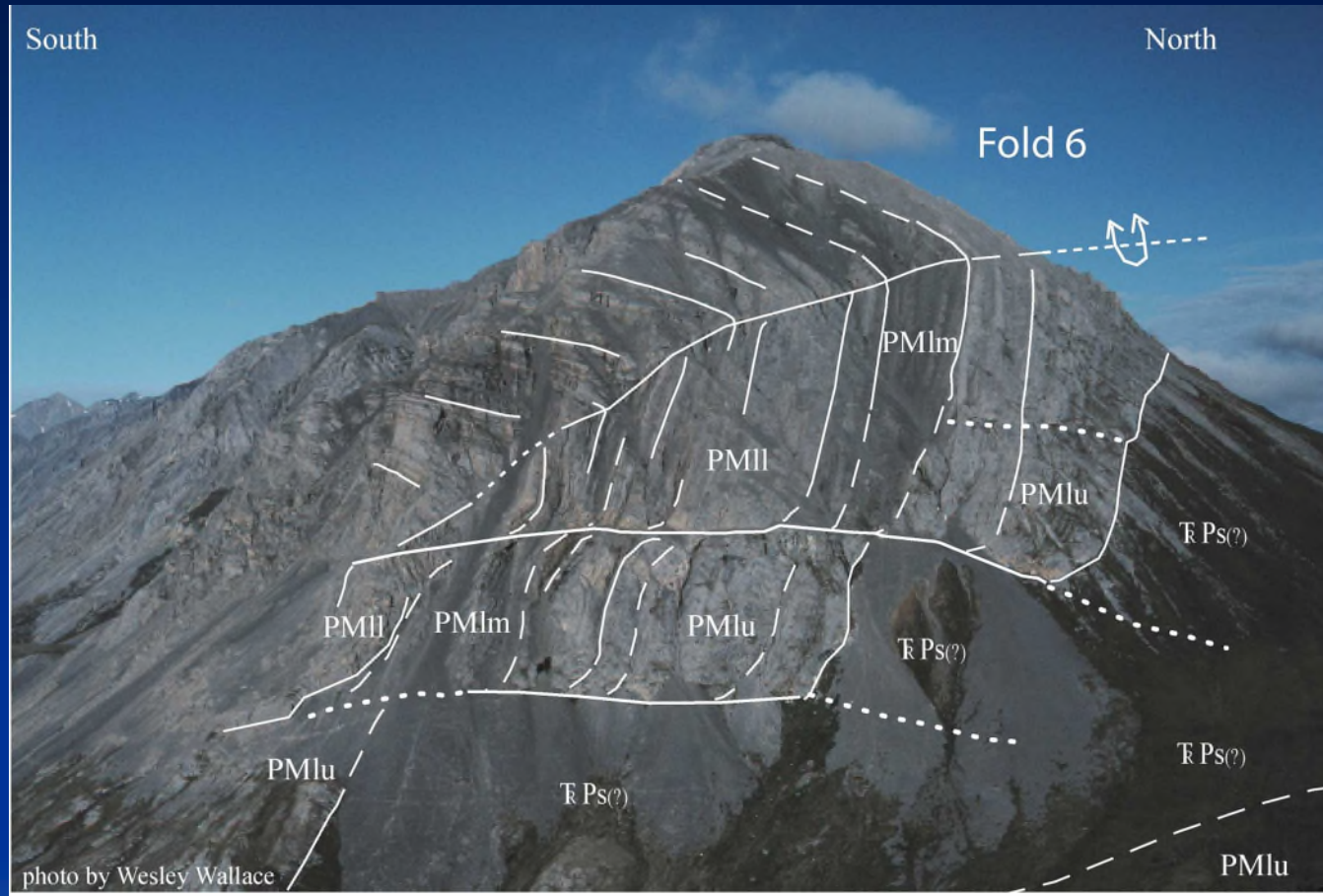


# Use Rules of Structure To Interpret Geology Maps

- 1) Strike of beds is always parallel to the direction of the contacts.
- 2) Rock layers dip towards the youngest exposed rock layers.
- 3) Oldest rocks exposed in the center of eroded anticlines and domes.
- 4) Youngest rocks exposed in the center of eroded synclines and basins.
- 5) Horizontal folds form parallel sets of belt-like outcrop patterns.
- 6) Plunging synclines form "V" or "U" shaped, belt-like outcrop patterns.
  - ✓ Fold plunges toward *open* end of "U" pattern.
- 7) Plunging anticlines form "V" or "U" shaped, belt-like outcrop patterns.
  - ✓ Fold plunges toward *closed* end of "V" or "U" pattern.
- 8) Steeper the dip of the layer, the more narrow the width of its outcrop.
- 9) Hanging wall *moves up* relative to foot wall in reverse and thrust faults.
- 10) Hanging wall *moves down* relative to foot wall in normal faults.
- 11) Vertical slickenside grooving indicates dip-slip fault movement
- 12) Horizontal slickenside grooving indicates slip-slip fault movement



# Geology Map Web References



<http://www.nature.nps.gov/geology/usgsnps/gmap/gmap1.html#unique>

<http://www.globalchange.umich.edu/Ben/ES/earthstructure.htm>

<http://www.winona.edu/geology/MRW/maps.htm>

<http://www.nps.gov/archive/yell/slidefile/scenics/outsideynp/Page.htm>