

Summary Geologic History Of the Rocky Mountain Region

Page One - Cenozoic

Compiled by L.S. Fichter, Fall, 1994

Department of Geology

James Madison University

Age	Event	Tectonic or Geographic Units	Formations or Examples	Descriptive History
5-0 my	Glaciation	Erosion and Creation of the modern unconformity		
28-5 my Miocene Pliocene	Dissection of High Plains and Rocky Mtn. Basins	Colorado piedmont, Pecos Valley New Mexico	Uplifted edges of Paleozoic strata (e.g. Fountain, Minturn) form prominent hogbacks (e.g. Garden of the Gods)	Except for the Gangplank in WY, high plains now separated from Front Range pediment
	Broad vertical uplift up to 5000 feet	Entire western U.S. including the Colorado plateau, Basin and Range province, Front Range of the Rockies	Front Range (Pikes Peak), Sangre de Cristo Mtns, and many other uplifts. Plus Rio Grande valley, St. Luis Park, Arkansas valley	Maximum summits rise to over 14000 feet, most in Colorado along the front range. Simultaneously broad graben valley dropped, mostly behind the Front Range dividing the region into mountains separated by deep valleys.
	Yellowstone hot spot begins its journey	Columbia River Plateau	Columbia river plateau flood basalts	Lavas bury all structure and topography throughout Columbia plateau region
	Switch to mafic volcanism			May correspond to North America overriding Pacific ocean rift center
65-28 my Paleogene	Wide spread felsic volcanism	Invade as a variety of extrusive volcanic fields and intrusives; now mostly uplifted/exposed. Probably associated with east dipping subducting plate.	San Juan Mtns.; 39 Mile volcanic field; Jemez and Datil volcanics; Wind River Mtns., Yellowstone	Widespread felsic volcanic events invade Pre-Cambrian basement and Phanerozoic strata. Widespread mineralization (e.g. Leadville and Colorado gold fields)
	Intermountain basin filling and High Plains deposition	Formation of sub-summit pediment as Laramide Mtns eroded and become buried in their own debris.	Green River, Uinta, Wind River, etc basins	Intermountain basin filling continues through Miocene or later
UNCONFORMITY Erosion of Laramide uplifts down to deep Precambrian basement				

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Page Two - Mesozoic

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Age	Event	Tectonic or Geographic Units	Formations or Examples	Descriptive History
UNCONFORMITY				
Erosion of Laramide uplifts down to deep Precambrian basement				
65-45 my Late Cretaceous/ Paleocene	LARAMIDE OROGENY	FORELAND	Mesaverde Gp and younger prograding non-marine and nearshore fms. Offshore Lewis and Pierre shale	Beginning of K, widespread wedge of molasse sediments spreads eastward. Thick coals
		FOLD AND THRUST Central and Northern Rockies	Large thrust belt zones spreading eastward in WY, ID, MT & into Canadian Rockies	In many places Precambrian basement lifted to high elevations and Phanerozoic sedimentary units stripped off exposing PreC basement.
		FAULT BLOCK Southern Rockies. N-S trending normal faults	Front Range, Sangra de Cristo, Mosquito, Sawatch, etc. ranges Uplift 15-25,000 feet	
		INTRUSIVES AND VOLCANICS	Idaho/Boulder (MO) batholiths; Coast Range (Canada) batholiths	East dipping subduction; continuation of Nevadan and Sevier
Early-Mid Cretaceous	Great Cretaceous Seaway	Narrow seaway from Gulf of Mexico to Arctic Ocean. Remains active through rest of Cretaceous	Foreland basin of Sevier and Laramide orogenies; Mancose sh and Niabraro chalk between orogenies.	In the area of the western great plains and eastward
	SEVIER OROGENY	Canadian Rockies complicated by two or more docking terranes beginning in the Jurassic		Tectonic events have shifted east and broadened relative to Nevadan orogeny due to shallowing dip of subducting plate.
		FORELAND	Indianola gravels changing eastward to Mancose shale in Great Cretaceous seaway	Nevadan, Sevier and Laramide orogenies all result from the same east dipping subduction zone. Orogenic pulses correspond to increases in subduction rate. Interorogenic calm to slowing subduction rate..
		FOLD AND THRUST BELT	From far southeast Ne through central UT, eastern WY and northwest through Alberta & BC	
		Franciscan MELANGE and Great Valley (Calif) sequence	Outer arc ridge and trough	
Late Jurassic	NEVADAN OROGENY	FORELAND BASIN in Wyoming, Colorado and east	Sundance sea and Morrison clastic wedge	Early Sundance sea pushed east by thrusting, then overrun by subareal Morrison
		FOLD AND THRUST BELT	From eastern Nevada north through Utah and Idaho	Canadian terranes: Stikine, Cache Creek, Eastern Assemblages
		IGNEOUS: Sierra Nevada batholith emplaced in eastern CA		Evidence of volcanic activity runs up through Canadian Rockies
		TRENCH: Franciscan Accretionary Wedge	Turbidite melanges of graywackes, dark mudstones, cherts, carbonates	Generated by an eastern dipping subduction zone under North America
Early Jurassic	Arid Borderlands	WEST	Gypsum Springs & Sundance	Widespread arid conditions result in evaporates and large wind blown dunes
		EAST: Zion Nat. Park	Navajo sandstone; large scale cross bedding	
Triassic	Platform Redbeds	EAST: Painted Desert/ Petrified Forest but deposits from Arizona to Canada	Moenkopi, Chinle (Docum Gp of TX/OK), Wingate, Glen Canyon etc.	Semi-arid to arid savannahs with gallery forests (abndt vertebrates/giant redwoods)
	Marginal Marine	WEST	Dinwoody, Woodside Thaynes, Chugwater, Nugget	Continental edge marine

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Page Three - Paleozoic

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Age	Event	Tectonic or Geographic Units	Formations or Examples	Descriptive History
Permian	Texas Permian Basin	West TX, NM: Delaware and Midland Basins; El Capitan reef	Bone Springs blk sh, Capitan Reef, etc. Thick evaporite deposits	Final Retreat of Absaroka sea; exits to southwest
	SONOMA OROGENY	EAST - Central Cordillera, Mexico to Idaho	[AZ: Supai, Hermit (deChelly) Coconino (Bird Spring ls to west), Toroweep, Kaibab] [UT: Park City Gp, Phosphoria]	Non-marine remnants of Ancestral Rockies to east grading to marine deposits in west. (Semi)arid climates
		WEST - Sonomia terrane/Havallah sequence; northern CA & NE	Golconda thrust in Nevada brings Havallah sequence onto craton.	Same location/cause as Antler orogeny; Debate about subduction direction
UNCONFORMITY (Permian/Triassic - Progressive erosion of Ancestral Rockies; Fountain, Minturn, Hermosa, Sangra de Cristo formations)				
Pennsylvanian	ANCESTRAL ROCKIES (Colorado orogeny)	CO: Frontrangia, Uncompahgria, Zuni uplifts (tops stripped down to basement) Paradox basin between uplifts	Cutler/Fountain/Hermosa coarse clastics along graben edges; carbonates (reefs)/ evaporates in center) Rapid facies changes	Caused by wrenching of craton along basement fracture zone; colliding South America (Gondwana); Pangaea suturing
		AZ Supai (non-marine) grading to Callville ls		
UNCONFORMITY (Major offlap early in Absaroka)				
Mississippian	Orogenic Calm		Madison/Redwall/Leadville crinoidal/oolitic Limestones	Widespread, thick, resistant, prominent
Devonian	ANTLER OROGENY	WEST: Klamath/Sierra arc (Roberts Mtn terrane); Nevada/Idaho deformation. Roberts Mtn thrust in Nevada	Remnants of arc in northern California and western Nevada	↑ Dev. Volcanic arc develops along subduction facing either west or east depending on model
		EAST: carbonate platform along continental edge	Wide, thick carbonates NM, UT, CO east WY north through Canada	→ ↑ Dev. ↓ Dev thin, patchy exposures
Silurian	UNCONFORMITY Offlap of Tippecanoe: except for → Sil (Lone Mtn/Laketown/Fusselman ls) most of Cordillera exposed			
Ordovician	Exposure of craton across much of region	Only divergent margin remains subaqueous	Bighorn dolomite: NE, ID north into Canada UT: Eureka qtz.	A line through central Nevada and Idaho separates eastern carbonates from western black shales.
UNCONFORMITY Sauk-Tippecanoe boundary: exposure of craton across much of region in lower Ordovician				
Cambrian	Sauk transgression across broad stable craton	Divergent Continental Margin existing from 1.0-1.3 rifting	↓ C: Prospect/Flathead/Tapeats ss; Pioche/Wolsey/Bright Angle sh; Howell/Mauve ls	Time transgressive onlap thinning and younging east toward Transcontinental Arch
		Transcontinental arch forms low islands	→ ↑ C carbonates dominate across region → C Burgess shale in BC deposited off edge of continental shelf	

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Page Four - Archaean and Proterozoic

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Late Proterozoic	.6 Glaciation		Tillites found in the Belt series		
	.8-.6 Windermere	Continental margin sandstones and shales deposited at beginning of Sauk transgression. Thick tholeiite volcanics in lower part	Canada	Laid unconformably on deformed Belt-Purcell rocks	
	?? Craton Wide Orthogonal Fracture Zones	Colorado, Walker-Texas, Olympic Wichita, Lewis & Clark lineaments. Date not clear	Set of NE and NW trending fractures in basement; minor N-S lineament present	Lineaments of recurrent structural movement in basement between Transcontinental arch and Cordilleran continental margin..	
	1.0-1.3 Rifting	Aulacogens: Belt/Purcell, Uinta Unkar/Chuar Amargosa	Grand Canyon Gp/ Belt Purcell, etc Diverging continent may have been Antarctica or Siberia	Belt contains 53,000 feet of strata, largely quartzites.	
0.6-1.8 Middle Proterozoic	1.0-1.1 Abortive Rifting	Keweenawan/ Mid-continent gravity high	Transcontinental Arch	An aborted rifting event identified in Minn, but extending into the southwest	
	Anorogenic Magmatism	1.0-1.2	e.g. Pike's Peak Granite - bimodal peraluminous to peralkaline granite, mafics, anorthosites	Colorado	A period of little or no evidence of orogenic cycles but world wide anorogenic bimodal magmatism giving rise to andesine-labradorite anorthosites, rapakivi granites, plateau basalts, alkaline complexes, etc. Many of these appear for the first time in earth history and represent an important landmark in earth history. Many now exposed rocks formed as much as 35 km deep.
		1.1	Rapakivi granite/ acid volcanics	Nevada, Colorado	
		1.53-1.58	Granite intrusion into Stillwater complex	Montana	
		1.6	Basalts, Rhyolites, Granites	Arizona	
		1.7	Granites	Colorado	
1.8 - 2.5 Early Proterozoic	1.6-1.8 Proterozoic Crustal Accretion	Major pieces of western US generated but extending eastward across to east coast	Scattered exposures from southern Wyoming to northern Mexico; exposures in Grand Canyon (Vishnu schist and Zoroaster granite)	Rocks formed by island arc activity with associated sediments coming on board from the south	
	1.8-1.9 Suturing of Archean terranes	Suturing occurs along Trans-Hudson Belt	Wyoming/Hearne belt sutures with Superior province to east	Beginning of consolidation of North American continental core. Extends far beyond Cordillera	
	2.7 Stillwater Complex	Part of continent wide basic and ultrabasic dike swarm	Beartooth Mtns. of Montana	Intruded originally as a subhorizontal sheet into early PreC schists and gneisses. Some have attributed to boloid impact.	
>2.5 Archean	Generation of Archean micro-continent terranes	Wyoming/Hearne, Rae, and Slave	Wyoming province exposed in Wyoming uplifts and Black Hills	Microcontinents formed by early subduction zones. Were probably sutured in the Archean by arc-arc collisions.	