

System or Series	Formation and member	Western Black Hills			Fanny Peak quadrangle						
		Lithology	Thickness (feet)	Remarks	Lithology	Thickness (feet)	Contact	Measured section	Remarks		
Quaternary					Calcareous spring deposits (tufa). Terrace gravel and alluvium. Landslide deposits.				Along east side of Stockade Beaver Creek valley. Along valleys of master streams. Principally along west side Stockade Beaver Creek and south side of Whoopup Creek.		
	Pierre Shale	Principally gray to black shale, sandy shale, and sandstone containing many beds of bentonite; fossiliferous.	2,700 avg in Newcastle area.	Description of western and northern flanks of Black Hills: Robinson, Mapel, and Cobban (1959). Marine origin.	Light-gray claystone and shale containing abundant red-brown concretions and thin beds of siderite.	400+	Top not exposed; lower contact poorly exposed, but gradational with Niobrara on west side of Black Hills.		Upper part covered by alluvium. Exposures poor. Lower 50 ft is Gammon Ferruginous Member; remainder of exposed thickness probably all Mitten Black Shale Member or possibly equivalents of Sharon Springs Member.		
Upper Cretaceous	Niobrara Formation	Chalk marl and calcareous shale; numerous thin beds of bentonite. Dark gray when fresh; weathers light yellow.	125-225	Cobban (1951). Marine origin.	Speckled chalk marl and calcareous shale, some thin beds of bentonite.	170	Poorly exposed, but gradational with units above and below throughout the Black Hills.		White specks are algal remains (Goodman, 1951, p. 24-26). Abundant fossils: <i>Ostrea congesta</i> Conrad.		
	Carlile Shale	Shale and sandstone	600 avg	Definition: Gilbert (1896, p. 565). Fauna: Cobban (1951, p. 2187-2190). Marine origin.	Gray shale and sandstone	535±	Gradational with units above and below.		Poor exposures and local variation in dip on the monocline make accurate measurements of thickness difficult. Best exposures along irrigation ditch south of LAK Ranch office, sec. 7, T. 44 N., R. 60 W., Weston County, Wyo.		
	Sage Breaks Member	Mostly gray noncalcareous shale.	200-300	Cobban (1951)	Gray noncalcareous shale	250	do				
	Turner Sandy Member	Sandstone and shale	160 in Newcastle, Wyo., area.	Definition: Rubey (1930, p. 4); Cobban (1951).	Gray to brown medium-grained sandstone and gray shale.	150	do				
	Lower unnamed member	Dark-gray shale; calcareous and ferruginous concretions.	125 max	Cobban (1951)	Dark-gray shale; calcareous and ferruginous concretions.	125			Base of Carlile considered to be at top of uppermost brown fossiliferous limestone bed of Greenhorn.		
	Greenhorn Formation	Three facies of limestone, shale, and marl.	270 in Newcastle, Wyo., area.	Definition (in Colorado): Gilbert (1896, p. 564). Description (in Black Hills): Rubey (1930). Marine origin.	Limestone and calcareous shale. Mapped as upper and lower units: upper unit 70 ft thick; consists of 20 ft of resistant thin-bedded shaly, fossiliferous gray to brown limestone interbedded with some gray mudstone overlying 50 ft of soft gray to brown calcareous shale containing some thin beds of brown fossiliferous limestone. Lower unit is 200 ft of brown and gray calcareous shale.	270	Lower contact of lower unit gradational but placed at top of gray-red bentonite regarded as uppermost bed of Belle Fourche. At about this stratigraphic level, shale beds below are black and noncalcareous; those above are brown to gray and calcareous.		Contacts not well exposed. Best exposures in W½ sec. 18, T. 44 N., R. 60 W., Weston County, Wyo. Fossiliferous beds contain sharks teeth and abundant <i>Inoceramus tabulatus</i> .		
	Belle Fourche Shale	Gray to black shale; some beds of bentonite.	550 at Osage, Wyo.; 700 at Thornton, Wyo.	Definition: Collier (1922, p. 83). Marine origin.	Gray to jet-black shale; thin beds of bentonite and scattered concretions of oligonite (iron-manganese carbonate). Weathers gray to black. Extremely gummy when wet.	400	Lower contact: Top of Clay Spur Bentonite Bed (Knechtel and Patterson, 1956) which is within 5 ft of distinct color change upward from gray shale of Mowry to black of Belle Fourche.		Best exposure in central part of sec. 18, T. 44 N., R. 60 W., Weston County, Wyo.		
	Mowry shale	Dark-gray siliceous shale; thin beds of sandstone and bentonite.	165 at Newcastle, Wyo.; 230 at northeast corner of Wyoming.	Definition: Collier (1922, p. 82). Description: Rubey (1929). Marine origin.	Dark-gray siliceous shale; thin beds of bentonite and gray to brown sandstone. Weathers to silver-gray flakes.	150	Lower contact gradational with Newcastle Sandstone.		Best exposures in central part of sec. 18, T. 44 N., R. 60 W., Weston County, Wyo. Fish scales abundant.		
	Newcastle Sandstone	Lenticular beds of sandstone and shale; lesser amounts of siltstone and a few beds of impure coal and bentonite.	0-100	Definition: Hancock (1920, p. 40). Description: Grace (1952).	Gray to brown lenticular sandstone, fine to very fine grained, commonly crossbedded and carbonaceous. Some interbedded siltstone and claystone and thin beds of bentonite.	20-62	Generally poorly exposed except for sandy facies. Gradational contacts with units above and below.	14	Good exposures in small hogback 20 to 60 ft high just west of the hogback of Inyan Kara in secs. 7, 15, 19, 30, and 31, T. 44 N., R. 60 W., Weston County, Wyo. (See text for further discussion of this unit.)		
	Skull Creek Shale	Dark-gray to black soft flaky shale interbedded with sandstone and siltstone, especially near the top and bottom.	250	Definition: Collier (1922, p. 79). Marine origin.	Dark-gray to black soft flaky shale interbedded with sandstone and siltstone, especially near the top and bottom. Some calcareous concretions having cone-in-cone structures.	200	Gradational with the Fall River Formation in a zone about 5 ft thick.		Forms a small valley between the hogbacks formed by the Newcastle Sandstone and the Fall River Formation. Generally not well exposed. Contains some fish scales.		
Lower Cretaceous	Inyan Kara Group	Fall River Formation	Sandstone, siltstone, and mudstone.	110-150	History of definition, redefinition, and description: Waagé (1959). Terrestrial or marginal origin: see text.	Chiefly yellow to brown sandstone beds, some carbonaceous, and gray to black carbonaceous siltstone and mudstone.	125 (avg)	Base is unconformable on Lakota Formation.	13	Mapped as lower, middle, and upper units. (See text.)	
		Lakota Formation	do	40-250	Description and redefinition: Waagé (1959). Terrestrial origin: see text.	Chiefly white to brown sandstone; some conglomerate; varicolored mudstone, and brown carbonaceous siltstone.	200 (avg)	Base apparently gradational to Morrison Formation in this quadrangle. Contact placed at change from green and gray shale of Morrison below to brown carbonaceous siltstone of Lakota above.	12	See text for detailed description of formation.	
		Fuson Member	Mudstone, siltstone, and sandstone.			Varicolored mudstone	60 (avg)				See text.
		Minnewaste Limestone Member	Limestone	0-80	In southern Black Hills only. Absent in Fanny Peak quadrangle.		70 (avg)				Absent from Fanny Peak quadrangle.
		Chilson Member	Sandstone, siltstone, and mudstone.		Definition: Post and Bell (1961).	S ₁ sandstone	40-100				See text.
						Chocolate-brown siltstone	20 (avg)				
Upper Jurassic	Morrison Formation	Mostly gray, green, and purple mudstone and shale, some calcareous; some limestone.	100 (avg)	Beulah shales of Darton (1901a); term brought to Black Hills (Darton, 1901b). Age and correlation: Reeside (1952, p. 22-26) and Yen (1952). Continental origin.	Mostly gray, green, and purple claystone and shale; discontinuous beds and pods of sublithographic limestone, especially in the lower half.	100 (avg)	Base is at top of 15 ft of light-gray sandstone (yellow when weathered) at the top of the Sundance Formation.	11	Scattered exposures along base of east face of hogback of Inyan Kara. Generally forms covered slopes. Best exposures at west side of Whoopup Canyon in central sec. 29, T. 44 N., R. 60 W., in LAK Draw SW¼ sec. 8, T. 44 N., R. 60 W., SW¼ sec. 5, T. 44 N., R. 60 W., on slopes of west side of Stockade Beaver Creek valley in secs. 30, 31, T. 45 N., R. 60 W., and sec. 25, T. 45 N., R. 61 W.—all in Weston County, Wyo. Ostracodes at Whoopup Canyon locality above: species of <i>Darwinula</i> , " <i>Metacypria</i> ," " <i>Gomphocythere</i> ," <i>Theriosinocum</i> (all identified by I. G. Sohn).		
	Sundance Formation	Mostly gray and green shale, silty sandstone, and sandstone; thin beds of limestone; some red beds.	475 (max)	Definition: Darton (1899, p. 387-393). Division and description: Imlay (1947). Description and correlation: Peterson (1954). Marine and terrestrial(?) origin.	Mostly gray and green shale, silty sandstone, and thin beds of limestone. Some red beds.	335± (max)	Lower contact unconformable	10	Has five members, only four present here; lowermost member, the Canyon Springs, is absent.		
	Redwater Shale Member	Green shale and light-gray sandstone.	80-100	Marine origin	Gray to green shale; some light-gray sandstone and sandy oolitic fossiliferous limestone; impure pink gypsum in upper 40 ft. Fine-grained sandstone with calcareous laminae. Glauconite abundant, especially near the base.	100-150	Base poorly exposed. Change of color from red of Lak to green of Redwater.		Best exposures along east face of hogback of Inyan Kara from north of Whoopup Creek to LAK Reservoir. <i>Balanites</i> abundant in upper one-third. Commonly forms covered slopes. Soil is green to gray.		
	Lak Member	Red siltstone and sandstone.	40-80	Terrestrial(?) origin. No fossils found.	Red siltstone and poorly cemented sandstone. A few beds of gray to green sandy siltstone within 15 ft of top.	70 (avg)	Gradational with Hulett		Generally forms covered slopes above cliffs of Hulett sandstone. Red soil and lack of marine fossils suggests terrestrial origin. Type locality on west side of Stockade Beaver Creek, sec. 18, T. 45 N., R. 60 W., Weston County, Wyo. (Imlay, 1947, p. 267).		
	Hulett Sandstone Member	Gray to yellow sandstone. Ripple marks common.	40-75	Marine origin	Chiefly fine-grained gray to yellow sandstone firmly cemented by calcite. Some partings of green shale. Ripple marks common.	50 (avg)	Gradational with Stockade Beaver		Commonly forms ledges between covered slopes.		
	Stockade Beaver Shale Member	Principally green shale.	50-80	do	Dark-green fissile shale, some calcareous; thin beds and laminae of fine-grained light-gray sandstone and siltstone, especially in uppermost and lowermost parts.	65 (avg)	Lower contact unconformable		Type section: sec. 18, T. 45 N., R. 60 W., Weston County, Wyo. (Imlay, 1947, p. 261).		
Middle Jurassic	Gypsum Spring Formation	White gypsum, gray to red claystone, and gray limestone.	0-125	Description: Mapel and Bergendahl (1956). Unit is thin south and east of northern Black Hills.	White gypsum	4-12	do	10	Formation shown by line symbol on plate 25.		
Triassic and Permian	Spearfish Formation	Red claystone, siltstone, and sandstone; some gypsum, anhydrite, and dolomite.	450-600	Definition: Darton (1899, p. 387). Correlation: McKee and others (1959). Non-marine.	Red siltstone and sandstone, gypsum, and dolomite. Conspicuous zone of gypsum about 100 ft thick begins about 100 ft above base. (See plate 25.)	500 (est)	Lower contact with top of Minnekahta Limestone is sharp and presumably conformable.		Generally poorly exposed. Forms the bottom of the valleys of Stockade Beaver Creek, LAK Draw, and Ferguson Canyon. Beds of gypsum form low ridges.		
Permian	Minnekahta Limestone	Gray to purple thin-bedded limestone.	25-40 (30 avg)	Definition: Darton (1901a, p. 511). Marine origin.	Gray to purple thin-bedded shaly to coarsely crystalline limestone and some calcareous siltstone in lower and middle 2 to 3 ft.	25-40	Lower contact is conformable on top of purple siltstone of Opeche.	9	Has secondary gravity-sliding structures (see text). Fossils not abundant; fragments of crinoids and ray-finned fish (see text). Formation name means "hot spring" in Sioux language.		
	Opeche Formation	Red and purple shale, siltstone, and sandstone.	70-120 (75 avg)	Definition: Darton (1901a, p. 513).	Brick-red shale, siltstone, and fine-grained sandstone. Purple siltstone in upper 15 ft. Some beds of gypsum.	70-120	Lower contact gradational, but contact placed at base of red beds.	5, 6, 7, 8			
Carboniferous	Pennsylvanian and Permian		Red and yellow sandstone; limestone and dolomite; shale; some gypsum and anhydrite in upper parts.	600-700 at surface; about 900 in subsurface.	Definition: Winchell (1875, p. 65). Redefinition: Darton (1901a, p. 510). Gypsum and anhydrite absent in exposures, but present in subsurface (see text). Marine origin.	Mapped as four parts: Breccia of lithic units 1 and 2; sandstone and upper limestone of lithic unit 3; lower limestone of lithic units 4-6.	700 (avg) in exposures.	Lower contact unconformable with top of Pahasapa Limestone. (See text.)	2, 3, 4, 6	See text for detailed descriptions of formation and possible correlation.	
					Lithic units 1 and 2: Breccia, red, yellow, and white sandstone, calcareous fine-grained sandstone; red and gray limestone and dolomite, some cherty and silty; some red shale and siltstone. No subsurface data available in this quadrangle.	250-300	See text	2, 3, 4, 6	Brecciation formed by removal of gypsum and anhydrite. Excellent exposures (see text). Minnelusa, unit 1-2 on plate 25.		
					Lithic unit 3: Sandstone, mostly yellow fine-grained calcareous friable sandstone. Some yellow to gray limestone and calcareous siltstone. Some chert. Upper limestone, mostly gray cherty limestone and dolomite, some calcareous fine-grained sandstone, black chert, and dark-gray to black shale and siltstone.	40-200		2, 3, 4	Thickens eastward from Fanny Peak Canyon to Redbird Canyon. Exposures good. Minnelusa, unit 3s on plate 25.		
					Lithic units 4, 5, 6: Lower limestone, red, yellow, gray, and brown limestone and dolomite; red, gray, green calcareous shale and mudstone and calcareous sandstone. Some chert.	70-165 (100 avg)	Lower contact is base of limestone sequence above red and gray shale (see below).	2, 4	Dark cherty limestone in Redbird Canyon; contains <i>Linopectus</i> sp., of Pennsylvanian to Permian age (identified by J. T. Dutro, Jr.). Thickens westward from Boles and Resbird Canyons to Fanny Peak Canyon. Exposures good. Minnelusa, unit 31 on plate 25.		
					Gray, pink, and light-yellow fossiliferous limestone. Weathers deep gray.	300-630 (Darton and Paige, 1925, p. 7).	Definition: Darton (1901a, p. 510).	Gray, pink, and light-yellow fossiliferous limestone. Weathers deep gray.	250+	Base not exposed	1, 2, 4
Lower Mississippian	Pahasapa Limestone									Only upper 250(?) ft exposed. Forms steep cliffs in Canyons cutting the Fanny Peak monocline. Best exposures in secs. 33, 28, 21, and 16, T. 45 N., R. 60 W., Weston County, Wyo. Fossils: Girty, <i>Syringopora</i> aff. <i>S. surcularia</i> Girty, <i>Syringopora</i> aff. <i>S. surcularia</i> Girty, <i>Vesiculophyllum</i> ? sp., <i>Spirifer</i> aff. <i>S. madisonensis</i> Girty, <i>Spirifer</i> sp. (<i>centronatus</i> -type), <i>Spirifer</i> sp., ostracodes, indet., all of Early Mississippian age. (Fossils identified by W. J. Sando and J. T. Dutro, Jr.)	