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GEOLOGIC MAP AND COAL STRATIGRAPHY OF THE BLUE GAP QUADRANGLE, EASTERN WASHAKIE BASIN, CARBON COUNTY, WYOMING

By
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2005

Base from U.S. Geological Survey, 1982
Projection and 10,000-foot grid ticks: Wyoming
coordinate system, east central zone (transverse Mercator)
1000-meter Universal Transverse Mercator grid, zone 13
1927 North American Datum

SCALE 1:24 000
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped by R.D. Hettinger and J.G. Honey, 1976 and 1977
Geologic linework digitized by Anna K. Scarbrough and Joseph A. East
Edited by Alessandro J. Donatich, Central Publications Group

DESCRIPTION OF MAP UNITS

Eolian sand dunes (Holocene and (or) Pleistocene)—Wind-blown sand deposited along southwest margin of a large dune field that extends northeast across the adjoining Garden Gulch and Sulphur Springs 7.5-minute quadrangles (fig. 1). Dune field is about 10 mi long and 3 mi wide and occupies the Sand Hills region in the Sulphur Springs 7.5-minute quadrangle (fig. 1). Additional small isolated eolian deposits are widespread throughout quadrangle but were not mapped

Colluvium and eolian sand, undifferentiated (Holocene and (or) Pleistocene)—Large area of slope wash and wind-blown sand. Undifferentiated deposits of colluvium and eolian sand are widespread across quadrangle but were mapped only where they obscure large areas of bedrock

Alluvium (Holocene and (or) Pleistocene)—Clay, silt, sand, and gravel deposited along courses of Blue Gap Draw, and Cow, Dry Cow, Wild Cow, and Muddy Creeks

Alluvium and colluvium, undifferentiated (Holocene and (or) Pleistocene)—Alluvium, alluvial fan, slope wash, and slump deposits located along upper reaches of alluvial valleys, slopes that flank alluvial valleys, and slopes and drainages of intermittent streams; small areas of bedrock may be exposed locally

Terrace deposits (Holocene and (or) Pleistocene)—Thin, unconsolidated to locally cemented deposits of silt, sand, and gravel; pebbles are abundant and boulders are rare. Cobbles are generally less than 4 in. in diameter and composed of a variety of rock types including sandstone, chert, ironstone, dark-gray limestone, gneiss, schist, white and red quartz, white granite, and dark-gray, black, and green mafic igneous rock. Boulders are as much as 1.5 ft across and composed of white quartzite, and white and pink granite

Gravel deposits (Holocene and (or) Pleistocene)—Deposits of uncertain origin; possibly derived from widespread preexisting surfaces. Deposit in T. 16 N., R. 91 W. consists of a thin veneer of chert pebbles and scattered cobbles of white granite and quartzite. Deposits in T. 15 N., R. 92 W. consist of a very thin to thick layer of sand that overlies a

thin veneer of chert pebbles and cobbles, some of which contain gastropod fossils derived from the Green River Formation; these gravels may have been deposited along an ancestral course of Muddy Creek, which flowed from sec. 3, T. 15 N., R. 92 W. southeast to sec. 30, T. 15 N., R. 91 W., through the valley occupied by highway 789. Muddy Creek was subsequently diverted through secs. 1 and 2, T. 15 N., R. 92 W., owing to stream capture by an ancestral tributary to Cow Creek

Wasatch Formation (Eocene)

Cathedral Bluffs Tongue—Only the lowest 20–40 ft are present on a broad gentle slope in southwestern part of Blue Gap 7.5-minute quadrangle. There, unit generally weathers to a reddish-brown soil; intermittent exposures consist of olive-gray, maroon, red, and orange mottled mudstone and very light gray, light-gray, and orange, fine-to coarse-grained, trough crossbedded, micaceous sandstone. Just west of quadrangle, in secs. 5 and 8, T. 15 N., R. 92 W., the Cathedral Bluffs Tongue intertongues with organic-rich fissile shale in the Tipton Tongue of the Green River Formation. Southwest of quadrangle, in sec. 14, T. 14 N., R. 93 W., the Cathedral Bluffs Tongue is 1,360 ft thick in the True Oil Company, Mattie No. 1 well (Honey, 1988)

Main body—Exposed only in southwestern part of Blue Gap 7.5-minute quadrangle. Predominantly varicolored (light-gray, red, maroon, and green) mottled mudstone with interbeds of light-gray and grayish-brown, very fine grained to medium-grained sandstone. Lenticular bodies of fine- to coarse-grained conglomeratic sandstone are less common. Mudstone is commonly rooted. Unit locally forms fluted badlands. Contact with the underlying Fort Union Formation is sharp and unconformable. The basal part of the Wasatch Formation contains hard, ledge-forming, reddish-brown, iron oxide-stained lenticular bodies of sandstone, conglomeratic sandstone, and conglomerate; sandstone is medium to coarse grained, feldspathic or arkosic; pebbles are as much as 2 in. in diameter, and consist of chert, quartzite, quartz, limestone, porphyritic igneous rock, and silicified wood. The lenticular bodies are as much as 10 ft thick and encased in light-gray, friable, pebbly sandstone and mudrock. Root casts extend from the basal sandstones into underlying rock. Upper 25–70 ft of main body forms slopes, lacks fluting, and consists of light-brownish-gray, olive-gray, and yellow-brown, fine- to medium-grained, well-sorted, sharp-based sandstones that fine upward into thinner units of variegated mudstone.

The main body of the Wasatch Formation is about 1,220 ft thick in sec. 22, T. 15 N., R. 92 W., as determined from geophysical logs from the Mexican Flats 2-22-15-92 well (DH13, sheet 2)

Green River Formation (Eocene)

Tipton Tongue—Yellowish-brown and yellowish-gray sandstone and dark-yellowish-brown, organic-rich, fissile shale; thickness 45–95 ft where exposed in Blue Gap 7.5-minute quadrangle. Intertongues locally with overlying Cathedral Bluffs Tongue and underlying main body of Wasatch Formation. In sec. 22, T. 15 N., R. 92 W., the Tipton Tongue consists of 40–90 ft of sandstone and contains less than 5 ft of brownish-gray fissile shale at its base. Sandstone is fine to coarse grained, and locally contains scattered chert pebbles 0.25 in. to 1.5 in. in diameter, mollusk shells and shell fragments, bone fragments, and root casts; sandstone is commonly massive but also has beds that are cross stratified and ripple laminated. Sandstone thins northward, and in sec. 9, T. 15 N., R. 92 W. the Tipton consists of a basal 20-ft-thick organic-rich shale overlain by a 25- to 30-ft-thick sandstone that is in turn overlain by about 20 ft of organic-rich shale; sandstone is fine to coarse grained, trough crossbedded to massive, and locally contains algal heads and scattered chert pebbles. Tipton lithologies are similar to those described by Roehler (1988) in the Tipton Tongue about 9 mi south of quadrangle. Roehler (1988) interpreted those lithologies as deposits of lacustrine, low-energy fluvial, and freshwater delta environments that formed on the eastern shore of ancient Lake Gosiute

Fort Union Formation (Paleocene)

Overland Member—Light- to medium-gray sandstones, mudstones, and siltstones, with less common beds of grayish-brown to dusky-purple ironstone and grayish-brown carbonaceous shale; forms intermittent, light-gray to white, fluted badlands. The member includes a basal sandstone zone overlain by a thick fine-grained interval. Basal sandstone zone represents an abrupt increase in grain size from rocks in the underlying China Butte Member, and its contact with the China Butte Member is probably unconformable (Honey and Hettinger, 2004). Basal sandstone zone is about 60 ft thick and dominated by amalgamated channel-form bodies of trough and planar tabular crossbedded, fine- to coarse-grained, feldspathic sandstone with lenses of very coarse grained sandstone containing scattered feldspar granules, mud chips, and subangular to rounded pebbles of chert, quartzite, and silicified wood. Fine-grained upper part of member is 380–530 ft thick in quadrangle and about 900 ft thick at type section of the Overland Member located 2 mi north of quadrangle (Honey and Hettinger, 2004); southward thinning is attributed to truncation at base of the overlying Wasatch Formation. Fine-grained upper part of member is dominated by sandy siltstone, sandy shale, shaly siltstone, and mudstone, but it also contains lenticular sandstones as much as 20 ft thick. Sandstone is fine to medium grained, feldspathic, and generally massive, bioturbated, or locally trough and planar tabular crossbedded. Near the contact with the overlying Wasatch Formation, sandstones contain dispersed chert pebbles, and mudstones are locally mottled purple and red. Also present are a few beds less than 2 ft thick of carbonaceous shale, sandstone, and ironstone; ironstone beds are sandy and pisolitic. Crayfish burrows are locally present in all lithologies (Hasiotis and Honey, 2000).
Outcrops of the Overland Member are about 440–560 ft thick and thin from north to south. Thickness about 660–840 ft thick in subsurface (see oil and gas wells, table 1 on sheet 2)
Blue Gap Member—Poorly exposed in Blue Gap 7.5-minute quadrangle. In sec. 24, T. 15 N., R. 92 W. (at measured section 45), the member is dominated by interbedded mudstone, siltstone, and shale, with minor thin beds of sandstone. Mudstone, siltstone, and shale are light to medium dark gray and light olive brown, sandy in places, and in units 15–45 ft thick. Interbeds of sandstone are light to medium gray, very fine grained to fine grained, and less than 1 ft thick. Member also includes a 3.5-ft-thick, dusky-blue, fine-grained sandstone; a 5-ft-thick, dark-yellowish-orange, medium-grained sandstone; and a 20-ft-thick, poorly exposed, light-gray, medium-grained sandstone. Base of member is recognized by the first thick interval of mudrock located about 140 ft stratigraphically above the Fillmore Ranch coal zone of the underlying China Butte Member. The Blue Gap Member is commonly underlain by laterally continuous, reddish-purple, fine-grained sandstone that is hard, iron cemented, and generally less than a few feet thick; this sandstone locally forms a prominent hogback and marks the top of the underlying China Butte Member. The Blue Gap Member thins to the north; thickness about 80–160 ft where exposed, and 90–150 ft in subsurface (see oil and gas wells, table 1 on sheet 2)
China Butte Member—Sandstone, mudrock, and coal. Fossils of roots, coalified plant fragments, leaves, wood, bone fragments, fish scales, and isolated burrow traces are present in all lithologies. Sandstone is light whitish gray, light yellow gray, light orange brown, fine to medium grained, and less commonly very fine or coarse grained. Sandstone beds are trough and planar cross-stratified, ripple laminated, convoluted, or massive. Sandstone is typically 30–250 ft thick, laterally extensive, and multistoried; individual stories are 10–50 ft thick, laterally and vertically amalgamated, and channel-form. Mudrock is commonly fissile and composed of light- to medium-gray, dusky-brown, or black siltstone, mudstone, and carbonaceous shale interbedded in laterally extensive units 15–140 ft thick. Mudrock units contain orange-brown to light-gray, very fine grained to fine-grained, trough crossbedded, and ripple laminated sandstone in discontinuous beds less than 1 ft thick, and in lenticular bodies as much as 10 ft thick.

Mudrock units also contain laterally extensive beds of black coal 1–22 ft thick (including partings); coal is commonly burned to red and orange clinker on outcrop.
The base of the China Butte Member is a laterally persistent 2- to 4-ft-thick conglomerate and conglomeratic sandstone characterized by abundant pebbles in a coarse-grained, iron oxide-cemented sandstone matrix; pebbles consist of gray and black chert and lesser amounts of white and pink quartzite and quartz, and porphyritic felsic igneous rock. Conglomerate commonly forms a resistant, reddish-brown ledge that overlies an unconformity between Cretaceous and Tertiary strata (Honey and Hettinger, 1989b; Hettinger and others, 1991; Hettinger and Kirschbaum, 1991; Honey and Hettinger, 2004). A palynological sample collected about 50 ft above the basal conglomerate (USGS palynomorph locality D6860, NWcNWc sec. 12, T. 15 N., R. 92 W.) contains early Paleocene palynomorphs typical of zone P2 of Nichols and Ott (1978) (Hettinger and others, 1991). Late Cretaceous (Maastrichtian) palynomorphs were identified in sample D6474, collected 85 ft below the conglomerate horizon in SEcSWc sec. 29, T. 15 N., R. 91 W., in the southerly adjoining Peach Orchard Flats 7.5-minute quadrangle (Honey and Hettinger, 2004). Collectively, the two samples bracket the stratigraphic position of the Cretaceous-Tertiary unconformity (Honey and Hettinger, 2004).
Thickness about 900 ft near southern part of quadrangle and about 1,100 ft in northern part. Similar thicknesses were measured in subsurface (see oil and gas wells, table 1 on sheet 2).
Mapped coal zones include, from youngest to oldest, the Fillmore Ranch (FR), Muddy Creek (containing coal beds MC4, MC3, MC2, MC1, and MClower), lower Separation Creek (SClower), Wild Cow (WC), Olson Draw equivalent (OD) and Red Rim (RR). The Fillmore Ranch, Muddy Creek, lower Separation Creek, Olson Draw, and Red Rim coal zones were originally named and mapped in the Seaverson Reservoir and Fillmore Ranch 7.5-minute quadrangles (fig. 1) by Edson (1979) and Honey and Hettinger (1989a). Based on detailed mapping and correlation studies, the names have been applied to coal zones in the Blue Gap 7.5-minute quadrangle. The following exceptions have been made to the established coal-zone nomenclature of Edson (1979) and Honey and Hettinger (1989a):
(1) The Muddy Creek coal bed of Edson (1979) and Honey and Hettinger (1989a) is one of several coal beds that occupy an interval of mudrock that is referred to as the Muddy Creek coal zone in this report. The Muddy Creek coal zone in the Blue Gap 7.5-minute quadrangle contains the MC4, MC3, MC2, MC1, and MClower coal beds, which were mapped individually. In the adjoining Peach Orchard Flats 7.5-minute quadrangle (fig. 1), the MC4 and MC3 coal beds were mapped as the Muddy Creek upper coal zone and the MC2 and MC1 coal beds were mapped as the Muddy Creek lower coal zone; those divisions are shown along the left margin of the correlation chart (sheet 2).
(2) The Wild Cow coal zone is informally named for coal-bearing strata located between the lower Olson Draw and lower Separation Creek coal zones in the Doty Mountain 7.5-minute quadrangle; it takes its name from Wild Cow Creek in the Blue Gap 7.5-minute quadrangle.
(3) The lower Olson Draw coal zone was mapped in the adjoining Doty Mountain 7.5-minute quadrangle (fig. 1) but is absent across most of the Blue Gap 7.5-minute quadrangle. A coal zone at roughly the same stratigraphic position near the quadrangle's southern boundary is referred to as the Olson Draw equivalent coal zone (see Honey and Hettinger, 2004)
Lance Formation (Upper Cretaceous)
Red Rim Member—Mainly very light gray and white, fine- to coarse-grained, quartz-rich sandstone containing grains of feldspar, clay altered from feldspar, and black chert. Pebbles are common in upper part. Sandstone is in 30- to 150-ft-thick, laterally extensive units separated by 5- to 40-ft-thick layers of brown and gray silty shale, carbonaceous shale, and mudstone. Sandstone is soft and friable, forming valley floors, covered slopes, and cliffs. Each unit of sandstone is composed of vertically and laterally amalgamated,

channel-form bodies 5–20 ft thick. Sandstone bodies are massive to trough crossbedded, ripple laminated in the upper few feet, and capped by thin ledges of ironstone; iron-oxide concretions several feet across are common. Some sandstone bodies contain basal lags with flat clasts of claystone as much as 1 in. long and blocks of mudstone several feet in diameter. Sandstone bodies are interpreted as fluvial channel deposits. Member displays an overall coarsening-upward grain size. Lower 350–480 ft of member contains fine- to medium-grained sandstone. Upper 150–250 ft of member coarsens upward, and channel bodies display strong crosscutting relations; sandstones are generally medium to very coarse grained and contain abundant pebbles of quartz and chert 0.25–0.5 in. in diameter. Pebbles in upper part are generally along foresets or in lag, but also occur as isolated clasts in sandstone matrix. The Red Rim Member appears to intertongue with the lower member of the Lance Formation, and it is sharply overlain by the basal conglomerate of the Fort Union Formation. The Red Rim Member thickens from south to north and is about 500–685 ft thick where it is exposed in quadrangle. The Red Rim Member is about 350–415 ft thick in subsurface (see oil and gas wells, table 1 on sheet 2)

Lower member—Predominantly thinly interbedded yellow-brown, dusky-brown, medium- to dark-gray, and greenish-gray mudrock lithologies that include claystone, siltstone, clayey shale, and carbonaceous shale. Plant fragments are common in mudrock, and leaf impressions were seen in a few sandstones. Yellow-brown to very light gray, fine- to medium-grained sandstone is common in upper 400–550 ft of member; it forms massive or trough crossbedded, lenticular, multistoried units that are 10–40 ft thick. Sandstone units are separated by 10- to 80-ft-thick intervals of mudrock, and contain the first appearance of detrital chert above the Lewis Shale. Sandstone is a minor component in the lower 700–1,000 ft of member, where it is typically in purplish-brown to gray, lenticular, very fine grained to fine-grained, ripple-laminated beds less than 3 ft thick. Lower part of member also contains rare lenticular bodies of yellow-gray to very light gray, very fine grained to fine-grained, trough crossbedded sandstone as much as 20 ft thick. Basal 70 ft of member contains lenticular beds of coquina and three unnamed beds of coal that are 1–9.8 ft thick.

The lower member of the Lance Formation is interpreted to have accumulated in fluvial, floodplain, and coastal-plain environments. Coastal-plain and mire deposits in basal 100 ft of member intertongue with shoreface strata in the underlying Fox Hills Sandstone. Thickness about 1,275–1,370 ft in the subsurface (see oil and gas wells, table 1 on sheet 2). About 1 mi south of Blue Gap quadrangle, in secs. 28, 29, and 33, T. 15 N., R. 92 W., the lower member of the Lance was measured to be about 1,675 ft thick on outcrop (Honey and Hettinger, 2004)

Fox Hills Sandstone (Upper Cretaceous)—Nearshore marine and marginal marine in origin. Contains one to five sandstones that are about 5–80 ft thick, and several tongues of gray shale that are about 10–40 ft thick. Contacts between shale tongues and overlying sandstones are gradational. Sandstones are grayish orange to yellowish gray and concretionary, and typically coarsen upward from very fine grained to fine- or medium-grained beds. Sandstones are generally massive but also display low-angle bedding, trough crossbedding, and ripple laminations, and contain oyster shells and trace fossils of Ophiomorpha. Thickness about 80–250 ft in outcrop (Henderson, 1962; Gill and others, 1970) and about 130–200 ft in subsurface (see oil and gas wells, table 1 on sheet 2). Base of formation is gradational with underlying Lewis Shale

Lewis Shale (Upper Cretaceous)—Marine shale and sandstone that weather grayish yellow and grayish brown. The Lewis Shale is poorly exposed and forms a wide valley of low relief. Gill and others (1970) divided the formation into an upper part, the medial Dad Sandstone Member, and a lower part at its principal reference section located 1 mi south of quadrangle in secs. 27 and 28, T. 15 N., R. 91 W. The upper part and Dad Sandstone Member were mapped from the principal reference section northward to Cow Creek. North of Cow Creek, the upper part and Dad Sandstone Member are indistinct and mapped as a single unit. The Lewis Shale is 2,340–2,525 ft thick in oil and gas wells

listed in table 1; basal 150 ft not exposed in quadrangle. The Lewis Shale intertongues with the underlying Almond Formation of the Mesaverde Group

Upper part—Shale, olive-gray and silty, contains beds of silty, very fine grained sandstone less than 0.5 ft thick in upper 100 ft. Surface exposures are about 330 ft thick (Gill and others, 1970). Thickness about 395–755 ft in subsurface (see oil and gas wells, table 1 on sheet 2). Intertongues with the underlying Dad Sandstone Member

Dad Sandstone Member—Thick, pale-yellowish-gray and light-brown, locally concretionary sandstones encased in olive-gray mudrock. Mudrock comprises thinly interbedded to interlaminated very fine grained sandstone, siltstone, and mudstone. Forms covered valley with small rounded hills and cuestas. Just south of Wild Cow Creek, member contains 25- to 80-ft-thick sandstones separated by 20- to 150-ft-thick sandy shales (Gill and others, 1970). Thick sandstones are laterally continuous to laterally discontinuous. Laterally continuous sandstones are very fine grained to fine grained, sharp based, massive to parallel bedded, and as much as 12 ft thick (Witton, 1999). Laterally discontinuous sandstones are as much as 50 ft thick and lens shaped, and overlie erosional contacts; sandstone is fine to medium grained, massive, convoluted, parallel bedded, and ripple laminated, and contains siltstone clasts as much as 1 ft across (Witton, 1999). Member was interpreted as a turbidite and suspension fallout deposit in a marine environment (Perman, 1990; Pyles and Slatt, 2000; Witton, 1999).

The Dad Sandstone Member is 585 ft thick near southern boundary of quadrangle (Gill and others, 1970), about 760–860 ft thick in oil and gas wells listed in table 1, and about 1,050 ft thick in the Tom Brown No. 1 Federal drill hole (no. 35 on fig. 3). Increased thickness is attributed to addition of sandstones in lower part of member. Intertongues with lower part of the Lewis Shale

Lower part—Dark-gray sandy shale. Drill-hole data indicate the lower part of the Lewis Shale is about 730–870 ft thick in northern part of quadrangle and about 990–1,170 ft thick in southern part of quadrangle. Henderson (1962) measured the lower part of the Lewis Shale to be 1,150 ft thick in T. 15 N., R. 91 W., just north of Wild Cow Creek. Basal 150 ft not exposed in quadrangle. The lower part of the Lewis Shale intertongues with the underlying Almond Formation of the Mesaverde Group

Upper part and Dad Sandstone Member, undivided—Members are indistinct north of Cow Creek, owing to increased content of siltstone and sandstone in the upper part of the Lewis Shale. An estimated 950–1,500 ft of undivided strata is exposed in quadrangle

Contact—Approximately located. Dashed where covered or inferred

Coal bed or zone—Dashed where covered or inferred. Abbreviations: Fillmore Ranch coal zone (FR), Muddy Creek coal zone (MC; includes coal beds MC4, MC3, MC2, MC1, and MClower), lower Separation Creek coal zone (SClower), Wild Cow coal zone (WC), Olson Draw coal zone equivalent (OD), and Red Rim coal zone (RR). Near measured section 1, coal beds MC1 and MC3 are mapped with a single line labeled MC1, 3. In some areas, widespread surficial deposits obscure the coal beds. Although coal beds may lie below the surficial deposits, they were not mapped unless aerial photographs, drill holes, coal flour, or animal digging substantiated their presence

Clinker—Burned coal bed and rocks baked by burning of coal bed

Outcrop of clinker

Fault—Dashed where approximately located; dotted where concealed. Bar and ball on downthrown side

Strike and dip of beds

Measured on outcrop by authors

Measured on outcrop by Henderson (1962)

USGS palynomorph locality

Drill hole—Showing number on map, coal correlation chart (sheet 2), and table 1 on sheet 2

Line of measured stratigraphic section—Showing number on map (sheet 1) and stratigraphic section on sheet 2
Short measured section of coal bed or coal zone—Showing number on map (sheet 1) and stratigraphic section on sheet 2. Leader points to measured section locality

INTRODUCTION

Geologic mapping of the Blue Gap 7.5-minute quadrangle, Carbon County, Wyoming (sheet 1), was conducted in 1975–1977 as part of a larger effort to acquire detailed data on Upper Cretaceous and Paleocene coal-bearing strata in the eastern part of the Washakie Basin (fig. 1). Field observations were initially mapped on aerial photographs at scales of about 1:20,000, 1:29,000, and 1:36,000, and on the topographic base of the 1957 Doty Mountain 15-minute quadrangle. A PG-2 stereoplotter was used to transfer the geology onto the 1:24,000-scale topographic base map of the 1982 Blue Gap 7.5-minute quadrangle. Our preliminary coal correlation charts and maps of coal outcrops and faults were used by the Dames and Moore Company (1979; their plates 1 and 3) to show the coal stratigraphy in the quadrangle. Love and Christiansen (1985) used our mapping on the Geologic Map of Wyoming. This report revises our previous coal correlations and shows exposures of coal beds, formation boundaries, and faults on a topographic base, with emphasis on coal-bearing strata in the Paleocene Fort Union Formation and Upper Cretaceous Lance Formation. Coal in the more deeply buried Upper Cretaceous Mesaverde Group is not addressed.

Measured sections of coal-bearing strata in the Fort Union and Lance Formations are shown on sheets 1 and 2. Also shown on sheet 2 are lithologic interpretations of geophysical logs recorded from 14 drill holes (table 1); included are five coal-test holes drilled in 1978 by the U.S. Geological Survey (USGS), five uranium-test holes reported by the Dames and Moore Company (1979; their plates 1 and 3), and four oil and gas wells. Geophysical logs for the USGS coal-test holes are available on microfiche through M.J. Systems, 5085 Oakland Street, Denver, CO 80239.

Bedrock exposed in the Blue Gap 7.5-minute quadrangle includes: (1) marine and shoreface strata in the Upper Cretaceous Lewis Shale and Fox Hills Sandstone, (2) continental strata in the Upper Cretaceous Lance Formation, Paleocene Fort Union Formation, and main body and Cathedral Bluffs Tongue of the Eocene Wasatch Formation, and (3) deltaic and lacustrine strata in the Tipton Tongue of the Eocene Green River Formation. The Lewis Shale overlies the Upper Cretaceous Almond Formation of the Mesaverde Group, which is exposed east of the quadrangle. Gill and others (1970) divided the Lewis Shale into a lower part, the Dad Sandstone Member, and an upper part. Honey and Hettinger (2004) divided the Lance Formation into a lower member and the Red Rim Member, and they divided the Fort Union Formation into the China Butte, Blue Gap, and Overland Members. The formations and members are shown on the generalized stratigraphic column in figure 2. Except where noted, formation thicknesses are based on measured surface sections and selected drill holes listed in table 1.

Structural aspects of the Blue Gap quadrangle are depicted by a structure contour map constructed on the top of the Mesaverde Group, which ranges from more than 6,400 ft above sea level in the northeastern part of the quadrangle to about 1,200 ft below sea level in the southwestern part (fig. 3). Drawing of the structural isolines was aided by data from 57 oil and gas wells (table 2); where subsurface control was lacking, depths to the contour horizon were inferred from data on thicknesses of formations lying above the Mesaverde Group. Strata generally strike northwest and dip less than 10 degrees southwest across much of the quadrangle. However, dips from 10 to 28 degrees were recorded on the west- to southwest-dipping limb of a monocline that underlies exposures of the Lance and Fort Union Formations. Strata are also folded across the east-west-trending Dad arch (fig. 1) in the northwestern part of the quadrangle. The broad axis of the arch was not shown on the geologic map (sheet 1), owing to its imprecise location.

Strata are also displaced by several faults that roughly parallel the axis of the Dad arch. Collectively, the faults delineate a series of blocks that are generally rotated down to the west and up to the east. Field mapping shows displacement of the Fox Hills, Lance, and Fort Union and readily reveals the downward-rotated part of the blocks. However, the faults were difficult to map northeastward across the Lewis Shale, owing to poor exposures and a lack of marker beds. As such, fault traces across the Lewis Shale are based on (1) the lateral discontinuity of strata viewed on aerial photographs, (2) subtle displacement along the mapped base of the Dad Sandstone Member, and (3) discontinuity of structure contours.

About 57 oil and gas wells have been drilled in the Blue Gap 7.5-minute quadrangle (fig. 3, table 2). Named fields include Blue Gap, Cow Creek, Deep Gulch, Dry Cow Creek, and Robbers Gulch. The field names of Sun Dog and Atlantic Rim also appear on headers of three wells drilled in sec. 17, T. 16 N., R. 91 W. Producing strata and trapping conditions in various fields are as follows: (1) Blue Gap and Robbers Gulch—stratigraphic traps in the Cretaceous Mesaverde Group (Hall, 1992); (2) Cow Creek—structural and (or) stratigraphic traps in the Cretaceous Mesaverde Group and Morapos, Frontier, and Dakota Formations, and the Jurassic Nugget Sandstone (Reinert, 1979); (3) Dry Cow Creek—gas from coal beds in the Cretaceous Mesaverde Group (Wyoming Oil and Gas Conservation Commission, 2004); and (4) Deep Gulch—structural traps in the Cretaceous Mesaverde Group and Frontier Formation (Cardinal, 1992).

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