UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Map of Precambrian and Adjacent Phanerozoic Rocks of the Hartville Uplift, Goshen, Niobrara, and Platte Counties, Wyoming

By

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DESCRIPTION OF MAP UNITS

QUATERNARY AND TERTIARY DEPOSITS

Qal ALLUVIUM (HOLOCENE)--Mainly floodplain silt and clay. Includes prominent local alluvial pea to cobble gravels with rounded clasts of Precambrian crystalline rocks and Paleozoic limestone and chert. Includes terrace gravels in Antelope Hills area

Qt TERRACE GRAVEL (HOLOCENE)--Alluvial silt to gravel in terraces 20-200 feet (6-61 m) above modern flood plains. Includes several successive terrace levels

Tu ARIKAREE FORMATION (MIOCENE)--Buff to reddish gray, fine- to coarse-grained, poorly to well cemented sandstone, siltstone, and minor conglomerate. Conglomerate locally prominent, as between Hartville and Guernsey, near Mother Featherlegs cemetery, or as local basal plaster on exhumed Precambrian hills like Bald Butte. Contains local vertebrate and invertebrate fossils. As mapped includes red conglomerate of White River Formation (Oligocene) in Antelope Hills. Varies from feather edge to 400 feet (122 m) thick

PALEOZOIC ROCKS

GOOSE EGG FORMATION (PERMIAN) (after Maughan, 1964)

Pgg Red mudstone, siltstone, gypsum, and minor limestone of Glendo Shale Member at base and some higher members. 200-300 feet (61-91 m) thick

Pgm Minnekahta Limestone member--Distinctive purple to bluish well-layered limestone. 30-40 feet (9-12 m) thick

Pgo Opeche Shale Member--Red claystone. 50-90 feet (15-27 m) thick

HARTVILLE FORMATION (PERMIAN TO MISSISSIPPIAN(?))--Numbered units are divisions of Condra and Reed (1935) with some mapping modified from Denson and Botinelly (1949)

Ph1 Unit 1 (Permian)--Gray limestone, sandstone, dolomite and breccia. 250 feet (76 m) thick

Ph2 Unit 2(Pennsylvanian)--Gray limestone and dolomite with thin sandstones. 225 feet (69 m) thick

Ph3 Unit 3 (Pennsylvanian)--Gray limestone with minor red shale. 175 feet (53 m) thick

Ph2-3 Units 2 and 3, undifferentiated (Pennsylvanian)--Gray limestone and sandstone

Ph4-5 Units 4 and 5, undifferentiated (Pennsylvanian)--Fine-grained light-gray limestone and dolomite with delicate fossil shells; red shale. 150-300 feet (46-91 m) thick

PPhu Units 1 through 5, undifferentiated (Permian and Pennsylvanian)--Gray limestone, dolomite, sandstone and shale

PMh6 Unit 6 (Pennsylvanian or Mississippian)--Medium-grained noncalcareous red to buff unfossiliferous sandstone and quartzite. Local hematitic breccia fill depressions in surface on Guernsey Formation. Equivalent to Bell sandstone, an economic term, of Hunt (1938) and Fairbank Formation of Condra and others (1940). 75-100 feet (23-30 m) thick

Mg GUERNSEY FORMATION (MISSISSIPPIAN)--Light-gray locally oolitic cliff-forming limestone and dolomite with common brachiopod and horn coral fossils. 10-300 feet (3-91 m) thick (may be cut out locally in Foxworthy Draw)

DCq QUARTZITE (DEVONIAN TO CAMBRIAN)--Three-part marker unit with internal unconformities: Upper quartz-pebble dolomite-matrix conglomerate, or quartzite; medial purplish- to greenish-gray thinly layered limestone or dolomite; and lower brown quartzite, red hematitic quartzite or hematitic-pebble conglomerate, and red hematitic quartz breccia (hematitic quartzite or quartzite clastic dikes expecially prominent where unit rests on Precambrian dolomite). Feather edge to 50 feet (15 m) thick, thickening to north; any one or all units may locally be cut out (such as in vicinity of Hell Gap); upper and lower quartzites locally distinguishable even where medial corbonate unit is missing (as in Wildcat Hills), but they may be indistinguishable most places where medial carbonate unit is missing. Upper two units most prominent in southern part of area (Hartville to Haystack Range); these units probably equivalent to local Devonian fossiliferous facies previously included at base of Guernsey Formation in Cassa anticline and Little Wildcat Canyon (Love and others, 1949; Love and others, 1953; Jenkins and McCoy, 1958). Brachiopods, crinoids and bryozoans have been recently collected from the medial carbonate unit in Sparks Canyon and east of Hartville. Uppermost Devonian conodonts have been recently identified by Bruce R. Wardlaw from the Sparks Canyon locality (written commun., 7/27/78). The lower quartzite unit contains horizontal-branching worm(?) tubes in the Haystack Range and vertical worm(?) tubes in Twin Hills; this quartzite is now known to extend southeast of its previously mapped zero isopach (Love and others, 1949; Denson and Botinelly, 1949; Robinson, 1957, fig. 8, p. 14) even though it is locally quite thin or missing. This unit, unfossiliferous in the Hartville Uplift, may be continuous or correlative with Middle Cambrian Flathead Quartzite of Montana and northwest Wyoming and the Upper Cambrian and Lower Ordovician Deadwood Formation of the Black Hills of the South Dakota and northeast Wyoming. The Deadwood, in the Bear Lodge Mountains of northeast Wyoming, contains a fossil suite of middle Upper Cambrian fish plates, trilobites, a conodont, linguloid brachiopods, and worm tubes (Repetski, 1978a and 1978b; M. H. Staatz, written commun., 1978). Robinson (1957, figs. 12, 13, p. 22-23) shows Flathead-Deadwood transgressing time lines to

become youngest in the area of the southern Hartville Uplift. Many granular Precambrian rocks beneath the basal quartzite are commonly weathered to a depth of as much as 30 feet (9 m) with progressive upward concentration of hematite and clay within this weathered zone. Field exposures in this zone are "soft", commonly characterized by an absence of resistant outcrop and covered with low vegetation; in the subsurface many drillers speak of "hitting a snowdrift" when they strike this zone due to the increased speed of drill penetration. A similar zone beneath the Flathead has been ascribed to low intensity subaerial weathering in a semi-arid to arid climate (Kennedy, 1980)

PRECAMBRIAN METAINTRUSIVE ROCKS

pe PEGMATITE (PROTEROZOIC X)--White to gray, coarse-grained to exceptionally coarse grained, zoned to unzoned feldspar-quartz-muscovite-tourmaline granitic dikes with lesser biotite, garnet, and beryl (Ball, 1907b; Hanley and others, 1950; Carl, 1961 and 1962). Pegmatites occur preferentially in swarms of many individual concordant to discordant bodies in the schist of Silver Springs (mainly in three areas: the northern Haystack Range, north and south of Silver Springs, and near Lusk), or cutting the granite of Haystack Range withing 1 1/2 miles (2.4 km) of Seward Pass or the diorite of Twin Hills east of the Ollie Damrow Ranch. Pegmatites of the latter two swarms are clearly about 1.7 b.y. old or younger, and there is one indication that the schist swarms may be about the same age: A minimum age of 1.62 b.y. is provided by a Rb-Sr determination on book muscovite (Z. E. Peterman, written commun., 1980) from the Ruth Prospect on the southeast side of Garnet Hill (Hanley and others, 1950, fig. 33, p. 118; this is equivalent to the pegmatite at station 96 of Carl, 1961, fig. 1, p. 3, and of Carl, 1962, fig. 1, p. 1096)

Xa AMPHIBOLITE (PROTEROZOIC X)--Dark-green medium-grained hornblende-plagioclase amphibolite tabular dikes, which cut granite of Haystack Range or old isoclinal folds; not directly dated. Some marginal chill zones preserved

GRANITE OF HAYSTACK RANGE (PROTEROZOIC X)

Xh Medium- to coarse-grained feldspar-quartz-biotite quartz monzonitic and granitic augen gneiss as exposed in steep-sided stocks in the northern and southern Haystack Range, as well as in isolated smaller dikes elsewhere. A Rb-Sr whole-rock isochron age of 1.72 b.y. is defined by four samples from the southern Haystack Range (including on Xhf sample), two from north of McCann Pass, and one from a dike 1 3/4 miles (2.8 km) northwest of Bald Butte (Z. E. Peterman, written commun., 1980). The muscovite granite body cutting the schist on Sullivan Ridge (extreme north end of uplift) gives discordant Rb-Sr whole-rock and muscovite model ages of 1.91 and 1.60 b.y., respectively (Z. E. Peterman, written commun., 1980), but the rock is provisionally correlated with the other granites of Proterozoic X age

Xhi Fine-grained granite phase concentrated in northwest part of southern stock. Locally grades into or occurs as dikes in Xh

Xt DIORITE OF TWIN HILLS (PROTEROZOIC X)--Dark-gray medium-grained uniform plagioclase-hornblende-biotite-quartz monzonitic to mafic diorite gneiss with local clinopyroxene and orthoclase. Believed to form a large largely covered pluton centered on Twin Hills, locally diked by or included in the granite of Haystack Range. Two size fractions of zircon from one sample southeast of the Floyd Damrow Ranch give a U-Pb discordia intercept age of 1.74 b.y. (Z. E. Peterman, written commun., 1980)

Aa AMPHIBOLITE (ARCHEAN)--Dark-green medium-grained hornblende-plagioclase amphibolite and hornblendite dikes. Generally planar to branching tabular bodies within granite of Rawhide Buttes; locally isoclinally folded within schist of Silver Springs in southern part of uplift. Locally, as in Rawhide Creek, brown-colored and calcareous or otherwise altered beneath Paleozoic unconformity

GRANITE OF RAWHIDE BUTTES (ARCHEAN)

Ar Pink, red, or gray feldspar-quartz-biotite coarse-grained granitic augen gneiss to medium-grained uniform gneiss. Includes Aa amphibolite dikes in Rawhide Buttes area. Rb-Sr data for a number of whole-rock samples indicate that the general age of these granitic rocks is 2.6±.1 b.y. Local components may be as old as 2.9 b.y. (Rb-Sr model ages) in the outlying areas of Twin Hills, Cassa anticline, and Antelope Hills. Whole-rock Rb-Sr ages have been lowered to 2.3±.1 b.y. in sheared or cataclastic zones east of Guernsey, north of Kimble Ranch, and at Flattop Butte (Z. E. Peterman, written commun., 1979). Most granite bodies contain swarms of metamorphosed former tholeiite dikes (Aa) (for example, the Rawhide Buttes body, except along its western margin) but the granite body under Flattop Butte contains only one Aa dike; the explanation of these differing occurences is not readily apparent

Ars Local sillimanite-pod phase of granite, recognized only on Little Rawhide Butte and Bald Butte

he HEMATITE of several ages (mainly ARCHEAN on map)--Earthy red pure-hematite and hematite schist deposits of several types at several stratigraphic or structural levels. Includes: (1) Pure-hematite deposits in pods near the contact between the schist of Silver Springs and the dolomite of Wildcat Hills at the Chicago Mine, Sunrise Mine, and Good Fortune Mine (Ball, 1907a; Frey, 1947a, 1947b; Ebbet, 1956; Carter, 1963). These ore deposits were originally allocated to a secondary origin (Leith, 1906; Ball, 1907a, p. 200) and are said to have been formed by groundwater oxidation and enrichment of originally ferruginous beds (Ebbett, 1956, p. 97, 98; Bayley and James, 1973, p. 949). The location of the ores where the overlying carbonates are thinnest (Chicago Mine) and where much schist is silicified (between Chicago and

Good Fortune Mines) suggests that some of the hematite may be entirely due to ground water emplacement during post-deposition carbonate dissolution. (2) Hematitic quartzites of unknown origin in the lowest part of the section in western Muskrat Canyon. (3) Surface hematite gossans along the McCann Pass fault and areas to the north that pass downward into pyrrhotite-pyrite fault breccias of probable Precambrian age. Not mapped are local hematite-copper concentration associated with several periods of Paleozoic karst weathering, and local hematite-uranium concentration associated with Laramide faults south of Silver Springs and west of Lusk (Bromley, 1953)

WHALEN GROUP OF SMITH (1903) (ARCHEAN)--Over 12,000 feet (3,600 m) of metasediments and metavolcanics that have experienced at least two regional metamorphisms, probably near 2.6 and 1.7 b.y., that have raised most rocks to sillimanite grade. Rb-Sr and K-Ar mineral ages and whole-rock Rb-Sr ages of metasedimentary rocks are in the range 1.3 to 1.9 b.y. (Goldich and others, 1966, p. 5390-5394; Z. E. Peterman, written commun., 1979). These ages reflect regional uplift and faulting in late Proterozoic X or early Proterozoic Y time such as is proposed for much of the Precambrian in the southern third of Wyoming (Peterman and Hildreth, 1978)

Formation of Wildcat Hills--Metacarbonate unit with a southern facies exposed nearly continuously from Sparks Canyon to Wildcat Hils and a northern facies exposed discontinuously along the west side of Rawhide Buttes, Bald Butte and other hills to the north. Uppermost and lowermost parts of section truncated by the granite of Rawhide Buttes. Thickness 200-3,000 feet (60-900 m)

Awd — Southern facies: Gray, buff, pink, and white medium-grained dolomite and siliceous dolomite (silica in secondary layers parallel to bedding or in irregular veins and boxworks) with near-contact phases consisting of yellow to dark-brown muscovite dolomite, clastic crossbedded siliceous ferrodolomite (round quartz granules and pebbles to 1 cm), and quartzite; abundant local concentrically layered algal stromatolitic mounds. Northern facies: White to gray dolomite, tremolite dolomite, chodrodite dolomite, and calc silicate marble interlayered with locally predominant layered amphibolites (Awa) and muscovite schists (Aws)

Awa — Dark-green layered hornblende-plagioclase amphibolite with minor cummingtonite interlayers, present only in northern facies

Aws — Gray to brown plagioclase-quartz-muscovite-biotite schist with local sillimanite rosettes, present throughout northern facies or near lower contact of southern facies

Schist of Silver Springs--Predominantly metashale; thickness varies from feather edge to perhaps as much as 7,000 feet (2,100 m), with average near 4,000 feet (1,200 m)

Asg — Gray medium-grained granular plagioclase-quartz-biotite schist and quartz-granule metagraywacke to micaceous garnet-sillimanite schist; includes local graphitic, calcareous, and alusitic or pyritic schist phases. Muscovite more prominent and grain size coarser north of Silver Springs and west and north of Lusk to Sullivan Ridge. Graded quartz-granule metagraywackes most prominent southeast of Frederick Ranch and on southernmost buried hill east of Guernsey. Varicolored silicified schist prominent between Chicago and Good Fortune Mines. Unit sheared, mylonitized and much thinned north of Kimble Ranch

Asa — Dark-green layered amphibolite in single layer near base of formation mainly north of Silver Springs

Asq — Quartzite facies on Sullivan Ridge

Asm — Rare marble interlayers

Metabasalt of Mother Featherlegs--Predominantly a metavolcanic unit, the nearest thing to a geologic time line in the stratigraphic section of the Hartville Uplift. For the etymology of "Mother Featherlegs", see Wendleton, 1978. Thickness varies from 400 to perhaps as much as 5000 feet (120-1,500), with an average near 2,500 feet (750 m)

Af — Dark-green rock which ranges from medium-grained amphibolite, fine-grained actinolite-biotite-chlorite schist, and chlorite schist (from Muskrat Canyon to Wildcat Hills and from the Kimble Ranch area to the Chicago Mine) to coarse-grained amphibolite northeast of Guernsey. Contains minor inter-layered light-colored cummingtonite schist in layered amphibolite in upper half of unit north and northeast of Mother Featherlegs cemetery, and pillow-structured or massive amphibolite near the base. Pillows prominent in two lower stratigaphic horizons in Muskrat Canyon. Amygdules and fragmental agglomerate structures preserved locally from Muskrat Canyon to Wildcat Hills and west northwest of Frederick Ranch. Unit may contain undifferentiated Aa dikes locally. In Antelope Hills this map unit includes distinctive interlayered calcareous amphibolite and anthophyllite schist that may belong in a separate stratigraphic unit

Afm — Local white (black layered) calcareous marble interlayers near top unit northwest of Bear Canyon and near bottom of unit north of Guernsey stone quarry. In Antelope Hills this map unit includes distinctive chloritic marble and dolomite, diopsidic calc silicate rock, quartzite with round microcline grains, and biotite or muscovite schist, all of which may belong in a separate stratigraphic unit

Afs — Local dark-gray to green biotite and muscovite schist and graded shale-pebble and quartz-granule feldspathic metagraywacke, most prominent between Muskrat Canyon and Wildcat Hills, and also northwest of Frederick Ranch

Afc — Calc-silicate pod amphibolite prominent near base of formation north of Guernsey stone quarry. Calc-silicate pods are white to light green, range from lemon to grapefruit size and shape, form 30 to 50 percent of the rock, and contain actinolite, diopside, talc, and aluminous epidote

Formation of Muskrat Canyon--Metacarbonate unit exposed in a northern facies from Muskrat Canyon to Aego Creek and in the Copperbelt Mine-Omaha Mine area up the east side of Flattop Butte to east of Mother Featherlegs cemetery; and in a southern facies northeast, north, and northwest of Guernsey. The southern facies is nearly pure carbonate while the northern facies contains many interlayers of clastic schist, metagraywacke, and quartzite. Thickness 3,000-5,000 feet (900-1,500 m), bottom not exposed

Amd — Gray, pink, white, and yellow dolomite and tremolite dolomite with tremolite, especially in southern facies, in sprays resembling turkey tracks. Rare talc schist interlayers in southern facies. In northern facies dolomite occurs either minutely interlayered with muscovite schist or in blunt ended abruply terminated algal bioherms surrounded by schist and measuring several tens to hundreds of feet in diameter

Ams — Gray biotite, muscovite, and sillimanite schist (metashale) and graded quartz-granule metagraywacke and local quartzite. Prominent in eastern parts of Muskrat and Little Wildcat Canyons and west of Omaha and Copperbelt Mines

Amq — Gray to red crossbedded siliceous to ferruginous quartzite near base of unit in northern facies. Exposed only in western part of Muskrat Canyon. Base not exposed

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CORRELATION OF MAP UNITS