DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1831
SHEET 1 OF 2

INTRODUCTION

This thickness map of a Late Cretaceous interval in the northwestern part of the San Juan Basin is part of a study of the relationship between ancient shorelines and coal-forming swamps during the final regression of the Cretaceous epicontinental sea. The top of the thickness interval is the top of the Pictured Cliffs Sandstone. The base of the interval is a thin time marker, the Huerfanito Bentonite Bed of the Lewis Shale. The interval includes all of the Pictured Cliffs Sandstone and the upper part of the Lewis Shale. The northwest boundary of the map area is the outcrop of the Pictured Cliffs Sandstone and the Lewis Shale.

Data used for the isopach map are mostly from interpretation of geophysical logs of oil and gas wells, southeast of the outcrop in parts of the Cortez, Durango, Farmington, and Navajo Reservoir 1:100,000-scale quadrangles, Colorado and New Mexico. Cross sections A-A' and B-B' give examples of geophysical logs that show some of the variations in the isopach interval.

GEOLOGIC SETTING

The San Juan Basin, which is in the southeastern part of the Colorado Plateau, is a structural basin that lies mostly in northwestern New Mexico and extends into southwestern Colorado (see index map). Structures of the basin were formed generally during late Cretaceous and early Tertiary time (Kelley, 1951). The Hogback Monocline forms the northwest boundary of the inner part of the San Juan Basin. In the monocline the rocks generally dip steeply southeast toward the deeper part of the basin. Two local structures, Barker dome and Southern Ute dome, are mostly in T. 31 and 32 N., R. 14 W., directly west of the Hogback Monocline.

The Pictured Cliffs Sandstone is a regressive shoreline deposit that interfingers southwestward in its upper part with the mostly overlying and partly equivalent lagoonal and fluvial Fruitland Formation, and that interfingers northeastward in its lower part with the mostly underlying and partly equivalent marine Lewis Shale. The Fruitland Formation, Pictured Cliffs Sandstone, and Lewis Shale are well exposed in the Hogback Monocline.

PREVIOUS WORK

Stratigraphic relations of the Pictured Cliffs Sandstone and adjacent rocks are described in U.S. Geological Survey reports of areas along the northwest edge of the San Juan Basin (see index of sources). Newman (1982) has suggested that counterclockwise currents transported sands from the Piceance delta in northwestern Colorado to southwestern Colorado to help form the barrier sand that is now the Pictured Cliffs Sandstone.

The Huerfanito Bentonite Bed of the Lewis Shale, used for the base of the isopach interval, was identified and named in the subsurface by Fassett and Hinds (1971). They traced the bed throughout the San Juan Basin and prepared an isopach map of the Pictured Cliffs–Huerfanito interval to help show stratigraphic variations at the top of the Pictured Cliffs. The Huerfanito Bentonite Bed may have been identified by J.R. Gill and W.A. Cobban (Cobban, 1973) at the surface, near Barker Dome in the NE 1/4 sec. 6, T. 31 N., R. 13 W. The Huerfanito is tentatively placed in the Baculites scotti ammonite zone of the late Campanian Stage.

DISCUSSION

Abrupt local increases in thickness of the isopach interval are generally due to the addition of beds at the top of the Pictured Cliffs Sandstone; they also reflect an increase in thickness of the Lewis Shale. The sandstone buildups mark pauses in the northeastward retreat of the Cretaceous sea, and they show the approximate positions and trends of the shorelines at various places during the withdrawal.

Barnes, Baltz, and Hayes (1954), Hayes and Zapp (1955), and Zapp (1949) refer to at least six places along the outcrop at which the upper part of the Pictured Cliffs intertongues with, and replaces, the lower part of the overlying Fruitland Formation. In two places the resulting stratigraphic rise at the top of the Pictured Cliffs is described as being as much as 100 ft. Four rises are identified on the map of Hayes and Zapp as shorelines L, N, P, and R; the locations of these rises, as well as two stratigraphic rises of Barnes and others (1954) and Zapp (1949), are shown on the accompanying isopach map. Lagoonal deposits, including coal, are found in the lower part of the Fruitland Formation on the landward side of the buildups or stratigraphic rises of the Pictured Cliffs; the thicker coals generally lie behind the more prominent rises.

South of the 740-foot isopach in the southern part of the map area are three of the stratigraphic rises (shorelines L, N, and P) shown at the surface on a geologic map by Hayes and Zapp (1955). Attempts to extend the shorelines into the subsurface are shown as stippled bands on the isopach map. These bands suggest only that there was an approximately 100-foot rise northeastward in the southern part of the map area. In this area, the Pictured Cliffs Sandstone is typically between 100 and 200 ft thick. On some logs the Pictured Cliffs appears to include several regressive sandstones and transgressive shales under a more massive barrier sandstone at the top.

In a wide northwest-trending band across the middle of the map area, the Pictured Cliffs–Huerfanito interval is slightly thinner than in areas immediately to the north or south. However, Hayes and Zapp (1955) show a stratigraphic rise of 100 ft at shoreline R, near the area of general thinning. In the subsurface the Pictured Cliffs generally is between 100 and 150 feet thick, and evidence of intertonguing with the Lewis Shale, in contrast with the southern part of the map area, has essentially disappeared (see logs 3, 4, and 8 of cross sections A-A' and B-B'). The shoreline apparently prograded rapidly across this area. In some places, an increase also occurs in percent of sandstone near the base of the Fruitland Formation. Some of the sandstone beds are probably fluvial; others may be marine beds that intertongue with the fluvial sandstone beds. The Fruitland–Pictured Cliffs contact, especially in the western part of the map area, is difficult to select consistently within the sandstone sequence on geophysical logs.

The relatively thin Pictured Cliffs, the increase in sandstones at the base of the Fruitland Formation, and a generally thinner Pictured Cliffs–Huerfanito interval, suggest incipient uplift in this and nearby areas of Barker dome and Southern Ute dome during Fruitland–Pictured Cliffs time. This uplift provided a local rapid retreat of the sea, possibly local subaerial erosion, and a local influx of sediments probably from the west.

The largest rise of the Pictured Cliffs Sandstone is in the northern part of the area, near Durango, Colo., where there were two major pauses in the regression. One rise is near the 800-foot isopach, which possibly coincides with a 65-foot rise described by Barnes and others (1954). The area south of the 800-foot thickness line is approximately where Fassett and Hinds (1971) show some of the thickest accumulation of coal beds in the San Juan Basin. The second largest rise is between the 960- and 1140-foot isopachs and roughly agrees with the rise described by Zapp (1949), near Durango, where the thickest coal bed of the San Juan Basin was measured at the surface.

REFERENCES CITED

Barnes, Harley, Baltz, E.H., Jr., and Hayes, P.T., 1954, Geology and fuel resources of the Red Mesa area, La Plata and Montezuma Counties, Colorado: U.S. Geological Survey Oil and Gas Investigations Map OM-149, scale 1:62,500.

Cobban, W.A., 1973, Significant ammonite finds in uppermost Mancos Shale and overlying formations between Barker Dome, New Mexico, and Grand Junction, Colorado; in Cretaceous and Tertiary rocks of the southern Colorado Plateau: Four Corners Geological Society Memoir, p. 148-153.

Fassett, J.E., and Hinds, J.S., 1971, Geology and fuel resources of the Fruitland Formation and Kirtland Shale of the San San Juan Basin, New Mexico and Colorado: U.S. Geological Survey Professional Paper 676, 76 p.

Hayes, P.T., and Zapp, A.D., 1955, Geology and fuel resources of the Upper Cretaceous rocks of the Barker Dome-Fruitland area, San Juan County, New Mexico: U.S. Geological Survey Oil and Gas Investigations Map OM-144, scale 1:62,500.

Kelley, V.C., 1951, Tectonics of the San Juan Basin; in South and west sides of the San Juan Basin, New Mexico: New Mexico Geological Society Guidebook, 2nd Field Conference, p. 124-131.

Newman, K.R., 1982, Stratigraphic framework of Upper Cretaceous (Campanian) coal in western Colorado; in Southeastern Piceance Basin, Grand Junction Geological Society Field Trip, p. 61-64.

Zapp, A.D., 1949, Geology and coal resources of the Durango area, La Plata and Montezuma Counties, Colorado: U.S. Geological Survey Oil and Gas Investigations Preliminary Map OM-109, scale 1:31,680.

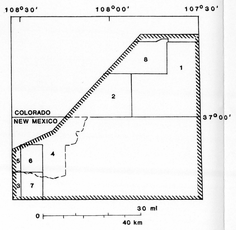
Kpc — CONTACT OF PICTURED CLIFFS SANDSTONE (Kpc) OR UNDERLYING LEWIS SHALE (Kl)--Dashed where approximately located; dotted where concealed

740 — ISOPACH--Shows thickness of interval between top of Pictured Cliffs Sandstone and Huerfanito Bentonite Bed of Lewis Shale. Hachures indicate areas where interval becomes thinner. Contour interval 20 ft

960 — SHORELINE OR BUILDUP--Extended into the subsurface from buildup areas of Pictured Cliffs Sandstone identified in outcrop

? • DRILL HOLE--Queried where location is uncertain

INDEX MAP SHOWING LOCATION OF THE STUDY AREA (SHADED)



INDEX OF SOURCES USED FOR OUTCROP OF PICTURED CLIFFS SANDSTONE AND LEWIS SHALE. MAP AREA IS OUTLINED BY HACHURES.

1. Barnes, Harley, 1953, Geology of the Ignacio and Pagosa Springs quadrangles, La Plata and Archuleta Counties, Colorado: U.S. Geological Survey Oil and Gas Investigations Map OM-138, scale 1:63,360.
2. Barnes, Harley, Baltz, E.H., Jr., and Hayes, P.T., 1954, Geology and fuel resources of the Red Mesa area, La Plata and Montezuma Counties, Colorado: U.S. Geological Survey Oil and Gas Investigations Map OM-149, scale 1:62,500.
3. Beaumont, E.C., 1955, Preliminary geologic map of the Shiprock and Hogback quadrangles, San Juan County, New Mexico: U.S. Geological Survey Coal Investigations Map C-29, scale 1:48,000.
4. Hayes, P.T., and Zapp, A.D., 1955, Geology and fuel resources of the Upper Cretaceous rocks of the Barker Dome-Fruitland area, San Juan County, New Mexico: U.S. Geological Survey Oil and Gas Investigations Map OM-144, scale 1:62,500.
5. O'Sullivan, R.B., and Beaumont, E.C., 1957, Preliminary geologic map of western San Juan Basin, San Juan and McKinley Counties, New Mexico: U.S. Geological Survey Oil and Gas Investigations Map OM-190, scale 1:125,000.
6. Strobell, J.D., Jr., Hayes, P.T., and O'Sullivan, R.B., 1980, Preliminary geologic map of the Waterflow quadrangle, San Juan County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1253, scale 1:24,000.
7. Weide, D.L., O'Sullivan, R.B., and Hallet, J.S., 1979, Preliminary geologic map of the Fruitland quadrangle, San Juan County, New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1089, scale 1:24,000.
8. Zapp, A.D., 1949, Geology and coal resources of the Durango area, La Plata and Montezuma Counties, Colorado: U.S. Geological Survey Oil and Gas Investigations Preliminary Map OM-109, scale 1:31,680.

Base from U.S. Geological Survey 1:100,000
Farmington, Navajo Reservoir, 1980; Cortez, 1982; Durango, 1983

SCALE 1:100 000
1 ½ 0 1 2 3 4 5 MILES
1 .5 0 1 2 3 4 5 KILOMETERS

ISOPACH MAP OF INTERVAL BETWEEN TOP OF THE PICTURED CLIFFS SANDSTONE AND THE HUERFANITO BENTONITE BED OF THE LEWIS SHALE, LA PLATA COUNTY, COLORADO, AND RIO ARRIBA AND SAN JUAN COUNTIES, NEW MEXICO

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1986

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1986

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