Proximal and distal braided alluvial facies in the lower braided interval of the Dakota Sandstone, northeastern New Mexico

George B. Asquith and J. L. Gilbert, 1976, pp. 153-155

in:

Vermejo Park, Ewing, R. C.; Kues, B. S.; [eds.], New Mexico Geological Society 27th Annual Fall Field Conference Guidebook, 306 p.

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PROXIMAL AND DISTAL BRAIDED ALLUVIAL FACIES IN THE LOWER BRAIDED INTERVAL OF THE DAKOTA SANDSTONE NORTHEASTERN NEW MEXICO

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INTRODUCTION

Location

The study area is located in the northeastern corner of New Mexico. Approximate boundaries are the Texas-Oklahoma-New Mexico border, the Colorado-New Mexico border, the extreme eastern edge of the Sangre de Cristo Mountains, and Interstate Highway 40.

Stratigraphy

The Cretaceous Dakota Sandstone unconformably overlies the Jurassic Morrison Formation in the western portion of the study area (Mora and San Miguel counties). However, the Morrison is overlain by the Lower Cretaceous Purgatoire Formation in the Raton Basin (Colfax County) and in the east and southeast portions of the study area (Union and Harding counties plus the eastern edge of San Miguel County).

Jacka and Brand (1973) subdivided the Dakota Sandstone in northeastern New Mexico into three intervals: a lower braided alluvial interval, a middle meanderbelt interval, and an upper marine sandstone interval. Mankin (1958) recognized a similar three-fold subdivision of the Dakota Sandstone in northeastern New Mexico. This same three-fold subdivision of the Dakota Sandstone is present in the subsurface in the Raton Basin (Fig. 1).

The lower braided alluvial interval consists of a sheet-like body of sandstone and conglomerate with numerous scour-and-fill structures. Dominant sedimentary structures are planar cross stratification, trough cross-stratification, and horizontal stratification with minor ripples. The main rock type is pale yellowish-brown to white, fine to coarse grained, moderately well-sorted quartz arenite. Conglomerate lenses composed predominately of chert pebbles are common especially at sections located in the western part of the study area. The braided alluvial interval attains a maximum thickness of 195 ft in the western portion of the study area and thins to less than 50 ft in the eastern and southeastern portion of the study area (Gilbert and Asquith, 1976). Directional analysis of 300 cross-stratification measurements from 12 locations indicates east to southeast transport directions with a grand vector mean of 121° (Gilbert and Asquith, 1976).

The meanderbelt interval conformably overlies the braided alluvial interval and is composed of silty shale and interbedded point bar channel sandstones. The silty shale is light to dark gray, thin-bedded, and lignitic. The lenticular sandstones are white to light brown, fine to very fine grained and form lens-shaped bodies which exhibit trough and ripple cross-stratification. The meanderbelt interval probably records headward erosion of the early Laramide uplands to the west, which was accompanied by a decrease in gradient over the area and the ultimate submergence of the region by a shallow sea (Jacka and Brand, 1973). The meanderbelt interval averages 25 ft in thickness throughout the study area.

A transgressive shorezone marine sandstone interval unconformably overlies the meanderbelt interval. The marine sandstone is light yellowish-brown, well-sorted, and horizontally stratified quartz arenite. Vertical burrows of *Ophiomorpha* are present in the upper portions of the interval near the contact with the overlying marine Graneros Shale. The marine sandstone interval averages 12 ft in thickness in the study area.

SEDIMENTARY STRUCTURE FACIES ANALYSIS

To determine the extent of the proximal and distal braided stream facies (Smith, 1970) for the lower braided interval of the Dakota Sandstone, 12 stratigraphic sections were measured

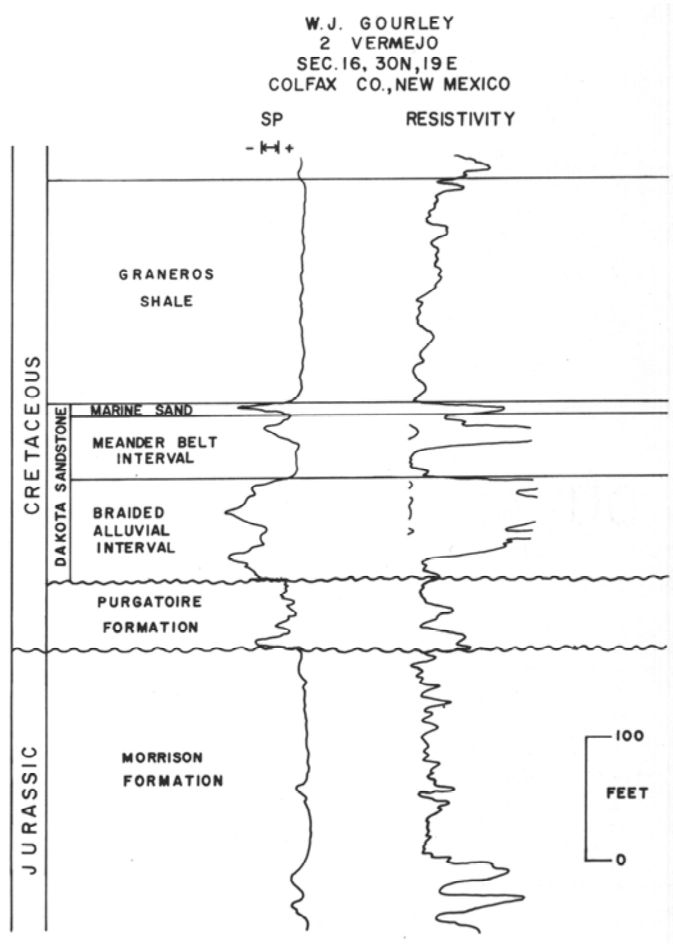

Figure 1. Typical electric log characteristics of the Dakota Sandstone in the Raton Basin, Colfax County, New Mexico (after Gilbert and Asquith, 1976).

(Fig. 2). At each location the sedimentary structure data were collected and compiled so that it could be analyzed by computer (Asquith and others, 1975).

The computer program (Asquith and others, 1975) calculated: 1) total thickness and percentage of each variety of sedimentary structure in each of the stratigraphic sections, 2) stratification ratio (planar cross stratification/planar cross stratification + horizontal stratification; Smith, 1970) and 3) percentage data for three component sedimentary facies plots (Allen, 1970).

Observations by Smith (1970) on the South Platte-Platte River in Colorado and Nebraska and Silurian clastics of the north-central Appalachians demonstrated that the stratification ratio (planar cross stratification/planar cross stratification + horizontal stratification) could be utilized to determine the ratio between transverse and longitudinal bars for braided streams. A predominance of longitudinal bars (proximal braided stream facies) was indicated by a low stratification ratio (0.3 or less) and a predominance of transverse bars (distal braided stream facies) was indicated by a high stratification ratio (0.6 or greater).

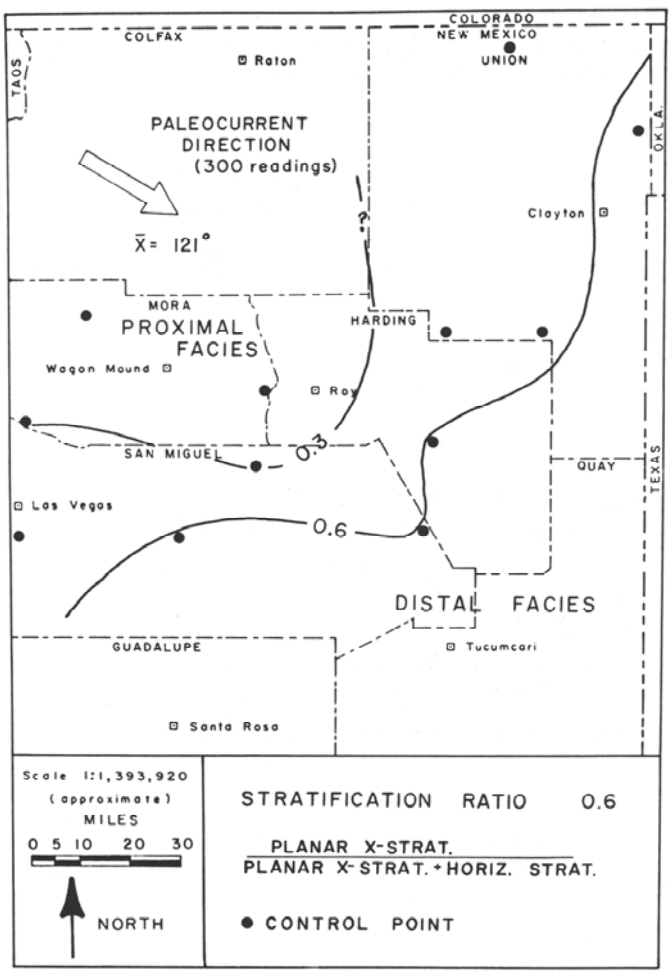

Figure 2. Map of stratification ratio (planar cross stratification/planar cross stratification + horizontal stratification) for the lower braided interval of the Dakota Sandstone in northeastern New Mexico. The arrow indicates the vector mean transport direction based on 300 readings.

The stratification ratio for the braided alluvial interval of the Dakota Sandstone varies from 0.21 to 0.66 (Gilbert and Asquith, 1976). The ratio is lower (predominantly longitudinal bars) in the west and northwest portions of the study area and is higher (predominantly transverse bars) in the east and southeast portions of the study area (Fig. 2). The same proximal-distal relationship is indicated in a three component sedimentary facies plot of planar cross-stratification, trough cross-stratification, and horizontal stratification (Fig. 3). Similar data for the South Platte-Platte River and the Silurian clastics (Smith, 1970) are included for comparison.

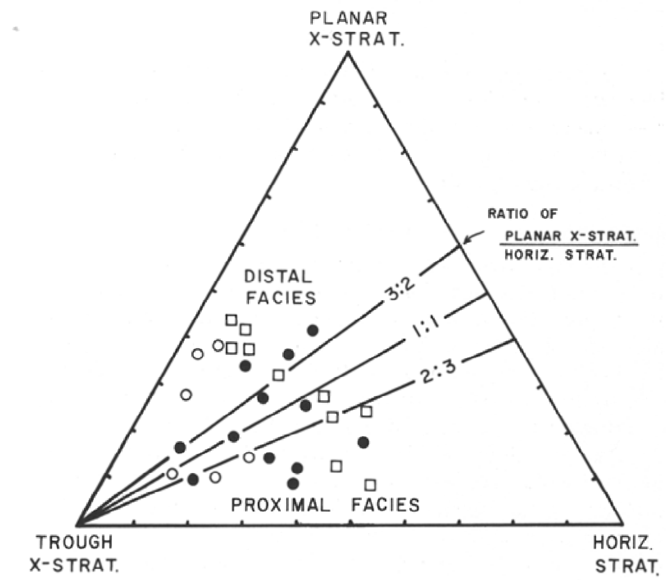

Figure 3. Three component sedimentary facies plot (planar cross stratification-trough cross stratification-horizontal stratification) (after Gilbert and Asquith, 1976).
- ● *Braided alluvial interval Dakota Sandstone, northeastern New Mexico.*
- □ *South Platte-Platte River, Colorado and Nebraska (Smith, 1970).*
- ○ *Silurian clastics, north-central Appalachians (Smith, 1970).*

Smith (1970, p. 3009 and 2996) noted that the downstream distance to the distal facies, where transverse bars first became predominant (0.6 stratification ratio), varied from 100 miles for the Silurian clastics to 230 miles for the South Platte-Platte River. Smith's work suggests that the source area for the lower braided interval of the Dakota Sandstone would have been somewhere between 100 and 230 miles to the west and northwest of the 0.6 stratification ratio contour (Fig. 4). Therefore, the most probable source areas would have been the Cretaceous Apishapa and the Uncompahgre-San Luis uplifts postulated by McGookey and others (1972). Further evidence suggesting that these uplifts were the source areas for the lower braided interval of the Dakota Sandstone is the presence of chert pebbles derived from dissolution of the Devonian Espiritu Santo, Mississippian Tererro, and Pennsylvanian Madera limestones which crop out west of the study area in the Sangre de Cristo Mountains (Jacka and Brand, 1973, p. 25).

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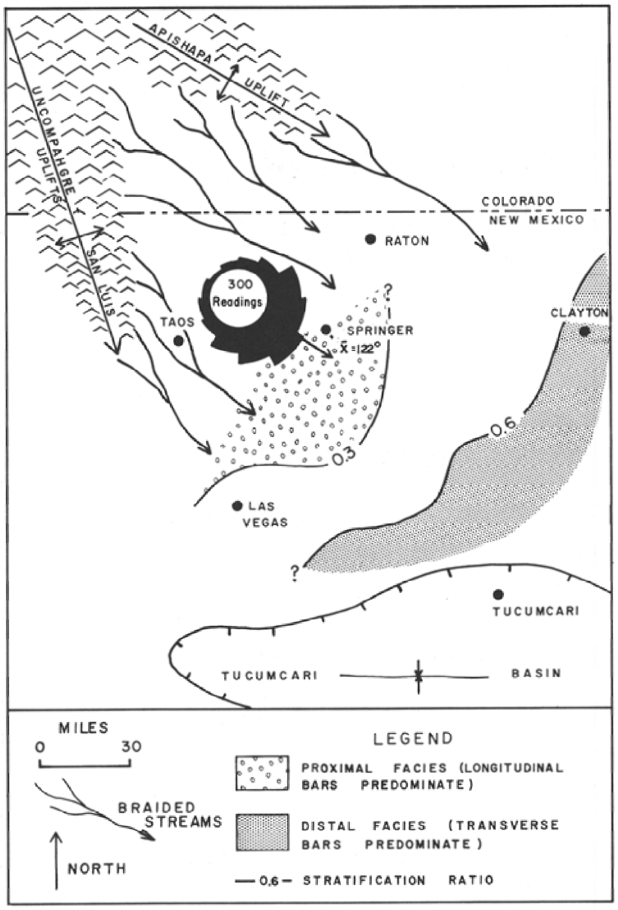

Figure 4. Paleogeographic map of northeastern New Mexico and southeastern Colorado during deposition of the lower braided alluvial interval of the Dakota Sandstone (after Gilbert and Asquith, 1976). The locations of the uplifts are after McGookey and others (1972).

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