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Depositional Environment and Sequence Stratigraphy of the Dakota Sandstone (Lower Cretaceous) in Ridgway Area, Southwestern Colorado

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Study Area

Facies and sequence stratigraphic analysis of the Lower Cretaceous Dakota Sandstone is completed in southwestern Colorado, along Highway 550, between the towns of Montrose and Ridgway

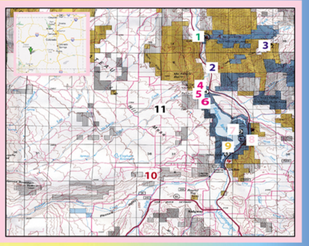
Previous Work

The Dakota Sandstone was first named by Meek and Hayden (1868) for the basal coarse grained Cretaceous strata near the village of Dakota City, northeastern Nebraska. The unit now known as the Dakota Sandstone has been identified by various other names: Dakota Formation, Dakota Group and Naturita Formation. In the Colorado Plateau, Young (1960) used the name of Naturita Formation to describe this unit and the name of Cedar Mountain Formation to describe the underlying Burro Canyon Formation. He grouped the two formations into the Dakota Group. In the Gunnison area (South Central Colorado), Bartleson (1989), used the terms of Dakota Sandstone and Burro Canyon to describe these two separate units. Here, the terms of Dakota Sandstone and Burro Canyon Formation will be used.

Map of Southwestern Colorado showing the study area

Methods

Although the Dakota Sandstone is well exposed in the study area, its depositional environment is not well documented. This study is based on outcrop investigation. The Dakota Sandstone is studied via eleven measured sections between the towns of Montrose and Ridgway. These sections are oriented N-S and cover a distance of approximately 15 Km. Each section ranges from 30 to 50 m and is measured using a Jacob's staff. The sedimentological observations include description of lithologies, and physical and biogenic sedimentary structures, as well as bedding attributes such as bed thickness, bedding contacts, etc. Attention is paid to the recognition of major bounding surfaces formed in response to base level changes (i.e., parasequence and sequence boundaries). Photo mosaics were taken to help determine the architecture of beds and bed sets. Correlation of measured sections using a sequence stratigraphic approach document lateral facies changes and extent of deltaic subenvironments across the study area, as well as the connectivity (or lack of) of the seemingly continuous deltaic sandstones within this formation.



Map of the Ridgway area showing the eleven sections

Eleven sections have been described:

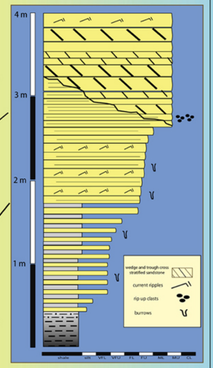
- Billy Creek ( )
- Chaffee Creek ( )
- Pa Cu Chu Pak (4,5,6)
- Dutch Charlie (7,8)
- Dallas Creek (9)
- Jack's place ( )
- Mine section (11)

Scientific Importance

This study provides a detailed depositional setting of the deltaic Dakota Sandstone in southwestern Colorado. The use of a sequence stratigraphic approach allows a better understanding of lateral facies changes associated with these river-dominated deltas.

Depositional facies

1- River-dominated delta: delta plain, distributary channel and delta front



2 - Fluvial and associated flood plain

- This poorly exposed facies occurs at the base of the Dakota Sandstone and contains channel-fill sandstone, flood plain silty shale and thin beds of coal.
- Channel-fill sandstone average 0.5 m in thickness, and consists of upward-fining sandstones. Individual channel-fill sandstones are traced for 3 km laterally.
- The floodplain is represented by gray-colored silty shale. Thin beds of coal occur sporadically.

Deltaic subenvironments

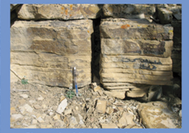
1- Distributary channel:
- erosionaly truncates delta front sandstone.
- it is characterized by a basal scour.
- it is comprised of medium to coarse grained sandstone.
- lag deposit of mud-clasts or pebbles commonly seen.
- it is dominated by wedge-shape and trough cross bedded sandstone.
- up to 2 m thick.

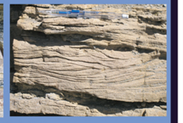

Distributary channel showing trough cross bedded sandstone


Rip up clasts at the base of the distributary channel

2- Delta front:
- upward-coarsening and thickening succession of sandstone beds.
- silty-shale at the base (distal delta front) grading upward into upper-medium to lower-coarse sandstone at the top (proximal delta front).
- it is the thickest and the most extensive facies in the Dakota Sandstone.
- it exhibits lateral continuity between the different measured sections.
- delta front facies are approximately 1.4 m to 6 m in thickness, with an average of about 4 m thick.
- sandstone beds range from 1 cm at the base of this succession to 10 or 20 cm at the top.
- the sandstone beds are characterized by well-defined planar bedding and current ripple laminations that occur as a couplet. Some current ripples are wave modified.
- *Arenicolites* are abundant locally; *Diplocraterion* occurs randomly.


Proximal delta front with upward thickening beds of sandstone


Plannar bedding in proximal delta front


Wave ripple lamina


Distal delta front showing coarsening-upward beds of sandstone

Arenicolites are vertical U-shaped dwelling burrows. We seldom find the complete burrow. It usually appears as a single, J-shape burrow. This vertical burrow varies from 5 cm to 10 cm long. Arenicolites usually indicate a brackish environment. They are indicators of stressed environments.

Diplocraterion is describe in only one section. "It is a U-shaped burrow oriented perpendicular to the bedding surface with spreite apparent between the limbs of the U. Its length reaches 60 cm. This burrow is developed primarily in sandy sediment where relatively high levels of wave or current energy are typical" (Hasiotis, 2002)

Wave influence is seen at the top of the Dakota Sandstone

Wave influence near the top of the Dakota sandstone is shown by the presence of wave ripple cross lamina, wave modified current ripple cross lamina and hummocky cross stratification (HCS)

The HCS: - have been traced for up to 12 Km
- they are either present as individual beds 20 cm thick or amalgamated beds 2 m thick
- HCS beds consist of fine grain sandstone
- burrowing and escape structures can be present


Amalgamated HCS showing swales and hummocks


individual beds of HCS


Wave ripples on bedding plane


Wave modified current ripple lamina

Facies distribution

Fluvial channel and floodplain deposit are present at the base of the formation. Deltaic deposits dominate the upper half of the formation. Wave influence is seen in the upper 7m of the formation. Wave influence is interpreted from the presence of HCS, wave ripples and wave-modified current ripples