

# Carbonate Microfacies of the Cedar Mesa Sandstone: Examples from a Mixed Clastic/Evaporitic Continental Sabkha.

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### Introduction

Arid continental environments are typically dominated by aeolian, alluvial and fluvial deposits. Carbonates, though less common, feature in many arid continental settings. However within arid continental basins are often overlooked, yet they can provide vital insight into the depositional history, climatic or tectonic controls of a basin. This work presents the first systematic study of the petrography of carbonates found within the Cedar Mesa Sandstone Formation of Western USA. These deposits represent an early Permian desert system, where the deposits grade into a mixed evaporite/carbonate and clastic sequence, interpreted as sabkha deposits, which is the main focus of this study. Whilst many authors have worked within the aeolian facies, comparatively little attention has been paid to the mixed evaporitic/clastic/carbonate aeolian sabkha transition zone. This work aims to generate a detailed microfacies of the carbonates present within the Cedar Mesa Sandstone, in order to develop an understanding of the carbonate components, formation mechanisms and to establish what these deposits may clarify or add to the formations depositional story.

### Geology

Field samples consist mainly of dark grey to blue massive micritic carbonate mudstone, occasional they have a nodular texture resulting in a wackestone classification, or are sand rich resulting in a Packstone classification. The carbonates occasionally appear interbedded with gypsum or with chert nodules but are predominantly blocky units no greater than 40 cm in thickness. The carbonates outcrop either in isolated lens or as laterally continuous flatbeds.

## Results & Interpretation

### Microfacies 1

This microfacies contains a strong clastic component within a darker, homogenous dark brown carbonate mudstone matrix. Quartz grains are dominantly formed of well-rounded to sub-rounded, fine to medium-grained with minor components of evaporite minerals/ microbial textures. Clastic content ranges from 10%- >60%, with minimal occurrences of stomatactis or skeletal grains.

### Microfacies 2

This facies outcrops as laterally continuous dark grey to blue fine grained carbonate Mudstone or Wackestone. The microfacies show a dominant dark brown carbonate mudstone matrix, with minimal occurrences of ostracods, red iron oxide and isolated quartz grains. The sample shows larger reworked grains and is poorly sorted.

### Microfacies 3

This microfacies can be characterised by a dominant laminoid fenestral fabric consisting of elongate strings of regularly spaced birdseye-like voids between laminated, peloidal and oncoidal clotted fabrics, and thinner, and more irregular fenestrae within laminated micrites, which often show undulose micrites (displayed as alternating lighter and darker laminae) with elongate fenestrae.

### Microfacies 4

This facies is characterised by a horizontally laminated dark brown carbonate mudstone matrix, alternating with either laminated quartz bands or undulose laminations of light brown to grey microbial clotted fabrics. Quartz grains are well sorted and rounded. One example shows a complete horizontally aligned Ostracod, but otherwise the microfacies is barren of skeletal grains.

### Microfacies 5

This microfacies is characterised by brown laminated carbonate mud matrix with a clotted texture, interspersed laminations of microspar and common bioclasts with some peloidal and clotted areas with a lighter grey/green microbial cauliflower textures. The bioclasts comprise horizontally aligned ostracods. Birdseye and isolated fenestral cavities are present, particularly within the more micritic layers.

### Conclusions

This work presents preliminary results from the first systematic study of the petrography of carbonates found within the arid continental Cedar Mesa Sandstone Formation. Five microfacies have been described, which represents the deposits formed close to arid continental sabkhas within either more arid or humid periods. Arid deposits are linked to either isolated interdune areas which are clastic rich due to influx of aeolian sands, or microbial carbonates formed around the edge of evaporite rich sabkhas. Humid deposits show reworking of these microbial mats and laminated ostracod rich suspension deposits formed within longer lived lakes and clastic rich interdune deposits that are interconnected to wider environments and show periodic clastic influx, most likely from fluvial sheetflood type deposits. The carbonate deposits occur sporadically interbedded with the clastic deposits, however when divided into microfacies climatic trends can be interpreted, this allows for correlation of climatic cycles across the basin and prediction of where both carbonate and clastic facies will occur in space and time.

