The Greenbrier Group: A Stratigraphic Model For Middle Mississippian Eustatic Fluctuations and Evidence for the Presence of Paleo-Carbonate Islands.

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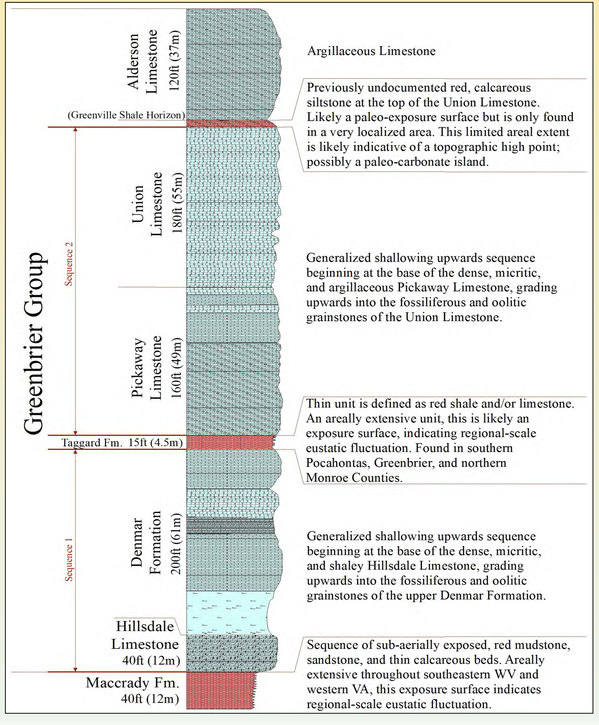
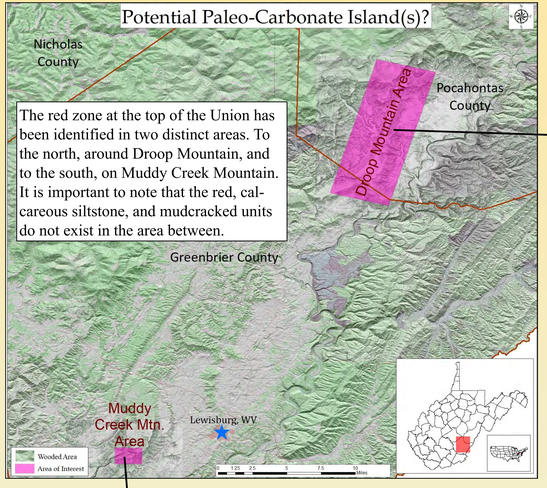
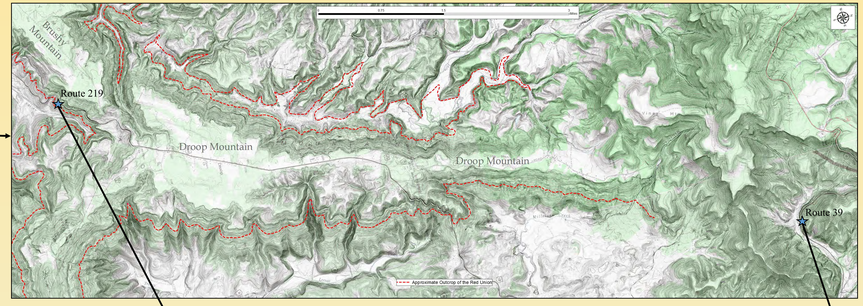
THE GEOLOGICAL SOCIETY OF AMERICA® CONNECTS 2023 15–18 October Pittsburgh, Pennsylvania, USA

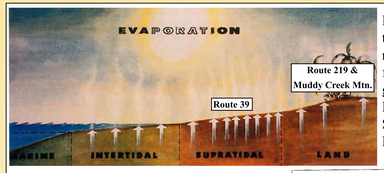
Abstract

The middle-Mississippian Greenbrier Limestone Group (comprised of the basal Hillsdale Limestone, Denmar Formation, Taggard Shale, Pickaway Limestone, Union Limestone, Greenville Shale, and capped by the Alderson Limestone) is the most extensive carbonate sequence in the state of West Virginia, records significant basinal/facies changes, and can be used as a proxy for eustatic change in southeastern West Virginia. In southern Pocahontas County, WV, the Greenbrier Group is about 800 feet thick and can be split into two distinguishable shallowing upward sequences. Beginning above the Hillsdale Limestone, the lowermost of these is entirely contained within the Denmar Formation (~240 feet thick), the base of which is comprised of dense, micritic limestone which grades upward into oolitic, fossiliferous beds at the top. The second sequence begins at the upper contact of the Taggard Shale (a red shale, limestone, mudstone, and paleosol zone), and includes the dense, micritic Pickaway Limestone (~180 feet thick) at the base, grading upwards into the fossiliferous and oolitic Union Limestone (~160 feet thick) above. Notably, in this region, the Greenville Shale (a black, fissile, fossiliferous shale) is absent and a repeating zone of thin, red limestones, interspersed with red shales is found at the top of the Union Limestone. Farther north, in central Pocahontas County, the Greenville exists as a 5-10-foot-thick package of finely bedded, red mudstones with columnar structures which are interpreted as stacked mud-crack sequences; like those expected in the supratidal facies of a tidal flat. The combination of highly desiccated, red shales of the Greenville to the north with the lack of Greenville, and red limestone/shale zone at the top of the Union, farther south is tentatively interpreted as a supratidal zone within a tidal flat, and a subaerially exposed carbonate island. Another red limestone zone further south may indicate the presence of a pale-carbonate island chain, however limited exposures has made this delineation difficult.



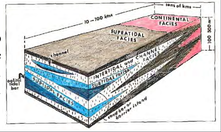


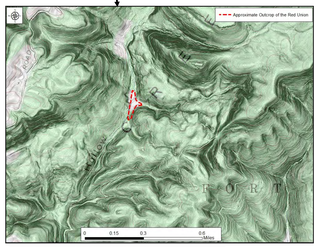




Proposed depositional model for the relationship between facies found during geologic mapping. Figure adapted from Shinn, 1983, AAPG Memoir 33.

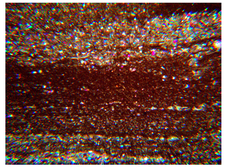
Idealized model showing the inter-relationship of the depositional facies, as well as the stacked sequence of eustatic fluctuations. Figure from Shinn, 1983, AAPG Memoir 33.





Muddy Creek Mtn.

This site is lithologically identical to Route 219, red calcareous siltstone, and the reduced solubility resulted in stratigraphic controls on speleogenesis of the cave pictured below. The full extent of this zone is unknown. This locality was only discovered because of exposures in the cave. Note: no supratidal facies have been found near this locale.



25x magnification of the red, calcareous siltstone, under cross polarization.

Red, calcareous siltstone.

Route 219

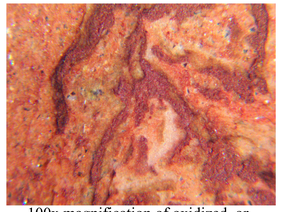
. Lithology:
- 6 to 15 feet thick.
- Interbedded calcareously cemented siltstone and red, fissile shale.
- Weathers brown, fresh surface red.
- Some organic debris present in the siltstone.

. Best correlates with the top of the Union Limestone.

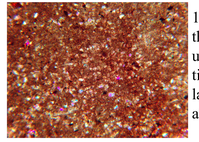
. Union Limestone is typically light to dark grey in color, fossiliferous, oolitic, and highly soluble.

. In areas where this facies is present, the overlying Greenville Shale is absent.

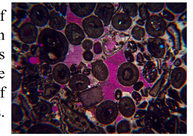
. Interpretation: likely exposed in a terrestrial environment allowing for the oxidation of the non-carbonate sediment.



100x magnification of oxidized, organic debris under reflected light.



100x magnification of the calcareous siltstone, under cross polarization. Note the relative lack of carbonate minerals.



25x magnification of typical oolitic Union Limestone, under cross polarization. Note the relative abundance of carbonate minerals.

Route 39

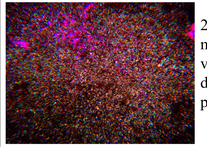
. Lithology:
- 6 to 10 feet thick.
- Reddish-brown fissile shale.
- Some crystalline laminations.
- Dominated by stacked mud-crack features.

. Best correlates with the Greenville Shale

. Greenville Shale is typically black, fissile, and fossiliferous.

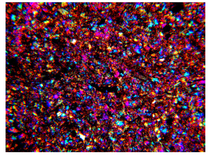
. Typical Union Limestone facies are present below this unit.

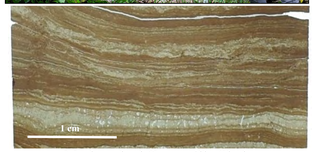
. Interpretation: likely deposited in a supratidal environment where extended dry periods allowed for the formation of mud cracks.



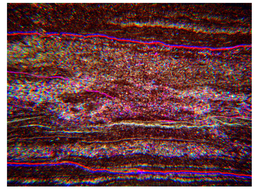
25x magnification of mudcracked Greenville Shale along bedding, under cross polarization.

100x magnification of typical Greenville Shale, under cross polarization. Note the high calcareous content.





Mudcracked Greenville Shale



25x magnification of mudcracked Greenville Shale showing the bedding laminations, under cross polarization.