Paleoenvironmental interpretation of the Bandera Shale Formation, Marmaton Group, Desmoinesian Stage, Middle Pennsylvanian in southeastern Kansas

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Abstract. In southeastern Kansas and northeastern Oklahoma the Bandera Shale Formation (BSF) (Middle Pennsylvanian) crops out from Linn to Labette Counties in Kansas and in Nowata County, Oklahoma in units ranging from 12 cm to 20 m thick. The BSF consist of shale, sandstone, and coal, is stratigraphically located between the underlying Pawnee Limestone and overlying Altamont Limestone Formations of the Marmaton Group. Preliminary results from 6 stratigraphically measured exposures, lithologic and petrographic analyses, sedimentary structures and fossil evidence indicate that variability in the BSF can be related to marginal marine depositional environments. Previous studies from rock exposures have interpreted the BFS to be non-marine in origin [1, 2, & 3]. Recently a subsurface log analysis has interpreted the BSF as mainly marine [4]. This study serves to clarify the discrepancy between log and rock exposure interpretations.

Introduction

Paleogeographic reconstruction of the Mid-Continent during deposition of the BSF and BSQM indicate that the Cherokee Platform was surrounded by topographic highs in all but the south side as depicted in (fig. 1). These features were formed in response to the collision of the South American Plate with the North American Plate during the formation of Pangaea. The Cherokee Platform formed as the Chautauqua Arch subsided due to rejuvenation of the Ouachita and Ancestral Rockies associated feature the Nemaha Uplift and uplift of the Ozark Dome. The Nemaha Uplift and the Ozark Dome are considered to be possible sources for BSF sediment. The BSF stratigraphically thins northward on to the Bourbon Arch and stratigraphically pinches out southward on the shelf edge of the Arkoma Basin. The BSF is present throughout Kansas; however the Bandera Sandstone Quarry Member (BSQM) is limited to the Cherokee Platform. The BSF based on rock exposures has been previously interpreted as mainly non-marine in origin consisting of shale, sandstone, and basal coal according to [1, 2, 3]. Conversely, the BSF was attributed to mainly marine deposition based on subsurface geophysical logs and limited field observations [4]. This study re-interprets the environments of deposition of the BSF, its relation to sea-level fluctuations, and paleotectonic history.

Methods, Results, Discussion, and Significance

Exposed sections the BSF were measured using standard stratigraphic techniques at 6 locations in the study area (fig. 1). Stratigraphic columns were constructed for each measured section to prepare isopach, stratigraphic, and structural maps of the study area. Lithologic and petrographic analyses were performed on selected samples collected. Thin sections were prepared from selected saw-slabbed hand samples. Photographs, measurements, and sketches of the sedimentary structures and fossil identification at the exposures were documented and analyzed.

Preliminary results based on 6 stratigraphically measured exposures, lithological, petrographical analysis, paleontological evidence, and sedimentary structures exhibited the BSF on the Cherokee Platform were deposited in predominantly marine conditions. The basal MCM and underclays were deposited in a non-marine environment. The majority of the BSF contain calcareous siltstones and mudstones which were deposited under low energy marine conditions. The BSQM contains a lowermost rhymically laminated, ripple marked, sandstone with abundant trace fossils on the bedding planes resembling tidal deposits. The uppermost BSQM sandstone contains abundant loading features, cross-bedding, and organic material, indicating rapid and heavy sedimentation associated with deltaic depositional settings. At the top of the BSF a clay unit is present indicating sediment source for the sand was interrupted or transported to other adjacent basins near the
end of BSF deposition on the Cherokee Platform.

Sea-level fluctuations observed in the Mid-Continent region throughout Pennsylvanian times are the result of glacial and tectonic events. The BSF (fig. 2) displays a record of a sea-level low stand at the base of the unit represented by coal in the MCM. As sea-level rose siliciclastics were transported and deposited into the Cherokee

Platform. Subsequent reworking from a marine inundation cleaned and sorted sands and redeposited clays further off shore. Tidal and deltaic features are observed in the BSQM indicating a marginal marine depositional environment. Clay units represent final BSF deposition and are considered to be deposited during maximum sea-level high stand.

The BSF has economic significance. Both the BSQM has been quarried in Bourbon County for flagstone and the MCM has been extensively strip mined for coal in southeastern Kansas and southwestern Missouri. This study serves to re-interpret the paleoenvironment of the BSF, and give insight to sea-level change and paleotectonic history on the Cherokee Platform.

Conclusions

The BSF based on lithologic, petrographic, paleontologic evidence, and sedimentary features from 6 stratigraphically measured exposures in southeastern Kansas and northeastern Oklahoma exhibits terrestrial depositional environment in the lower MCM and a marginal marine depositional environment in the BSQM. The top of the BSF represents the maximum sea level high stand with the appearance of clay as the final unit of siliciclastics and the end of BSF and the deposition of carbonates in the overlying Altamont Limestone Formation.

Acknowledgements

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References

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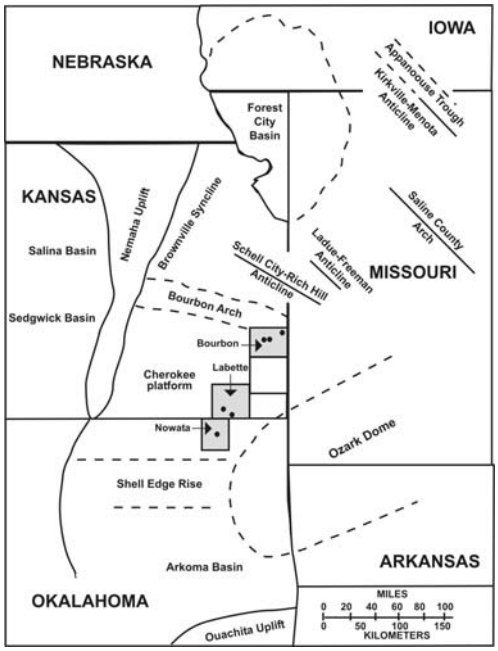

Figure 1: Location of measured exposures (•) and paleogeographic map, of structural features of the Mid-Continent region during Desmoinesian time.

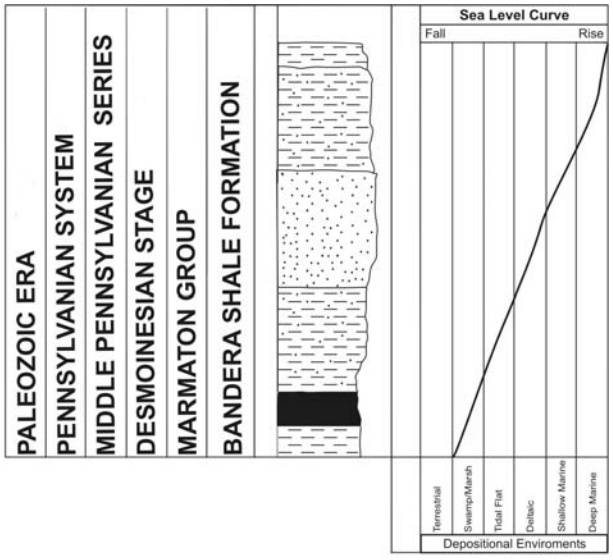

Figure 2: Depositional environment and sea-level curve of the BSF.