geoconvention
Virtual Event
September 21-23
2020
CSPG • CSEG • CWLS • GAC • MAC • IAH

High Resolution Sequence Stratigraphy Fluvial Aggradational Cycles in the Late Cretaceous Dilco Member of the Crevasse Canyon Formation, Seboyeta, New Mexico.

Brayden, M, Ralph and Janok, P, Bhattacharya

McMaster University

Summary

Paralic environments occur at or near sea level, demarcating the unique transition between marine and non-marine environments. The high degree of variability, complexity, and increasing importance placed in distinguishing modern paralic environments have led to greater subdivision within them. However, the plethora of classifications allocated to these modern sub-environments are juxtaposed to the lack of classifications allocated to ancient sub-environments. Detailed sequence stratigraphic analysis on what was initially interpreted to be continuously aggrading coastal plain facies with a lack of fluvial channel sandstones, reveal 17 unique facies and 6 facies associations within the upper Cretaceous Dilco Member of the Crevasse Canyon Formation, north of Seboyeta New Mexico. Furthermore, these facies associations cumulatively combine to represent 14 fluvial aggradational cycles (FACs), 6 FAC sets, and two paralic sequences. These paralic stratal units indicate a higher degree of cyclicity related to the Dilco member than previously thought and reveal the level of detail that can be used in classifying ancient paralic environments. Furthermore, facies analysis led to the observation that at least one multistory channel outcrops north of Seboyeta and subsequently demarcates a sequence boundary in one of the measured sections. The development time of pertinent FACs are estimated to range from 50 years to 5,550 years and reflect autogenic controls. FAC sets in this study are estimated to range from 500 years to 15,000 years and were interpreted to be associated with significant channel avulsion in addition to base level changes related to climate controls that subsequently alter the amount of glacial ice and/or water held in aquifers. Lastly, the estimated duration for the most representative paralic sequence is less than 32,000 years and is interpreted to be associated with glacial and aquifer-eustasy caused predominantly from Milankovitch cycle driven climate change.

Theory / Method

Modern sequence stratigraphic theory is largely based on work made by L.L. Sloss, W.C. Krumbein, and several Exxon researchers (Driese and Nordt, 2013). The work primarily analyzes marine successions including their nature and depositional cyclicity (Driese and Nordt, 2013). This includes identifying stacking patterns based on cyclic parasequences, parasequence sets, and sequences. However, recent sequence stratigraphic research has applied such staking pattern methodology to paralic successions, taking terrestrial deposition and pedogenesis more into account (Driesse and Nordt, 2013). FACs are the most fundamental cyclic stratal in these depositional settings. These successions generally have a disconformable lower boundary and an upper boundary that either contains a poorly developed paleosol or is disconformably overlain by the succeeding FAC without a paleosol (Driesse and Nordt, 2013).

The horizontal distance between measured sections was chosen to be greater than at least 0.4 kilometers in order to avoid oversampling, while observing local variations in sedimentological data. The three Dilco Member sections were measured at a centimeter scale over the course of 9 days. Furthermore, a total of 131 paleocurrents were obtained from cross bed foresets, ripple cross laminations, and wave ripple laminations. Trenching between cliff exposures in partially covered slope sections revealed subtle changes within shale and siltstone units that were previously considered analogues as well as a bentonite layer that was used as a lower isochronous datum. Additional foraminifera analysis was later carried out on several mudstone hand samples collected from the field, to better understand the lithology and determining whether any marine incursion events had occurred.

Fluvial aggradation cycles observed in the Dilco Member are distinguished as mappable decimeter to meter-scale stratal units that generally fine upwards and are bounded by either a channel sandstone (surface representing erosional truncation) or a pedogenically modified surface (Famubode and Bhattacharya, 2016). Conversely, fluvial aggradation cycle sets observed in the Dilco Member are distinguished as mappable decimeter to meter-scale accumulations of successive FACs. They are generally bounded by either a channel sandstone (or some surface representing erosional truncation), a coal seam or a relatively more mature paleosol (Kraus and Aslan, 1999; Prochnow et al., 2006; Cleveland et al., 2007; Famubode and Bhattacharya, 2016).

Acknowledgements

This research acknowledges project funding from the NSERC Discovery Grant RPG IN 05780-14, Quantitative Sedimentology Laboratories Consortium with British Petroleum as current sponsors, and through the Susan Cunningham Research Chair.

Furthermore, this research respectively worked in consortium with the Seboyeta land grand in New Mexico. All those interested in conducting field work within New Mexico should seek out land permits from the proper pueblo, Apache tribe, or from the Navajo Nation depending on the nature and locality of the research.

References

Cleveland, D.M., Atchley, S.C., and Nordt, L.C., (2007). Continental Sequence Stratigraphy of the Upper Triassic (Norian Rhaetian) Chinle Strata, Northern New Mexico, U.S.A.: Allocyclic and Autocyclic Origins of Paleosol Bearing Alluvial Successions. Journal of Sedimentary Research, 77, 909–924.

Driese, S.G. and Nordt, L.C., (2013). New Frontiers in Paleopedology and Terrestrial Paleoclimatology: Paleosols and Soil Surface Analog Systems. SEPM Society for Sedimentary Geology, 104.

Famubode, O.A. and Bhattacharya J.P., (2016). Sequence Stratigraphic Analysis Of The Youngest Nonmarine Sequence In The Cretaceous Ferron Notom Delta, South Central Utah, U.S.A. Journal of Sedimentary Research, 86, 168 – 198.

Kraus, M.J., and Aslan, A., (1999). Palaeosol sequences in floodplain environments: a hierarchical approach, in Thiry, M., and Simon-Coincon, R., eds., Palaeoweathering, Palaeosurfaces and Related Continental Deposits. *International Association of Sedimentologists, Special Publication* **27**, 303–321.

Prochnow, S.J., Atchley, S.C., Boucher, T., Nordt, L.C., and Hudec, M.R., (2006) The influence of salt withdrawal subsidence on paleosol maturity, sedimentation rates, and cyclic fluvial deposition in the Triassic Chinle Formation: the Big Bend minibasin near Castle Valley, Utah. *Sedimentology*, **53**, 1319–1345.