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Technical Session 1: Paleoclimatology and Paleogeography (Thursday, June 8, 2023, 9:45 AM)

REAPPRAISAL OF THE MORENO HILL FORMATION, NEW MEXICO (USA)

Cilliers, Charl D.[1], Tucker, Ryan T.[1], Zanno, Lindsay E.[2,3]
[1]Department of Earth Sciences, Faculty of Science, Stellenbosch University, Private Bag X1, Matieland 7602, South Africa, cdcilliers@sun.ac.za, tucker@sun.ac.za; [2]Paleontology, North Carolina Museum of Natural Sciences, 11 W. Jones St., Raleigh, North Carolina, USA 27601, lindsay.zanno@naturalsciences.org; [3]Department of Biological Sciences, Campus Box 7617, North Carolina State University, Raleigh, North Carolina, USA 27695

The mid-Cretaceous is demarcated by enigmatic yet globally significant tectonic and climatic processes (Huber et al., 2018). Although our understanding of the Cenomanian–Turonian is improving, geological and paleontological data immediately succeeding the Cretaceous Thermal Maximum remains fragmentary (Nesbitt et al., 2019; Cilliers, 2022). Fortunately, potential insights into the Turonian–Coniacian transition are preserved within the Moreno Hill Formation (MHF) of the Salt Lake Coal Field (SLCF) in west-central New Mexico (McLellan et al., 1983). Despite this importance, the MHF has hitherto undergone limited geohistorical interpretations.

Recently, we constructed new temporal, palaeoenvironmental, and stratigraphic frameworks for this globally important fossil-bearing sedimentary succession. We

conducted U/Pb radiometric age dating of detrital zircons sampled from the historically defined lower, middle, and upper members of the MHF via LA-ICP-MS and CA-TIMS (Cilliers et al., 2021). Our study found that sediment transport and emplacement occurred during two non-coeval pulses of volcanism. The lower and middle members were emplaced after an eruption at 90.855 ± 0.040 Ma (late Turonian). A subsequent, younger pulse of volcanism at 88.632 ± 0.072 Ma (early Coniacian) is preserved in the upper MHF. Although sediment transport and emplacement were ongoing, the different zircon populations indicate the MHF to be diachronous. Based on geographic proximity, the Peninsular Ranges and Sierra Nevada Batholiths were likely source terranes for the above-mentioned youthful zircon grains and populations (Pecha et al., 2018).

With the additional assessment of co-occurring recycled zircon grains, we were able to strengthen tenuous linkages to key sediment source terranes and simultaneously construct a meaningful drainage history. By and large, most grains are derived from uplifted and eroded portions of the Yavapai/Mazatzal and Grenville to the west and south via the Sevier Fold and Thrust Belt and Mogollon Highlands (Pecha et al., 2018). Chiefly, this study identified the markedly different detrital histories of the lower and middle members when compared to the upper member to be a result of tectonically driven landscape modification. This difference is linked to the ongoing eastward migration of the forebulge, which gradually diverted westerly and north-westerly-lying feeder systems (e.g., Sierra Nevada Batholith and Sevier Highlands), synchronous with the development of the Maria Fold and Thrust Belt as a sediment source from the west to the southwest around 90–86 Ma (Cilliers et al., 2021; Szwarc et al., 2015).

We further assessed preserved Turonian–Coniacian climatic and environmental changes. Utilizing facies analysis and architectural reconstruction (Miall, 2016), we identified that the majority of lower member floodplain sediment was modified by pedogenic processes, with the most frequent facies comprising stacked gleyed vertisols, histosols, vertic histosols, and protosols (Tabor et al., 2017). These alternating paleosols indicate that groundwater fluctuated during a regional (southern Colorado Plateau) regression (R1) coincident with the latest Greenhorn Cyclothem which was followed by the New Mexico-specific T2–R2 transgressive-regressive sequence (Molenaar, 1983). Overall regression and base level fall within the lower member following the T2 is corroborated by the transition from relatively more-sulfurous coastal to less-sulfurous fluvial coals and by increasingly bedload-rich multi-story channel complexes (Hoffman, 1994; Cilliers, 2022). Transitioning to the upper member, sedimentary patterns and pedogenic development remain consistent with continued base level fall and slight aridification albeit with continuing groundwater flux. Whereas westerly feeder system diversion probably contributed to a return to single-story sandstones, more suspended-load-rich fluvial sediment and thin upper member coals are also linked to landward effects of another minor (T3) transgression (Elder & Kirkland, 1993). Therefore, MHF sediment modification occurred in a developing upper delta floodplain during punctuated regression of the Western Interior Seaway coincident with the latest Greenhorn through early Niobrara Cyclothems (Blakey, 2014; Miall & Catuneanu, 2019). We consider the Rufiji (Tanzania) or Godavari Rivers (India) as useful modern analogs.

Bolstered by shifting provenance, slight facies-based differences between the lower and upper MHF support a revised subdivision from three to two informal members. Using this two-member subdivision as a foundation for stratigraphic reappraisal we first resolved the stratigraphy of field sites in the southern SLCF where the MHF is mostly mapped as undivided. By including sedimentary, paleocurrent, structural, and existing spatial data within a parsimonious progradational geomorphologic model three sites were assigned to the lower MMF and one site to the upper member. Correlations to the seaward Gallup Delta (Molenaar et al., 2002) and contemporaneous Kaiparowits, Notom, Last Chance, Vernal, Frontier, and Cardium fluvio-deltaic systems (Bhattacharya & MacEachern, 2009) were then reassessed and strengthened. The lower member correlates to the Tres Hermanos Formation (Carthage and Ramah members), the uppermost Gallup Sandstone, and the Crevasse Canyon Formation (Torrivio Sandstone Member) and regionally to the middle–upper Toreva, Straight Cliffs (Tibbet Canyon and Smoky Hollow members), lower Funk Valley, upper Ferron Sandstone, Frontier (Dry Hollow Member), and Cardium formations. The upper member correlates to the Crevasse Canyon Formation (Dilco Coal Member) and regionally to the lower Wepo and Straight Cliffs (John Henry Member) formations. Ongoing progradation of the Gallup Delta system in response to the Greenhorn Regression likely resulted in continued maturation of the Moreno Hill floodplain and the biological communities therein (Cilliers, 2022).

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Poster Session 3 (Saturday, June 10, 2023)

BROKEN BONES AND BRUISED EGOS: TRAUMA AND INFECTION IN CERATOPSID DINOSAURS

Conway, Brian P.[1] and Peterson, Joseph E.[1]
[1]*University of Wisconsin-Oshkosh, Harrington Hall. 845 Elmwood Ave, Oshkosh, Wisconsin, USA 54901,* conwaybr59@uwosh.edu

Paleopathologies are useful data for interpreting disease and behavior in extinct organisms. Isolated pathological specimens record discrete events in an individual's life, but pathologies common to many within a population may suggest habitual behaviors or diseases (Moodie, 1923; Peterson et al., 2013; Stilson et al., 2015; Wolff et al., 2009; Woodruff et al., 2022). Ceratopsian dinosaurs are frequently speculated to have used their cranial horns and bosses against conspecifics in agonistic interactions (Farke et al., 2009; Farlow & Dodson, 1976; Hatcher, 1907; Hieronymus et al., 2009). Studying their distributions and frequencies of pathology is one way to test this hypothesis. The crania of these animals frequently exhibit lesions, fracture calluses, extra fenestrae, and other pathologies suggesting traumatic injury or unusual ontogenetic change (Campbell et al., 2018; Farke et al., 2009; Tanke & Farke, 2006). The axial and appendicular skeletons receive less attention despite the abundance of bonebed material (but see Tanke & Rothschild, 2010).