Channels, Overbanks and Paleosols: The Relationship Between Climate, Base Level and Lithofacies Heterogeneity Within the Triassic Sonsela Member, PFNP Arizona

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Sedimentologic, stratigraphic and paleopedologic investigations of the Late Triassic Sonsela Member in the Petrified Forest National Park (PFNP) reveal a cyclic succession of alluvial deposits and bounding paleosols. Sedimentologic data from eight measured sections are used to characterize the spatial distribution of alluvial architectural elements along a continuous 1.2 km Sonsela outcrop. Architectural elements include downstream accretion, lateral accretion, crevasse splay, and overbank deposits that indicate a mixed-load fluvial system. Within the measured sections, paleosol profiles were repetitively described along the bounding discontinuity surfaces that partition the stratigraphic succession into seven fining-upward meter-scale depositional cycles. Lithofacies and paleosols were walked-out to establish distributions and variability within cycles. Cycles systematically stack in response to what was a longer-period variation in accommodation. Cycles at the base of the succession are thick and dominated by extensive downstream-accretion deposits, and associated bounding discontinuities have weak paleosol development. Cycles in the upper portion of the succession are thinner and dominated by more discontinuous lateral accretion, crevasse splay and overbank deposits, and bounding discontinuities have better developed, well-drained paleosols. The uppermost portion of the succession is characterized by very thin cycles with discontinuous channel sandstones, and bounding paleosols that are well-developed and poorly drained. Point-counts of porosity within channel facies and subsequent transform to permeability (on the basis of grain size and sorting) provides a 2D depiction of the lateral variability in reservoir quality as correlated to architectural element. Flow baffles between cycles coincide with paleosols owing to their low permeability silty-clay to clayey-silt texture. The reduction in both reservoir quality and continuity within the study interval was produced by fluvial aggradation during an episode of long term accommodation deceleration within a period of uniform climatic conditions.