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Late Paleozoic Sediment Routing Systems of the Appalachian Basin – Linkages with Alleghanian Orogenesis

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Sedimentary rocks of the lower Breathitt Group of the Pocahontas Basin preserve an Early Pennsylvanian record of alluvial sedimentation during initial foreland basin subsidence associated with the Alleghanian orogeny. Breathitt Group strata provide an opportunity to review the depositional response of a large-scale integrated drainage network to unsteady tectonic load variations at convergent plate margins. Observations of rapid changes in the relative distribution of longitudinal and transverse alluvial facies belts, abrupt changes in siliciclastic provenance and enhanced transgressions within the context of an ancient, marginal-marine foreland basin provide stratigraphic evidence to disentangle a recurring, low-frequency residual tectonic signature from high-frequency glacioeustatic events.

Results from basin-wide facies analysis of outcrops, well data and cores, corroborated with petrography and detrital zircon geochronology, support a two end-member depositional model of coexisting transverse and longitudinal alluvial systems infilling the foredeep during eustatic lowstands. Immature lithic sandstones, were deposited within a SE-NW oriented transverse drainage system supplied directly from the evolving orogen. Quartzarenites were deposited within a strike-parallel NE-SW oriented axial drainage, forming elongate belts along the western basin margin. Detrital zircon geochronology demonstrates that sediment in both alluvial systems was recycled from older Palaeozoic sedimentary rocks uplifted during the Alleghanian orogeny. Sediment in transverse alluvial systems was derived in part from proximal Avalonian terranes and that in longitudinal river systems was derived in part from the distant Archean Superior and Yavapai-Mazatzal Provinces.

Integrating subsurface and provenance data indicates significant, repeated paleogeographical shifts in alluvial facies distribution. Distinct wedges comprising composite sequences are bounded by successive shifts in alluvial facies and define three low-frequency tectonic accommodation cycles. These cycles define short-term episodes of unsteady westward migration of the flexural Appalachian Basin, constraining the relative timing of deformation events during cratonward progression of the Alleghanian orogenic wedge.

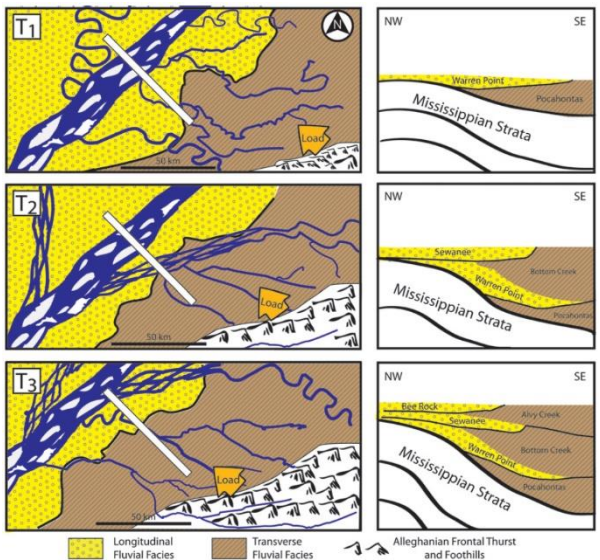

Figure 1: Series of paleogeographic maps tracking trends in the eastern limit of quartzarenite facies during early Pennsylvanian tectonic events T1, T2 and T3. Fluvial facies distributions derived from the isochore maps of Grimm et al., [1].

References:

[1] Grimm et al. (2013) Basin Res 25 (4): 450-470