

# Detrital Zircon U-Pb Data of Pennsylvanian to Lower Permian Sandstones from the Eastern Shelf of the Permian Basin — Insights into Syn-Collisional Sediment Provenance and Sediment Routing Systems

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## Abstract

The Permian and Fort Worth Basins of central Texas are part of system of flexural foreland basin in front of the Ouachita orogenic collision zone that developed along the southern margin of Laurentia in late Paleozoic times. Significant controversy surrounds sediment provenance of Pennsylvanian syn-orogenic strata, paleo-drainage evolution, and sediment routing system during the Ouachita collision. In particular, the existence and importance of an Alleghanian axial drainage system versus a transverse sediment delivery system from the Ouachita orogenic belt and Gondwana hinterland remain controversial. This study presents new zircon U-Pb data from 20+ sandstone samples from the Eastern Shelf of the Permian Basin, spanning Atokan Smithwick, Desmoinesian Strawn Group, and Virgilian-Wolfcampian Cisco Group sandstones exposed along the northern and north-western margin of the Proterozoic Llano Uplift. The data show rather consistent detrital zircon U-Pb spectra dominated by Grenville (930 and 1100 Ma) and late Neoproterozoic (700-600 Ma) and subordinate Carboniferous, Ordovician, Cambrian, Meso- and Paleoproterozoic, and Archean zircon age components. While the spectra are rather monotonous, the different Paleozoic and Neoproterozoic age components increase stratigraphically up-section, particularly in the Cisco Group, at the

expense of Meso- and Paleo-Proterozoic components. More importantly, however, the observed detrital zircon signatures are in stark contrast to typical Alleghanian spectra, dominated by >1 Ga and Ordovician zircon ages, hence arguing against a significant axial sediment routing system. In particular, the presence of Carboniferous (320-350 Ma) zircons, likely derived from the pre-collisional magmatic arc, the prominent Neoproterozoic and 930 Ma age peaks argue for derivation from the orogenic hinterland, recycling the former rifted margin, and tapping into Gondwana and Oaxaquian source terranes and therefore a transverse syn-collisional sediment routing system. The marked increase in Cambrian zircons in the Virgilian-Wolfcampian Cisco Group appears to point to a more significant northern source from the S Oklahoma aulacogen with time. Early Meso-Proterozoic to Archean detrital zircon do not exhibit any well-developed peaks and could be sourced from either Laurentia or Amazonia or recycled from the former continental margins involved in the collision. In summary, the relatively consistent and cosmopolitan detrital zircon U-Pb age signatures of Atokan-Wolfcampian syn-orogenic strata in central Texas argue for a persistent and dominant Pennsylvanian to early Permian sediment delivery system to the eastern Permian Basin via the Eastern Shelf directly from the collision zones and/or the Gondwanan orogenic hinterland.

*Key Words: Detrital zircon, geochronology, Pennsylvanian, Permian, Eastern Shelf, Permian Basin*