Detrital Zircon Provenance Trends Across the Plio-Pleistocene Upper Santa Fe Group, Implications for Drainage Evolution of the Ancestral Rio Grande Fluvial System

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Axial-fluvial strata exposed throughout the Rio Grande rift (RGR) corridor preserve a ~4 m.y. record of provenance and drainage-network configurations from the Plio-early Pleistocene ancestral Rio Grande river just prior to incision and the arrival of the modern river system at ~1 Ma. Presented here are U-Pb detrital zircon ages from 8 samples (N=2382) collected from the Camp Rice and equivalent Palomas Formation in the Socorro, Hatch/Rincon-Jornada del Muerto, and Mesilla basins in central and southern New Mexico. Samples were collected from the three basins at equivalent stratigraphic horizons (5.0, 3.1, and 1.6 Ma) where known age constraints exist.

The Socorro basin is the furthest upstream locality in this study and records peak ages at 1684, 1442, 1076, 520, 421, 168, 87, 34, and 5 Ma. The Hatch/Rincon-Jornada del Muerto basin is downstream and south of the Socorro basin and exhibits peak ages at 1679, 1431, 1072, 618, 514, 421, 217, 166, 83, 35, 28, and 5 Ma. The Mesilla basin is the southernmost downstream locality in this study and preserves peak ages at 1687, 1432, 1034, 602, 522, 430, 224, 189, 165, 95, 64, 35, and 28 Ma. Peak ages from all samples overlap with Precambrian source areas of the Yavapai-Mazatzal, A-type granite, and Grenville provinces. The strongest Phanerozoic peaks overlap with the Permian–Cretaceous Cordilleran arc and late Eocene–Oligocene calderas of southern New Mexico.

Comparison of detrital zircon trends with previous studies in the northern portion of the RGR provide a spatial and temporally extensive record of drainage configuration during the Plio-Pleistocene phase of drainage development. The oldest stratigraphic intervals of Pliocene axial-fluvial strata (~5.0–4.5 Ma) contain the highest percentage of zircons that overlap in age with late Cenozoic volcanic fields. Recycled Cordilleran arc-derived zircons are rare in the northernmost part of the rift corridor (i.e. southern Colorado and northern New Mexico) but increase in percentage throughout central New Mexico and decrease slightly in southern New Mexico. Younger, Late Pliocene stratigraphic horizons (~3.1–2.6 Ma) throughout New Mexico record decreased contributions of zircons derived from late Cenozoic volcanic fields relative to older axial-fluvial strata. The youngest, (Pleistocene) stratigraphic intervals range in age from 2.0–1.6 Ma and contain some of the highest percentages of recycled Cordilleran arc-derived zircons in the study with much lower percentages of late Cenozoic-age zircons.

Provenance trends across the RGR reflect an upsection transition from initial, caldera-dominated sources available during the Pliocene, to more Colorado Plateau-dominated recycled sources during the Pleistocene stage of drainage development. This trend may reflect denudation of the Colorado Plateau possibly as a result of headward erosion of the Rio Puerco and Rio San Jose during the late Pliocene. The absence of zircons that overlap in age with late Cenozoic volcanic fields at the youngest stratigraphic horizons may reflect hydrologic closure of the Upper San Luis basin following emplacement of the Taos Plateau volcanic field in northern New Mexico and southern Colorado.