Project Title

Constraining the Oligo-Miocene transition from endorheic (closed basin) rift sedimentation during the earliest stages of the ancestral Rio Grande river south-central New Mexico

Problem and Purpose of Study

The Oligocene–Miocene history of the early, endorheic (closed-basin) ancestral Rio Grande depositional system in southern New Mexico is preserved in the Rincon Valley and Hayner Ranch formations that outcrop along the modern Rio Grande rift (RGR) margin in the Jornada del Muerto basin and central Mesilla basin in southern New Mexico (Fig. 1, 2; (Koning et al., 2016; Mack and Seager, 1990; Mack et al., 2006; Mack et al., 1994; Mack et al., 1997; Mack et al., 2009). The RGR preserves a near-continuous record of sedimentation and volcanism from late Eocene–Present, and although a considerable amount of previous work has focused on documenting the onset, extent, and geochemistry of Eocene–Oligocene volcanism during the early stages of the RGR, very little is known about drainage development and sediment dispersal during the latest Oligocene–Miocene. This project proposes a field- and lab-based approach that includes collection of new sedimentologic, stratigraphic, provenance, and detrital geochronologic data sets will test the timing and evolution of the transition from endorheic to exorheic conditions in southern New Mexico. At the largest scale, data will be used to help constrain late Oligocene–Miocene, endorheic (closed-basin), lacustrine-dominated conditions just prior to the Miocene–Pliocene integration of the ancestral Rio Grande river. Results from this project will also be used to better understand the transition to more exorheic (open-basin) fluvial-dominated conditions that occurred at the very end of the Miocene (Connel et al., 2005; Respasch et al., 2017). In addition, results will foster a better understanding on the tectonic mechanisms driving river integration and the rates at which the transition to exorheic-basin conditions take place in continental rift settings.

Significance of Study

The Rio Grande rift (RGR) is the only location in North America where the modern interplay between exhumation, erosion, and sedimentation in a narrow, active, continental rift zone can be directly observed. New Mexico provides an excellent opportunity to carry out this project given the unique distribution of bedrock source areas that have been exposed as a result of continental rifting (e.g., Cenozoic volcanic fields, recycled Paleozoic–Mesozoic stratigraphy of the Colorado plateau, and Precambrian basement sources). At the largest scale, data from this study will be used to constrain endorheic, lacustrine-dominated conditions just prior to the integration of the ancestral Rio Grande river and will also be used to better understand the transition to more exorheic fluvial-dominated conditions that occurred at the very end of the Miocene. Although beyond the scope of this project, results from this study should also provide additional constraint on lacustrine and axial-fluvial rift strata that commonly represent the source and late-stage reservoir components of continental rift petroleum systems, respectively, as well as provide a better understanding of the Miocene groundwater aquifer system for southern New Mexico (including the greater Las Cruces region; pop.>100,000).

Research Plan, Approach, and Methods

I propose conducting a 12–15 day field study at three field localities in the south-central RGR corridor in New Mexico. Three field localities have been selected in the Jornada del Muerto basin and central Mesilla basin (near Las Cruces, NM) (Fig. 1). Field work at each locality will include measurement of detailed stratigraphic sections and sample collection for U-Pb detrital zircon geochronologic analyses (N=7), and sandstone modal composition determination (N=24). Samples will be collected across two synrift, stratigraphic units (Hayner Ranch and Rincon Valley formations), both of which have some preexisting geochronologic constraint. U-Pb results will be compared to ages of potential source areas in the closed headwater drainages of the RGR which expose Cenozoic rocks of the Mogollon-Datil volcanic field (and age equivalent volcanic rocks), recycled Paleozoic–Mesozoic stratigraphy along the southeastern margin of the Colorado plateau (e.g., Mesozoic eolianites), and Paleo-Mesoproterozoic basement sources (e.g., Yavapai and Mazatal provinces) that outcrop along the flanks of the RGR. The stratigraphic intervals of interest in this proposed study include (1) Oligocene alluvial-fan and lacustrine strata of the Hayner Ranch Formation, and (2) alluvial-fan and fluvial dominated strata of the Miocene Rincon Valley Formation. All samples will be collected in the context of measured stratigraphic sections. Each of these stratigraphic horizons record the very earliest stages of rift sedimentation along with the transition from early-stage endorheic conditions to late Miocene–earliest Pliocene establishment and integration of the fluvial dominated, ancestral Rio Grande river.

Research Timeline

A majority of field work for this project will be carried out in mid/late Spring 2022 and will include measured stratigraphic sections, collection of detrital zircon and sandstone samples for modal composition determination. Sample preparation (e.g., mineral separation and billets for thin sections) will take place at NMSU during April and May of 2022. I plan to travel to Tucson, Arizona, to analyze detrital zircon samples at the University of Arizona's LaserChron Center during the third week of June, 2022. I will start point counting in early July and plan to have all sandstone modal composition data collected by the end of August, 2022. I will also be preparing and submitting a first-authored abstract for the 2022 GSA Annual Meeting that will take place in Denver, Colorado, in October, 2022. I plan to spend Fall, 2022, interpreting and illustrating my U-Pb detrital zircon ages and sandstone modal point-count data. Preliminary results from my project will be presented at the 2022 GSA Annual Meeting in Denver, Colorado. I also plan to present a formal talk of my preliminary results at the NMSU, Department of Geological Sciences weekly colloquium in either October or November or 2022. I will conclude any remaining data interpretations and plan to submit an abstract and present at the 2023 New Mexico Geological Society Spring Meeting in Socorro, New Mexico. I am aiming to have a complete and defendable draft of my thesis ready to present by late Spring or early Summer of 2023.

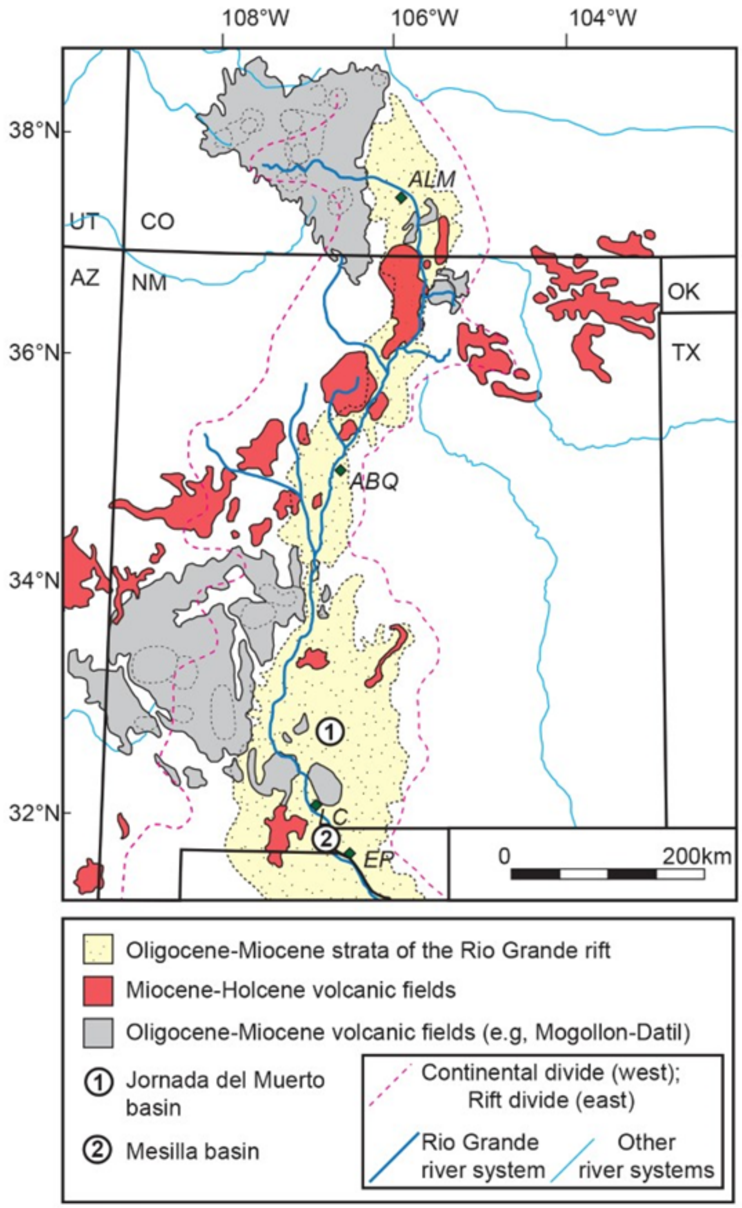

FIGURE 1. Generalized geology and stratigraphic overview of the mid-late Cenozoic Rio Grande rift with focus on central and southern New Mexico (Jornada del Muerto and Mesilla basins). Map modified in part from Repasch et al (2017). Geologic map denotes Oligocene-Miocene synrift strata and volcanic fields (e.g., San Juan, Latir, and Mogollon Datil) as well as the Miocene -Holocene Jemez Lineament in the context of the Rio Grande rift. White circles denote field localities in the Jornada del Muerto and Mesilla basins. At each field locality, samples will be collected for detrital zircon analyses and modal composition determination. All samples will be collected in the context of measured stratigraphic sections at three localities in each of the two basins.

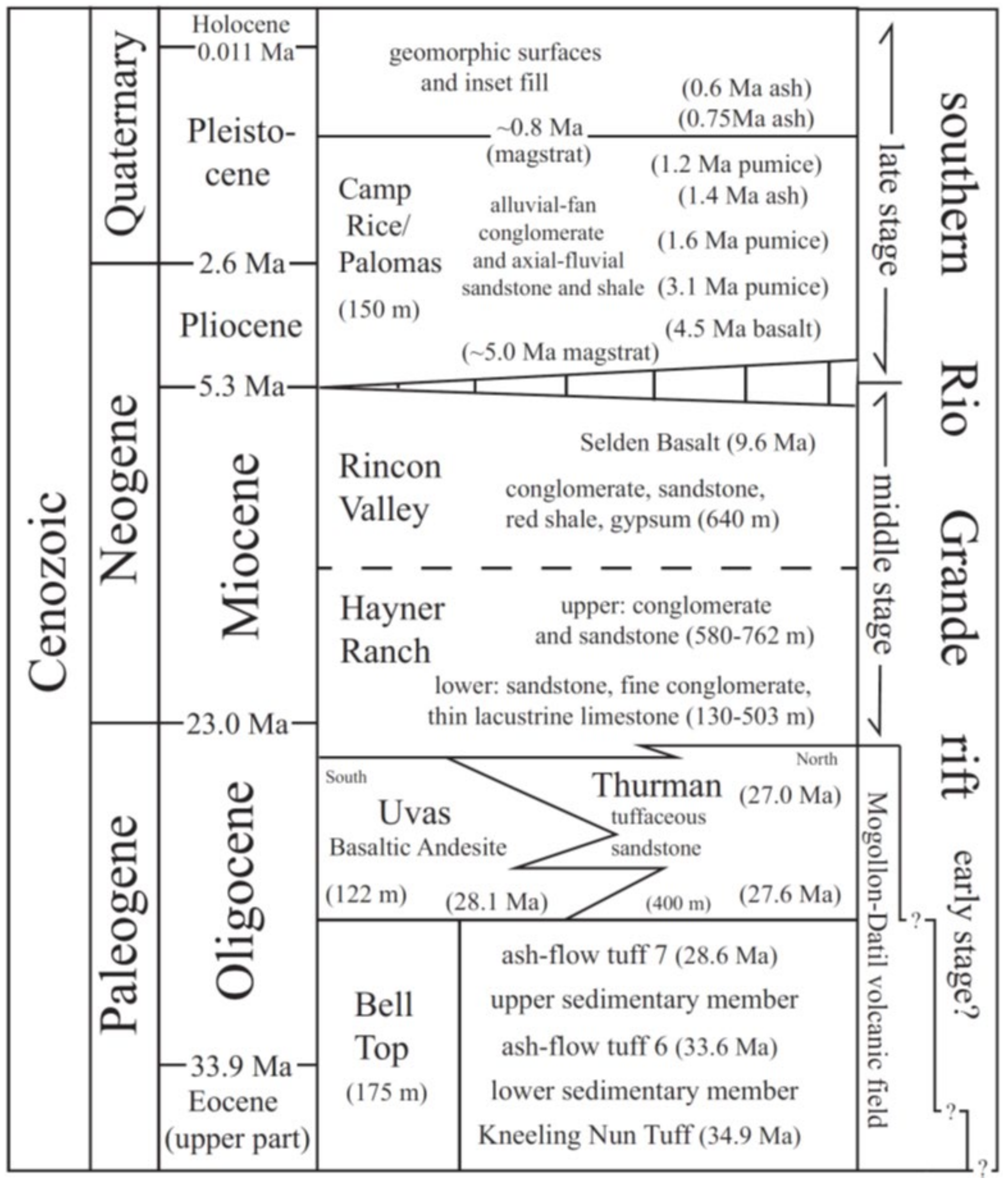

FIGURE 2. Stratigraphic overview of Olio-Miocene to Present strata of the Rio Grande rift from the headwaters in southernmost Colorado (left side of figure) to central and southern New Mexico (center and right side of figure). The focus of this study are on latest Oligocene to latest Miocene strata of the Hayner Ranch and Rincon Valley formations in southern New Mexico. These strata represent the early-and late-stages of endorheic (closed-basin) sedimentation just prior to the integration of the ancestral Rio Grande river at the Miocene–Pliocene boundary. Stratigraphic column modified from Greg Mack; personal communication/ not published).

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