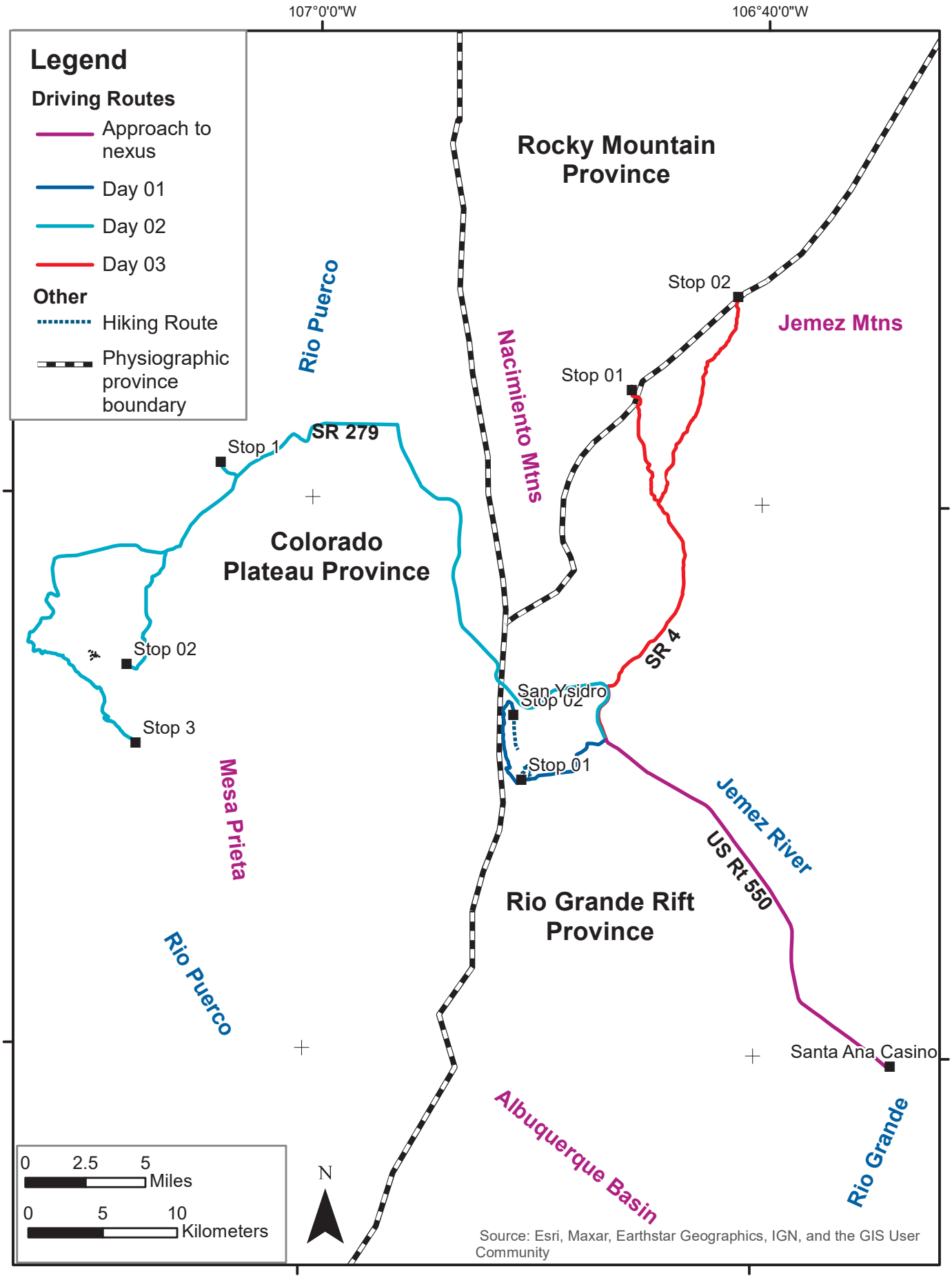
GEOLOGY OF THE NACIMIENTO MOUNTAINS AND RIO PUERCO VALLEY

New Mexico Geological Society
2024


107°0'0"W
106°40'0"W
35°40'0"N
35°20'0"N
Legend
Driving Routes
Approach to nexus
Day 01
Day 02
Day 03
Other
Hiking Route
Physiographic province boundary
Rocky Mountain Province
Colorado Plateau Province
Rio Grande Rift Province
Rio Puerco
Nacimiento Mtns
Jemez Mtns
Mesa Prieta
Albuquerque Basin
Rio Grande
Jemez River
SR 279
SR 4
US Rt 550
Stop 1
Stop 02
Stop 3
Stop 01
Stop 02
San Ysidro
Stop 01
Santa Ana Casino
0 2.5 5 Miles
0 5 10 Kilometers
N
Source: Esri, Maxar, Earthstar Geographics, IGN, and the GIS User Community

GEOLOGY OF THE NACIMIENTO MOUNTAINS AND RIO PUERCO VALLEY

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New Mexico Geological Society
74th Annual Field Conference
October 23-26, 2024

The New Mexico Geological Society is a tax-exempt corporation registered in the State of New Mexico that promotes interest in geology and associated sciences, fosters scientific research and publications, encourages cooperation among its members, and stimulates interest in New Mexico geology. These goals are met through annual fall field conferences held in different locations in New Mexico or adjoining states and annual spring meetings, generally held in Socorro, New Mexico, where oral and poster presentations on different aspects of New Mexico geology are given.

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CONFERENCE ORGANIZERS' MESSAGE

An encompassing theme for the 2024 New Mexico Geological Society (NMGS) Fall Field Conference involves New Mexico's storied landscapes through deep time and the continued need to connect geoheritage and human heritage. The venue is Bernalillo, New Mexico, located on the Rio Grande just north of and becoming part of a rapidly expanding Albuquerque metropolitan area. The history of this community, like much of New Mexico, is that of a nexus involving very long interactions among Indigenous, Hispano, Anglo, and other cultures. Our geoheritage gains strength from this unique cultural richness as well as our unique geology.

We thank the Pueblos of Santa Ana, Zia, and Jemez, as this field conference studies geology across their present and traditional homelands. We recognize and honor them as original caretakers with deep connections to the land. We recognize that geology (the study of the Earth) is also part of Indigenous knowledge systems. Rivers are another theme of this field conference and of our common human heritage and geoheritage: the Rio Grande, Rio Jemez, and Rio Puerco have shaped our landscapes and host many of our stops and discussions.

We are trying new things for the 74th NMGS Fall Field Conference. The traditional minipapers are peer reviewed and folded in with the technical papers this year rather than included with the road log section. All the papers and road logs are open access and freely available on the NMGS website in PDF format during and after the meeting (https://nmgs.nmt.edu/publications/guidebooks/74). To save costs and paper, we are printing fewer hard copies of the full guidebook—mainly just for participants and libraries. Hold onto yours; it may be worth a fortune some day! We are emphasizing a scientific theme that we hope can integrate the different stops conceptually and may carry momentum into future NMGS field conferences. Next year, the 2025 fall field conference—NMGS's 75th—will be centered in Cuba and will examine the Colorado Plateau edge and the San Juan Basin. The following year, the 2026 fall field conference (the 76th) will be centered in the Albuquerque area and will focus on the Rio Grande rift and rocks exposed in its rift-flanks.

The geologic theme is *the Nacimiento nexus*. A nexus is a connection or central link in a system; for example, you are at a nexus when you find yourself in the middle of an intersection. The Nacimiento nexus is where three major physiographic provinces meet: the Colorado Plateau, the Rocky Mountains, and the Rio Grande rift. Also converging at this crossroads are the northeast-trending Jemez lineament and the Jemez Mountains containing the Valles Caldera supervolcano. Regional physiographic provinces are defined based on their distinctive topographic character, but topography also reflects geologic underpinnings. Thus, to examine the Nacimiento nexus requires a synthesis of what makes these adjoining provinces similar and different (Karlstrom et al., 2024). The details can be complex but the summary is simple: the Rocky Mountains, Colorado Plateau, and Rio Grande rift share many aspects of a common geologic history of Proterozoic crust formation, regional Paleozoic and Mesozoic depositional systems that record the biological evolution of life on Earth, and a multistage Cenozoic uplift and denudation history that has shaped our landscapes. The spectacular region near San Ysidro lays bare aspects of each of these shared chapters of New Mexico's geology. The physiographic boundaries between the mountains, plateau, and rift are transitional as the region undergoes geomorphic response to neotectonics.

We hope this conference is enjoyable for all and that it promotes respectful mutual education and interactions about geology.

Karl Karlstrom
Dan Koning

DEDICATION

The New Mexico Geological Society is pleased to dedicate this 2024 Fall Field Conference guidebook to Dr. Matthew Heizler. Matt has made important advances in $^{40}Ar/^{39}Ar$ geochronology and thermochronology and their application to geologic problems. He and his co-workers have built the New Mexico Geochronology Research Laboratory into one of the most respected and influential $^{40}Ar/^{39}Ar$ geochronology facilities in the world. Matt's research is prolific and strongly collaborative, and it has resulted in innovations for better $^{40}Ar/^{39}Ar$ analytical techniques. Matt is forceful in his research, humble and genuine as an individual, a great teacher and mentor of students, and a tireless advocate for geochronology.

Matt's scientific breakthroughs continue to resonate globally for the geosciences. They include a now-precise 66.0 Ma timing of the K-Pg boundary and evidence that dinosaurs were doing well (not declining) just before the extinction. He continues to work on understanding diffusion kinetics of feldspars and micas and has made innovations in precise dating of feldspar grains as young as a few thousand years old! With the *EarthTime* initiative, he conducted inter-lab cross calibration between U-Pb and $^{40}Ar/^{39}Ar$ dating systems for improved accuracy of geochronology in general. Sedimentary rocks are hard to date unless they contain tephras or interbedded lava flows; his new applications of dating and noble gas fingerprinting of detrital sanidine (on tens of thousands of single grains) provide new maximum depositional ages, reveal the nature of the eroding source regions, and can sometimes pinpoint the exact Cenozoic volcanic eruption that the grain came from. Matt's work on the cooling history of crystalline rocks in the Proterozoic orogens of the southwestern United States, Paleozoic orogens of New England, and many places globally illuminates how mountain belts erode and cool and "what happened" in deep time across Great Unconformities.

Teaching and mentoring are equally strong elements of Matt's contributions at New Mexico Tech, across the state of New Mexico, and internationally. Through his distance education class and in the lab, numerous graduate students have been "brought up" with best lab practices as they continue to make many contributions at the research and laboratory levels—a nice legacy for his mentoring. Matt has also taught numerous short courses at professional meetings and *EarthTime*.

Matt came from upstate Minnesota, where he returns most years for ice fishing that supplies the annual NMGS Spring Meeting fish fry, which he hosts with Lynn Heizler, herself a highly valued New Mexico Bureau of Geology and Mineral Resources (NMBGMR) microprobe technician. Matt and Lynn met at University of Minnesota-Duluth, where they both got their B.S. degrees in 1982. Matt went to University of Maine at Orono for his M.S. (1985) and to UCLA for his Ph.D. (1993). He came to New Mexico in 1993 and has served as NMBGMR Geochronologist and Deputy Director, as well as Adjunct Professor in New Mexico Tech's Department of Earth and Environmental Sciences. Matt retires in 2024 and will continue to help the lab as an Emeritus contributor.

Matt's versatility in applying the $^{40}Ar/^{39}Ar$ method is unmatched. He is a complete educator and scientist and an unparalleled collaborator.

Karl Karlstrom

PRESIDENT'S MESSAGE

Welcome, all, to the 74th Fall Field Conference! While there may be nothing new under the sun, there is something new for the Society in 2024: for the first time in its history, the NMGS Fall Field Conference is based out of Bernalillo. I am pleased to be here with you as part of our unique society of teachers and learners. As always, this year's conference provides us with opportunities for catching up with each other, welcoming new arrivals into the New Mexico geology community, rehashing old memories, and, most importantly, experiencing the world-class geology of our home. I cannot wait to get to the outcrops with all of you.

This year's conference will cause all of us to think about boundaries and borders in geoscience. Are they easily defined and precise, or are they thick and blurry? Does one subdiscipline define boundaries in the same way as the next, and why or why not? With open minds and eagerness to learn, let us explore these questions and more. The geology introduced in this year's conference will serve as an excellent foundation for the next two Fall Field Conferences. In 2025, the 75th Fall Field Conference will focus on the eastern margin of the San Juan Basin near Cuba for the first time since 1992. In 2026, the 76th Fall Field Conference will see a return to Albuquerque, which last hosted a Fall Field Conference in the last year of the previous millennium.

As in every autumn since 1950, this year we owe a debt of gratitude to the many volunteers who make our Fall Field Conferences the unrivaled experiences that they are. I extend heartfelt thanks and admiration to Karl Karlstrom, who has led this year's Fall Field Conference committee and advocated for the concept of a geological nexus—well explained in his introduction later in this volume. The logistical success of this conference will be due to tireless work from Nels Iverson, who has done such a grand job that he just might be asked to do it again next year. Road logging through the never-ending traffic of U.S. Highway 550, the deep dust of the Rio Puerco Valley, and pernicious speed traps of Highway 4 is a tedious endeavor, and we have the remarkable expertise of Laura Crossey, Larry Crumpler, Maya Elrick, Dan Koning, and Steve Wells to thank for their detailed efforts. The numerous and diverse science manuscripts in this volume represent the continuation of NMGS guidebooks serving as the public record for new research into New Mexico's geology, and we have the editorial efforts of Jayne Aubele, Johanna Blake, Larry Crumpler, Fraser Goff, Nels Iverson, Karl Karlstrom, Shari Kelley, Dan Koning, and Spencer Lucas to thank for that. My gratitude to NMGS Webmaster Adam Read and NMGS Registration Chair Connie Apache grows daily; please join me in offering hearty thanks when you see them, as their work makes the Society run.

In the past year, the Society has awarded over $50,000 to New Mexico's geology students in the form of scholarships, competitive grants, registration for Spring and Fall Conferences, and book awards. I thank the NMGS Foundation for acting as stewards for Society finances. I especially thank the numerous donors who make many of these scholarships possible; your generosity is directly helping the next generation of New Mexican geologists. Special thanks also are due to Scholarships Committee Chair Susan Lucas Kamat, whose unselfish dedication has helped deliver a years-long succession of student support.

I have thanked a number of people by name, but there are countless others whose generous contributions of their expertise, time, and resources ensure that the New Mexico Geological Society is the best there is. We owe each of them thanks, as well. It has been an honor and an inspiration to work with each of the considerate and dedicated souls we find, year after year, in our march forward. Thank you!

Kevin M. Hobbs
2024 NMGS President

NEW MEXICO GEOLOGICAL SOCIETY FOUNDATION

The New Mexico Geological Society (NMGS) Foundation was established in 2003 with the mission of providing a source of funding for educational and scientific objectives that benefit the geologic profession in New Mexico and the general public. The NMGS has a distinguished history as one of the premier state geologic organizations in the country, dating to its founding in 1947. One of the primary attributes that differentiates the NMGS from many state geological societies is ready access to world-class geologic outcrops and efforts to get young geoscience students out of the classroom and into this natural laboratory to gain hands-on experience during the annual Fall Field Conferences. NMGS Fall Field Conference organizers and presenters are at the forefront of their geoscience fields and use the latest technologies and applications to optimize students' learning and broaden their educational experiences.

The NMGS Foundation was created as a 501(c)(3) nonprofit corporation. Its revenues are responsible for supporting activities including the annual NMGS Fall Field Trip, NMGS Spring Meeting, numerous NMGS grants-in-aid to students undertaking geologic research in the state of New Mexico, and scholarships to students attending four-year colleges and research universities throughout New Mexico.

Meeting the objective of ensuring student participation in NMGS annual field trips and research events will continue the legacy NMGS events hold as premier nationwide destinations for geoscience education. In that spirit, we invite you to join us in supporting the NMGS with a philanthropic gift. To make a gift, please go to https://nmgs.nmt.edu/donations.

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The Rio Salado, looking west, heading back after the first-day field trip afternoon stops. Rio Salado is aptly named for its high salt content.