Front Matter

(Usually includes Dedication, President's Message, & Conference Organizer's Message.)

in:
Socorro Region III, Koning, Daniel J.; Hobbs, Kevin J.; Phillips, Fred M.; Nelson, W. John; Cather, Steven M.; Jakle, Anne C.; Van Der Werff, Brittney, New Mexico Geological Society 72nd Annual Fall Field Conference Guidebook, 426 p. https://doi.org/10.56577/FFC-72

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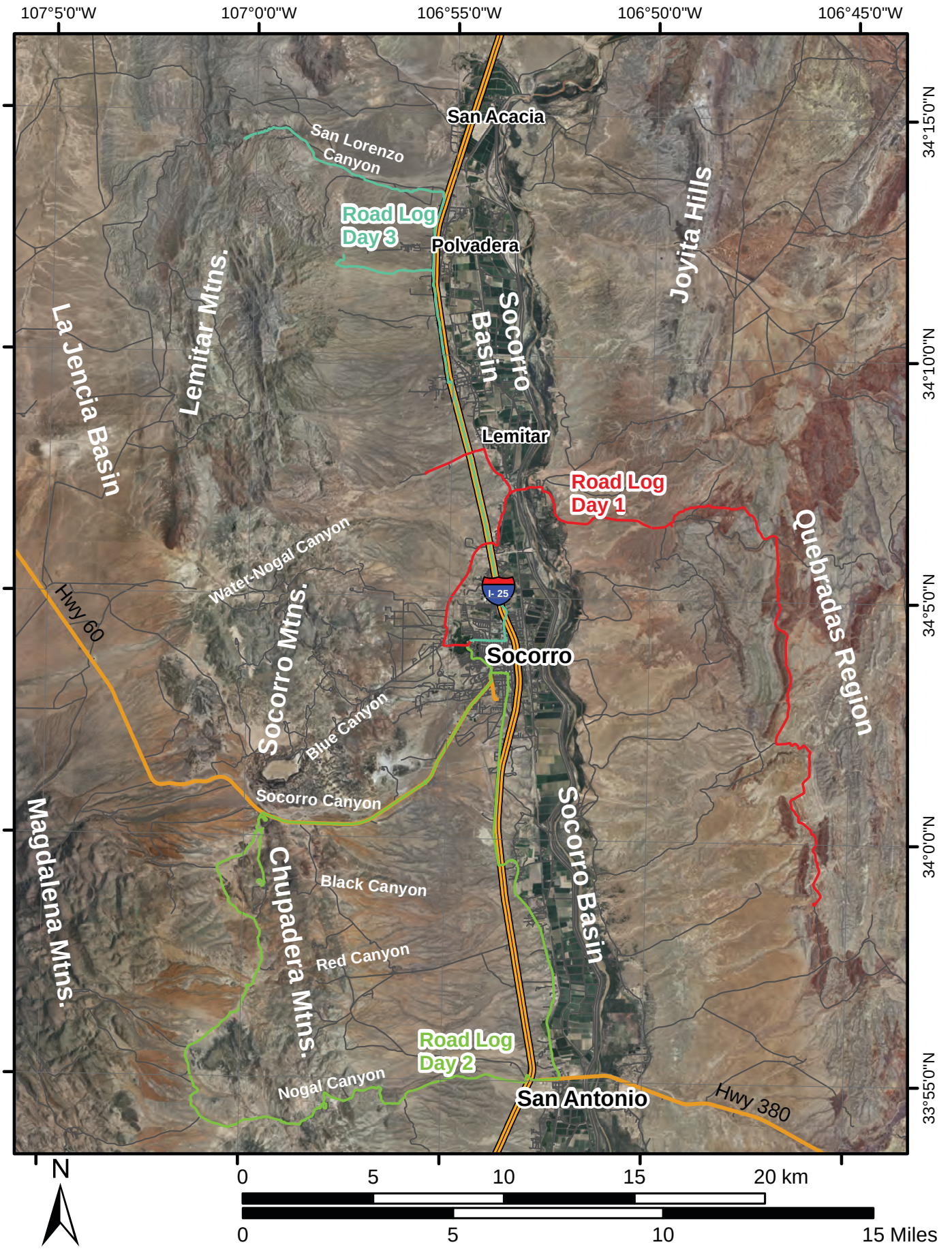
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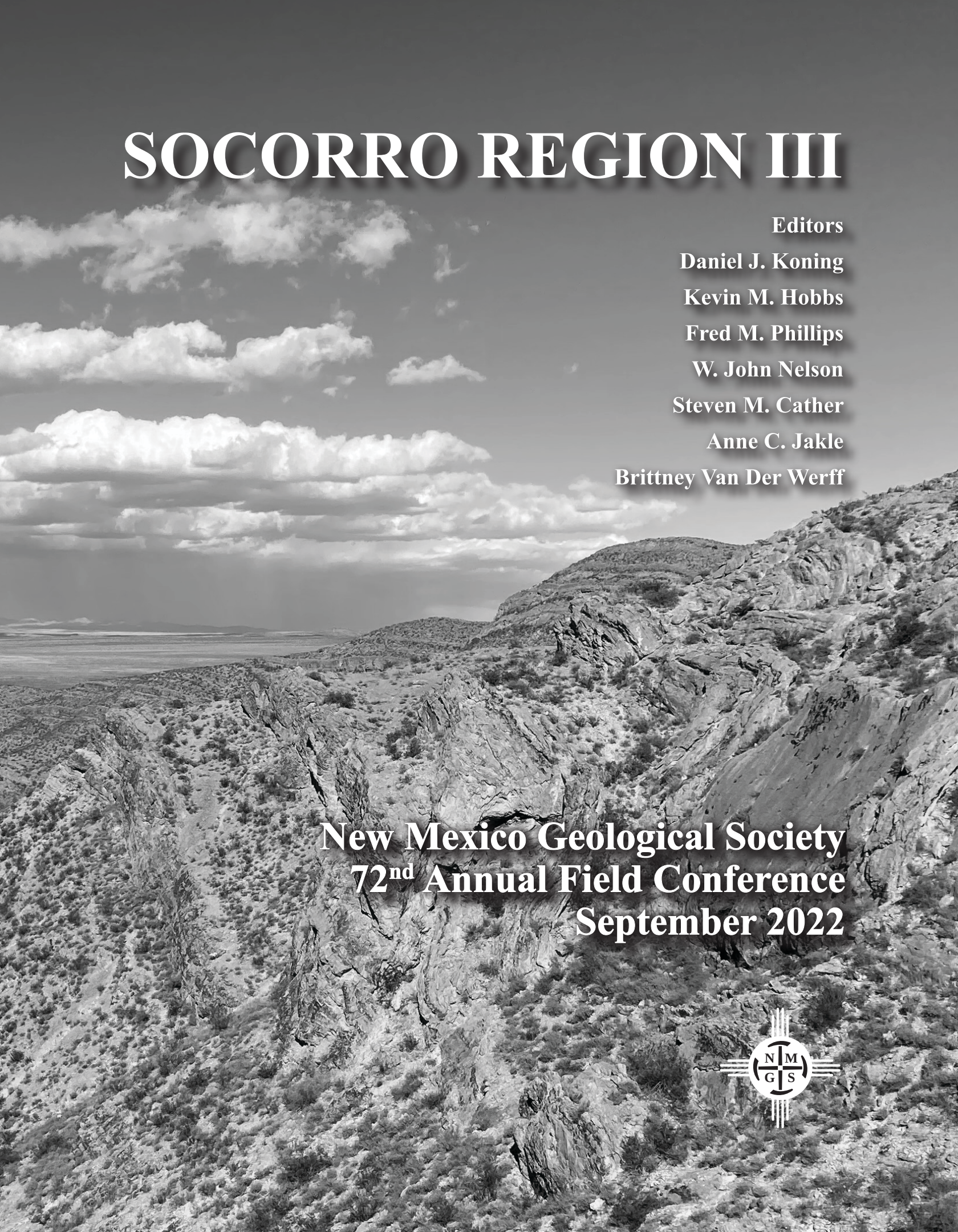

SOCORRO REGION III

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New Mexico Geological Society
72nd Annual Field Conference
September 2022

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.

NEW MEXICO GEOLOGICAL SOCIETY, INC.
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Copyeditor: Anne C. Jakle
Design and Layout: Brittney Van Der Werff
Front Cover: Richard M. Chamberlin
Inside Front Cover: Daniel J. Koning
Title Page: Snir Attia
Back Cover: Daniel J. Koning
Inside Back Cover (stratigraphic sections): Daniel J. Koning and Richard M. Chamberlin
Printer: Starline Printing, Albuquerque, New Mexico

ISBN NO. 1-58546-115-6
EAN NO. 978-1-58546-115-8

72nd ANNUAL FALL FIELD CONFERENCE GUIDEBOOK
FIRST EDITION 2022
PRINTED IN THE U.S.A.

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CENOZOIC STRATIGRAPHY, SEDIMENTATION, & PALEONTOLOGY

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IGNEOUS ROCKS AND ECONOMIC GEOLOGY

HYDROGEOLOGY

GEOLOGY AND HISTORY

CONFERENCE ORGANIZERS' MESSAGE

After nearly 40 years, it is well worth coming back to Socorro for the 72nd Annual Fall Field Conference. There is truly a tremendous amount of the geologic history of New Mexico encapsulated in the crystalline basement, volcanic rocks, and sedimentary strata that surround this town. New Mexico Tech geology students, and those of us working at NM Tech, are very fortunate to have such a beautiful and geologically illustrative landscape in our backyard.

The previous trip in 1983 (the 34th NMGS Fall Field Conference), organized mainly by the extraordinary Charles (Chuck) Chapin, covered a vast amount of territory, and the associated road log and papers provide a comprehensive look at Socorro geology. The 1983 Guidebook ranks as one of the best in the Society's history, and it nicely showcases the major advances made at that time of understanding the Cenozoic volcanic and tectonic history of the Socorro area, in addition to summarizing the work done on the Pennsylvanian, Cretaceous, and Eocene sedimentary rocks.

It is honestly a little intimidating to try to improve on the 34th Fall Field Conference, but in the 40 years since 1983 new research has occurred that has increased our understanding of Socorro geology. Post-1983 research that we elucidate in this guidebook includes: (1) refinements in the nature and age of the volcanic and sedimentary deposits of the Socorro caldera, preserved in the 32–29 Ma Luis Lopez Formation; (2) new age constraints for late Miocene volcanism at Socorro; (3) better understanding of the history of rift tectonism in Socorro, including domino-block tilting and evolution of fault systems and accommodation zones; (4) documentation and age constraints for potassic metasomatism and manganese precipitation southwest of Socorro; (5) refinements of the stratigraphy, sedimentology, and structure of the Pennsylvanian-Permian strata east of Socorro, in the Quebradas—nicely illustrated and synthesized in the Quebradas compilation map of Steve Cather; and (6) mapping and age control of the middle to late Quaternary terrace deposits in the Socorro valley. Much of this new research was made possible by STATEMAP geologic mapping combined with a plethora of precise $^{40}Ar/^{39}Ar$ ages from the New Mexico Geochronology Research Laboratory.

Some papers either summarizing or expanding on relatively recent research near Socorro did not make it into the guidebook. The recent efforts include (1) the exciting discovery of the Socorro magma body that may locally offset terrace deposits (Fialko and Simons, 2001; Sion et al., 2020—citations are included in the Road Log Reference Page); (2) sedimentation and geomorphic research of the Arroyo de los Pinos (Stark and Cadol, 2022); (3) work on the Eagle Picher Superfund site; (4) Santa Fe Group stratigraphy west of the Rio Grande on the Bosque del Apache National Wildlife Refuge (Cikoski, 2010); and (5) hydrogeology and fault history adjoining the Loma Blanca fault along the Rio Salado (Barnes et al., 2021; Williams et al., 2017). Geologic mapping, volcanic research, and economic geology studies encompassing the Magdalena Mountains west of Socorro (Chamberlin et al., 2020) has not been incorporated into either the 1983 Guidebook or this guidebook, and we hope the geology of these mountains are covered in a future NMGS Fall Field Conference.

We hope you thoroughly enjoy this year's field trip, learn more about the fascinating geologic story of this part of the state, and catch up on the lives of friends and colleagues.

Daniel Koning
Richard Chamberlin
W. John Nelson
Susan Lucas Kamat
Scott Elrick
Kevin M. Hobbs

DEDICATION

The New Mexico Geological Society is pleased to dedicate this year's guidebook to Richard M. Chamberlin. Over his career, Richard has methodically mapped and studied the rough terrain west of Socorro, particularly outcrops exposed in the Chupadera, Socorro, Lemitar, and Magdalena Mountains. The rewards of this toil are the development of a complex Cenozoic stratigraphy and characterization of geologic structures, which together tell a fascinating story of the Cenozoic geology in the Socorro area. Richard is meticulous and lives by the adage "the devil is in the details." No one knows the geology of the mountains west of Socorro as well as he does.

Richard Chamberlin was born in 1943 in Reading, Pennsylvania. He came to New Mexico Tech in the early 1960s as a Chemistry major. Something which attracted him to the school was that Tech did not have a foreign language requirement. Switching majors, Richard graduated with a B.S. in Geology in 1967. It was at Tech that he met his wife, Louise; they married in January 1970, more than 52 years ago.

War in Vietnam dominated the news in the late 1960s, and Richard received his draft notice in 1967. But instead of going into the army, he voluntarily enlisted in the navy and graduated from the U.S. Naval Reserve Officer Candidate School (Newport, Rhode Island) in 1968 and served on active duty until 1970.

When his naval service ended, he returned to Socorro and graduated with an M.S. in Geology in 1975. His thesis was the geology of the Council Rock district, and his advisor was Dr. Charles Chapin (who has also contributed immensely in advancing our knowledge of Socorro County geology, especially Eocene-Oligocene volcanic stratigraphy). During the summers of 1973 and 1974, Richard worked as an exploration geologist, first with NORANDA Exploration Inc. and then with Exxon.

Richard followed his M.S. with a five-year Ph.D. study at the Colorado School of Mines, graduating in 1980. His dissertation was the Cenozoic geology of the Socorro Mountain area, a topic of which he is undoubtedly the expert.

After his Ph.D., Richard went to work with the New Mexico Bureau of Geology and Mineral Resources as an economic geologist (1980–1990), concluding that period with a sabbatical in which he and his family moved to Australia. When Richard returned, he continued as a field Economic Geologist (1990–1996) before being promoted to Senior Field Geologist (1996–present). During his time at the Bureau, Richard has mapped the following 7.5-minute quadrangles covering much of the Socorro Basin and mountains to the west: Luis Lopez, Socorro, Lemitar, Water Canyon, and San Lorenzo Spring. He has also conducted reconnaissance mapping in the Datil area (NMBGMR Open-file Report 406), which he used as fodder for organizing the 1994 NMGS Fall Field Conference. Many of Richard's publications (mostly published through the NM Geological Society and NM Bureau of Geology and Mineral Resources) center on the Cenozoic volcanism, geochronology, and stratigraphy of Socorro County and central New Mexico.

Richard and Louise have two children: Robert (born 1979) and Christopher (born 1981). Robert and Christopher often accompanied their father in the field, where Richard taught them basic geologic skills. The ability to read a topographic map later proved to be a tremendously important (even life-saving) skill for Robert during his two tours in Afghanistan in 2005 and 2007.

Richard is a methodical, detail-oriented geologist. By painstakingly walking outcrops and objectively "reading the rocks," he has unraveled the complex Cenozoic geology of the Socorro area. Particularly noteworthy and impressive accomplishments of Richard are: interpreting the eruptive history of the Socorro caldera and subsequent early Oligocene volcanism southwest of Socorro, as well as emplacement of related dikes; deciphering Miocene-Pliocene rhyolitic and basaltic volcanism in the Socorro area; mapping and dating these volcanic markers (tephra, lava flows) in the Santa Fe Group; and recognizing (and mapping) numerous Santa Fe Group facies as well as rift structures that have deformed these strata. His recognition of multiple generations of faults in the western mountains, particularly the Lemitar Mountains, provides robust documentation of fault-bounded, domino-block-style rift deformation. His interest in dike emplacement has led to collaboration with colleagues regarding emplacement of the Socorro magma body and heat flow in the Socorro and Albuquerque basins. Richard has also taken time to mentor generations of undergraduate and graduate students at New Mexico Tech. Richard's willingness to question and critique paradigms and models, and cognizance of the role of physics in his geologic interpretations, are reflected in the following expressions one often hears from him: "Mother nature does not care about models!" and "Gravity always wins!"

With gratitude for a job well done, the New Mexico Geological Society dedicates its 2022 Fall Field Guidebook to Richard M. Chamberlin.

Dan Koning and Dave Love

PRESIDENT'S MESSAGE

I am pleased to welcome you to the 72nd annual Fall Field Conference of the New Mexico Geological Society. It is pleasure to do so because even though the manner in which we interact with colleagues has changed, we have continued to serve the interests of our membership.

I am happy to report that, despite the continuing pandemic, the New Mexico Geological Society is well and thriving, thanks to the passion and commitments made by its members, by Bureau personnel, and by many others. The in-person 2022 Annual Spring Meeting was a great success, with 89 registered participants. Also, we have awarded $31,400 in student scholarships, although the number of applicants was slightly lower than last year.

The Society was able to successfully hold the twice-postponed 2021 Mount Taylor Area Fall Field Conference as an *in-between* Field Conference (May 16–18, 2022), with 88 registered members participating. The Field Conference was very successful, with excellent in-field discussions regarding the complicated structures, stratigraphy, and resources of this region. Representatives from 'Intera Delivers Geoscience and Engineering Solutions' informed our group about the current restoration of the L-Bar uranium mill site. A takeaway from this visit was that geoscientists must endeavor to strive for better care of our global environment, an endeavor in which our community is very well qualified to lead.

We were very pleased that the Pueblo of Laguna allowed us access into the amphitheater of Mount Taylor volcano, which exposes Cretaceous-age bedrocks in its interior. Pueblo members explained the significance of this sacred mountain to their culture and looked after our safety and well-being in the amphitheater. Overall, the three-day Field Conference highlighted the fact that many geological problems remain to be solved.

This year's upcoming field trips promise to be equally interesting. The pre-meeting *optional* excursion to the Little San Pascual Mountains will feature new mapping by Dan Koning, W. John Nelson, and Scott Elrick. These mountains offer wonderful exposures of late Paleozoic strata deformed by both the Laramide orogeny and rift-related extension. The sites to be visited by the main trip on Day 1 include the Quebradas Hills, where the principal objective will be to interpret various Laramide-age, fault-related folds. We will also discuss low-angle detachment faults (delineated in the forthcoming Quebradas compilation map of Steve Cather) and stratigraphic relations along the eastern margin of the Socorro Basin. Day 2 will be hosted in the Chupadera Hills, site of detailed mapping by Richard Chamberlin and Ted Eggleston, along with precise age determinations from the New Mexico Geochronology Research Laboratory. These data allow interpretation of a major tilt reversal across the Socorro accommodation zone and Early Oligocene volcanic history involving a pair of calderas. On Day 3, in the Lemitar Mountains and San Lorenzo Canyon north of Socorro, we will view exposures exhibiting a major rift unconformity, low-angle faulting, domino-block tilting, and relay-ramp structures.

There is much to like and learn from these excursions. Enjoy these trips in the Land of Enchantment!

W. Scott Baldridge
2022 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, which 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 75 years ago in 1947. One of the primary attributes that differentiates the NMGS from many state geological societies is the ready access to world-class geologic outcrops and the effort 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 that optimize students' learning experiences and broaden their educational experience.

The NMGS Foundation was created as a Non-Profit Organization (501(c)(3) Corporation) whose revenues are responsible for supporting activities that include the annual NMGS Fall Field Trip, NMGS Spring Meeting, numerous NMGS Grants-in-Aid to students undertaking geological research in the state of New Mexico, and scholarships to students attending four-year colleges and research universities throughout New Mexico.

The objective of ensuring student participation in NMGS annual field trips and research events will continue the legacy of NMGS events as a premier nationwide destination for education in the geosciences. In that spirit, we invite you to join us in supporting the NMGS with a philanthropic gift. You can go to https://nmgs.nmt.edu/donations to make your gift.

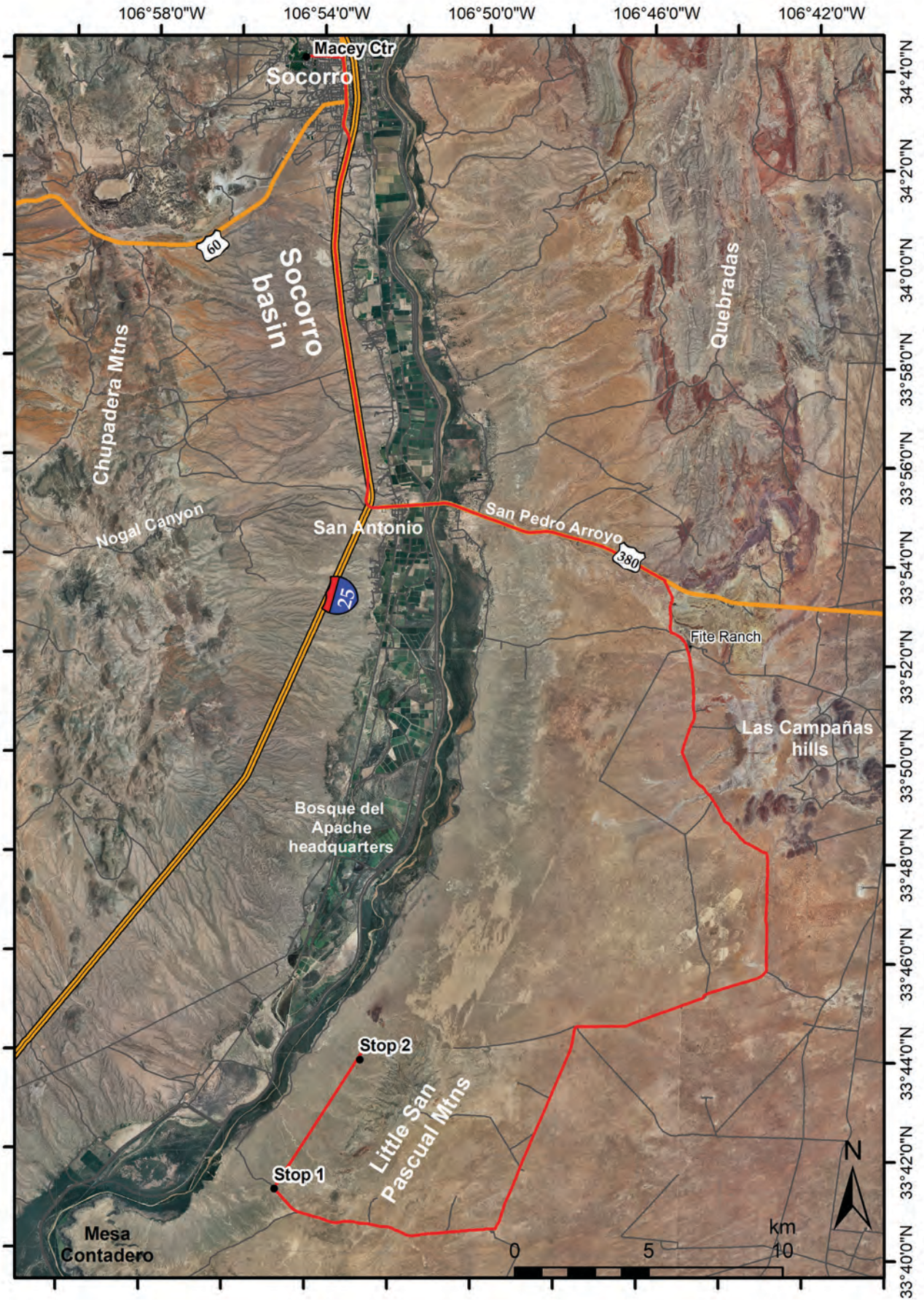

FIGURE PM.1. Field trip route (red), location of stops, and important geographic features.