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Front Matter

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

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This is a section from the 1989 NMGS Fall Field Conference Guidebook.

Annual NMGS Fall Field Conference Guidebooks

Every fall since 1950, the New Mexico Geological Society (NMGS) has held an annual Fall Field Conference that explores some region of New Mexico (or surrounding states). Always well attended, these conferences provide a guidebook to participants. Besides detailed road logs, the guidebooks contain many well written, edited, and peer-reviewed geoscience papers. These books have set the national standard for geologic guidebooks and are an essential geologic reference for anyone working in or around New Mexico.

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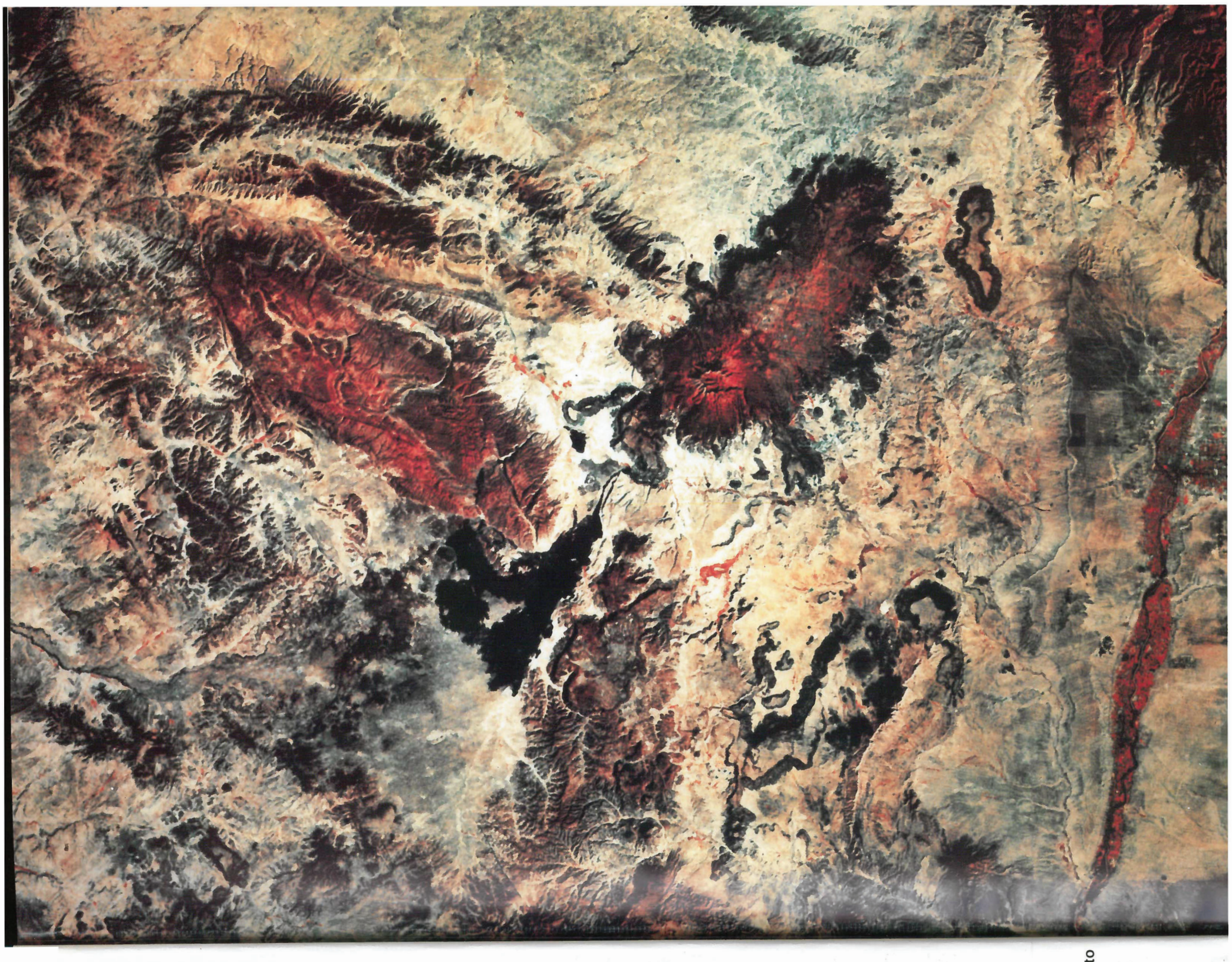
NMGS has decided to make peer-reviewed papers from our Fall Field Conference guidebooks available for free download. This is in keeping with our mission of promoting interest, research, and cooperation regarding geology in New Mexico. However, guidebook sales represent a significant proportion of our operating budget. Therefore, only *research papers* are available for download. *Road logs*, *mini-papers*, and other selected content are available only in print for recent guidebooks.

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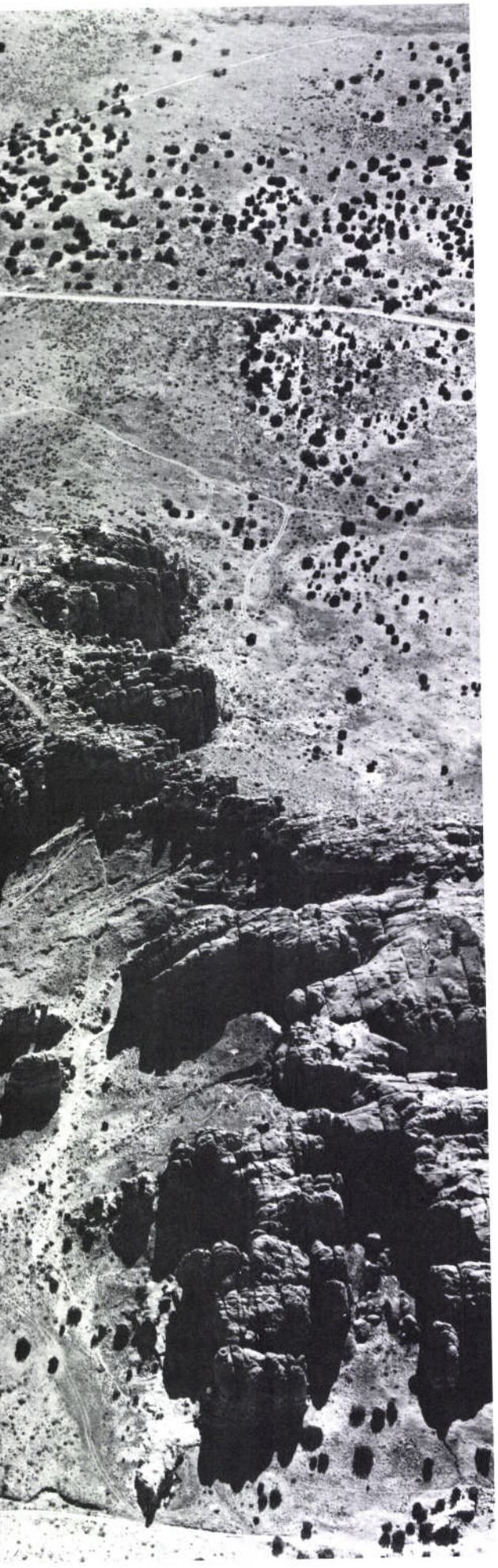


Sierra Nacimiento

Gallup
Nutria Monocline
Zuni Mountains
Upper Nutria
Rio Nutria
Zuni Pueblo
Rio Pescado
Zuni River
DY Mountain
Galestina Monocline
Atarque Monocline
Draw
Pinitos
Atarque
Fence Lake
dike
Moreno Hill
Cerro Prieto
dike
Zuni Salt Lake
Tejana Mesa
dike
dike
N
Mt. Taylor
Grants
Exit 89
Bandera Crater
Sanostee Overlook
McCartys Flow
North Plains
basalt flow
Cebollita Mesa
Acoma Pueblo
Mesa del Oro
Rio San Jose
Mesa Gigante
STOP 1
DAY 1
Lucero Mesa
Ladron Peak
Puerco
Rio Grande
Albuquer

Southeastern Colorado Plateau





Southeastern Colorado Plateau

Editors

ORIN J. ANDERSON

SPENCER G. LUCAS

DAVID W. LOVE

STEVEN M. CATHER

New Mexico Geological Society Fortieth Annual Field Conference, September 28—October 1, 1989

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FOREWORD

Our volunteer field trip committee again has targeted a geologically interesting and scenic region. Here the structures, stratigraphy and mineral deposits range from the Rio Grande rift on the east, the San Juan Basin part of the Colorado Plateau on the north and the Datil-Mogollon volcanic field to the south, with the route traversing the eastern border fault zone, Acoma sag, Zuni Mountains and Fence Lake–North Plains regions. It encompasses most types of geologic structures, facies changes of the Upper Paleozoic and Mesozoic sediments, Tertiary-Quaternary volcanics and related sediments, deposits of coal, uranium, oil and gas, metallic ores and industrial rocks and minerals and many other facets of geologic significance.

The journey begins on the alluvial fans west of the Sandia Mountains, across the Rio Grande to the first stop in the Rio Puerco fault zone, then to sandstone pipes in the Jurassic rocks west of Mesita, on to the spectacular setting of Acoma Pueblo and hence north to the Cretaceous-Jurassic contact and with a final stop southeast of Grants on New Mexico Highway 117, just south of Interstate 40, to examine the Jurassic-Cretaceous strata overlooking the Quaternary malpais. Day 2 begins on the west side of Cebolleta Mesa at the Sandstone Bluffs overlook and southwest to an aggregate pit to see structures related to the Hickman fault zone, then southwest to Techado where the Tertiary Baca Formation overlies the Cretaceous Moreno Hill Formation with an extensive paleoweathering zone at the contact. Then to the major stop of Moreno Hill on the southern margin on the Colorado Plateau to discuss structure and physiography, the Salt Lake coal field, and to note at the outcrop the contrast with Cretaceous strata to the north in the Zuni basin. A fitting climax is stopping at the D.Y. Mountain ancient-Zuni holy-place ruins of Dowa Yalanne to discuss the outcropping Jurassic rocks. On the third day, after an evening in Gallup, the conference goes a short distance to the east to see the structure and stratigraphy of the Hogback, then south to the Carbon No. 2 coal mine to discuss coal stratigraphy. After a stop south of Gallup along New Mexico Highway 602 to see the Bidahochi Formation, we continue south and then northeast to the magnificent exposures along the Hogback at Upper Nutria where the Glorieta, San Andres, Chinle, Entrada, Zuni–Cow Springs, Dakota, Mancos, Tres Hermanos, Pescado, Gallup and Crevasse Canyon units are spectacularly exposed, as well as the structures related to the Hogback. Then, on the way eastward around the southern flank of the Zuni Mountains through Ramah to the final stop at Bandera Crater we travel northeast to Grants and join Interstate 40 back to Albuquerque.

As always, the field conference features hands-on outcrop stops as well as regional views. Detailed road logs insure that future users of the guidebook have full geologic cover of the routes. The guidebook articles are an informative potpourri thoroughly covering the stratigraphy, structure and mineral deposits of the region. As is expected of all NMGS guidebooks, this one includes pertinent up-to-date geologic information of the regions and is the best recent reference. The articles are, in ascending stratigraphic order: Precambrian rocks in the Zuni Mountains by Virginia McLemore and Chris McKee; Mississippian rocks by Gus Armstrong and Lee Holcomb; Permian measured section by Bob Colpitts; faunas in the San Andres Limestone by Barry Kues; the Triassic Moenkopi and Chinle formations by Spence Lucas and Steve Hayden; Upper Triassic Chinle and Lower Jurassic Wingate Sandstone by Russ Dubiel; Middle and Upper Jurassic nomenclature by Steve Condon; intertongued Dakota Sandstone and Mancos Shale by Don Owen and Diane Sparks; Cretaceous mollusks by Bill Cobban and Steve Hook; Pliocene Bidahochi Formation by Dave Love; the Cenozoic basin-fill of the Albuquerque basin by Rick Lozinsky; and the Mogollon Rim Formation by Andre Potochnik.

Steve Cather's article on post-Laramide tectonics and volcanic transition encompasses sedimentation and tectonics. Jerry Hoffer and Leroy Corbitt describe explosion-collapse craters in the Quemado basalt field that lies on the southwest flank of the region, and Rick Harrison gives tectonic implications of exotic blocks in early Tertiary volcanics. Hydrogeology is featured by Bill White and Tim Kelly's report on the San Andres–Glorieta aquifer and by Bill White's description of Ojo de Gallo near San Rafael. The abundant mineral resources of the region are described in articles by Bruce Black and Ron Broadhead on petroleum exploration, Bill Chenoweth on the Ambrosia Lake uranium district, Gretchen Roybal on the Gallup coal field, Virginia McLemore on base and precious metal deposits in the Zuni Mountains, Jim Barker, Virginia McLemore, Marc Wilson and George Austin on the industrial minerals of the East Grants ridge area, George Austin and Ed Smith's description of the pressed-earth block industry in Grants, Jeff Minier and Marshall Reiter's coal maturation studies, and Jim Fassett's description of coal-bed methane in the Cretaceous coals.

As is to be expected in this junction region of structural and physiographic provinces, the articles on geologic structure are highlights, particularly as related to new interpretations. Tim Kelly and Chuck Reynolds describe the structure of the Malpais Valley near San Rafael. Richard Jenkins and Randy Keller give their interpretation of basement structures and geophysical anomalies in the area. Marvin Millgate describes relationships among faults, folds and mid-Tertiary igneous rocks, and Dick Chamberlin and Orin Anderson give new interpretations for the structures of the Laramide Zuni uplift. They will point out their evidence in the outcrops at field trip stops.

Kudos are deserved by the field trip leaders Orin Anderson and Dick Chamberlin, the guidebook editors Orin Anderson, Spencer Lucas, Dave Love and Steve Cather, all of the NMGS members who served on the road logging committee and to the arrangement committees and especially the authors of the guidebook articles. The field conference

will complement the Rocky Mountain Section meeting of the American Association of Petroleum Geologists which begins in Albuquerque following our field conference. This guidebook and field conference are a fitting climax to the administration of the NMGS officers for 1989, Robyn Wright, President; Louis Martinez, Vice President; Robert G. Myers, Treasurer; and William X. Chavez, Jr., Secretary. The officers do not receive as much credit as they deserve.

This is the 40th Field Conference of the New Mexico Geological Society, and along with the 40th Field Conference of the Wyoming Geological Association which was held earlier in Casper, are the two premiere, continuous full-scale geologic society conferences, held by statewide groups. Our 40 trips have covered most parts of New Mexico and adjoining states, including northern Mexico. But as shown by this field conference, the constant advancement of geologic art and study in New Mexico brings out new information, alternate interpretations and useful scientific data even though the area may be revisited three or four times.

As our editors point out, this is also the 30th anniversary of the first NMGS field conference in west-central New Mexico and they note the significant evolution of geologic thought and concepts during those thirty years. These include the vast improvement in radiometric dating methods allowing detailed identification of volcanic eruptive events and related sedimentation, and tying into the transition from Laramide compressional deformation to the younger extensional tectonics. Much new information on the two major mineral resources of coal and uranium has accrued during those three decades. Most significantly the editors point out that the key to geologic progress continues to be good field observations utilizing biostratigraphy, petrography, sedimentation interpretation, with our main preliminary tools being our geologic pick, the Brunton compass, hand lens and field notebook. Ed Beaumont, 1959 NMGS President, commented in that thirty-year-old guidebook, that these field conferences have sampled the geology of all parts of New Mexico and neighboring states, made permanent significant contributions to the understanding of the areas visited, and by adding geologic knowledge and focusing the attention of outsiders on the areas, NMGS has contributed to their economic development. The guidebooks are the most important permanent contribution of our field conferences, but the on-the-rocks frank discussions of geologic problems are also a benefit as is the opportunity to obtain an intangible sense of feeling for an area, which is difficult to achieve from a distance.

On our 40th renewal of this annual event, let us remember those field conference chairmen who no longer answer the roll call, Vincent Kelley, Caswell Silver, Charles Reed and Torn Stip. But the year is 1989, and NMGS is fortunate to have the dedicated geologists who today have put together this field conference and guidebook. We are all in your debt. Muchas gracias.

Frank E. Kottlowski



Charles H. Maxwell

DEDICATION

The 1989 New Mexico Geological Society Guidebook is dedicated to Charles H. Maxwell, career U.S. Geological Survey employee. A native New Mexican (Sierra Co. birth certificate no. 21), Charlie graduated from Hot Springs High School (now T. or C.) and attended the University of New Mexico earning a B.S. in geology in 1950, and an M.S. in 1952. His years in graduate school happened to coincide with the first and second NMGS field conferences, and Charlie claims to have been one of the horde of nameless students who assembled the very first guidebook (1950).

Charlie's career with the U.S. Geological Survey spans 37 years and has included tours of duty in Brazil, Kentucky, Washington, D.C. and Denver. Each duty station found him thoroughly involved with field mapping (or map interpretation) and mineral resource evaluation, categories which are at the core of our discipline; categories for which his New Mexico training had left him well prepared. His bibliograpy, which totals more than 80 items, includes 20 geologic maps, most of which lie within New Mexico. Of the remaining 60 publications, many relate to base or precious metals deposits, radioactive materials or strategic minerals in New Mexico and the U.S. Eight of them are in NMGS publications. Since 1973 he has generally been the project chief in these investigations, which include wilderness study areas. However, Charlie never used that title as a license to sit at a desk; he did the field work.

His corollary interest and expertise in mineralogy have made his name a household word among professionals and amateur collectors alike, and his frequent attendance at and participation in local meetings and symposia attest to his continuing interest in New Mexico.

A more enthusiastic and knowledgeable proponent of New Mexico and its diverse geology would be difficult to find. In recognition and appreciation of this, the New Mexico Geological Society dedicates this 40th NMGS Guidebook to Charles H. Maxwell.

Orin J. Anderson

PRESIDENT'S MESSAGE

Welcome to the 40th New Mexico Geological Society Fall Field Conference! We celebrate a long history of instructive and enjoyable field conferences with this year's trip to the southeastern Colorado Plateau and are proud to offer our "Ruby Anniversary" conference in conjunction with the Rocky Mountain Section Meeting of the American Association of Petroleum Geologists.

As always, the Society owes a major vote of thanks to the folks who have been instrumental in bringing the field conference and guidebook to fruition. Our appreciation goes to: General Co-Chairmen Orin Anderson and Richard Chamberlin; Guidebook Editors Orin Anderson, Dave Love and Steve Cather; Managing Editor Spencer Lucas; Logistics Coordinators Jim Olsen, Russ Jentgen and Ed Heffern; and Publications Chairman Richard Chamberlin. I take this opportunity to thank Frank E. Kottlowski and the staff of the New Mexico Bureau of Mines and Mineral Resources for their long-standing support of the Society and its publication efforts. Especially appreciated is the cheerful dedication of Norma Meeks (Publications) and Jill Collis (Membership). I further direct your attention to the Committee Page of this guidebook, where many other volunteers are recognized for their dedicated road logging and technical support. We are looking forward to a diverse and excellent field trip thanks to the efforts of these folks and the many contributing authors.

It's not too soon to begin planning next fall's schedule, which won't be complete without participation in a trip to the Sangre de Cristo Mountains! Organized by Chris Mawer (UNM), Paul Bauer (NMBMMR) and Steve Hayden (UNM), the Society will visit the eastern Sangres and Moreno Valley region for the first time in over 20 years. Come prepared for a broad sampling of structural and economic geology, sedimentary basin analysis and provocative reinterpretation of the Precambrian history of the area.

The Society continues to sponsor actively scholarships by underwriting the annual Spring Meeting in Socorro, by providing research grants to undergraduate and graduate students and by awarding prizes at local and regional science fairs. We are proud to award annually the prestigious Kottlowski, Wellnitz and Pipkin Fellowships to outstanding graduate and undergraduate students in New Mexico. We thank the many volunteers who have contributed time and effort to these endeavors, and encourage each of you to continue in your generous financial support of these scholarship funds.

Finally, thanks to all the unsung heros and volunteers who always seem to say "Yes" when the Society seeks their input and/or effort. It has been a real pleasure to serve as an executive officer of this organization over the years, and the dedicated volunteer "spirit of excellence" is the primary reason that this job is so much fun.

Robyn Wright, President

EDITORS' MESSAGE

Thirty years ago, the New Mexico Geological Society was preparing to embark on a field conference to west-central New Mexico. The president's message in the guidebook for that year (1959) began: "Nine years .. . and ten field trips ago the New Mexico Geological Society undertook the first in this series of annual field conferences." This year we can say that thirty-nine years and forty field trips ago the Society undertook the first in this series of annual field conferences.

We are proud to state that four contributors to the guidebook of thirty years ago have also contributed to this guidebook. They are Augustus Armstrong, Sid Ash, Frank Kottlowski and Clay Smith. It is this kind of continuity and dedication that provides the core of a strong professional society into which the New Mexico Geological Society has evolved.

Thus we salute the efforts of those before us, at the same time recognizing the evolution of geologic thought and concepts. Perhaps the most important concept that has since evolved is plate tectonics. This concept has been accepted nearly universally and has influenced the thinking on Rocky Mountain foreland deformation and the origin of the Colorado Plateau and its monoclines, the Basin and Range, and the Rio Grande rift. These structural elements will be seen or discussed on the field trip.

Also of importance are the technological advancements in the area of radiometric dating methods. These advancements have permitted an accurate chronology of mid- to late Tertiary volcanism. Major eruptive events during that time resulted in the regional ash-flow tuffs (in itself a new concept) characteristic of the Mogollon-Datil volcanic field which neighbors our conference area on the south. An improved understanding of Tertiary volcanic stratigraphy has enabled volcanologists to shed light on the nature and timing of the transition from Laramide compressional deformation to the onset of extensional tectonics. The latter--crustal extension—is an important factor in the delineation of the Colorado Plateau as a structural entity. Heat-flow measurements have also helped in defining the Plateau, and from there it was a logical step to look at coal-maturation data as an indicator of maximum heat flow.

With respect to coal, much has transpired in the last thirty years. In 1958-59, the coal industry in New Mexico was at an all-time low since its inception in the 1880's. In the ensuing 30 years, production has increased from 200,000 tons/yr to more than 20 million, a 100-fold increase. This is reflected in sharply increased interest in the resources of the Salt Lake coal field and the Zuni basin, both of which are on our route.

Additional changes have come about in the time-honored conventional ways—good field observations and regional correlations. One of the most important tools in this regard is biostratigraphy, and it alone was responsible for unraveling the problem of correlating Cretaceous rocks of the Zuni basin with those of the San Juan Basin, Acoma sag and Socorro County.

Many problems remain, but the information and interpretations in the road logs and the technical papers reflect current thought and approaches. With this in mind, we welcome you to west-central New Mexico and the *Southeastern Colorado Plateau.*

Orin J. Anderson
Spencer G. Lucas
David W. Love
Steven M. Cather

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GUIDEBOOK

Orin J. Anderson, *Editor* ..... New Mexico Bureau of Mines and Mineral Resources
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Darrell Daude ..... New Mexico Bureau of Mines and Mineral Resources

PUBLICATIONS

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Edward L. Heffern ..... U.S. Bureau of Land Management

TECHNICAL ASSISTANCE

Welex, A Division of Halliburton Services ..... Mobile Sound Equipment
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1 9 8 9
FIELD CONFERENCE SCHEDULE

Thursday, September 28 Registration Day

4:30-9:00 p.m.	Registration: Albuquerque Hilton Hotel.
6:00–?	Cocktail party: Cantina Lounge in Hilton Hotel.

Friday, September 29 First Day

7:45 a.m.	Rendezvous in parking lot of Hilton Hotel, 1901 University Blvd. NE, Albuquerque. Registration for late arrivals will be held at Stop 1.
8:00 a.m.	Buses depart for first day's tour (lunch provided).
6:30 p.m.	Poolside dinner at The Inn in Grants.

Saturday, September 30 Second Day

8:00 a.m.	Buses depart from the parking lot of The Inn in Grants for second day tour (lunch provided).
7:00 p.m.	Banquet dinner at The Inn in Gallup.
8:00 p.m.	Speaker: Dr. William Brown, Baylor University.

Sunday, October 1 Third Day

8:00 a.m.	Buses depart from parking lot of The Inn in Gallup for third day's tour (lunch provided).
6:00 p.m.	Estimated arrival at Hilton Hotel in Albuquerque.

CREDITS

Front Cover: Drawing of Dowa Yalanne (D.Y. Mountain or Corn Mountain) near Zuni Pueblo, by Randy Pence from a photo by S. G. Lucas.

Front End Sheet: LANDSAT false-color composite image of west-central New Mexico and corresponding map of topographic features and highways drafted by Michael Wooldridge.

Title Page: Photograph of Acoma Pueblo by Paul L. Sealey.

Back End Sheet: Field trip routes and stratigraphic column, drafted by Michael Wooldridge and Rebecca Titus.

Manuscript Preparation: Lynne McNeil, New Mexico Bureau of Mines and Mineral Resources.

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