Guidebook
of the
ALBUQUERQUE COUNTRY
Edited by
Stuart A. Northrop
TWELFTH FIELD CONFERENCE
October 6, 7, and 8, 1961
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IN POCKET

Geologic map of the Albuquerque country
by
Stuart A. Northrop and Arlette Hill

Tectonic map of a part of the upper Rio Grande area, New Mexico
by
V. C. Kelley
PRESIDENT'S MESSAGE

THE BROAD VIEW

—— is important to all geologists, regardless of their status within the science, and regardless of their degree of professional specialization. To provide this view is the distinct privilege of the only non-affiliated Geological Society serving New Mexico. We take this seriously enough to consider it a duty.

The Twelfth Field Conference of the New Mexico Geological Society brings us back from far-flung and comprehensive forays into the far corners of the State—and some adjacent areas—back to the environs of the great population center, Albuquerque. Here, through the efforts of professional and student geologists, a wide variety of geologic, mineralogic, paleontologic, and physiographic information is continually updated and expanded. In every direction, new data add to a better understanding of familiar geologic features and of their interrelated importance.

Under the able guidance of Charles B. Read of the United States Geological Survey, 5th president of the Society, as general chairman of the Conference, and of Stuart A. Northrop of the Geology Department at the University of New Mexico, 3rd president of the Society, as editor of the Guidebook, we will have an authoritative look at a variety of features at the very heart of New Mexico geology. The trip leaders and the guidebook authors are outstanding students of their phases of geologic interest and of their areas of investigation.

To every geologist in New Mexico, and in the surrounding territory, this Conference will be a valuable experience in re-orientation, and the guidebook will be an indispensable addition to his professional library.

The committee's ingenuity in operating this Conference from Albuquerque as a hub, with a return to the city each evening, works to the advantage of all participants. Scheduling on a week end permits more of our friends to whomgeology is an avocation to come "rock-hounding" with us. This is an ideal field trip in many respects. We express our gratitude to the many committee members, authors, and trip leaders whose efforts make it so. Much work was done, also, by members who shared the serious responsibilities of the Society, but whose names do not appear in these formal listings.

These conscientious workers find their reward in your enthusiastic attendance, and your appreciative acceptance and use of the guidebook. They gain, also, in ability and effectiveness in their own field of endeavor through the experience of this cooperative effort. This is the way an effective scientific society works, and this is the reason it is effective.

The members of the executive committee welcome you. We know you will enjoy the comradeship and discussions with friends of mutual interest. We believe you will be inspired by inspection of geologic phenomena from Precambrian to Recent, and from stratigraphic and structural to igneous and mineralized. We hope you will be stimulated by the invigorating climate from warm, low deserts to cool, majestic pine-clad mountains.

Join us, too, next May at our Technical Meeting in Albuquerque. And plan ahead for our next Field Conference. Our delayed plans with the Arizona Geological Society should develop, and will take us into the "Tonto Rim" country from westernmost-central New Mexico into east-central Arizona.

Richard D. Holt, President
New Mexico Geological Society
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PUBLICATIONS OF THE NEW MEXICO GEOLOGICAL SOCIETY

1. Guidebook of the San Juan Basin [covering north and east sides], New Mexico and Colorado; First Field Conference, 1950; edited by Vincent C. Kelley and others; 153 pages, 40 illustrations. (Out of print)
2. Guidebook of the south and west sides of the San Juan Basin, New Mexico and Arizona; Second Field Conference, 1951; edited by Clay T. Smith and Caswell Silver; 163 pages, 69 illustrations. (Out of print)
4. Guidebook of southwestern New Mexico; Fourth Field Conference, 1953; edited by Frank E. Kotlowski and others; 165 pages, 67 illustrations. $5.00
5. Guidebook of southeastern New Mexico; Fifth Field Conference, 1954; edited by T. F. Stipp; 213 pages, 83 illustrations. $5.00
6. Guidebook of south-central New Mexico; Sixth Field Conference, 1955; edited by J. Paul Fitzsimmons; 193 pages, 70 illustrations. Prepared with the cooperation of the Roswell Geological Society. $7.00 (Only a few copies left)
7. Guidebook of southeastern Sangre de Cristo Mountains, New Mexico (Raton Basin); Seventh Field Conference, 1956; edited by A. Rosenzweig; 154 pages, 61 illustrations. $7.00
8. Guidebook of southwestern San Juan Mountains, Colorado (Four Corners Area); Eighth Field Conference, 1957; edited by Frank E. Kotlowski; 258 pages, 109 illustrations. $7.00
10. Guidebook of west-central New Mexico; Tenth Field Conference, 1959; edited by James E. Weir, Jr. and Elmer H. Boltz, Jr.; 162 pages, 83 illustrations, hard binding. $8.50

These publications are available by mail (please add 25¢ for handling and postage) from the New Mexico Bureau of Mines and Mineral Resources, Campus Station, Socorro, New Mexico. Also over-the-counter sales at either the Bureau of Mines or the Department of Geology, University of New Mexico, Albuquerque. Checks should be made payable to the New Mexico Geological Society. Geologic maps accompanying certain guidebooks are available by mail or over the counter at the Bureau of Mines, Socorro, as follows:

(a) Geologic map of the Sierra County region, New Mexico; compiled by Vincent C. Kelley; accompanies Guidebook of the Sixth Field Conference. $1.00
(b) Geologic map of the Rio Chama country; compiled by Clay T. Smith and William R. Muehlberger; accompanies Guidebook of the Eleventh Field Conference. $0.50
(c) Geologic map of the Albuquerque country; compiled by Stuart A. Northrop and Arlette Hill; accompanies Guidebook of the Twelfth Field Conference. $1.00

SCHEDULE

Thursday, October 5
5:00-10:00 p.m.

Friday, October 6
7:30 a.m.

Saturday, October 7
7:30 a.m.

Sunday, October 8
7:30 a.m.

Registration, New Mexico Union, University of New Mexico Campus, Albuquerque, New Mexico.

Caravan assembles on East Central (U. S. 66-East) at Juan Tabo Road.

Caravan assembles on West Central (U. S. 66-West), 3 miles west of Rio Grande bridge.

Caravan assembles on San Mateo Blvd., N.E., at Montgomery Road.

Field Conference ends near Santa Fe.
A FEW WORDS FROM THE EDITOR

A glance at the accompanying geologic map (in pocket) will reveal that Albuquerque is not at the geographic center of the map-area. One of the chief reasons for this is that the U. S. Geological Survey’s revised map of the northeastern quarter of the State has not yet been published. The map from which the Guidebook map was compiled is Dane and Bachman’s (1957) “Preliminary geologic map of the northwestern part of New Mexico” (U. S. Geol. Survey Misc. Geol. Inv. Map 1-224), which distinguishes more than 78 stratigraphic units. It seemed to some of us that a map designed for use on a field conference, in conjunction with a road log, should be kept as simple as possible. Thus, the Guidebook map employs only 10 stratigraphic units. (In the planning stages, we referred to our map as a “60-mile-an-hour map.”)

It has not been possible to cover all aspects of the geology of the Albuquerque country in this Guidebook. The Guidebook does not pretend to be a compendium of all that is known of the geology of the area. Many significant facets are described in one or more chapters, but several short articles might have been prepared to deal with certain other aspects. The geologic literature is voluminous and many important published papers are neither cited in the text nor even included in the several lists of references. At one time we thought of compiling a complete bibliography—a sort of master bibliography—for the Guidebook, but this would have entailed so much repetition that we abandoned the idea.

Geographic Names.—Map-makers seem to delight in changing geographic names in the Southwest. Note the following changes in names of certain features in the area on U. S. G. S. maps from 1928 to 1960.

**Darton’s Geologic Map (1928)**
- Ladron Pk
- Mesa Chivato
- Nacimiento Mts
- San Pedro Mtn (near Cuba)
- San Pedro Mts (near Golden)
- Valle Mts

**New Mexico Base Map (1960)**
- Ladron Mts
- Cebolleta Mts
- Sierra Nacimiento
- San Pedro Mountains
- Jemez Mountains

The Ladron Mountains, just south of the south edge of the Guidebook area, have also been referred to as Sierra Ladron and Sierra Ladrones. The Jemez Mountains have been called the Sierra de los Valles; the latter term is properly applied to only a part of the mountains surmounting the Jemez Plateau. The great depression at the summit of the Jemez Plateau has been called Jemez crater, Jemez caldera, Valles crater, Valles caldera, and is often referred to by many local people as the Valle Grande. Actually, Valle Grande is simply one of several valleys occupying the caldera, as pointed out by Ross, Smith, and Bailey in their article in the Guidebook.

Incidentally, the editor has not followed Geological Survey style in every particular. For example, he prefers “New Mexico” to the Survey’s familiar abbreviation “N. Mex.” He does not care for the Survey’s use of “N. Mex. Univ.”, but prefers “Univ. New Mexico” (partly because the institution near Las Cruces now calls itself “New Mexico State University”). He has generally shortened “New Mexico Institute of Mining and Technology State Bureau of Mines and Mineral Resources” to “New Mexico Bur. Mines and Mineral Resources.” The editor has a distinct aversion to the recently adopted capitalization of stratigraphic terms, such as system, group, and formation, in “Permian System,” “Santa Fe Group,” “Madera Limestone.” Again, the editor sees no necessity for the hyphen in such color terms as “light gray” or “reddish brown” when used as modifiers before the noun. On the other hand, he has retained the hyphen in such terms as “olive-green” and “chocolate-brown.” (The reader will find some inconsistencies in hyphenation of color terms between chapters edited early and those edited late.) Writers have been allowed individual preference in some cases; some prefer “Abo Pass” and others, “Abo pass;” some prefer “Sandia Crest” and others, “Sandia crest.” Some prefer “aligned” and others, “aligned.”

The Geological Survey has long frowned on citation of theses and dissertations on the grounds that “unpublished theses generally are not conveniently available.” However, such material is now becoming available in microfilm form. In this Guidebook frequent citation of unpublished theses is made. We believe that such a great storehouse of information should not go unmentioned.

Every paper submitted for the Guidebook has been read by Charles B. Read, and the editor has profited greatly by his long experience with field conferences and guidebooks.

Stuart A. Northrop
PHYSIOGRAPHIC SETTING

According to the well-known Fenneman map, "Physical Divisions of the United States" (U. S. Geol. Survey, 1930), within a radius of 90 miles of Albuquerque there are three major physiographic divisions, four provinces, and seven sections, as follows:

INTERIOR PLAINS major division
   Great Plains province
      Raton section (13g)
      Pecos Valley section (13h)
   Rocky Mountain System major division
      Southern Rocky Mountains province (16)
         (not subdivided into sections)
   Intermontane Plateaus major division
      Colorado Plateaus province
      Navajo section (21d)
      Datil section (21f)
      Basin and Range province
         Mexican Highland section (22d)
         Sacramento section (22e)

Characteristics of the sections are as follows:

   Raton section: trenched peneplain surmounted by dissected lava-capped plateaus and buttes.
   Pecos Valley section: late mature to old plain.
   Southern Rocky Mountains province: complex mountains of various types; intermont basins.
   Navajo section: young plateaus; smaller relief than the Canyon Lands section (21c) of Colorado and Utah.
   Datil section: lava flows entire or in remnants; volcanic necks.
   Mexican Highland section: isolated ranges (largely dissected block mountains) separated by aggraded desert plains.
   Sacramento section: mature block mountains of gently tilted strata; block plateaus; bolsons.

The only section well represented in the State that does not approach to within 90 miles of Albuquerque is the High Plains (13d), about 150 miles east of Albuquerque. The Canyon Lands section (21c) barely enters the State at the northwest corner; this is about 175 miles from Albuquerque.

Note that the Rocky Mountains terminate between Santa Fe and Las Vegas, despite a National Geographic Society map that shows them extending clear across New Mexico and terminating in West Texas. (It is reliably reported that the reason for this was that the Society had many members residing in Texas who liked to think that their State included a bit of the Rockies! These people still invade New Mexico and Colorado to fish.) Of course, it all depends on the point of view. Structurally, the Sandia-Manzano Range may partake of some of the characteristics of the Southern Rocky Mountains province, but Fenneman's classification stresses physiography, and the Rio Grande depression, the Sandia-Manzano Range, and the Estancia bolson certainly resemble Basin and Range physiography—with "isolated ranges (largely dissected block mountains) separated by aggraded desert plains."
PHOTO MOSAIC MAPS OF SANDIA, LUCERO, AND JEMEZ AREAS, CENTRAL NEW MEXICO

LOWELL E. BOGART

Bogart and Wilson, Photogeologists, Albuquerque

INTRODUCTION

This paper is intended to demonstrate use of mosaics in reconnaissance mapping of land form, rock type, and regional structure. The photo map provides an excellent base for compilation of geologic data. All the qualities of a map are combined with the infinite detail of a photograph to present geologic data in a completeness unapproachable with line drawing.

Three maps are presented, one for each trip of the three-day conference. They are: Figure 1, Sandia Mountains-Hagan Basin Area; Figure 2, Lucero Area; and Figure 3, Jemez Area. Where possible, the route traversed and stops are shown.

Each map delineates land forms that are clearly expressed by reason of rock type, elevation, or structure. Lithologic type and stratigraphic position are shown only in the broadest sense. Structural grain is mapped in a detail dependent upon degree of expression visible on aerial photographs.

It must be emphasized that all data presented here result from mosaic interpretation without benefit of stereoscopic study. Accordingly, the position, or even presence, of some data on the maps may precipitate controversy. With this pleasant thought, we plunge into the three areas.

ACKNOWLEDGMENTS

Thanks are due Sinclair Oil and Gas Company and the Ground Water Branch of the U. S. Geological Survey for loan of mosaics. Gratitude is extended Charles de Sutter for aid in geologic annotation and Gene D. Wilson for critical review of the paper.

SANDIA MOUNTAINS-HAGAN BASIN AREA

Figure 1, bounded by 35°00', 35°30' N. Lat. and 106°00', 106°30' W. Long., includes the Sandia-San Pedro-Ortiz Mountains chain and bordering basins. Rocks ranging in age from Precambrian to Recent crop out.

Geomorphology

The Sandia Mountains trend N-S along the western side of the map. Precambrian granite occupies the western face of the mountains and is partially buried by alluvial fans to the west. Granite terrane is characterized by jointed. Dendritic drainage erodes granite into a texture of spines and pinnacles. Superposed upon the granite and dipping eastward into the Tijeras and Hagan coal basins is a sedimentary sequence from Pennsylvanian to Cretaceous in age. The Pennsylvanian limestone that forms the dip slope of the Sandia Mountains supports dense tree cover.

The South Mountain-San Pedro Mountains-Ortiz Mountains-Cerrillos Hills chain forms an intrusive belt. Note the distinctive texture of these areas. All of the peaks except Cerrillos Hills, at the north end, have coarse, rugged texture and dendritic drainage. Cerrillos Hills are low, partially obscured and exhibit fine texture on photos. The well-exposed geomorphology and structure of the porphyry belt is bounded on the east by the featureless Estancia Valley.

The barren lowland between Ortiz Mountains and Sandia Mountains is a synclinal area called the Hagan coal basin. Strata in the basin are partially covered by pediment gravel on the eastern side and faulted against Tertiary Santa Fe beds on the western side. Note the dendritic, sharp texture of the drainage pattern on the Santa Fe formation. This type of drainage pattern occurs on shales and unconsolidated fine clastics. Predominant lithology of Santa Fe beds is sandstone and siltstone which are poorly consolidated.

Characteristic of semi-arid climates, all the uplift areas are surrounded and partially obscured by alluvial aprons of their own erosional debris.

Structure

The Sandia Mountain-Hagan basin area clearly exhibits several major structural features. Tijeras fault is one of major proportion trending NE-SW through Tijeras Canyon. It appears to have large vertical and horizontal displacement. Along its trace the fault forms the boundary of several features: an area of metamorphic terrane, the Tijeras coal basin, and a Precambrian block northeast of San Antonio.

The Hagan fault forms the western boundary of the Hagan basin and terminates the north end of the Sandia Mountains. Santa Fe beds on the west are faulted against Cretaceous and older strata to the east.

The La Bajada fault extends northward from the west side of the Ortiz Mountains. It forms an account for the same Cretaceous beds on both sides of the fault, dipping steeply eastward but separated by several miles. Northward, the fault scarp rises to form a prominent physiographic feature.

There appears to be a major fault zone along the topographic saddle occupied by San Antonio and extending southeastward into the Estancia Valley. The Tijeras coal basin appears downfaulted two miles south of a Precambrian block. To the southeast, the Pennsylvanian outcrop terminates along this line.

The Tijeras coal basin is a folded wedge of Cretaceous rocks lying between two major faults. Throw on the Tijeras fault must be great because Precambrian basement is several thousand feet below the coal basin whereas basement is upthrown to 10,000 feet above sea level in the Sandia Mountains a few miles west.

The South Mountain-Ortiz Mountains-Cerrillos Hills form a belt of intrusive porphyry trending NNE-SSW. Surrounding the intrusive is a radial dike swarm. The porphyry belt is cut by the Tijeras fault zone at an angle near 30°.

LUCERO AREA

Figure 2, bounded by 34°30', 35°00' N. Lat. and 107°15', 107°45' W. Long., illustrates the Lucero uplift and adjacent basalt-capped mesas. The uplift has monoclinal west dip and is bordered on the east by a major thrust fault, Comanche fault.

Geomorphology

The Lucero uplift is dominated by a NE-trending scarp of Permian beds which plunges northward under basalt-capped Mesa Lucero. To the east the scarp rapidly descends into an open, low relief valley of Permian and Penn-
sylvanian rocks. The dip slope on Permian rocks is west-
ernly and northwesterly.

The western portion of the map shows several promi-
inent mesas that are capped with basalt. A very distinc-
tive geomorphic feature of this area is the halo of land-
slide talus peripheral to each flow. Where flows cap in-
competent Triassic Chinle shale, the talus forms stair steeps 
of concentric landslide blocks. The talus apron is usually 
widest on the western side of flows because of the angle of 
divergence between flow surfaces and underlying beds. Not e 
this condition surrounding Mesa del Oro. Sediments 
and lava converge at the northern tip of the mesa where local dip of strata is south. In areas where basalt flows 
occur updip and lie on Permian sandstones, the apron 
of landslide is missing.

The open valley, between Cerro Verde and the Jurassic 
cliffs in the northwest corner of the map, is formed on 
Triassic shale. The ENE-WSW lineations in the center of 
the valley suggest fracturing but may be merely the re-
sult of sand which is aligned by prevailing winds through 
wind gaps. The marked lineation, however, suggests struc-
tural origin.

Structure

Forces that elevated Lucero uplift, and folded and 
ruptured the rocks, appear to be essentially E-W 
compression. This compression thrust Pennsylvanian 
rocks toward the east and aligned fold axes in a N-S 
direction. Major faulting and folding is generally N-S in 
the southern part of the area. To the north this direction 
is complemented by NE- and NW-trending faults. The area 
between Mesa Lucero and Gallina Mesa is 
complexly faulted in a pattern suggesting shear. Elsewhere, the pattern suggests normal faulting of small 
magnitude.

Along the southern edge of the map, several N-S 
anticlines are well exposed. Conspicuously absent are 
well-defined synclines separating the anticlines. This sug-
gests that folds are denuded only slightly into the ampli-
tude of folding, so that synclines are sharp and narrow in 
extent compared to anticlines. In some cases it appears 
that this condition results in two anticlines being separated 
merely by a fault. The anticlines have steep limbs, narrow 
linear trend, and small area of closure. In most cases, 
plunge is north. Because of shape and size of these folds, 
they are not attractive as exploration targets for 
petroleum. Much greater importance can be attached to 
the broad structural highs that are suggested in several 
places by open, semicircular amphitheaters eroded in cliff-
formers.

JEMEZ AREA

Figure 3, bounded by 35°30', 36°00' N. Lat. and 
106°00', 107°00' W. Long., includes the prominent Jemez 
uplift and numerous basalt-capped mesas. Figure 3 is 
dominated by the very large Jemez volcano and the fault-
trend belt of porphyry intrusions, and intervening basins. 

Geomorphology

The Jemez caldera, one of the three largest extinct 
volcanoes known, is a feature of great impact when viewed 
on aerial photographs. It has a circular rim, approximately 
12 miles in diameter, which represents the central collapsed 
portion of the volcano. Within the rim are numerous 
younger cones resulting from renewed activity. Redondo 
Peak is the largest of these. Valle Grande is an elongated, 
open valley in the southwestern block of the caldera. The 
volcano is centered over the western fault boundary of the 
Rio Grande graben. This boundary fault zone no doubt 
controls the drainage and on the east by the Rio Grande graben.

Along the west side of Jemez volcano is Nacimiento 
Mountains, a fault block uplifted and partially thrust over 
sediments of the San Juan Basin. The west front of the 
Nacimiento Mountains is a prominent geomorphic as well as 
structural feature. It is mainly a high-angle reverse 
fault but forms a thrust in places. The fault is a strikingly 
linear boundary between granite terrane on the east and 
the steeply dipping hanging wall on the west.

Two areas of basaltic extrusion occur near the base 
of Jemez volcano. Santa Ana Mesa, composed of flows 
and cinder cones, is located due south of Jemez caldera. 
Only the northernmost portion of Santa Ana Mesa is 
shown. Cerros del Rio is located southeast of Jemez caldera 
and is composed of flows and a large mass of cinder cones. 
The La Bajada scarp forms the western border of Cerros 
del Rio.

Most of the area south and east of Jemez volcano, 
with the exception of the two areas of extrusives, is covered 
by Santa Fe beds of Tertiary age. The Santa Fe forma-
tion contains a variety of unconsolidated sands and silts 
that erode into a finely dendritic drainage pattern very 
similar to that formed on shale. Note the area of parallel 
Drainage southwest of Pojoaque which contrasts with sur-
rounding textures. Although on one flank of a drainage 
divide, it may have a structural rather than a geomorphic 
origin.

Structure

Nacimiento uplift, with associated faulting, domin-
ates the structural grain of Figure 3. Nacimiento fault, 
separating basin from uplift, is long and linear. Intersec-
ting this fault at approximately 45° is a complex set of 
NE- and NW-trending faults. They appear to be tear 
faults while faults trending N-S are normal. One promin-
ent NE-trending fault zone bisects Sierra Nacimiento and 
extends southwestward into the Basin. The entire 
west flank of Jemez Mountains is complexly faulted.

Another area of complex faulting is Cerros del Rio. 
NE-trending faults appear to terminate against La Bajada 
fault. Note the linear course of Rio Grande parallel to 
these faults. Therefore, this portion of the river may be 
controlled but there is no direct evidence visible on 
photographs. Similarly, this portion of the river is parallel 
to the margin of the Rio Grande graben.

Several faults are shown on the dissected volcanic 
slope of Jemez Mountains. Some exhibit fair evidence 
while others are conjectural.

Just west of San Ysidro is a normal fault of large 
throw that elevates Red Mesa. The mesa plunges south 
under Rio Salado valley and its edges are upturned by 
faults both on the east and west.

Along the west side of Nacimiento fault there are 
several folds plunging northwestward into the San Juan 
Basin. They diverge from Nacimiento fault at an angle 
of 15°. They appear, therefore, to be drag folds asso-
ciated with a major wrench fault—the Nacimiento fault.

Several hot springs occur parallel to Nacimiento fault 
but some distance west. They indicate that the major 
frontal fault is, in actuality, a zone of rupture that extends 
somewhat west of the surface trace.

SUMMARY

Aerial mosaics are uniquely descriptive in presenta-
tion of geomorphic and structural data. Figure 1 shows 
the fault-block Sandia Mountains, the northeastward-ex-
tending belt of porphyry intrusions, and intervening basins. 
Figure 2 illustrates the monoclinal west dip of the Lucero 
uplift and numerous basalt-capped mesas. Figure 3 is 
dominated by the very large Jemez volcano and the fault-
block Nacimiento Mountains bordering the San Juan Basin.
Figure 1. — Road index of Albuquerque showing assembly points for the three field trips.