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Photomosaic maps of Sandia, Lucero, and Jemez areas, central New Mexico

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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 characteristically 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 Hagancoal 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 Antonito.

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. Its throw accounts 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 Antonito 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 intrusives 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.

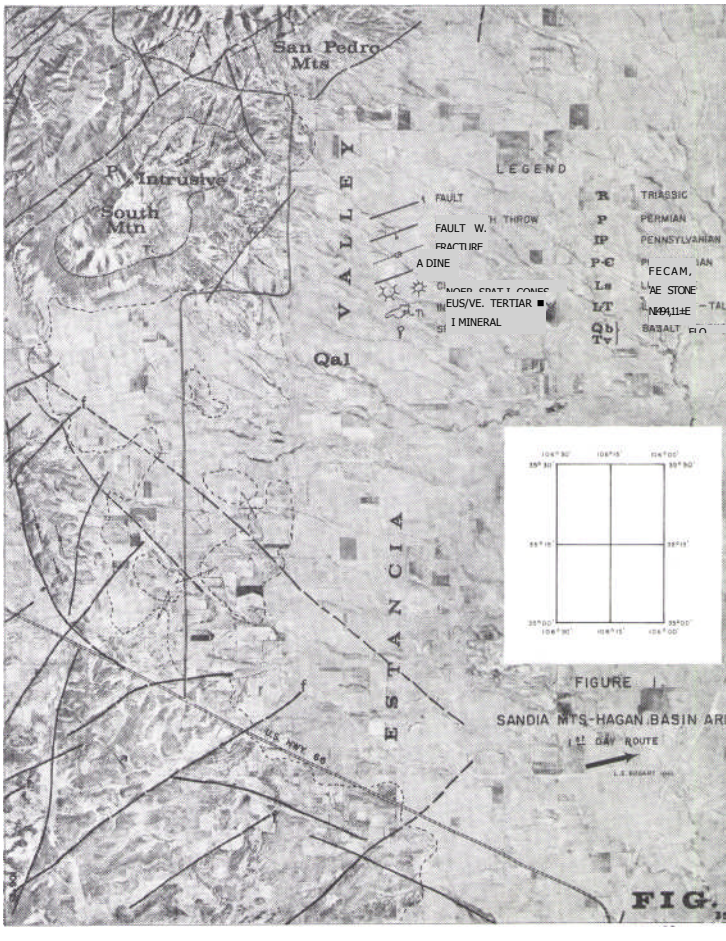
Geomorphology

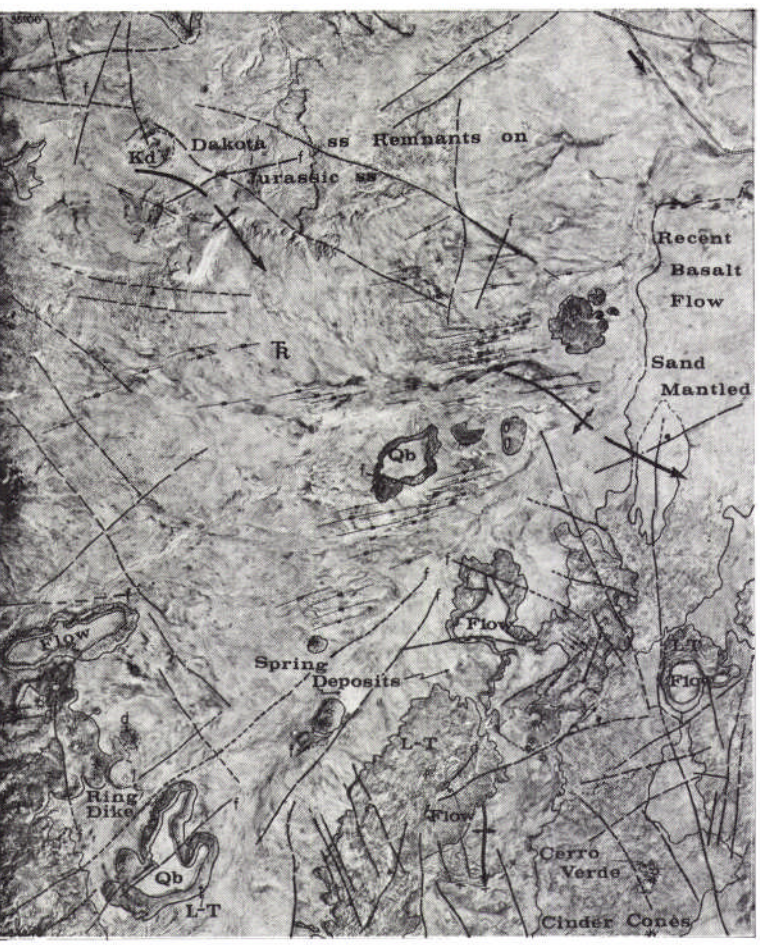
The Lucero uplift is dominated by a NE-trending scarp of Permian beds which plunges northward under basalt-capped Mesa Lucero. To the east the scarp rapidly descends into an open, low relief valley of Permian and Penn-


Flow
Santa
Fe
Fm
Hagan
Fault
Cretaceous
Basin
Coal
RUINS
STOP 5
PLACITAS
STOP 4
HAGAN
IP P
IP Ls
P€


Cortilins
Intrusive
Fault
Bonito
LOS CERRILLOS
CREEK
MADRID
Alluvial
Slope
Ortiz Mts
Intrusive
GOLDEN


Sandia Mts
P€
Sandia Crest
STOP 1
PA-AKO RUINS
STOP 2
Slope
SAN ANTONIO
Granite
Terrane
Dip
Fault
Tijeras
Coal Basin
Ls
P
STOP
TIJERAS
IP
Metamorphic


San Pedro Mts
Intrusive
South Mtn
VALLEY
Qal
ESTANCIA
LEGEND
FAULT
FAULT W. THROW
FRACTURE
ANTICLINE
TRIASSIC
PERMIAN
PENNSYLVANIAN
FIGURE 1
SANDIA MTS-HAGAN BASIN AR
1st DAY ROUTE







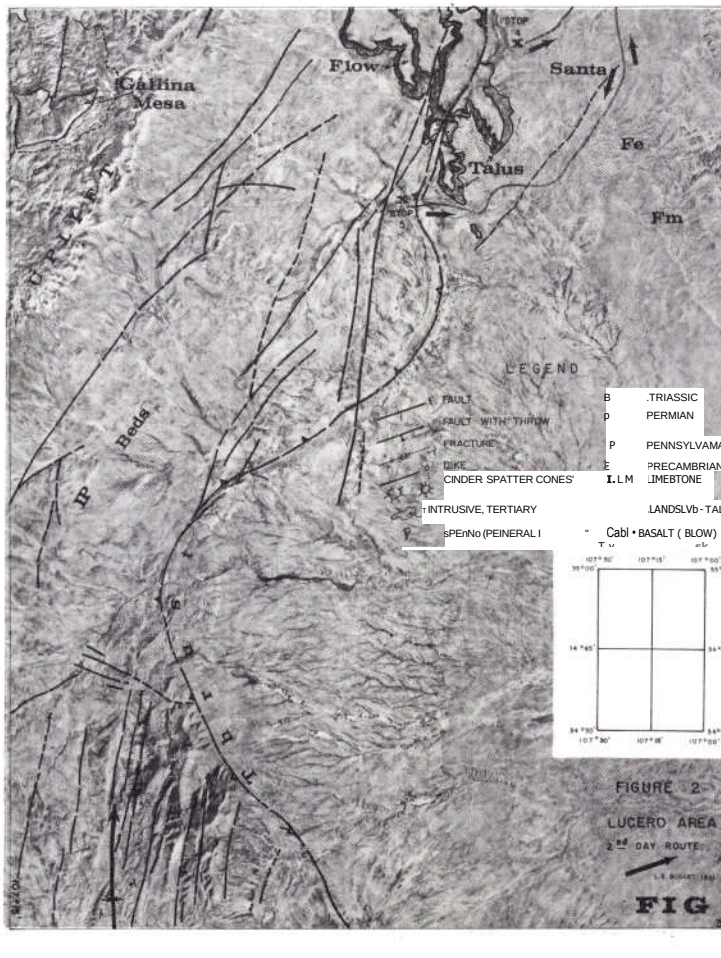


FIGURE 2-
LUCERO AREA
2 DAY ROUTE

FIG

sylvanian rocks. The dip slope on Permian rocks is westerly and northwesterly.

The western portion of the map shows several prominent mesas that are capped with basalt. A very distinctive geomorphic feature of this area is the halo of landslide talus peripheral to each flow. Where flows cap incompetent Triassic Chinle shale, the talus forms stair steeps of concentric landslide blocks. The talus apron is usually wider on the western side of flows because of the angle of divergence between flow surfaces and underlying beds. Note 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 result of sand which is aligned by prevailing winds through wind gaps. The marked lineation, however, suggests structural 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 suggests that folds are denuded only slightly into the amplitude 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 caldera bordered on the west by the Nacimiento uplift and on the east by the Rio Grande graben.

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 southeastern part of the caldera. The volcano is centered over the western fault boundary of the Rio Grande graben. This boundary fault zone no doubt provided an avenue for the escape of extrusives.

Completely surrounding the caldera is the main sloping body of the volcano which has been deeply dissected by drainage. This slope, from rim to base, is an average distance of 14 miles. Thus, the entire volcano has an approximate diameter of 40 miles.

Along the west side of Jemez volcano is Nacimiento Mountains, a fault block uplifted and partially thrust over sediments of the San Juan Baisn. 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 o thrust in places. The fault is a strikingly linear boundary between granite terrane on the east and the steeply dipping hogback 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 formation contains a variety of unconsolidated sands and silts which 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 surrounding 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, dominates the structural grain of Figure 3. Nacimiento fault, separating basin from uplift, is long and linear. Intersecting 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 prominent NE-trending fault zone bisects Sierra Nacimiento and extends southwestward into the Basin. The entire southwest 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 fault controlled but there is no direct evidence visible on photographs. Similariy, 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 associated 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

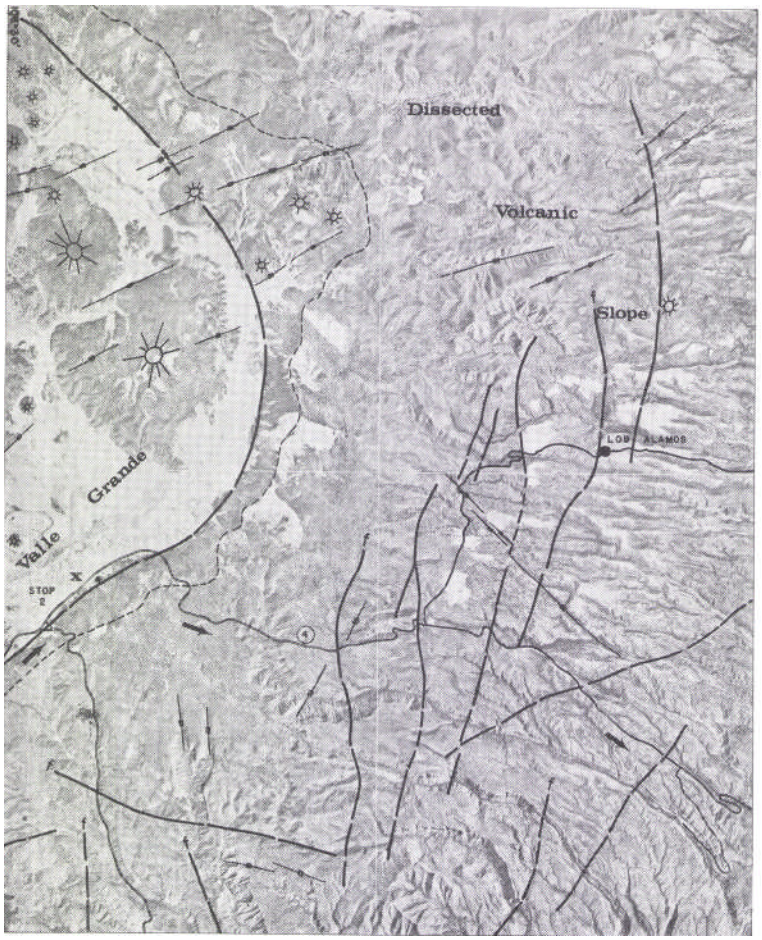
Aerial mosaics are uniquely descriptive in presentation of geomorphic and structural data. Figure 1 shows the fault-block Sandia Mountains, the northeastward-extending belt of porphyry intrusions, and intervening basins. Figure 2 illustrates the monoclinal west dip of the Lucero uplift and numerous basalt-capped mesas. Figure 3 is dominated by the very large Jemez volcano and the fault-block Nacimiento Mountains bordering the San Juan Basin.


Permian
Tv
And
Triassic
Tv
Granite
Terrane
Tv
IP Beds
Hogback
Granite
Terrane
Tv
LA VENTANA
SAN JUAN BASIN
RIO PUERCO


Dissected
Volcanic
Slope
Jemez
Caldera
Redondo Peak
LA CUEVA
BATTLESHIP ROCK
P - IP
Beds
Tv
JOYO


Granite
IP Beds
Terrane
PROBABLE FAULT
HOT SPRINGS
SOUTHERN
PR
Zone
Fault
SAN YSIDRO


JEMEZ RIVER
STORY
Tv
Permian
VEREZ PUEBLO
Santa
Fe
Flows
Fm
Flow



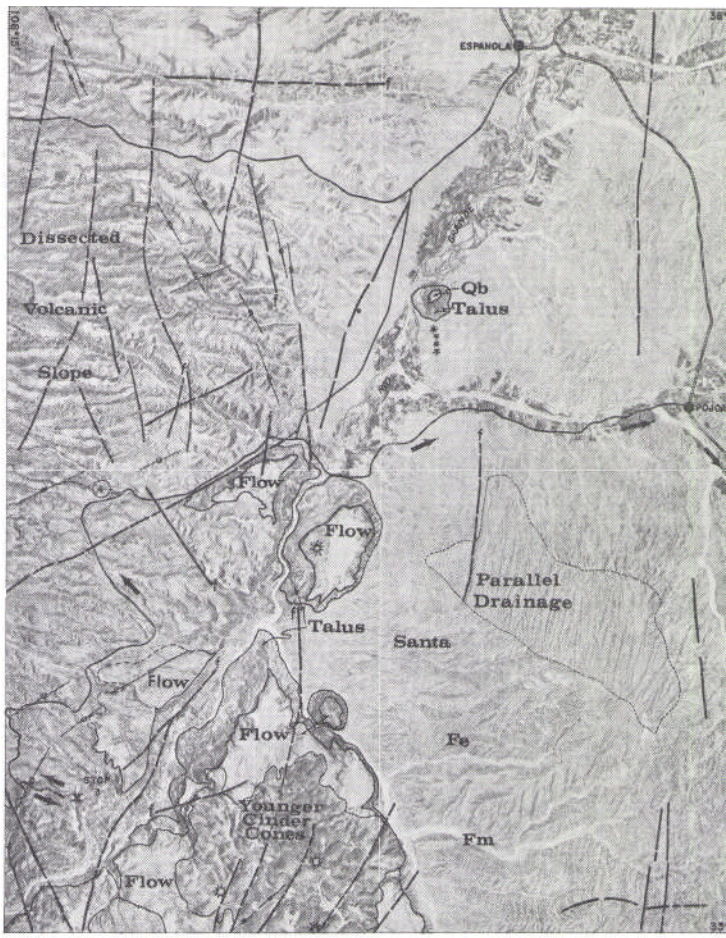






FIGURE 3

JEMEZ MTN. AREA

3 i Oar ROUTE

L.E. BOSART 1961

FIG.