NEW MEXICO GEOLOGICAL SOCIETY

Guidebook
OF THE
South and West Sides
OF THE
SAN JUAN BASIN
NEW MEXICO AND ARIZONA

SECOND FIELD CONFERENCE

October 12-13-14, 1951
NEW MEXICO GEOLOGICAL SOCIETY * SECOND FIELD CONFERENCE * SAN JUAN BASIN

EDUCATIONAL INSTITUTIONS

University of New Mexico
Albuquerque

New Mexico Institute of Mining & Technology
Socorro

EDUCATIONAL INSTITUTIONS

Welcome to the University:

The University of New Mexico hopes that you will make yourselves at home on the campus during registration for the Field Conference of the New Mexico Geological Society.

The campus is situated on an eminence in the eastern part of Albuquerque, almost within the shadow of the towering Sandia Mountains to the east, and overlooks the historic Rio Grande to the west. The campus is a mile above sea level.

It is our hope that you may find time to visit around the campus and see the modified Indian pueblo style of architecture which has been incorporated uniformly into its buildings.

The scope of the institution's educational program is wide and therefore many departments serve the petroleum industry in one way or another. The departments of chemical engineering, mechanical engineering, electrical engineering, and civil engineering, all within the College of Engineering, train men who take active parts in the various phases of the petroleum industry. The large Fuels Section of the U. S. Geological Survey is located at the University of New Mexico.

The University has a very fine library and its facilities are made available to industry and the public. The geology library has proved especially useful to the petroleum geologists in this part of the State.

The Department of Geology is located on the second floor, west wing of the building in which registration is held. They have a fine museum in which are exhibits of minerals, fossils, and rocks. In addition to their regular exhibits, there are special displays for this occasion, including maps, charts, and cross sections of the San Juan Basin region.

The faculty of the Department of Geology has had a long and wide interest in the geology of New Mexico, and its members are very active in geological research in and near the San Juan Basin. The department graduates students with bachelor's and master's degrees specialized in stratigraphy, paleontology, sedimentation, mineralogy, petrography, or mining geology.

It is my hope that you will have a most enjoyable and successful Field Conference.

Sincerely yours,

Tom L. Popejoy
President
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FOREWORD

The New Mexico Geological Society welcomes you to its Second Field Conference. We hope by means of this conference to round out the study of the San Juan Basin undertaken at the First Field Conference in November 1950. Much of the section you will see is highly controversial and it is hoped that new ideas and conclusions may be developed under stimulus of discussion and good fellowship.

We regret the necessity for so much travel over gravel or other non-surfaced roads; the areas which we will traverse comprise some of the finest combinations of colorful vistas and perfect outcrops known anywhere and perhaps the scenery and geology will compensate in a small way for the inconveniences.

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Sherman A. Wengerd
One year term
University of New Mexico

ACKNOWLEDGMENTS

The Conference Committee gratefully thanks each person and organization contributing to the field conference and guidebook.

The Committee is especially indebted to the University of New Mexico for providing facilities for registration; to the United States Geological Survey for the Polaroid Land Camera used to illustrate the road logs; and to the New Mexico Bureau of Mines and Mineral Resources for providing office facilities and personnel for the preparation of the guidebook. The Humble Oil and Refining Company through its Albuquerque and Roswell offices contributed markedly to the preparation of the guidebook. The State Geologists at Santa Fe contributed a great deal of statistical information as well as maps. Many of the maps and plates in the guidebook were possible only through the cooperation of the Cartographic Office of the U. S. Soil Conservation Service which provided the reproductions for printing.
NEW MEXICO GEOLOGICAL SOCIETY * SECOND FIELD CONFERENCE* SAN JUAN BASIN

CONFERENCE COMMITTEE

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Vincent C. Kelley .......................................... University of New Mexico
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Caswell Silver ........................................... Consulting Geologist

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Marion Jo Cowan (Drafting) .................................... U. S. Geological Survey
Hilda Kalish (Drafting) ....................................... New Mexico Bureau of Mines and Mineral Resources

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Edward C. Beaumont .......................................... U. S. Geological Survey
John W. Harshbarger ......................................... U. S. Geological Survey
William B. Hoover .......................................... Humble Oil and Refining Company
Vincent C. Kelley ........................................... University of New Mexico
Charles B. Read ........................................... U. S. Geological Survey
Gordon Wood .................................................

Trip Arrangements

Samuel Johnson (Chairman) .................................. Consulting Geologist
Eugene Callaghan (Reservations) ................................ New Mexico Bureau of Mines and Mineral Resources
Stewart M. Jones (Caravan) ................................ New Mexico Institute of Mining and Technology
Edward C. Beaumont .......................................... U. S. Geological Survey
William B. Hoover .......................................... Humble Oil and Refining Company
Sherman A. Wengerd .......................................... University of New Mexico
Mark Whelan ................................................ Independent

Registration

Gordon Wood (Chairman) ..................................... U. S. Geological Survey
J. Paul Fitzsimmons .......................................... University of New Mexico
NEW MEXICO GEOLOGICAL SOCIETY * SECOND FIELD CONFERENCE * SAN JUAN BASIN

SCHEDULE

Thursday, October 11
2:00 p.m. Registration. Administration Building, University of New Mexico.

Friday, October 12
7:00 a.m. Caravan assembles on northeast corner of University Campus.
7:30 a.m. Caravan leaves Albuquerque, New Mexico.
5:30 p.m. Caravan arrives Grants, New Mexico.
7:00 p.m. Informal dinner and program arranged by the Grants Chamber of Commerce.

Saturday, October 13. Grants, New Mexico to Gallup, New Mexico.
6:00 a.m. Breakfast in Grants, New Mexico.
7:30 a.m. Caravan leaves Grants, New Mexico assembling at west end of town.
6:00 p.m. Caravan arrives Gallup, New Mexico.
7:30 p.m. Informal dinner with Kodachrome slides of second and third days trip by W. B. Hoover, Humble Oil and Refining Company.

Sunday, October 14. Gallup, New Mexico to near Shiprock, New Mexico.
6:00 a.m. Breakfast in Gallup, New Mexico.
7:30 a.m. Caravan leaves Gallup, New Mexico assembling at west "Y".
6:00 p.m. Caravan disbands near Shiprock, New Mexico.

Conference Ends.
GENERAL INSTRUCTIONS

1. It is essential that the caravan start each morning at the announced time. Your cooperation will be appreciated.

2. You will be seated in a different car each day (except drivers). Your car assignments are listed on the slips which give your room assignments and your total charges for the trip. If you wish to ride in a special car, please notify some member of the Arrangements committee the night before you make the change.

3. You will be assigned to your lodging reservations at the time of registration. Please do not make any subsequent change of room without notifying some member of the Arrangements Committee.

4. Please pay your lodging bill in advance or before you go to breakfast so as to not delay the departure time of the caravan.

5. The third day of the Conference is almost exclusively within the confines of the Navajo Indian Reservation; roads are poorly marked and in many cases impassible. Please do not leave the caravan before the completion of the Conference without notifying some member of the Arrangements Committee.

6. There will be several pick-up trucks in the caravan and if you have luggage which will not fit in the car in which you are riding notify a member of the Arrangements Committee and you will be provided with space for your luggage in some other car in the caravan.

7. The person sitting in the front seat with the driver should keep him informed of stops, points of danger, points of interest, etc., noted in the road log, and he should read the geologic road log to the driver.

SPECIAL INSTRUCTIONS TO CAR DRIVERS

1. DO NOT DISREGARD THE WARNINGS IN THE ROAD LOGS CONCERNING ROAD CONDITIONS, THEY ARE FOR YOUR PROTECTION.

2. You will be given a numbered placard for attachment to your rear window. This number designates your position in the caravan.

3. If for any reason you have dropped out of line, you may resume your position at any subsequent stop. A space will be left for you by the driver in your rear at all stops until you return.

4. Never pass another Conference car while the caravan is in motion unless that car has dropped out of line.

5. If you have car trouble, please stop at the side of the road and allow the caravan to pass. If you need help, flag down the tow-car which will be at the rear of the caravan.

6. Please service your car at night to insure prompt departure the following morning.

7. Gasoline cannot be purchased on the Navajo reservation on Sunday. As noted elsewhere in the road log, the Society is making arrangements for a tank truck to bring gas to the last stop on the third day of the conference; the gas will be sold in a strictly cash transaction because of the limitations of time. You are requested to determine carefully how much you will need to return to Gallup or wherever you may be heading before the truck is ready to service you. Use as little as possible in order that everyone may be served in the shortest possible time. Oil may also be purchased at this same stop.

8. Water is very scarce and if your car has a tendency to overheat, you should carry water with you on both the second and third days of the trip. The grade over the Chuska Mountains at the end of the third day of the trip is exceedingly steep and the great majority of cars boil traversing this pass. There is a spring about one-third of the way up the hill which will provide plenty of water but in order to keep the caravan moving, only those which are in especial need should stop.

9. At stops when double parking in more than one line, drive as close as possible to the adjacent line and leave as little space as possible (one foot or less) between bumpers.
INTRODUCTION

Clay T. Smith
New Mexico Institute of Mining and Technology

The San Juan Basin, which is roughly circular, includes much of northeastern New Mexico, a narrow strip of northeastern Arizona, and a zone 25 miles wide in southwestern Colorado, or a total area of almost 20,000 square miles. The greater part of the basin is drained by the San Juan River, but much of the south and west sides is drained by tributaries of the Little Colorado River. The extreme southwestern corner is within the watershed of the Rio Grande.

Except for badland surfaces in areas of Tertiary sediments, the inner portion of the basin is characterized by shallow, open valleys separated by broad mesas or by low cuestas. In regions of Cretaceous and older rocks the surface is more varied in appearance. Prominent hogbacks follow the margins of the basin and are sharp ridges where dips are steep as along the north side. Maximum altitudes along the south and west sides of the basin rarely exceed 9,500 feet and a maximum relief of 5,000 feet is noted at Mount Taylor.

The climate is semi-arid to arid although some of the uplift areas receive considerable snowfall. Nearly all the precipitation is in the form of scattered, intense thundershowers in the summer months; such storms may produce rainfall measurable in inches, but only over an area of a few square miles or less.

Density of population is much greater on the well-watered north side of the basin; Gallup and Grants are the only towns of any consequence on the south and west sides. U. S. Highways 66, 84, 160, 550, and 666 outline much of the basin rim, but roads in the central part are poor. New Mexico Highway 44 crosses the basin diagonally connecting Albuquerque and Durango, the principal supply centers, through Cuba and Aztec. The main line of the Atchison, Topeka and Santa Fe Railroad crosses the southern part of the basin, and a narrow-gauge line of the Denver and Rio Grande Western serves Chama, Durango, Aztec and Farmington. Air service by Frontier Airlines reaches Gallup, Farmington, Durango, and Cortez and connects with north-south and east-west transcontinental airlines at Albuquerque.

Grazing and minor amounts of farming furnish the principal occupation for the Indians who make up the largest part of the population outside the towns around the margin of the basin. Elsewhere in this guidebook, the groundwater conditions and the possibilities for additional grazing and farming are estimated. Lack of sufficient precipitation in recent years has made water problems critical in the livelihood of the several thousand Indians who occupy the Navajo, Hopi, Zuni, and Pueblo Reservations in the basin. Over one-third of the land in the basin is in Indian Reservations or controlled by allotments.

Sedimentary rocks in the basin proper are almost exclusively of Mesozoic age or younger, although older Paleozoic and pre-Cambrian outcrops occur in the uplift areas or along the steeply upturned edges of the basin. The geologic record is more complete along the north and east sides of the basin than along the south and west sides. The central part of the basin is covered with early Tertiary sedimentary rocks, which are surrounded by a more or less circular outcrop of Cretaceous beds in a bewildering variety of facies changes and marine and non-marine intertonguing. In general, Jurassic and Triassic rocks mark the outer limits of the depressed part of the basin and on the south and west sides the adjacent...
uplifts are capped with thick Permian sediments. Locally, extensive areas of pre-Cambrian rocks are exposed in the higher more deeply eroded parts of the uplift areas. Small intrusive plugs, dikes and associated flows mostly of basaltic composition and Tertiary and Quaternary age are scattered indiscriminately along marginal parts of the basin. Along the south and west sides of the basin the rocks show only slight erosional disconformities throughout large parts of the section; karst topography on upper Permian limestone, extensive truncation at the base of the upper Cretaceous and an angular unconformity at the base of lower Tertiary rocks are the only evidences of non-deposition and orogeny. Elsewhere the rocks are essentially parallel throughout the section.

The first field conference of the New Mexico Geological Society visited outcrops along the north and east sides of the San Juan Basin and examined rocks which have been exploited most heavily during the current search for petroleum. Since it was impossible to cover all of the region last year, the second field conference is completing the study of the nearly circular basin by examining the rocks on the south and west sides. Access to the west side of the basin is limited and the exposures are such that it is difficult to route the trip to see all of the section in as many places as is desirable. As a result, the first day is spent mostly in Tertiary or younger rocks with only limited views of the older parts of the section until afternoon when Cretaceous and Permian rocks are along the route. The last stop of the day allows study of the pre-Cambrian and overlying Pennsylvanian rocks in the eastern end of the Zuni Mountains. Most of the second day is devoted to Cretaceous rocks where excellent exposures of widespread marine and non-marine intertonguing will be examined in detail. The last day permits examination of Permian rocks as well as one of the most spectacular Jurassic sections exposed in the western United States.

A great deal of the trip will be on private land or on Indian Reservation; pictures of scenery, geology, or of the caravan are permissible but please do not photograph the Indians or their homes without permission. As you will be passing through some of the most colorful and photogenic country in the southwest, you are welcome to drop out of the caravan for photography at any time and may regain your position at the next stop.

The guidebook consists of five short papers on the rocks exposed along the route of the field conference and several papers of a regional nature which discuss the tectonic history, mineral resources, land status, groundwater resources, and the history of gas and oil development and production in the San Juan Basin. Some of these papers are reprinted from the 1950 guidebook; some are revised and completely rewritten contributions from similar papers in the 1950 guidebook; and most are new discussions written by persons most familiar with the south and west sides of the basin. The emphasis in this guidebook has been placed on the road log and its accompanying illustrations and all of the material is deliberately slanted toward the south and west sides of the basin. For the broader regional features of the San Juan Basin, the reader is referred to the 1950 guidebook.