

PROCEEDINGS OF THE 41st ANNUAL HIGHWAY GEOLOGY SYMPOSIUM

AUGUST 15 - 17, 1990.
Albuquerque, New Mexico

CO-SPONSORED BY

New Mexico State Highway and Transportation Department

and

New Mexico State University
Department of Civil, Agricultural and Geological Engineering

ORGANIZING COMMITTEE

Kenneth R. White, Chairman, NMSU

Kulathu A. Aiyer, NMSU

Steven M. Huddleson, NMSHTD

Kathryn Kretz, NMSHTD



Highway Geology Symposium

HISTORY, ORGANIZATION AND FUNCTION

Established to foster a better understanding and closer cooperation between geologists and civil engineers in the highway industry, the Highway Geology Symposium (HGS) was organized and held its first meeting on February 16, 1950, in Richmond, Virginia. Since then 39 consecutive annual meetings have been held in 26 different states. Between 1950 and 1962, the meetings were held east of the Mississippi River, with Virginia, Ohio, West Virginia, Maryland, North Carolina, Pennsylvania, Georgia, Florida, and Tennessee serving as the host states.

In 1962, the Symposium moved west for the first time to Phoenix, Arizona. Since then, it has rotated, for the most part, back and forth from east to west. Following meetings in Texas and Missouri in 1963 and 1964, the Annual Symposium moved to different locations as follows:

| <u>Year</u> | <u>HGS Location</u> | <u>Year</u> | <u>HGS Location</u> |
|-------------|---------------------|-------------|-----------------------|
| 1965 | Lexington, KY | 1966 | Ames, IA |
| 1967 | Lafayette, IN | 1968 | Morgantown, WV |
| 1969 | Urbana, IL | 1970 | Lawrence, KS |
| 1971 | Norman, OK | 1972 | Old Point Comfort, VA |
| 1973 | Sheridan, WY | 1974 | Raleigh, NC |
| 1975 | Coeur d'Alene, ID | 1976 | Orlando, FL |
| 1977 | Rapid City, SD | 1978 | Annapolis, MD |
| 1979 | Portland, OR | 1980 | Austin, TX |
| 1981 | Gatlinburg, TN | 1982 | Vail, CO |
| 1983 | Stone Mountain, GA | 1984 | San Jose, CA |
| 1985 | Clarksville, IN | 1986 | Helena, MT |
| 1987 | Pittsburgh, PA | 1988 | Park City, UT |
| 1989 | Montgomery, AL | 1990 | Albuquerque, NM |

Unlike most groups and organizations that meet on a regular basis, the Highway Geology Symposium has no central headquarters, no annual dues, and no formal membership requirements. The governing body of the Symposium is a steering committee composed of approximately 20 engineering geologists and geotechnical engineers from state and federal agencies, colleges and universities, as well as private service companies and consulting firms throughout the country. Steering committee members are elected for three-year terms, with their elections and re-elections being determined principally by their interests and participation in and contribution to the symposium. The officers include a chairman, vice chairman, secretary, and treasurer, all of whom are elected for a two-year term. Officers except for the treasurer may only succeed themselves for one additional term.

A number of three-member standing committees conduct the affairs of the organization. The lack of rigid requirements, routing, and the relatively relaxed overall functioning of the organization is what attracts many of the participants.

Meeting sites are chosen two or four years in advance and are selected by the Steering Committee following presentations made by representatives of potential host states. These presentations are usually made at the steering committee meeting which is held during the Annual Symposium. Upon selection, the state representative becomes the state chairman and a member protem of the Steering Committee.

The symposia are generally for two and one-half days, with a day-and-a-half for technical papers and a full-day for the field trip. The symposium usually begins on Wednesday morning. The field trip is usually Thursday, followed by the annual banquet that evening. The final technical session generally ends by noon on Friday.

The field trip is the focus of the meeting. In most cases, the trips cover approximately from 150 to 200 miles, provide for six to eight scheduled stops, and require about eight hours. Occasionally, cultural stops are scheduled around geological and geotechnical points of interest. To cite a few examples, in Wyoming, the group viewed landslides in the Big Horn Mountains; Florida's trip included a tour of Cape Canaveral and the NASA space installation; the Idaho and South Dakota trips dealt principally with mining activities; North Carolina provided stops at a quarry site, a dam construction site, and a nuclear generating site; in Maryland, the group visited the Chesapeake Bay hydraulic model and the Goddard Space Center; the Oregon trip included visits to the Columbia River Gorge and Mount Hood; the Central Mineral Region was visited in Texas; and the Tennessee trip provided stops at several repaired landslides in Appalachia. The Colorado field trip consisted of stops at geological and geotechnical problem areas along Interstate 70 in Vail Pass and Glenwood Canyon, while the Georgia trip in 1983 concentrated on highway design and construction problems in the Atlanta urban environment. The 1984 field trip had stops in the San Francisco Bay area which illustrated the planning, construction and maintenance of transportation systems. In 1985, the one day trip illustrated new highway construction procedures in the greater Louisville area. The 1986 field trip was through the Rockies of recent interstate construction in the Boulder Batholith. The trip highlight was a stop at the Berkeley Pit in Butte, Montana, an open pit copper mine.

At the technical sessions, case histories and state-of-the-art papers are most common with highly theoretical papers the exception. The papers presented at the technical sessions are published in the annual proceedings. Some of the more recent proceedings may be obtained from the Treasurer of the Symposium.

Las Cruces, New Mexico
August 1990

Organizing Committee
41st Annual Highway Geology
Symposium



Highway Geology Symposium

MEDALLION AWARD WINNERS

| | |
|---------------------|------|
| Hugh Chase | 1970 |
| Tom Parrott | 1970 |
| Paul Price | 1970 |
| K. B. Woods | 1971 |
| R. J. Edmonson | 1972 |
| C. S. Mullin | 1974 |
| A. C. Dodson | 1975 |
| Burrell Whitlow | 1978 |
| Bill Sherman | 1980 |
| Virgil Burgat | 1981 |
| Henry Mathis | 1982 |
| David Royster | 1982 |
| Terry West | 1983 |
| Dave Bingham | 1984 |
| Vernon Bump | 1986 |
| C. W. (Bill) Lovell | 1989 |

In 1969, the Symposium instituted an awards program, and with the support of Mobile Drilling Company of Indianapolis, Indiana designed a plaque to be presented to individuals who have made significant contributions to the Highway Geology Symposium over a period of years. The award, a 3.5" medallion mounted on a walnut shield and appropriately inscribed, is presented during the banquet at the Annual Symposium.



Highway Geology Symposium

EMERITUS MEMBERS

R. F. Baker

Virgil E. Burgat

Robert G. Charboneau

Hugh Chase

A. C. Dodson

Walter F. Fredericksen

John Lemish

George S. Meadors, Jr.

W. T. Parrot

Paul Price

David L. Royster

Bill Sherman

Berke Thompson

Ed J. Zeigler



Highway Geology Symposium

STEERING COMMITTEE OFFICERS

| | |
|---|------|
| Mr. Willard McCasland - Chairman Materials Division Oklahoma Department of Transportation 200 N.E. 21st Street Oklahoma City, OK 73105 (405) 521-2677 | 1991 |
| Mr. Harry Moore - Vice Chairman Geological Engineering Supervisor I Tennessee Department of Transportation Geotechnical Section, P. O. Box 58 Knoxville, TN 37901 (615) 594-6219 or (615) 933-6776 | 1991 |
| Mr. Sam I. Thornton - Secretary University of Arkansas Department of Civil Engineering Fayetteville, AR 72701 (501) 575-6024 | 1990 |
| Mr. W. D. Bingham - Treasurer State Highway Geologist Department of Transportation Division of Highways Raleigh, NC 27611 (919) 733-6911 | 1990 |



Highway Geology Symposium

STEERING COMMITTEE MEMBERS

| | <u>Term Expires</u> |
|--|---------------------|
| Mr. Vernon Bump Foundation Engineer Division of Engineering Department of Transportation Pierre, South Dakota 57501 Phone - (605) 773-3401 | 1990 |
| Mr. John B. Gilmore Colorado Highway Department 4340 East Louisiana Denver, Colorado 80222 Phone - (303) 757-9275 | 1992 |
| Mr. Joseph A. Gutierrez Mgr. Mine Planning and Development Mideast Division Vulcan Materials Company P. O. Box 4195 Winston-Salem, North Carolina 27105 Phone - (919) 767-4600 | 1991 |
| Mr. Jeffery L. Hynes Colorado Geological Survey 1313 Sherman Street, Room 715 Denver, Colorado 80203 Phone (303) 866-3520 | 1991 |
| Mr. Charles T. Janick Soils Engineer Pennsylvania Department of Transportation 1118 State Street Harrisburg, Pennsylvania 17120 | 1991 |
| Ms. Kathleen Keller 200 Vista Del Verde Hopehull, AL 36043 | 1991 |
| Mr. Harry Ludowise 6308 NE 12th Ave. Vancouver, WA 98665 | 1992 |

| | |
|---|------|
| <p>Mr. Marvin McCauley California Department of Transportation 5900 Folsom Boulevard Sacramento, California 95819</p> | 1991 |
| <p>Mr. Henry Mathis Manager, Geotechnical Branch Division of Materials Kentucky Department of Highways Frankfort, Kentucky 40622 Phone - (502) 564-2374</p> | 1992 |
| <p>Mr. David Mitchell Chief, Geotechnical Bureau Georgia Department of Transportation 15 Kennedy Drive Forest Park, Georgia 30050 Phone - (404) 363-7546</p> | 1990 |
| <p>Mr. Gary Riedl Chief Geologist Wyoming Highway Department P. O. Box 1708 Cheyenne, Wyoming 82002-9019 Phone - (307) 777-7450</p> | 1992 |
| <p>Dr. Terry West Associate Professor Department of Earth, Atmospheric Science and Civil Engineering Purdue University West Lafayette, Indiana 47907 Phone - (317) 494-3296</p> | 1991 |
| <p>Mr. W. A. Wisner Geologist Florida Department of Transportation Office of Materials and Research P. O. Box 1029 Gainesville, Florida 32602 Phone - (904) 372-5304</p> | 1990 |
| <p>Mr. Burrell S. Whitlow President Geotechnics, Inc. 321 Walnut Avenue, (P.O. Box 217) Vinton, Virginia 24179 Phone - (703) 344-4569; 344-0198</p> | 1992 |
| <p>Mr. Terry Yarger Geologist Montana Department of Highways 2701 Prospect Avenue Helena, Montana 59620 Phone - (406) 444-6280</p> | 1991 |



Highway Geology Symposium

STANDING COMMITTEES

| | |
|---|---|
| Medallion Selection Committee | Harry Moore, Chairman Burrell Whitlow Vacant |
| Public Relations Committee | Charles Janik, Chairman Dave Bingham (Eastern States) Terry Yarger (Western States) |
| By-Laws Committee | Burrell Whitlow, Chairman Henry Mathis Bill Wisner |
| Publications and Proceedings Committee | Dave Bingham, Chairman Joe Gutierrez Jeff Haynes |
| Emeritus Members Committee | Terry West, Chairman Dave Mitchell |
| Committee on Guidelines for Appointments to National Steering Committee | Harry Ludowise Willard McCasland |
| Historian/Reporter | Jeff Hynes |
| Mailing List Committee | Willard McCasland, Chairman Bill Wisner Vacant |



Highway Geology Symposium

CHAIRMEN OF LOCAL ARRANGEMENTS FOR UPCOMING SYMPOSIUMS

| | |
|--|----------|
| Verne McGuffey Assistant Director, Soil Mechanics Bureau NYS DOT 1220 Washington Avenue State Campus, Building 7 Albany, NY 12232 | 1991 |
| Sam Thornton Department of Civil Engineering University of Arkansas Fayetteville, AR 72701 | 1992 |
| Dr. R. Janardhanam Department of Civil Engineering University of South Florida Tampa, FL 33620-5350 | 1993 |
| Geology Branch Wyoming Highway Department Cheyenne, WY 82202-9019 | 1994 (?) |
| West Virginia Department of Highways 312 Michigan Avenue Charleston, WV 25311 | 1995 (?) |



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August 15 - 17, 1990

Albuquerque, New Mexico

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|---------------------|--------------------------------------|--|
| Kenneth R. White | Chairman | Department of Civil, Agricultural, and Geological Engineering New Mexico State University Box 30001, Dept. 3CE Las Cruces, New Mexico 88003 |
| Kulathu A. Aiyer | Registration Technical Program | Department of Civil, Agricultural, and Geological Engineering New Mexico State University Box 30001, Dept. 3CE Las Cruces, New Mexico 88003 |
| Steven M. Huddleson | Field Trip Exhibits | New Mexico State Highway and Transportation Department P. O. Box 1149 Santa Fe, New Mexico 87504 |
| Kathryn Kretz | Field Trip Exhibits | New Mexico State Highway and Transportation Department P. O. Box 1149 Santa Fe, New Mexico 87504 |

3:20 PM to 5:00 PM

DESIGN OF GEOGRID WALL WITH WICK DRAINS IN TUCUMCARI, NEW MEXICO - Edward Rector and Richard Lueck, NMSHTD

GEOGRID-EXPANSIVE CLAY EMBANKMENT - Sam Thornton and Michael McGuire, University of Arkansas

CREATING AN ELEVATED CATCHMENT AREA USING A PRECAST MODULAR WALL SYSTEM - Richard Cross, NY State Thruway Authority

17 MILES TO MOUNT ST. HELENS: OPERATIONAL ASPECTS OF THE GEOTECHNICAL INVESTIGATION - George Deardorff and David Findley, Golder Associates, Inc.

THURSDAY, 16 AUGUST 1990

8:00 AM to 4:00 PM

FIELD TRIP

5:30 PM to 9:00 PM

SOCIAL HOUR-BANQUET

Speaker - Dr. Lawrence Lattman, President, NMIMT, Socorro

FRIDAY, 17 AUGUST 1990

8:00 AM to 12 Noon

EXHIBITOR DISPLAY

TECHNICAL SESSION III - BALLROOM Moderator - Dr. Joseph Finney, CAGE Dept., NMSU

8:30 AM to 10:00 AM

ANALYSIS AND DESIGN OF TIEBACK WALL NO. 5 IN STEUBENVILLE, OHIO - Richard Humphries and Gordon Elliott, Golder Associates, Inc.; Gerald Cafarelli and John Hollenbaugh, URS Consultants; Eugene Geiger, OH DOT

ALTERNATIVE METHODS FOR RETAINING WALLS - Peter Nicholson and Spark Johnston, Nicholson Construction Co.

T-WALL-ENGINEERED FOR ECONOMY - Thomas Neel, The Neel Co.

10:00 AM to 10:20 AM

Coffee Break

10:20 AM to 12 Noon

SLOPE FAILURE PROBABILITY FOR LAYERED SOILS - Sam Thornton and Steven Garret, University of Arkansas

FEDERAL HIGHWAY ADMINISTRATION'S TECHNOLOGY TRANSFER ACTIVITIES IN GEOTECHNICAL ENGINEERING - Chien Tan Chang, FHWA

DATA ACQUISITION SYSTEM FOR MECHANICAL DUTCH CONE PENETROMETER - Steven Huddleson, NMSHTD

FLORIDA'S MINERAL AGGREGATE CONTROL PROGRAM - William Wisner, Florida DOT

12 Noon

Symposium Adjourns

PAPERS

GEOLOGY OF NEW MEXICO

Russell E. Clemons
New Mexico State University, Las Cruces, NM 88003

Introduction

This paper is intended as a geological overview of New Mexico. The state's enchanting landscape and its natural resources are like a huge museum showcase. Layers of rocks exposed in highway cuts, valley walls, and mountain slopes represent pages of earth history that geologists "read" and interpret to learn how New Mexico has appeared for the past 2 billion years. Figure 1 contains an abbreviated version of this historical record. Landforms such as canyons and mountain ranges determined routing of early trains and roads in the state. Subsequently, discovery of mineral deposits in the mountains, oil and gas in the northwest and southeast corners of the state, and coal in San Juan and Colfax Counties provided purposes of routing and building other highways and railroads throughout the state.

New Mexico contains parts of five physiographic provinces: Colorado Plateau, Rocky Mountain, Great Plains, Basin and Range, and Datil-Mogollon (Fig. 2). Each province contains geologic materials and features, the combination of which, distinguish it from the other provinces by a distinct pattern of landforms related to geologic features that evolved through time. The Colorado Plateau is a region of scarped tablelands with broad valleys and local canyons cut in Mesozoic and Cenozoic rocks. Volcanic features, like Mount Taylor, and young basalt flows are widespread along the southern and southeastern borders. The Rocky Mountains include the high mountain areas and Rio Grande gorge of north-central New Mexico. Much of this province is composed of Tertiary and Precambrian rocks (Fig. 3). The Great Plains consists of high plateaus cut by Canadian and Cimarron River canyons in the northeast. Extensive basalt flows and Miocene alluvium (Ogalla Formation) discontinuously cover older rocks. Southward the province becomes broad lowland plains and terraced valleys of the Pecos and Canadian Rivers. Dissolution of Permian limestone and gypsum has produced extensive karst topography in the Santa Rosa-Vaughn-Fort Sumner region. Farther south an extensive cover of eolian and fluvial sediments mantle the Ogallala caprock. The Basin and Range province is characterized by fault-block mountain ranges separated by broad, elongate basins (valleys) having internal drainage. Narrow Rio Grande and Gila River valleys are incised into basin fill and older rocks. The Datil-Mogollon province, a transition area between the Basin and Range, and Colorado Plateau, is a volcanic terrane dominated by high tablelands, broad structural basins, and scattered fault-block ranges.

