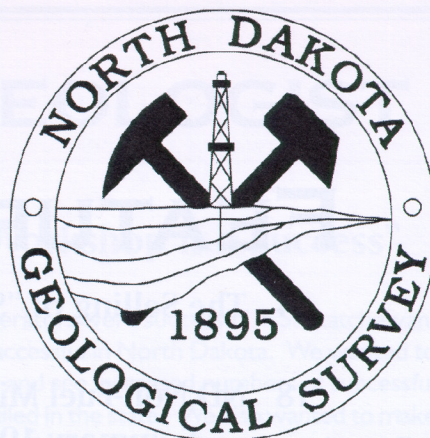


NDGS NEWSLETTER



Industrial Commission of North Dakota
North Dakota Geological Survey

Volume 25, No. 2
Summer/Fall 1998



A sand and gravel operation in north-central Divide County. In the background, the operator has stockpiled sand that was separated from the cobbles and pea gravel by mechanical sieving. Jon Reiten, Montana Bureau of Mines and Geology, stands at the top of this poorly sorted glaciofluvial deposit. Sand and gravel is the third most important mineral commodity in North Dakota, behind oil-and-gas, and coal. See Ann Fritz's article on page 18-19.

FEATURES

- 14 The Selling of "Sue"
- 18 ND Non-Fuel Minerals
Summary 1997

DEPARTMENTS

- 1 From the State Geologist
- 2 News In Brief
- 6 Meetings & Conferences
- 9 Teaching Tools
- 10 ESIC News
- 20 New Publications



State Of North Dakota

INDUSTRIAL COMMISSION

Edward T. Schafer, Governor
Heidi Heitkamp, Attorney General
Roger Johnson, Commissioner of Agriculture

GEOLOGICAL SURVEY

John P. Bluemle, State Geologist

Randolph B. Burke • Paul E. Diehl • Ann M.K. Fritz
Thomas J. Heck • John W. Hoganson • Julie A. LeFever
Karen J.R. Mitchell • Edward C. Murphy • Ryan Waldkirch

SUPPORT STAFF

Karen Gutenkunst, Business Manager

Rich Baker • Lisa Lehr • Sheila Glaser • Kent Hollands
Elroy Kadrmass • Steve Kranich • Jim Lindholm • Russ Prange
Evie Roberson • Sheila Senger • Don Thom

NDGS NEWSLETTER

Ann M. K. Fritz • Editor
Lisa Lehr • Layout and Design

NDGS Newsletter (ISSN: 0889-3594) is published quarterly by the North Dakota Geological Survey, a division of the Industrial Commission of North Dakota. *NDGS Newsletter* is designed to reach a wide spectrum of readers interested in the geology and mineral resources of North Dakota. Single copies of *NDGS Newsletter* are distributed free upon request. Please share the *NDGS Newsletter*; we encourage its reproduction if recognition is given.

Your comments - and contributed articles, photographs, meeting announcements, and news items - are welcome. Correspondence, subscription requests, and address changes should be addressed to: Editor, *NDGS Newsletter*, North Dakota Geological Survey, 600 East Boulevard Avenue, Bismarck, ND 58505-0840 (701) 328-8000.

When requesting a change of address, please include the number on the upper right hand corner of the mailing label.

FROM THE STATE GEOLOGIST

By John P. Bluemle

“Sixth International Williston Basin Horizontal Workshop is a Success”



The Survey's subsurface geologists and I have almost recovered from the highly successful Sixth International Williston Basin Horizontal Well Workshop, held in Bismarck on May 3 through 5. On page six, Dr. Paul Diehl, NDGS geologist, has summarized the Workshop, which consisted of three days of information and technology exchanges, a core workshop, and a

field trip. Paul was Program Chairman for the event, and he put the technical program together. Paul also coordinated the displays and compiled the 400-page Workshop volume. Attendance at this year's event was 577: 258 from Canada and 319 from the US.

The highly successful series of Workshops was initiated in 1993, a joint venture of the North Dakota Geological Survey and Saskatchewan Energy and Mines. Malcolm Wilson, of Saskatchewan Energy and Mines, and Bill McClellan and I of the NDGS, got together back in the fall of 1992 to plan the first Workshop, a one-day meeting held on May 13, 1993 in Minot, North Dakota. Our intent was to provide an informal forum that would enable people from both sides of the border and from all branches of the petroleum industry to get together to get acquainted, exchange ideas and information, and make deals. We expected 70 people for that event, but 170 showed up. The first two Horizontal Well Workshops were held in Minot, the third in Regina. Since 1996, the workshops have alternated between Bismarck and Regina.

In the early 1990s, the Canadians' success in drilling horizontal wells drew the attention of North Dakota producers. We had horizontal production in North Dakota, but only from the Bakken Formation. The Bakken horizontal play was beginning to die in North Dakota, but at the same time, we noticed that in Saskatchewan they were drilling a lot of successful horizontal wells in formations other than the Bakken and the Province was surpassing annual production levels each year.

The initial idea of the Workshops was to get together and

determine why operators were successful in Saskatchewan, but were not as successful in North Dakota. We wanted to turn things around and see increased numbers of successful horizontal wells drilled in the state. We also wanted to make the Canadians aware that the productive zones in North Dakota are similar to those in Canada. And finally, we hoped to attract Canadian investment south of the border. Certainly, we have achieved all of these goals and much more.

By all measures, the concept of the Horizontal Well Workshop has been successful beyond all our expectations. Probably one of the key factors in the success of the Horizontal Workshop concept is that the meeting is specific to the Williston Basin. It appeals to people in all areas of the petroleum industry: geologists, engineers, landmen, service-industry people, information service people, government scientists and regulators, and others. Many people have remarked that they feel "at home" with the Horizontal Workshop and they consider it to be "their" meeting. For many participants, it has become the main or only major conference they attend every year.

We have been able to keep the costs to registrants at our Workshops low because of the generous contributions of industry sponsors. This year, approximately 45% of the cost of the Workshop was underwritten by donations from companies active in all parts of the oil industry - a strong statement on the part of people in industry that they consider this event to be a valuable one meriting their support. A listing of everyone who participated in this Spring's Workshop is posted at the NDGS Web Site at <http://www.state.nd.us/ndgs/1998.html>

What have the Horizontal Workshops accomplished? They have played a large role in providing information on the successes and failures of nearly all the operators drilling horizontal wells in the Williston Basin. Furthermore, they have resulted in the transfer and application of a huge amount of technical information. They have provided a network for everyone interested in horizontal drilling and other advanced technology. The Workshops are not the only reason horizontal drilling has come so far in the past few years, but they have definitely hastened the process and added to its success. Certainly, there would have been horizontal wells drilled in the Williston Basin without the Workshops, but not nearly so many or so successfully. If it weren't for horizontal wells, produc-

in North Dakota and Saskatchewan would be declining, as it is in many other places.

The next in this series of Workshops, the Seventh Interna-

tional Williston Basin Horizontal Well Workshop, will be held in Regina, Saskatchewan, April 25 - 27, 1999. And, for those of you who really like to plan ahead, we are tentatively looking at an eighth Workshop May 7-9, 2000 in Bismarck.

NEWS IN BRIEF

Compiled By Ann Fritz, Editor



Heritage Outbound Road Trips Set For This Summer

Submitted by Marcia Wolter Britton of the ND State Historical Society

A new program offering exciting outdoor heritage experiences for adults will take place three weekends this summer. Two day-long heritage road trips and one overnight trip will offer a variety of interdisciplinary topics based on exhibits featured at the North Dakota Heritage Center in Bismarck.

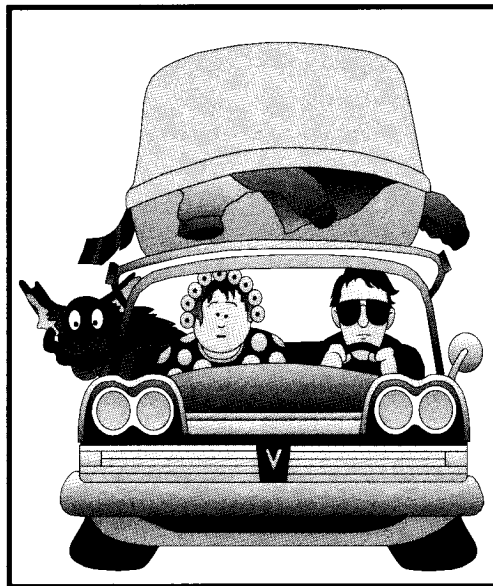
The program, Heritage Outbound Summer Road Trips, is scheduled for the weekends of June 20, July 18, and August 22-23.

Program instruction and road trip guides will be provided by the sponsors, which are the State Historical Society of North Dakota, the North Dakota Geological Survey, the North Dakota Game and Fish Department and the Bismarck Art and Galleries Association (BAGA). Preregistration is required for all trips.

Kicking off the series on Saturday, June 20 is "Heritage Outbound: Art and History," from 8AM to 5PM. The road trip will take participants on a journey from the Earth, Water and Fire exhibit on North Dakota clay (see article in Spring NDGS Newsletter, page 13) at the ND Heritage Center to Hebron, ND, home of the Hebron Brick Factory. In Hebron, the group will enjoy a picnic lunch and a pottery workshop conducted by Hebron potter Robyn Reynolds, using native North Dakota clay. The preregistration cost is \$35 and space is limited to 20 people.

On Saturday, July 18, the program theme will be "Heritage Outbound: Paleontology," again from 8 AM to 5 PM. It will feature paleontology laboratory activities and a slide and

gallery tour at the North Dakota Heritage Center, presented by Dr. John Hoganson. A road trip is also scheduled to the Stumpf Natural Area, listed in the North Dakota Natural Areas Registry, where participants will visit archeological and paleontological sites during an afternoon of picnicking and hiking in rugged terrain. Preregistration fee is \$35 and space is limited to 20 people.



Concluding the summer road trip series on Saturday and Sunday, August 22-23 is "Heritage Outbound: Western Dakota." Participants will have the chance to experience a distinctive taste of the West by: helping with a dinosaur dig; trying a hand at sketching or photographing the special habitat of the Limber Pines; viewing the restoration of the historic Mystic Theater in Marmarth; and bunking overnight at the Marmarth Historical Society's bunkhouse in Slope County. Biologist and photographer Chris Grondahl from the

ND Game and Fish Department, NDGS Paleontologist John Hoganson, and a BAGA local artist will serve as guides and instructors. Departure from the ND Heritage Center is scheduled for Saturday, August 22 at 7 AM, with a return planned for Sunday, August 23 at 6 PM. A preregistration fee of \$85 is required and space is limited to 15 participants.

To preregister or for more information, call the Education and Interpretation Division of the State Historical Society of North Dakota at (701) 328-2666.

NDGS Receives Prairie Partner Award

By John P. Bluemle

On May 12 through the 14, U.S. Forest Service National Grasslands managers from around the United States attended a National Grassland Manager's Conference in Dickinson, North Dakota. Approximately 70 Forest Service professionals heard from a variety of federal and other officials about good management practices on the grasslands and had the opportunity to take a field trip through the scenic Little Missouri National Grassland south of Medora.

I attended the conference, participating as an invited speaker, addressing the issue of the importance of the National Grassland in North Dakota from the perspective of geology. My emphasis was on the oil and gas resources on the Little Missouri National Grassland, their importance to the federal, state, and local communities, and the need to understand the potential for de-

veloping future hydrocarbon resources on the grassland. I also discussed the water resources of the Sheyenne National Grassland and the extensive paleontological resources of the Little Missouri National Grassland.

The NDGS has been working closely with the U.S. Forest Service to protect the fossil resources and we have drawn up agreements to most effectively manage these resources. John Hoganson, NDGS Paleontologist, also attended the conference, helping lead the tour and showing the group some of the geology and fossil sites on which he has been working. John also spoke to the group on May 14.

Following an evening banquet in Medora, several awards were presented. I accepted the "Prairie Partner Award" on *(Continued on Page 5)*

NDGS Receives Certificate From FEMA

It is nice to get a "thank you" card, especially from the Federal Government. In April of this year, the NDGS received a certificate of appreciation from the Federal Emergency Management Agency (FEMA) and the North Dakota Division of Emergency Management. The certificate (shown below), signed by Lesli Rucker, Federal Coordinating Officer, and Major General Keith Bjerke, State Coordinating Officer, was given "in grateful appreciation and recognition of exemplary work in support of disaster response and recovery operations for the severe flooding, winter storms, heavy spring rain, rapid snow melt, high winds and ice jams that resulted in President Clinton's disaster declaration on April 7, 1997."

Prior to the flooding in the Red River Valley, NDGS geologists were contacted by FEMA representatives to provide geologic information for that agency. Currently, NDGS geologists Ed Murphy and Julie LeFever, and cartographer Ryan Waldkirch are working on a revised flood plain map of the Grand Forks - East Grand Forks area. This map, as well as other geologic maps produced by the NDGS, can assist emergency managers by identifying areas that are likely to be flooded during high run-off years.



Secretary of State Gives Certificate of Appreciation to NDGS

The ND Geological Survey, and cartographer Ryan Waldkirch in particular, were recognized by Secretary of State Al Jaeger in a brief ceremony on April 3, 1998 in the State Capitol for our work in creating a map of North Dakota's Legislative Districts. The project began in late 1997, when the Secretary of State's office undertook a project to create a map of the state's 49 legislative districts. The goal was to create a map which clearly identified the boundaries of North Dakota's 49 Legislative Districts from the boundaries of the state's 53 counties. Another priority in creating the map was to provide a detailed visual description of North Dakota's smaller legislative districts located in the state's larger population centers.

In a letter dated February 23, 1998 to State Geologist John Bluemle, Secretary of State Al Jaeger writes, "I would like to take this opportunity to thank you and the Geological Survey for your willingness to assist the Secretary of State's office in developing the map entitled North Dakota Legislative Districts. We are very pleased with the results of the map and have already been receiving very positive comments from elected officials, members of the public, and the media.

I also want to recognize the individual at the Geological Survey responsible for making this map possible. Ryan Waldkirch, with your approval, volunteered his valuable time and tremendous talents towards the creation and completion of this map. Without Ryan's efforts and the cooperation of the North Dakota Geological Survey, this project would not have been possible."

A copy of the North Dakota Legislative Districts map can be obtained from the Secretary of State's office. The mailing address is 600 E. Boulevard Avenue, Bismarck, ND 58505-0500 or by calling (701) 328-2900.



On April 3, 1998, Secretary of State Al Jaeger (far left) presented Ryan Waldkirch and John Bluemle certificates of appreciation for the ND Geological Survey's work on the *ND Legislative Districts* map.

Buchholtz Resigns From NDGS Staff

Gina Buchholtz, Information Processing Specialist and Layout and Design Manager of the NDGS Newsletter, resigned effective March 31. Gina's resignation came at a busy time for the NDGS, as we were preparing for this issue of the NDGS Newsletter and more importantly, preparing for the Sixth Annual Horizontal Well Workshop. During her two years with the NDGS, Gina organized the NDGS Library, assisted in organization and registration for the Horizontal Well Workshop, designed the layout of the NDGS Newsletter as well as other NDGS publications, and had many more duties, too numerous to mention. The staff of the NDGS wish Gina the best of luck as she continues her education and broadens her career horizons!

CORRECTION

In the article about the North Dakota fossil exhibit in Washington D.C. on page 4 of the Spring NDGS Newsletter, Barbara Beasley's affiliation was incorrectly identified. Ms. Beasley is a U.S. Forest Service paleontologist not a USGS paleontologist as is stated in the article. My sincere apologies to Ms. Beasley and her colleagues at the U.S. Forest Service for this error. - Ann Fritz, Editor

Summary Report of the Red River of the North National Water Quality Assessment Now Available

In 1991, Congress appropriated funds for the U.S. Geological Survey (USGS) to begin the National Water Quality Assessment (NAWQA) Program. The program will help meet the needs for sound, scientific information necessary for reliable resource management decisions for our nations river basins and aquifers. The NAWQA Program is assessing the water quality conditions of more than 50 of the Nation's largest and most important river basins and aquifers, known as study units. Collectively, these study units cover about one-half of the land area of the United States and include sources of drinking water used by about 70 percent of the U.S. population. (For more information about the NAWQA Program in the Red River of the North Basin, see a related article in the Spring, 1997 NDGS Newsletter, v. 24, no. 1, pages 5-6).

The U.S. Geological Survey has recently completed a report which summarizes the major findings that emerged between 1992 and 1995 from the water-quality assessment of the Red River of the North Basin (Stoner, J.D., and others, 1998, *Water Quality in the Red River of the North Basin, Minnesota, North Dakota, and South Dakota, 1992-1995*, U.S. Geological Survey Circular 1169). The 33-page, color illustrated report addresses many of the concerns raised by regulators, water-utility managers, industry representatives, and other scientists, engineers, public officials, and members of stakeholder groups who provided advice and input to the USGS during this NAWQA study-unit investigation. The information contained in the report may also interest those who

simply wish to know more about the quality of water in the rivers and aquifers in the area where they live. A free copy of the report can be obtained from the U.S. Geological Survey, Information Services, Box 25286 Federal Center, Denver, CO 80225. The report is also available on the Internet via the World Wide Web at URL: <http://water.usgs.gov/lookup/get?circ1169>.

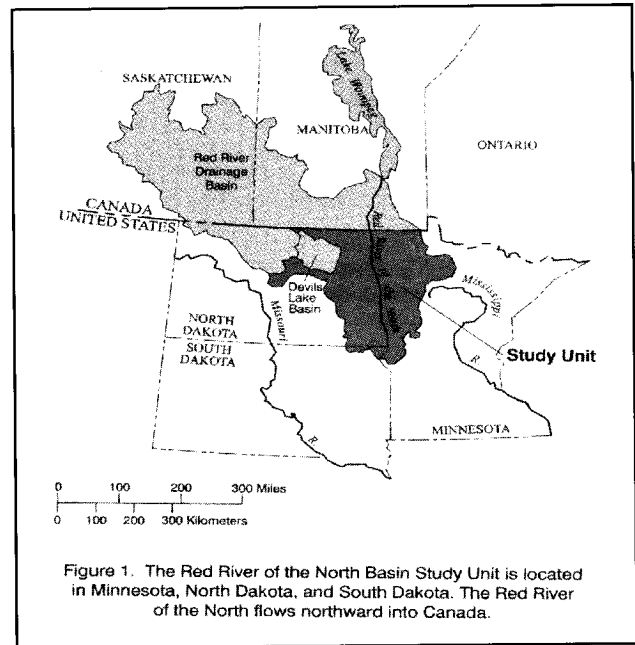


Figure 1. The Red River of the North Basin Study Unit is located in Minnesota, North Dakota, and South Dakota. The Red River of the North flows northward into Canada.

Prairie Partner Award

(Continued from Page 3) behalf of the NDGS. Tom S. Thompson, Chairman of the National Grasslands Council, read the following citation at the time of presenting the award:

"The Little Missouri National Grassland and the Grand River National Grassland are underlain by major fossil-bearing formations, which contain some of the most important fossils in the world. Management and protection of the paleontological resources has only been possible through our partnership with the North Dakota Geological Survey.

The Geological Survey has provided training for the National Grassland personnel in inventory techniques, collection techniques, and in excavation and restoration. They provide management recommendations that have been used for special use permits, project planning and for the northern Great Plains planning process.

Dr. John Bluemle is the State Geologist for the NDGS and is responsible for the support of this partnership. The work that is being done on the ground to protect and study the paleontological resources, as described to us by Dr. John Hoganson of the NDGS, is a model for the Forest Service.

We thank Dr. Bluemle and Dr. Hoganson for their leadership and support of Forest Service management."

The "Prairie Partner Award" is on display at the NDGS offices in Bismark.

MEETINGS & CONFERENCES

Second Announcement:

Eighth International Williston Basin Symposium

Sponsors: the Saskatchewan, North Dakota and Montana Geological Societies

The Eighth International Williston Basin Symposium will be held October 19 to 21 at the Ramada Renaissance Hotel in Regina, Saskatchewan, Canada. The tentative schedule for the symposium is as follows:

Sunday, October 18, 1998: Set up of poster and commercial displays, registration and ice-breaker

Monday, October 19, 1998: Registration, technical sessions, poster and commercial displays, luncheon banquet, and social evening

Tuesday, October 20, 1998: Technical sessions, poster and commercial displays

Wednesday, October 21, 1998: Core Workshop at the Subsurface Geological Laboratory.

In addition, at least two pre-conference field trips will be offered. The first is "Manitoba: Paleozoic Outcrops" lead by Ruth Bezys. The second field trip will be to the Bears Paw and Little Rocky Mountains in northern Montana lead by Don Kent. The dates of the trips have yet to be finalized, but will most likely be Friday October 16th to Sunday October 18.

CORE WORKSHOP

Deep Rights Reversion comes into effect in Saskatchewan in 1998, so special interest in rocks of Devonian age and older is expected. Displays in the workshop will therefore be strictly limited to cores of such rocks. Descriptive accounts for publication in a workshop manual are requested. They must be submitted in camera-ready format by August 31, 1998. If you wish to make a workshop presentation, please contact: Kim Kreis at e-mail kkreis@gov.sk.ca, phone (306) 787-2620, or Fax (306) 787-4608.

COMMERCIAL DISPLAYS

Because of the present high levels of exploration for and development of Ordovician oil plays in Saskatchewan and North Dakota and the probable increase in exploration activity in Devonian and older strata after Deep Rights Reversion comes into effect, this conference is expected to attract in excess of 500 delegates. If your organization is interested in publicizing its equipment and services at this important event please contact:

Lloyd Freeman at e-mail: vista.freeman@sk.sympatico.ca, phone (306) 791-6970,

or Fax (306) 525-9540. Details about booth sizes, locations and costs will be sent upon request.

SPONSORSHIPS

Sponsor contributions are essential to keeping down the cost of registration and maintaining the traditional high quality of the conference. All sponsors will receive full recognition, both in the Proceedings Volume and during the symposium. If you are interested in becoming a sponsor of the conference or of a specific event during the conference, please contact Malcolm Wilson at e-mail mwilson@gov.sk.ca, phone (306) 787-2618 or 7662, or Fax (306) 787-2333.

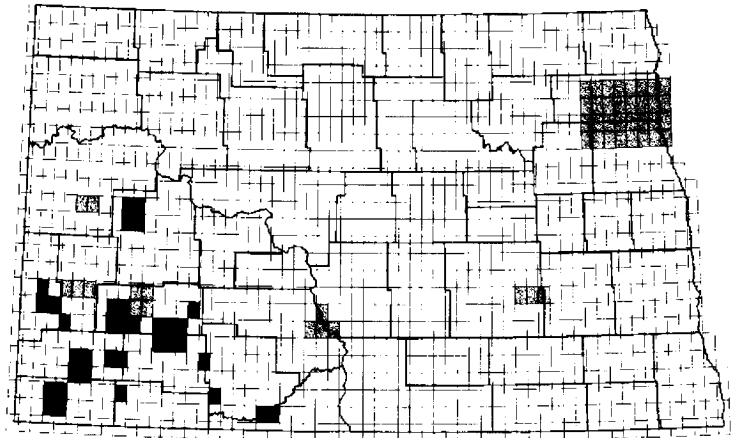
GENERAL INFORMATION

For more information about the Eighth International Williston Basin Symposium, or for questions regarding registration information, you can view the Symposium web site at <http://www.gov.sk.ca/enermine/about/intwilst.htm>. For general inquiries about the conference, please contact Chris Gilboy at e-mail cgilboy@gov.sk.ca, phone (306) 787-2573, or Fax (306) 787-4608. You can also contact Don Kent at e-mail kentdo@meena.cc.uregina.ca, phone (306) 789-7040, or Fax (306) 761-1567.

State Geological Surveys Meet In Washington, D.C.

North Dakota Surface Geology

Mapped through the USGS StateMap and CoGeomap Programs



7.5 Minute quads completed through the StateMap Program (1992-1998)

7.5 Minute quads completed through the CoGeomap Project (1988-1992)

Areas of the State mapped under cooperative programs over the past ten years. Squares represent the USGS 7.5 minute quadrangle maps (quads) of the State.

By Ed Murphy

State Geological Surveys from across the country met in Washington, D.C. on March 15-18 to discuss natural resource and environmental issues with various federal agencies. The main item on the agenda was the status and future of STATEMAP, a cooperative mapping program between the state surveys and the United States Geological Survey (USGS). Since 1987, the USGS and state surveys have cooperated on geologic mapping programs. COGEO MAP, the forerunner of these matching grant programs, was replaced in 1992 by STATEMAP. The North Dakota Geological Survey (NDGS) has participated in a total of seven different cooperative projects resulting in several NDGS reports and detailed geologic maps (1:24,000 scale) covering approximately 6% of the state. Several of these projects (Jamestown, Dickinson, and Bismarck) have focused on detailed geologic mapping of urban settings. Other map topics have included the geology of both the north and south units of the Theodore Roosevelt National Park, the geology of the major buttes in western North Dakota, the Cretaceous/Tertiary boundary in the south-central portion of the State, and the geology of Walsh and northern Grand Forks counties.

In 1992, the U.S. Congress passed the National Geologic Mapping Act after determining geologic maps were not being compiled at a rate sufficient to provide the nation with vital geologic information. The act, which includes the STATEMAP program, was unanimously re-authorized by Congress last summer. In an effort to familiarize Congress with the results of this program, a reception was held on the evening of March 18th in the Rayburn House Building for congressional delegations.

Congressman Earl Pomeroy visits the North Dakota exhibit during the congressional reception in Washington, D.C (Ed Murphy on the right). The recently completed surface geology map of the Bismarck Quadrangle was on display. Photo courtesy of John Steinmetz, Montana Bureau Of Mines and Geology.



Sixth International Williston Basin Horizontal Well Workshop Was An Apparent Success

By Paul Diehl

With the generous financial support of oil industry firms, and with the participation of about 600 registrants (Fig. 1), the Sixth International Williston Basin Horizontal Well Workshop was held at the Radisson Inn Bismarck, May 3-5. As in the past, the workshop was hosted and organized by the North Dakota Geological Survey (NDGS) and the Saskatchewan Energy and Mines (SEM). Workshop participants came from seventeen states and three Canadian provinces (Fig. 2) and represented the spectrum of professions within the oil & gas industry. "Thank you" to all who gave their support and participation to make this workshop a success.

A pre-workshop "Coal Country" field trip was held Sunday, May 3 prior to the evening welcoming Ice Breaker. The trip included tours of the Great Plains Synfuels Plant, Antelope Valley Station, and The Coteau Properties Company's Freedom Mine. The tours were of special interest since Dakota Gasification Company has completed an agreement to supply CO₂ to be used in an enhanced oil-recovery project in Weyburn Oil Field near Weyburn, Saskatchewan.

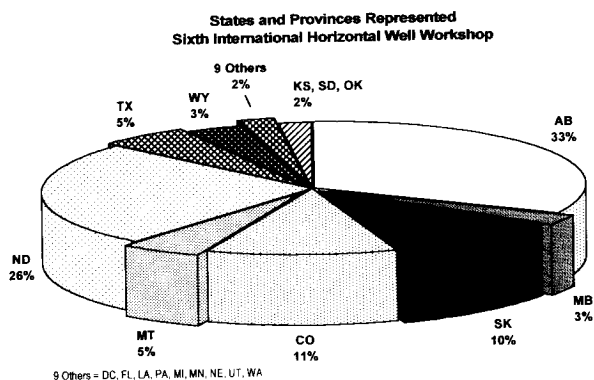
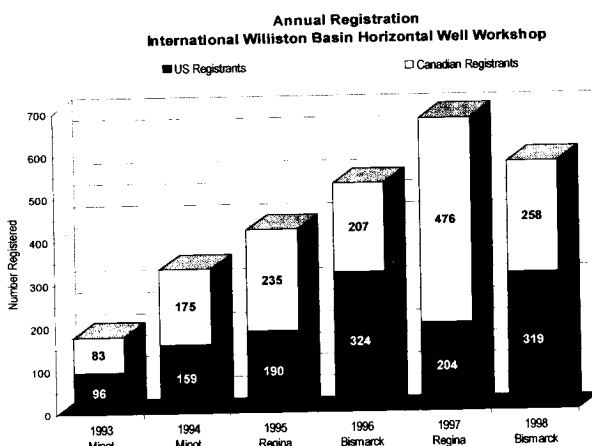
During the Monday luncheon, workshop participants had the opportunity to hear addresses by Eldon Lautermilch, Minister of Saskatchewan Energy and Mines, and by North Dakota Attorney General, Heidi Heitkamp. Later that day, North Dakota Commissioner of Agriculture, Roger Johnson spoke to the group. NDGS and SEM extends a special thanks to these people for making time in their schedules to talk to the workshop participants.

This year a record sixty displays were set up in the courtyard and Missouri Ballroom areas of the Radisson. Oral presentations included updates of horizontal well activity of the states and provinces within the Williston Basin. Technical papers included topics such as legalities surrounding horizontal drilling, CO₂ transportation and injection, new engineering technologies to drill and complete horizontal wells, production logging in horizontal wells, geology and hydrogeology of various oil-producing formations, new techniques of crosswell seismic imaging, and downhole control of paraffin, scale, corrosion, emulsion, salt, and hydrogen sulfide by microbes. A total of twenty-one presentations were made during the two day workshop.

On Tuesday afternoon and evening, rock cores representative of many of the formations which are oil-productive in horizontal wells in the Williston Basin were on display. The cores sparked much discussion about the significance of features vis-

ible in the rocks and about their geologic interpretations as well as their completion and production engineering implications.

A 400-page workshop volume containing the workshop agenda; an outline, abstract, or paper of the oral presentations; and the well logs, core analyses, and completion reports of the intervals of the wells represented by the displayed cores was provided to all registrants. The workshop volume can be purchased from the Saskatchewan Energy and Mines for \$20 US (\$25 Canadian). Please make checks payable to **Horizontal Workshop** and mail to: **Horizontal Well Workshop**, Attn. Brenda Maximuik, Saskatchewan Energy and Mines, 1914 Hamilton Street, 14th Floor, Regina, SK S4P 4V4 Canada. Brenda can be reached at (306) 787-7632 or fax (306) 787-2333.



TEACHING TOOLS



NDGS and SHSND will Co-Sponsor Earth Science Fair

Why Celebrate Earth Science Week?

- To give students new opportunities to discover the Earth Sciences
- To highlight the contributions that the Earth Sciences make to society
- To publicize the message that Earth Science is all around us
- To encourage stewardship of the Earth
- To develop a mechanism for geoscientists to share their knowledge and enthusiasm about the Earth and how it works
- To have fun!!!

The countdown to Earth Science Week has begun, mark your calendars now for the October celebration! As part of the Earth Science Week celebration, the North Dakota Geological Survey (NDGS) and the State Historical Society of North Dakota (SHSND) are planning an Earth Science Fair to be held at the ND Heritage Center on October 23-25, 1998.

Events on Friday, October 23 will be geared towards school groups of all ages. Teachers from all over the state are invited to bring their classes to the Heritage Center for a day of Earth Science excitement and activities focusing on the geology, paleontology, and natural resources of North Dakota. Demonstrations and lectures presented by geologists of the NDGS will be scheduled throughout the day, as well as video presentations, and special interpretation at selected Heritage Center exhibits. Preregistration is required for the Friday sessions, and sessions will be filled on a first-come, first-serve basis. Registration and more detailed information will be mailed to teachers and schools later this summer.

The Earth Science Fair will continue on Saturday, October 24, with family oriented events and activities. Activities include a walking tour of the State Capitol grounds, slide presentations on geologic hazards and the prehistoric life in North Dakota, as ongoing demonstrations by NDGS geologists. In addition, NDGS

geologists will be available to answer your questions about North Dakota's rocks, minerals, fossils, and other natural resources.

The Earth Science Fair will conclude on Sunday, October 25 with a 2:00 PM slide presentation on the "Rise and Fall of the Dinosaurs" presented by Dr. John Hoganson, NDGS paleontologist. All events on Saturday and Sunday are free and open to the public.

Earth Science Week began in 1997 when the American Association of State Geologists passed a resolution declaring the second week of October as "Earth Science Week." The American Geological Institute (AGI), in conjunction with the Institute's 50th anniversary, is the national sponsor of Earth Science Week and is the lead organization in coordinating national events. To date, the governors of Alabama, Colorado, Illinois, Kansas, Nevada, North Carolina, North Dakota, and Ohio have already issued Earth Science Week proclamations. North Dakota's proclamation was reported last fall in the NDGS Newsletter (volume 24, no. 3, on page 3). The establishment of an annual celebration of the earth sciences is based on other national science-recognition weeks like National Chemistry Week in November (started by the American Chemical Society) and National Engineers Week in February (started by the National Society of Professional Engineers).

"The goal for Earth Science Week," says AGI president Susan Landon, "is to have every geoscientist in the country do something in their community to promote the earth sciences." AGI will sponsor the annual Earth Science Week, serve as a clearinghouse of ideas for activities, and provide support materials that make it easy for geoscientists to participate. Earth

Science Week has enormous potential for increasing public awareness and understanding of the importance of the earth sciences in our lives, says coordinator Julie Jackson.

The focus of Earth Science Week is on activities that will occur within individual communities, hence the Earth Science Fair at the Heritage Center will focus on North Dakota geology and natural resources. A common theme uniting each state's proclamation of Earth Science Week is the recognition that an understanding of geology and the earth sciences can help citizens make wise decisions for land management and use, is crucial to addressing environmental and ecological issues, and provides the basis for preparing for and recovering from natural disasters. The annual October celebration will give geoscientists and earth-science organizations repeated opportunities to: give students new opportunities to discover earth sciences; highlight the contributions that earth sciences make to society; publicize the message that earth science is all around us; encourage stewardship of the Earth; and develop a mechanism for geoscientists to share their knowledge and enthusiasm about the Earth and how it works.



For more information about the North Dakota Earth Science Fair that will be held October 23-25, please contact either Ann Fritz, Karen Mitchell or John Hoganson of the NDGS at (701) 328-8000. You can also check out the AGI Earth Science Week Website. There is a link available to it from the NDGS Home Page. The URL address is: <http://www.state.nd.us/ndgs/NDGS.HomePage.html>

Some ideas for your own Earth Science Week Celebration . . .

- Create an Earth Science display at your local school, company, or in a community business or library.
- Give a presentation to a local club or organization such as the Girl or Boy Scouts.
- Have an "Earth Science At Work In Our Community" poster or essay contest.
- Visit a classroom to lead an activity, demonstration or discussion about Earth Science related topics.

ESIC NEWS



The NDGS is an affiliate of the Earth Science Information Center (ESIC) network. Coordinated by the U.S. Geological Survey, the nationwide ESIC network provides information about geologic, hydrologic, topographic and land use maps, books and reports; aerial, satellite, and radar images and related products; earth science and map data in digital form and related applications software; and geodetic data. As a ESIC office, the NDGS can assist the public in locating earth science materials dealing with North Dakota, as well as other states. For more information contact Karen Mitchell or Ryan Waldkirch at (701)328-8000.

GENERAL INFORMATION

Updated Geographic Names Information System CD-ROM Is Now Available

The Geographic Names Information System (GNIS) CD-ROM dated March 1998 has been published and is now available for sale. The new CD includes the Antarctica Geographic Names Data Base (AGNDB) containing names approved by the United States Board on Geographic Names for features in Antarctica and the area extending northward to the Antarctic

Convergence. All of the names in the AGNDB are for natural features such as mountains, glaciers, peninsulas, capes, bays, islands, and sub-glacial entities. The names of scientific stations have not been included at this time, but may appear in the texts of some entries. An information sheet on the AGNDB and an errata sheet on Antarctic names will be included with the CD. In addition, the AGNDB is available on-line at <<http://mapping.usgs.gov/www/gnis/antform.html>>. Customers can order the GNIS CD-ROM from either the USGS-ESIC, 507 National Center, Reston, VA 20192 or the NDGS ESIC in Bismarck. The price is \$57.00 plus a \$3.50 handling charge per order. Visa or MasterCard orders can be faxed to the USGS ESIC office at 703-648-5548. *Reprinted from ESIC Information Bulletin 410.*

Cartographic Catalog Discontinued

The Cartographic Catalog, an information database distributed on a CD-ROM, has been discontinued. This database has been used for determining the availability of maps, atlases, images, digital data, and earth science related books, studies, indexes, and computer software. It has not been maintained for several years and the data on the current CD-ROM is out-of-date and incomplete. The Cartographic Catalog CD-ROM and the Cartographic Catalog Users Manual have been declared out-of-print and are no longer available for sale. *Reprinted from ESIC Information Bulletin 404.*

New and Recently Revised Publications from the USGS

The USGS has recently released several new and revised Fact Sheets and publications. The following free publications are now available:

- "Landsat Data" FS-084-97, a new Fact Sheet, published December 1997 (EarthFax document number 3510, 2 pages)
- "Innovative Partnerships" FS-214-96, a revised Fact Sheet, published December 1997, supersedes May 1997 edition (EarthFax document number 3031, 2 pages)
- "Index to National Aerial Photography Program Contracted 1997-2003 (NAPP III)", a new Index published July 1, 1997 (File number TUS5679)
- "Aerial Photographs and Satellite Images" 96-0011, a revised General Interest Publication, published September 1997, supersedes previous edition of April 1995
- "Digital Orthophoto Quadrangles", revised Fact Sheet 129-95, February 1998 (EarthFax document number 3301)
- "Declassified Intelligence Satellite Photographs", revised Fact Sheet 090-96, February 1998 (EarthFax document number 3503)
- "National Wetlands Inventory Products", revised Fact Sheet 191-95, February 1998 (EarthFax document number 3901)

The revised fact sheets supersede all previous editions. Single copies of Fact Sheets can be obtained from EarthFax by calling 703-648-4888. Requests for multiple copies and/or other publications can be sent to USGS-Information Services, Box 25286, Denver, CO 80225 or faxed to 303-202-4693. Requests for fact sheets can also be made through the NDGS ESIC office by calling 701-328-8000. *Reprinted from ESIC Information Bulletins 399 and 409.*

Revised Theme Fact Sheets

The following revised Theme Fact Sheets are now available from the USGS:

- "The U.S. Geological Survey Recent Highlights- Natural Resources" FS-187-97, December 1997 (supersedes FS-010-97)
- "The U.S. Geological Survey Recent Highlights - Hazards" FS 188-97, December 1997 (supersedes FS-248-96)
- "The U.S. Geological Survey Recent Highlights - Environmental Effects on Human and Wildlife Health" FS-189-97, December 1997 (supersedes FS-247-96)
- "The U.S. Geological Survey Recent Highlights - Information Management - Innovative Earth Science Databases" FS-190-97, December 1997 (supersedes FS-011-97)

Requests for this information can be sent to USGS-Information Services, Box 25286, Denver, CO 80225 or faxed to 303-202-4693. *Reprinted from ESIC Information Bulletin 401.*

New Minnesota Map List

The USGS has released a new Minnesota State Map List "Minnesota Map List" (File number TMNB; EarthFax document number 3171, 24 pages), published January 1998. This new list supersedes the "Minnesota Catalog of Topographic Maps". The revised map list now include coordinates. Single copies of the map list can be obtained from EarthFax at 703-648-4888. Requests for multiple copies can be sent to USGS-Information Services, Box 25286, Denver, CO 80225 or faxed to 303-202-4693. *Reprinted from ESIC Information Bulletin 405.*

Principal Meridians and Base Lines Map

The Bureau of Land Management map, "Principal Meridians and Base Lines Governing The United States Public (Land Surveys," has been reprinted by the U.S. Geological Survey and is now available for sale. Available in two sizes, 8.5" x 11" or 11" x 17", the map also gives dates which indicate the establishment of initial points or the first survey. The larger version of the map has two charts on the back showing identification of corners on subdivision of section lines and markings for corners on subdivision lines of elongated sections.

TUS5677, 8.5" x 11" Principal Meridians and Base Lines Map
TUS5678, 11" x 17" Principal Meridians and Base Lines Map

The cost for each map is \$4.00, plus a \$3.50 handling charge for each mail order. Customers can send orders to USGS, Information Services, Box 25286, Denver, CO 80225 or fax credit card orders to 303-202-4693. *Reprinted from ESIC Information Bulletin 406.*

EDUCATIONAL MATERIALS

A Topographic Field Trip of Washington, D.C.

Two versions of "A Topographic Field Trip of Washington, D.C.", a CD-ROM designed to teach middle school students map interpretation skills through a game-like adventure, are now available. The first version, for Macintosh systems only (file number 01-WASHDC), was developed and produced as a prototype with educational resources funding and is available free of charge. The USGS has developed and produced the second version for dual platforms, Macintosh and Windows systems (file number 01-WASHDC2), as a sales item. The dual platform version contains improvements in content and navigational capabilities. The Macintosh only version is free of charge while the supply lasts. As of March 9, 1998, the dual platform version is available for \$11.50, plus a \$3.50 handling charge per order if purchased by mail.

The Macintosh system requirements are: Macintosh systems with 256 color, 13-inch monitors or greater; at least 8MB of RAM; System 7 or greater; Macintosh-compatible CD-ROM drive; and 15-20 MB of free disk space. The Windows system requirements are: 486-33 Mhz; 16MB of RAM; Windows 3.1x or Windows 95; CD-ROM drive; 256 color, 13-inch monitor or greater; Windows compatible sound card; and 15-20MB of free disk space.

The "Topographic Field Trip of Washington, D.C." can be ordered from USGS-Information Services, Box 25286, Denver, CO 80225. Orders can be faxed to 303-202-4693. *Reprinted from ESIC Information Bulletin 400.*

Water Resources Education Initiative Poster Series: Coastal Hazards

A new poster in the Water Resources Education Initiative Poster Series is now available. In recognition of the Year of the Ocean, this poster on coastal hazards depicts how hurricanes, tsunamis, and coastal erosion can change the shape of the coast and affect nearby environments. The poster also shows how communities can prepare for and respond to these natural hazards.

The last in a series of nine posters, this poster was developed in cooperation with NOAA, UNESCO, and the Intergovernmental Oceanographic Commission. Other posters in the series cover watersheds, hazardous waste, wetlands, water use, wastewater treatment, navigation, ground water, and water quality. The posters can be joined to create a large wall mural. Grade School and Middle School versions of the Oceans poster are available in color with educational activities shown on the reverse side. A black and white version is also available.

- 96-0453 Oceans water poster - black and white
- 96-0454 Oceans water poster for Grade School
- 96-0455 Oceans water poster for Middle School

These posters are free of charge and can be ordered from USGS-Information Services, Box 25286, Denver, CO 80225. Requests can be faxed to 303-202-4693. *Reprinted from ESIC Information Bulletin 403.*

DIGITAL DATA

Two new CD-ROM's are now available for sale: DDS-46 "Resource Assessment of the Venezuelan Guayana Shield" This CD-ROM contains vector-based digital maps of the geology and resource assessment of the Venezuela Guayana Shield originally published as paper maps in 1993 in USGS Bulletin 2062, at a scale of 1:1,000,000 and revised in 1993-95 as separate maps at a scale of 1:500,000. Data layers include geology and faults, favorable domains for selected deposit types, and mineral deposits. The CD can be used on Macintosh; DOS, Windows 3.x, 95, or NT; or UNIX platforms. Acrobat for Macintosh, Windows, and UNIX as well as ArcView 1 for Windows 3.x are included on the CD. \$32.00

Open-File Report 97-540 "Atlas of GLORIA Sidescan-Sonar Imagery of the Exclusive Economic Zone of the United States: EEZ-View" This CD-ROM contains GLORIA sidescan imagery of all the deepwater portion of the EEZ mapped during the 8 years of data collection. The images are accompanied by brief tutorial overviews of plate tectonics, remote sensing with GLORIA, and highlights of interesting features from each of the geographic areas. Interactive links to word definitions, enlarged images, captions, shaded-relief images, and geologic maps makes this CD-ROM an attractive introductory tool for high school or college classes in marine geology or mapping with remote sensing. Images and text are presented via an ArcView Data Publisher project for Windows 3.xx, Windows NT 3.51, or NT 4.0. \$32.00

Orders can be sent to USGS-Information Services, Box 25286, Denver, CO 80225 or faxed to 303-202-4693. *Reprinted from ESIC Information Bulletin 402.*

FEATURES

The Selling of the *Tyrannosaurus rex* Named “Sue”: Its Effect on North Dakota’s Fossil Resource Management Program

By John W. Hoganson

In the mid-1980’s, the North Dakota Geological Survey Fossil Resource Management Program was initiated to address the need for management of North Dakota’s fossil resources. For more than a century, collectors have come to North Dakota to hunt for fossils and numerous important specimens have been removed from the state. Many of these fossils are now in the collections of museums and universities in the eastern United States. In 1989, two laws were passed in North Dakota to greatly enhance our fossil resource management efforts. The legislation that “recreated” the North Dakota Geological Survey (NDCC 54-17.4) directs the Geological Survey to operate and maintain a public repository for fossils, thus creating a North Dakota State Fossil Collection. This collection is being developed and housed at the Geological Survey’s paleontology laboratory located in the North Dakota Heritage Center in Bismarck. Also in 1989, North Dakota’s Paleontological Resource Protection Act (NDCC 54-17.3) was ratified. This law gives the North Dakota Industrial Commission, acting through the office of the State Geologist, the responsibility to manage and protect fossil resources on lands owned by the State of North Dakota and its political subdivisions.

However, a new challenge for the management of North Dakota’s fossil resources has developed in the past few years as the result of a thriving international market for fossils and the resulting collecting and selling of fossils by profiteers. The most startling example is the recent auction of the most complete skeleton ever found of a *Tyrannosaurus rex* for \$8.36 million!

Auction of the *T. rex* named “Sue”

In 1990 the Black Hills Institute, a private company located in Hill City, South Dakota that collects and sells fossils, discovered the remains of a *Tyrannosaurus rex* on Maurice Williams’ ranch near Faith, South Dakota. The fossil was named “Sue” because it was discovered by Sue, a former employee of the Black Hills Institute. This started a bizarre and ridiculous trend of giving names to fossil dinosaur specimens (almost as ridiculous as Johnny Cash’s old song, “A Boy Named Sue”).

Peter Larson, owner of the Black Hills Institute, and a team of bone hunters excavated the fossil and paid Maurice Williams \$5,000 for the specimen. They transported the fossil to their Hill City headquarters. Word spread quickly around the paleontological community that a remarkably complete and well-preserved *T. rex* specimen had been found by the Black Hills Institute and was for sale.

An ownership dispute developed over the fossil between the Black Hills Institute and Maurice Williams. Maurice Williams claimed that the payment of \$5,000 was only for the right to look for fossils on his property, not for the actual excavation and possession of the specimen. Williams, a Sioux tribal member, apparently did not have the authority to sell the fossil without the permission of the Department of Inte-

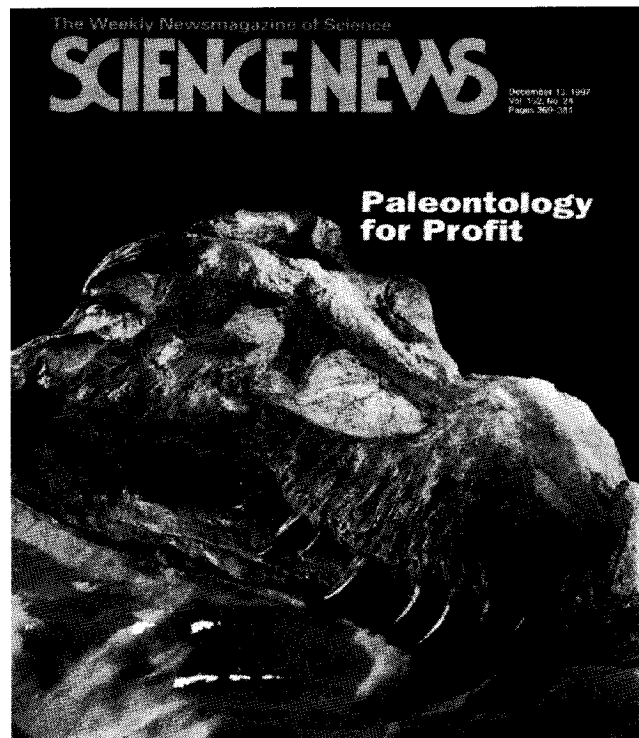


Figure 1. Cover of December 13, 1997 Science News magazine showing the skull of the *T. rex* known as “Sue.”

rior, because the federal government was holding the land in trust for him. The federal government confiscated the specimen and transported it to the South Dakota School of Mines and Technology for protection until the dispute was resolved. (I was asked by the FBI to be a member of the team of paleontologists to make sure the specimen was safely transported to the School of Mines, but North Dakota Attorney General Nick Spaeth decided it was best that the Survey stay out of the situation. As it turned out he was correct because several law suits resulted from the incident.) Larson and Williams both accused each other of wrong doing and the fate of the *T. rex* skeleton was left to be decided by the courts.

Eventually, the courts awarded the fossil to Williams and the Bureau of Indian Affairs was directed to work with Williams to do something with the fossil that would be for his best interest. They decided to sell the fossil to the highest bidder and Sotheby's, the large New York City-based auction company, was commissioned to hold the auction. On October 4, 1997, at Sotheby's auction house in New York City, after a bidding frenzy that lasted nine minutes, the Field Museum of Natural History in Chicago purchased the specimen for \$8.36 million, with most of the proceeds going to Williams. Funding for the purchase was in part provided by Disney Enterprises and McDonald's. It should be noted that Peter Larson's subsequent legal problems and eventual conviction for illegal fossil collecting and customs violations resulting in his incarceration in a federal prison for two years, had nothing to do with the *T. rex* named "Sue" controversy.

Reaction of the professional paleontology community to the sale of "Sue"

The professional paleontology community anxiously anticipated the *T. rex* auction because of uncertainty as to whether the important specimen would end up in a private collection, thereby making it unavailable for scientific study and public display, or in a public repository in this country. The ultimate concern was the effect the sale would have on the science of paleontology. During the months prior to the sale, there was speculation about how much the specimen would sell for. Its sale, for the unprecedented amount of over \$8 million, shocked the paleontology community and heightened concern. The week after the auction, I was in Chicago attending the annual conference of the Society of Vertebrate Paleontology (SVP). The effect of the sale of the dinosaur on the science of paleontology was a major topic of discussion in the SVP Government Liaison Committee of which I am a member. The Government Liaison Committee is made up of paleontologists from throughout the country and helps establish policy for the SVP regarding fossil-resource management and other paleontological issues.

At the conference, the SVP released a position

statement regarding the sale of "Sue." The statement expressed support to the Chicago Field Museum and the foundations, corporations, and individuals that recognize that the specimen is of great significance to science and society. The SVP statement also praised the groups that provided funding for the purchase of the specimen to insure that it will remain in the public domain for scientific research and education. Prior to the sale, professional paleontologists were concerned that the specimen would be purchased by an individual collector (private bidders were involved in the bidding at the auction) and/or end up leaving the country. Many fossils, particularly dinosaur specimens, are being sold by commercial collectors to overseas buyers. Some of these buyers are bonafide museums, others use fossils to decorate office buildings, and some are fossil collectors and speculators. The SVP position statement does express a grave concern that there will be an increase in fossil collecting for commercial purposes and marketing of fossils because of the sale of "Sue" and the high price obtained. A concern was also expressed in the statement that there will be increased pressure by profiteers to open public lands for commercial collecting of fossils. Collecting of vertebrate fossils from public lands for commercial purposes is, at this time, prohibited. Allowing commercial fossil collecting on public lands would remove important fossils from the public trust and would prevent scientific study of most of these fossils and their use in educational activities. Commercial fossil dealers have been lobbying in Washington, D.C. to open federally administered public lands for indiscriminate fossil collecting for profit.

Ramifications of the sale of "Sue"

It is not too early to tell what some of the ramifications will be from the sale of "Sue." For example, another *T. rex* skeleton (with the equally ridiculous name of "Z-rex") collected in South Dakota in 1992 by commercial fossil dealers from Kansas, is now on the market. It is reputed to be one of the most complete *T. rex* skeletons ever found. The asking price is \$15 million. An incident believed to be triggered by the sale of "Sue" occurred last fall near Fort Peck, in northeastern Montana. There, a paleontologist from the University of Norte Dame was excavating a partial tyrannosaurus skeleton. The former owners of the property where the specimen was being excavated attempted to steal the fossil before it was completely removed from the ground and consequently damaged the specimen. Also, as a result of the auction of "Sue," at least one western museum has been asked by property owners to return dinosaur fossils that had been collected from their property, even though the museum paleontologists that collected the fossils had permission from the land owners to do so. In many areas where dinosaur fossils are found, it is becoming more difficult for professional paleontologists to obtain permission to collect fossils on private property because of the commer-



Figure 2. "Wanted Poster" for dinosaur fossils recently posted in businesses in Marmath, North Dakota.

cial value of fossils.

In North Dakota, the state has management responsibility for fossils found on state (public) lands and on lands owned by political subdivisions of the state. Federal agencies (USFS, BLM, Corps of Engineers, National Park Service, Bureau of Reclamation) have management responsibility for fossils found on federal public lands. Tribal governments manage fossils on reservation lands. Permission must be obtained, usually through a permit-granting process, from those fossil resource management agencies to collect certain kinds of fossils, mostly vertebrate fossils, from public lands under their jurisdictions. For example, the North Dakota Geological Survey issues permits to collect certain kinds of fossils (mostly vertebrate fossils) on state-administered property. However, in North Dakota and perhaps in all states, fossils occurring on private property belong to the landowner (unlike in Canada where most fossils, even those found on private land, are considered to be public property). Landowners in North Dakota can do what they wish with fossils found on their property.

In badland areas of southwestern North Dakota near the town of Marmarth, Slope County and in Bowman County, where the dinosaur fossil-bearing Hell Creek Formation is extensively exposed, several out-of-state fossil hunting groups are looking for and collecting dinosaur bones this summer. There is no doubt that the public interest in fossils, in part, as a result of the *Jurassic Park* and *The Lost World* movies, and the huge amount of money being paid for fossils such as "Sue" has prompted an increase in dinosaur fossil collecting in North Dakota. These groups have made contractual arrangements with property owners to collect fossils in that area. Eight of these groups are commercial fossil dealers and the others are either sponsored by museums or universities. Some of the

collectors are credentialed and qualified paleontologists, but most are not. In any case, all of the fossils collected by them will likely leave North Dakota forever. This has been happening for many years in that area of the state. In recent years advertising signs have even been posted in the post office and cafes in Marmarth by commercial fossil dealers. (Figure 2) In fact, as I write, a *Triceratops* dinosaur skull collected in Bowman County in 1995 is for sale on the Internet for \$65,000 (Figure 3). Stephen Jay Gould, a noted



Figure 3. *Triceratops* skull from Bowman County, North Dakota 'for sale' on the Internet.

paleontologist, has termed this commercialization of fossils as the "Great Dinosaur Ripoff."

Landowners have a legal right to sell property that belongs to them, even though they are fossils. Those of us who spend a lot of time in southwestern North Dakota realize how difficult it is to make a living these days ranching and farming. Commercial fossil activities have, however, created a social conflict because some citizens do not believe it is right to sell the fossils and want them to stay in North Dakota while others are not concerned about the loss of the fossils from the area. Because of the mixed nature of land ownership (private, state, federal, and county) in Bowman and Slope counties, federal, state, and county officials are monitoring fossil-collecting activities to make sure that these collectors do not illegally remove fossils from the public lands.

The North Dakota Geological Survey is able to manage and help regulate fossil collecting on state, federal and other public lands because we have legislated responsibility to be stewards of our fossil resources. The NDGS is serious

about its responsibility to preserve North Dakota fossils for the benefit of North Dakotans. We must make sure that responsibility is not taken away by efforts of commercial fossil collectors because fossils are part of our natural heritage; they need to be kept in the public domain for scientific and educational purposes. In fact, I believe we must work toward strengthening our laws, particularly at the federal level, to insure that fossil resources are adequately protected for future generations. It is heartening to know that the great majority of people in this country believe that fossils found on federal public lands belong to everyone in the United States, should not be privately owned, and should be housed in public facilities. In a recent national poll, commissioned by The Dinosaur Society, more than 85% of the people polled from around the United States agreed with these views.

But what about fossils found on private property in North Dakota? There have been two major effects on North Dakota's Fossil Resource Management Program as a result of the high prices being paid by commercial fossil hunters for fossils collected from privately owned property. First, the state cannot compete financially with commercial fossil collectors who offer private property owners large sums of money to collect fossils from their land. Consequently, museums like the North Dakota Heritage Center, where we are developing exhibits of North Dakota's prehistoric life, can not obtain specimens collected in North Dakota by commercial fossil dealers. Second, because of lease agreements between the landowners and commercial collectors, we can not obtain permission to collect fossils for the state from those commercially leased private lands. Most fossil specimens collected by commercial dealers will never be available for the enjoyment of the citizens of the state and for the education of our children. In addition to the loss of fossil specimens through commercial collecting activities, the state also loses the scientific information that the fossils provide. Fossils are our only means of knowing what kinds of plants and animals inhabited North Dakota at different times in the geologic past. They also provide us with information about past climate and how climate has changed through time. The loss of that information is as devastating to the state of North Dakota as the loss of the fossil specimens themselves.

Let me end this essay on an optimistic note. There

are many private land owners in North Dakota who believe that North Dakota fossils should remain in North Dakota for scientific study and public display even though they are aware of the economic value of fossils found on their property. An example of citizen support is provided by one of the North Dakota Geological Survey's current projects, the restoration of a mosasaur skeleton for exhibit at the North Dakota Heritage Center. Mosasaurs were large (20 to 25 feet long) marine reptiles that lived at the same time as the land-dwelling dinosaurs. The nearly complete skeleton of a mosasaur was found on Bev and Orville Tranby's property near Cooperstown, Griggs County by Mike Hanson and Dennis Halvorson of Cooperstown. The Tranby's have donated the specimen to the state for study and permanent exhibit at the North Dakota Heritage Center.

North Dakota has a wonderful program, called the Natural Areas Registry Program, which is intended to preserve natural areas, including important paleontological sites, located on private property. The Natural Areas Registry Program is a citizen-based conservation program administered by the North Dakota Parks and Recreation Department. The North Dakota Geological Survey takes an active role in the program when paleontological sites are being considered for the natural areas registry. As part of this program, the state identifies significant natural areas and approaches the property owner to suggest that the site be preserved. If the owner agrees, the state then advises that landowner about appropriate preservation procedures. It is a highly effective program because the landowner retains ownership of the property and assumes the lead role in preserving the natural area with help from the state. There are already about 50 registered natural areas in North Dakota. Most of these are biological sites, but five of the sites, such as the Stumpf site in Morton County (see my winter 1994 *NDGS Newsletter* article, v. 21, no. 4, p.7-10), are registered natural areas because they are significant fossil sites. Landowners, who register their land in the program, are recognized for their contribution to the betterment of the State of North Dakota at a ceremony at which time the Governor presents them with a certificate of appreciation and a plaque. We are all indebted to these property owners for their willingness to preserve these important fossil sites and other natural areas.

North Dakota Non-Fuel Minerals Summary - 1997

By Ann M.K. Fritz

The term "non-fuel" mineral can mean a variety of materials. Examples of non-fuel minerals would be metals such as gold, silver or copper. In North Dakota, however, non-fuel minerals include volcanic ash, carbonates, natural mineral salts of boron, bromine, calcium, chlorine, helium, iodine, lithium, magnesium, nitrogen, phosphorus, potassium, sodium, thorium, uranium and sulfur. Non-fuel minerals also include sand, gravel, crushed rock and clay. Non-fuel minerals are important economically as they are used in manufacturing, as additives in certain products, and also used for road or building construction.

The following report was submitted to the U.S. Geological Survey in March, 1998 for inclusion in the *1997 USGS Minerals Yearbook*. Each year the USGS publishes non-fuel mineral industry statistics for all 50 states as well as U.S. Territories and administered lands. Foreign non-fuel mineral industry statistics are also included in the *Minerals Yearbook*.

During calendar year 1997, there were 18 active surface mining operations reporting to the North Dakota State Soil Conservation Committee (SSCC). The following are total operations according to the reports submitted:

Acres Affected: 288.2 Minerals Mined:

gravel & sand	1,932,647	cubic yards
clay	79,540	cubic yards
rock	101,541	cubic yards
TOTAL	2,113,728	cubic yards

There are 51 pits ranging in size from 0.8 to 60 acres with a total of 329,761 cubic yards of overburden disturbed. Hebron Brick Company in Morton County continues to lead the state in clay products production and accounts for 57% of the clay mined in the state.

In the fall of 1997, American Colloidal Company submitted a permit to conduct surface mining operations for leonardite in Bowman County. Leonardite, associated with lignite, is an oxidized lignite. Currently, GeoResources is the only other leonardite mining and processing operator in North Dakota, besides American Colloidal Company. The two companies produced a combined total of 59,446 metric tons of leonardite in 1997. Leonardite is processed and used as a dispersant and viscosity control in oil-well drilling muds, as a

stabilizer for ion-exchange resins in water treatment, and as a soil conditioner. American Colloidal Company anticipates 36,000 to 72,500 metric tons of leonardite per year to be processed, depending on market demands. The company hopes to begin production in the summer of 1998. The life of the mine is expected to be six years.

During the 1997 legislative session, two bills passed that directly affect the non-fuel minerals industry. During the session, funding for the SSCC was cut by 75%, staff was decreased to essentially one person, and some of their duties were assigned to other state agencies (see article in Summer, 1997 *NDGS Newsletter*, page three about the soil digitizing duties assigned to the NDGS). The SSCC was designated by the Legislature to administer the Surface Mining Reports Law, which requires any person conducting surface mining operations for minerals other than coal to comply with the reporting requirements of North Dakota Century Code (NDCC) Chapter 38-16. The law requires that any person conducting surface mining operations for minerals other than coal, who, within one calendar year, removes 10,000 cubic yards or more of earthen materials or products, including overburden, and affects one-half acre or more in combined mining operations to report. Minerals included are: cement rock, clay, gravel, limestone, manganese, molybdenum, peat, potash, pumicite, salt, sand, scoria, stone, sodium sulfate, zeolite, or other minerals, but does not include coal. The SSCC has the regulatory authority to administer the reporting requirement, while actual regulatory authority for most of these mining activities rests with the North Dakota Geological Survey. The law, however, is ambiguous at best.

Also passed during the 1997 legislative session was an amendment clarifying the definition of subsurface minerals. The definition of subsurface minerals as it now appears in the NDCC Chapter 38-12, Regulation, Development and Production of Subsurface Minerals, and in NDCC Chapter 38-15, Resolution of Conflicts in Subsurface Mineral Production is as follows:

"Subsurface minerals" means all naturally occurring elements and their compounds, volcanic ash, precious metals, carbonates, and natural mineral salts of boron, bromine, calcium, chlorine, helium, iodine, lithium, magnesium, nitrogen, phosphorus, potassium, sodium, thorium, uranium, and sulfur, and their compounds, but does not

include sand and gravel and rocks crushed for sand and gravel. (NDCC Ch. 38-12-01.07)

The definition still uses very broad language, but the addition of specific minerals and elements limits some of the confusion regarding the inclusion of sand and gravel in the subsurface mineral law. Sand and gravel mining activities are subject to the reporting requirement mentioned above (NDCC Ch. 38-16, Surface Mining Reports).

Although the SSCC staff was reduced, mine operators are still required to submit reports. It should be noted that some operators, even though they are not required by law to report a summary of surface mining activities (i.e., the person removes less than 10,000 cubic yards of materials per year, or affects less than one-half acre of land), voluntarily submit reports to the SSCC. Therefore, the summary of surface mining statistics presented here is a conservative estimate of the amount of non-fuel minerals mined in North Dakota during 1997.

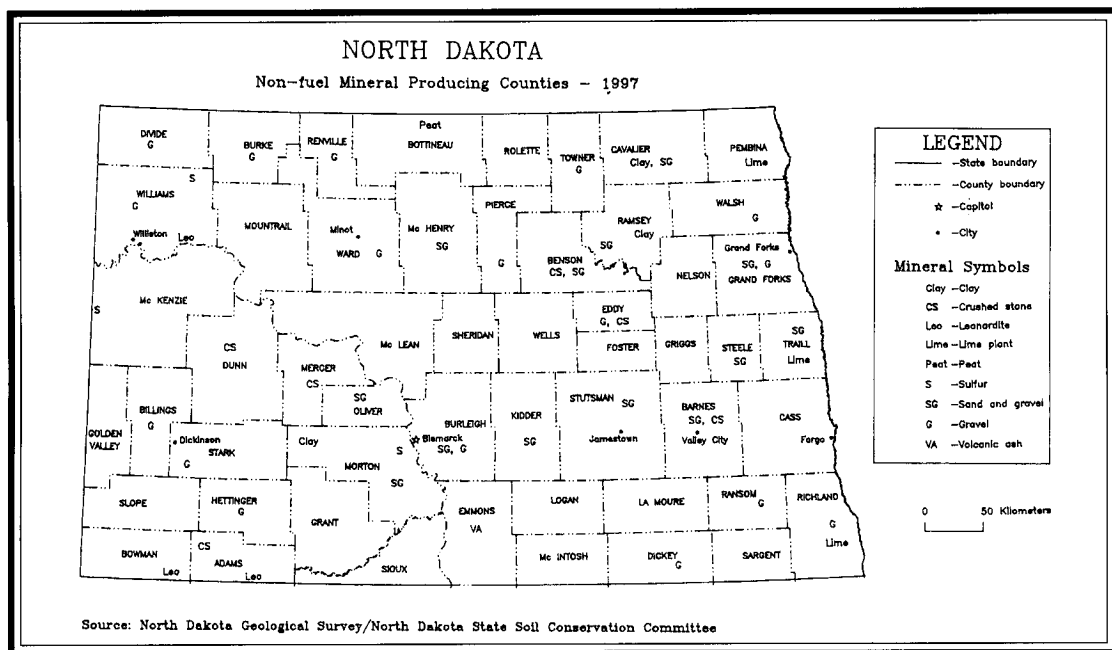
The coal gasification plant located near Beulah

that they are now using a low sulfur coal.

The NDGS continues the process of entering all of the geologic information from its subsurface mineral program into a computerized database. This information will be used for a number of purposes, including re-defining the State's uranium deposits.

Besides this summary, there is a wealth of mineral information available from both the NDGS and the USGS. The NDGS has published a variety of publications about the non-fuel mineral resources of North Dakota, including sodium sulfate, clay, potash, and a new publication about coal bed methane (see *New Publications* on page 20 in this issue). Contact the NDGS Publications Clerk for more details and to order publications. The NDGS also has a portion of our website dedicated to the mineral resources of North Dakota. The Mineral Resources of North Dakota site is located at: <http://www.ndsu.nodak.edu/instruct/schwert/ndgs/minerals.htm>

The USGS also has mineral resource information available to the public. If you have a fax machine, the USGS



brought an anhydrous ammonia plant on-line in the spring of 1997. The plant has the capacity to produce 1,150 (short) tons of anhydrous ammonia per day, but currently is producing 1,050 (short) tons due to NO_x emission limits. Total production of anhydrous ammonia in 1997 was 206,762 tons. In 1997, the gasification plant also produced 3,620,951 liters of krypton and xenon; 196,846 gallons of methanol; and 546,754 gallons of liquid nitrogen. Ammonium sulfate production from the stack gas scrubber was 100,213 short tons in 1997. Production will be limited in 1998 due to the fact

operates MINES FaxBack, a 24-hour service you can call to get information about specific mineral commodities. To order materials from MINES FaxBack, call 703-648-4999. The URL (Universal Resource Locator) address for the USGS Minerals Information Internet site is <http://minerals.er.usgs.gov/minerals/>. For information about acquiring copies of the 1997 *USGS Mineral Yearbook*, when it becomes available, or any other information listed here, please contact the NDGS Office at 701-328-8000.

NEW PUBLICATIONS

The Coal Bed Methane Potential of North Dakota Lignites

by Edward C. Murphy and Gerard E. Goven

Recent success in the production of coal bed methane from sub-bituminous coals in Wyoming has sparked interest in potential gas generation by lignites in the Williston Basin. This report attempts to answer the commonly asked questions about North Dakota's coal resources and coal bed methane. A half dozen or so areas of thick coals (greater than 20 feet) are identified as potential sites for gas exploration. In preparation for this report, senior and retired coal and uranium geologists, miners, water well drillers, loggers, and regulatory agency personnel were interviewed. The 38 page report also includes references to numerous North Dakota coal reports.

NDGS Open File Report 98-1

\$5.00

Collective Bibliography of North Dakota Geology

The Collective Bibliography of North Dakota Geology is a collaborative effort of the North Dakota State University (NDSU) Libraries and the North Dakota Geological Survey (NDGS). The project was first suggested by Dr. Allan Ashworth, chair of the NDSU Geosciences Department, and lead by Lura Joseph, Physical Sciences Librarian at NDSU. Lura received considerable help from Gayle Noraker, who helped convert the print bibliographies to digital format, and performed extensive proofreading of the database, and Russ Jury, the computer wizard who created the low-level database and wrote the HTML and perl scripts to handle searching and administration.

The database presently is a combination of three print resources from the NDGS:

- Scott, Mary Woods, 1972, Annotated bibliography of the Geology of North Dakota, 1806-1959, North Dakota Geological Survey Miscellaneous Series No.49. Grand Forks, ND: North Dakota Geological Survey, 132 p.
- Scott, Mary Woods, 1981, Annotated bibliography of the Geology of North Dakota, 1960-1979, North Dakota Geological Survey Miscellaneous Series No. 60. Grand Forks, ND: North Dakota Geological Survey, 287 p.
- Greenwood, Larry; Heck, Thomas J.; Biek, Robert F.; and Bluemle, John P., 1996, Bibliography of the Geology of North Dakota, 1980-1993, North Dakota Miscellaneous Series No. 83. Bismarck, ND: North Dakota Geological Survey, 370 p.

The database currently contains over 4,000 references searchable in either a simple or advanced search interface. In the simple search interface, the user enters a word or phrase as a keyword. In the advanced search, the user can search by author, date, title, print source or annotation. Some auxiliary materials in the print indexes are not included in this electronic database. To purchase the print indexes and other NDGS publications, contact the North Dakota Geological Survey Publications Clerk.

Collective Bibliography of North Dakota Geology - *ONLINE* at <http://www.dp3.lib.ndsu.nodak.edu/ndgs/>