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GEOLOGICAL SOCIETY OF AMERICA



ST
LOUIS

FRONTIERS IN GEOSCIENCE . . .

1989
ANNUAL MEETING
AND
EXPOSITION

**Cervantes Convention Center
St. Louis, Missouri
November 6-9, 1989**

**PREREGISTRATION DUE
OCTOBER 6**

GSA, P.O. Box 9140, Boulder, CO 80301 (303) 447-2020



1989 GSA ANNUAL MEETING

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APPRECIATION FROM GSA

The Geological Society of America is grateful to and sincerely thanks all those who have contributed to the success of this meeting: the 1989 Local Committee for its leadership; the speakers for their contributions to the science; exhibitors for their financial support, products, and information; the associated societies for their programs; sponsors and volunteers for their support. To each and every one a special thanks from GSA's Council and staff.

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Society of Vertebrate Paleontologists



FRONTIERS IN GEOSCIENCE

MEET US IN ST. LOUIS— GATEWAY TO THE NEXT 100 YEARS

Do you know about the new St. Louis? The St. Louis Renaissance has brought excitement to the banks of the Mississippi River. Commitment to change has created plenty to intrigue the scientific mind and to entertain the cultural enthusiast.

Have you heard about the St. Louis Renaissance that began with Eero Saarinen's Gateway Arch? Since its completion in 1965, St. Louisians have taken that gateway spirit to heart, backed by the enthusiastic financing of those major corporations that make St. Louis home base. If you haven't been in St. Louis in the past five years, you'll be surprised. You'll find a city that has creatively combined a rich and varied past with a dynamic future.

Do you know about Union Station, the new Rouse project that turned the former site of the world's busiest train station into

a festive marketplace? (Rouse Company is the developer for Boston's Faneuil Hall and Baltimore's Harborplace.) How about St. Louis Science Centre, the art museum, the fantastic Fox Theater, or the Powell Symphony Hall, housing the nation's second oldest major orchestra? Have you visited the St. Louis Zoo's Living World, a first of its kind year-round facility featuring the greatest variety of animal species and high-tech interpretative exhibits ever assembled under one roof? Have you heard about the 79-acre Botanical Garden with the country's first geodesic Climetron as well as a serene Japanese garden? For shoppers there is St. Louis Centre, the largest under-glass shopping mall in the country—and it's only steps from the hotels.

Do you know that St. Louis is home to over 100 of the Fortune 500 companies? Have you visited McDonnell Douglas, pioneer and leader in aerospace, or Anheuser-Busch, the world's largest producer of beer? How about enjoying an evening with your friends at Laclede's Landing, entertainment heart of downtown St. Louis? There is a **lot** to do.



Courtesy of St. Louis Convention & Visitors Commission

On top of these attractions, St. Louis is centrally located. It is easily accessible to the many universities and corporations within a 500-mile radius. Fortunately, it is also reasonably priced. It is a perfect place to welcome GSA as it explores frontiers in its 101st year.

In keeping with the Frontiers of Geoscience theme, the concept of theme sessions has been expanded dramatically. This is an approach to interdisciplinary programming that will serve to integrate information and to explore strategies for those significant, unanswered questions.

When Charles Lindbergh named his record-breaking plane "The Spirit of St. Louis," little did he know that St. Louis

was to become one of the world's aerospace centers. When Laclède decided to start a trading post near the confluence of the Missouri and Mississippi rivers, he knew St. Louis was the "Gateway to the West," but couldn't have envisioned Cervantes Convention Center, let alone 5000 geologists. Thanks to these pioneers and to all the others, then and now, St. Louis still is an excellent site—this time as GSA's gateway to its second century. Join us for a great get-together!





TECHNICAL PROGRAM

Papers will be selected and the program scheduled by the 36-member Joint Technical Program Committee (JTPC) meeting on August 18–19. Abstract notices will be received by September 4.

The session schedule will appear in the September issue of GSA News & Information.

Over 2,000 technical papers will be presented during 112 sessions, from Monday through Thursday. In addition, several invited symposia will occur on Sunday. Session formats represent a spectrum of alternatives between invited and volunteered papers. These formats will include open symposia (partly invited, partly volunteered), and theme sessions (volunteered for a specified, pre-announced topic).

SYMPOSIA

Symposia titles are definite; the dates, however, are subject to change by the Joint Technical Program Committee, which meets August 18–19. In general, symposia papers have been invited. Those with a volunteered component (open symposia) are indicated with an asterisk (*).

S1. Geoscience Research and Public Policy.

1989 Annual Meeting Committee Frontiers Symposium. Brian J. Mitchell, St. Louis University. Wednesday, November 8, afternoon.

The 1989 St. Louis Local Committee, chaired by Brian J. Mitchell, St. Louis University, will convene a special symposium that will explore questions of national priorities and funding levels in geoscience research which are likely to be prevalent over the next several years. These factors can be expected to have a major effect on the extent to which frontiers can be expanded in the geosciences during that time.

The nature and level of support of scientific research is subject to change, perhaps because of changing national goals, important scientific breakthroughs, defense considerations, or changes in the outlook and perception of persons who are influential in setting government policies in science. This symposium will provide scientists an opportunity to ask questions of and express concerns to leaders who are in a position to influence research policy.

To address these questions, leaders in governmental science-related agencies, the legislative branch of government, and academia have been invited to address questions of priorities and funding in the geosciences from the perspective of their offices or positions.

Speakers include Frank Press, president of the National Academy of Sciences; Dallas L. Peck, director of the U.S. Geological Survey; James F. Hays, director of Earth Sciences at the National Science Foundation; Peter J. Wyllie, California Institute of Technology, chairman of the National Academy of Sciences Committee on the Solid-Earth Sciences: A Critical Assessment; and Robert A. Phinney, Princeton University, president of IRIS and organizer of the Workshop on Continental Dynamics. Representatives from the legislative branch of government will be participating as well.

S2. Cenozoic Deep-Sea Foraminifera: Distribution and Environments.

Cushman Foundation. Kenneth G. Miller, Rutgers University. Tuesday, November 7, morning.

S3. Molecular Approaches to Paleoclimatic and Paleoenvironmental Reconstruction.

Geochemical Society—Organic Chemistry Division. Simon C. Brassell, Stanford University. Sunday, November 5, afternoon.

S4. Frontiers in Geoscience Information.

Geoscience Information Society. Mary B. Ansari, University of Nevada—Reno. Monday, November 6, morning.

S5. Application of Modern Powder Diffraction Techniques to Problems in Mineralogy and Geology.

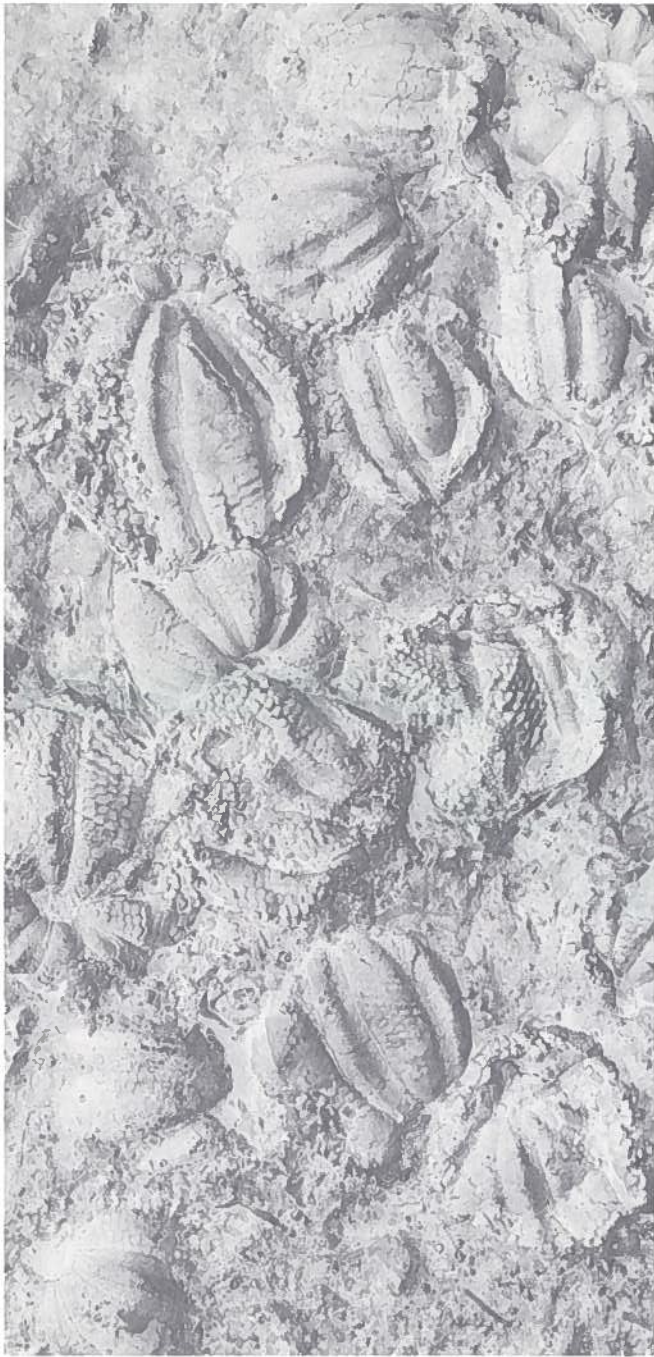
Mineralogical Society of America. David L. Bish, Los Alamos National Laboratory. Monday, November 6, afternoon.

S6. Remote Sensing and Geographic Information Systems: Techniques on the Frontier of Change.

National Association of Geology Teachers. Richard C. Stenstrom, Beloit College. Monday, November 6, afternoon.

S7. Radiations and Recoveries from Mass Extinctions.

Paleontological Society. Thor A. Hansen, Western Washington University. Monday, November 6, morning.



Large slab of *Melonechinus* sp. from St. Louis Limestone, Mississippian age. Courtesy of Washington University—Photo by John Simon.

- S8. Potential for Olympic Dam-type Cu-Au-U-REE Deposits in the Proterozoic Granite-Rhyolite Terranes, Midcontinent, U.S.A.** Society of Economic Geologists. Geza Kisvarsanyi, University of Missouri—Rolla. Monday, November 6, morning.
- S9. Mississippi Valley-type Deposits.** Society of Economic Geologists. David L. Leach, USGS, Denver. Sunday, November 5, all day.

- S10. Becker and Van Hise's Challenges: Geology and Geophysics Since 1904.** History of Geology Division. Clifford M. Nelson, USGS, Reston. Tuesday, November 7, afternoon.
- S11. Geologic Exploration of the Solar System: Past, Present, and Future.** Planetary Geology Division. Ronald Greeley, Arizona State University. Tuesday, November 7, morning.
- S12. The Legacy of T. C. Chamberlin.** Quaternary Geology and Geomorphology Division. Allan F. Schneider, University of Wisconsin—Parkside. Tuesday, November 7, morning.
- *S13. Implications for the Geological Sciences from Recent Developments in Geochemical Techniques and Instrumentation.** Geochemical Society. J. Michael Rhodes, University of Massachusetts; Alan Zindler, Lamont-Doherty Geological Observatory. Tuesday, November 7, afternoon.
- *S14. Sigma Gamma Epsilon Research Symposium.** Sigma Gamma Epsilon. Austin A. Sartin, Centenary College; Charles J. Mankin, Sigma Gamma Epsilon. Tuesday, November 7, afternoon.
- *S15. Geological Controls on the Regional Distribution of Archaeological Sites.** Archaeological Geology Division. Robert M. Thorson, University of Connecticut. Wednesday, November 8, morning.
- *S16. Modern and Ancient Environments of Coal Formation.** Coal Geology Division. James C. Cobb, University of Kentucky; C. Blaine Cecil, USGS, Reston. Monday, November 6, morning.
- *S17. Site Characterization for Conditions of Non-Darcian Flow.** Engineering Geology and Hydrogeology Divisions. Jeffrey R. Keaton, Sergeant, Hauskins & Beckwith, Salt Lake City, Utah; John F. Harsh, Roy F. Weston, Inc., West Chester, Pennsylvania. Thursday, November 9, all day.
- *S18. Intraplate Seismicity and Deformation: Geological and Geophysical Constraints.** Geophysics Division. William V. Stauder, St. Louis University; Archibald C. Johnston, Memphis State University. Tuesday, November 7, afternoon.
- *S19. Rates and Duration of Deformational Processes and Orogenic Events.** Structural Geology and Tectonics Division. Gregory A. Davis, University of Southern California—Los Angeles; Randall R. Parrish, Geological Survey of Canada; Robert J. Twiss, University of California. Monday, November 6, morning.

THEME SESSIONS

Papers for theme sessions will be submitted for the titles listed below. These titles will appear in the final schedule if a sufficient number of abstracts are received by the abstracts deadline to constitute a minimum two-hour theme session. This issue of *GSA News & Information* precedes the abstracts deadline so all available theme titles are listed. [The final schedule will appear in the September issue.](#)

- T1. Geological Mapping in the Next Several Decades.**
- T2. The Effects of Man on the Mississippi River and Its Delta.**
- T3. Correlation and Basin Analysis of Nonfossiliferous Sedimentary Rocks.**
- T4. Magma Currents, Melt Migration, and Geochemical Transport in Mafic Igneous Complexes.**
- T5. The Effects of Greenhouse Warming on North American Deserts: Holocene Analogues.**
- T6. Trace Element and Isotopic Studies with the Ion Microprobe.**
- T7. Sub-Mediterranean "Giant Salt" as a Deep-Water Brine Precipitate: An Alternative to the Evaporite Hypothesis.**
- T8. Quantitative Structural Geology: The Nature, Mechanism, and Implications of Natural Deformation.**
- T9. The First Half of Earth History.**
- T10. Seismic Tomography and Mantle Dynamics.**
- T11. Global Sedimentary Geology.**
- T12. A Growing Crisis in (Geo)Science Education.**
- T13. The Lunar Science Frontier: Implications for the Earth's Past and Future.**
- T14. Tectonometamorphism.**
- T15. Continental Dynamics.**
- T16. Volcanism and Climate.**
- T17. Mantle Plumes and Mass Extinctions.**
- T18. Geoscience and the Arts.**
- T19. New Concepts in Understanding Fluid-Rock Interactions at High Temperatures: Problems and Solutions.**
- T20. Physical Properties of the Lower Continental Crust.**
- T21. Frontiers of Fluid-Inclusion Research.**
- T22. Application of Artificial Intelligence, Expert System, or Knowledge-based System Methods in Geological Sciences.**

- T23. Determining the Relative Timing of Pluton Emplacement and Regional Deformation.**
- T24. Geomorphic Processes and Landform Evolution.**
- T25. Late Eocene-Oligocene Climatic and Biotic Evolution.**
- T26. Hydrothermal Organic Geochemistry.**
- T27. Cretaceous Record of the Eastern Margin of the Western Interior Seaway.**
- T28. Hydrogeologic Challenges for the Next Decade.**
- T29. Thermal and Hydrologic Evolution of Accretionary Prisms: Modern and Ancient Examples.**
- T30. Origin of Brines in the Earth's Crust.**
- T31. Geologic Causes of Natural Radionuclide Anomalies.**
- T32. Rock-Water Interactions in Carbonate Rocks and Sediments.**

FIELD TRIPS

St. Louis provides an ideal starting place for field trips to see many aspects of midcontinent geology. The trips summarized are coordinated, where possible, with the technical program to offer an opportunity to visit areas that are subjects of discussion at symposia and in targeted sessions.

Several trips will visit areas far from the Midwest, where the meeting theme "Frontiers in Geoscience" presents compelling opportunities to see significant geologic terranes.

All trips begin and end in St. Louis unless otherwise noted. Participants must provide their own transportation to the starting point and from the termination point for those trips not originating or terminating in St. Louis. Trips are technical in nature and can be physically rigorous. Please check with the trip leader if you have any questions.

Trip costs include transportation for the trip itself and guidebook. They also may include costs of other services as noted by the following symbols: B—Breakfast; L—Lunch; D—Dinner; S—Snack; and ON—Overnight lodging. For some trips, group-rate fares have been arranged to get participants to St. Louis at the termination of a field trip or to another city for the start of a postmeeting trip. If you do not wish to take advantage of this air travel, please register using the fee without airfare for that trip.

Preregistration for a field trip is recommended because of participant limitations. All participants are accepted on a first-come, first-served basis through GSA headquarters. **PREREGISTRATION DEADLINE:** Must be RECEIVED at GSA headquarters no later than October 6.

The registration form and procedures are provided in this announcement. Registration for field trips after the deadline may be possible if trip logistics and space permit; contact the GSA Registration Coordinator. Meeting registration fees are not required for those participating only in field trips. Although preregistration is advised, on-site registration for mini-trips and postmeeting trips MAY be possible during the meeting at the Field Trip Desk, Cervantes Convention Center, Seventh Street entrance.

CANCELLATION DEADLINE IS OCTOBER 13. No refunds will be given after this date. If GSA must cancel a field trip because of logistics or registration requirements, a full refund will be issued to trip registrants as soon as possible after the meeting. Also, please be aware of cancellation deadlines and penalties imposed by airlines. You may wish to cancel your flight arrangements if a trip you have registered for is canceled. It is a good idea to plan alternatives ahead of time.

GUIDEBOOKS may be purchased at the Field Trip Desk during the meeting. After the meeting, contact the Missouri Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401-0250; (314) 364-1752.

For further field trip information, contact 1989 Field Trip Chairman Jerry D. Vineyard, Missouri Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401-0250, (314) 364-1752; Field Trip Co-Chairman W. Keith Wedge, Missouri Geological Survey, P.O. Box 250, Rolla, MO 65401-0250, (314) 364-1752; or Registration Coordinator, GSA headquarters.

PREMEETING

- 1. Archaeological Geology and Geomorphology in the Central Mississippi-Lower Illinois Valley Region, Illinois and Missouri.** *Edwin R. Hajic, Dept. of Geology, University of Illinois, Urbana, IL 61801, (217) 333-4389; Russell W. Graham and Michael D. Wiant, Illinois State Museum, Springfield. November 5. Cost: \$60 (1 B, 1 L, S). Limit: 40.*

This trip will examine contextual relations between late Quaternary geology, interpreted paleo-environments, and the extensive archaeological record in the American Bottom, central Mississippi Valley, and lower Illinois Valley. Discussions will focus on geomorphic and cultural patterns and trends, and strengths and weaknesses of specific

approaches and techniques used to decipher these relations. In the American Bottom, we will inspect alluvial stratigraphy, paleo-Indian through Mississippian archaeology, and vertebrate paleontology at the deeply stratified Modoc Rock Shelter, Barnhart mastodon sites, and the Cahokia Mounds Mississippian ceremonial center (a World Heritage site). In the lower Illinois Valley, we will examine alluvial and colluvial stratigraphy, geomorphology, geochronology, and archaeology at the deeply stratified Koster site and the flood-plain Thebes component at the Twin Ditch site. At the mouth of the Illinois River, we will conclude with examination of late Woodfordian glaciofluvial and slackwater terrace sediments and discussion of alluvial chronology, Mississippi River-Illinois River interaction, and fluvial environments contemporaneous with the paleo-Indian occupation.

- 2. Late Pennsylvanian and Early Permian Cyclic Sedimentation, Paleogeography, Paleogeology, and Biostratigraphy in Kansas and Nebraska.**

Roger K. Pabian, Conservation and Survey Division, IANR, University of Nebraska, Lincoln, NE 68588-0517, (402) 472-7564; Robert F. Diffendal, Jr., Nebraska Conservation and Survey Division, Lincoln; Lynn Watney and Chris Maples, Kansas Geological Survey, Lawrence; Philip H. Heckel, University of Iowa, Iowa City; Ron West and R. Matsumoto, Kansas State University, Manhattan; Royal H. Mapes and Gene Mapes, Ohio University, Athens; Hans-Peter Schulze, University of Kansas, Lawrence; Ted Huscher, University of Nebraska, Lincoln; Peter Holterhoff, University of Cincinnati; R. M. Joeckel, University of Florida, Gainesville. November 2 (evening)-5. Trip begins in Kansas City, Missouri. Cost: \$210 (3 ON, 3 L, S). Limit: 41.

Classic cyclothems in the Missourian Series (Pennsylvanian) of Kansas will be observed, and interpretations of sea-level changes shown. These will be compared to cyclothems in the Wabauunsee Group (Pennsylvanian), in which regressive cyclothem facies do not fully develop, and to cyclothems in the Council Grove (Permian), in which regressive facies do develop and show a return to normal sedimentation sequences. This trip will feature many new exposures and sites never before visited on a major field trip.





3. Depositional Environments and Geology of Coals of the Lower Pennsylvanian of the Western Part of the Appalachian Basin and the Eastern Part of the Illinois Basin in Kentucky, Indiana, and Illinois.

James C. Cobb, Kentucky Geological Survey, Mining and Mineral Resources Building, University of Kentucky, Lexington, KY 40506-0107, (606) 257-5500; Donald R. Chesnut, Jr., and Stephen F. Greb, Kentucky Geological Survey, Lexington; Erik P. Kvale, Indiana Geological Survey, Bloomington; Joe Devera, Illinois State Geological Survey, Urbana. Sponsored by the Coal Geology Division. November 3-5. Trip begins in Lexington, Kentucky. Cost: \$205 (2 ON, 2 L, 1 D, S). Limit: 42.

This trip will begin on the western side of the Central Appalachian Basin and will end in the Illinois Basin. The first day will be a field day viewing the lower Pennsylvanian section, and the second day will be a workshop day highlighting the current work on the interpretation of the Pennsylvanian section in both basins. Leaders will emphasize architectural analysis and bedform geometry of sandstone units, new thoughts on tidal and marine influences on Pennsylvanian sedimentation, and tectonic influences on Pennsylvanian sedimentation, with a stop at a debris flow in the Appalachian basin. Overnight stays will include Mammoth Cave and historic New Harmony, Indiana, home of David Dale Owen, a pioneering state geologist for three states, who initiated geological surveys for 16 territories during the mid-1800s. A night tour of Mammoth Cave is also planned.

4. Geology and Hydrogeology of the Proposed Nuclear Waste Repository at Yucca Mountain, Nevada, and Surrounding Area.

Steven R. Mattson, Science Applications International Corp., Suite 407, 101 Convention Center Dr., Las Vegas, NV 89109, (702) 794-7615; Bruce M. Crowe and David E. Broxton, Los Alamos National Laboratory, Los Alamos, New Mexico; Anthony Buono, USGS, Las Vegas; Paul P. Orkild, USGS, Denver. November 2-4. Trip begins in Las Vegas, Nevada. Cost: \$398 (2 ON, 3 L, S, airfare to St. Louis); \$170 without airfare. Limit: 40. U.S. CITIZENS ONLY.

This trip will center on the geology of the Yucca Mountain region in southern Nevada, which is being characterized as a potential site for the nation's first high-level nuclear waste repository. If the repository site is licensed, an estimated 50,000 to 70,000 metric tons of radioactive waste would be isolated in densely welded tuff in the unsaturated zone for 10,000 years. Participants will visit both surface and underground test facilities and geologic stops, including the Climax Facility experimental repository in the Climax stock (quartz monzonite); G-Tunnel in zeolitized, bedded, and ash-flow tuff; metallogenic occurrences and structure found in altered tuffs in the Bullfrog Gold District; Bare Mountain faulting and tectonics; geology and hydrogeology of southern Crater Flat; and Lathrop Wells volcanic center. On Yucca Mountain, participants will review the local and regional geology and the hydrogeology of the saturated and unsaturated zones, faulting history, basaltic and silicic volcanism, and the proposed geologic testing while viewing the exploratory shaft site. The trip will conclude with a visit to Trench 14 to see the Bow Ridge fault and deposits of calcite-silica and the geology of the proposed surface facility site that would handle and package the waste prior to emplacement.

5. Regional Stratigraphy, Facies, and Paleoenvironments in the Cambrian of Southern Missouri.

Vincent E. Kurtz, Southwest Missouri State University, Box 87, 901 S. National, Springfield, MO 65804-0089, (417) 836-5800; James R. Palmer, Missouri Division of Geology and Land Survey, Rolla. November 3-4. Cost: \$110 (1 ON, 1 B, 2 L, 1 D, S). Limit: 40.

Uppermost Cambrian rocks in southern Missouri host world-class Mississippi Valley-type lead-zinc deposits and are prolific ground water aquifers. Trip participants will see alluvial to marine sandstones in the basal Cambrian, and intrashelf basin-to-carbonate ramp-to-platform sequences within the regional upper Cambrian carbonate shelf. There were two major transgressions within the regional carbonate shelf that deposited intrashelf basin sediments, the first during the early Dresbachian and the second at the Dresbachian-Franconian boundary. Examination of exposures in the field during the day, coupled with inspection of drill cores during an evening session, will provide a comprehensive overview of Late Cambrian stratigraphy and depositional environments in southern Missouri.

Small-scale observable features within the regional-scale framework to be observed include "early" dolomitization, multiple fracturing and brecciation stages, and pre-ore porosity and pore-occluding siliceous cements as well as Mississippi Valley-type mineralization that occludes porosity.

The Sedimentary Geology Division will subsidize students who are valid Division members. Students

MUST PAY THE FULL TRIP FEE WHEN REGISTERING, but will receive \$50 after the meeting directly from the Division.

- 6. Surface Effects of the 1811–1812 New Madrid Earthquake Sequence and Seismotectonics of the New Madrid Seismic Zone, Western Tennessee, Northeastern Arkansas and Southeastern Missouri.** *Eugene S. Schweig III, Center for Earthquake Research and Information, Memphis State University, Memphis, TN 38152, (901) 678-2007; Randall W. Jibson, USGS, Reston. November 3 (evening)–5. Cost: \$160 (2 ON, 1 L, 2 D, S). Limit: 40.*

The New Madrid seismic zone extends along the Mississippi Valley from Marked Tree, Arkansas, to near Cairo, Illinois. In the winter of 1811–1812 this zone was the site of at least four earthquakes of magnitude eight or greater. Although no major earthquakes have occurred in the region since 1895, the zone remains the most seismically active area in the central and eastern United States. On this field trip we will examine surficial effects of the New Madrid earthquakes. Among the features are sand blows exposed at the surface in fields and in drainage ditches and landslides that occurred along the bluffs of the Mississippi River. We will also visit and discuss the implications of Reelfoot scarp, Reelfoot Lake, and the Lake County uplift. In Missouri we will examine a newly discovered feature, probably representing the first documented example of surface faulting related to the New Madrid earthquake sequence. Evening discussions will focus on seismotectonic implications of seismic reflection and other geophysical data.

- 7. Hydrogeology of Shallow Karst Ground Water Systems in Southeastern Missouri.** *James E. Vandike, Missouri Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401-0250, (314) 364-1752; Paul Blanchard, University of Missouri, Columbia; Cynthia Endicott, Missouri Division of Geology and Land Survey, Rolla. November 4–5. Cost: \$120 (1 ON, all meals, S). Limit: 30.*

Extensive surface karst in eastern Missouri, including parts of St. Louis, have undergone urban development and other environmental changes. The impact of such changes on ground water will be the focus of this trip. Participants will visit urbanized karst in southern St. Louis and then follow the Mississippi River southeast along the northeastern flank of the Ozark uplift to the Perryville sinkhole plain. Stops will illustrate relations between karst landforms, urban development, storm-water rainage, and stratigraphy. Participants will see intense surface karst developed on Ordovician carbonates, and the modification of karst features to enhance storm water drainage. Strategies to deal with contamination of ground water in karst will be

discussed at stops including karst windows, resurgence, and modified sinkholes. Methodology and results of extensive dye-tracing work to define ground-water flow paths in karst will be illustrated.

- 8. “Olympic Dam-type” Deposits and Geology of Precambrian Rocks in the St. Francois Mountains Terrane, Missouri.** *Eva B. Kisvarsanyi, Missouri Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401, (314) 364-1752; V. Max Brown, University of Toledo, Toledo, Ohio; Richard D. Hagni, University of Missouri, Rolla. November 2–4. Cosponsored by SEG. Cost: \$225 (2 ON, all meals). Limit: 25.*

The St. Francois Mountains, comprising outcrops of Middle Proterozoic rhyolite ash-flow tuffs and ring-complex granites, provide a splendid example of anorogenic intraplate magmatism in the United States midcontinent. This trip will include an overview of the Precambrian geology of the region, examine the volcanic and plutonic rocks, and visit ore deposits that are variants of the giant Olympic Dam deposit in south Australia. The first day includes a visit to the Pea Ridge underground iron mine, and to the historic Pilot Knob surface iron mine. The second and third days concentrate on the pyroclastic rock stratigraphy and petrology and on collapse structures in the southern part of the mountains. At individual stops, a variety of rhyolitic ash-flow tuffs, lava flows, breccias, and a trachyandesite will be examined. Stops will feature one ring intrusion and one central pluton of the terrane and the Ag-W-Sn deposits of the Silver Mine District.

HALF-DAY MINI-TRIPS (held during the meeting)

- 9. Central United States Earthquakes and the St. Louis University Seismic Network.** *Sean T. Morrissey, Dept. of Earth and Atmospheric Sciences, St. Louis University, St. Louis, MO 63156, (314) 658-3131. November 5 (2:00 to 4:30 p.m.). Cost: None. Guidebook not included. Limit: 30.*

Tour the seismic data center for the Central Mississippi Valley Seismic Network, operated by St. Louis University. Methods of retrieving data from approximately 50 stations using analog and digital recording systems will be demonstrated. Seismicity patterns in the New Madrid Seismic Zone and surrounding regions and recent discoveries concerning the nature of fault-zone properties at New Madrid will be discussed.

10. The Geologic Story of the St. Louis Riverfront (A Walking Tour). *Arthur W. Hebrank, Missouri Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401-0250, (314) 364-1752. November 6 (morning). Cost: \$5. Limit: 50.*

This walking tour of the St. Louis riverfront will describe the geology around the Gateway Arch and the Jefferson National Expansion Memorial Plaza and the stone masonry used in the construction of the Old Cathedral and Eads Bridge and will discuss stone paving methods along the levee and at Laclede's Landing.

11. Engineering Geology and Industrial Minerals Aspects of the Greater St. Louis-Illinois Area. *Paul B. DuMontelle, Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820, (217) 333-5114; James W. Baxter, Illinois State Geological Survey, Champaign; Alan G. Goodfield, Illinois Department of Transportation, Springfield. November 7 (morning). Cost: \$35 (S). Limit: 40.*

The engineering geology aspects of the design and construction of Illinois Interstate 255, which crosses the Mississippi River east of St. Louis, will be discussed. Visits will be made to a limestone quarry and to a sand pit. Subsidence features over an abandoned coal mine will be observed.

12. Digital Cartography, Map Library, and Data Base Management Systems of Washington University's Department of Earth and Planetary Sciences. *Raymond E. Arvidson, Dept. of Earth and Planetary Sciences, Washington University, Campus Box 1169, One Brookings Dr., St. Louis, MO 63130, (314) 889-5610; Clara McLeod, Earth and Planetary Sciences Library, Washington University. November 8 (morning). Cost: \$10 (does not include guidebook). Limit: 40.*

This tour of Washington University's Department of Earth and Planetary Sciences will include (1) an address and discussion on "The Future of Digital Map Catalogs and Digital Cartography in General," especially in terms of procedures for generating, storing, and accessing digital maps; (2) a brief tour of the Earth and Planetary Sciences Library and a hands-on demonstration of its electronic Map Catalog, which utilizes current relational database management technology; and (3) a visit to the NASA Regional Planetary Image Facility and hands-on demonstrations of its Image Retrieval and Processing System (RPIF-IRPS) which was developed jointly by workers at the RPIF, Washington University, and the Astrogeology Branch, U.S. Geological Survey, Flagstaff, Arizona. The system allows researchers to find broad information about raw and derived planetary data,

to conduct detailed search and browse sessions for image, mosaic, and map information, and to process image data.

13. Aerospace Center, U.S. Defense Mapping Agency. *Ron Blouse, U.S. Defense Mapping Agency, 8900 S. Broadway, St. Louis AFS, MO 63118, (314) 263-8410; Captain Dale Hotzaphel, U.S. Air Force. November 9 (morning). Cost: \$10. Limit: 40.*

Tour of the Graphic Arts Department of the Defense Mapping Agency's Aerospace Center. A film and guided tour will demonstrate the production and distribution of approximately 15 million maps and charts per year.

POSTMEETING

Attention field trip participants with Friday morning departures: GSA has tickets for a Thursday evening St. Louis Blues hockey game. Meet early for an Italian dinner on The Hill. See page 224 for details.

14. Engineering and Environmental Geology of the St. Louis Area, Missouri. *Mimi Garstang, Missouri Division of Geology and Land Survey, P.O. Box 250, Rolla, MO 65401-0250, (314) 364-1752; David Hoffman and Peter Price, Missouri Division of Geology and Land Survey, Rolla; Michael J. Navin, U.S. Army Corps of Engineers, St. Louis. November 10. Cost: \$50 (1 L, S). Limit: 30.*

This trip will visit St. Louis-area sites at which engineering geology activities are under way during the GSA meeting. These will include the Weldon Spring Superfund site, where radioactive wastes are intermixed with wastes from a military explosives plant and hazardous waste disposal planning is under way. At Corps of Engineers Lock and Dam 26, an excursion boat will be boarded. The engineering geology considerations involving development of American Bottom floodplains, Lock and Dam 27, Eads Bridge, the Arch and other sites along the way will be viewed and discussed from the deck of the *Blankenship* excursion boat. Participants will gain an overview of St. Louis-area geology as it relates to engineering and environmental concerns.

15. Transition from Passive Margin to Foreland Basin Sedimentation: The Atoka Formation of the Arkoma Basin, Arkansas and Oklahoma. *David W. Houseknecht, Dept. of Geology, University of Missouri, Columbia, MO 65211, (314) 882-6285; Marvin O. Woods, University of Missouri—Columbia. November 9 (evening)—12. Trip ends in Tulsa, Oklahoma. Cost: \$320 (3 B, 3 L, 1 D, 3 ON, airfare to Little Rock, Arkansas); \$225 without airfare. Limit: 45.*

A longitudinal traverse of the Arkoma basin, this trip will focus on vertical and lateral facies relations within strata deposited just prior to, during, and just following the obduction-induced development of the Arkoma foreland basin. The Atoka Formation, deposited during the most dynamic phase of basin development, will be emphasized. The trip will illustrate changes in petrofacies, sediment distribution patterns, and depositional environments that accompanied the onset of Ouachita orogenesis. The Sedimentary Geology Division will subsidize students who are valid Division members. Students **MUST PAY THE FULL TRIP FEE WHEN REGISTERING**, but will receive \$50 after the meeting directly from the Division.

16. Quaternary Loess and Glacial Record of Southwestern Illinois. *Leon R. Follmer, Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820, (217) 244-6945; E. D. McKay III, Illinois State Geological Survey, Champaign; Edwin R. Hajic, University of Illinois, Urbana. November 10. Cost: \$50 (1 L, S). Limit: 40.*

This trip will visit multiple loess sequences with paleosols in the classic area of Wisconsinan loess in the borderland area of Illinoian glacial deposits. Other stops will allow participants to examine Illinoian till stratigraphy and the Quaternary record of the lower Illinois River valley.

17. Cyclic Strata of the Late Pennsylvanian Outlier, East-Central Illinois. *C. Pius Weibel, Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820, (217) 244-2493; R. L. Langenheim, Jr., University of Illinois, Urbana. November 10-11. Cost: \$88 (1 ON, 1 B, 2 L, S). Limit: 25.*

This trip will examine the strata that bridge the gap between the terrestrially dominated Appalachian sequence and the marine-dominated Midcontinent sequence. Participants will discuss current and proposed lithostratigraphic classification of these cyclothemic strata, collect macrofossils, coals, and coal balls; and discuss lithostratigraphic and biostratigraphic correlations with the Appalachian Basin, the Midcontinent, and north-central Texas and their paleogeographic implications. Visits to exposures illustrating depositional and diagenetic environments of limestones, shales, and coals will give opportunities to discuss controlling factors of the alternating marine and deltaic deposits, such as glacial-eustatic sea-level changes, PACs, autocyclicity/allocyclicity, and rhythmic tectonism.

18. Selected Economic Mineral Deposits of Central Arkansas. *J. Michael Howard, Arkansas Geological Commission, 3815 W. Roosevelt Rd., Little Rock, AR 72204, (501) 371-1488; Benjamin F. Clardy and Charles G. Stone, Arkansas Geological Commission, Little Rock. November 10-11. Trip ends in Little Rock, Arkansas. Cost: \$183 (1 ON, 2 L, S, airfare to Little Rock), \$125 without airfare. Limit: 44.*

The trip will visit quartz crystal, novaculite (tripoli-whetstone), barite, and vanadium mines in the complexly deformed Cambrian-Mississippian age strata of the Ouachita Mountains. Tour nepheline syenite quarries and study the relation of various Cretaceous plutonic rocks and their alteration effects. Visit bauxite and kaolin clay mines formed by the lateritic weathering of nepheline syenite in Paleocene-Eocene time.

19. Mississippi Valley-type Mineralization of the Viburnum Trend, Missouri. *Richard D. Hagni, Dept. of Geology, 125 McNutt Hall, University of Missouri, Rolla, MO 65401, (314) 341-4616; Raymond M. Coveney, Jr., University of Missouri, Kansas City. November 9 (evening)-11. Cosponsored by SEG. Cost: \$150 (2 ON, all meals, S). Limit: 45.*

Underground visits to one of four lead-zinc mines in the Viburnum Trend will be featured on this trip, which includes an extra overnight stay in order to meet mine operational requirements. The trip will focus on Pb-Zn ores and nearby host rocks, including examination of outcrops of dolomitized Bonneterre facies beds, which are stratigraphically equivalent to ore zones in the Old Lead Belt and in the Viburnum Trend, currently the world's largest producer of lead.



1989 ST. LOUIS EXHIBITORS

Cervantes Convention Center

*Relax
Enjoy*

daily food and beverage service during exhibit hours

**SUNDAY
NOVEMBER 5**

6:00 p.m.
to
9:00 p.m.

**MONDAY
NOVEMBER 6**

9:00 a.m.
to
5:00 p.m.

**TUESDAY
NOVEMBER 7**

9:00 a.m.
to
5:00 p.m.

**WEDNESDAY
NOVEMBER 8**

8:00 a.m.
to
4:00 p.m.

As we go to press:

AAPG Bookstore
AAPG Visiting Petroleum Geologists Program
Academic Press, Inc.
American Geological Institute
American Geophysical Union
American Institute of Professional Geologists
Apple Computer, Inc.
Applied Research Lab/Fisons Instruments
ASC Scientific
Association of Geoscientists for International Development
Ben Meadows Company
Blackwell Scientific Publications
Blake Industries, Inc.
Cal Graeber Minerals
Cambridge University Press
Cameca Instruments, Inc.
Champan & Hall
ChemPet Research—CPR
Circum-Pacific Map Project
CJS Sciences Ltd.
Columbia University Press
Cushman Foundation
Dapple Systems
Delsi, Inc.
Desert Research Institute
Economic Geology Publishing Company
Elsevier Science Publishing Company
Encyclopaedia Britannica
Finnigan MAT
Foundation for Field Research
General Supply Corporation
Geographics
Geological Association of Canada
Geology Stuff
Geoscience Information Society
Geoscience Resources, Inc.
Geotech Computer Systems
GSA Bookstore
GSA Combined Publishers Display
GSA Foundation

GSA Geology & Public Policy Committee
GSA Planetary Geology Division
GSA Sections
Hillquist
Howard Minerals
Interactive Concepts
Intermagetics General/Magstream
International Union of Geological Sciences
JCPDS
JEOL USA, Inc.
Jet Propulsion Laboratory
Joint Oceanographic Institute
Kendall/Hunt Publishing Company
Kentucky Geological Survey
Kevex Corporation
Krueger Enterprises, Inc.
Lubrecht and Cramer Ltd.
Macmillan Publishing Company
McGraw Hill Book Company
Merrill Publishing Company
Micromeritics Instrument Corporation
Mineralogical Society of America
Mountain Press Publishing Company
National Association of Geology Teachers
National Science Foundation
National Earth Science Teachers Association
Natural History Books
Nature's Own
Nebraska Geological Survey
Nikon Inc., Instrument Group
Northern Illinois University
Ohio State University
Oklahoma Geological Survey
Online Computer Library Center
Oxford University Press
Paleontological Society
Pergamon Press, Inc.
Philips Electronic Instruments, Inc.
Pikes Peak Lithographing Company
Prentice-Hall, Inc.
Princeton University Press

Rice University
Rigaku, USA
Rocklabs
RockWare, Inc.
Rocky Mountain Association of Geologists
SEPM
Sari Pacific
Saunders College Publishing
Schonstedt Instrument Company
Scintag, Inc.
Siemens Analytical X-Ray Instruments
Sigma Gamma Epsilon
Society of Economic Geologists
Southwest Missouri State University
Spectrex Corporation
Spex Industries, Inc.
Springer-Verlag New York, Inc.
St. Louis University
STN International
The Mining Gallery
The Stone Company
University of Chicago Press
University of Kentucky
University of Nebraska
University of Oklahoma
University of Wyoming
Unwin Hyman, Inc.
U.S. Bureau of Mines
U.S. Department of Energy
U.S. Geological Survey
U.S. National Committee on Geology
VG Instruments, Inc.
WAAIME, Idaho-CDA Section
W. H. Freeman & Company
Washington State University
Washington University
Wild Leitz USA
Wiley & Sons, Inc.
William C. Brown Publishers
Williams & Heintz Map Corporation
Wright State University
X-Ray Assay Laboratories Ltd.

Rush

New exhibitors contact Exhibits Manager, GSA headquarters

SPECIAL EVENTS

Frontiers Welcoming Reception

Cervantes Convention Center
Sunday, November 5, 6:00 to 9:00 p.m.

The Welcoming Reception leads off the meeting with St. Louis blues and Mississippi Dixieland entertainment as the Exhibit Hall opens on the first night of the 101st GSA Annual Meeting. Everyone is invited. For your convenience, the Registration Area will be open until 7:00 p.m.

The reception is sponsored by the exhibitors. Please express your appreciation to the exhibitors on page 222.

We suggest you make dinner reservations for Sunday evening. A restaurant guide will be in your registration packet, or ask at your hotel for recommendations. Also, a dining hostess will be available in the Registration Area.

GSA Presidential Address and Awards Ceremonies

Adam's Mark Hotel, Promenade Ballroom
Monday, November 6, 5:30 to 6:30 p.m.

GSA President Randolph W. Bromery's address, "The First Year of the Second Century," will be followed immediately by the GSA Awards Ceremonies. After his address, President Bromery will present GSA's first Young Scientist Award to Mark P. Cloos, the 1989 Day Medal to Dan P. McKenzie, and the 1989 Penrose Medal to Warren B. Hamilton. Recognition will also be given to newly elected Honorary Fellows Rushdi Said and Gabriel Dengo. Everyone is invited to congratulate the medalists during the cocktail reception that immediately follows.

Alumni Night

Adam's Mark Hotel, St. Louis Ballroom
Monday, November 6, 7:00 to 9:30 p.m.

Over 60 universities and colleges will be represented at the alumni receptions. If you would like your university to hold a reception, contact the Events Coordinator, GSA headquarters. This is a good night to get together with friends. The Adam's Mark concierge will be available to assist you in making dinner reservations.



The Blues Cruise

Wednesday, November 8, 7:30 to 11:15 p.m. • The President Riverboat

Feel like a good time? Join the party on the Blues Cruise Wednesday night! This special event will be devoted exclusively to your evening's entertainment. After a day in sessions, clean up, enjoy a good meal, and head to the riverfront and board the *President* for a three-hour cruise down the Mississippi River. You will be entertained by two of the best local blues bands: the Leroy Pierson Band and the Soulard Blues Band. The bands will play the current version of the music that made St. Louis famous—a mix of traditional blues, rhythm and blues, early rock, and reggae. You will see and hear that the blues are alive and well in St. Louis.

Shuttle buses will transport you from the hotels to the riverfront and back again, but it's a short walk from downtown to the *President*, docked by the Gateway Arch. The doors of the riverboat will open at 7:30 p.m., and the ship will leave promptly at 8:00 p.m. The bands will start and the place should be jumping in no time. Although we will probably be tempted to keep the party going right on down to New Orleans, the *President* will be back at the dock by about 11:00 p.m.

Tickets (includes 2 drink coupons and dry snacks): \$11.

Ticketed Meal Functions

Associated societies and GSA divisions invite their members and other interested guests to join them for their annual meal functions, special addresses, and awards ceremonies. You do not need to be registered for the meeting; everyone is welcome. Please check the registration form for event dates and to order tickets. Location and times will appear on the ticket.

FRONTIERS PHOTO SALON

SPORTS EVENTS

Frontiers Forest Park Runs

Wednesday, November 8, 6:30 to 9:00 a.m.

Forest Park, the site of the 1904 World's Fair and one of the largest city parks in the country, is the location for this year's 5K and 10K runs. The course will cover level and gently rolling areas of the park. Early November weather should be clear and cool, so bring sweats.

Buses will transport runners from the Cervantes Convention Center at 6:30 p.m. to Forest Park (about 5 miles), and back after the races. The race will be professionally directed and timed by the St. Louis Track Club. Water will be provided on the course, with refreshments and prizes at the finish. GSA will provide race shirts, so be sure to indicate your shirt size on the registration form. Shirts and maps may be picked up in the Registration Area.

Fee (includes shirt): \$12.

Blues Hockey Night

Thursday, November 9, 7:30 to 10:30 p.m.

Thursday night blues can be fun. GSA has reserved seats for the St. Louis Blues hockey game. This NHL team plays at the Arena, just south of Forest Park and north of "The Hill," a part of town famous for its Italian restaurants. You are responsible for your own transportation, but we'll get together at Cervantes for those interested in carpooling or going to eat. Exact time and place will be with your ticket. GSA and NHL should be a great combination—a good cause for the Blues.

Fee: \$15.

YMCA

St. Louis offers a complete and convenient downtown YMCA Fitness Center. With your hotel room key and a daily (\$8) or weekly (\$20) fee you can enjoy the facilities. Brochures will be available at the Information Desk at Cervantes.

Do you have an entry for GSA's first photo contest? Entries will be judged on the basis of impact, content, composition, and overall presentation. Entries will be screened for suitability. Photos will be displayed on the second level of the Cervantes Convention Center. Judging by GSA editors will take place on Sunday, November 5. First, second, and third place prizes will be awarded for color and black and white photos. The first place color photo will appear on the cover of *Geology*. (Photos that have already appeared on the cover of *Geology* are not eligible.) The first place black and white photo will appear on a cover of *GSA News & Information*. All entries will be returned by November 30, 1989. Take your best shot, and good luck!

- Color or black and white prints
- Print size: minimum 8" x 10"; maximum 20" x 24"
- Mounted on white, blue, beige, or black mat board
- Description on front lower right edge of mat board
- Your name and address on back of mat board
- One black and white and/or one color photo per photographer

To enter, fill out the entry form and send it, along with your photo before OCTOBER 1 to
Raymond E. Arvidson
Dept. of Earth & Planetary Sciences
Washington University
Campus Box 1169
St. Louis, MO 63130

QUESTIONS? CALL GSA MEETINGS DEPT.

CLIP AND SEND WITH ENTRY BY OCTOBER 1

Name _____

Institution _____

Address _____

City _____ State _____ ZIP Code _____

Telephone number _____

Description of photo _____

PROFESSIONAL HORIZONS

GSA SHORT COURSES

Would you like to learn something new, brush up on the latest, or refresh on the basics? GSA short courses will be held immediately before the Annual Meeting in St. Louis and are open to members and nonmembers. Registration for the meeting is not required.

Preregistration is recommended; on-site is \$25 additional.

You may register for GSA courses on the Annual Meeting Preregistration Form on page 237.

PREREGISTRATION DEADLINE—OCTOBER 6 FOR MORE INFORMATION CONTACT GSA COURSE REGISTRAR

Cancellation

Registration substitutions may be made at any time. Requests for refunds must be received by GSA no later than October 13.

1. Contaminant Hydrogeology: Practical Monitoring, Protection, and Cleanup

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Cervantes Convention Center.

For newcomers to practical contaminant hydrogeology as it is applied daily to soil and ground-water contamination problems. Topics covered:

- theoretical and practical elements of geologic and hydrogeologic investigations
- subsurface drilling procedures and sampling
- monitoring well construction
- water sampling techniques
- contaminant transport and fate—general concepts
- data interpretation
- aquifer analysis
- criteria for selecting monitoring and remediation procedures
- site cleanup
- regulations
- client and budgetary considerations

Case histories explore the application of techniques in LUST, CERCLA, and RCRA projects, hazardous waste landfill siting, leaking underground tanks, and contaminated properties in several states.

Faculty: Christopher M. Palmer, senior geologist, Geostrategies, Inc.; Jeffrey L. Peterson, senior hydroecologist, Geostrategies, Inc.

Limit: 40. Fee: \$185; includes course manual and lunch both days.

2. Creating Geological Applications with Macintosh HyperCard

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Cervantes Convention Center. Cosponsor: National Association of Geology Teachers.

For all geologists, including graduate students, academics, and industry representatives. Only limited computer experience is needed. This hands-on course introduces the capabilities of Apple computer's innovative and versatile software, HyperCard for the Macintosh, demonstrates applications, and provides a foundation for its use. Hundreds of HyperCard stacks have appeared since 1987 and are used increasingly by educators, businesses, and researchers. Topics covered:

- organizing and using information in stacks—basic navigation
- creating stacks—creating backgrounds, graphics, new fields; working with buttons; creating and modifying cards
- introduction to scripting—programming in HyperCard, basic commands, card scripting, visual effects, field information
- linking cards to other programs
- incorporating animation and sound
- controlling videodisc players
- creating your own stack

The Macintosh computers used in this course are provided by Apple Computer, Inc., Chesterfield, Missouri.

Faculty: H. Robert Burger, Dept. of Geology, Smith College.

Limit: 40. Fee: \$140; includes course manual and disks containing several stacks, tools, and scanned images to use to prepare your own stacks.

3. Current Aspects of Basin Analysis and Sedimentary Geology: A Two-Day Overview

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Cervantes Convention Center. Cosponsor: Sedimentary Geology Division.

ATTENTION STUDENTS: The Sedimentary Geology Division will subsidize students who are valid Division members. Students MUST PAY THE FULL COURSE FEE when registering, but will be reimbursed \$50 after the meeting by the Sedimentary Geology Division.

For earth scientists in advanced academic and governmental programs and oil, mining, or hydrologic/engineering companies. An expanded version of the one-day course presented at the 1987 GSA Annual Meeting in Phoenix, this course provides an overview of both basin analysis and

sedimentary geology, stressing the interdisciplinary aspects of basin analysis and how geodynamic processes of basin formation and thermal history influence the nature of sediment fills and maturation of the sediment through diagenesis, and fluid circulation. Basin analyses from the Illinois basin and the North Sea illustrate interdisciplinary approaches. Topics covered illustrate sediment interpretation as a barometer of basin tectonic processes and extrinsic basinal processes during basin evolution:

- methods of tectonic subsidence and geohistory analysis
- basin classification
- paleogeography
- sedimentary facies
- black shales
- cratonic sequences
- seismic stratigraphy
- sea-level history
- pelagic cycles
- clastic diagenesis
- fluid migration through sedimentary basins
- North Sea; Illinois basin

Faculty: George deV. Klein, Dept. of Geology, University of Illinois at Urbana—Champaign.

Limit: 100. Fee: \$140; includes course manual and lunch both days.

4. Fission-Track Analysis: Theory and Applications *Frontiers in Geoscience, 1989 Theme Course.*

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Sheraton Hotel.

This introductory course for academic and industry geoscientists, including advanced graduate students, reviews the theory of fission-track dating methods and their application to geoscience problems. Topics covered:

- formation and revelation of fission tracks in solids
- measurement of fission-track ages; laboratory techniques; calibration of the age equation; error estimation
- interpretation of measured ages—effects of environmental factors, especially temperature
- applications of fission-track analysis in geochronology and thermochronology

Applications include:

- thermal histories of sedimentary basins—especially hydrocarbon generation
- timing of mineralization
- timing of tectonic or erosional unroofing of geologic terrains
- dating ash beds and lava flows
- dating landform development
- reconstructing provenance from sedimentary rocks

The Nikon microscopes used in this course are provided by Frank E. Fryer, Inc., Carpentersville, Illinois.

Faculty: Kevin D. Crowley, Dept. of Geology, Miami University of Ohio; Charles W. Naeser, Branch of Isotope Geology, USGS, Denver; Nancy D. Naeser, Branch of Central Regional Geology, USGS, Denver.

Limit: 75. Fee: \$140; includes course manual and lunch on Saturday.

5. Geological Considerations in Hazardous-Waste Site Characterization

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Cervantes Convention Center.

For the professional, this course discusses the solution of geologic, hydrogeologic, and geotechnical problems encountered in the characterization of sites for hazardous-waste management. Topics covered:

- evaluation of geologic and ground-water conditions for site characterization
- design and installation of monitoring wells
- geophysical techniques for site characterization
- geologic and hydrogeologic factors influencing the selection and implementation of remedial actions
- design of engineered liners, covers, and cut-off walls
- remedial action contract negotiation

Faculty: John D. Rockaway, Dept. of Geological Engineering, University of Missouri—Rolla; Allen W. Hatheway, Dept. of Geological Engineering, University of Missouri—Rolla; Gregory L. Hempen, U.S. Army Engineer District, St. Louis; Christopher R. Ryan, President, Geo-Con, Inc.; Charles Riggs, Project Manager for Hazardous Wastes and Senior Hydrologist, Sverdrup Corporation.

Limit: 50. Fee: \$155; includes course manual.

6. Planning Hydrologic and Geologic Investigations and Reports

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Cervantes Convention Center. Cosponsor: Hydrogeology Division.

For those with some experience in hydrologic and geologic investigations, this short course, through lectures and exercises, provides guidelines to improve the technical quality, readability, and timeliness of hydrologic and geologic investigations and technical reports. Topics covered:

- planning project proposals, cost estimates
- project management and review—use of management by objectives
- report planning and organization
- report writing
- report review

Faculty: John E. Moore, USGS, Reston; Terry L. Steinborn, Dames & Moore.

Limit: 75. Fee: \$155; includes course manual and lunch both days.

7. Quantitative Interpretation of Joints and Faults

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m., Holiday Inn Riverfront Hotel. Cosponsor: Structural Geology and Tectonics Division.

For the structural geologist who wants to brush up on modern methods of field interpretation of joints and faults. This general course focuses on the treatment of field examples and includes an introduction to laboratory techniques and theoretical analysis. Topics covered:

- observational approaches—the morphologies of outcrop-scale joints and fault surfaces
- kinematics—analyses of faults and joints; sampling the field methods
- lab and theory—fracture toughness testing; triaxial and friction tests; introduction to fracture mechanics
- dynamic interpretation—fault-slip techniques; regional patterns and genesis; local problems in crack propagation

Faculty: Terry Engelder, Dept. of Geosciences, Pennsylvania State University; Richard W. Allmendinger, Dept. of Geological Sciences, Cornell University; Atila Aydin, Dept. of Earth and Atmospheric Sciences, Purdue University; David D. Pollard, Dept. of Applied Earth Sciences, Stanford University.

Limit: 100. Fee: \$140; includes course manual and lunch both days.

8. Fabric of Cements in Paleozoic Limestones

Sunday, November 5, 8 a.m. to 5 p.m., Washington University, St. Louis. Cosponsor: Sedimentary Geology Division.

ATTENTION STUDENTS: The Sedimentary Geology Division will subsidize students who are valid Division members. Students MUST PAY THE FULL COURSE FEE when registering, but will be reimbursed \$50 after the meeting by the Sedimentary Geology Division.

For intermediate to advanced graduate students or professionals working on Paleozoic carbonate rocks in depositional environments, or those working on carbonates of other ages and who are interested in comparing the results of their diagenetic analyses with those in Paleozoic rocks. Topics covered:

- principles of cement-fabric interpretation
- fabrics characteristic of various diagenetic environments
- case studies of fabrics in various Paleozoic sequences

This is a hands-on laboratory session in addition to presentations.

Faculty: Kenneth R. Walker, Dept. of Geological Sciences, University of Tennessee; Stephen O. Moshier, Dept. of Geology, University of Kentucky; Robert E. Johnson, Resource Applications, Inc.; Lawrence J. Weber, Jr., Mobil Oil Production Company; D. Gregory Jernigan, Martin Marietta

Energy Systems; J. Lincoln Foreman, Oak Ridge National Laboratory; Keith E. Roberson, Dept. of Geological Sciences, University of Tennessee; D. Mark Steinhauft, Dept. of Geological Sciences, University of Tennessee.

Limit: 30. Fee: \$155; includes course manual.

9. Glaciotectonic Structures and Landforms

Sunday, November 5, 8 a.m. to 5 p.m., Sheraton Hotel. Cosponsor: Quaternary Geology and Geomorphology Division.

For professional geologists and graduate students with some experience in glacial and/or structural geology. Topics covered:

- glaciotectonic structures and landforms—recognition, description, classification, distribution, methods of analysis
- typical glaciotectonic settings from the United States, Canada, and Scandinavia
- applied aspects of mining and construction in glacially disrupted terrain

Faculty: James S. Aber, Dept. of Earth Science, Emporia State University.

Limit: 30. Fee: \$80; includes course manual and lunch.

10. Quaternary Climates: The Ocean Sedimentary Record

Frontiers in Geoscience, 1989 Theme Course. Sunday, November 5, 8 a.m. to 5 p.m., Cervantes Convention Center.

For geologists who want to increase their awareness about climatic processes and the history of climate change. This course summarizes current knowledge of climatic controls of oceanic sedimentation and shows how that record has been used to infer the history and mechanisms of climate change. Course material can be used as a state-of-the-art unit for a class in Quaternary geology. Topics covered:

- the nature of and interactions among the several climatic subsystems (atmosphere, ocean, cryosphere, land surface)
- the Milankovitch theory of orbital forcing of climate systems
- the marine stratigraphy of the Quaternary
- processes and patterns of oceanic sedimentation during the Quaternary and their temporal variability





- techniques for establishing links between the oceanic and terrestrial records of Quaternary climatic change

Faculty: David K. Rea, Dept. of Geological Sciences, University of Michigan; Margaret Leinen, Graduate School of Oceanography, University of Rhode Island.

Limit: 75. Fee: \$95; includes course manual and lunch.

ASSOCIATED SOCIETIES: SHORT COURSES/ WORKSHOPS/FORUM

Advanced Powder Diffraction Techniques Short Course

Saturday, November 4, 8 a.m. to 5 p.m.; Sunday, November 5, 8 a.m. to 5 p.m. A welcoming reception will be held Friday evening, November 3. Holiday Inn Convention Centre Hotel. Sponsored by the Mineralogical Society of America.

This short course will cover some of the more advanced aspects of powder diffraction as applied to the geological sciences. The course will begin with summaries of the principles of powder diffraction, x-ray instrumentation, experimental procedures, and sample preparation. Detailed treatments of quantitative analysis, diffraction applied to clays and glasses, and powder diffraction software will be included. Finally, profile refinement, Rietveld refinement using x-ray data, synchrotron powder diffraction, and neutron diffraction will be described using mineralogical examples.

Cost: MSA member—\$125; MSA student member—\$25; nonmember—\$165; student nonmember—\$45. For information and registration: MSA Business Office, 1625 I Street, N.W., Suite 414, Washington, DC 20006; (202) 775-4344.

The Age of Dinosaurs Short Course

Sunday, November 5, 8:15 a.m. to 5:30 p.m., Adam's Mark Hotel. Cosponsors: National Association of Geology Teachers, Paleontological Society, and Society of Vertebrate Paleontology.

This course is designed to bring nonspecialists up to date on recent advances in the knowledge of dinosaurs and to provide participants with a basis on which to develop an introductory dinosaur course in their own institutions. It will be taught by 12 dinosaur specialists, and ample discussion time is planned. Geologic, ecologic, and evolutionary aspects will be covered, along with new ideas and issues.

Faculty: K. Padian, D. Fastovsky, B. H. Tiffney, P. Sereno, D. B. Norman, J. McIntosh, T. Rowe, P. J. Currie, J. A. Gauthier, M. Lockley, J. D. Archibald, D. Chure.

No cost. Course notes will be available on-site for approximately \$15. **PREREGISTRATION IS REQUIRED.** To reserve a seat, please write by **OCTOBER 1, 1989**, to Kevin Padian, Museum of Paleontology, University of California, Berkeley, CA 94720.

GIS Geological Field Trip Workshop: Components of a Well-Run Trip

Tuesday, November 7, 1:30 to 3:30 p.m. Sponsored by the Geoscience Information Society.

Advice and criticism about organizing and planning a field trip will be given from several viewpoints, including those of the geologist responsible for the field trip concept and its organization; the outfitter who plans for a trip down the Grand Canyon, in Baja California, or in some other remote location; the participant who has been involved in the superb to the not so superb; the guidebook author/editor who develops the road log and supporting papers; the information specialist who tries to acquire and make guidebooks available; and the user who plans to retrace the trip or use the guidebook in the classroom.

No cost or registration. For information: Claren M. Kidd, Geology Library, University of Oklahoma, 830 Van Vleet Oval, Room 103, Norman, OK 73019; (405) 325-6217.

GeoRef Beginners Workshop

Tuesday, November 7, 8 to 11 a.m. Sponsored by the Geoscience Information Society and GeoRef.

Learn how to search AGI's GeoRef on-line database of over a million geological references from 1785 to the present. The workshop will teach beginning and prospective searchers about (1) the GeoRef database and its subject coverage, (2) Boolean logic, (3) on-line search commands, and (4) designing effective search strategies. Sample searches will be displayed, and the GeoRef Thesaurus and other on-line search aids will be described. General discussion and questions will follow.

No cost or registration. For information: Margy Walsh, Texaco E & P Technology Division, P.O. Box 770070, Houston, TX 77215-0070; (713) 954-6000, ext 6630.

GeoRef Advanced Workshop

*Wednesday, November 8, 1:30 to 4:30 p.m.
Sponsored by the Geoscience Information Society
and GeoRef.*

The workshop is designed to address the skills and knowledge needed to search the GeoRef database effectively beyond the beginner level. A panel of expert searchers will share experiences using the GeoRef database on multiple search systems and will discuss problems and special techniques for each system. Questions from attendees will be discussed by the panel and by others attending who may have appropriate expertise.

No cost or registration. For information: Margy Walsh, Texaco E & P Technology Division, P.O. Box 770070, Houston, TX 77215-0070; (713) 954-6000, ext. 6630.

GIS Database Forum

*Thursday, November 9, 9 to 11 a.m. Sponsored by
the Geoscience Information Society.*

Representatives of several numeric and other end-user-focused databases will discuss their services and describe access to users. These databases include raw numerical data as well as small, tightly focused bibliographic files, and all are available, with a minimum of fuss, to the end-user. Most disciplines in the geosciences will be interested in at least one of these databases.

No cost or registration. For information: Jim O'Donnell, Geology Library 170-25, California Institute of Technology, Pasadena, CA 91125; (818) 356-2199.

Teaching Earthquakes and Volcanoes Workshop

*Saturday, November 4, 1 to 5 p.m. Sponsored by the
National Association of Geology Teachers.*

NAGT would like to increase the amount of geology that is taught in elementary schools. This workshop will give teachers a scientifically coherent method of teaching plate tectonics, which is a basic concept in understanding other geologic principles. The material to be presented has been piloted in several schools in the San Francisco Bay area and is part of a complete K-6 Science, Math, and Technology Curriculum and Program developed by scientists and educators of Math/Science Nucleus.

PREREGISTRATION IS REQUIRED. For information and preregistration: Joyce R. Blueford, Math/Science Nucleus, 3710 Yale Way, Fremont, CA 94538; (415) 490-MATH(6284).

MEET THE GSA CONGRESSIONAL SCIENCE FELLOW

*Tuesday, November 7, 12:15 to 1:15 p.m.
Cervantes Convention Center. Sponsored by the
GSA Geology and Public Policy Committee.*

The Geology and Public Policy Committee of GSA invites you to meet with Elizabeth Robinson, who has spent a year working in the office of Congressman Richard A. Gephardt (D—Mo.). Some issues that Robinson has dealt with are municipal waste, hazardous waste, global warming, and scientific and technologic competitiveness. Also, you will have the chance to meet with former congressional fellows. Bring your lunch from the nearby refreshment stand, and join us for this stimulating noon-time break.

GSA EMPLOYMENT SERVICE FORUM: FUTURE EMPLOYMENT OPPORTUNITIES IN THE GEOLOGICAL SCIENCES

*Monday, November 6, 1:00 to 3:00 p.m.,
Adam's Mark Hotel*

Are you interested in salary scales, tips for successful interviews, and an overview of employment opportunities? What are the current trends in academia, government, industry, and consulting and the impact of federal legislation on job demand? Attend the GSA Employment Service Forum to hear from seven experts. Each panel member will speak briefly on the outlook in a specific area and answer questions from the audience. The 1989 speakers are Chairman Dick Paull, University of Wisconsin; Sam Adams, Colorado School of Mines; J. D. Edwards, Pecten International Company; Charles Mankin, Oklahoma Geological Survey; John D. McGurk, U.S. Geological Survey, Reston; Dave Stephenson, Harding Lawson Associates; and Steve Stow, Oak Ridge National Laboratory. For further information: GSA Membership Services Manager, GSA headquarters.

Please make your reservation with the Housing Bureau. Note: All rooms are subject to 9.85% tax and a \$1.50 per night fee.

1 HOLIDAY INN CONVENTION CENTRE

Ninth Street & Convention Plaza Boulevard, St. Louis,
MO 63101

(314) 421-4000 (150-room block)

1 block from the Cervantes Convention Center

Single: \$55 Double: \$65

297-room property with a five-story atrium and an indoor pool, jacuzzi, and exercise room. Two restaurants. Located next door to the Cervantes Convention Center and walking distance to most downtown attractions. Free overnight parking for registered hotel guests. Unguaranteed reservations held until 6 p.m.

Check-in: 3 p.m. Check-out: 12 noon
CC: AX, CB, D, DC, MC, V

2 SHERATON ST. LOUIS HOTEL

910 North Seventh Street, St. Louis, MO 63101

(314) 231-5100 (550-room block)

1 block from the Cervantes Convention Center

Single: \$77 Double: \$89

Children under 17 accompanied by parent are free. Two restaurants, cocktail lounge, 24-hour room service, valet laundry. \$7 per day parking and Avis Rent-A-Car office on the property. Complimentary health facility. Unheated outdoor pool. Newspaper and gift shop. Unguaranteed reservations held until 4 p.m.

Check-in: 3 p.m. Check-out: 1 p.m.
CC: AX, CB, D, DC, ER, MC, V

3 DAYS INN AT THE ARCH

333 Washington Avenue, St. Louis, MO 63102

(314) 621-7900 (125-room block)

4 blocks from the Cervantes Convention Center

Single: \$42 Double: \$42

Children under 18 accompanied by parent are free. Two blocks from St. Louis Center shopping mall. Full-service restaurant and lounge. Indoor pool, sauna, and recreation area. Coin-operated guest laundry. Attached covered parking at \$4.50 per day. Unguaranteed reservations held until 4 p.m.

Check-in: 2 p.m. Check-out: 12 noon
CC: AX, D, DC, MC, V

4 HOLIDAY INN DOWNTOWN/RIVERFRONT

200 North Fourth Street, St. Louis, MO 63102

(314) 621-8200 (300-room block)

6 blocks from the Cervantes Convention Center

Single: \$59 Double: \$68

Children under 18 accompanied by parent are free. Full-service 29-story hotel. Two restaurants, lounge, valet service, and laundry. Free indoor self-parking. Access to health club. Located directly across from the Gateway Arch and riverfront. Within walking distance to St. Louis Centre, Laclede's Landing, shopping, and restaurants. Unguaranteed reservations held until 6 p.m.

Check-in: 2 p.m. Check-out: 12 noon
CC: AX, CB, D, DC, MC, V

5 ADAM'S MARK ST. LOUIS—HEADQUARTERS

Fourth and Chestnut, St. Louis, MO 63102

(314) 241-7400 (750-room block)

7 blocks from the Cervantes Convention Center

Single: \$81 Double: \$91

St. Louis's finest and newest, European flavor and comfort. Full-service hotel with four cocktail lounges and three restaurants for casual to elegant dining. Complete fitness center with indoor swimming pool, whirlpool, saunas, racquetball courts, and exercise equipment. Self-parking \$8 per day and valet parking upon request. Concierge, laundry, and valet service, gift shop, pay movie channels. Located next to the Gateway Arch, providing a wonderful view from many rooms. Unguaranteed reservations held until 6 p.m.

Check-in: 3 p.m. Check-out: 12 noon
CC: AX, CB, D, DC, MC, V

6 CLARION HOTEL—ST. LOUIS

200 South Fourth Street, St. Louis, MO 63102

(314) 241-9500 (200-room block)

9 blocks from the Cervantes Convention Center

Single: \$57 Double: \$65

Children under 18 accompanied by parent are free. Full-service hotel with complimentary fitness center, including indoor swimming pool, whirlpool, saunas, and exercise equipment. The revolving Top of the Riverfront Restaurant, on the 29th floor, is one of two restaurants. Laundry and valet service. Attached garage parking at \$8 per day. Unguaranteed reservations held until 6 p.m.

Check-in: 2 p.m. Check-out: 12 noon
CC: AX, CB, D, DC, MC, V

7 MARRIOTT PAVILION DOWNTOWN

One Broadway, St. Louis, MO 63102

(314) 421-1776 (200-room block)

8 blocks from the Cervantes Convention Center

Single: \$75 Double: \$85

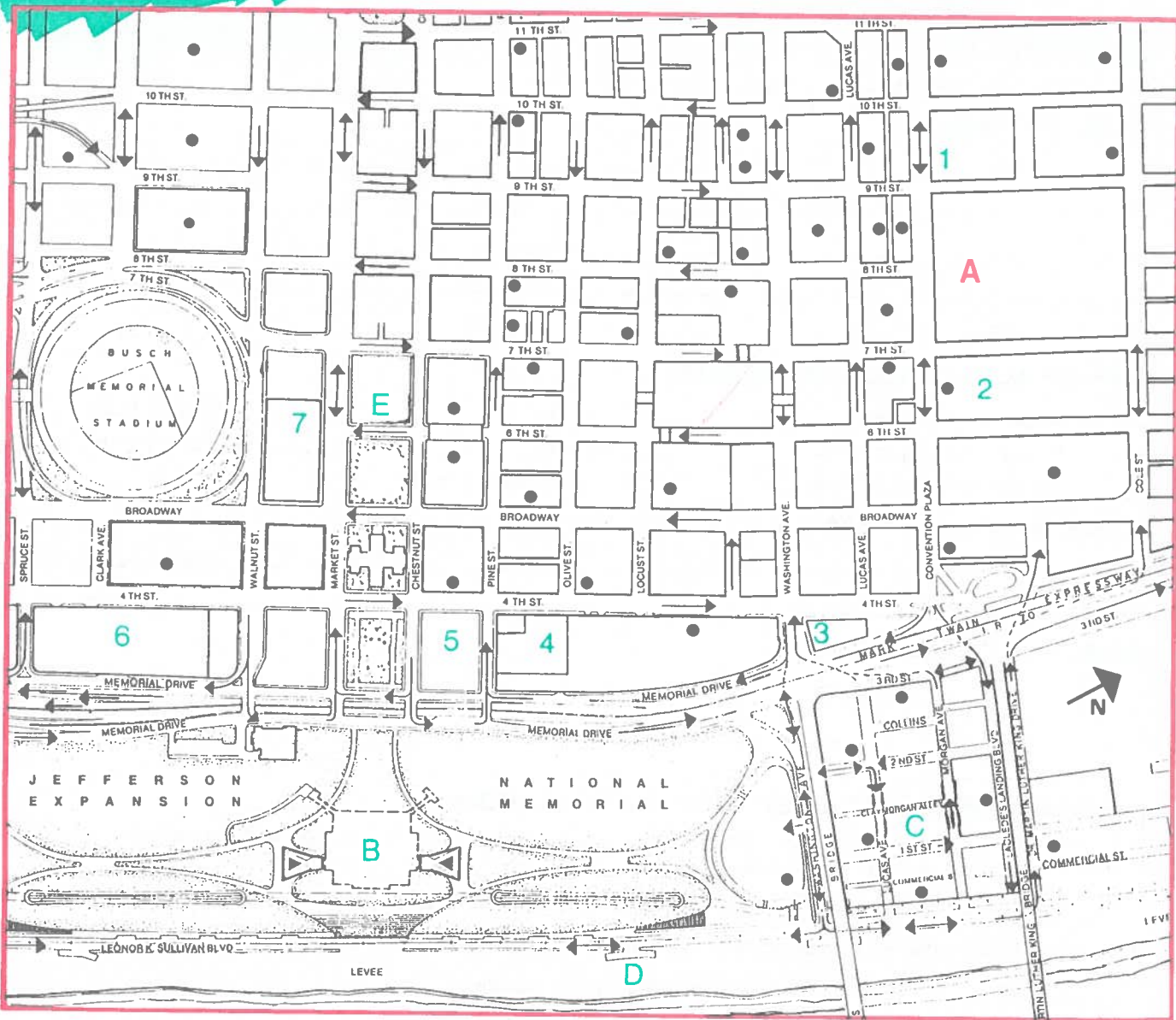
Located downtown, two blocks from the Gateway Arch. Two restaurants offer casual and fancy dining, and one lounge.

Full health club offering heated indoor pool, exercise equipment, saunas, and whirlpool. Concierge, laundry, and valet service. Self-parking is \$8 per day. Gift shops. Unguaranteed reservations are held until 6 p.m.

Check-in: 4 p.m. Check-out: 12 noon
CC: AX, CB, D, DC, MC, V

Credit card (CC) codes: AX = American Express / CB = Carte Blanche / D = Discover / DC = Diners Club / ER = Enroute / MC = MasterCard / V = VISA

DOWNTOWN ST. LOUIS



HOTELS

1. HOLIDAY INN CONVENTION CENTRE
2. SHERATON ST. LOUIS HOTEL
3. DAYS INN AT THE ARCH
4. HOLIDAY INN DOWNTOWN/RIVERFRONT
5. ADAM'S MARK ST. LOUIS
6. CLARION HOTEL—ST. LOUIS
7. MARRIOTT PAVILION DOWNTOWN

NON-HOTEL LOCATIONS

- A. CERVANTES CONVENTION CENTER
- B. GATEWAY ARCH MUSEUM
- C. LACLEDE'S LANDING
- D. PRESIDENT RIVERBOAT DOCK
- E. ST. LOUIS VISITORS CENTER

Dots indicate public parking lots. Rates range from \$1 minimum charge per ½ hour to \$8.50 maximum charge for all day. Some lots are open 24 hours per day, allowing overnight parking. Most lots, however, are unattended after 10:00 p.m.



GSA OFFICIAL HOUSING REQUEST FORM

Your Housing Request Form must be received BY OCTOBER 13. Please complete and send to:

St. Louis Convention & Visitors Commission/GSA Housing
10 South Broadway, Suite 300
St. Louis, MO 63102
(314) 421-1023

(Please print or type all information below and keep a copy.)

HOTEL PREFERENCE:

1. _____
2. _____
3. _____
4. _____

Rate requested \$ _____

TYPE OF ACCOMMODATION NEEDED:

- | | | |
|--|---|--|
| <input type="checkbox"/> Single (1 bed, 1 person) | <input type="checkbox"/> Triple | <input type="checkbox"/> 1 Bedroom Suite |
| <input type="checkbox"/> Double (1 bed, 2 persons) | <input type="checkbox"/> Quad | <input type="checkbox"/> 2 Bedroom Suite |
| <input type="checkbox"/> Dbl/Dbl (2 beds, 2 persons) | <input type="checkbox"/> Add rollaway to room | |

NOTE: All rooms are subject to 9.85% tax and a \$1.50 fee per night.

ARRIVAL DAY/DATE _____ TIME _____ a.m./p.m.

DEPARTURE DAY/DATE _____ TIME _____ a.m./p.m.

NAMES OF OCCUPANTS:

1. _____ 3. _____
2. _____ 4. _____

GUARANTEED ROOM RESERVATION AUTHORIZATION:

I understand that my reservation may not be held after the hotel guarantee time. I also understand that the hotel may bill me for one night's housing if I fail to properly cancel a guaranteed reservation. Please check one:

- Credit card information provided below to guarantee my reservation.
- My guarantee will be made directly to the hotel *after* I have received my hotel confirmation.
- I will take my chances. No guarantee deposit will be provided.

Please guarantee my room reservation with the following:

American Express Carte Blanche Diners Club Discover MasterCard VISA

NAME (as listed on credit card) _____

SIGNATURE _____

CARD NUMBER _____ EXP. DATE _____

DO NOT SEND CASH OR CHECKS WITH THIS FORM

MAIL CONFIRMATION TO:

Name _____ Telephone () _____

Address _____ City _____

State _____ ZIP _____ Country _____

HOUSING

GSA has blocked rooms at seven hotels that are offering special convention rates to GSA meeting attendees. GSA endorses these hotels for quality, cleanliness, and service. All hotels have sprinkler systems except the Days Inn, which relies on smoke detectors.

RESERVATIONS

Fill out the attached Official Housing Request Form and mail it to the address shown on the form. Your Housing Request Form must be RECEIVED BY FRIDAY, OCTOBER 13. Reservations will not be accepted unless they are on the GSA form.

AFTER FRIDAY, OCTOBER 13, you are responsible for making your own reservation directly with the hotel. Note that (1) many hotels will be filled at this time, and (2) hotels will be able to offer the special GSA rate on an as-available basis.

ASSIGNMENT

Hotel rooms will be assigned on a first-come, first-served basis as they are received by the Housing Bureau. Once your request is received, the Bureau will send an acknowledgment to both you and your assigned hotel.

You will then receive a confirmation from the hotel. This is a notice that the hotel received the information from the Bureau and that the reservation has been entered into their system.

DEPOSITS/GUARANTEES

All GSA hotels suggest a first night's room deposit. Deposits can be made by (1) including a credit card number and expiration date on the housing form, or (2) sending payment directly to the hotel once you have received your confirmation from the hotel. The deposit amount should be the cost of one night's stay at your assigned hotel. Note that the Housing Bureau will ONLY accept credit card numbers, not checks or cash. When making payment directly to the hotel, be sure to give them your confirmed reservation number.

Once the hotel receives your deposit, it automatically guarantees your reservation. The guarantee assures you that no matter what time you arrive on your scheduled arrival day, your room will be held until 6:00 a.m. the following day. If you have not guaranteed your reservation, most St. Louis hotels will not hold your room beyond 4:00 p.m. of the scheduled arrival day.

CHANGES AND CANCELLATIONS

BEFORE OCTOBER 13, all changes and cancellations to your room reservation should be sent, in writing, to the Housing Bureau.

AFTER OCTOBER 13, all changes and

cancellations to your room reservation must be telephoned in to your hotel. Your notice of cancellation must be received AT LEAST 48 HOURS in advance of your scheduled arrival to receive a full refund on your first night's room deposit. Please show courtesy as a professional geologist to notify the hotel if your plans change.

Supply your hotel reservation number at the time of any change or cancellation.

NOTE: All rooms are subject to 9.85% tax and a \$1.50 per night fee.

CONVENIENCES

INFORMATION/MESSAGES

Friday, November 3 to Thursday, November 9.

Cervantes Information (314) 342-5900
Messages (314) 342-5901
Adam's Mark (314) 241-7400

CHILD CARE

GSA will offer a cooperative child-care service. UNTIL OCTOBER 11, the GSA Meetings Coordinator will accept names, addresses, and phone numbers of interested participants. You may also include information on your children and where you will be staying. ON OCTOBER 16, the information will be shared with everyone who has responded. Participants are responsible for contacting one another. You may also call your hotel for local child-care services.

NEWS ROOM

Sunday, November 5 to Thursday, November 9, Cervantes Convention Center.

The News Room provides information on many topics for release to the news media. Please come in to let us know of material that is noteworthy for the science or general press. Also, members of the press may receive complimentary registration with appropriate press credentials. In advance of the meeting, contact Sandra Rush, (303) 443-8489, or the Communications Coordinator, GSA headquarters.

MISSOURI TRAVEL

Fall in the Ozarks is beautiful. Interested in a pre- or postmeeting get-away?

Missouri Division of Tourism, P.O. Box 1055, Jefferson City, MO 65102, 1-314-751-4133

St. Louis Convention & Visitors Commission, 10 S. Broadway, Suite 300, St. Louis, MO 63102, 1-800-247-9791

REGISTRATION

PREREGISTER TODAY!

PREREGISTRATION MUST BE RECEIVED NO LATER THAN OCTOBER 6.

1. Member Discount! GSA professional members and members of GSA's Associated Societies pay \$40 less for preregistration than nonmembers. GSA student members may register for \$20 less.
2. Save! There is an additional 18% savings in registration fees if you register before the preregistration deadline! Advance registration is suggested for many of the special activities because of participation limits. Use the preregistration form provided in this announcement.
3. Registration is necessary for technical sessions and the exhibit hall. Badges must be worn for activities from 10:00 a.m. Sunday through 5:00 p.m. Thursday.
4. Registration discounts are given to GSA or Associated Society members. Associated Societies that qualify for this discount are indicated on p. 211 and on the registration form. Please indicate your affiliation(s) and member number and register using the member rates.
5. Full payment MUST accompany registration. Unpaid purchase orders are NOT accepted as valid registration. Charge cards are accepted as indicated on the preregistration form. If using a charge card, please recheck the card number given so that errors will not delay your registration.
6. Register one professional or student per form. Copy the form for your records. On the registration form, one-day registrants MUST select the day they plan to attend.
7. Guest registration is required to participate in guest activities, to attend technical sessions, or to visit the exhibit hall. Guest registrations MUST be accompanied by either a professional or student registration.
8. CURRENT student ID is required to obtain special student rates at both the on-site and preregistration counters. Students not carrying a current student ID when they arrive to pick up registration materials will be required to pay the professional fee.

CANCELLATIONS AND REFUNDS

GSA will refund advance registration fees for cancellations received in writing by OCTOBER 13.

NO REFUNDS WILL BE MADE ON CANCELLATION NOTICES RECEIVED AFTER THIS DATE. Refunds will be mailed from GSA after the meeting; there is a \$10 processing fee. Refunds for fees paid by credit card will be credited according to the card number on the preregistration form. NO refunds for on-site registration and ticket sales.

REGISTRATION FEES

	Advance (by Oct. 6)	On-Site	One-Day
Professional—Member	\$110	\$130	\$65
Professional—Nonmember	\$150	\$170	\$85
Student—Member	\$ 45	\$ 55	\$28
Student—Nonmember	\$ 65	\$ 75	\$38
Guest	\$ 45	\$ 55	N/A

ON-SITE REGISTRATION SCHEDULE

Cervantes Convention Center, Hall B

Sunday, November 5	10:00 a.m. to 7:00 p.m.
Monday, November 6	7:30 a.m. to 5:00 p.m.
Tuesday, November 7	7:30 a.m. to 5:00 p.m.
Wednesday, November 8	7:30 a.m. to 2:00 p.m.
Thursday, November 9	7:30 a.m. to 12:00 p.m.

AN EXCITING NEW REASON TO JOIN GSA!

GSA recently announced a reduction in membership dues, making this the best time ever to join the Society. Now, dues of \$40 to become a new member equal the \$40 you save by attending the 1989 Annual Meeting as a member. It's like joining GSA for free! Even professional registrants who pay the nonmember registration fee and apply for membership by March 31, 1990, can take advantage of this opportunity. Simply attach a copy of your meeting registration form to your membership application and submit it to GSA headquarters.

Likewise, students who pay the new membership dues of \$20 to become a Student Associate will receive a \$20 discount on their Annual Meeting registration. Again, it's like becoming a new GSA Student Associate for free!

The \$40 registration discount for members mentioned above applies to professional members of GSA or an Associated Society. The Associated Societies that qualify are listed on the registration form. Membership applications are available prior to the meeting from GSA headquarters. During the meeting, they can be picked up at the Membership Booth in the Registration Area of the Cervantes Convention Center, Hall B.

PREREGISTRATION FORM

1989 GSA Annual Meeting • November 6-9

Preregistration must be RECEIVED by October 6. Payment and form MUST accompany each preregistration request. Unpaid purchase orders are NOT accepted as valid registration. One form per registrant. Cancellation deadline: October 13. No refunds will be given on cancellations received after this date. Shaded areas are badge information.

Please print ** Copy for your records

Name (Last) _____ (First) _____
 Institution/Employer _____ Nickname for badge _____
 Mailing Address _____
 City _____ State _____ ZIP code _____
 Country _____ Business phone _____ Home phone _____
 Guest/Spouse Name (Last) _____ (First) _____
 City _____ State/Country _____

Circle Member Affiliations: (1) GSA (Member # _____) (2) CF (3) GS (4) GIS (5) MSA (6) NAGT (7) PS (8) SEG (9) AWG (10) SGE (11) AGID (12) SVP (13) NESTA

(registration required for participation in all events)

	Price	Qty	Amount
Professional Member (member of affiliation checked above)	(1) \$110	1	\$
Member One-Day (circle day: S M T W T)	(2) \$65	1	\$
Professional Nonmember	(3) \$150	1	\$
Nonmember One-Day (circle day: S M T W T)	(4) \$85	1	\$
Student Member (member of affiliation checked above)	(5) \$45	1	\$
Member One-Day (circle day: S M T W T)	(6) \$28	1	\$
Student Nonmember	(7) \$65	1	\$
Nonmember One-Day (circle day: S M T W T)	(8) \$38	1	\$
Guest (fill in name above for badge)	(9) \$45	—	\$
Day in the Park	(11) \$28	—	\$
Cave Tour	(12) \$20	—	\$
St. Louis Grandeur	(13) \$27	—	\$
A Visit to St. Charles	(14) \$15	—	\$
Historic St. Louis Walking Tour	(15) \$5	—	\$
Total Column A			\$

PREREGISTRATION FEES

GUEST ACTIVITIES

Remit in U.S. funds, payable to 1989 GSA Annual Meeting, or charge:

American Express Diners Club/Carte Blanche MasterCard VISA

Card expires: _____ mo. / _____ yr. _____ card number

Signature _____

(PREREGISTRATION MUST BE RECEIVED BY OCTOBER 6!)

Column B	Qty	Amount
Nov. 9	(16)	\$
Nov. 8	(17)	\$
Nov. 8	(18)	\$
Nov. 8	(19)	\$

St. Louis Blues Hockey Game
 5K Run (check T-shirt size: S_M_L_XL)
 10K Run (check T-shirt size: S_M_L_XL)
 Blues Cruise

(luncheons unless noted)

Engineering Geology
 History of Geology Division
 Geophysics Division
 Geoscience Information Society
 Hydrogeology Division
 Mineralogical Society
 National Assoc. Geology Teachers
 Paleontological Society
 Sedimentary Geology Breakfast
 Women Geoscientists Breakfast
 Coal Geology Division
 Geochemical Society
 Quaternary Geology & Geomorphology
 Society of Economic Geologists

SPECIAL EVENTS*

TICKETED MEAL FUNCTIONS*

FIELD TRIPS*

GSA SHORT COURSES*

1	Archaeological Geology, Central Mississippi	Nov. 5	(34)	\$60	1	\$
2	Pennsylvanian and Permian, Kansas & Nebr.	Nov. 2-5	(35)	\$210	1	\$
3	Coal Geology, Appalachian Basin/Illinois Basin	Nov. 3-5	(36)	\$205	1	\$
4	Geology & Hydrogeology, Nuclear Waste w/ Air	Nov. 2-4	(37)	\$398	1	\$
4a	Geology & Hydrogeology, Nuclear Waste w/o Air	Nov. 2-4	(38)	\$170	1	\$
5	Regional Stratigraphy, Facies & Depositional	Nov. 3-4	(39)	\$110	1	\$
6	Surface Effects 1811-1812 New Madrid Earthquake	Nov. 3-5	(40)	\$160	1	\$
7	Hydrogeology, Shallow Karst Groundwater System	Nov. 4-5	(41)	\$120	1	\$
8	Olympic Dam-Type Deposits St. Francois Mtns.	Nov. 2-4	(42)	\$225	1	\$
9	Earthquakes & St. Louis Univ. Seismic Network	Nov. 5	(43)	n/c	1	\$
10	Geologic Story, St. Louis Riverfront	Nov. 5	(44)	\$5	1	\$
11	Engineering Geology/Industrial Minerals	Nov. 7	(45)	\$35	1	\$
12	Washington Univ. Planetary Image Facility	Nov. 8	(46)	\$10	1	\$
13	Defense Mapping Agency's Aerospace Center	Nov. 9	(47)	\$10	1	\$
14	Engineering/Environmental Geology, St. Louis	Nov. 10	(48)	\$50	1	\$
15	Transition Sedimentation, Arkoma Basin w/ Air	Nov. 9-12	(49)	\$320	1	\$
15a	Transition Sedimentation, Arkoma Basin w/o Air	Nov. 9-12	(50)	\$225	1	\$
16	Quaternary Loess/Glacial Record, SW Illinois	Nov. 10	(51)	\$50	1	\$
17	Cyclic Strata, Late Pennsylvanian Outlier	Nov. 10-11	(52)	\$88	1	\$
18	Selected Economic Mineral Deposits w/ Air	Nov. 10-11	(53)	\$183	1	\$
18a	Selected Economic Mineral Deposits w/o Air	Nov. 10-11	(54)	\$125	1	\$
19	Mississippi Valley-Type Mineralization	Nov. 9-11	(55)	\$150	1	\$

Check here if already registered for a short course.

- Contaminant Hydrogeology
- Geological Applications, Macintosh HyperCard
- Basin Analysis and Sedimentary Geology
- Fission-Track Analysis: Theory & Application
- Hazardous-Waste Site Characterization
- Hydrologic & Geologic Investigations/Reports
- Quantitative Interpretation, Joints and Faults
- Fabric of Cements in Paleozoic Limestones
- Glaciotectionic Structures and Landforms
- Quaternary Climates: Ocean Sedimentary Record

*Meeting registration not required

Column A + B = Total Remittance (full payment must be enclosed)

FOR OFFICE USE ONLY

Deposit Date _____ Comment _____
 Balance Due \$ _____ A/R _____
 Refund \$ _____ A/P _____
 Refund Ck # _____
 Refund Date _____

Mail to: 1989 GSA Annual Meeting, P.O. Box 9140, Boulder, CO 80301



TRANSPORTATION

AIR

We suggest you visit your travel agent early to get the best reservation and airfare you can. GSA has designated the Cain Travel Group of Boulder, Colorado, as the official airline reservation agent for the 1989 GSA Annual Meeting. Meeting participants are encouraged to call Cain's toll-free number to take advantage of discounted fares on selected airlines.

Trans World Airlines (TWA) has been named the official carrier; United and Delta Airlines are additional carriers. Reduced rates are 5% off any available discount fare. These fares generally have some restrictions. The discount offered from normal coach fares will be 40% to 45%, with no minimum stay or advance purchase requirements.

To make a reservation:

- Call 1-800-346-4747 (toll-free outside Colorado) or (303) 443-2246 (collect from Canada or Colorado).
- Hours: Monday through Friday 8 a.m. to 5:30 p.m., MDT.
- Call early for best availability and identify yourself as a GSA traveler.
- Be aware of restrictions applying to discount tickets.
- Tickets can be paid for by check (payable to Cain Travel), by major credit card, or invoiced to your company. Final payment must reach Cain Travel no later than ten days prior to departure to allow for mailing time.
- All tickets will be mailed via certified mail upon receipt of payment unless requested otherwise.
- After tickets are issued, you are protected from fare increases; if a fare decreases, call Cain Travel for an adjustment.
- Cain Travel will have an on-site Customer Service Desk at the Cervantes Convention Center in St. Louis.

GROUND

The Lambert St. Louis International Airport is 12 miles from the Cervantes Convention Center and the downtown area (approximately a 20-minute ride). Transportation options are as follows.

Airport Limousine Service

Airport to hotel. Open from 5:30 a.m. to 10:00 p.m., 7 days a week. To purchase a ticket, go to the booth opposite Exit 13 in the baggage claim area. Departures are every 20 minutes. Cost: \$6.

Hotel to airport. The Airport Limousine Service stops at all major downtown hotels every 20 minutes. For additional information or advance reservations call (314) 385-7400. Cost: \$6.

Taxi Cabs

Only certain taxi companies are permitted to have taxi stands at the airport. Therefore, you may experience a waiting line for service. All vehicles are metered. Charges range from \$1.00 to \$2.35 for the first mile and from \$0.50 to \$0.90 for each additional mile. Our advice: share a cab.

Bi-State Transit

Take the #4 Natural Bridge bus from the airport to downtown. Bi-State Transit buses service the St. Louis metropolitan area from 5:30 a.m. to 11:00 p.m. weekdays, and from 5:30 a.m. to 9:00 p.m. weekends. The Bi-State "Levee Line" is a free bus ride between Union Station and the Mississippi Riverfront. Look for the specially painted Levee Line buses. For general information, call Bi-State at 231-2345.

GSA Shuttle

GSA will operate a free shuttle service throughout the meeting. GSA hotel guests will be transported to and from the Cervantes Convention Center during meeting hours. The shuttle will also operate during special events at the Cervantes Convention Center and hotels.

This service will be provided each day (Sunday through Thursday) beginning at 6:30 a.m. and continuing at frequent intervals through the meeting hours. The service will continue into the evening for the special events. Look for shuttle schedules posted in GSA hotel lobbies and in registration packets. Each bus will be identified by a "Shuttle Bus" sign in the front window.

Car Rental

Budget is the official car rental agency for the meeting. Identify yourself as a GSA delegate and get guaranteed, discounted, daily/weekly rates as follows: economy/compact \$31/\$155; intermediate \$33/\$165; full size \$35/\$175; luxury \$49/\$195; mini (15-passenger) van \$70/\$325. Four-door models may be requested in the full-size and luxury class cars at no additional cost. Unlimited mileage. Vehicles may be dropped at the Lambert St. Louis International Airport, downtown (near the Adam's Mark), or in Chesterfield with no drop charges. Advance reservations are recommended. Call Budget at (800) 772-3773.

ABSTRACTS WITH PROGRAMS

Volume 21, Number 6

1989 Annual Meeting

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Members and nonmembers residing in the U.S., Canada, and Mexico only may take advantage of GSA's special advance copy purchase option of the Annual Meeting issue of *Abstracts with Programs*. These advance copies will be mailed about three weeks prior to the meeting via first-class mail. An additional charge of \$3.75 has been added to the member price of \$15.00 and to the nonmember price of \$18.75 to cover first-class postage costs.

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ON-SITE PURCHASE

Meeting attendees may also purchase copies of *Abstracts with Programs* on-site in the registration area of the Cervantes Convention Center. Price: \$18.75 to all customers.

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