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INSIDE

Tectonic Wedging Beneath Fore-arc Basins: Ancient and Modern Examples from California and the Lesser Antilles

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View north up the Great Valley Group homocline on the west side of Capay Valley, California. These Upper Cretaceous subsea-fan rocks may have been rotated to their present moderate to steep east dips along west-vergent thrusts that rise from the east-vergent master detachment that underlies the Coast Ranges and western Sacramento Valley. Photo by Stephen Phipps. Flight courtesy of Norman Pease.

ABSTRACT

Eastward-tapering tectonic wedges, interpreted to underlie the western Great Valley of California, may be analogous to underthrust wedges beneath the Tobago trough in the Lesser Antilles arc-trench system. In both regions, the proposed wedges consist of accretionary prism rocks thrust arcward beneath a fore-arc basin. The wedges are bounded above by a roof thrust or passive backthrust, and they appear to have propagated by forward imbrication and duplexing beneath the fore-arc basin. Displacement on the bounding thrust systems is zero at the wedge tips. Seismic refraction, gravity, and magnetic studies suggest that the fore-arc basement in both regions dips gently seaward and does not form a buttress to prevent arcward underthrusting. Propagation of the wedges during plate convergence and subduction is reflected in patterns of syntectonic sedimentation in the Great Valley and Tobago trough fore-arc basins.

The Lesser Antilles analogue implies that a mantle-rooted subduction-zone suture associated with late Mesozoic and Tertiary plate convergence beneath western California is not exposed in the eastern Coast Ranges. Instead, the dominant crustal-scale structure may be a subhorizontal detachment surface beneath the accretionary prism and tectonic wedge. Late Cenozoic thrust and strike-slip faults of the Coast Ranges may all root in this detachment. Seismically active blind thrusts in the western Great Valley may be reactivated structures associated with earlier tectonic wedging. The Lesser Antilles analogue may thus provide insights into the kinematics of active crustal shortening in the Coast Ranges and western Great Valley.

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INTRODUCTION

Over the past two decades, the Mesozoic-Paleogene rocks of the California Coast Ranges, principally the Great Valley and Franciscan complexes, have become the classic on-land model for sedimentary and tectonic processes at convergent margins. Recent structural and geophysical work in the California Coast Ranges suggest, however, that a revision of this classic model is in order. Structural, geophysical, and ocean-drilling studies of the Lesser Antilles fore arc suggest that this region may constitute an actualistic model for a reinterpretation of the California Coast Ranges. This new model potentially offers insights into processes within convergent margins, the mechanisms of crustal growth, and the kinematics of transpressional plate motion.

Recent geophysical studies suggest that eastward-tapering tectonic wedges underlie the western margin of California's Great Valley (Wentworth et al., 1984; Wentworth and Zoback, 1989; see Fig. 1A). The wedges are bounded below by a west-dipping detachment system, and above by an east-dipping roof thrust or a series of east-dipping backthrusts. Displacement on the thrusts bounding the wedges is zero at the wedge tips at their eastern end. The kinematics of wedge emplacement may be similar to the growth and propagation of passive roof duplexes or "triangle zones" in the eastern Canadian Cordillera (Unruh and Moores, 1992; Jones, 1982; Price, 1986).

The origin of these wedges is enigmatic. The wedges underlie the western margin of a Mesozoic to Tertiary fore-arc basin. Stratigraphic and structural relations suggest that the wedges were emplaced by early Tertiary time (Wentworth et al., 1984), and thus are temporally related to plate convergence and subduction beneath western California. Recent studies of the Lesser Antilles arc-trench system suggest the existence of similar underthrust wedges beneath the Tobago trough fore-arc basin (Torrini and Speed, 1989; see Fig. 1B). The underthrust wedges of the Lesser Antilles system are probably related to the growth of a two-sided outer-arc ridge between the trench and fore-arc basin, and represent arcward underthrusting of the accretionary prism.

In this paper we compare the late Mesozoic to Tertiary trench-arc system in western California to the modern Lesser Antilles trench-arc system. The general structural similarity between the two regions and the importance of arcward-vergent thrusting in accretionary complexes were pointed out by Silver and Reed (1988). The eastward-tapering tectonic wedges beneath the western Great Valley of California are viewed as analogous to underthrust wedges beneath the Tobago trough.

Wedging *continued on p. 188*

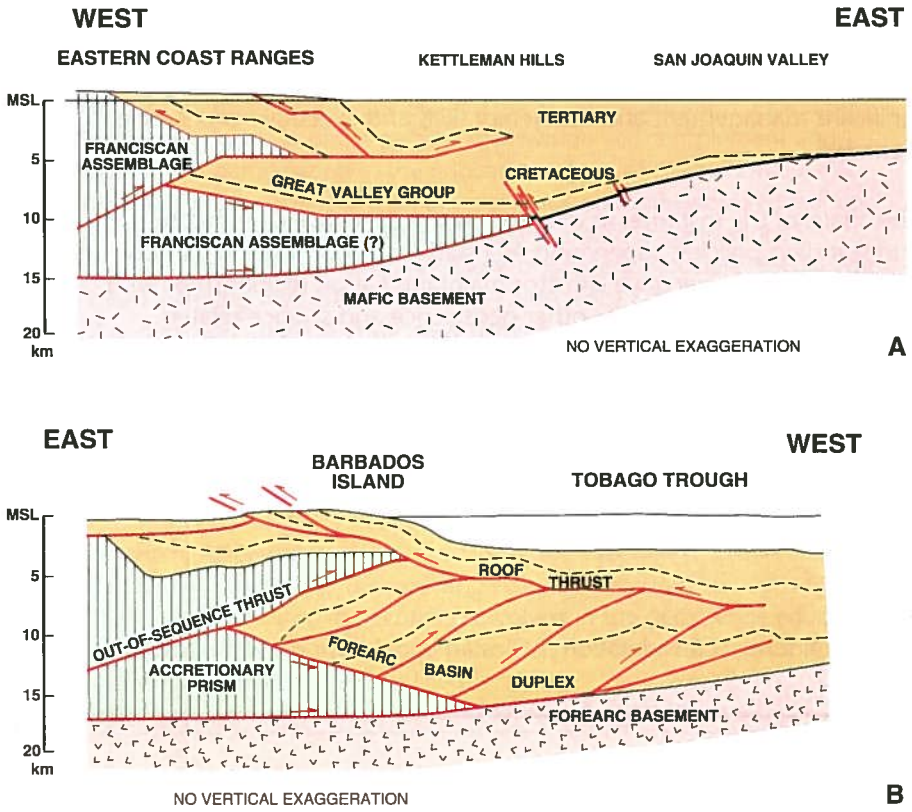

Figure 1. A: Tectonic wedges beneath the western San Joaquin Valley, California, inferred from analysis of seismic reflection and refraction data (modified from Fig. 2 in Wentworth et al., 1984). The wedges are interpreted to consist primarily of accretionary prism rocks of the Franciscan assemblage simultaneously thrust eastward over subhorizontal to gently west-dipping fore-arc basement, and beneath strata of the Mesozoic Great Valley group. East-vergent out-of-sequence thrusts have imbricated the Franciscan wedge. West-vergent backthrusts exposed in the eastern Coast Ranges are rooted in the out-of-sequence thrust. **B:** Model for tectonic wedging beneath the Tobago trough in the Lesser Antilles arc-trench system, based on interpretation of seismic reflection and refraction data (modified from Fig. 16 in Torrini and Speed, 1989). Note the similarities between the Lesser Antilles and western San Joaquin Valley wedges.

IN THIS ISSUE

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GSA Establishes Institute for Environmental Education

The GSA Committee on Long-Range Planning and the Council have formally approved the establishment of an Institute for Environmental Education. This initiative was undertaken to provide an authoritative means for dealing with environmental issues, practice, and problems that involve the geological sciences.

A main purpose of the Institute for Environmental Education is to provide an interface between the private and public sectors and the geological community on matters of the environment. In order to accomplish its objectives, the institute will encourage various GSA committees, divisions, and sections to take the initiative with regard to environmentally related activities of particular interest to them. However, the institute will be a recognized partner in such activities, and will provide support where appropriate. In particular, close working relationships will be established with the Committee on Geology and Public Policy and the Committee on Education. Because environmental issues are often closely tied to aspects of engineering geology, hydrogeology, and Quaternary geology and geomorphology, many of the institute's activities will be of particular interest to these GSA divisions. Symposia and theme sessions on environmental issues will be held at annual meetings, and from these, conferences or workshops addressing factors important to the resolution of the issue will be held.

The mission of the GSA Institute for Environmental Education comprises three aspects:

(1) ***Communication*** of geological and geotechnical information relative to environmental issues;
(2) ***Training*** relevant to environmental practice;
(3) Support of ***research*** relevant to environmental problems.

Mindful of the mission of GSA to promote the "application of geology to the wise use of the Earth," the institute will sponsor programs that are directed at the applied geological sciences and involve aspects of communication, training, and research in the areas of geologic hazards mitigation, land use management, mineral and engineering resource management, waste management, and water resource management.

Communication

Sensitive and complex environmental issues that are not addressed carefully and thoughtfully often lead to polarization, a breakdown in communications, and a lack of resolution. Utilizing the more than 17,000 geologists and applied geoscientists who are members of GSA as a network, the Institute for Environmental Education can effectively communicate information relevant to environmental issues both within the geological community and in the public and private sectors. By helping participants on all sides of issues to become better informed, the institute can contribute to a successful resolution.

In collaboration with the sections, divisions, and committees of the Society, the institute will sponsor multidisciplinary conferences and workshops on environmental issues and other activities to promote positive interaction among all parties concerned with an issue. Emphasis will be placed on important geologic aspects that are relevant to a particular issue. This approach will enable individual "constituencies" involved with an issue—each having different backgrounds and perspectives—to develop positions on a solid base of geological knowledge pertinent to the issue.

Training

Curricula in many colleges and universities typically tend to be focused and are very specific to branches of applied geoscience such as engineering geology or hydrogeology. Many times such highly focused curricula do not adequately prepare an individual for the variety of tasks that a practicing environmental geoscientist might be called upon to do. Invariably, additional training must be provided by the employer, or the individual becomes part of a team whose collective expertise is adequate to the tasks at hand. In either instance, the employer makes an investment that is often at risk as the individual or the team becomes a marketable commodity. The Institute for Environmental Education internship program will provide supervised practical training in environmental practice for advanced students, while at the same time giving an employer additional help at a low cost, a larger pool of trained individuals from which to select possible employees, and a potential employee well versed in operations of the company. The internship program represents well the mission of the institute by providing training, fulfilling a need, and establishing an interface between institutions of higher education and the private sector. In addition, short courses and in-house seminars will provide training in specialized subject areas important to practitioners in their work. Conversely, seminars and short courses given by experienced practitioners can be valuable in effecting changes in the curricula of applied geoscience.

Research

Many environmental problems, and activities that affect the environment, require new and innovative assessment methodologies, feasibility studies, or technologies to achieve given objectives. Even where established procedures and techniques can be used, an evaluation of the site-specific conditions frequently is required. The institute will sponsor a wide variety of applied research needed to better deal with these problems and activities. It will provide summer research grant support for graduate students working on environmental problems as well as technical integration support. The latter addresses the all too common problem of finding either the expertise or the funds needed to undertake a research project. The institute will also maintain a register of environmental research geoscientists and of organizations that might provide financial support for environmental research. It will serve as a technical integrator in bringing together all essential elements of an issue or project.

It is anticipated that programs sponsored by the Institute for Environmental Education will be supported by organizations, companies, and corporations interested or operating in the environmental sector. Specific details regarding programs and guidelines will be announced as each program is initiated. ■

GSA FORUM

Bruce F. Molnia

Forum is a monthly feature of *GSA Today* in which many sides of an issue or question of interest to the geological community are explored. Each Forum presentation consists of an informative, neutral introduction to the month's topic followed by two or more opposing views concerning the Forum topic. Selection of future Forum topics and participants is the responsibility of the Forum Editor. Suggestions for future Forum topics are welcome and should be sent to: Bruce F. Molnia, Forum Editor, U.S. Geological Survey, 917 National Center, Reston, VA 22092; (703) 648-4120; fax 703-648-4227.

ISSUE: Ethnic Minorities in the Geosciences

Why are so few ethnic minorities enrolling and employed in geoscience?

PERSPECTIVE 1: Introduction

Marilyn J. Suiter, American Geological Institute, Alexandria, Virginia

Global economics, particularly of commodities dependent on natural resources, have been dynamic in recent years. This activity, combined with the growing concern about environmental management, has stimulated interest in geoscience and the role of geoscience in our society. In the geoscience community, these issues have also worked to increase interest in the dynamics of the human-resources pool.

Demographic studies indicate that the group of new scientists and technicians who will direct, develop, and apply geoscience in the next decades will be increasingly female and ethnic minority. The historical demographics of geoscientists indicate that those populations have had minimal quantitative representation. This paucity, combined with the recent significant decrease in the numbers of those electing geoscience as a major (and the shrinking 18- to 24-year-old population available and eligible for college enrollment) indicates that if we are to remain competitive as a scientific discipline and industry, we must look at new ways to attract individuals into the geosciences, and especially those from groups that have previously not participated in large numbers.

Populations for such recruitment are diverse. They include adults who are interested in redirecting their careers or who have had a hiatus in their educational development (sometimes called "retreads"), individuals with disabilities (including physical handicaps) and, of course, women and ethnic minorities. All of these groups represent available recruitment pools, but women and ethnic minorities are the largest source for meaningful numbers of geoscientists.

Geoscience enrollment surveys over the past 10 years indicate that the percentage of women enrolling as geoscience majors has been increasing (percentage of geoscience degrees awarded to women has also increased, although erratically). Employment of women in geoscience has also increased, particularly in re-emerging fields, such as the hydrogeosciences. Although there are still problems for women in geoscience, there has been significant improvement.

However, this Forum focuses on ethnic minorities. Increases in enrollment and employment for this group have been quite small and impermanent. Why are there so few ethnic minorities enrolling and employed in geoscience?

PERSPECTIVE 2: Role Models as a Key to the Underrepresentation of Minorities in Geoscience

Louis A. Fernandez, California State University at San Bernardino

Ethnic minorities represent 4.5% of the professional population in the geosciences. During the 1980s minority participation in geoscience degree programs clearly was less than 5%. Why do so few minorities select the geosciences as an academic major and a career? Much has been written and many projects and programs have been undertaken addressing the scarcity of minorities in the geosciences. Although we have seen some modest gains in the past 20 years, the fact that over 30% of the labor force in the next decade will be composed of ethnic minorities will make the question (problem) loom ever larger.

Reflecting back on some 20 years of recruiting minority high-school students into the geosciences through a summer geology program at the University of New Orleans, I have been convinced that the single most important factor contributing to the low participation of minorities is the scarcity of minority geoscience role models. Arriving at this conclusion took many conversations with students who opted for geoscience careers after participating in our summer program (a six-week lecture and laboratory geology course). The conversations typically went as follows: "What part of the summer program convinced you to decide to major in geology?" The response: "The Black geologist you invited as a guest speaker to lecture on the geology of Mars."

Assuredly, the task before us is most complex. The problems are diverse and the solutions will require continued cooperation among academic institutions, professional societies, and funding agencies (public and private). Those groups must continue to work to address the problem of educational deficiencies of precollege minority students, to introduce more earth science into the precollege curriculum, to develop alliances between minority colleges and universities that do not have geoscience programs and other four-year colleges and institutions that do have geoscience programs. Simultaneously, the practicing minority geoscientist, whether in government, industry, or academia, needs to be heard and seen if we are to make any inroads into increasing the participation of minorities in the geosciences.

PERSPECTIVE 3: The Underrepresentation of Minorities in Geoscience: An Academic Perspective from a Dominantly Minority Institution

Constance M. Hill, Virginia State University, Petersburg

Among the many colleges and universities in the United States, 126 are designated as Historically Black Colleges and Universities (HBCUs). Only three HBCUs have ever offered degrees in the geological sciences. This represents less than 3% of these historic institutions.

Perhaps just as small, if not smaller, is the percentage of minority faculty at HBCUs and at all other colleges and universities providing courses in the geosciences. If one assumes that the career choices and decisions of college students are even remotely affected by those individuals from whom they receive their education, then the vast majority of minority students who attend college will never even consider the geological sciences as a career option. The probability is high that they will never be exposed to a minority individual who has achieved some level of success in this very important science. Unless they attend one of the few HBCUs that offer degrees in geoscience, many minority students when hearing the word "geology" will continue to respond "Isn't that about rocks?" They will not understand that geology is more than "just about rocks" and that it is a means by which they may contribute to the betterment of their society.

There are far too few minority individuals who hold teaching or administrative positions in geoscience higher education. The reasons, of course, are understandable, ranging from lower salaries to an absence of such opportunities in general. In recent years, however, many geology departments have actively sought minority applicants to fill vacant teaching positions without much success. More and more ethnic minorities need to be encouraged to pursue college teaching as a career.

Minority teachers are needed not only at HBCUs but at every college and university that offers a geoscience program. Minority faculty must not only be present in academic programs, they must also be active and visible in the community. They must give talks at local public and private schools, including at the elementary level. They must be willing to judge science fairs and provide assistance to eighth- and ninth-graders who need help with science projects. They must be available to advise the undecided-major undergraduate student that geoscience is a possible academic program with resulting career opportunities. This kind of involvement demystifies geology and brings the study of Earth down to earth.

Finally, to help alleviate the problem of underrepresentation of minorities in academia, it is imperative that those minority institutions that have programs in geology retain them, and that degree-granting programs are established at other minority institutions. Dwindling enrollment and economic factors have had a severe negative impact on geology departments at HBCUs. Every effort must be made to preserve and strengthen their programs.

PERSPECTIVE 4: Ethnic Minorities in the U.S. Geological Survey Geologic Division

William R. Greenwood, U.S. Geological Survey, Reston, Virginia

As a result of funding constraints, the Geologic Division of the U.S. Geological Survey decreased from 2759 permanent personnel, including 1640 scientists, in 1984, to 2417 permanent personnel, including 1490 scientists, in 1990. In 1984, African-Americans, Hispanics, Native Americans, and Asian-Pacific Americans composed about 8% of total personnel and 4% of Division scientists. In 1990, the percentage of minority permanent personnel was 7% of the total, while the percentage of Division minority scientists remained at 4%. During this period, the Division had active programs of outreach to minorities, including summer intern positions supported by the Minorities Participation in the Earth Sciences (MPES) program and graduate research

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New GSA Division

The Council of the Society at its meeting in May approved the establishment of a Geoscience Education Division with the understanding that the scope of this division is to include the whole of geosciences education and is to be a voluntary subset of GSA. The formal petition supporting the formation of this new division was accompanied by the signatures of 226 GSA members.

The main purpose of the division is to foster discussions and active participation of members of the Society in earth-science education, including earth-science education of the public. The division will complement and seek to expand participation in the education efforts of the National Earth Science Teachers Association, the National Association of Geology Teachers, the National Science Teachers Association, and similar organizations.

Any Member, Fellow, Honorary Fellow, or Student Associate of GSA who is in good standing may affiliate with the Geoscience Education Division.

The inaugural meeting of the new division will be held during the 1991 Annual Meeting in San Diego and is scheduled for Tuesday, October 22, from 4:30 to 5:30 p.m. at the San Diego Marriott Hotel, Marina Ballroom F. On Wednesday, October 23, a luncheon business meeting is scheduled from 12:15 to 2:30 p.m. in Marina Ballroom E at the Marriott. Provisional officers for the new division are John R. Carpenter (University of South Carolina), Chair; Dorothy L. Stout (Cypress College), First Vice-Chair; Whitman Cross II (Birmingham, Alabama), Second Vice-Chair; and Stephen H. Stow (Oak Ridge National Laboratory, Tennessee), Secretary-Treasurer.

All persons interested in becoming involved in the geoscience education efforts of the Society are urged to join this new division and, if possible, attend the initial meetings in San Diego.

Wedging *continued from p. 185*

This modern analogue perhaps has implications for the deep crustal structure of western California and for the kinematics of late Cenozoic transpressional deformation between the Pacific and North American plates.

TECTONIC WEDGING AND CRUSTAL STRUCTURE IN WESTERN CALIFORNIA

Through late Mesozoic and most of Tertiary time, the Pacific–North American plate boundary in western California was a convergent margin (Dickinson and Seely, 1979). With formation of the Mendocino triple junction during latest Oligocene time and its subsequent northward migration, plate convergence and subduction were replaced by transform faulting (Atwater, 1989). More recently, a change in relative plate motion at 3.4–3.9 Ma increased transpressional deformation along the plate boundary (Harbert, 1991). Late Cenozoic uplift of the Coast Ranges and the development of seismically active fold-and-thrust belts parallel to the San Andreas fault in western California may be an accommodation of transpressional plate motion (Namson and Davis, 1988; Harbert and Cox, 1989; Harbert, 1991).

Traditional Plate-Tectonic Models

Until recently, the crustal structure of the western California Coast Ranges was thought to be well understood in the context of this plate-tectonic scenario (Fig. 2). From west to east, the Coast Ranges have been divided into three lithotectonic belts (Bailey et al., 1970; Dickinson and Seely, 1979): (1) a Late Jurassic to Neogene accretionary complex, now represented by the Franciscan assemblage; (2) a fragmentary Late Jurassic ophiolite, in thrust contact with and structurally overlying the Franciscan assemblage; and (3) fore-arc basin strata of Late Jurassic to Tertiary age (Ingersoll, 1978). Mesozoic fore-arc strata are referred to collectively as the Great Valley group.

In early plate-tectonic models of California, these lithotectonic belts were interpreted as elements of the Mesozoic to Tertiary arc-trench system (Ingersoll, 1978; Dickinson and Seely, 1979). According to these models, the ophiolite is the uplifted, east-tilted basement of the fore-arc basin. The thrust contact between the ophiolite and structurally underlying Franciscan assemblage is interpreted as a preserved, mantle-rooted subduction-zone suture. These models view the ophiolite as extending eastward beneath the fore-arc strata, possibly as a trapped fragment of oceanic crust, and suggest that it may act as a backstop to prevent arcward thrusting of the accretionary complex. The accretionary complex is interpreted to have grown from east to west by addition of thrust imbricates to the toe of the prism. Upward growth of the prism led to the development of an outer-arc ridge between the fore-arc basin and trench-slope break, which in turn ponded the fore-arc basin sediments. Aside from uplift, shortening, and some strike-slip modification, these models portray the suture and other tectonic elements of the former arc-trench system as generally intact (Fig. 2).

Reinterpretation: Tectonic Wedging and Imbricate Thrusting

Recent geological and geophysical studies have suggested a reevaluation of these models. Seismic refraction and reflection studies, as well as gravity and magnetic modeling, in the western Great Valley suggest that the crystalline Sierra Nevada basement extends beneath the Great Valley and westward beneath the Coast Ranges without major deflection (Wentworth et al., 1984; Griscom and Jachens, 1990). Resting on this seaward-dipping arc basement are eastward-tapering tectonic wedges (Wentworth et al., 1984; Fig. 1A). Structural relations suggest that the wedges were simultaneously thrust eastward over the crystalline basement and beneath the sedimentary deposits of the fore-arc basin. Seismic refraction studies indicate that the acoustic velocities of the rocks within the wedges are greater than the velocities of the overlying Great Valley group fore-arc strata. Wentworth et al. (1984) interpreted the higher velocities as evidence that the wedges consist primarily of Franciscan assemblage (Fig. 1A). If so, emplacement of the wedges represents eastward underthrusting of the accretionary complex beneath the fore-arc basin.

The wedges may have been emplaced by movement on west-dipping blind thrusts. Thrusts at high levels in the wedges terminate against east-dipping backthrusts or passive roof thrusts. Relatively younger thrusts root west of the wedge tips, ramp up to the east, and locally terminate against the backthrusts (Fig. 1A). These younger thrusts are "out-of-sequence" with respect to the faults that emplaced the wedges; that is, the younger thrusts are not successively developed at the wedge tip, as is the normal case. Examples of these structures have been described in the western San Joaquin Valley (Wentworth et al., 1984; see Fig. 1A) and in the southwestern Sacramento Valley (Unruh and Moores, 1992).

Timing of Wedging and Underthrusting

The history of wedge emplacement and propagation in western California is not yet fully documented. On the basis of stratigraphic and structural relations in the Coast Ranges, Wentworth et al. (1984) proposed that the tectonic wedges were emplaced beneath the western Great Valley by early Tertiary time.

Evidence for early Tertiary wedging, in the form of uplift and eastward tilting along the western fore-arc basin margin, can be inferred from angular unconformities between Upper Cretaceous fore-arc strata and early Tertiary submarine valley fill deposits. Analysis of subsurface data reveals that several cycles of submarine valley formation and filling occurred in the northern Great Valley during Tertiary time (Redwine, 1984; Almgren, 1984). Each cycle was preceded by a period of uplift and erosion along the western margin of the basin (Almgren, 1984).

The pattern of uplift, erosion, and subsequent filling of the submarine valleys is illustrated by the evolution of the Paleocene to early Eocene Princeton valley (Fig. 3). Correlated drill-hole data reveal that the thalweg of the Princeton valley (the deepest part of the channel) had a low gradient in its upper 112 km (12.3 m/km; 1.3°). As it crossed the western margin of the northern Great Valley basin, however, it abruptly cut 2133 m down through the Upper Cretaceous rocks over a lateral distance of 48 km or less (43.6 m/km; 4°). We attribute this increase in gradient to tectonic uplift above an eastward-tapering, underthrust wedge. Since the position of the Paleocene continental slope is unknown, it is not clear whether the Princeton valley formed simultaneously with the elevation of the Upper Cretaceous rocks that formed the continental slope, or whether the valley truncated previously elevated strata at its normal 1.3° gradient. Similar stratigraphic relations between the Paleocene Martinez submarine valley fill and underlying Upper Cretaceous in the west-central Great Valley (Almgren, 1984) suggest that uplift along the basin margin may have occurred in early Paleocene and perhaps latest Cretaceous time, and thus support the latter hypothesis.

The Princeton valley fill deposits in the northwestern Great Valley are separated from overlying Pliocene-Pleistocene strata by an angular unconformity. The unconformity progressively cuts down section through the Princeton valley fill deposits (e.g., Capay Formation) from east to west (Brooks et al., 1962, Pl. 25), suggesting post–early Eocene uplift and eastward tilting along the western basin margin. The Pliocene-Pleistocene strata above the angular unconformity are also tilted east, but to a lesser extent than the underlying strata (Unruh and Moores, 1992). These relations imply progressive uplift and eastward tilting in the northwestern Great Valley during the Tertiary. Numerous angular unconformities indicating progressive uplift and eastward tilting also separate Tertiary strata in the southwestern Great Valley (V. R. Ramirez, unpub. data). We attribute the uplift and tilting to progressive tectonic wedging.

Structural relations in the Coast Ranges indicate early Tertiary deformation due to marked contraction and

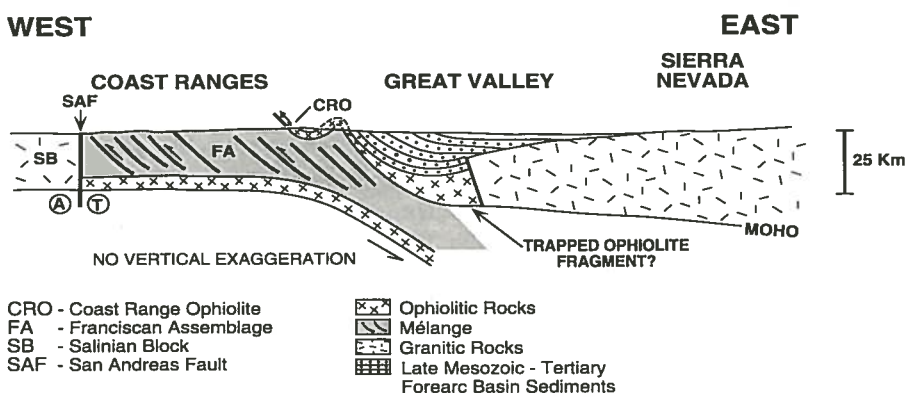

Figure 2. Early model for the crustal structure of western California (modified from Fig. 11 in Dickinson and Seely, 1979). The basement of the Great Valley fore-arc basin was thought to be uplifted, tilted eastward, and exposed in the eastern Coast Ranges as the Coast Range ophiolite. The thrust contact between the ophiolite and structurally underlying Franciscan assemblage was interpreted as a mantle-rooted subduction zone suture. The ophiolite was inferred to extend eastward beneath the Great Valley group fore-arc sediments and possibly serve as a buttress for the Franciscan accretionary wedge. These structural elements of the arc-trench system were thought to be intact but modified by regional shortening and strike-slip faulting.

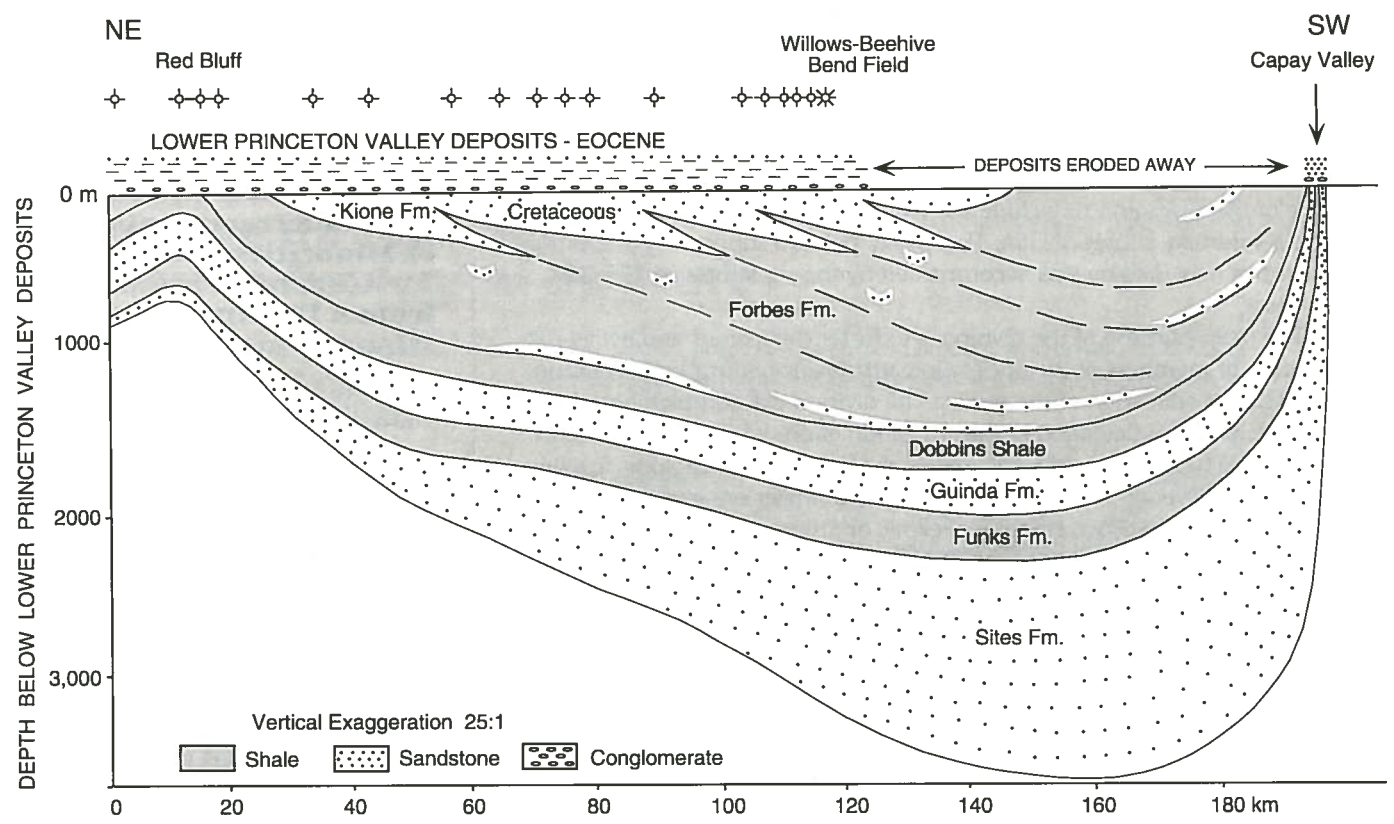

Figure 3. Cross section along the thalweg of the Eocene Princeton submarine valley, Sacramento Valley, California, from correlated drill hole data in Redwine (1972). Underlying units are Upper Cretaceous strata of the Great Valley group. The bottom of the Princeton valley has been flattened here to illustrate the downcutting that occurs to the southwest. West of the Willows– Beehive Bend gas field, the reconstructed gradient of the valley thalweg increases from approximately 1.3° to 4.0°. The increased gradient and greater downcutting are attributed to early Tertiary uplift driven by underthrusting and tectonic wedging beneath the western margin of the ancestral Sacramento Valley fore-arc basin. The Upper Cretaceous strata actually thicken to the southwest but appear to thin, owing to the vertical exaggeration of the figure.

perhaps tectonic wedging. In much of the northern Coast Ranges, surface structures are dominated by west-vergent imbricate thrusts (Suppe, 1978; Phipps, 1984; Ramirez, 1990). These thrusts shuffle Great Valley group strata, the Coast Range ophiolite, and Franciscan assemblage into a complex structural stack. The thrusts are associated with ramp anticlines with up to 12 km of structural relief. Fission-track dates from Franciscan rocks in the cores of the anticlines yield early Tertiary dates (Rahman, 1989; Dumitru, 1989; Miller, 1991; S. P. Phipps et al., unpublished), indicating that the rocks were uplifted through approximately 120 °C at that time (12 km depth at prevailing geothermal gradients). Tectonic wedging during latest Cretaceous to early Tertiary time provides a potential mechanism for the uplift suggested by the fission-track data. The west-vergent thrusts in the northern Coast Ranges may be backthrusts related to east-vergent wedging (Ramirez, 1990; Phipps et al., 1991), similar to backthrusts in the east-central Coast Ranges (Fig. 1A).

To summarize, we interpret stratigraphic, structural, and fission-track data as evidence that tectonic wedges were emplaced beneath the western Great Valley by early Tertiary time, and that the wedges were probably active episodically through Cenozoic time. Early to mid-Tertiary wedging was coeval with plate convergence and subduction beneath western California. Patterns of syntectonic sedimentation along the western Great Valley in early Tertiary time, described above, indicate that the tectonic wedges were propagating beneath a fore-arc basin, which was actively trapping sediment. The wedges, or thrusts related to wedging, may have been reactivated in late Cenozoic time in response to transpressional Pacific–North American plate motion (Wentworth et al., 1984; Unruh and Moores, 1992).

UNDERTHRUSTING BENEATH THE TOBAGO TROUGH, LESSER ANTILLES ARC-TRENCH SYSTEM

The southern Lesser Antilles fore-arc is distinguished by a 50–70-km-wide zone of active deformation between the structural high of the Barbados accretionary prism and the undeformed western part of the Tobago trough fore-arc basin (Fig. 1B). This zone, called the inner fore-arc deformation belt by Torrini and Speed (1989), is characterized by seaward-dipping blind thrusts propagating beneath the eastern margin of the fore-arc basin. The thrusts are interpreted to root in a deep detachment along the basement–accretionary prism contact, and rise to join a conjugate backthrust or passive roof thrust. Displacement on the thrust system is effectively zero at the intersection of the basal detachment and the backthrust, forming an arcward-tapering underthrust wedge (Fig. 1B). Seismic refraction and gravity studies suggest that the surface of the fore-arc basement dips gently seaward beneath the fore-arc basin and outer-arc ridge (Westbrook, 1975), and apparently does not form a buttress to prevent arcward underthrusting of the wedge.

Seismic reflection profiles reveal that the thrust wedge is characterized by a general lack of coherent seismic signals, except for discontinuous and isolated sets of dipping reflections. In contrast, the overlying fore-arc basin cover strata appear on reflection profiles as closely spaced, layered, and laterally continuous reflections. From these data, Torrini and Speed (1989) inferred that the underthrust wedge consists primarily of deformed layered rocks of the accretionary prism.

Underthrusting beneath the seaward margin of the Tobago trough has been accompanied by deformation of the cover strata above the tectonic wedge. Fore-arc strata riding up the roof thrust of the wedge are tilted westward toward the basin axis, reflecting the upper slope of the wedge taper. The tilting has been accompanied by seaward backthrusting within the fore-arc cover strata (Fig. 1B).

Torrini and Speed (1989) proposed that initial emplacement of the underthrust wedge was followed by an episode of shortening across the inner fore-arc deformation belt. The late deformation was accommodated primarily by thrusting and duplexing within the wedge. Relatively younger "out-of-sequence" thrusts cut older faults related to initial emplacement of the wedges (Fig. 1B). The late deformation is also reflected in patterns of syntectonic sedimentation along the eastern margin of the Tobago trough. Duplexing, out-of-sequence thrusting, and thrust-tip propagation have resulted in the local folding of the fore-arc cover strata. Sedimentation during growth of the fault-related folds has produced numerous onlap relations and angular unconformities along the eastern margin of the Tobago trough (Torrini and Speed, 1989).

COMPARISON OF THE LESSER ANTILLES AND WESTERN CALIFORNIA ARC-TRENCH SYSTEMS

The eastward-tapering tectonic wedges inferred to underlie the western Great Valley may be analogous to underthrust wedges beneath the Tobago trough. In both regions, the wedges have apparently propagated above a gently seaward-dipping basement surface and do not appear to be buttressed against trapped fragments of oceanic crust beneath the fore-arc basin. Tectonic wedging in both regions involves thrusting of accretionary complex rocks beneath a fore-arc basin. The style of underthrusting, including development of relatively younger "out-of-sequence" thrusts, is similar in both basins.

The cause of arcward wedging remains an unsolved problem. In the Lesser Antilles, Torrini and Speed (1989) suggested three possible causes: (1) formation of a new subduction zone and reconfiguration of the arc-trench system; (2) a change in the rate and relative obliquity of subduction; and (3) a change in accretion mechanism. Of these three mechanisms, changes in the rate and obliquity of subduction beneath western California during late Mesozoic and Tertiary time have been well documented (Engebretson et al., 1985; Harbert, 1991). Wedging in California may also have resulted from collision of exotic terranes, the existence of which was proposed by McLaughlin and Ohlin (1984).

Alternatively, the initiation of tectonic wedging may depend primarily on the geometry of the fore-arc basement surface and on rheology contrasts between the wedge and basement rocks. Experimental (Byrne et al., 1988) and numerical (Willet, 1990) modeling studies suggest that in the absence of a mechanical buttress beneath the fore-arc basin, the accretionary prism sediments will form a two-sided wedge that must maintain a critical taper in both directions. The models show that the outer-arc ridge in an arc-trench system may represent the crest of a two-sided wedge. As the ridge grows and begins to trap sediment in a fore-arc basin, accumulation of sediment on the arcward slope of the ridge will eventually reduce the taper of the wedge to the point where gravitational body forces are no longer sufficient to drive propagation of the wedge. Willet (1990) suggested that the accretionary prism, outer-arc ridge and fore-arc basin may form a single mechanical system that responds dynamically to changes in prism growth, accretion mechanism, isostatic compensation, and sediment supply. Recognition of tectonic wedging beneath a fore-arc basin in Taiwan (Lundberg, 1990), and in several other fore arcs discussed by Silver and Reed (1988), suggests that the process may be more common than previously recognized.

DISCUSSION

Tectonic wedging beneath the Tobago trough is an attractive kinematic analogue for the western Great Valley because it accounts for the interpreted tectonic wedges and provides a mechanism for progressive uplift, thrusting, and folding along the basin margin. At present, however, several elements of the model must be rigorously tested. The inference that the wedges in western California consist of Franciscan assemblage rocks comes primarily from interpretation of seismic reflection and refraction data (Wentworth et al., 1984). Meltzer (1988) re-examined some of these data from the Coalinga area and noted that relatively high velocity rocks at approximately 12 km depth, previously interpreted as Franciscan assemblage (Wentworth et al., 1984), produced coherent layered reflections. She interpreted these rocks as Great Valley strata and suggested tectonic thickening of the Cretaceous fore-arc basin strata as an alternative to underthrusting of accretionary prism rocks. An alternative interpretation of seismic reflection data across the Coalinga anticline showing no tectonic wedges was also proposed by Fielding et al. (1984). Additional deep seismic reflection and refraction studies, specifically designed to test the wedge hypothesis, must be conducted in the eastern Coast Ranges and western Great Valley.

The Lesser Antilles analogue potentially offers several insights into the crustal structure of western California. If the two regions are structurally analogous, the Mesozoic and Tertiary mantle-rooted subduction zone suture probably underlies the Franciscan assemblage and thus is nowhere exposed in the eastern Coast Ranges. The Lesser Antilles analogue also suggests that rather than a mantle-rooted subduction-zone suture, the dominant crustal-scale structure of the Coast Ranges may be a horizontal detachment surface that originally separated the accretionary prism from the subducting oceanic crust during plate convergence (Fig. 4). The presence of a major horizontal detachment or detachments beneath western California has been inferred from analysis of seismic reflection and refraction data (Meltzer, 1988), and from construction of regional balanced cross sections (Namson and Davis, 1988).

A subhorizontal detachment may significantly influence the kinematics of late Cenozoic transpression. Coeval translational and contractional structures in transpressional regimes probably share the same detachment system (Oldow et al., 1990). The late Cenozoic strike-slip and thrust faults that accommodate distributed Pacific–North American transpressional deformation in the northern Coast Ranges (Fox, 1983) may all be rooted in a mid-crustal detachment system inherited from Mesozoic and Tertiary tectonic wedging. Such a detachment is implicit in models for northern California lithospheric structure which suggest that the relative motion between the Pacific and North American plates in the mantle does not occur directly beneath the San Andreas fault (Furlong et al., 1989).

Preexisting thrust faults associated with emplacement of the tectonic wedges have apparently been reactivated to accommodate late Cenozoic shortening. These thrusts are responsible for Quaternary uplift and folding in the western Great Valley (Namson and Davis, 1988; Wentworth and Zoback, 1989; Unruh and Moores, 1992) and may also be responsible for the uplift of the northern Coast Ranges (Phipps et al., 1991). Furthermore, these thrusts are seismically active, as demonstrated by the 1892 Winters-Vacaville earthquake, the 1983 Coalinga earthquake, and recent microseismic activity in the western Great Valley (Stein and Ekström, 1989; Eaton, 1990; Unruh and Moores, 1992). The Lesser Antilles analogue may provide a framework for understanding the kinematics of reactivated faults within the tectonic wedges and assessing potential seismic hazards from blind thrusts.

ACKNOWLEDGMENTS

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Wedging *continued on p. 190*

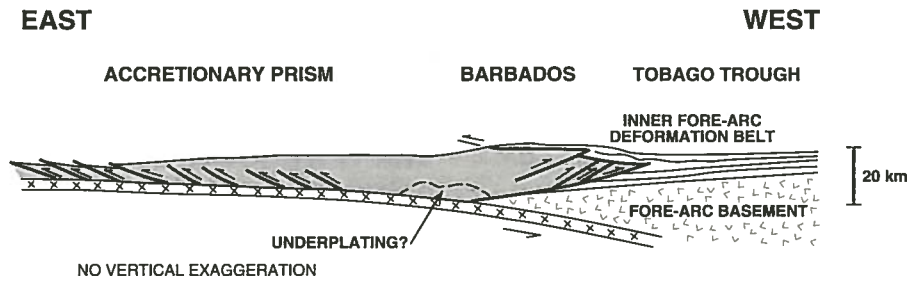

Figure 4. Generalized model for the Lesser Antilles arc-trench system (modified from Fig. 1 in Torrini and Speed, 1989). The accretionary complex is a two-sided wedge largely detached from the underlying fore-arc basement and down-going oceanic crust. The fore-arc basement dips gently seaward (east) and apparently does not form a buttress to prevent arcward wedging of the accretionary prism. The subduction zone suture approximately underlies the eastern Barbados ridge complex.

Wedging *continued from p. 189*

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support in the Graduate Intern Program. However, as the result of funding constraints, very few new scientists were hired to replace those lost by attrition. During this period the number of minority applicants for the Graduate Intern Program dropped sharply from the level of previous years.

Three years ago, realizing that near-term prospects for the permanent hiring of minority scientists were very limited, the Division focused efforts on expanding the educational pipeline for science, particularly for the kindergarten to grade 12 levels, with special emphasis on minority students. The Division expanded its activities with scientific societies and teacher associations in support of education and minority participation, including committees of the Geological Society of America, American Geological Institute, and American Geophysical Union. Partnerships were also formed with minority universities to support earth-science education, particularly the preparation and continued training of K–12 teachers. Summer intern positions have been provided for minority science and science-education majors, and funding for Graduate Intern positions has recently been increased. The Division plans to continue to serve as a training ground for minority scientists and science educators.

Now, as funding prospects appear to allow for at least modest replacement of scientific positions lost by attrition, the Division is preparing to form a Minority Advisory Committee to advise the Chief Geologist on ways to enhance the professional development of minority employees and guide efforts to recruit and retain outstanding minority earth scientists for our organization. The Division has combined all education, minority outreach, and personnel activities together under a Human Resources Officer in order to integrate and increase the impact of these activities.

In order to remain the premier Federal source of geologic knowledge, the Geologic Division must recruit and retain the best, brightest, and most dedicated earth scientists this country has to offer. Demographic trends indicate that in the near future the majority of the new scientists will be minorities and women. Our challenge is to help find, educate, and recruit them.

PERSPECTIVE 5: Building Children into Scientists

Robert M. Romero, Colorado Minority Engineering Association, Denver

The underrepresentation of ethnic minorities in engineering and science is well documented; the problem is even more acute in the geosciences. A lack of career awareness and poor preparation are the main reasons why there are so few Blacks, Hispanics, and Native Americans in geoscience careers.

The Colorado Minority Engineering Association (CMEA) adapted and modified the California Mathematics, Engineering, and Science Achievement (MESA) Program for use in Colorado in 1980. The CMEA/MESA program has grown from 30 students to more than 2220 students, statewide, to address problems of underrepresentation by ethnic minorities in science and engi-

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neering. The program has a success rate of 95%, thereby making a tremendous impact in Colorado. Using all of the resources of the community, including parents, universities and colleges, professional societies, and industry, students are made aware of all of the opportunities in various fields. The program stipulates a required grade-point average of 3.0 (4.0 scale) earned in a rigorous curriculum that includes four years of math, science, and English. This preparation enables participating students to meet and exceed college entrance requirements. The precollege preparation is also the major factor for the high collegiate retention rate of CMEA/MESA participants.

However, only a very small percentage of CMEA/MESA participants were going into geosciences. To address this situation, a career fair that focused only on the earth sciences was held at the Colorado School of Mines (CSM) in February 1991; more than 750 students attended. CMEA, Colorado Alliance for Science, and CSM were the primary sponsors for the event. Although the career fair was open to all middle-school and high-school students, about 40% were ethnic minority youth. During the first morning, those attending chose four out of 22 possible workshops dealing with all disciplines of earth science. In addition, 35 hands-on exhibits were available to all in the afternoon.

Plans for next year's event are already made. A network has been formed among schools, companies, and federal agencies. This is another direct result that will lead to ongoing activities to improve awareness of opportunities in the geosciences.

Reaching students at an early age and preparing them is the solution to increasing the numbers of ethnic minorities entering the geosciences. The American Geological Institute's Minority Geoscience Scholarship Program enables students to handle college expenses that may pose a financial deterrent. These programs of preparation and support are why CMEA/MESA's slogan is "It is better to build children than to repair men and women."

PERSPECTIVE 6: Community-Based Organizations and Science

Yolando S. George, American Association for the Advancement of Science, Washington, D.C.

Can community-based organizations organize K–12 science and mathematics education initiatives? The American Association for the Advancement of Science (AAAS) Directorate for Education and Human Resources Programs believes that if community organizations are connected to science resources, they can conduct effective science and mathematics education programs for youth and their teachers, parents, and community leaders.

Since 1985, AAAS has been involved in the development of community-based science and mathematics education coalitions through a Carnegie Foundation–funded project called Linkages. Through the Linkages project, AAAS has helped 16 national community-based organizations and their local branches to increase their level of program investment in science and mathematics education. Linkages connects science resources to organizations interested in and committed to community-based education.

Community groups involved in this effort include the National Urban League, ASPIRA (a Puerto Rican–based–group), National Council of La Raza, NAACP, SER Jobs for Progress (a Hispanic group), Girls, Inc., Recording for the Blind, Delta Sigma Theta, National Council of Negro Women, and others. Projects include developing preschool science materials and programs for use in day-care centers (National Urban League), developing hands-on science materials and programs for girls (Girls, Inc.), developing programs to increase the number of Hispanic-American families who visit science museums (National Council of La Raza), and identifying scientist volunteers to help record audio tapes of science and mathematics books for elementary, secondary, and university students (Recording for the Blind).

In addition to working with community groups, AAAS is also working with churches that serve the African-American community. In a study entitled "Saving Minds; Black Churches and Education," AAAS identified more than 250 churches that offer a variety of nonreligious education programs, including preschool and day-care services, after-school tutoring, field trips, and career and college programs. Using this study, AAAS developed coalitions of churches in 15 cities that conduct science, mathematics, and computer activities using local science resources such as science museums, zoos, botanical gardens, universities, and government laboratories.

AAAS services to community groups include staff training, materials development, program development, and assistance with fund raising. Materials developed include: "Get Into the Equation," "Math Power" (a series of participatory mathematics activities for use in school, home, and community), "Girl Scouts, Science, and Mathematics: Linkages for the Future," "Projecto Futuro" (K–8 curriculum for use with Hispanic children and their parents and teachers), "Notes for Parents," "Science Education News," and other publications.

Thus since the mid-1980s, the Linkages project effort has grown to include coalitions, collaborations, and networks that involve 16 national offices of community groups, more than 300 local community groups, nearly 500 churches, 45 science-based groups, 16 school districts, and 20 universities in 32 states. AAAS is continually looking for ways to foster collaborative efforts between science groups and community groups.

The next Forum will continue the discussion of the underrepresentation of ethnic minorities in the geosciences. Part 2 will address the issue from the perspective of major funding organizations. Funding organizations have impact in directing, by proposal selection, programs in this area. ■

About People

GSA Member **Robert A. Gastaldo**, Auburn University, Alabama, was awarded a Senior Scientist Research Award by the Alexander von Humboldt Foundation, Bonn, Germany.

Member **Robert H. Goldstein**, University of Kansas, received that university's Silver Anniversary Teaching Award at spring commencement.

Fellow **Michel T. Halbouty** is the 1991 recipient of the U.S. Geological Survey's John Wesley Powell Award.

Member **Brian C. Martinek** has been appointed Associate at Geraghty & Miller, Inc., Plainview, New York.

GSA Fellow and Centennial Science Coordinator (DNAG Project) **A.R. (Pete) Palmer**, Boulder, Colorado, is the 1991 recipient of the Association of Earth Science Editors' Award for Outstanding Editorial or Publishing Contributions.

Society participation endangered

Proposed Rules Restrict Federal Scientists

ATTENTION, ALL MEMBERS OF THE SOCIETY:

The Federal Register of July 23, 1991, contains proposed rules on "Standards of ethical conduct for employees of the Executive Branch" (5CFR 2635). Some parts of these proposed rules could affect the ability of Federal scientists to participate in the affairs of professional societies and civic groups as officers, councilors, or even committee members. The following excerpts are especially relevent.

Para. 2635.806 (p. 33811), "Participation in professional associations":

> "(a) An employee may use official time to attend or otherwise to participate in a substantive program sponsored by a professional association or similar organization when authorized by his supervisor on the basis of a determination that the substantive content of the program relates to the performance of the employee's official duties." [Note: This section is not a problem and is presented here for completeness.]
>
> "(b) Unless an employee is specifically authorized by statute, executive order or regulation to serve in an official capacity as an officer of a professional association or similar organization, he may not use official time to administer the internal affairs of any such organization or to carry out its business affairs, or to attend or to participate in meetings or events that primarily serve those purposes."
>
> "(c) An employee who is not simply a member but who serves, other than in his official capacity, as an officer, director, trustee or employee of a professional association or similar organization is prohibited from participating in his official capacity in any particular matter that has a direct and predictable effect on a financial interest of that organization."

It seems clear that these rules can drastically affect the ability of GSA or any other scientific professional society to involve Federal scientists in Society affairs, and we need to respond to the prospect.

If you share this concern, you should express your views *no later than September 20, 1991,* to

Office of Government Ethics
1201 New York Avenue, NW, Suite 500
Washington, DC 20005-3917
Attention: Ms. Wilcox.

For further information, contact Leslie Wilcox or Julie Loring, Office of Government Ethics, (202) 523-5757; fax 202-523-6325.

E-an Zen
Acting President, GSA

WASHINGTON REPORT

Bruce F. Molnia

Washington Report provides GSA membership with a monthly window on the activities of the federal agencies, Congress and the legislative process, and international interactions that could impact the geoscience community. In future issues, Washington Report will present summaries of agency and interagency programs, track legislation, and present insights into Washington, D.C., geopolitics as they pertain to the geosciences.

Undiscovered Oil and Gas Resources; An Entree to Washington Jargon, Part I

The National Academy Press recently published a report, "Undiscovered Oil and Gas Resources—An Evaluation of the Department of the Interior's 1989 Assessment Procedures." Using this report as a springboard, this month's Washington Report explores some of the "N" jargon that we, located near the banks of the Potomac, take for granted. Incidentally, the findings in the report are also presented.

On August 17, 1989, the Department of the Interior (DOI) released a report documenting estimates of the undiscovered oil and natural gas liquids resources and undiscovered natural gas resources of the United States, as of January 1, 1987. The report, prepared by the U.S. Geological Survey (USGS) and the Minerals Management Service (MMS) estimated that the United States has between 39 and 82 billion barrels (bbl) of undiscovered oil and natural gas liquids resources (the mean estimate is 58 bbl), and between 307 and 507 trillion cubic feet (tcf) of undiscovered natural gas resources (the mean estimate is 399 tcf). These resource estimates were significantly less than previous estimates of undiscovered resources released by the USGS in 1975 and 1981. The 1989 estimated mean volume of 49 bbl of undiscovered crude oil was 41% less than the 1981 estimate. The 1981 estimate was, in turn, slightly less than the 1975 estimate.

The 1989 report's foreword states that the assessment provides estimates of undiscovered conventional recoverable oil and gas resources located outside of known oil and gas fields. Additionally, the report states that the assessment covers only one of several categories of domestic oil and gas resources. Other resources, including substantial amounts of recoverable or potentially recoverable oil and gas, are not included. This category includes oil and gas yet to be recovered from known fields by enhanced recovery methods, and oil and gas from what are termed unconventional sources, such as tar sands, oil shales, gas in tight reservoirs, and gas in coal and in hydrates.

In 1988, prior to the release of the assessment, then Secretary of Interior Donald Hodell asked the National Research Council (NRC) of the National Academy of Sciences (NAS) to review the assessment process and examine the methodologies used to generate the results. The NRC established a Committee on Undiscovered Oil and Gas Resources to address these questions. The committee, chaired by Charles Mankin of the Oklahoma Geological Survey and composed of 17 members, began its analysis of the assessment process in early 1989. The results of this analysis process have just been released in "Undiscovered Oil and Gas Resources—An Evaluation of the Department of the Interior's 1989 Assessment Procedures."

In addition to the NRC review and prior to the 1989 report release, DOI requested and received reviews of the data, assumptions, and methodologies used in the assessment from the Energy Information Administration of the U.S. Department of Energy, the Association of American State Geologists, and the American Petroleum Institute. The 1989 DOI report includes the statement, "We have reviewed the comments and recommendations of these groups and we are confident that the methodologies and data employed in this assessment are geologically and technically sound and the estimates reasonable."

In August 1989, when the DOI report was issued, Secretary of Interior Manuel Lujan, Jr. stated that the estimates would be useful in guiding energy, land-use, and leasing policies by public and private organizations at the national, state, and local level.

Media response to the release of the DOI report keyed on the reduced resource assessments. *The Energy Daily* (August 18, 1989), *The Oil Daily* (August 18, 1989), and *The New York Times* (August 22, 1989) all ran headlines focused on the reduction in undiscovered resources resulting from the assessment as compared to previous evaluations.

The 1989 DOI assessment differed from the two previous assessments in that it was the first comprehensive national assessment that used a technique called "Play Analysis." In play analysis, a technique that requires a much higher level of geological information than needed in the two previous assessments, petroleum fields are grouped into subsets (plays) that have equal probabilities of petroleum accumulation. Each play is a family of petroleum reservoirs. Analysis of each play by use of statistical techniques and geological information results in the determination of the likelihood of additional undiscovered resources existing within that play. Hence, in play analysis, predictions about the magnitude of undiscovered resources are closely tied to geological knowledge about already discovered resources.

The 1991 NRC report points out that even though the mean values of the 1989 assessment are lower than the mean values of the two previous assessments, "the ranges of values of all three assessments overlap." In fact, the 1989 DOI assessment "was in the same range or higher than estimates prepared by some industry experts, including analysts from Sohio and Shell." The committee found four key characteristics of the 1989 assessment procedure that may have biased the assessment "toward overly conservative resource estimates." The four areas of concern are improper play definition, inadequate consideration of conceptual plays, insufficient consideration of probabilistic dependencies between variables, and the unintended imposition of economic constraints on technically recoverable resource computations.

The committee provided USGS and MMS with recommendations, "that, if implemented, will increase the level of confidence in their future assessments." The committee divided its recommendations into five categories. The first category, Assessment Boundaries, addresses how the agencies can ensure that every potential petroleum source is included in the future assessments. The second category, USGS and MMS Management, suggests ways that the agencies' managers can increase confidence in the assessment process. The third category, Geological Approaches in Data Base Use and Play Analysis, suggests how the agencies' geologists can upgrade their data bases and play-analysis techniques. The fourth category, Statistical Methods, recommends ways to ensure the proper application of statistics. The final category, Assessment Results, recommends ways to report future assessments so that users "understand better the uncertainty inherent in the results." The report's Executive Summary concludes that the DOI's procedures have been "overly conservative" and that the overall impact of implementing its recommendations will be an increase in future estimates of undiscovered resources. The report also notes that the absence of a permanent USGS resource assessment group "has constrained the ability to address resource assessment methodological problems with the vigor they deserve."

What is the NRC and why was it asked to evaluate the DOI report? How is the NRC different from the NAS, NAE, NSB, NSF, NASA, and the two other NRCs? The National Academy of Sciences (NAS) is not a federal agency. Rather, it is a private, nonprofit, self-perpetuating society of scholars engaging in scientific and engineering research. Chartered by Congress in 1863, the "academy" advises the federal government on scientific and technical matters. The National Academy of Engineering (NAE), a nongovernmental organization of "outstanding engineers" was established in 1964, under the charter of the NAS. The National Research Council (NRC) was organized by the NAS in 1916 to provide scientific and technical advice to the federal government. The NRC is the principal operating arm of the NAS and the NAE in providing services to the government, the public, and the scientific and engineering communities. The NRC consists of several commissions, which house boards, which host committees. The Committee on Undiscovered Oil and Gas Resources is a part of the Board of Earth Sciences and Resources, which is part of the NRC Commission on Geosciences, Environment, and Resources. NRC reports, such as "Undiscovered Oil and Gas Resources" are prepared through contracts funded by the federal agencies seeking Academy of Sciences advice.

The National Science Board (NSB) is not a part of the NRC. Rather, the NSB is a board appointed by the President; its function is to oversee the activities of the National Science Foundation (NSF). NSF is a federal government agency created by the National Science Foundation Act of 1950, whose aim is to promote and advance scientific and engineering progress in the United States. NSF does this by sponsoring scientific and engineering research and by supporting selected activities in science and engineering education. NSF does not itself conduct research nor operate laboratories, but it does support a series of National Research Centers (NRCs). The other NRC is the Nuclear Regulatory Commission, a federal agency. ■

ANNOUNCEMENT

Travel Grant Program 29th IGC in Kyoto, Japan—1992

The Geological Society of America is accepting applications for the 29th International Geological Congress (IGC) Travel Grant Program. The 1992 IGC will be held in Kyoto, Japan, August 24–September 3.

This program was established as a final act of the Organizing Committee for the U.S.-hosted 28th IGC held in Washington, D.C., in July 1989. Surplus funds available at the conclusion of the 28th IGC were transferred to the GSA Foundation with the stipulation that income from the fund be used to support the attendance of young geoscientists to future IGCs, until such time as the United States again hosts an IGC. Travel grants will consist of economy airfare to Japan and prepayment of the registration fee.

To be eligible, an applicant must be a resident or citizen of the United States (includes students); must have a birth date after August 31, 1952; and must have submitted an abstract for inclusion in the program of the 29th IGC.

Official application forms are available from the Grants Coordinator, GSA Headquarters, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301. Along with the form, applicants must include a copy of the abstract that was submitted to the 29th IGC. Applications must be supported by two letters from current or recent supervisors. Students may use faculty members. **Qualifying applications and letters of support must be postmarked no later than *October 31, 1991*.** Applicants will be notified of results early in 1992.

GSAF UPDATE

Robert L. Fuchs

One Gift—60 Years of Philanthropy

On July 31, 1931, R.A.F. Penrose, Jr., died in his hotel suite in Philadelphia. The subsequent distribution of the estate of this wealthy 67-year-old bachelor would have far-reaching effects on earth science, for a large part of his estate was bequeathed to the Geological Society of America, in which he played an active leadership role and served as president the year before his death.

The Penrose bequest was accepted by resolution of the GSA Council on October 17, 1931, 60 years and four days before the start of GSA's 1991 Annual Meeting in San Diego. What has resulted from this single gift of $3.9 million over the intervening years? What is continuing to happen? What can be expected in the future?

Certainly it is possible to quantify the dollars and cents that this very significant amount of 1931 money has grown to over the years. An equivalent gift today, assuming an average interest rate over the term of 5%, would be $67.2 million. At today's market value of $20 million, one might thus think that the Penrose Fund had been seriously depleted. However, in attempting to quantify the results of 60 years of Penrose philanthropy, attributes other than present fund balance must be analyzed. For example, 4846 geologists have benefited from student research grants provided by GSA. These awards have totaled $4,265,970, almost $4 million of which came from the Penrose Fund. The *Bulletin, Geology, GSA Today,* and hundreds of GSA publications have been subsidized by the income from this bequest. A headquarters building was built in Boulder, Colorado, in 1972, and the administration of the Society has been conducted rent-free for nearly 20 years since then. The annual rent on a building housing nearly 50 employees is not a paltry sum in any area of the country. Using a modest $10 per square foot, the rent support from the Penrose Fund to GSA has amounted to $2.8 million since 1972.

Perhaps the most interesting and creative role played by Penrose philanthropy over the years has been as a source of seed money for new GSA programs. The Penrose Endowment has been GSA's in-house venture capital fund. Science Awareness through Geoscience Education (SAGE) and the Institute for Environmental Education (IEE) are now realities because of start-up money supplied by the Penrose Fund. The Decade of North American Geology (DNAG) is a particular case in point. In 1980 a $200,000 advance got the Foundation up and running, giving it the ability to raise $3.3 million to pay for DNAG writing and publishing. Now it is the Penrose Fund that is absorbing the bulk of the DNAG cost overruns that have come about due to delays and increased size.

Since 1931, the Penrose gift has been the mainstay of GSA fiscal health and activities in support of geology. In the 21-year period beginning in 1970, the fund has given $16 million to GSA members in direct (budget) and indirect (rent) support. In 1991, we project that this annual gift from R.A.F. Penrose, Jr., to GSA will be $1.5 million. It is hard to think of a better example of long-term philanthropy.

The Penrose Endowment—A Depleting Asset?

While the munificence of the Penrose bequest cannot be denied, it would appear that our stewardship of this gift demonstrates a progessive erosion of real principal and the potential for further serious damage. Witness the per-member endowment, as shown in the accompanying table. These are startling numbers. The per-member endowment in current dollars has declined 84% since the gift was received, but of course membership has increased almost 28-fold over 60 years. Certainly it is unrealistic to think that the per-member wealth of 1931 could have been maintained, for Penrose himself expected that GSA would expand. His gift was intended to nurture this expansion.

The real concern arises when the effect of inflation is factored in the number. This calculation shows that the per-member endowment has declined 97% since 1931. Perhaps the only encouragement in this dreary picture is the relative stability of the constant dollar numbers over the past 20 years, indicating that GSA is realizing some success in holding the line against inflation, but barely.

The evidence is clear—Penrose philanthropy will continue its historic annual role of subsidizing Society operations and services, seeding new programs, and pulling GSA out of the occasional fiscal quicksands that can never be entirely avoided. However, the full development of new programs such as SAGE and IEE will need a new generation of philanthropists. In lieu of a wealthy Philadelphia bachelor, these philanthropists will be companies, institutions, government agencies, and—most important of all—GSA members. SAGE, IEE, and programs yet to come cannot exist without your current contributions, long-term planned gifts, and bequests. ■

Year	Penrose value in millions	GSA membership	Per-member endowment	PMR in Contrast $ @ 3% infl.
1931	$ 3.9	607	$6425	$6425
1961	$ 8.7	5868	$1483	$ 595
1971	$ 9.1	8353	$1089	$ 222
1981	$10.2	12,718	$ 802	$ 175
1990	$17.8*	16,801	$1059	$ 175

* Includes GSA Foundation—$1.352 million

In Memoriam

Stanley G. Wissler
Long Beach, California
October 25, 1990

Juan J. Zunino
Buenos Aires, Argentina
February 7, 1991

Rodney F. Parcel, Jr.
Perris, California
March 15, 1991

Richard P. Phillips
La Jolla, California
March 22, 1991

Harley C. Lee
Sarasota, Florida
March 30, 1991

Harry Christison Kent
Golden, Colorado
April 16, 1991

Aaron C. Waters
Tacoma, Washington
May 17, 1991

Harry Glicken
Tokyo, Japan
June 3, 1991

Joseph F. Poland
Sacramento, California
June 4, 1991

Paul Averitt
Lakewood, Colorado
June 22, 1991

Memorial Preprints

The following memorial preprints are now available, free of charge, by writing to GSA, P.O. Box 9140, Boulder, CO 80301.

Henry B. Beck
by Melville R. Mudge and Page C. Twiss

Howard A. Coombs
by Richard W. Galster

J. Edward Hoffmeister
by H. Gray Multer

Hans Karl Stauffer
by Karl W. Stauffer

Donors to the Foundation, May and June, 1991

Archaeological Geology Division
Sharon Geil

Birdsall
Robert N. Farvolden

Century Challenge
Mark Allen
Gregory A. Davis
Robert S. Dietz
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Lynette George
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Peter J. McCabe
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DNAG
Maurice B. Lynch*
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J. Hoover Mackin Award
Richard F. Madole*
Paul Dean Proctor

GEOSTAR FUNDS

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Paul E. Damon
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James Dillon
(in memory of Mary Fitzpatrick Dillon)
Catherine Hanks

GEOSTAR
Archie W. Berry, Jr.*
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G. Arthur Cooper*
Doak C. Cox
Jerry B. Dahm
Gerald H. Haddock*
David B. Mackenzie*
David L. Warburton

Institute for Environmental Education
Ann Guhman
M. Hassan Hassan
Arthur A. Socolow

Antoinette Lierman Medlin Scholarship
Buffalo Coal Company*
Consolidated Coal Company*

Memorial
Lawrence Wu*
(in memory of Donald L. Biggs)

Minority
Michele L. Aldrich*
Louis C. Pakiser, Jr.

Research
Rodey Batiza
James B. Benedict*
Joan R. Clark*
Robert F. Dill
Lluis Fontbote
(in memory of J. M. Fontbote)
Edwin E. Larson
James Lawrence
Greg Middleton
Mobil Oil Corporation*
Ronald G. Resmini
Brian P. Wernicke*

SAGE
Mr. & Mrs. Tom Kuper
Roy Therrien
Steve Urbanik
Margy Walsh

Unrestricted
Randolph W. Bromery
James A. Brown, Jr.*
Robert A. Cadigan*
Jack O. Colle
Paul E. Damon
Robert W. Deininger
Charles S. Denny*
Bruce E. Ehleringer*
Gilbert H. Espenshade*
Richard P. Fischer*
Charles L. Gardner
Andrew Griscom*
Kenneth M. Kaneshiro
Mark J. Logsdon*
Richard H. Mahard*
Jack E. Oliver*
Carel Otte*
Elaine R. Padovani*
Lisa M. Pratt
Jane Selverstone*
Daniel R. Shawe
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Malcolm P. Weiss*
Edmund G. Wermund, Jr.*
David Archer White*
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James H. Zumberge*

Women in Science
Emilie Jager*
Margaret O. Oros
Shirley A. Rawson
Jane H. Wallace*
David L. Warburton

Young Scientists Award
W. V. Swarzenski*

*Gifts of $100 or more.

Preliminary Announcement and Call for Papers

SOUTH-CENTRAL SECTION, GSA, 26th Annual Meeting

Houston, Texas
February 24–25, 1992

The 1992 South-Central Section meeting of the Geological Society of America is sponsored by the Department of Geology and Geophysics, Rice University, the Department of Geosciences, University of Houston, and the Houston Geological Society and will be held on the campus of Rice University, Houston, Texas.

CALL FOR PAPERS

Papers are invited for technical sessions, symposia, and poster sessions. The technical sessions will provide 15 minutes for presentation and 5 minutes for discussion. Symposia conveners may assign more time to invited key speakers. Papers of regional interest to geologists in the South-Central Section area as well as papers of general interest will be considered for the program. Poster presentations are encouraged. Please note that abstracts for symposia should be submitted directly to the appropriate convener.

REGISTRATION

Preregistration deadline:
January 20, 1992

Preregistration will be by mail and handled by GSA Headquarters. Registration forms will appear in the November issue of *GSA Today*. Preregistrants may pick up their registration materials at the Holiday Inn–Medical Center from 4:00 to 8:00 p.m., Sunday, February 23. Note: Only preregistrants will be able to attend the welcoming party on Sunday, February 23. For lower registration fees and to assist the local committee in planning, please preregister.

On-site registration will begin on Monday, February 24, from 7:00 a.m. to 4:30 p.m. and will continue on Tuesday, February 25, from 7:30 a.m. to 12:00 noon on the Rice campus.

SYMPOSIA

The following symposia are planned for the Houston meeting. Please note that abstracts for symposia should be submitted directly to individual conveners as noted below.

1. **Tectonics and Evolution of the Gulf of Mexico Basin.** Chairs: D. S. Sawyer (Rice University) and R. T. Buffler (University of Texas, Austin). Send abstracts to D. S. Sawyer, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251.
2. **Late Pleistocene–Holocene Climatic Record of the Gulf Coast.** Chairs: J. B. Anderson (Rice University) and M. B. Lagoe (University of Texas, Austin). Send abstracts to J. B. Anderson, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251.
3. **Comparison of North American and Eastern European Folded Belts.** Sponsored by GSA International Division. Chairs: A. W. Bally (Rice University) and M. A. Schuepbach (Maxus Energy Co., Dallas). Send abstracts to A. W. Bally, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251.
4. **Response of Carbonate Platform to Sea-level Fluctuations: Cases in the Caribbean and the Gulf of Mexico.** Chairs: A. W. Droxler (Rice University) and R. N. Ginsburg (University of Miami). Send abstracts to A. W. Droxler, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251.
5. **Sequence Stratigraphy of the Gulf Coast Paleogene: A Global Comparison.** Chairs: P. R. Vail (Rice University), W. W. Wornardt (Micro-Strat, Houston), and R. M. Mitchum (Geological Consultant, Houston). Send abstracts to R. M. Mitchum, 11767 Katy Freeway #300, Houston, TX 77079.
6. **Evolution of Grenville Basement.** Chairs: V. B. Sisson (Rice University), S. Mosher (University of Texas, Austin), and W. M. Lamb (Texas A&M University). Send abstracts to V. B. Sisson, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251.
7. **Hydrogeologic Controls on Contaminant Transport.** Sponsored by GSA Hydrogeology Division. Chairs: R. M. Capuano (University of Houston) and C. W. Kreitler (University of Texas, Austin). Send abstracts to Regina Capuano, Department of Geosciences, University of Houston, Houston, TX 77204.
8. **Mesozoic/Cenozoic Micropaleontology.** Sponsored by the Paleontological Society. Chairs: R. N. Rosen (Arco Oil and Gas Co., Houston) and R. W. Scott (Amoco Production Co., Tulsa). Send abstracts to Rashel N. Rosen, Arco Oil and Gas Co., P.O. Box 1364, Houston, TX 77251.
9. **The Role of Planetary Geology in the Undergraduate Geology Curriculum.** Sponsored by the National Association of Geology Teachers. Chair: Don Locke (NAGT). Send abstracts to Don Locke, 7721 El Padre Lane, Dallas, TX 75248.

FIELD TRIPS

Both premeeting and postmeeting field trips will be offered. Unless otherwise noted, all field trips begin and end in Houston. For details about particular field trips, contact the field trip leaders listed.

Premeeting

1. **Mid-Cretaceous Carbonates in Central Texas and Sea-level Variations** (2 days, Feb. 22–23). Leaders: A. W. Droxler, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251, (713) 527-4885; J. L. Wilson, Rice University; R. W. Scott, Amoco Production Co., Tulsa OK.
2. **Quaternary Evolution of the Trinity River Valley and Associated Coastal Barriers** (1 day, Feb. 23). Leader: J. B. Anderson, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251, (713) 527-4884.
3. **NASA Johnson Space Center** (1 day, Feb. 23). Leaders: J. W. Dietrich and D. L. Amsbury, (Solar System Exploration Division, NASA Johnson Space Center). For more information, contact Houston Geological Society, (713) 785-6402.
4. **Environmental/Engineering Geology in the Houston Metropolitan Area** (1 day, Feb. 23). Leaders: C. E. Norman, Department of Geosciences, University of Houston, Houston, TX 77204, (713) 461-7420; S. Aronow, Lamar University.
5. **Hockley Salt Dome** (1 day, Feb. 22). Leaders: Daryl Wilson, United Salt Corp.; Jeff McCartney, Texas Brine Corp. For more information, contact Houston Geological Society, (713) 785-6402.
6. **Recent Sediments of Southeast Texas** (1 day, Feb. 26). Leaders: R. J. LeBlanc, Sr., Rufe Leblanc School of Clastic Sediments, Houston. For more information, contact Houston Geological Society, (713) 785-6402.

Postmeeting

7. **Sequence Stratigraphy of the Middle and Upper Eocene, Brazos River** (1 day, Feb. 26). Leaders: T. E. Yancey, Department of Geology, Texas A&M University, College Station, TX 77843, (409) 845-0643; P. R. Vail, Rice University.
8. **Modern Mixed Carbonate/Siliciclastic Systems, Belize** (6 days, Feb. 26–March 2). Leader: A. W. Droxler, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251, (713) 527-4885.

SHORT COURSES

1. **Geologic Interpretation of Seismic Reflection Profiles** (Feb. 22, 23). Lecturers: A. W. Bally, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251; M. O. Withjack, Mobil Research and Development Co., Dallas, TX.
2. **Geochronology** (Feb. 23). Lecturers: J. E. Wright (U-Pb), Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251; P. C. Copeland (Ar-Ar), Department of Geosciences, University of Houston; K. A. Hegarty (fission track), Geotrack International, Houston.

ABSTRACTS

Abstracts are limited to approximately 250 words and must be submitted camera-ready on the official 1992 GSA abstract form, available from Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301, (303) 447-8850.

Send one original and five copies of abstracts to be considered for technical sessions and poster sessions to: Hans G. Avé Lallemant or J. E.Wright, GSA Technical Program Co-Chairs, Department of Geology and Geophysics, Rice University, Houston, TX 77251, (713) 527-4880.

Abstracts deadline:
November 6, 1991

PROJECTION EQUIPMENT

Projection equipment will be provided for 2" x 2" slides and a standard 35 mm carousel tray. Please bring your own carousel tray(s). Two projectors and two screens will be provided for each session. A single overhead projector will also be provided for each session.

EXHIBITS

Exhibits representing education, research, and industry will be displayed at the meeting site. For further information, contact Bill Peebles, Tejas Gas Corp., 1301 McKinney #700, Houston, TX 77010, (713) 658-0509.

STUDENT SUPPORT

The South-Central Section has funds available for grants to GSA Student Associates who are contributing to the meeting. Students are encouraged to apply for these grants. Most students who qualify will be funded to some degree. Send applications to Rena Bonem, South-Central Section Secretary, Department of Geology, Baylor University, Waco, TX 76798, (817) 755-2361.

Application letters must be sent by *January 1, 1992*. Letters should include certification that the student is a GSA Student Associate in the South-Central Section and is presenting a paper or poster session at the Houston meeting.

SPECIAL EVENTS AND ACTIVITIES

The welcoming party will be on Sunday, February 23 from 5:30 to 8:00 p.m. On Monday, February 24 there will be an early evening reception in the courtyard of the Rice Memorial Center for all registrants. There will also be a banquet with a distinguished speaker on Monday, February 24. The Paleontological Society will have a luncheon and business meeting at noon on Monday, February 24.

DETAILED INFORMATION

Information concerning registration, accommodations, and activities will appear in the November issue of *GSA Today* and as a part of *Abstracts with Programs* for 1992. Requests for additional information or suggestions should be addressed to the General Chair: Hans G. Avé Lallemant, Department of Geology and Geophysics, Rice University, P.O. Box 1892, Houston, TX 77251, (713) 527-4880. ■

Preliminary Announcement and Call for Papers

SOUTHEASTERN SECTION, GSA, 41st Annual Meeting

Winston-Salem, North Carolina
March 18–20, 1992

The Southeastern Section of the Geological Society of America will meet at the Stouffer Winston Plaza Hotel in Winston-Salem, North Carolina. The meeting will be hosted by the Department of Geology, University of North Carolina at Chapel Hill, with the cooperation of the Department of Geology and Earth Science, Guilford College, Greensboro, North Carolina.

CALL FOR PAPERS AND SYMPOSIA

Technical sessions will be held on Thursday and Friday, March 19 and 20. Papers are invited for oral presentations, poster sessions, and symposia. General oral sessions will allow 15 minutes for presentation and 5 minutes for discussion of each paper. Poster sessions will be set up for 4 hours; authors will be present to discuss the paper for a minimum of 2 hours. Conveners of symposia, in conjunction with the program committee, are responsible for determining the format for their sessions. Papers of general geological interest, as well as those of interest to geologists in the southeastern United States, will be considered for the program. Abstracts not accepted for symposia will be considered for regular technical sessions.

ABSTRACTS

Abstracts must be submitted camera-ready on official 1992 GSA abstract forms in accordance with instructions on the forms. Forms are available from Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-8850.

ABSTRACTS MUST BE RECEIVED BY NOVEMBER 26, 1991

All abstracts for symposia, oral technical sessions, and poster sessions should be sent to the program committee chairmen, John J. W. Rogers or Daniel A. Textoris, Department of Geology, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315.

SYMPOSIA

The following symposia have been organized. Those interested in participating are encouraged to contact the individual symposium conveners for information. The program committee also solicits suggestions for additional symposia.

1. **Geology of the Savannah River Site Area.** Van Price, Environmental Monitoring Section, Building 735-A, Westinghouse Savannah River Company, Aiken, SC 29801; Paul A. Thayer, Department of Earth Sciences, University of North Carolina, Wilmington, NC 28403-3297.
2. **Man-induced Coastal Evolution.** Orrin H. Pilkey, Department of Geology, Duke University, 206 Old Chemistry Building, Durham, NC 27706; Paul Gayes, Center for Marine and Wetland Studies, Coastal Carolina College, Conway, SC 29526; William J. Cleary, Department of Earth Sciences, University of North Carolina, Wilmington, NC 28403-3297.
3. **Southeastern U.S. Mineral Deposits.** Dennis J. LaPoint, Cominco American Resources Incorporated, P.O. Box 3810, Chapel Hill, NC 27515; C. Michael Lesher, Department of Geology, University of Alabama, Tuscaloosa, AL 35487-0338.
4. **Suspect Terrane Analyses: What Role for Sedimentary Geologists?** Frederick L. Schwab, Department of Geology, Washington & Lee University, Lexington, VA 24450; Michael F. Follo, Department of Geology, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315.
5. **Tectono-Stratigraphic Evolution of the Laurentian-Iapetus Margin in the Southern Appalachians.** J. Daniel Walker, Kentucky Geological Survey, 228 Mining and Mineral Resources Building, University of Kentucky, Lexington, KY 40506-0107; William A. Thomas, Department of Geological Sciences, University of Kentucky, Lexington, KY 40506-0059.
6. **Thermotectonic Evolution of the Appalachians.** A. Krishna Sinha, Department of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061; Steven A. Goldberg, Department of Geology, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599; Harold H. Stowell, Department of Geology, University of Alabama, Tuscaloosa, AL 35487.
7. **Workshop on North Carolina Geology for Middle and High School Teachers.** C. Q. Brown, Department of Geology, East Carolina University, Greenville, NC 27858-4353; co-sponsored by the Southeastern Sections of the Geological Society of America and the National Association of Geology Teachers.

POSTER SESSIONS

Half-day poster sessions are available to authors as part of the technical program. Poster sessions will be located in a central area of the hotel adjacent to oral technical sessions. Please identify your preference for a poster session on the GSA abstract form if you wish to take advantage of this means of communicating the results of your research.

FIELD TRIPS

Premeeting and postmeeting field trips are planned. For details, contact the field trip leader indicated by an asterisk (*) at the stated address or a member of the field trip committee: John M. Dennison (919-962-0686) and Kevin G. Stewart (919-962-0683), Department of Geology, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315.

Premeeting

1. **Hydrogeology of Indian Creek Basin, North Carolina.** One day. Charles C. Daniel (*), U.S. Geological Survey, Water Resources Division, 3916 Sunset Ridge Road, Raleigh, NC 27607, (919) 571-4033.
2. **Geology of Pilot Mountain, North Carolina.** One day. Keith I. McConnell (*), U.S. Nuclear Regulatory Commission, Mail Stop 4H-3, Washington, DC 20555, (301) 492-0532, and Robert D. Hatcher, Jr.
3. **Grandfather Mountain Window, North Carolina.** One day. Loren A. Raymond (*), Department of Geology, Appalachian State University, Boone, NC 28608, (704) 262-2749.
4. **Geology of Construction Materials in the Triad Area of North Carolina.** One day. Charles C. Almy (*), Department of Geology and Earth Science, Guilford College, Greensboro, NC 27410, (919) 292-5511.
5. **Gold in the Kings Mountain Belt of the Carolinas.** One day. Dennis J. LaPoint (*), Cominco American Resources Incorporated, P.O. Box 3810, Chapel Hill, NC 27515, (919) 929-0006.
6. **Stratigraphy and Heavy Mineral Deposits in Coastal Plain Near Wilson, North Carolina.** One day. Charles W. Hoffman (*), North Carolina Geological Survey, 4100 Reedy Creek Road, Raleigh, NC 27607, (919) 733-7353, and Robert H. Carpenter.
7. **Geology of Waste Management in the Triad Area.** One day. George L. Bain and John M. Stewart (*), Bain and Palmer Associates, 2641-G Randleman Road, Greensboro, NC 27406, (919) 272-9713.
8. **Silurian and Devonian Unconformities in Southwestern Virginia.** Two days. John M. Dennison (*), Department of Geology, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315, (919) 966-0686, and Steven L. Dorobek, Richard K. Bombach, Jonathan K. Filer, Jesse A. Shell. Sponsored by Eastern Section, SEPM.
9. **Molluscan Biostratigraphy of the Coastal Plain of North Carolina.** Two days. Joseph G. Carter (*), Department of Geology, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315, (919) 962-0685, and Lauck W. Ward, Thomas J. Rossbach, Jeffrey C. Nekola, and Lyle D. Campbell. Sponsored by Paleontological Society Southeastern Section.

Postmeeting

10. **Cambro-Ordovician Shelf Edge and Cyclic Facies and Drowning in Virginia.** One day. J. Fred Read (*), Department of Geological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 (703) 231-5124.
11. **Cretaceous and Tertiary Stratigraphy of Sand Hills Area, North Carolina.** One day. Suellen Cabe (*), Department of Geology & Geography, Pembroke State University, Pembroke, NC 28372, (919) 521-4214, and Charles W. Hoffman.
12. **Sedimentology of Triassic Dan River Group, North Carolina and Virginia.** One day. Paul A. Thayer (*), Department of Earth Sciences, University of North Carolina, Wilmington, NC 28403-3297, (919) 395-3780, and Eleanora I. Robbins.
13. **Stratigraphy and Structure of the Lower Ashe Formation (Upper Precambrian) along the Fries Fault in Southwestern Virginia.** One day. Robert Whisonant (*), Department of Geology, Radford University, Radford, VA 24142, (703) 831-5224, and Jonathan L. Tso.
14. **Blue Ridge Thrust Complex Northwest of the Grandfather Mountain Window, North Carolina and Tennessee.** Two days. Steven A. Goldberg (*), Department of Geology, University of North Carolina at Chapel Hill, CB# 3315, Mitchell Hall, Chapel Hill, NC 27599-3315, (919) 962-0692, and J. Robert Butler.

PROJECTION EQUIPMENT

All slides must be 2" x 2" and fit a standard 35 mm carousel tray. Please bring your own loaded carousel trays. One 35 mm slide projector will be available in each meeting room.

EXHIBITS

A limited number of exhibit booths for educational and research institutions and businesses will be available at a central location in the Stouffer Winston Plaza Hotel. The exhibit hall will be open all day Thursday and Friday. For further information and space reservations, contact Steven A. Goldberg, University of North Carolina, CB# 3315, Mitchell Hall, Chapel Hill, North Carolina 27599-3315, (919) 962-0689.

SOCIAL EVENT

A welcoming reception will be held on the evening of Wednesday, March 18, 1992, at the Sawtooth Building, a cultural and arts education facility in downtown Winston-Salem.

TRAVEL TO WINSTON-SALEM

Winston-Salem is on Interstate 40, about 200 miles from the coast and 75 miles from the Blue Ridge Mountains in western North Carolina. The Stouffer Winston Plaza Hotel is in downtown Winston-Salem, a short three-block drive north of Interstate 40 at the Cherry Street exit. Several major airlines serve the Piedmont Triad International Airport located just east of Winston-Salem; the Piedmont Shuttle and Air Transportation Service (ATS) provide transportation to and from downtown Winston-Salem. U.S. Air Express serves the Smith Reynolds Airport, a few minutes from downtown.

STUDENT ASSISTANCE

A limited amount of support for travel expenses of students presenting papers at the meeting is available from the Southeastern Section. For information, contact: Michael J. Neilson, Department of Geology, University of Alabama, Birmingham, AL 35294, (205) 934-5102.

REGISTRATION

A reduction in the registration fee will be offered for early registration. To encourage attendance by precollege earth science teachers, registration fees will be reduced for school teachers in public and private schools. One-day registration will be available during the meeting for professionals and students unable to attend the full meeting.

HOUSING

A large block of rooms has been reserved for meeting participants and their guests at the Stouffer Winston Plaza Hotel. For conference planning purposes and to ensure guaranteed room rates, it is important that you reserve your room well in advance of the meeting.

ADDITIONAL INFORMATION

More detailed information concerning fees and registration, hotel accommodations, field trips and other activities will appear in the December issue of *GSA Today* and as part of the GSA Southeastern Section *Abstracts with Programs* for 1992. Symposia and field trips listed in this announcement are tentative; additional suggestions are always appreciated. Inquiries or suggestions should be directed to: Paul D. Fullagar or P. Geoffrey Feiss, SEGSA Local Committee Co-Chairmen, Department of Geology, CB# 3315, Mitchell Hall, University of North Carolina, Chapel Hill, NC 27599-3315, (919) 966-4516, fax 919-966-4519. ■

Preliminary Announcement and Call for Papers

NORTHEASTERN SECTION, GSA, 27th Annual Meeting

Harrisburg, Pennsylvania
March 26–28, 1992

The Pennsylvania Geological Survey, the Harrisburg Area Geological Society, Pennsylvania State University, the Pennsylvania State System of Higher Education, Bloomsburg University, Shippensburg University, Edinboro University, Millersville University, Lock Haven University, West Chester University, and Dickinson College will host the Northeastern Section of the Geological Society of America meeting at the Harrisburg Hilton & Towers in Harrisburg. The Eastern Section of SEPM, the Northeastern Section of the Paleontological Society, and the Eastern Section of the National Association of Geology Teachers will be meeting with GSA's Northeastern Section.

Detailed Information

Information concerning registration, accommodations, and activities will appear in a future issue of *GSA Today* and as part of *Abstracts with Programs* for 1992. Requests for additional information or suggestions should be addressed to the General Chairmen,

Donald M. Hoskins
or William E. Kochanov
Pennsylvania Geological Survey
P.O. Box 2357
Harrisburg, PA 17105

CALL FOR PAPERS

Papers are invited from students and professionals for presentation at oral and poster theme and general sessions. Fifteen minutes for presentation and five minutes for discussion will be the format for the technical sessions. Papers of regional interest to geologists in northeastern North America as well as those of general geological interest will be considered for the program. Poster papers are encouraged. A special poster session is planned for undergraduate students (see Theme Sessions). Every attempt will be made to assure that oral and poster sessions will not conflict with related technical sessions.

SYMPOSIA

The following symposia will be presented at the Harrisburg meeting. Those wishing to contribute to a symposium should contact the convener directly. General information regarding symposia may be obtained by contacting David Gold, Symposia Chairman, Department of Geosciences, 339 Deike Building, Pennsylvania State University, University Park, PA 16802.

1. **Coal Geology of the Northern Appalachian Basin.** Alan Davis, Department of Geosciences, 339 Deike Building, Pennsylvania State University, University Park, PA 16802.
2. **Fabric Analysis in the Study of Argillaceous Sediment and Rock.** Sponsored by SEPM Eastern Section. Richard W. Faas, Department of Geology, Lafayette College, Easton, PA 18042.
3. **Stratigraphic Utility and Geochemical Discrimination of K-bentonites in Eastern North America.** Sponsored by SEPM Eastern Section. James R. Ebert, Department of Earth Sciences, SUNY—College at Oneonta, Oneonta, NY 13820.
4. **Gradients in Fossil and Recent Communities.** Dale A. Springer, Department of Geography & Earth Sciences, Bloomsburg University, Bloomsburg, PA 17815.
5. **Geology and Industrial Archeology in the Northeastern U.S.** Sponsored by the Society for Industrial Archeology. Jon Inners, Pennsylvania Geological Survey, P.O. Box 2357, Harrisburg, PA 17105. *Poster session.*
6. **Earthquake Hazard in Eastern North America.** Shelton S. Alexander, Department of Geosciences, 503 Deike Building, Pennsylvania State University, University Park, PA 16802.
7. **Revisions of Geology Curriculum to Meet the Needs of the 90s.** Jeff Niemitz, Department of Geology, Dickinson College, Carlisle, PA 17013.
8. **Geologic Record of Global Change.** Eric J. Barron, Earth System Science Center, 248 Deike Building, Pennsylvania State University, University Park, PA 16802. Also see Short Course 1.

THEME SESSIONS

The 1992 GSA Northeastern Section Meeting Organizing Committee invites papers related to the following broad themes of current interest. If sufficient papers are received, specific theme sessions will be scheduled under these titles. If insufficient papers are received, submitted papers will be considered for regular discipline sessions.

1. **Earth Scientists and Earth Science Educators: An Alliance for Geological Education.** See also: Special Poster Session 2, Symposium 7, Short Course 3, and Workshop.
2. **Hydrology/Hydrogeology and Geological Processes in the Central and Northern Appalachians.**
3. **Surface and Ground-Water Contamination: Geochemistry, Modeling, Evaluation, and Treatment.**
4. **Iapetan Rifting and Terrane Accretion.**
5. **Sedimentary Characterization of the Taconic/Acadian Orogens.**
6. **Geologic Controls on Siting Low-level Radioactive Waste Facilities in Northeastern North America.**
7. **Quaternary/Neotectonics of the Central Appalachians and Coastal Plain.**
8. **Pressure-Temperature-Time Deformation in Metamorphic Rocks.**
9. **Computer Applications in Geology.**
10. **Modeling Sedimentary Basins in the Appalachians.** See also Short Course 2.

POSTER SESSIONS

Poster booths (8' x 8') will be framed by pipe and drape and have three 4' x 8' Homosite tack boards. For general information regarding poster sessions, contact Norm Gillmeister, Poster Session Chairman, Department of Geography & Earth Science, Bloomsburg University, Bloomsburg, PA 17815.

Technical Poster Session

The option of using a computer or video for presentation of research results will be available as an alternative to poster board displays. Authors must write "technical poster" as the session category choice on the official abstract form. For general information regarding technical posters, contact Norm Gillmeister (address above) and William M. Jordan, A-V Services Chairman, Department of Earth Sciences, Millersville University, Millersville, PA 17551.

Special Poster Sessions

1. **Undergraduate Research.** The Organizing Committee is inviting undergraduates to participate in this session. Posters must be written by student(s) *only*. Topic emphasis on undergraduate research for any subdiscipline of geology.
2. **Laboratory and Field Techniques in Geoscience Education.** Sponsored by the NAGT Eastern Section. Brian B. Tormey, Department of Environmental Science, Pennsylvania State University, Altoona Campus, Altoona, PA 16601.

WORKSHOP

Field Techniques and Instrumentation in the Geosciences. A one-half day indoor/outdoor workshop illustrating a variety of geological field techniques and instruments: seismic profiling, resistivity, etc. Sponsored by NAGT Eastern Section. Brian B. Tormey, Department of Environmental Science, Pennsylvania State University, Altoona Campus, Altoona, PA 16601.

ABSTRACTS

Abstracts are limited to about 250 words and must be submitted camera-ready on the official 1992 GSA abstract form, available from: Abstracts Coordinator, Geological Society of America, P.O. Box 9140, Boulder, CO 80301, (303) 447-8850.

Send one original and five copies of abstracts to be considered for oral, poster, and symposium sessions to **Jeff Niemitz, Technical Program Chairman, Department of Geology, Dickinson College, Carlisle, PA 17013.** *Do not* send symposia abstracts to symposium conveners. Conveners will receive the abstracts from Jeff Niemitz.

Abstracts will be judged on the basis of scientific merit, information content, readability, and relevance to geologic problems of northeastern North America. There is no limit to the number of abstracts that may be submitted, but no more than two abstracts bearing an individual's name as first author will be accepted for the program. No author may give more than one oral presentation. Authors will be notified of acceptance or rejection during December 1991.

ABSTRACTS ARE DUE BY NOVEMBER 25, 1991

PROJECTION EQUIPMENT

All slides must fit in a standard 35 mm carousel tray. Two projectors and two screens will be provided in each of the technical sessions. If possible, bring your own loaded tray labeled with name, session, and time of paper.

SHORT COURSES

Short course scheduling is variable. For information on costs and registration, contact the people listed.

1. **Applications of Climate Models to Environmental Prediction.** Eric J. Barron, Earth System Science Center, 248 Deike Building, Pennsylvania State University, University Park, PA 16802.
2. **Simulating Clastic Sedimentary Basins: Physical Fundamentals and Computing Procedures.** Rudy Slingerland and Kevin Furlong, Department of Geosciences, 204A Deike Building, Pennsylvania State University, University Park, PA 16802.
3. **Microcomputer Techniques in Geoeducation.** Bob Berger, Department of Geology, Smith College, Northampton, MA 01063.

FIELD TRIP

Late Cenozoic Tectonic, Stratigraphic, and Geomorphic Development of the Lower Susquehanna River Drainage Basin (1 or 2 days). Frank J. Pazzaglia, Department of Geosciences, 801 Deike Building, Pennsylvania State University, University Park, PA 16802.

The field trip will be *before* the meeting. For information on cost and registration, contact Frank Pazzaglia (address above).

PUBLIC FORUM

A forum on **Geology and Public Policy** is tentatively scheduled for Friday evening, March 27, and will follow the technical sessions. The session is aimed at registrants but will be open to the public and will focus on the impact of geology on current environmental issues such as the siting of low-level radioactive and hazardous waste disposal areas and other facility siting. A panel of speakers representing various government and technical groups will offer discussion and response to questions from a mediator and from the audience.

EXHIBITS

Exhibits of geological research equipment and educational material will be on display in the Carlisle Room, adjacent to the poster sessions and refreshments. Booths (8' x 8') will be framed with pipe and drape and contain table and chairs. Special rates are available for nonprofit and educational organizations. For additional information, contact Wally Drexler, 104 Shearer Hall, Shippensburg University, Shippensburg, PA 17257.

SCIENCE THEATER

A wide variety of scientific films and videos of geologic interest will be shown in the William Penn Board Room during the meeting. A complete schedule of films will be included in the registration packet.

SPECIAL EVENTS

NAGT Luncheon, Thursday, March 26, 11:30 a.m.–12:30 p.m.

Welcoming Party, Hilton & Towers Atrium, 8–11 p.m.

Annual Banquet, Friday, March 27, 7:30–10:00 p.m.

Detailed information about a photo exhibit during the entire meeting will appear in the Final Announcement in *GSA Today.*

Organizations with specific needs for meeting rooms should contact Don Hoskins, Pennsylvania Geological Survey, P.O. Box 2357, Harrisburg, PA 17105.

REGISTRATION

Reduced registration fees will be offered for registration received prior to February 26, 1992. To encourage attendance by precollege earth science teachers, on-site registration fees will be reduced for secondary school teachers in private and public schools. One-day registration will be available during the meeting for professionals and students unable to attend more than one day.

HOUSING

A large block of rooms has been reserved for meeting participants and their guests at the Harrisburg Hilton & Towers. The Hilton & Towers is conveniently located at 2nd and Market Streets in downtown Harrisburg. Interstate highways provide easy access to the Harrisburg Metro area. Harrisburg International Airport is 15 minutes from downtown. For conference planning purposes and to ensure guaranteed room rates, it is important that you reserve your room *before February 26, 1992.* ■

DNAG NEWS

Allison R. (Pete) Palmer

Good News Continues

The end of the DNAG project is almost in sight! Volumes P-2, *Economic Geology: U.S.*, and K-2, *Quaternary Nonglacial Geology: U.S.*, are at the printer and both should be available for the Annual Meeting in San Diego.

Burt Slemmons was scheduled to be here August 21 and 22 to go over the galleys for *Neotectonics of North America*, and proofs for the *Geothermal Map of North America*, the last of the neotectonic maps related to this volume, have been received from the author for corrections. These will complete the Centennial contributions from the Geophysics and Structural Geology and Tectonics divisions.

The last major chapter for volume G-3, *The Cordilleran Orogen: U.S.* has been revised by Bob Christiansen and cleared by Mary Lou Zoback, and the Introduction for the volume is in our hands. The editors are scheduled to review the entire book galley on September 30 and October 1.

The last chapter for volume J, *The Gulf of Mexico Basin* is through review and back with Richard Nehring for revision. As soon as this is completed, that book is done.

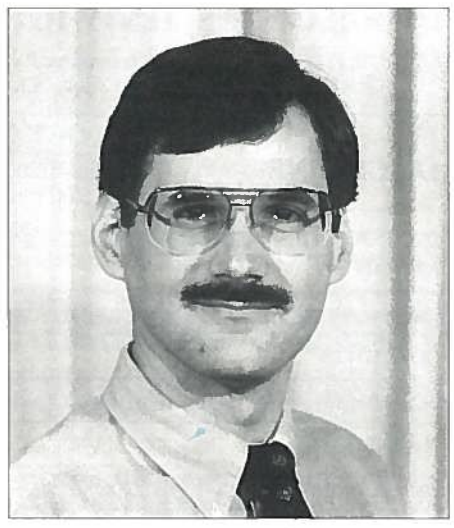
The last major chapter and the Introduction for volume C-2, *Precambrian: Conterminous U.S.* are written and in review, and the penultimate major chapter is one step further—back to chapter coordinator Paul Link to supervise some necessary revision.

Proofs for Transect E-1, Adirondacks to Georges Bank, are with the author for checking.

Still out there and not yet completed are only: *Geology of Alaska* (George Plafker and friends), *Phanerozoic Evolution of North American Continent/Ocean Transitions* (Bob Speed and friends), three Appalachian transects (Drake and Grow; Glover and Klitgord; Hatcher and Dillon) and the *Geologic Map of North America* (Reed, Wheeler, Palmer, Tucholke).

Authors for two or three more of the fully completed volumes will be listed next month. ■

GSA Congressional Science Fellow Named for 1991–1992



Kenneth B. Taylor has been selected as the sixth GSA Congressional Science Fellow. He will work as a special legislative assistant on the staff of a committee or member of the U.S. Congress from September 1991 through August 1992.

As a Congressional Science Fellow, Taylor's aim is "to help formulate responsible public policy through input of geoscientific information and expertise." He is also "strongly committed to increasing science awareness at all levels in public education."

Taylor recently received his Ph.D. in geophysics from Saint Louis University. His principal research interest is earthquake studies in the central United States, and his work on local and regional seismicity has been repeatedly recognized by the media and regional hazard mitigation groups as a resource for public education. He hopes to get placement in a congressional office where he can work on earthquake hazard reduction and programs to increase science education in primary and secondary schools. In addition, he is interested in any debate that includes geology such as hazardous waste disposal, oil and gas exploration in sensitive environments, and the possible exploitation of mineral resources in the Arctic and Antarctic regions.

Although most of his work involves earthquakes, Taylor's training has included both geology and geophysics. He received his B.S. in geology from the University of North Carolina at Chapel Hill in 1979, and his M.S. in geology from the University of South Carolina in 1981. After leaving South Carolina, he worked two years as a research geophysicist with Teledyne-Geotech, Garland, Texas, on projects ranging from secondary oil recovery and nuclear test ban verification to seismic recording of volcanic eruptions. In addition, he served as the co-chairman of the Student Assistants Committee for the 1989 GSA Annual Meeting in St. Louis.

The Fellowship

The GSA Congressional Science Fellowship is intended as a way to obtain first-hand experience in the public policy process and to educate the earth science community about the need for informed involvement; to demonstrate the value of such science-government interaction; and to make practical contributions to the more effective use of scientific and technical knowledge in government. Requirements for the fellowship include exceptional competence in some area of the earth sciences, cognizance of a broad range of matters outside the fellow's particular area, and a strong interest in working on a range of public policy problems.

The fellowship is funded by GSA and the U.S. Geological Survey, which supports 47% of the program with a $21,000 grant. Guided by the American Association for the Advancement of Science, the program places highly qualified, accomplished scientists with the offices of individual members of Congress and committees for a one-year assignment. Fellows perform in much the same way as regular staff members; they have the opportunity to be involved in varied legislative, oversight, and investigative activities. They offer their special knowledge, skills, and competence for the opportunity to acquire experience and the chance to contribute to the formulation of national policy. The GSA Congressional Fellow reports periodically to the GSA membership and to the USGS during the one-year period.

Selection Committee

On the selection committee for the fellowship this year were Patricia A. Jacobberger, Center for Earth and Planetary Studies, Smithsonian Institution; John N. Fischer, USGS; William L. Fisher, Bureau of Economic Geology, University of Texas at Austin; and Daniel R. Sarewitz, U.S. House Committee on Science, Space, and Technology. ■

OVERVIEW OF 1991 SAN DIEGO ANNUAL MEETING PROGRAM

October 20–24, 1991
San Diego Convention Center

There will be 189 technical sessions presented during the course of the meeting. Of these, symposia (invited papers) and theme sessions (volunteered papers submitted to a specific topic) are referred to by a number that precedes the title. All other sessions are referred to by discipline, such as Geochemistry I, II. Sessions are oral unless Poster is indicated.

SYMPOSIA

Keynote Symposium. The Global Challenge: Our Environment, Our Resources, Our Responsibilities. Oct. 21 a.m.

S 1. Archaeological Geology of the Archaic Period (8-3 ka) in North America. Archaeological Geology Division. Oct. 22 p.m.

S 2. Coalbed Methane: Geology, Recovery Technology, and Resources. Coal Geology Division. Oct. 21 a.m.

S 3. GeoRisk Assessment. Engineering Geology Division. Oct. 22 a.m.

S 4. Depositional Environments and the Development of Aquifers. Hydrogeology Division. Oct. 20 p.m./Oct. 23 a.m.

S 5. Geology of the Pacific Rim. International Division and Association for Geoscientists for International Development. Oct. 22 p.m.

S 6. Quaternary Climatic Change in Arid and Semiarid Western North America: Evidence from the Great Basin, Desert Southwest, and Great Plains. Quaternary Geology and Geomorphology Division. Oct. 23 a.m.

S 7. Fluvial Response to Base-level Changes: Eustatics vs. Tectonics—Part I. Sedimentary Geology Division. Oct. 22 a.m.

S 8. Strike-Slip Faulting: Geological and Geophysical Perspectives (full day). Geophysics and Structural Geology and Tectonics Divisions. Oct. 23 a.m/p.m.

S 9. The Global Climate Transition from the Late Paleocene to Early Eocene. CF. Oct. 22 a.m.

S 10. MASHing and Smashing: Geochemical Evidence for Long-term Crust-mantle Interaction Along a Cratonic Margin, Northwest U.S. GS. Oct. 22 p.m.

S 11. International Initiatives in Geoscience Information—A Global Perspective. GIS. Oct. 21 a.m.

S 12. Contact Metamorphism. MSA. Oct. 21 a.m.

S 13. New Approaches to Introductory Geology Courses. NAGT. Oct. 21 p.m.

S 14. Biotic Turnover Examined in a Phylogenetic Context. PS and SVP. Oct. 23 a.m.

S 15. Applications of Microanalytical Techniques to Economic Geology. SEG. Oct. 21 p.m.

S 16. Crustal-scale Controls on Ore Deposits. SEG. Oct. 20 a.m/p.m.

S 17. Survivability of Organic Matter at High Temperature: Implications for Life. GS-OGD. Oct. 20 a.m./p.m.

S 19. Continental Drift, Plate Tectonics, and Biogeography: The History of a Synthesis of Two Cultures. History of Geology Division. Oct. 21 a.m.

S 20. Venus and Earth: Tectonic and Volcanic Evolution. Planetary Geology Division. Oct. 22 a.m.

S 21. Geophysics of the Southwestern Cordillera—USA and Mexico. San Diego Annual Meeting Committee. Oct. 20 p.m.

S 22. PANGEA: Ice-house Processes, Climates, and Events on a Supercontinent. Sedimentary Geology Division and Global Sedimentary Geology Program. Oct. 20 p.m.

S 18. *Withdrawn*

PROGRAM BY SCIENTIFIC DISCIPLINES

KEY: I, II, ... X = Discipline session number; P = Posters; S = Symposium; T = Theme Session (listed under disciplines having the majority of the abstracts).
= Keynote Symposium, The Global Challenge.

DISCIPLINE	SUN, OCT. 20 8:00 a.m.–12:00 N 1:00–5:00 p.m.		MON, OCT. 21 8:00 a.m.–12:00 N 1:00–5:00 p.m.		TUES, OCT. 22 8:00 a.m.–12:00 N 1:30–5:30 p.m.		WED, OCT. 23 8:00 a.m.–12:00 N 1:30–5:30 p.m.		THURS, OCT. 24 8:00 a.m.–12:00 N 1:00–5:00 p.m.	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
ARCHAEOLOGY						S1	P	I		
COAL			S2	I	P					
COMPUTERS						P				P, T22
ECONOMIC	S16	S16		S15	I	II	III, T1/2	P	P	IV
ENGINEERING			I, P	T23	S3					
ENVIRONMENTAL			P, T14	P, T14, T17/18		I	II, T1/2	P	P	
GEOCHEMISTRY	S17	S17	I, P	T12	II, P	S10, III	IV, V	VI, VII	VIII	IX
GEOLOGY EDUCATION			P, T34	S13, P, T34			I			
GEOMORPHOLOGY				I		P, T6	II		T29	
GEOPHYSICS/ TECTONOGEOPHYSICS		S21	T21	I			S8	S8, P		
GEOSCIENCE INFORMATION			S11			I				
HISTORY			S19					I		
HYDROGEOLOGY		S4		T15, T21	P, T16	P	S4, P	I, P	II	
INTERNATIONAL						S5				
MARINE									P	I
MICROPALEONTOLOGY			I, P		S9					
MINERALOGY/ CRYSTALLOGRAPHY					I	P				
PALEOCEANOGRAPHY/ PALEOCLIMATOLOGY				T3	T3	T4	T4	I, P	II	
PALEONTOLOGY/ PALEOBOTANY					I, P, T10		S14, II	III, T11	IV	V
PETROLEUM			P			I				
PETROLOGY, EXPERIMENTAL			P	I						
PETROLOGY, IGNEOUS							I, P	II, P	III, P	IV
PETROLOGY, METAMORPHIC			S12					I	II	III, P
PETROLOGY, SEDIMENTARY			P, T7	P, T7						
PLANETARY/ REMOTE SENSING					S20		P	T30	I, P	P
PRECAMBRIAN			I	II						P
QUATERNARY			I	P		P	S6	T5	II, P	III
SEDIMENTOLOGY		S22	I	T8	S7	II	P		III	IV
STRATIGRAPHY				T26, T32	T9	P	P	I	II	III
STRUCTURAL				I	II, P, T32	P	S8	S8, T13	III, P	IV
TECTONICS			I	P	II, T25, T27	III, T25, T27	IV, P, T24	V, P, T28	VI, T28	VII, P T31
VOLCANOLOGY									I	II, P

THEME SESSIONS

T 1/2. The Global Challenge: Predictive Models for Global Environment and Resource Development. Oct. 23 a.m.

T 3. Global Climate Changes—I: The Geologic Record of Climate Dynamics. Oct. 21 p.m./Oct. 22 a.m.

T 4. Global Climate Changes—II: The Past, a Key to the Future. Oct. 22 p.m./ Oct. 23 a.m.

T 5. Global Warming and Geologic Evidence of Aridification During Late Quaternary Time. Quaternary Geology and Geomorphology Division. Oct. 23 p.m.

T 6. Fluvial Response to Base-level Changes: Eustatics vs. Tectonics—Part II. Sedimentary Geology Division. Oct. 22 p.m.

T 7. Processes Controlling the Composition of Siliciclastic Sediments. Oct. 21 a.m./p.m.

T 8. Global Sedimentary Geology of the Phanerozoic: A Theme Session in Honor of A. B. Ronov. Oct. 21 p.m.

T 9. Approaches to Sequence Stratigraphic Analysis—Examples from the Tertiary. Oct. 22 a.m.

T 10. The K-T Boundary—I: Late Cretaceous Extinctions: Catastrophes or Not? Oct. 22 a.m.

T 11. The K-T Boundary—II: Nonmarine Fossil Record at the Cretaceous-Tertiary Boundary. PS. Oct. 23 p.m.

T 12. Actinide-series Disequilibria in Igneous and Geothermal Processes. Oct. 21 p.m.

T 13. Solution Mass Transfer and Volume Strain in Crustal Rocks. Oct. 23 p.m.

T 14. Site Characterization Studies Related to Ground-Water and Surface-Water Contamination at Sites Operated by the U.S. Department of Energy. Oct. 21 a.m./p.m.

T 15. Geology, Hydrogeology, and Tectonics of Southern Nevada in Relation to the Potential Storage of High-Level Nuclear Waste. Oct. 21 p.m.

T 16. Characterization and Monitoring of Ground-Water Contamination at Hazardous Waste Sites: Research and Case Histories. Hydrogeology Division. Oct. 22 a.m.

T 17/18. Urban Geologic Hazards/Soil and Ground-Water Remediation Technology. Engineering Geology Division. Oct. 21 p.m.

T 21. Geophysical Exploration for Ground Water in Arid and Semi-Arid Regions. Hydrogeology Division. Oct. 21 p.m.

T 22. Multivariate Statistical Methods in the Geosciences. Hydrogeology Division. Oct. 24 p.m.

T 23. Failure Mechanisms of Megaslides. Engineering Geology Division. Oct. 21 p.m.

T 24. Active Margin of Antarctica—Proterozoic to Holocene. Oct. 23 a.m.

T 25. Cenozoic Extension in the Cordillera: Geometry, Timing, Mechanisms, and Regional Controls. Oct. 22 a.m./p.m.

T 26. Mesozoic Stratigraphic and Structural Evolution of Northwestern Mexico. Oct. 21 p.m.

T 27. Jurassic Magmatism and Tectonics of the North American Cordillera. *Dedicated to Richard L. Armstrong.* Oct. 22 a.m./p.m.

T 28. Tectonics of Modern and Ancient Accretionary Prisms. Oct. 23 p.m./ Oct. 24 a.m.

T 29. Landscapes of Tectonically Active Strike-Slip, Normal and Reverse Faults. Oct. 24 a.m.

T 30. New Views of the Moon: The Lunar Frontier Revisited. Oct. 23 p.m.

T 31. Southern California Areal Mapping Project—Accomplishments, Work-in Progress, Goals (POSTER SESSION). Oct. 24 p.m.

T 32. Baja California: Geologic History of the Peninsula and Gulf of California. Oct. 22 a.m.

T 34. Earth Scientists and Science Educators: Common Ground. NESTA. Oct. 21 a.m./p.m.

T 19, T 20, T 33. *Withdrawn*

PROGRAM CALENDAR

SUNDAY OCTOBER 20 A.M.

SESSION 1, 8:00 a.m., SDCC:Room 9
GS—ORGANIC GEOCHEMISTRY DIVISION SYMPOSIUM (S17): SURVIVABILITY OF ORGANIC MATTER AT HIGH TEMPERATURE: IMPLICATIONS FOR LIFE (PART I)

SESSION 2, 8:00 a.m., SDCC:Room 8
SEG SYMPOSIUM (S16): CRUSTAL-SCALE CONTROLS ON ORE DEPOSITS (PART I)

SUNDAY OCTOBER 20 P.M.

SESSION 3, 1:00 p.m., SDCC:Room 10
GEOPHYSICS OF THE SOUTHWESTERN CORDILLERA—USA AND MEXICO SYMPOSIUM (S21)

SESSION 4, 1:30 p.m., SDCC:Room 9
GS—ORGANIC GEOCHEMISTRY DIVISION SYMPOSIUM (S17): SURVIVABILITY OF ORGANIC MATTER AT HIGH TEMPERATURE: IMPLICATIONS FOR LIFE (PART II)

SESSION 5, 3:00 p.m., SDCC:Room 7B
HYDROGEOLOGY DIVISION SYMPOSIUM (S4): DEPOSITIONAL ENVIRONMENTS AND THE DEVELOPMENT OF AQUIFERS (PART I)

SESSION 6, 1:00 p.m., SDCC:Room 11A
SEDIMENTARY GEOLOGY AND GLOBAL SEDIMENTARY GEOLOGY PROGRAM SYMPOSIUM (S22): PANGEA: ICE-HOUSE PROCESSES, CLIMATES, AND EVENTS ON A SUPERCONTINENT

SESSION 7, 1:15 p.m., SDCC:Room 8
SEG SYMPOSIUM (S16): CRUSTAL-SCALE CONTROLS ON ORE DEPOSITS (PART II)

MONDAY OCTOBER 21 A.M.

SESSION 8, 8:00 a.m., SDCC:Room 6E
CF—MICROPALEONTOLOGY

SESSION 9, 8:00 a.m., SDCC:Hall B
CF—MICROPALEONTOLOGY (POSTERS)

SESSION 10, 8:00 a.m., SDCC:Room 7A
COAL GEOLOGY DIVISION SYMPOSIUM (S2): COALBED METHANE: GEOLOGY, RECOVERY TECHNOLOGY, AND RESOURCES

SESSION 11, 8:00 a.m., SDCC:Room 10
ENGINEERING GEOLOGY

SESSION 12, 8:00 a.m., SDCC:Hall B
ENGINEERING GEOLOGY (POSTERS)

SESSION 13, 8:00 a.m., SDCC:Room 17B
GIS SYMPOSIUM (S11): INTERNATIONAL INITIATIVES IN GEOSCIENCE INFORMATION—A GLOBAL PERSPECTIVE

SESSION 14, 8:00 a.m., SDCC:Room 9
GS—GEOCHEMISTRY I: IGNEOUS GEOCHEMISTRY: ISOTOPE AND TRACE ELEMENT

SESSION 15, 8:00 a.m., SDCC:Room 17A
HISTORY OF GEOLOGY DIVISION SYMPOSIUM (S19): CONTINENTAL DRIFT, PLATE TECTONICS, AND BIOGEOGRAPHY: THE HISTORY OF A SYNTHESIS OF TWO CULTURES

SESSION 16, 8:45 a.m., SDCC:Room 6AB
KEYNOTE SYMPOSIUM: THE GLOBAL CHALLENGE: OUR ENVIRONMENT, OUR RESOURCES, OUR RESPONSIBILITIES

SESSION 17, 8:00 a.m., SDCC:Room 16AB
MSA SYMPOSIUM (S12): CONTACT METAMORPHISM

SESSION 18, 8:00 a.m., SDCC:Hall B
MSA—EXPERIMENTAL PETROLOGY (POSTERS)

SESSION 19, 8:00 a.m., SDCC:Hall B
NAGT—GEOLOGICAL EDUCATION (POSTERS)

ASSOCIATED SOCIETIES SPONSORING SESSIONS

CF ..... Cushman Foundation
GS ..... Geochemical Society
GIS ..... Geoscience Information Society
MSA ..... Mineralogical Society of America
NAGT ..... National Association of Geology Teachers
PS ..... Paleontological Society
SEG ..... Society of Economic Geologists

SESSION 20, 8:00 a.m., SDCC:Hall B
PETROLEUM GEOLOGY (POSTERS)

SESSION 21, 8:00 a.m., SDCC:Room 7B
PRECAMBRIAN I

SESSION 22, 8:00 a.m., SDCC:Room 11A
QUATERNARY I

SESSION 23, 8:00 a.m., SDCC:Hall B
SEDIMENTARY PETROLOGY: CARBONATE SEDIMENTOLOGY (POSTERS)

SESSION 24, 8:00 a.m., SDCC:Room 6C
SEDIMENTOLOGY I: SEDIMENTATION AND TECTONICS

SESSION 25, 8:00 a.m., SDCC:Room 14AB
T 7. PROCESSES CONTROLLING THE COMPOSITION OF SILICICLASTIC SEDIMENTS (PART I)

SESSION 26, 8:00 a.m., SDCC:Hall B
T 12. ACTINIDE-SERIES DISEQUILIBRIA IN IGNEOUS AND GEOTHERMAL PROCESSES (POSTERS)

SESSION 27, 8:00 a.m., SDCC:Room 6D
T 14. SITE CHARACTERIZATION STUDIES RELATED TO GROUND-WATER AND SURFACE-WATER CONTAMINATION AT SITES OPERATED BY THE U.S. DEPARTMENT OF ENERGY (PART I)

SESSION 28, 8:00 a.m., SDCC:Hall B
T 17/18. ENGINEERING GEOLOGY DIVISION: URBAN GEOLOGIC HAZARDS: SOIL AND GROUNDWATER REMEDIATION TECHNOLOGY (POSTERS)

SESSION 29, 8:00 a.m., SDCC:Room 8
T 34. NESTA: EARTH SCIENTISTS AND SCIENCE EDUCATORS: COMMON GROUND (PART I)

SESSION 30, 8:00 a.m., SDCC:Room 6F
TECTONICS I: BASIN AND RANGE; NEOTECTONICS

MONDAY OCTOBER 21 P.M.

SESSION 31, 1:00 p.m., SDCC:Room 7A
COAL GEOLOGY I

SESSION 32, 1:00 p.m., SDCC:Room 15A
GEOMORPHOLOGY I

SESSION 33, 1:00 p.m., SDCC:Room 17B
GEOPHYSICS/TECTONOGEOPHYSICS

SESSION 34, 1:00 p.m., SDCC:Room 17A
MSA—EXPERIMENTAL PETROLOGY

SESSION 35, 1:00 p.m., SDCC:Room 9
NAGT SYMPOSIUM (S13): NEW APPROACHES TO INTRODUCTORY GEOLOGY COURSES

SESSION 36, 1:00 p.m., SDCC:Room 7B
PRECAMBRIAN II

SESSION 37, 1:00 p.m., SDCC:Hall B
QUATERNARY GEOLOGY (POSTERS I)

SESSION 38, 1:00 p.m., SDCC:Room 6C
SEG SYMPOSIUM (S15): APPLICATIONS OF MICRO-ANALYTICAL TECHNIQUES TO ECONOMIC GEOLOGY

SESSION 39, 1:00 p.m., SDCC:Room 16AB
STRUCTURAL GEOLOGY I: FAULTS

SESSION 40, 1:30 p.m., SDCC:Room 6B
T 3. GLOBAL CLIMATE CHANGES—I: THE GEOLOGIC RECORD OF CLIMATE DYNAMICS (PART I)

SESSION 41, 1:00 p.m., SDCC:Room 14AB
T 7. PROCESSES CONTROLLING THE COMPOSITION OF SILICICLASTIC SEDIMENTS (PART II)

SESSION 42, 1:00 p.m., SDCC:Hall B
T 7. PROCESSES CONTROLLING THE COMPOSITION OF SILICICLASTIC SEDIMENTS (POSTERS)

SESSION 43, 1:00 p.m., SDCC:Room 6E
T 8. GLOBAL SEDIMENTARY GEOLOGY OF THE PHANEROZOIC: A THEME SESSION IN HONOR OF A. B. RONOV

SESSION 44, 2:00 p.m., SDCC:Room 8
T 12. ACTINIDE-SERIES DISEQUILIBRIA IN IGNEOUS AND GEOTHERMAL PROCESSES

SESSION 45, 1:00 p.m., SDCC:Room 6D
T 14. SITE CHARACTERIZATION STUDIES RELATED TO GROUND-WATER AND SURFACE-WATER CONTAMINATION AT SITES OPERATED BY THE U.S. DEPARTMENT OF ENERGY (PART II)

SESSION 46, 1:00 p.m., SDCC:Hall B
T 14. SITE CHARACTERIZATION STUDIES RELATED TO GROUND-WATER AND SURFACE-WATER CONTAMINATION AT SITES OPERATED BY THE U.S. DEPARTMENT OF ENERGY (POSTERS)

SESSION 47, 1:00 p.m., SDCC:Room 6F
T 15. SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC): GEOLOGY, HYDROLOGY, AND TECTONICS OF SOUTHERN NEVADA IN RELATION TO THE POTENTIAL STORAGE OF HIGH-LEVEL NUCLEAR WASTE

SESSION 48, 1:30 p.m., SDCC:Room 11A
T 17/18. ENGINEERING GEOLOGY DIVISION: URBAN GEOLOGIC HAZARDS/ SOIL AND GROUND-WATER REMEDIATION TECHNOLOGY

SESSION 49, 2:15 p.m., SDCC:Room 7B
T 21. HYDROGEOLOGY DIVISION: GEOPHYSICAL EXPLORATION FOR GROUNDWATER IN ARID AND SEMI-ARID REGIONS

SESSION 50, 2:00 p.m., SDCC:Room 6D
T 23. ENGINEERING GEOLOGY DIVISION: FAILURE MECHANISMS OF MEGASLIDES

SESSION 51, 2:45 p.m., SDCC:Room 14AB
T 26. MESOZOIC STRATIGRAPHIC AND STRUCTURAL EVOLUTION OF NORTHWESTERN MEXICO

SESSION 52, 1:00 p.m., SDCC:Room 8
T 34. NESTA: EARTH SCIENTISTS AND SCIENCE EDUCATORS: COMMON GROUND (PART II)

SESSION 53, 1:00 p.m., SDCC:Hall B
T 34. NESTA: EARTH SCIENTISTS AND SCIENCE EDUCATORS: COMMON GROUND (POSTERS)

SESSION 54, 1:00 p.m., SDCC:Hall B
TECTONICS (POSTERS)

TUESDAY OCTOBER 22 A.M.

SESSION 55, 8:00 a.m., SDCC:Room 11A
CF SYMPOSIUM (S9): THE GLOBAL CLIMATE TRANSITION FROM THE LATE PALEOCENE TO EARLY EOCENE

SESSION 56, 8:00 a.m., SDCC:Hall B
COAL GEOLOGY (POSTERS)

SESSION 57, 8:00 a.m., SDCC:Room 6D
ENGINEERING GEOLOGY DIVISION SYMPOSIUM (S3): GEORISK ASSESSMENT

SESSION 58, 10:30 a.m., SDCC:Room 17A
GS—GEOCHEMISTRY II: GEOCHEMISTRY OF SURFACES

SESSION 59, 8:00 a.m., SDCC:Hall B
GS—HYDROTHERMAL AND IGNEOUS GEOCHEMISTRY (POSTERS)

SESSION 60, 8:00 a.m., SDCC:Hall B
GS—ISOTOPE AND AQUEOUS GEOCHEMISTRY (POSTERS)

SESSION 61, 8:00 a.m., SDCC:Hall B
GS—SEDIMENTARY GEOCHEMISTRY (POSTERS)

SESSION 62, 8:00 a.m., SDCC:Room 17B
MSA—MINERALOGY/CRYSTALLOGRAPHY

SESSION 63, 8:00 a.m., SDCC:Room 8
PLANETARY GEOLOGY DIVISION SYMPOSIUM (S20): VENUS AND EARTH: TECTONIC AND VOLCANIC EVOLUTION

SESSION 64, 8:00 a.m., SDCC:Room 7B
PS—PALEONTOLOGY I: MOLLUSCA THROUGH TIME

SESSION 65, 8:00 a.m., SDCC:Hall B
PS—PALEONTOLOGY/PALEOBOTANY (POSTERS)

SESSION 66, 8:00 a.m., SDCC:Room 6E
SEDIMENTARY GEOLOGY DIVISION SYMPOSIUM (S7): FLUVIAL RESPONSE TO BASE-LEVEL CHANGES: EUSTATICS VS. TECTONICS (PART I)

SESSION 67, 8:00 a.m., SDCC:Room 6C
SEG—ECONOMIC GEOLOGY I: STRATIFORM AND STRATABOUND DEPOSITS; DEPOSITS IN METAMORPHIC TERRAINS

SESSION 68, 8:00 a.m., SDCC:Room 9
STRUCTURAL GEOLOGY II: DEFORMATION/MAGMATISM AND DUCTILE SHEAR ZONES

SESSION 69, 8:00 a.m., SDCC:Room 6B
T 3. GLOBAL CLIMATE CHANGES—I: THE GEOLOGIC RECORD OF CLIMATE DYNAMICS (PART II)

SESSION 70, 8:00 a.m., SDCC:Room 7A
T 9. APPROACHES TO SEQUENCE STRATIGRAPHIC ANALYSIS—EXAMPLES FROM THE TERTIARY

SESSION 71, 8:30 a.m., SDCC:Room 15A
T 10. THE K-T BOUNDARY—I: LATE CRETACEOUS EXTINCTIONS: CATASTROPHES OR NOT?

SESSION 72, 8:00 a.m., SDCC:Hall B
T 15. SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC): GEOLOGY, HYDROGEOLOGY AND TECTONICS OF SOUTHERN NEVADA IN RELATION TO THE POTENTIAL STORAGE OF HIGH-LEVEL NUCLEAR WASTE (POSTERS)

SESSION 73, 8:00 a.m., SDCC:Room 6F
T 16. HYDROGEOLOGY DIVISION: CHARACTERIZATION AND MONITORING OF GROUND-WATER CONTAMINATION AT HAZARDOUS WASTE SITES: RESEARCH AND CASE HISTORIES

SESSION 74, 8:15 a.m., SDCC:Room 16AB
T 25. CENEZOIC EXTENSION IN THE CORDILLERA: GEOMETRY, TIMING, MECHANISMS, AND REGIONAL CONTROLS (PART I)

SESSION 75, 8:00 a.m., SDCC:Room 14AB
T 27. JURASSIC MAGMATISM AND TECTONICS OF THE NORTH AMERICAN CORDILLERA. *DEDICATED TO RICHARD L. ARMSTRONG.* (PART I: CANADA TO GREAT BASIN)

SESSION 76, 8:00 a.m., SDCC:Room 17A
T 32. BAJA CALIFORNIA: GEOLOGIC HISTORY OF THE PENINSULA AND GULF OF CALIFORNIA

SESSION 77, 8:00 a.m., SDCC:Hall B
T 32. BAJA CALIFORNIA: GEOLOGIC HISTORY OF THE PENINSULA AND GULF OF CALIFORNIA (POSTERS)

SESSION 78, 8:00 a.m., SDCC:Room 10
TECTONICS II: STRIKE-SLIP TECTONICS

TUESDAY OCTOBER 22 P.M.

SESSION 79, 1:30 p.m., SDCC:Room 17B
ARCHAEOLOGICAL GEOLOGY DIVISION SYMPOSIUM (S1): ARCHAEOLOGICAL GEOLOGY OF THE ARCHAIC PERIOD (8–3 ka) IN NORTH AMERICA

SESSION 80, 1:30 p.m., SDCC:Hall B
COMPUTERS (POSTERS)

SESSION 81, 1:30 p.m., SDCC:Room 6D
ENVIRONMENTAL GEOLOGY/ ENGINEERING GEOLOGY I

SESSION 82, 1:30 p.m., SDCC:Hall B
GEOMORPHOLOGY (POSTERS)

SESSION 83, 1:30 p.m., SDCC:Room 7B
GIS—CURRENT ISSUES IN GEOSCIENCE INFORMATION

SESSION 84, 1:30 p.m., SDCC:Room 9
GS SYMPOSIUM (S10): MASHING AND SMASHING: GEOCHEMICAL EVIDENCE FOR LONG-TERM CRUST-MANTLE INTERACTION ALONG A CRATONIC MARGIN, NORTHWEST U.S.

SESSION 85, 1:30 p.m., SDCC:Room 17A
GS—GEOCHEMISTRY III: THERMODYNAMICS OF AQUEOUS SOLUTIONS

SESSION 86, 1:30 p.m., SDCC:Hall B
HYDROGEOLOGY (POSTERS I)

SESSION 87, 1:30 p.m., SDCC:Room 6F
INTERNATIONAL DIVISION AND AGID (S5): GEOLOGY OF THE PACIFIC RIM

SESSION 88, 1:30 p.m., SDCC:Hall B
MSA—MINERALOGY/CRYSTALLOGRAPHY (POSTERS)

SESSION 89, 1:30 p.m., SDCC:Room 11A
PETROLEUM GEOLOGY

SESSION 90, 1:30 p.m., SDCC:Hall B
QUATERNARY GEOLOGY (POSTERS II)

SESSION 91, 1:30 p.m., SDCC:Room 8
SEDIMENTOLOGY II: CARBONATES

SESSION 92, 1:30 p.m., SDCC:Room 6C
SEG—ECONOMIC GEOLOGY II: EPITHERMAL DEPOSITS: INFLUENCE OF MAGMATIC VOLATILES ON MINERALIZATION

SESSION 93, 1:30 p.m., SDCC:Hall B
STRUCTURAL GEOLOGY (POSTERS)

SESSION 94, 1:30 p.m., SDCC:Room 6B
T 4. GLOBAL CLIMATE CHANGES—II: THE PAST, A KEY TO THE FUTURE (PART I)

SESSION 95, 1:30 p.m., SDCC:Room 6E
T 6. SEDIMENTARY GEOLOGY DIVISION: FLUVIAL RESPONSE TO BASE-LEVEL CHANGES: EUSTATICS VS. TECTONICS

SESSION 96, 1:30 p.m., SDCC:Hall B
T 9. APPROACHES TO SEQUENCE STRATIGRAPHIC ANALYSIS—EXAMPLES FROM THE TERTIARY (POSTERS)

SESSION 97, 1:30 p.m., SDCC:Hall B
T 16. HYDROGEOLOGY DIVISION: CHARACTERIZATION AND MONITORING OF GROUND-WATER CONTAMINATION AT HAZARDOUS WASTE SITES: RESEARCH AND CASE HISTORIES (POSTERS)

SESSION 98, 1:30 p.m., SDCC:Room 16AB
T 25: CENOZOIC EXTENSION IN THE CORDILLERA: GEOMETRY, TIMING, MECHANISMS, AND REGIONAL CONTROLS (PART II)

SESSION 99, 1:30 p.m., SDCC:Room 14AB
T 27. JURASSIC MAGMATISM AND TECTONICS OF THE NORTH AMERICAN

CORDILLERA. *DEDICATED TO RICHARD L. ARMSTRONG.* (PART II: SIERRA NEVADA TO SOUTHERN ARIZONA)

SESSION 100, 2:45 p.m., SDCC:Room 10
TECTONICS III: BASIN EVOLUTION

WEDNESDAY OCTOBER 23 A.M.

SESSION 101, 8:00 a.m., SDCC:Hall B
ARCHAEOLOGICAL GEOLOGY (POSTERS)

SESSION 102, 8:00 a.m., SDCC:Room 7A
ENVIRONMENTAL GEOLOGY/ ENGINEERING GEOLOGY II

SESSION 103, 10:15 a.m., SDCC:Room 7A
GEOMORPHOLOGY II

SESSION 104, 8:00 a.m., SDCC:Room 6C
GEOPHYSICS AND STRUCTURE AND TECTONICS DIVISIONS SYMPOSIUM (S8): STRIKE-SLIP FAULTING: GEOLOGICAL AND GEOPHYSICAL PERSPECTIVES (PART I)

SESSION 105, 8:00 a.m., SDCC:Room 11A
GS—GEOCHEMISTRY IV: GEOCHEMICAL KINETICS: FIELD VS. LABORATORY RATES (PART I)

SESSION 106, 8:00 a.m., SDCC:Room 17A
GS—GEOCHEMISTRY V: ISOTOPE GEOCHEMISTRY, TECHNIQUES AND APPLICATIONS TO FLUIDS

SESSION 107, 8:00 a.m., SDCC:Room 10
HYDROGEOLOGY DIVISION SYMPOSIUM (S4): DEPOSITIONAL ENVIRONMENTS AND THE DEVELOPMENT OF AQUIFERS

SESSION 108, 8:00 a.m., SDCC:Hall B
HYDROGEOLOGY (POSTERS II)

SESSION 109, 8:00 a.m., SDCC:Room 6D
MSA—IGNEOUS PETROLOGY I: MAGMA CHAMBER PROCESSES, LAYERED INTRUSIONS, ANORTHOSITES AND THE MANTLE

SESSION 110, 8:00 a.m., SDCC:Hall B
MSA—IGNEOUS PETROLOGY (POSTERS I)

SESSION 111, 8:30 a.m., SDCC:Room 16AB
NAGT—GEOLOGICAL EDUCATION

SESSION 112, 8:00 a.m., SDCC:Hall B
PLANETARY GEOLOGY (POSTERS)

SESSION 113, 8:00 a.m., SDCC:Room 7B
PS—PALEONTOLOGY II: PALEOZOIC ORGANISMS

SESSION 114, 8:25 a.m., SDCC:Room 9
PS/SVP SYMPOSIUM (S14): BIOTIC TURNOVER EXAMINED IN A PHYLOGENETIC CONTEXT

SESSION 115, 8:00 a.m., SDCC:Room 6F
QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION SYMPOSIUM (S6): QUATERNARY CLIMATIC CHANGE IN ARID AND SEMIARID WESTERN NORTH AMERICA: EVIDENCE FROM THE GREAT BASIN, DESERT SOUTHWEST, AND GREAT PLAINS

SESSION 116, 8:00 a.m., SDCC:Hall B
SEDIMENTOLOGY: DIAGENESIS (POSTERS)

SESSION 117, 8:00 a.m., SDCC:Room 6E
SEG—ECONOMIC GEOLOGY III: MAGMATIC AND MAGMA-HYDROTHERMAL DEPOSITS

SESSION 118, 8:00 a.m., SDCC:Hall B
STRATIGRAPHY (POSTERS)

SESSION 119, 8:00 a.m., SDCC:Room 17B
T 1/2. PREDICTIVE MODELS FOR GLOBAL ENVIRONMENT AND RESOURCE DEVELOPMENT

SESSION 120, 8:00 a.m., SDCC:Room 6B
T 4. GLOBAL CLIMATE CHANGES—II: THE PAST, A KEY TO THE FUTURE (PART II)

SESSION 121, 8:00 a.m., SDCC:Room 8
T 24. ACTIVE MARGIN OF ANTARCTICA—PROTEROZOIC TO HOLOCENE

SESSION 122, 8:00 a.m., SDCC:Hall B
T 27. JURASSIC MAGMATISM AND TECTONICS OF THE NORTH AMERICAN CORDILLERA. *DEDICATED TO RICHARD L. ARMSTRONG.* (POSTERS)

SESSION 123, 8:00 a.m., SDCC:Room 14AB
TECTONICS IV: PRECAMBRIAN, APPALACHIANS, CALEDONIDES

WEDNESDAY OCTOBER 23 P.M.

SESSION 124, 1:30 p.m., SDCC:Room 17B
ARCHAEOLOGICAL GEOLOGY

SESSION 125, 1:30 p.m., SDCC:Room 6C
GEOPHYSICS AND STRUCTURE AND TECTONICS DIVISIONS SYMPOSIUM (S8): STRIKE-SLIP FAULTING: GEOLOGICAL AND GEOPHYSICAL PERSPECTIVES (PART II)

SESSION 126, 1:30 p.m., SDCC:Hall B
GEOPHYSICS/TECTONOGEOPHYSICS (POSTERS)

SESSION 127, 2:45 p.m., SDCC:Room 11A
GS—GEOCHEMISTRY VII: GEOCHEMICAL KINETICS: FIELD VS. LABORATORY RATES (PART II)

SESSION 128, 1:30 p.m., SDCC:Room 11A
GS—GEOCHEMISTRY VI: ISOTOPIC FRACTIONATION, EXCHANGE, AND DIFFUSION

SESSION 129, 3:30 p.m., SDCC:Room 17B
HISTORY OF GEOLOGY

SESSION 130, 1:30 p.m., SDCC:Room 8
HYDROGEOLOGY I

SESSION 131, 1:30 p.m., SDCC:Hall B
HYDROGEOLOGY (POSTERS III)

SESSION 132, 1:30 p.m., SDCC:Hall B
MSA—IGNEOUS PETROLOGY: INTRUSIVE ROCKS (POSTERS II)

SESSION 133, 1:30 p.m., SDCC:Room 6D
MSA—IGNEOUS PETROLOGY II: VOLCANIC ROCKS: OCEANS, ALEUTIANS, COLUMBIA RIVER, MEXICO

SESSION 134, 1:30 p.m., SDCC:Room 9
MSA—METAMORPHIC PETROLOGY I: CONSTRAINTS ON P-T-TIME

SESSION 135, 1:30 p.m., SDCC:Room 6B
PALEOCEANOGRAPHY/PALEOCLIMATOLOGY I

SESSION 136, 1:30 p.m., SDCC:Hall B
PALEOCEANOGRAPHY/PALEOCLIMATOLOGY (POSTERS)

SESSION 137, 1:30 p.m., SDCC:Room 7B
PS—PALEONTOLOGY III: PALEOECOLOGY, TAPHONOMY, AND PRESERVATION

SESSION 138, 1:30 p.m., SDCC:Room 16AB
STRATIGRAPHY I

SESSION 139, 1:30 p.m., SDCC:Hall B
T 1/2. PREDICTIVE MODELS FOR GLOBAL ENVIRONMENT AND RESOURCE DEVELOPMENT (POSTERS)

SESSION 140, 1:30 p.m., SDCC:Hall B
T 3/4. GLOBAL CLIMATE CHANGES: THE GEOLOGIC RECORD OF CLIMATE DYNAMICS (POSTERS)

SESSION 141, 1:30 p.m., SDCC:Room 6F
T 5. QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION: GLOBAL WARMING AND GEOLOGIC EVIDENCE OF ARIDIFICATION DURING LATE QUATERNARY TIME

SESSION 142, 1:30 p.m., SDCC:Room 10
T 11. THE K-T BOUNDARY—II: NONMARINE FOSSIL RECORD AT THE CRETACEOUS-TERTIARY BOUNDARY

SESSION 143, 1:30 p.m., SDCC:Room 17A
T 13. SOLUTION MASS TRANSFER AND VOLUME STRAIN IN CRUSTAL ROCKS

SESSION 144, 1:30 p.m., SDCC:Hall B
T 24. ACTIVE MARGIN OF ANTARCTICA—PROTEROZOIC TO HOLOCENE (POSTERS)

SESSION 145, 1:30 p.m., SDCC:Room 6E
T 28. TECTONICS OF MODERN AND ANCIENT ACCRETIONARY PRISMS (PART I)

SESSION 146, 1:30 p.m., SDCC:Room 7A
T 30. NEW VIEWS OF THE MOON: THE LUNAR FRONTIER REVISITED

SESSION 147, 1:30 p.m., SDCC:Room 14AB
TECTONICS V: EUROPE AND ASIA

THURSDAY OCTOBER 24 A.M.

SESSION 148, 8:00 a.m., SDCC:Hall B
ENVIRONMENTAL GEOLOGY/ENGINEERING GEOLOGY (POSTERS)

SESSION 149, 8:00 a.m., SDCC:Room 11A
GS—GEOCHEMISTRY VIII: SEDIMENTARY AND DIAGENETIC

SESSION 150, 8:00 a.m., SDCC:Room 6E
HYDROGEOLOGY II

SESSION 151, 8:00 a.m., SDCC:Hall B
MARINE GEOLOGY (POSTERS)

SESSION 152, 8:00 a.m., SDCC:Room 6D
MSA—IGNEOUS PETROLOGY III: INTRUSIVE ROCKS

SESSION 153, 8:00 a.m., SDCC:Hall B
MSA—IGNEOUS PETROLOGY: VOLCANIC ROCKS (POSTERS III)

SESSION 154, 8:00 a.m., SDCC:Room 9
MSA—METAMORPHIC PETROLOGY II: METAMORPHIC PHASE PETROLOGY AND STABLE ISOTOPES

SESSION 155, 8:00 a.m., SDCC:Room 7A
MSA—VOLCANOLOGY I

SESSION 156, 8:00 a.m., SDCC:Room 6F
PALEOCEANOGRAPHY/PALEOCLIMATOLOGY II

SESSION 157, 8:00 a.m., SDCC:Room 17A
PLANETARY GEOLOGY: VENUS, MARS, TERRESTRIAL IMPACT STRUCTURES

SESSION 158, 8:00 a.m., SDCC:Room 7B
PS—PALEONTOLOGY IV: BIOSTRATIGRAPHY AND PALEOBIOLOGY

SESSION 159, 8:00 a.m., SDCC:Room 10
QUATERNARY GEOLOGY II

SESSION 160, 8:00 a.m., SDCC:Hall B
REMOTE SENSING: SURFICIAL DEPOSITS (POSTERS)

SESSION 161, 8:00 a.m., SDCC:Room 8
SEDIMENTOLOGY III: DIAGENESIS/CLASTIC AND CARBONATE

SESSION 162, 8:00 a.m., SDCC:Hall B
SEG—ECONOMIC GEOLOGY (POSTERS)

SESSION 163, 8:00 a.m., SDCC:Room 17B
STRATIGRAPHY II

SESSION 164, 8:00 a.m., SDCC:Room 16AB
STRUCTURAL GEOLOGY III: FOLD AND THRUST BELTS

SESSION 165, 8:00 a.m., SDCC:Hall B
T 5. QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION: GLOBAL WARMING AND GEOLOGIC EVIDENCE OF ARIDIFICATION DURING LATE QUATERNARY TIME (POSTERS)

SESSION 166, 8:00 a.m., SDCC:Hall B
T 13. SOLUTION MASS TRANSFER AND VOLUME STRAIN IN CRUSTAL ROCKS (POSTERS)

SESSION 167, 8:00 a.m., SDCC:Room 6C
T 28. TECTONICS OF MODERN AND ANCIENT ACCRETIONARY PRISMS (PART II)

SESSION 168, 8:00 a.m., SDCC:Room 14AB
T 29. LANDSCAPES OF TECTONICALLY ACTIVE STRIKE-SLIP, NORMAL AND REVERSE FAULTS

SESSION 169, 8:00 a.m., SDCC:Room 6B
TECTONICS VI: NORTHERN CORDILLERA

THURSDAY OCTOBER 24 P.M.

SESSION 170, 1:00 p.m., SDCC:Room 11A
GS—GEOCHEMISTRY IX: SEDIMENTARY FLUID FLOW

SESSION 171, 1:00 p.m., SDCC:Room 17A
MARINE GEOLOGY

SESSION 172, 1:00 p.m., SDCC:Room 6D
MSA—IGNEOUS PETROLOGY IV: MOSTLY SILICIC VOLCANICS

SESSION 173, 1:00 p.m., SDCC:Room 9
MSA—METAMORPHIC PETROLOGY III: METAMORPHIC PROCESSES AND REGIONAL STUDIES

SESSION 174, 1:00 p.m., SDCC:Hall B
MSA—METAMORPHIC PETROLOGY (POSTERS)

SESSION 175, 3:15 p.m., SDCC:Room 11A
MSA—VOLCANOLOGY II

SESSION 176, 1:00 p.m., SDCC:Hall B
MSA—VOLCANOLOGY (POSTERS)

SESSION 177, 1:00 p.m., SDCC:Hall B
PRECAMBRIAN (POSTERS)

SESSION 178, 1:00 p.m., SDCC:Room 7B
PS—PALEONTOLOGY/PALEOBOTANY V: EARLY LIFE, PLANTS, VERTEBRATES, AND MISCELLANY

SESSION 179, 1:00 p.m., SDCC:Room 10
QUATERNARY GEOLOGY III

SESSION 180, 1:00 p.m., SDCC:Room 8
SEDIMENTOLOGY IV: CLASTIC SEDIMENTOLOGY

SESSION 181, 1:00 p.m., SDCC:Room 6E
SEG—ECONOMIC GEOLOGY IV: ECONOMIC GEOLOGY POTPOURRI

SESSION 182, 1:00 p.m., SDCC:Room 17B
STRATIGRAPHY III

SESSION 183, 1:00 p.m., SDCC:Room 16AB
STRUCTURAL GEOLOGY IV: FRACTURES, FOLDS, AND FABRICS

SESSION 184, 1:00 p.m., SDCC:Room 14AB
T 22. HYDROGEOLOGY DIVISION: MULTIVARIATE STATISTICAL METHODS IN THE GEOSCIENCES

SESSION 185, 1:00 p.m., SDCC:Hall B
T 22. HYDROGEOLOGY DIVISION: MULTIVARIATE STATISTICAL METHODS IN GEOSCIENCES (POSTERS)

SESSION 186, 1:00 p.m., SDCC:Hall B
T 28. TECTONICS OF MODERN AND ANCIENT ACCRETIONARY PRISMS (POSTERS)

SESSION 187, 1:00 p.m., SDCC:Hall B
T 30. NEW VIEWS OF THE MOON: THE LUNAR FRONTIER REVISITED (POSTERS)

SESSION 188, 1:00 p.m., SDCC:Hall B
T 31. SOUTHERN CALIFORNIA AREAL MAPPING PROJECTS—PRELIMINARY ACCOMPLISHMENTS, WORK-IN-PROGRESS, GOALS (POSTERS)

SESSION 189, 1:00 p.m., SDCC:Room 6B
TECTONICS VII: SOUTHERN CORDILLERA

EVENT HIGHLIGHTS

See on-site program for final times and locations of events.
MT = Marriott
SDCC = San Diego Convention Center

SUNDAY

- Field Trips & Short Courses
- Tennis Tournament, MT, 9:00 a.m.–1:00 p.m.
- Guest Tours
  - Wild Animal Park, 10:00 a.m.–3:00 p.m.
  - Best of San Diego Tour and Harbor Cruise, 12:00 noon–4:00 p.m.
- Assoc. for Women Geoscientists Luncheon, MT, 12:00 noon–2:30 p.m.
- Welcoming Party, SDCC, 6:00–9:00 p.m.

MONDAY

- Guest Seminar, MT, Welcome to San Diego, 8:00–8:30 a.m.
- Exhibits, SDCC, 9:00 a.m.–6:00 p.m.
- Science Theater, SDCC, 9:00 a.m.–4:30 p.m.
- Guest Tours
  - Tijuana Shopping and Lunch, 11:00 a.m.–4:00 p.m.
  - Gaslamp Tour and High Tea, 12:00 noon–4:00 p.m.
- Engineering Geology Luncheon, MT, 12:30–2:00 p.m.
- GS Luncheon, MT, 12:30–2:00 p.m.
- GIS Luncheon, MT, 12:30–1:30 p.m.
- Congressional Field Hearing: Earthquake Preparedness, SDCC, 1:00–5:00 p.m.
- Volleyball, Embarcadero Park, 4:00–7:00 p.m.
- Exhibitor Reception, SDCC, 4:30– 6:00 p.m.
- Global Challenge Roundup, SDCC, 5:00–6:45 p.m.
- Alumni Night, MT, 7:00–9:00 p.m.

TUESDAY

- Assoc. for Women Geoscientists Breakfast, MT, 7:00–10:30 a.m.
- Sedimentary Geology Division Breakfast, MT, 7:00–9:00 a.m.
- Half-Day Mini Trip, Geology of San Diego 8:30 a.m.–12:00 noon and 12:30–4:00 p.m.
- Guest Seminar, MT, Historical San Diego, 9:00–10:30 a.m.
- Exhibits, SDCC, 9:00 a.m.–5:30 p.m.
- Science Theater, SDCC, 9:00 a.m.–4:30 p.m.
- Guest Tour, Zoo Behind-the-Scenes Tour, 11:00 a.m.–4:00 p.m.
- NAGT Luncheon, MT, 11:45 a.m.–2:00 p.m.
- Geophysics Division Luncheon, MT, 12:00 noon–1:30 p.m.
- History of Geology Division Luncheon, MT, 12:00 noon–1:30 p.m.
- PS Luncheon, MT, 12:00 noon–5:00 p.m.
- Volleyball, Embarcadero Park, 12:00 noon–2:00 p.m.
- Geology and Public Policy Forum, SDCC, 12:15–1:45 p.m.
- Magellan Forum on Venus, SDCC, 12:15–1:15 p.m.
- MSA Luncheon, MT, 12:15–2:00 p.m.
- Hydrogeology Division Luncheon, MT, 12:30–3:30 p.m.
- Guest Tour, La Jolla Lunch and Shopping, 1:00–5:00 p.m.
- Maps Live with Tom Dibblee, SDCC, 1:00–5:30 p.m.
- GSA Presidential Tribute and Awards Ceremony, SDCC, 5:30– 7:00 p.m.
- Bay Lights Dinner Cruise, San Diego Bay, 7:30–10:00 p.m.
- Dance the Night Away Beach Party, SDCC, 7:30–10:30 p.m.

WEDNESDAY

- 5K Run, MT, 7:00–9:00 a.m.
- Exhibits, SDCC, 8:00 a.m.–5:30 p.m.—Last Day!
- Half-Day Mini Trip, Downtown San Diego Blob, 8:30 a.m.–12:00 noon
- Guest Seminar, MT, Earthquakes: Past and Future, 9:00–10:00 a.m.
- Science Theater, SDCC, 9:00 a.m.–4:30 p.m.
- Guest Tour, Presidio Park and Old Town Lunch, 10:00 a.m.–3:00 p.m.
- SEG Luncheon, MT, 11:30 a.m.–2:00 p.m.
- Coal Geology Division Luncheon, MT, 12:00 Noon–4:00 p.m.
- Geoscience Education Division Luncheon, MT, 12:15–2:30 p.m.
- Guest Seminar, MT, Mexican Cooking, 3:30–4:30 p.m.
- Volleyball, Embarcadero Park, 4:00–7:00 p.m.
- ¡Vamos a Mexico!, Tijuana, 6:00–11:00 p.m.

THURSDAY

- Science Theater, SDCC, 9:00 a.m.–4:30 p.m.
- Guest Seminar, MT, Colors, 10:00–11:00 a.m.
- Global Challenge Rapporteur Session, SDCC, 1:30–3:30 p.m.
- T.A.C. (Thursday Afternoon Club), SDCC, 3:30–5:00 p.m.

GSA ANNUAL MEETINGS

■ 1991

GSA Annual Meeting, San Diego, California
October 21–24

Student Travel Grants

The Northeastern and Southeastern Sections of GSA are offering financial assistance to GSA Student Associates who are enrolled in institutions within these respective sections for travel to the 1991 Annual Meeting in San Diego in October. Application forms and additional information may be obtained from the section secretaries: Northeastern Section, Kenneth N. Weaver, (303) 554-5559, deadline September 20; Southeastern Section, Michael J. Neilson, (202) 934-5102, deadline October 5.

■ 1992

GSA Annual Meeting, Cincinnati, Ohio
October 26–29

Call for 1992 Short Course Proposals

Have you thought about giving a short course? The GSA Committee on Short Courses invites those interested in proposing a GSA sponsored or cosponsored short course to contact GSA headquarters for proposal guidelines.

Short courses may be conducted in conjunction with all GSA annual or section meetings, but we are particularly interested in identifying short courses to be offered during the 1992 Annual Meeting in Cincinnati or the 1993 Annual Meeting in Boston.

Proposals for the Cincinnati meeting must be received by December 1, 1991. Selection of courses will be made by February 1, 1992, leaving 8 months for preparing course manuals and making arrangements.

For proposal guidelines or information contact: Edna A. Collis, Short Course Coordinator, GSA Meetings Department, P.O. Box 9140, Boulder, CO 80301; (303) 447-2020.

■ FUTURE

Cincinnati	October 26–29	1992
Boston	October 25–28	1993
Seattle	October 24–27	1994
New Orleans	November 6–9	1995
Denver	October 28–31	1996
Denver	October 25–28	1999

For general information on technical program participation (1991 or beyond) contact: Sue Beggs, Meetings Manager, GSA headquarters.

GSA SECTION MEETINGS

■ 1992

South-Central, Houston, Texas, Rice University, February 24–25
Hans G. Avé Lallemant, Dept. of Geology and Geophysics, P.O. Box 1892, Rice University, Houston, TX 77251; (713) 527-4889

Southeastern, Winston-Salem, North Carolina, Stouffer-Winston Plaza, March 18–20, Paul D. Fullagar, Dept. of Geology, CB 3315 Mitchell Hall, University of North Carolina, Chapel Hill, NC 27599-3315; (919) 962-0677

Northeastern, Harrisburg, Pennsylvania, Harrisburg Hilton, March 26–28
Donald M. Hoskins, Pennsylvania Geological Survey, Dept. of Environmental Resources, P.O. Box 2357, Harrisburg, PA 17105; (717) 787-2169

North-Central, Iowa City, Iowa, University of Iowa, April 30–May 1
Raymond R. Anderson, Iowa DNR, Geological Survey, University of Iowa, 123 N. Capital St., Iowa City, IA 52242; (319) 335-1575

Cordilleran, Eugene, Oregon, Eugene Hilton Conference Center, May 11–13
A. Dana Johnston, Dept. of Geological Sciences, University of Oregon, Eugene, OR 97403-1272; (503) 346-5588

Rocky Mountain, Ogden, Utah, Ogden Park Hotel, May 13–15 *Note Date Change*
Sidney R. Ash, Dept. of Geology, Weber State University, Ogden, UT 84408-2507; (801) 626-6908

■ 1993 (tentative)

Cordilleran–Rocky Mountain	undecided	Reno, Nevada
South-Central	March 15–16	Fort Worth, Texas
Northeastern	March 22–24	Burlington, Vermont
North-Central	March 28–29	Rolla, Missouri
Southeastern	April 1–2	Tallahassee, Florida

1991 GSA ANNUAL MEETING, San Diego, October 21–24

Planning to Go to Graduate School?

Shortcut your search for just the right graduate school program to suit your needs. Come to the San Diego Annual Meeting and meet with your favorite school without spending the travel time and money to go to each school for interviews. The schools participating are listed below.

If you would like to receive a complete list of schools with the contact persons and telephone numbers, so that you can set up an appointment separately or during the scheduled time in San Diego, please write or call Kathy Lynch, GSA Meetings Department, (303) 447-2020 or 1-800-472-1988.

Graduate School Interview Schedule and Table Assignments (T#)
San Diego Convention Center, Room 15B

University Participating	MONDAY October 21 A.M.	MONDAY October 21 P.M.	TUESDAY October 22 A.M.	TUESDAY October 22 P.M.	WEDNESDAY October 23 A.M.	WEDNESDAY October 23 P.M.	THURSDAY October 24 A.M.	THURSDAY October 24 P.M.
Arizona State Univ.					T1			
Brigham Young Univ.				T1	T2			
Brown Univ.					T3			
California State Univ./Long Beach				T2	T4			
Cornell Univ.				T3	T5			
George Washington Univ.				T4				
Lehigh Univ.		T1						
Louisiana State Univ.	T1			T5				
Miami Univ.					T6			
Northeast Louisiana Univ.		T2						
Northwestern Univ.		T3				T1		
San Diego State University					T7	T2		
State Univ. New York/Albany				T6				
Teachers College, Columbia Univ.			T1			T3		
Texas A&M Univ.—Geology	T2	T4	T2	T7				
Texas A&M Univ.—Geophysics		T5		T8				
Univ. of Akron			T3		T8			
Univ. of Alabama		T6		T9				
Univ. of Alaska				T10		T4		
Univ. of Arizona		T7		T11				
Univ. of California/Berkeley						T5		
Univ. of California/Los Angeles	T3	T8	T4					
Univ. of California/Riverside		T9			T9			
Univ. of California/Santa Barbara			T5	T12	T10	T6		
Univ. of Cincinnati			T6					
Univ. of Georgia				T13	T11			
Univ. of Hawaii		T10		T14				
Univ. of Idaho	T4	T11			T12	T7	T1	T1
Univ. of Illinois/Urbana	T5			T15				
Univ. of Kentucky				T16				
Univ. of Massachusetts					T13			
Univ. of Miami	T6		T7					
Univ. of Missouri/Columbia				T17				
Univ. of Missouri/Kansas City			T8					
Univ. of Nevada/Reno					T14	T8		
Univ. of New Mexico	T7	T12						
Univ. of North Carolina/Chapel Hill	T8	T13	T9		T15	T9		
Univ. of North Carolina/Wilmington		T14		T18		T10		T2
Univ. of North Dakota			T10	T19				
Univ. of Oklahoma		T15						
Univ. of Pennsylvania	T9			T20				
Univ. of Southern California				T21	T16			
Univ. of South Carolina—Earth Sci.			T11	T22	T17	T11		
Univ. of South Carolina—Geology							T2	T3
Univ. of Texas/El Paso		T16						
Univ. of Texas/San Antonio	T10			T23				
Univ. of Utah	T11	T17	T12		T18	T12	T3	T4
Univ. of Vermont			T13			T13		
Utah State Univ.			T14	T24				
Virginia Poly. Inst. & State Univ.		T18		T25				
Western Washington Univ.		T19	T15					

Roger Revelle Dies

Roger R. D. Revelle, prominent oceanographer and world leader in the application of science and technology to help solve problems in developing countries, died on July 15, 1991, at the age of 82. Revelle, a GSA Fellow, was Honorary Chairman of the 1991 Annual Meeting in San Diego.

He was a founder of the University of California, San Diego campus and served as director of the University's Scripps Institution of Oceanography from 1951 to 1964. A professor emeritus at the time of his death, Revelle was an active member of the UCSD community. His counsel and guidance were sought by national and international agencies in areas ranging from the environment and education to agriculture and world population. He was described in an article by *New York Times* science writer Walter Sullivan as "one of the two or three most articulate spokesmen for science in the western world."

Revelle is often described as the "grandfather of the greenhouse effect." His work on global warming was a major factor in his selection in November 1990 for the National Medal of Science, which he received from President George Bush. The citation reads "for his pioneering work in the areas of carbon dioxide and climate modification, oceanographic exploration presaging plate tectonics, and the biological effects of radiation in the marine environment, and studies of human population growth and global food supplies."

New Honorary Fellows

Lee Gladish

The achievements of three internationally known geoscientists will be recognized at the 1991 GSA Annual Meeting in San Diego at the end of October. GSA Council members, at their meeting last May, voted to confer Honorary Fellowship upon the three, who represent various disciplines and localities around the world. They are Valdar Jaanusson of Stockholm, Sweden; Hans Laubscher of Basel, Switzerland; and Richard L. Stanton of Armidale, New South Wales, Australia.

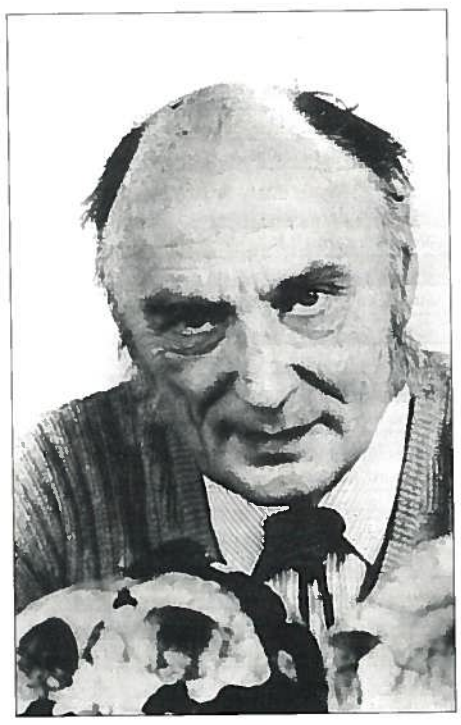
GSA Honorary Fellowships are awarded to outstanding geologists who have distinguished themselves internationally through their geological work or have rendered special service to the Society. Most Honorary Fellows live outside North America.

Valdar Jaanusson

Some of his fellow geoscientists refer to Jaanusson as a Renaissance man in paleontology and in stratigraphy; others refer to him simply as "Mr. Ordovician." Being born in Nömme, Estonia, has enabled Jaanusson to play a key role in many forums, conferences, and field trips as an intermediary between western and Soviet geoscientists. His scientific contributions are all the more remarkable for his difficult early years and the continuing emotional issues experienced by anyone from the Baltic republics.

Jaanusson did his undergraduate and graduate work at Uppsala University, earning his Doctor of Science in 1957. He taught at Uppsala until 1962, when he was named curator in charge of fossil invertebrates at the Swedish Museum of Natural History, Stockholm. On leave from that position, he returned to teaching at Uppsala during 1966–1967 and then taught at Ohio State University during 1971–1972. In 1982 he was named Professor and Head of the Department of Palaeozoology, Swedish Museum of Natural History, a position equivalent to Director of the Museum of Natural History of the Smithsonian Institution.

Jaanusson's doctoral thesis, which dealt with Ordovician ostracodes, is considered a major contribution to knowledge of fossil arthropods. He had previously published papers on trilobites, brachiopods, and Ordovician stratigraphy of the Baltic province. He has continued to contribute significant studies of ostracodes, trilobites, and graptolites, and in an early paper (1957) looked into the functional mechanics of the articulate brachiopod hinge and laid the groundwork for building a taxonomic framework for this group.



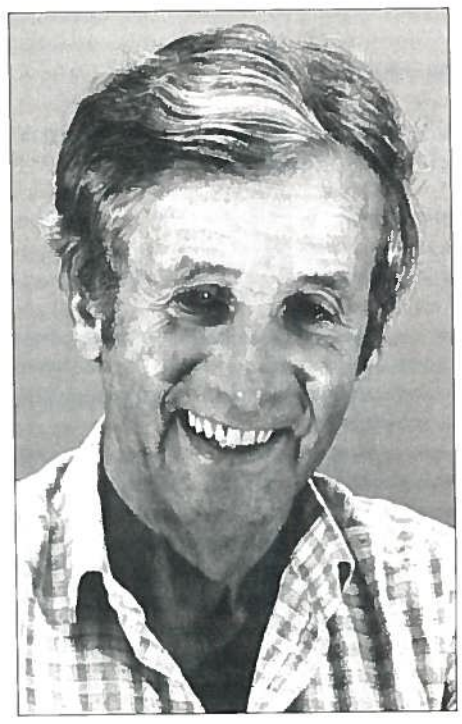
Jaanusson is not just a paleontologist, however. He has conducted and published some of the most detailed and meaningful studies ever made of carbonate textures and their depositional significance; he has lifted Baltic Ordovician stratigraphy from a disorganized and highly provincial set of poorly defined units to a system of precisely defined units that are applicable throughout the Balto-Scandic province.

Hans Laubscher

Laubscher is one of the world's leading structural geologists. His main contributions involve the kinematics of folding; reconstruction of folded belts, particularly the Alpine and Mediterranean folded belts; and the role of the Ivera body as representative of continental mantle. More recently Laubscher has been involved with interpretation of deep seismic profiles.

As an innovator and creative scientist on the structural and tectonic evolution of the Alpine system, with particular attention to the Jura Mountains and the southern Alps, Laubscher's early works on the Jura were well ahead of their time. His early studies demonstrated the critical importance of three-dimensional palinspastic restoration in the Jura because of the map-view curvature and the presence of large-displacement strike-slip faults, a study that is still being pursued today. His later studies on retrodeformation of the Alps also preceded modern attempts with balanced cross-section techniques, but his research has not been restricted to Alpine geology. He has conducted field studies in northeastern South America, in the Andean chain, and in the northwestern U.S. Cordillera, the latter in the late 1970s and early 1980s when he completed the most insightful analysis of deformation in the Columbia Plateau ever undertaken to that time.

He earned his Ph.D. at the University of Basel in 1947 and spent the next 10 years as a structural geologist for Mobil Oil in Venezuela. Since then he



has taught at the University of Basel, where he served as professor and chairman of the Department of Geology, and at the University of Illinois. From 1964 to 1968 he served on the Swiss Committee for Upper Mantle project; from 1968 to 1976 as secretary of the Commission of Structural Geology, IUGS; and from 1978 to 1981 as adviser for the Washington Public Power Supply System. Despite his recent retirement from the University of Basel, he continues to be a highly productive researcher.

Richard L. Stanton

Stanton's contributions to geology are in mineral deposits, economic geology, metamorphic petrology, and volcanology. His early advocacy in 1958, just three years after earning his Ph.D. from the University of Sydney, of a synsedimentary origin for rich, volcanic-hosted massive base-metal sulfide ores put him among the earliest to offer this new and innovative understanding of synsedimentary origins. Although highly controversial, and not widely accepted at the time, it preceded by a decade the direct seafloor observations that ultimately confirmed its validity. His publications on the evidence for a synsedimentary origin for world-class deposits, such as at Mt. Isa and Broken Hill, Australia, earned him the respect of economic geologists everywhere. His studies and interpretations of the premetamorphic origin of scores of sulfide deposits, and the effects of high-grade metamorphism on these ores, spawned a whole school of sulfide metamorphic petrologists.

"Just ordinary rocks produced by normal rock-forming processes" is the way Stanton described ores in his very successful book *Ore Petrology*, published in 1972. The book has been widely used in universities for nearly 20 years and has provided new approaches to, and understanding of, the petrology of metallic ores.

His current research activities involve fundamental work on the petrochemistry, petrogenesis, and stratigraphy of volcanic rocks and sequences in volcanic island arcs of the western Pacific and their relevance to the origin of volcanogenic massive base metal sulfide deposits.

In addition to helping to reorder the thinking on the origin of sulfide deposits, Stanton has been a mining geologist for Broken Hill South Limited; has done field work on numerous occasions in the Solomon Islands and New Caledonia; and has taught both undergraduate and graduate courses at the University of Sydney, and at the University of New England in Armidale, New South Wales, Australia. ■

GSA Awards Research Grants for 1991

June Forstrom, Research Grants Administrator

The GSA Committee on Research Grants met in Boulder, Colorado, in April and awarded $278,526 to 240 student applicants and a total of $12,000 for research to two postdoctoral candidates.

Of the 240 proposals recommended for support, 90 were master's proposals and 150 were doctoral proposals. The size of the average award increased from $787 in 1990 to $1161 this year. Proposal requests totaled $647,293.

The Committee's budget included $150,000 from the Penrose Endowment, $125,000 from the National Science Foundation, $3000 income from the Harold T. Stearns Fund, and $4900 for awards from four GSA Divisions: Engineering Geology, Hydrogeology, Sedimentary Geology and Structural Geology and Tectonics. It also included $27,800 from the GSA Foundation as follows: $1300 from the Gretchen L. Blechschmidt Fund, $600 from the Cox Fund (Geophysics Division Award), $1400 from the Dillon Fund for Alaska Research, $500 from the Minority Funds, $15,000 from the Foundation Research Fund (which includes $6700 from oil companies), and $9000 in Unrestricted Funds from Geostar and Century Challenge. The Gladys W. Cole and W. Storrs Cole Awards were funded by income from the two Cole Award Funds, $3000 from GSA and $9000 from the GSA Foundation.

Committee members for 1991 are Chairman Patricia H. Cashman, members John A. Breyer, Richard A. Davis, Jr., Howard W. Day, Molly Fritz Miller, Stephen G. Wells, and National Science Foundation conferee Thomas O. Wright. There were 493 student applicants this year.

Cole Awards for Postdoctoral Research

The Gladys W. Cole Memorial Research Award for 1991 went to Stephen Gene Wells of the University of California, Riverside, to support his project titled "Surficial Processes and Geomorphic Evolution of Desert Pavement Landscapes." This award, established in 1980, is restricted to support of research for the investigation of the geomorphology of semiarid and arid terrains in the United States and Mexico.

The W. Storrs Cole Memorial Research Award for research in invertebrate micropaleontology was established in 1989. The first award was presented this year to Robert C. Thunell, University of South Carolina, for his project "Seasonal Changes in the Depth Stratification of Planktonic Foraminifera."

Eligibility for both Cole awards is restricted to GSA Fellows between 30 and 65 years of age.

Student Awards

Gretchen L. Blechschmidt Research Award. The family and friends of Gretchen Louise Blechschmidt established a fund in her memory in 1990 to support research for women in the geological sciences. The first presentation of the award was made this year. The recipient is Dawn Y. Sumner, Massachusetts Institute of Technology, for "Massive Carbonate Precipitation on the Seafloor and Its Effects on Diagenesis in the Late Archean Campbellrand-Malmani Platform, South Africa."

John T. Dillon Alaska Research Award. This award was established in memory of John Dillon, who was particularly noted for his radiometric dating work in the Brooks Range, the results of which have had a major impact on the geologic understanding of this mountain range. The 1991 recipient is Jeffrey M. Amato, Stanford University, for "Interrelation of Magmatism, Metamorphism, and Deformation, Kigluaik Mountains, Seward Peninsula, Alaska."

Robert K. Fahnestock Award. This grant is awarded to the applicant with the best proposal in sediment transport or related aspects of fluvial geomorphology. The 1991 recipient is David Joseph Topping, University of Washington, for his project titled "Construction of a Detailed Flow and Sediment-transport Model for Gravel Transport on Alluvial Fans."

Harold T. Stearns Fellowship Award. The three recipients of this award, for research on aspects of the geology of Pacific islands and the circum-Pacific region, are Raymond E. Beiersdorfer, University of California, Davis, for "Metamorphic Petrology of Pumpellyite-Actinolite Facies Schists from the South Island, New Zealand"; Charles J. Greig, University of Arizona, for "Accretion History of the Stikine Terrane, from U-Pb Geochronology and Provenance of Detrital Zircons, Jura-Cretaceous Bowser Basin and Basement Rocks, Northwestern British Columbia, Canada"; and Kennen S. Tillman, Brown University, for "Evolution of a Convergent Plate Boundary in Central Taiwan, Republic of China."

Industrial Donations and Awards. Donations from Marathon Oil Foundation ($4500), Mobil Oil Corporation ($2000), and Amoco Production Company ($200) are funding grants to the following applicants: Paul Belasky, University of California, Los Angeles, for "Permian Fusulinids and Corals of the Koryak Region, USSR: Aid to Longitudinal Constraints in Paleogeographic Reconstructions of the Pacific Region"; Paul D. Howell, University of Michigan for "Subsidence History of the Michigan Basin"; Jonathan Lucas Jee, University of Florida, for "Geologic Evolution of Eocene Strata of the Western Florida Carbonate Platform"; L. (Koldo) Nunez-Betelu, University of Calgary, for "Regional Palynology, Stratigraphy, Sedimentology and Hydrocarbon Potential of the Kanguk Formation (Upper Cretaceous), Canadian Arctic Archipelego"; Juan Contreras Perez, National University of Mexico, for "Mechanical Instability of Carbonate Platform Margins."

Outstanding Mention. The Committee on Research Grants specially recognized 23 of the proposals as being of exceptionally high merit in conception and presentation: Eric Beam, University of Texas, Austin, for "Deformation in the Footwall of the Maclaren Glacier Metamorphic Belt"; Raymond E. Beiersdorfer, University of California, Davis, for "Metamorphic Petrology of Pumpellyite-Actinolite Facies Schists from the South Island, New Zealand"; Paul Belasky, University of California, Los Angeles, for "Permian Fusulinids and Corals of the Koryak Region, USSR: Aid to Longitudinal Constraints in Paleogeographic Reconstructions of the Pacific Ocean"; Julie Dee Bell, Bowling Green State University, for "Microstructural History and the Partitioning of Strain Between Deformation Mechanisms in a Quartz Arenite of the Central Appalachian Foreland"; J. Daniel Bryant, Columbia University, for "Trace Element and Stable Isotopic Analyses of late Miocene Fossil Horses from Burge Quarry, Nebraska"; Michael D. Campbell, University of California, Los Angeles, for "Compositional Variations in Upper Cretaceous Conglomerates from Several Tectonic Blocks of the Western Transverse Ranges"; John M. Eiler, University of Wisconsin, Madison, for "Micro-analytical Stable Isotopic Studies of Diffusion and Reaction Domains in Adirondack Granulites: Constraints on Metamorphic History"; Michael B.J. Foster, University of Minnesota, Minneapolis, for "Identification of Septic System Effluent in Ground Water by Deconvolution of Small Catchment Hydrochemistry"; Charles J. Greig, University of Arizona, for "Accretion History of the Stikine Terrane, from U-Pb Geochronology and Provenance of Detrital Zircons, Jura-Cretaceous Bowser Basin and Basement Rocks, Northwestern British Columbia, Canada"; Bernard A. Housen, University of Michigan, for "Effect of Cleavage Development on Magnetite and Its Remanence: Rotation or Recrystallization?"; Paul D. Howell, University of Michigan, for "Subsidence History of the Michigan Basin"; Richard J. Nevle, Stanford University, for "The Effects of Dikes on Permeability and Hydrothermal Alteration of Layered Gabbros, the Kap Edvard Holm Complex, East Greenland"; Susan L. Richardson, Yale University, for "An Investigation of the C-value Paradox in Foraminiferans"; Raymond R. Rogers, University of Chicago, for "Taphonomic Transect through the Upper Cretaceous Two Medicine and Judith River Formations, Northwestern and North-central Montana"; Kathryn A. Schubel, SUNY at Binghamton, for "Formation and Diagenesis of Holocene/Pleistocene Great Basin Tufas"; David C. Smith, Georgia State University, for "Microstructural and Geochemical Analyses of Mylonites and Cataclasites in the Bitterroot Mountains, Montana"; Richard E. Smith, Texas A&M University, for "The Evolution of Fluid Pressure in a Deforming Thrust Terrane"; Sharon M. Stern, University of North Carolina, Chapel Hill, for "Field and Experimental Studies of Monocline Formation, East Kaibab Monocline, Utah"; Dawn Y. Sumner, Massachusetts Institute of Technology, for "Massive Carbonate Precipitation on the Seafloor and Its Effects on Diagenesis in the Late Archean Campbellrand-Malmani Platform, South Africa"; Kennen S. Tillman, Brown University, for "Evolution of a Convergent Plate Boundary in Central Taiwan, Republic of China"; David Joseph Topping, University of Washington, for "Construction of a Detailed Flow and Sediment-transport Model for Gravel Transport on Alluvial Fans"; Maya M. Wheelock, Johns Hopkins University, for "In Situ Magmatic Differentiation: The Formation of Granophyres in Mafic Sills"; Robert S. Young, Duke University, for "The Impact of Sea-Level Rise on the Coastal Wetlands in Pamlico and Albemarle Sounds, North Carolina: A Study of Wetland Dynamics."

Other Successful Applicants. Other applicants recommended for funding are the following: Lon D. Abbott, Mark Abbott, Benjamin N. Adams, Gerardo J. Aguirre-Diaz, C. Brannon Andersen, Thomas R. Armstrong, Andres Aslan, Matthew Charles Averill, Paul Alex Azevedo, Susan R. Baron, Jolanta Barbara Bednarczyk, Nellena Beedle, Gorden L. Bell, Jr., Vladimir Benes, Laura Martin Benninger, Kenneth A. Bevis, Brian E. Bodenbender, Stefan S. Boettcher, Wendy A. Bohrson, Cleone Botelho, Theresa M. Boundy, William D. Briggs, Sanford L. Britt, Cheryl L. Brown, Kathleen M. Browne, Michael Patrick Bunds, Roland Burgmann, Patrick A. Burkhart, Beverly A. Burns, Patricia M. Butcher, John O.D. Byrd, Anthony J. Caldanaro, Jr., Marta Lucia Calvache, Phyllis A. Camilleri, Patricia A. Campbell, Enrique A. Carbillido-Sanchez, Robert W. Carr, David Paul Cheney, Tadiwos Chernet, John W. Christensen, Jr., Douglas H. Clark, Drew M. Clemens, Janet E. Coker, Katherine A. Connors, Martz C. Corbin, David Irving Cordero, Frank Aldemaro Corsetti, Ronadh Cox, Gregg A. Crandall, J. Warner Cribb, Lisel D. Currie, Kimberley A. D'Arcy, Benjamin F. Dattilo, Marybeth Victoria Davies, John Steven Davis, Cole Davisson, Sylvia Maria de Araujo, David L. Dettman, Carl N. Drummond, Douglas K. Dvoracek, Elizabeth A. Eide, Harold Ekstrom, Marcia A. Escamilla, Timothy Fagan, Christopher M. Fedo, John Field, Jeffrey A. Fillipone, Robert P. Fillmore, Haakon Fossen, Daniel L. Frederick, Dorothy E. Freidel, Julio Friedmann, David J. Fruit, Susan J. Fuertsch, Catherine L. Gaskin, James Donald Gleason, Paul Denis Godin, Lawrence I. Goldman, Carlos M. Gonzales-Leon, Michael D. Green, Kenneth Grossenbacher, Michael J. Grubensky, Paul R. Haberstroh, Catherine Ann Hajcak, Robyn Hannigan, Kimberly A. Hannula, Douglas R. Hardy, Joel T. Harper, Robert Harrington, Douglas E. Harris, Kevin R. Hayes, Rosalyn K. Hayward, Christoph E. Heubeck, Stephen C. Hildreth, Jr., Ronald J. Hill, Margaret A. Hodgkins, James E. Holl, Kathryn Hoppe, Linda L. Horn, Noel C. Howe, Audrey D. Huerta, Jane W. Hultberg, Donna L. Hunt, Lewis Edward Hunter, Peter J. Hutchinson, Robert Matthew Joeckel, Beverly J. Johnson, Anthony T. Jones, Grigorios D. Kasselas, Myra Keep, Karan S. Keith, Mohammed Khalequzzaman, Glenn A. Klimchuk, Gretchen Kohler, Khib A. Kugler, Maureen Palanker Leshendok, Xing Li, Anneliese Lilje, Thomas R. Loftin, Coleen Love, Changsheng Lu, Gang Lu, Ken MacLeod, Robert Bruce MacNaughton, Mitchell John Malone, Jane Masterson, David P. Mayo, Brian W. McArdell, Eric McDonald, Richard R. McDonald, Mitchell G. McGinnis, Jerry McManus, Mario Mejia-Navarro, Kirsten Margaret Menking, Raoul Miller, William G. Minarik, Jeremy Neil Mitchell, Barbara J. Munn, Matthew W. Nyman, Amy L. Ollendorf, Peter Osmolovsky, Stephen Palmes, Shannon M. Parsons, Tom Parsons, William P. Patterson, Jane N. Pedrick, Andrew P. Perham, Andrew Perry, William N. Pizzolato, James J. Pospichal, Stephen S. Potts, Stuart P. Raeburn, Troy Rasbury, Michael G. Rasmussen, Mark Andrew Rathmell, Robert M. Reed, Robert W. Reynolds, Timothy Patrick Rose, Steve Paul Rowe, Kaustuv Roy, Nita Sahai, Apostolos Sarris, Mary Ellen Satterfield, Stephen J. Schaefer, Linda Marie Schieber, Jay A. Schneider, Michele Ann Seidl, Michelle A. Seward, Peng Sha, Mary Amy Sheldon, Glenn Shubert Shell, Jr., Mary A. Siders, Lynn Simmons, Teri R. Smith, Michael J. Soreghan, Christopher C. Spaur, Ian Stewart Spooner, Andrew W. Staley, Robert A. Stevens, Michael A. Stewart, Judith A. Lopas Stoopes, Jeffrey C. Strasser, Uwe Strecker, Richard J. Stuck, Matt Stuk, Colin D. Sumrall, Carol M. Tang, Wendy L. Taylor, Cora Grace Terrell, Richard E. Terry, Robert C. Thomas, Stephen D. Thorne, Kenneth J. Tobin, Raymond Torres, Matthew W. Totten, Michelle Troksa, Steve Van Winkle, Ping Wang, Thomas L. Weaver, Katherine J. Whidden, Marion Wiggins, Rodney A. Willard, James H. Willemin, Steven Kay Williams, Thomas Edward Williamson, Joseph E. (Ted) Worthington, Juanjuan Xia, John Christopher Yarnold, J. Douglas Yule, John F. Zaengle, William G. Zempolich, Susan Zimmerman, Marchell Marie Zoglman. ■

GSA Divisions and Sections Award 1991 Grants

June Forstrom, Research Grants Administrator

Division Research Grants

Seven of the 12 GSA divisions offer grants for outstanding student research. Divisions that do not currently offer grants are Archaeological Geology, Geoscience Education, History of Geology, International, and Planetary Geology.

The **Coal Geology Division** presented its fourth annual Antoinette Lierman Medlin Scholarship Award in 1991 to Yalan Tang, University of Kentucky, for her proposal titled "Petrography, Mineralogy and Trace Element Geochemistry of the Fire Clay Coal, Eastern Kentucky Coal Field; Implications Concerning the Peat-Forming Environments." The Division considers proposals from any full-time graduate student who is conducting research in coal geology.

The second annual **Engineering Geology Division** Anniversary Award for outstanding student research was presented this year to Kevin R. Hayes, a candidate for the M.S. degree at Pennsylvania State University. The title of his research project is "A Study of Fracture Systems and Fossil Stress in the Allegheny Plateau near Ebensburg, Pennsylvania."

The **Geophysics Division** presented its fourth annual Allan V. Cox Student Research Award in 1991 for an outstanding student research proposal submitted to the GSA Research Grants Program. David J. Fruit, a Ph.D. candidate at the University of Oklahoma received the award for his research project titled "Paleomagnetism of the Pennsylvanian Belden Formation on an Asymmetric Fold, Sweetwater Creek, N.W. Colorado."

The second annual awards for outstanding student research from the **Hydrogeology Division** were presented in 1991 to six students: John Field, University of Arizona, for "Towards an Accurate Model of Alluvial Fan Flooding"; Michael B.J. Foster, University of Minnesota, Minneapolis, for "Identification of Septic System Effluent in Ground Water by Deconvolution of Small Catchment Hydrochemistry"; Karan S. Keith, Indiana University, for "The Effect of Selected Chemical Pollutants on the Hydraulic Conductivity of Smectite, Palygorskite and Sepiolite Clay Blends"; Teri R. Smith, Kent State University, for "The Relationship of Iron Bacteria Geochemistry to Trace Metal Distribution in an Acid Mine Drainage Stream, N.E. Ohio"; Matt Stuk, Western Michigan University, for "Temporal Variations of Nitrogen in a Shallow Aquifer Impacted by Irrigated Agriculture"; Robert S. Young, Duke University, for "The Impact of Sea-level Rise on the Coastal Wetlands in Pamlico and Albemarle Sounds, North Carolina: A Study of Wetland Dynamics."

The **Quaternary Geology and Geomorphology Division** awarded Mackin grants to two students in 1991. The two doctoral degree candidates who received the award are: Eric Von Mcdonald, University of New Mexico, for "The Influence of Climate Change and Dust Flux on Soils Developed on Quaternary Deposits in Arid and Semi-arid Environments," and Robert S. Young, Duke University, for "The Impact of Sea-level Rise on the Coastal Wetlands in Albemarle and Pamlico Sounds, North Carolina: A Study of Wetland Dynamics."

Thirty-five Mackin grants have been awarded since the Division made its first award in 1974.

The **Sedimentary Geology Division** presented its fifth annual award for an outstanding student research proposal submitted to the GSA Research Grants Program to Kathryn A. Schubel, M.S. candidate at the State University of New York at Binghamton. The award was for her research project titled "Formation and Diagenesis of Holocene/Pleistocene Great Basin Tufas."

The **Structural Geology and Tectonics Division** presented its sixth annual award for outstanding student research in 1991. The recipient is Richard E. Smith, a doctoral degree candidate at Texas A&M University. His project title is "The Evolution of Fluid Pressure in a Deforming Thrust Terrane."

Section Research Grants

The **North-Central Section** did not award any student research grants in 1991; they will award grants to undergraduate students within the North-Central Section beginning in 1992.

The **South-Central Section** presented its fourth annual research awards to qualified students in the section in 1991. Recipients are students who attend a college or university in the South-Central Section geographic area and have submitted applications to the GSA Research Grants Program. The awards presented this year went to Cheryl L. Metz, Texas A&M University, for "Stratigraphic, Sedimentologic and Paleoecologic Analysis of the Temporal and Areal Distribution of Late Cretaceous (mid-Campanian) Storm Deposits; West Texas to East-Central Utah," and to Lee S. Potter of the University of Texas, Austin, for "Trace Element and Isotopic Variation along Strike in the Trans-Pecos Alkalic Belt, West Texas."

GSA's **Southeastern Section** awarded research grants to 13 qualified students within the section. They are Mark G. Adams, University of North Carolina, Chapel Hill, for "Pressure and Temperature History of and the Role of Fluids in the Emplacement of the Beech Mountain Thrust Sheet, Northwestern North Carolina"; Daniel A. Cenderelli, West Virginia University, for "Analysis of Debris-flow Processes and Sedimentology in Baxter State Park, Maine"; Donald W. Harrison, University of Alabama, for "Regional Correlation of Lignites Occurring in the Midway and Wilcox Groups of Southern Alabama and Eastern Mississippi Assessment of Variations in Coal Characteristics"; Judith Kreps, Georgia State University, for "Stratigraphy, Geochemistry, and Correlation of Neogene Basalts, Beaverhead and Madison Counties, Montana"; Srinivasan Krishnan, University of Tennessee, Knoxville, for "Depositional History and Diagenesis of Middle Cambrian Maryville Limestone, East Tennessee: Platform Margin-to-Basin Transition"; Steven P. Lundblad, University of North Carolina, Chapel Hill, for "Controls on Carbonate Platform Differentiation, Northern Apennines, Italy"; William T. Maul, Florida Institute of Technology, for "Depositional Interpretation of Holocene Marine Sediment Sequences Using Benthic Foraminifera"; Stephen A. Schellenberg, University of South Florida, for "Biostratigraphy and Amino Acid Correlation of Quaternary Deposits in San Salvador, Bahamas: Cerion Landsnails as a Multi-purpose Tool"; James G. Spratt, University of South Florida, for "Geophysical Investigation and Evaluation of the Hydrologic Significance of Fractures in a Tertiary Carbonate Aquifer"; Qi Su, University of North Carolina, Chapel Hill, for "Geochronological and Isotopic Studies of Crossnore-type Plutons in the Blue Ridge of the Southern Appalachians: Effects of Ductile Deformation"; Charles H. Trupe, University of North Carolina, Chapel Hill, for "A Comparative Study of Deformation and Metamorphism in the Blue Ridge Thrust Complex, Western North Carolina and Eastern Tennessee"; William K. Waggoner, University of Tennessee, Knoxville, for "Fluid Flow and Fluid-rock Interactions in the Stone Mountain Thrust, Western Blue Ridge Province, North Carolina"; Kathleen A. Ward, West Virginia University, for "Metamorphism and Deformation of Metapelites from Phippsburg Peninsula, Maine."

The remaining three sections—Northeastern, Rocky Mountain, and Cordilleran—do not currently offer research grants. ■

MEETINGS

■ Indicates new or changed information

GSA Penrose Conferences

October 1991

Development and Evolution of Foreland Basins, October 6–11, 1991, Oliana, Spain. Information: James H. Meyers, Dept. of Geology, Winona State University, Winona, MN 55987; (507) 457-5266 (dir.), (507) 457-5000 (dept.); fax 507-457-5586; Douglas W. Burbank, Dept. of Geological Sciences, University of Southern California, Los Angeles, CA 90089-0740; Lee J. Suttner, Dept. of Geology, Indiana University, Bloomington, IN 47405; Cai Puigdefabregas, Dept. de Politica Territorial, Servei Geologica de Catalunya, Diputacio, 92, 5e, 08015 Barcelona, Spain.

March 1992

■ **Continental Tectonics and Magmatism of the Jurassic North American Cordillera**, March 28–April 3, 1992, Lake Havasu City, Arizona. Information: David M. Miller, U.S. Geological Survey, 345 Middlefield Road, MS-975, Menlo Park, CA 94025, (415) 329-4923, fax 415-329-4936; or Richard M. Tosdal (same address), (415) 329-5423.

May 1992

■ **The Origin and Evolution of the Coast Mountains, British Columbia, Yukon, and Alaska**, May 16–21, 1992 (tentative), Whistler, British Columbia. Information: George E. Gehrels, Dept. of Geosciences, University of Arizona, Tucson, AZ 85721; (602) 621-6026, fax 602-621-2672; Maria Luisa Crawford, Dept. of Geology, Bryn Mawr College, Bryn Mawr, PA 19010; (215) 526-5111, fax 215-526-5086; James W.H. Monger, Geological Survey of Canada, 100 West Pender Street, Vancouver, B.C., Canada V6B 1R8; (604) 666-6743 or 0529, fax 604-666-1124.

Other Meetings

September

International Symposium on Computer Applications in Geoscience, September 2–6, 1991, Beijing, China. Information: Zhang Bojun, 31 Xue Yuan Rd., Beijing 100083, China; phone 2012233, ext. 312; fax 2024674; telex 222484 GBCC CN.

Geometry of Naturally Deformed Rocks (John Ramsay Meeting), September 9–11, 1991, Zürich, Switzerland. Information: E. Pour, Geologisches Institut, ETH-Zentrum, CH-8092, Zürich, Switzerland; phone 256 36 80; fax 252-70-08.

International Symposium on Fossil Cnidaria Including Archaeocyatha and Porifera, September 9–14, 1991, Münster, Germany. Information: Fossil VI. Cnidaria, Pferdegasse 3, D-4400 Münster, Germany.

Gold and Platinum in Central Africa, September 11–13, 1991, Bujumbura, Burundi. Information: W. Pohl, Institute of Geosciences, Technical University, P.O. Box 3329, D-33 Braunschweig, Germany.

Wyoming Geological Association 42nd Annual Fall Field Conference: Mineral Resources of Wyoming, September 14–18, 1991, Laramie, Wyoming. Information: Gary A. Winter, General Chairman, P.O. Box 2957, Casper, WY 82602; (307) 261-5463, fax 307-261-5136.

Integrating Geographic Information Systems and Environmental Modeling International Conference, September 15–18, 1991, Boulder, Colorado. Information: GIS/Modeling Conference Secretariat, NCGIA, University of California, Santa Barbara, CA 93106; (805) 893-8224; fax 805-893-8617; E-mail ncgia @ncgia.ucsb.edu or ncgia@voodoo.bitnet.

Second International Conference on the Abatement of Acidic Drainage, September 16–18, 1991, Montreal, Québec. Information: Pamela Friedrich, Centre des Recherches Minérales, 1665, boulevard Hamel, Édifice 2, 1er étage, Québec, Québec G1N 3Y7, Canada.

2nd International Symposium on Environmental Geochemistry, September 16–19, 1991, Uppsala, Sweden. Information: Mats Olsson, Dept. of Forest Soils, Swedish University of Agricultural Sciences, Box 7001, S-750 07 Uppsala, Sweden; phone 46-18-672212; fax 46-18-300831.

Rocky Mountain Association of Geologists Field Conference: Coalbed Methane of Western North America, September 17–20, 1991, Glenwood Springs, Colorado. Information: Rocky Mountain Association of Geologists, 730 17th St., Suite 350, Denver, CO 80202, (303) 573-8621.

Geotechnica: International Trade Fair and Congress for Geosciences and Technology, September 18–21, 1991, Cologne, Germany. Information: Alfred-Wegener-Stiftung zur Förderung der Geowissenschaften, Postfach 20 14 48, D-5300 Bonn 2, Germany; phone (0228) 302-260 261.

22nd Annual Geomorphology Symposium: Periglacial Geomorphology, September 21–22, 1991, Buffalo, New York. Information: John C. Dixon, Department of Geography, University of Arkansas, Fayetteville, AR 72701; (501) 575-5808.

Denver GeoTech/Geochautauqua '91, A Geocomputing Conference, September 21–24, 1991, Denver, Colorado. Information: Mark Cramer, GeoTech, 11100 E. Dartmouth Avenue, #190, Aurora, CO 80014; (303) 752-4951; fax 303-752-4979.

Hydrocarbon Contaminated Soils: Analysis, Fate, Environmental & Public Health Effects, and Remediation, Sixth National Conference, September 23–26, 1991, Amherst, Massachusetts. Information: Paul T. Kostecki, Division of Public Health, University of Massachusetts, Amherst, MA 01003; or Linda S. Rosen, Morrill Health Program, University of Massachusetts, Amherst, MA 01003-0081; (413) 545-2934.

Second Hutton Symposium on Granites and Related Rocks, September 23–28, 1991, Canberra, Australia. Information: ACTS, GPO Box 2200, Canberra City, ACT 2601, Australia.

15th International Cartographic Conference–9th General Assembly of the International Cartographic Association, September 23–October 1, 1991, Bournemouth, England. Information: James R. Carter, Academic Computing, Illinois State University, Normal, IL 61761; (309) 438-3758; fax 309-438-5319.

International Mine Water Association Fourth Congress, September 25–30, 1991, Ljubljana, Yugoslavia. Information: Miron Veselic, S.P. Geoloski Zavod Ljubljana, Dimiceva 14, 61000 Ljubljana, Yugoslavia; fax 38 61 371 557.

56th Annual Field Conference of Pennsylvania Geologists: The Geology of South Mountain, September 26–28, 1991, Carlisle, Pennsylvania. Information: Field Conference of PA Geologists, P.O. Box 1124, Harrisburg, PA 17108-1124; (717) 787-2169.

New England Intercollegiate Geological Field Conference, September 28–30, 1991, Princeton, Maine. Information: Allan Ludman, Department of Geology, Queens College, 65-30 Kissena Blvd., Flushing, NY 11367-0904.

1991 American Association of Petroleum Geologists International Conference and Exhibition, September 29–October 2, 1991, London, England. Information: 1991 AAPG International Conference, P.O. Box 979, Tulsa, OK 74101-0979.

Underwater Mining Institute, September 29–October 2, 1991, Honolulu, Hawaii. Information: Allen H. Miller, UMI Coordinator, Underwater Mining Institute, 1800 University Ave., Madison, WI 53705; (608) 262-0645; fax 608-263-2063.

■ **Association of Engineering Geologists Annual Meeting**, September 29–October 5, 1991, Chicago, Illinois. Information: Theodore R. Maynard, Bureau of Engineering, Department of Public Works, 320 North Clark Street, Room 700, Chicago, IL 60610; (312) 744-3530.

Society of Organic Petrology 8th Annual Meeting, September 30–October 1, 1991, Lexington, Kentucky. Information: Jim Hower, Center for Applied Energy Research, 3572 Iron Works Pike, Lexington, KY 40511; (606) 257-0261; fax 606-257-0220.

October

■ **Seismic Anisotropy in the Mantle and Geodynamics of Orogenic Belts**, October 1–3, 1991, Montpellier, France. Information: Alain Vauchez, Laboratoire de Tectonophysique, Place Eugène Bataillon, 34095 Montpellier Cedex 05, France; phone 61-14-3602; fax 67-14-3603; telex 490944.

Clay Minerals Society 28th Annual Meeting, October 5–10, 1991, Houston, Texas. Information: Dave Pevear, Program Services/CM, 91, Lunar and Planetary Institute, 3303 NASA Rd. 1, Houston, TX 77058-4399; (713) 965-4452; fax 713-966-6115.

■ **Geothermal Resources Council Annual Meeting**, October 6–9, 1991, Sparks, Nevada. Information: Grace Mata, Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617-1350; (916) 758-2360.

Fifth International Congress on Pacific Neogene Stratigraphy and IGCP 246, October 6–10, 1991, Shizuoka, Japan. Information: V-CPNS-IGCP246 Organizing Committee, Geoscience Institute, Faculty of Science, Shizuoka University, Shizuoka 422, Japan; fax 81-542-37-9895.

Federation of Analytical Chemistry and Spectroscopy Societies and Pacific Conference on Chemistry and Spectroscopy, October 6–11, 1991, Anaheim, California. Information: FACSS, P.O. Box 278, Manhattan, KS 66502-0003; (301) 846-4797.

■ **36th Annual Midwest Ground Water Conference**, October 9–11, 1991, Indianapolis, Indiana. Information: William J. Steen, Indiana Department of Natural Resources, Division of Water, 2475 Directors Row, Indianapolis, IN 46241; (317) 232-4164.

New Mexico Geological Society 42nd Fall Field Conference: Sierra Blanca Basin–Ruidoso Region, October 9–12, 1991, Ruidoso, New Mexico. Information: Neil Whitehead III, New Mexico Bureau of Mines and Mineral Resources, Campus Station, Socorro, NM 87801; (505) 835-5752; fax 505-835-6333.

Rocky Mountain Friends of the Pleistocene Annual Field Trip, October 11–13, 1991, Lake Bonneville, Utah. Information: Richard Van Horn, U.S. Geological Survey, Box 25046, MS 966, Denver, CO 80225.

Tri-State (Illinois, Wisconsin, Iowa) Geological Field Conference, October 11–13, 1991, Charleston, Illinois. Information: Kaylin Johns, School of Adult and Continuing Education, Eastern Illinois University, Charleston, IL 61920.

■ **Eastern Section, Seismological Society of America**, October 14–16, 1991, Memphis, Tennessee. Information: Arch Johnston, CERI, Memphis State University, Memphis, TN 38152; (901) 678-2007; fax 901-323-2857; E-mail essa@bilbo.memst.edu.

International Symposium on Debris Flow and Flood Disaster Protection, October 14–20, 1991, Emeishan City, Sichuan Province, China. Information: Tong Yuling, International Research and Training Centre on Erosion and Sedimentation (IRTCES), P.O. Box 366, Beijing, China 100044; phone 8413372; telex 22786 ITCES CN; fax 8412539.

American Institute of Professional Geologists Annual Meeting, October 16–19, 1991, Gatlinburg, Tennessee. Information: Lawrence I. Benson, ERC/EDGE, P.O. Box 22879, Knoxville, TN 37933-0879; (615) 966-9761; fax 615-966-4155.

New York State Geological Association 63rd Annual Field Conference, October 18–20, 1991, Oneonta, New York. Information: James R. Ebert, Department of Earth Sciences, State University of New York, Oneonta, NY 13820-4015; (607) 431-3065; fax 607-431-2107.

International Symposium on Geological Hazards and Prevention, October 20–25, 1991, Beijing, People's Republic of China. Information: Chu Zhanchang, Secretariat, Organizing Committee, International Symposium on Geological Hazards and Prevention, 64, Funei St., Beijing, People's Republic of China; phone 658561-410.

Geological Society of America Annual Meeting, October 21–24, 1991, San Diego, California. Information: GSA, Meetings Dept., P.O. Box 9140, Boulder, CO 80301; (303) 447-2020; fax 303-447-1133.

■ **Society of Vertebrate Paleontology 51st Annual Meeting**, October 24–26, 1991, San Diego, California. Information: Maureen Gibbons or Barbara Groeger, SDNHM-SVP 91, Department of

Biology, San Diego State University, San Diego, CA 92182-0057; Maureen Gibbons: (619) 594-5387; Barbara Groeger: (619) 594-5686; fax 619-594-5676.

Brazilian Geophysical Society Second International Congress, October 28–November 1, 1991, Salvador City, Bahia, Brazil. Information: Brazilian Geophysical Society—SBGf, Alberto Brum Novaes, Universidade Federal da Bahia/UFBa-PPPG, Rua Caetano Moura 123, Federacão 40.210, Salvador BA, Brasil; phone 55-071-2370408.

Arbuckle Group Core Workshop and Field Trip, October 29–31, 1991, Norman, Oklahoma. Information: Kenneth S. Johnson, Oklahoma Geological Survey, University of Oklahoma, 100 East Boyd, Rm. N-131, Norman, OK 73019; (405) 325-3031.

November

■ **Geological Association of New Jersey 8th Annual Meeting and Field Trip**, November 1–2, 1991, King of Prussia, Pennsylvania. Information: Sue Halsey, 1 Heritage Court, West Trenton, NJ 08628; (609) 777-0339; fax 609-633-7950.

Hydrology and Hydrogeology in the '90s: Issues, Strategies and Technologies, November 3–7, 1991, Orlando, Florida. Information: AIH, 3416 University Ave. S.E., Minneapolis, MN 55414; (612) 379-1030.

■ **Carolina Geological Society 1991 Field Conference**, November 8–10, 1991, Murphy, North Carolina. Information: Stephen A. Kish, Dept. of Geology B-160, Florida State University, Tallahassee, FL 32306; (904) 644-2064.

5th International Circum-Pacific Terrane Conference, November 11–28, 1991, Santiago, Chile. Information: D. G. Howell, U.S. Geological Survey, MS 902, 345 Middlefield Rd., Menlo Park, CA 94025; (415) 329-5430.

Eastern Oil Shale Symposium, November 13–15, 1991, Lexington, Kentucky. Information: Geaunita H. Caylor, University of Kentucky/OISTL, 411 Breckinridge Hall, Lexington, KY 40506-0056; (606) 257-2820; fax 606-258-1049.

Clean Seas 91, International Conference on Marine Pollution, November 19–22, 1991, Valletta, Malta. Information: Lesley Ann Sandbach, Project Manager, Clean Seas 91, The Spearhead Group, Rowe House, 55-59 Fife Road, Kingston upon Thames, Surrey KT1 1TA, UK; phone 081 549 5831 (intl: + 44-81-549-5831); telex 928042 SPEARS G; fax 081-541-5657 (intl: + 44-81-541-5657).

Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Restoration, November 20–22, 1991, Houston, Texas. Information: Petroleum Hydrocarbons Conference/National Water Well Association, P.O. Box 182039, Dept. #017, Columbus, OH 43218; (614) 761-1711.

December

■ **Paleozoic-Mesozoic Inversion Tectonics, Southern Africa**, December 2–6, 1991, Cape Town, South Africa. Information: Maarten de Wit or Ian Ransome, Dept. of Geology, University of Cape Town, Rondebosch 7700, South Africa; phone 021-6502921/25; fax 021-6503783.

IGCP 264 Remote Sensing Spectral Properties (5th Meeting)—Geological Applications of Remote Sensing with Emphasis on Spectral Properties, December 2–12, 1991, Pune, India. Information: Melvin Podwysocki, Co-Chairman IGCP264, USGS, National Center, MS 913, Reston, VA 22092; fax 703-648-6057.

Mining Indonesia '91, December 4–7, 1991, Jakarta, Indonesia. Information: Eileen M. Lavine, Information Services, Inc., 4733 Bethesda Ave., #735, Bethesda, MD 20814; (301) 656-2942; fax 301-656-3179.

1992

February

6th International Symposium on Landslides, February 10–14, 1992, Christchurch, New Zealand. Information: ISL 1992 Secretariat, c/o Guthreys Pacific Ltd., P.O. Box 22-255, Christchurch, New Zealand; fax 643-790-175; telex NZ4243 Guthreys.

■ **U.S. Geological Survey 8th Annual McKelvey Forum on Energy Resources**, February 18–20, 1992, Houston, Texas. Information: Christine Turner, USGS, Box 25046 MS 939, Federal Center, Denver, Colorado 80225; (303) 236-1561.

First South Asia Geological Congress—GEOSAS-I, February 23–27, 1992, Islamabad, Pakistan. Information: Hilal A. Raza, GEOSAS-I Secretary General, Hydrocarbon Development Institute of Pakistan, P.O. Box 1308, Islamabad, Pakistan; phone 9251-823690 or 821417; telex 5516 HDIP PK; fax 9251-828773.

■ **GSA South-Central Section Meeting**, February 24–25, 1992, Houston, Texas. Information: Hans G. Avé Lallemant, Dept. of Geology and Geophysics, P.O. Box 1892, Rice University, Houston, TX 77251; (713) 527-4889.

Society for Mining, Metallurgy, and Exploration Annual Meeting, February 24–27, 1992, Phoenix, Arizona. Information: Meetings Department, SME, P.O. Box 625002, Littleton, CO 80162; (303) 973-9550; fax 303-979-3461.

March

■ **21st Computer Simulated Mineral Exploration Workshop**, March 3–30, 1992, Fontainebleau, France. Information: L. Zanone, Ecole des Mines de Paris, CGGM-IGM, 35, rue Saint-Honoré, 77305 Fontainebleau Cédex, France; phone (33 1) 64 69 49 30; telex 694 736 F; fax (33 1) 64 69 47 01.

Circum-Pacific Council for Energy and Mineral Resources Symposium, Sustainable Development: Energy and Mineral Resources and the Environmental Impact of Their Utilization in the Circum-Pacific Region, March 9–12, 1991, Bangkok, Thailand. Information: Mary Stewart, Circum-Pacific Council, 5100 Westheimer, Suite 500, Houston, TX 77056; fax 713-622-5360.

■ **GSA Southeastern Section Meeting**, March 18–20, 1992, Winston-Salem, North Carolina. Information: Paul D. Fullager, Dept. of Geology, CB 3315 Mitchell Hall, University of North Carolina, Chapel Hill, NC 27599-3315; (919) 962-0677.

Second Conference on Earthquake Hazards in the Eastern San Francisco Bay Area, March 25–28, 1992, Hayward, California. Information: Sue Ellen Hirschfeld, Dept. of Geological Sciences, California State University, Hayward, CA 94542; (415) 881-3486.

■ **GSA Northeastern Section Meeting**, March 26–28, 1992, Harrisburg, Pennsylvania. Information: Donald M. Hoskins, Pennsylvania Geological Survey, Dept. of Environmental Resources, P.O. Box 2357, Harrisburg, PA 17105; (717) 787-2169.

April

XVII General Assembly of the European Geophysical Society, April 6–10, 1992, Edinburgh, Scotland. Information: EGS Office, Postfach 49, 3411 Katlenburg-Lindau, Germany; phone (49) 5556-1440; fax 49-5556-4709; telex 965564 zil d; E-mail SPAN: LINMPI::EGS; EARN: U0085@DGOGWDG5.

American Association of Petroleum Geologists Southwest Section, April 12–14, 1992, Midland, Texas. Information: West Texas Geological Society, P.O. Box 1595, Midland, TX 79702; (915) 683-1573. (*Abstracts deadline: December 1, 1991.*)

■ **1992 International High-Level Radioactive Waste Management Conference**, April 12–16, 1992, Las Vegas, Nevada. Information: James Tulenko, Attn: TRANSACTIONS Office, American Nuclear Society, 555 N. Kensington Avenue, La Grange Park, IL 60525.

■ **Fifth Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP)**, April 26–29, 1992, Oakbrook, Illinois. Information: Mark Cramer, 11100 E. Dartmouth Ave., Suite 190, Aurora, CO 80014; (303) 752-4951. (*Abstracts deadline: November 1, 1991.*)

■ **GSA North-Central Section Meeting**, April 30–May 1, 1992, Iowa City, Iowa. Information: Raymond R. Anderson, Iowa DNR, Geological Survey, University of Iowa, 123 N. Capital St., Iowa City, IA 52242; (319) 335-1575.

May

■ **First Canadian Symposium on Geotechnique and Natural Hazards**, May 6–9, 1992, Vancouver, British Columbia. Information: Organizing Secretary, Geohazards '92, 970 Burrard St., Vancouver, BC V6Z 1Y3, Canada; (604) 663-1651; fax 604-663-1940.

Lower Palaeozoic of Ibero-America (International Conference, IGCP-IUGS/UNESCO) and International Workshop: Natural Resources of the Circum-Gondwanan Lower Palaeozoic, May 8–12, 1992, Mérida, Spain. Information: Juan Carlos Gutiérrez-Marco, Instituto de Geología Económica, Facultad de Ciencias Geologicas, 28040-Madrid, Spain; fax 34-1-5439162.

■ **GSA Cordilleran Section Meeting**, May 11–13, 1992, Eugene, Oregon. Information: A. Dana Johnston, Dept. of Geological Sciences, University of Oregon, Eugene, OR 97403-1272; (503) 346-5588.

■ **GSA Rocky Mountain Section Meeting**, May 13–15, 1992, Ogden, Utah. Information: Sidney R. Ash, Dept. of Geology, Weber State University, Ogden, UT 84408-2507; (801) 626-6908.

Pan-American Current Research on Fluid Inclusions (PACROFI IV), May 22–24, 1992, Lake Arrowhead, California. Information: Michael A. McKibben, Department of Earth Sciences, University of California, Riverside, CA 92521-0423; (714) 787-3444; fax 714-787-4324. (*Abstracts deadline: March 1, 1992.*)

The Euramerican Coal Province: Controls on Tropical Peat Accumulation in the Late Paleozoic, May 24–27, 1992, Wolfville, Nova Scotia, Canada. Information: John H. Calder, Nova Scotia Dept. of Mines and Energy, P.O. Box 1087, Halifax, Nova Scotia B3J 2X1, Canada; (902) 424-5364; fax 902-424-0528; or Martin R. Gibling, Dept. of Geology, Dalhousie University, Halifax, Nova Scotia B3H 3J5, Canada; (902) 494-2355.

■ **Project PANGEA (GSGP) Research Workshop**, May 24–29, 1992, Lawrence, Kansas. Information: Project Pangea, P.O. Box 5061, Station A, Champaign, IL 61825-5061; (217) 333-2076.

Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting, May 25–27, 1992, Wolfville, Nova Scotia, Canada. Information: Aubrey Fricker, General Secretary, Atlantic Geoscience Centre, Bedford Institute of Oceanography, P.O. Box 1006, Dartmouth, Nova Scotia B2Y 4A2, Canada; (902) 426-6759; fax 902-426-4465.

■ **Third International Conference on Engineering, Construction and Operations in Space**, May 31–June 4, 1992, Denver, Colorado. Information: Stein Sture, SPACE 92 Technical Co-Chairman, Dept. of Civil, Environmental, & Architectural Engineering, University of Colorado, Boulder, CO 80309-0428; (303) 492-7651; fax 303-492-7317.

June

■ **33rd U.S. Symposium on Rock Mechanics**, June 8–10, 1992, Santa Fe, New Mexico. Information: Wolfgang R. Wawersik, Geomechanics Division 6232, Sandia National Laboratories, Albuquerque, NM 87185; (505) 844-4342; fax 505-844-7354.

American Association of Petroleum Geologists Annual Meeting, June 21–24, 1992, Calgary, Alberta, Canada. Information: George Eynon, General Chairman, Bow Valley Industries, Ltd., P.O. Box 6610, Postal Station D, Calgary, Alberta, T2P 3R7, Canada; (403) 261-6100; or AAPG Convention Department, P.O. Box 979, Tulsa, OK 74101; (918) 584-2555.

Interpraevent 1992—Protection of Habitat against Floods, Debris Flows and Avalanches, June 29–July 3, 1992, Berne, Switzerland. Information: Interpraevent 1992, c/o Bundesamt für Wasserwirtschaft, Postfach 2743, CH-3001 Berne, Switzerland.

July

7th International Symposium on Water-Rock Interaction, July 13–22, 1992, Park City, Utah. Information: Yousif Kharaka, Secretary-General, U.S. Geological Survey, MS 427, 345 Middlefield Road, Menlo Park, CA 94025; (415) 329-4535; fax 415-329-5110.

■ **Society for Industrial and Applied Mathematics Annual Meeting**, July 19–24, 1992, Los Angeles, California. Information: SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688; (215) 382-9800; fax 215-386-7999; E-mail: siamconfs@wharton.upenn.edu. (*Abstracts deadline: January 6, 1992.*)

■ **International Committee for Coal Petrology 44th Meeting**, July 20–24, 1992, University Park, Pennsylvania. Information: Alan Davis, Penn State University, 205 Research Bldg. E, University Park, PA 16802; (814) 865-6544, fax 814-865-3573.

Northeastern Science Foundation–History of Earth Sciences Society

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Meeting on the History of Geology, July 29–August 1, 1992, Troy, New York. Information: Gerald M. Friedman, Northeastern Science Foundation, P.O. Box 746, Troy, NY 12181-0746; (518) 273-3247; fax (518) 273-3249.

August

29th International Geological Congress, August 24–September 3, 1992, Kyoto, Japan. Information: Secretary General, IGC-92 Office, P.O. Box 65, Tsukuba, Ibaraki 305, Japan; phone 81-298-54-3627; fax 81-298-54-3629; telex 3652511 GSJ J.

■ **IAS/SEPM Research Conference on Carbonate Stratigraphic Sequences: Sequence Boundaries and Associated Facies** (Emphasis on Outcrop and Processes Studies), August 30–September 3, 1992, La Seu, Spain. Information: Toni Simo, Dept. Geology and Geophysics, University of Wisconsin, 1215 W. Dayton St., Madison, WI 53706, (608) 262-5987; fax 608-262-0693; E-mail simo@geology.wisc.edu; or Mark Harris, Dept. Geosciences, University of Wisconsin, P.O. Box 413, Milwaukee, WI 53201, (414) 229-5452; or Evan Franseen, Kansas Geological Survey, 1930 Constant Ave., Lawrence, KS 66047, (913) 864-5317.

September

5th International Symposium on Seismic Reflection Profiling of the Continental Lithosphere, September 6–12, 1992, Banff, Alberta, Canada. Information: R. M. Clowes, Lithoprobe Secretariat, 6339 Stores Road, University of British Columbia, Vancouver, BC V6T 1Z4, Canada; (604) 822-4202; fax 604-822-6958; or A. G. Green, Geological Survey of Canada, 1 Observatory Crescent, Ottawa, Ontario K1A 0Y3; fax 613-992-8836.

■ **International Symposium on the Geology of the Black Sea Region**, September 7–11, 1992, Ankara, Turkey. Information: ISGB Sekreterliği, MTA Genel Müdürlüğü, 06520 Ankara, Türkiye; phone (90)-(4)-223 69 27; fax 90-(4)-222 82 78. (*Abstracts deadline: March 1, 1992.*)

■ **Applications of Strain: From Microstructures to Mountain Belts**, September 8–12, 1992, Liscomb Mills, Nova Scotia, Canada. Information: Mark Brandon, Dept. of Geology and Geophysics, Yale University, P.O. Box 6666, New Haven, CT 06511-8130, (203) 432-3135; or Scott R. Paterson, Dept. of Geological Sciences, University of Southern California, Los Angeles, CA 90089-0740, (213) 740-6130.

The Transition from Basalt to Metabasalt: Environments, Processes, and Petrogenesis, September 9–15, 1992, Davis, California. Information: Peter Schiffman, Dept. of Geology, University of California, Davis, CA 95616; (916) 752-3669; E-mail PSchiffman@UCDavis.edu.

4th International Conference on Paleoceanography, September 21–25, 1992, Kiel, Germany. Information: ICP IV Organizing Committee c/o GEOMAR, Wischhofstrasse 1-3/Bldg. 4, D-2300 Kiel 14, Germany.

■ **23rd Annual Binghamton Geomorphology Symposium: Geomorphic Systems**, September 25–27, 1992, Oxford, Ohio. Information: Bill Renwick, Dept. of Geography, Miami University, Oxford, OH 45056, (513) 529-1362, E-mail BRENWICK@MIAMIU.BITNET, or Jonathan Phillips, Dept. of Geography, East Carolina University, Greenville, NC 27858, (919) 757-6082, E-mail GEPHILLI@ECUVM1.BITNET.

American Institute of Professional Geologists Annual Meeting, September 27–October 1, 1992, Lake Tahoe, Nevada. Information: Jon Price, AIPG, P.O. Box 665, Carson City, NV 89702; (702) 784-6691.

October

Association of Engineering Geologists Annual Meeting, October 3–9, 1992, Long Beach, California. Information: John Byer, Kovacs-Byer, Inc., 11430 Ventura Blvd., Studio City, CA 91604; (818) 980-0825.

■ **Fluid-Volcano Interactions**, October 4–9, 1992, Mount Hood, Oregon. Information: Steve Ingebritsen, U.S. Geological Survey, MS 439, 345 Middlefield Road, Menlo Park, CA 94025, (415) 329-4422, fax 415-329-4463; Bruce Christenson, Geothermal Research Centre, Private Bag 2000, Taupo, New Zealand; Craig Forster, Dept. of Geology and Geophysics, University of Utah, 719 W.C. Browning Building, Salt Lake City, UT 84112; Grant Heiken, Los Alamos National Laboratory, MS-D462, Los Alamos, NM 87545; Craig Manning, Dept. of Earth and Space Sciences, University of California, 405 Hilgard Avenue, Los Angeles, CA 90024.

■ **2nd International Congress on Energy, Environment and Technological Innovation**, October 12–16, 1992, Rome, Italy. Information: Secretaria CPA: Comisión de Promoción Académica, Facultad de Ingeniería, Universidad Central de Venezuela, Edif. Decanato, Caracas 1050, Venezuela; phone 58-2-6627538/7612; fax 58-2-6627327. (*Abstracts deadline: October 31, 1991.*)

Geological Society of America Annual Meeting, October 26–29, 1992, Cincinnati, Ohio. Information: GSA, Meetings Dept., P.O. Box 9140, Boulder, CO 80301; (303) 447-2020; fax 303-447-1133.

Send notices of meetings of general interest, in format above, to Editor, *GSA Today*, P.O. Box 9140, Boulder, CO 80301.

GSA *BULLETIN* and *GEOLOGY* Contents

The Geological Society of America
BULLETIN
Volume 103, Number 9, September 1991

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GEOLOGY

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NO. 9
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SEPTEMBER 1991

CLASSIFIED ADVERTISING

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Positions Open

TEXAS A&M UNIVERSITY
POSTDOCTORAL RESEARCH ASSOCIATE

The Gulf of Mexico Structural and Stratigraphic Synthesis Project invites applications for a full-time, Postdoctoral Research Associate position (Job #911072). The appointment is non-tenure with a duration of two years. The project is a cooperative effort between the Departments of Geophysics and Oceanography at Texas A&M University and the University of Texas Institute for Geophysics. It is a long-term, industry-supported effort aimed at developing an understanding of the basic mechanisms responsible for geologic evolution of the northern Gulf of Mexico. An extensive seismic, well-log and paleontologic data base has been assembled. Over 20 students have been involved in the project to date.

A Ph.D. in Geology, Oceanography or Geophysics is required. The successful applicant should have an understanding of the principles of seismic interpretation and seismic stratigraphy as evidenced by thesis research, publications in refereed journals or experience. Familiarity with the geology of the Gulf of Mexico or an area with similar structure and stratigraphy will be a strong plus.

Responsibilities of the successful applicant will be (1) assisting faculty investigators with the management of the project including preparation for three presentations per year to sponsoring petroleum industry companies and (2) undertaking one or more significant research projects within the overall project.

Please send a resume, transcripts and names of at least three references to the Employment Manager, Human Resources Department, Texas A&M University, College Station, TX 77843-1475. Please reference the job # and title.

Texas A&M University is an Affirmative Action/Equal Opportunity Employer.

INVERTEBRATE PALEONTOLOGY
ASSISTANT PROFESSOR

The Department of Geology at Colgate University invites applications for a tenure-stream position at the Assistant Professor level in the field of invertebrate paleontology. We seek an individual with a modern approach which includes concepts of paleoecology, biogeography and/or biostratigraphy. The successful applicant would teach invertebrate paleontology, would contribute to the department's introductory offerings, and would have the opportunity to teach an upper-level course in his/her specialty. Of particular interest to us are individuals who could take advantage of the rich Devonian fauna of the Hamilton Group which is present in local exposures. We encourage applicants who could also contribute to departmental offerings in hydrology and surficial processes. Applications from women and minorities are strongly encouraged. Applicants should have the Ph.D. in hand by September 1, 1992.

Colgate University is a highly selective liberal arts institution in rural upstate New York with an enrollment of 2700 men and women, and offers B.A. and M.A.T. degrees. The Department of Geology consists of eight full-time faculty members plus a part-time laboratory instructor. We have excellent facilities including numerous microscopes and computers, a modern SEM with EDS, XRD, XRF, AA and ion chromatograph.

Interested persons should send a letter of application, a curriculum vitae, and three letters of recommendation by October 1, 1991 to: Dr. Arthur Goldstein, Chairman, Department of Geology, Colgate University, Hamilton, NY 13346, (315) 824-7201.

Colgate University is an Equal Opportunity/ Affirmive Action Employer.

HYDROGEOLOGIST

Ph.D. in civil engineering and 3 years experience in the related occupation of Graduate Research Assistant/ Associate and Assistant Teacher. Conduct investigations of ground water flow and contaminant transport for ground water system having complex boundary conditions using computer modeling. Develop numerical models and codes using FORTRAN and BASIC programming languages. Conduct conceptual designs for containment system for control of migration of ground water contamination. Conduct investigations in surface water and stream/aquifer interactions. Develop numerical models and FORTRAN codes for large scale integrated watershed models. Conduct investigation in conjunctive uses of surface water and ground water resources by numerical approaches and multi-objective optimization techniques. Prepare technical papers for presentation and publication. 40 hr. wk.; salary $35,000/yr. Application by resume to Colorado Department of Labor and Employment, Division of Employment and Training, 300 Grant Street, Suite 900, Denver, CO 80203. Refer to Order No. CO3195408.

ENVIRONMENTAL PROFESSIONALS
CAREER OPPORTUNITIES

McLaren/Hart is a nationwide team of over 700 environmental professionals specializing in solving large-scale, complex and multi-site problems for the private sector. Through our reputation of high quality services, commitment to technical excellence, and client responsiveness, we have built a solid client base of many Fortune 500 companies.

McLaren/Hart is expanding and is seeking strong, self-motivated and technically superior professionals to join our team of highly skilled staff. Openings now exist for: GEOLOGISTS. The right candidate will have a B.S. Geology or related degree, drilling, site characterization, soil sample collection, and report writing experience. HYDROGEOLOGISTS. Candidates should have a B.S. Geology, or M.S. Civil Engineering or related degree. Must be able to provide technical anlaysis and support in review and interpretation of chemical, hydrogeological and geological data. Also, provide technical guidance for project planning.

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Please send your resume and salary history to: Dept. GSA, 1135 Atlantic Avenue, Alameda, California 94501. We are located in the San Francisco Bay Area.

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OCEAN SCIENCES

Associate/Full Professors. Several openings in fishery biology, remote sensing in marine resources, marine natural product, marine mineral resources, isolation of precious elements from sea water. Qualifications: Ph.D. and fluent in Mandarin Chinese. Duties: research and teaching. Applicants are invited to send curriculum vitae and list of three referees to: Dr. W. H. Wang, Institute of Marine Resources, National Sun Yat-sen University Kaohsiung, Taiwan, Republic of China.

ASSISTANT PROFESSOR
SEDIMENTOLOGY/STRATIGRAPHY

The Department of Geology at Colgate University invites applications for a three year appointment to be filled at the assistant professor level. Duties will begin in the fall of 1992 and will include teaching sedimentology and stratigraphy and other courses which might include paleoecology and/or petroleum geology. Research involvement with undergraduates is strongly encouraged.

Colgate University is a small liberal arts college in rural upstate New York. The Department of Geology consists of eight full-time faculty members, a laboratory instructor, and a part-time technician. Analytical facilities include an automated Diano XRD/XRF; Cambridge-Tracor Northern SEM-EDS with cathodoluminescence and ion chromatograph. We are especially well equipped for clay mineralogy studies. Applications from women and minorities are strongly encouraged.

Interested persons should send a letter of application, a curriculum vitae, and three letters of recommendation by October 1, 1991 to: Dr. Arthur Goldstein, Chairman, Department of Geology, Colgate University, 13 Oak Drive, Hamilton, NY 13346, (315) 824-7201.

Colgate University is an Equal Opportunity/Affirmive Action Employer.

GEOLOGY CHAIRPERSON

The University of Texas at Arlington, approximately 24,000 students, seeks applications and nominations for the position of Chairperson of the Department of Geology. Applicants should have demonstrated leadership ability, and a proven record of research, funding and teaching skills. The position is available September 1, 1992; salary will be competitive. Interested candidates should send a curriculum vitae, statements of administrative accomplishments and philosophy, and the names, addresses and telephone numbers of four references to: Dr. Edmund D. Brodie, Jr., Box 19498, U. T. Arlington, Arlington, Texas 76019-0498. Applications will be reviewed starting November 1, 1991.

An Equal Opportunity/Affirmative Action Employer.

GEOLOGISTS

Two Assistant/Associate professor level, tenure track positions in the Department of Geology, San Jose State University; appointments to begin either Spring Semester 1992, or Fall Semester 1992. Appointments will be at the Assistant Professor rank with consideration of the possibility of appointment at the Associate level dependent upon length and quality of teaching and research experience. Areas of expertise and interest being sought include desire and ability to teach field camp, structural geology, igneous petrology, mineralogy, interest, ability and experience in science education (the preparation of individuals to teach in K–12 science programs). Preference will be given to those individuals with interests and abilities in two or more of these areas. Successful candidates will be expected to teach courses in their own areas of expertise, general education science courses for the non-science major, supervise master's thesis research, and conduct their own research. Ph.D. degree in an appropriate geological science is required by time of appointment.

Applicants should submit a resume, copy of all graduate transcripts, names of three references, and a statement of professional goals to: Dr. John W. Williams, Chair of Search Committee, Department of Geology, San Jose State University, San Jose, CA 95192-0102, (408) 924-5050.

All materials must be received before October 1, 1991.

San Jose State University is an equal opportunity/affirmative action employer and is committed to increasing the diversity of its faculty.

UNIVERSITY OF WYOMING
Structural or Economic Geology

The Department of Geology and Geophysics invites applications for a tenure-track position at the assistant professor level in the broad fields of structural or economic geology. We are looking for a creative scientist who can combine the strengths of theoretical or experimental studies with solid field-based observations.

The successful candidate is expected to teach at the graduate and undergraduate level, supervise graduate students, and establish a vigorous research program. A Ph.D. is required before beginning employment. This position is subject to available funds but is scheduled to begin August, 1992. Interested persons should send a resume, a statement of research interests, and the names and addresses of at least three references to Dr. B. Ronald Frost, Search Committee Chair, Department of Geology and Geophysics, P.O. Box 3006, University of Wyoming, Laramie, WY 82071-3006. Closing date for application is November 15, 1991, or until the position is filled. The University of Wyoming is an affirmative-action/equal-opportunity employer. We strongly encourage applications from women and minorities.

JOI/USSAC Ocean Drilling Summer Research Program for Undergraduates

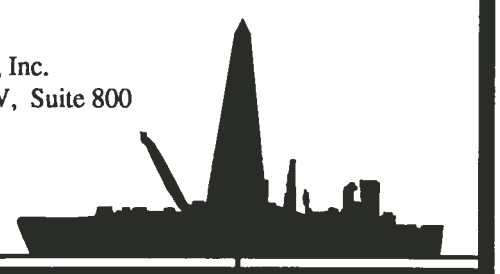
SEEKING PROGRAM COORDINATOR

The JOI/U.S. Science Support Program is seeking a Coordinator to organize the JOI/USSAC Ocean Drilling Summer Research Program for Undergraduates for the summer of 1992. This program is intended to provide students with the opportunity to work on challenging research projects using Ocean Drilling Program cores and downhole logs. The Program Coordinator will be responsible for designing, conducting, and administering a group-oriented program in which up to eight undergraduate students would participate.

Scientists with experience using Ocean Drilling Program data in their research are invited to submit proposals to develop this program (renewable for up to three years). Appropriate summer salary is available. The Program Coordinator must have access to facilities and equipment suitable for proposed student research projects. Funding is available only to scientists from U.S. institutions.

Proposal deadline is September 1, 1991.

For more information about this position and guidelines for proposal preparation, please contact:
Ms. Robin Smith
Joint Oceanographic Institutions, Inc.
1755 Massachusetts Avenue, NW, Suite 800
Washington, DC 20036-2102
Tele: (202) 232-3900
Fax: (202) 232-8203



Fault Zone Tectonics

U.S. Geological Survey

The Branch of Tectonophysics is soliciting applications from geophysicists and geologists with a knowledge of fault-zone tectonics and an interest in extending and improving existing programs to monitor near-fault deformation, especially in the Southern California region. Existing programs presently include the collection of creepmeter and alinement array data over actively slipping faults throughout California. The mission of the Branch is to reduce earthquake and volcanic hazards in the U.S. through investigations of earthquake mechanics, earthquake prediction, and long-term fault behavior.

Candidates should have a Ph.D. or equivalent in geophysics or geology and a record demonstrating ability or outstanding potential for research in fault-zone tectonics. The position is located in Pasadena, California at the U.S. Geological Survey Southern California Earthquake Observatory on the Campus of the California Institute of Technology. Responsibilities will include directing the near-fault-deformation activities of the Branch throughout California, expanding operations in Southern California, and integrating observations with related seismic, geodetic, and geologic observations. The candidate should have demonstrated ability with field work, instrument development, data analysis, and theoretical interpretation, and should have an interest in improving existing techniques and databases. The position will involve supervision of persons presently engaged in collecting and monitoring data, plus close interaction with USGS scientists in Pasadena and Menlo Park, California, as well as with scientists at the California Institute of Technology and the Southern California Earthquake Center.

This is a career civil service position with a starting salary of $40,278 to $66,574 (GS12-GS15) depending upon the qualifications. Applications will be reviewed by a search committee beginning on September 1, and will be accepted until a qualified applicant is selected. Interested persons should submit a resume of education, experience, and publications; a statement of research interests; a brief description of 2 or 3 key scientific contributions; and a completed Application for Federal Employment, with college transcripts, to William H. Prescott, Chief, Branch of Tectonophysics, U.S. Geological Survey, 345 Middlefield Road MS/977, Menlo Park, California 94025. Application for Federal Employment (SF 171) and OPM Form 1170 (for transcripts) are available from the address above or any US Government Office of Personnel Management.

United States citizenship is required. The U.S. Geological Survey is an Equal Opportunity Employer.

STRATIGRAPHER / PETROLEUM GEOLOGIST

The North Dakota Geological Survey invites applications for a newly created position in stratigraphy and petroleum geology. Applicants should have substantial well log correlation experience, as well as knowledge of core analysis, basin analysis, and sequence stratigraphy. Knowledge of Williston Basin stratigraphy and familiarity with computer applications in geology, particularly with GIS systems, are desirable.

Applicants should have either an M.S. or Ph.D. degree, preferably with petroleum industry experience. Starting salary for this position, which is classified Geologist II within the State Personnel System, will be between $26,000 and $30,000 plus benefits. Please submit a resume or letter stating qualifications, along with the names and addresses of at least three references, to Karen Gutenkunst, North Dakota Geological Survey, 600 East Boulevard, Bismarck, North Dakota 58505.

THE UNIVERSITY OF TEXAS AT DALLAS
ASSISTANT PROFESSOR
CARBONATE SEDIMENTOLOGIST

The Programs in Geosciences at The University of Texas at Dallas seek applications for a tenure-track position at the Assistant Professor level beginning September 1, 1992, in the general area of Carbonate Sedimentology/Petrology. Our goal is to complement existing sedimentology expertise and to build an interactive group with existing strengths in clastic sedimentology, micropaleontology/stratigraphy, geochemistry, petrology, tectonics/structure and geophysics/seismology. We seek a dynamic and aggressive scientist who is also a competent and enthusiastic teacher. We are particularly, but not exclusively, interested in an individual who will assume supervision of the stable isotope mass spectrometry laboratory. Duties will involve teaching undergraduate and graduate courses in the area of carbonate sedimentology, supervision of M.S. and Ph.D. students and possible participation in summer field camp. The position requires a Ph.D. Salary is negotiable.

UTD is a relatively new (22 years old) urban university that was formed from the nucleus of a private research institution (Southwest Center for Advanced Studies). UTD is conveniently located near three major oil company research laboratories. Major facilities within the Programs in Geosciences include: a new Convex mini supercomputer with array processor, a new automated electron microprobe, a SEM, three solid-source mass spectrometers, a 1988 Finnigan MAT Delta E gas-source mass spectrometer (with off-line carbonate sample preparation system), an organic geochemistry laboratory, a new automatic X-ray diffractometer, two AA spectrophotometers and high pressure–high temperature apparatuses for experimental petrology and rock deformation.

Applicants should send a letter outlining specific research interests, a resume (indication of sex and ethnicity for Affirmative Action statistical purposes is requested but not required), and names of three references to: Academic Search No. 2002, The University of Texas at Dallas, P.O. Box 830688, Richardson, TX 75083-0688.

Interviews will begin at the National GSA Meeting in San Diego in October 1991 and will continue until the position is filled.

GEOCHEMISTRY

California Institute of Technology, Division of Geological and Planetary Sciences. Applications are invited for a 2-year postdoctoral fellowship to study experimentally the fractionations of oxygen, hydrogen, and carbon isotopes in magmatic systems. Applicants should have a background in stable isotope geochemistry and/or experimental petrology.

Send resume and names of three references to Professors E. M. Stolper/S. Epstein (170-25), Division of Geological and Planetary Sciences, Caltech, Pasadena, CA 91125.

Caltech is an equal opportunity employer. Women and minorities are encouraged to apply.

POSTDOCTORAL POSITION
TYNDALL AIR FORCE BASE, FLORIDA

A research position is available in the Subsurface Chemical Processes Research Group at the Tyndall Air Force Base (TAFB) in Panama City, Florida. TAFB is the lead Air Force agency for research, development, testing and evaluation for environmental quality technology.

The research is in modeling the transport of organic chemical contaminants in laboratory model systems and interpreting transport data from a large-scale natural gradient field transport study that is underway. Emphasis will be given to chemical heterogeneities and their effects on solute transport. Application of existing solute transport models to data sets and some ab initio modeling will be required. The opportunity will also exist to help design and execute in-house laboratory experiments to elucidate solute transport mechanisms. A background in physical sciences with emphasis in hydrogeology, geology, or hydrology is preferred. A degree within last 3 years and U.S. citizenship or permanent resident alien status is required.

For information about the research project contact Thomas Stauffer at (904) 283-6059. For application materials contact Postgraduate Research Program at TAFB, Science/Engineering Education Division, Oak Ridge Associated Universities, P.O. Box 117, Oak Ridge, TN 37831-0117, (615) 576-3456.

RESEARCH SCIENTIST ASSOCIATE I
(Solid-Source Multicollector
Mass Spectrometer Technician)
The University of Texas

The Department of Geological Sciences invites applications for a full-time mass spectrometer technician. The individual will be responsible for day-to-day management of a laboratory that houses a Finnigan MAT 261 multicollector thermal ionization mass spectrometer. Specific duties will include assisting and collaborating with faculty in execution of research, training new users in mass spectrometer operation, routine instrument calibration and maintenance, trouble shooting, performing minor repairs, and when necessary, arranging repairs by specialists.

Minimum qualifications are a Bachelor's degree in geological sciences, chemistry, physics, or materials science. Competitive applicants should have computer programming skills and experience in solid-source mass spectrometry of radiogenic isotopic systems. An advanced degree in one of the above fields, familiarity with clean room protocol and experience in operating and maintaining a multicollector thermal ionization mass spectrometer are preferred.

Minimum salary is $2019 per month with an excellent fringe benefit package. Higher salary is possible commensurate with education and experience. Funding for this position is subject to renewal August 31, 1994. Application materials, including a resume and names, addresses, and phone numbers of three references, should be sent to Dr. Nicholas Walker, Technician Search Committee Chairman, Department of Geological Sciences, University of Texas, Austin, Texas 78713-7909. Applications will be accepted until October 31, 1991.

The University of Texas is an Equal Opportunity/Affirmative Aciton employer. Qualified minorities are encouraged to apply.

SUNY AT ALBANY/DEPT. OF GEOLOGICAL
Sciences/Sabbatical Replacement

Applications are invited for a 1 year temporary faculty position starting 1 Januray 1992. Duties will include teaching undergraduate courses in optical mineralogy, and metamorphic/sedimentary petrography/ petrology (spring semester), and igneous petrography/petrology, and one section of an introductory geology course for non-majors (fall semester). Preference will be given to applicants with a Ph.D. Send application, which must include a CV and names and addresses of three references, to Chairman, Dept. of Geological Sciences, SUNY at Albany, Albany, NY12222. Closing date 1 October 1991. SUNY at Albany is an affirmative action/equal opportunity employer; women and minorities are encouraged to apply.

Services & Supplies

6" MAP SCALES—Multiscale Products, 10558 Creston Dr., Los Altos, CA 94024 X5/92

FOR SALE: Journal of Petrology, Vol 1–24, $1750.00, and Thommen Altimeter 0-15000', 20' divs. $110.00. Reply GSA Code #1052.

FOR SALE: Kodak Starvue Reader/Printer S/N 11465. Enron Oil & Gas Company, (303-793-4632), $700.

Opportunities for Students

The Earth Sciences and Resources Institute at the University of South Carolina is currently seeking Master's and Ph.D. level graduate students to work with ESRI scientists in industry-sponsored geological studies in the USSR, South America, Czechoslovakia, and Africa. We seek self-motivated students with interests in sedimentology, stratigraphy, structural geology, tectonics or geophysics. Funded thesis research projects and teaching and research assistantships are available. The University of South Carolina is an equal opportunity/affirmative action employer.

Interested students are invited to submit a brief letter, unofficial transcripts and a statement of research interests to K.H. Fleischmann, Earth Sciences and Resources Institute, 901 Sumter St., Columbia, SC 29208. Phone: (803) 777-6484, Fax: (803) 777-6437.

We will be meeting and interviewing students at GSA in San Diego. If you are interested in interviewing at this time, please indicate this in your letter.

VICTORIAN INSTITUTE OF EARTH AND PLANETARY SCIENCES. Overseas applications now due. For those students interested in Australia, the deadline for scholarships is fast approaching. The OPRS (Overseas Postgraduate Research Scholarship Program for Study in Australia) or SOPF (Special Overseas Postgraduate Fund for Study in Australia) awards are critical to meeting the cost of study in Australia but their deadline is *September 1991*. These awards can be combined with scholarships available from the host institutions. The Victorian Institute of Earth and Planetary Sciences (VIEPS) is located in the state of Victoria, Australia and provides students with graduate programs in Geology, Geophysics, Geography & Environmental Sciences, Meteorology and Atmospheric Physics. For more information contact The Coordinator, VIEPS, GPO Box 2729X, Melbourne, Victoria 3001 Australia or fax 61 3 565 5062.

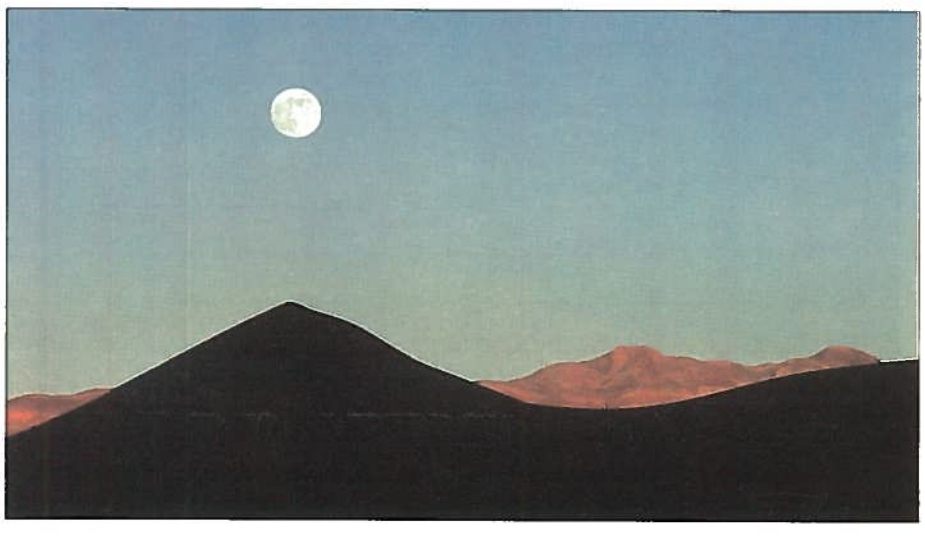
Graduate Studies in Thermochronology/Victorian Institute of Earth and Planetary Science (VIEPS), Melbourne, Australia. Professor Andrew Gleadow and Dr. David Foster are seeking MSc and Ph.D. candidates interested in applied and theoretical studies in apatite fission track and $^{40}Ar/^{39}Ar$ thermochronology. We are currently undertaking major research projects in the crustal extensional terranes of the Basin and Range Province, Aegean Sea, East Africa and southern Australasia/Antarctica; and the accretionary tectonics of eastern Australia. There are two scholarship schemes available to cover the cost of study in Australia and application details are available on request. The deadline is Sept. 27, 1991. Other scholarship support may be available from late 1991 from A.R.C. grants. Our fission track lab is the largest research lab of its kind in the world and our $^{40}Ar/^{39}Ar$ facility, currently being installed, features a VG3600 capable of single crystal analysis. VIEPS is located in the city of Melbourne, Australia and is a collaborative venture between La Trobe, Monash and Melbourne Universities. For more information contact The Coordinator, VIEPS, GPO Box 2729X, Melbourne, Victoria 3001 Australia or Fax 61 3 565 5062.

NOTICE

GSA Council Meeting

Meetings of the GSA Council are open to Fellows, Members, and Student Associates of the Society, who may attend as observers, except during executive sessions. Only councilors, officers, and section representatives may speak to agenda items, except by invitation of the chair. Because of space and seating limitations, notification of attendance must be received by the Executive Director prior to the meeting. The next meeting of the Council will be Wednesday morning, October 23, 1991, at the annual meeting in San Diego.

Cordilleran Section Meeting Photo Contest Winner



Moon rising over sand dunes, Death Valley, California by Martin Miller, University of Washington, Seattle.

Penrose Conference on North American Cordillera

A Geological Society of America Penrose Conference, "Continental Tectonics and Magmatism of the Jurassic North American Cordillera," will be held March 28 to April 3, 1992, in Lake Havasu City, Arizona. Conveners are Dick Tosdal and Dave Miller, U.S. Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025.

Magmatic and tectonic events associated with continental-margin subduction along the west coast of North America in the Jurassic widely affected continental crust for the first time during the evolution of the Cordillera far inboard of the magmatic arc and produced voluminous magmas both in and behind the arc. For most of the Cordillera, these magmatic and tectonic events transpired in the ~175 to 145 Ma time interval of the Middle and Late Jurassic. In some parts of the Cordillera, however, these events began in the Early Jurassic, or, in some locations, in the Triassic. The multidisciplinary researchers on global tectonics, magmatism, structure, stratigraphy, and geophysics at this conference will examine the behavior of the continent as the effects of full-scale subduction along its margin became manifest, the relation of plate tectonics to continental structure, the depositional patterns in the continental interior as a record of the orogenic effect of the subduction system, and the role of subduction in the generation of magmas and the clues that these magmas provide for deep-lithosphere processes, the ultimate source of energy for most continental tectonics. Comparing tectonic styles, magmatic characteristics, and timing of events along the North American Cordillera will provide much information about continental plate interactions with oceanic plates, effects of continental crust composition on magma, and effects of magmatism on the tectonics in the arc, and will provide an opportunity to meld paleogeographic information with tectonics and magmatism for the Jurassic.

The conference begins on a Saturday evening in Las Vegas, Nevada, with a welcoming gathering and introduction to the conference. Two and a half days of field trips and three days of conference sessions follow. A two-day field trip at the start of the conference will traverse the Jurassic arc in the southwestern United States. The trip begins on the craton with its sedimentary rock record, where Las Vegas is located, and will cross the fold and thrust belt of Cretaceous age into volcanic and plutonic rocks that constitute the eastern margin of the Jurassic arc, or possibly the back-arc environment. Interbedded within the volcanic rocks here are eolian sandstones that are incursions of the interior dune field into the arc. Within the magmatic arc, voluminous pyroclastic volcanic rocks and calc-alkalic plutons that characterize the Jurassic arc in southeastern California and southwestern Arizona, examples of intra-arc deformation, and the sedimentary rocks that record the cessation of arc activity and its subsequent degradation will also be examined. A half-day field trip during the conference sessions will visit the depositional base of Jurassic volcanic and sedimentary rocks. Conference sessions in Lake Havasu City will be divided into four broad but interrelated topics: (1) global tectonics, (2) magmatism, (3) stratigraphy and paleogeography, and (4) structure, geophysics, and tectonics of the Jurassic arc and crust. A concluding discussion and summary will occupy the morning of the last day.

The conference is organized to involve every participant. Each session will commence with a talk summarizing the topic region-wide and identifying the main problems and questions. A two-hour poster session will follow during which the participants present data relevant to the topic of that session. A short time will be allowed for very brief oral presentations (one slide) by a few participants in addition to their poster presentations. At the end of the session, the keynote speaker, plus other participants, will summarize the session and provoke discussion among the conference participants.

Participation in the conference will be limited to 60 persons. Prospective participants should apply by submitting a short summary of their contributions and their proposed topics for the conference and appropriate session(s) by *December 6, 1991,* to Dave Miller, U.S. Geological Survey, MS-975, 345 Middlefield Road, Menlo Park, CA 94025, U.S.A., (415) 329-4923, fax 415-329-4936. The registration fee for the conference will be approximately $600, including all transportation from Las Vegas to the site at Lake Havasu City and return, food, lodging (double occupancy), and all costs associated with the conference field trips. ■

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