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Refining Rodinia: Geologic Evidence for the Australia–Western U.S. connection in the Proterozoic

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ABSTRACT

Prior to the Grenvillian continent-continent collision at about 1.0 Ga, the southern margin of Laurentia was a long-lived convergent margin that extended from Greenland to southern California. The truncation of these 1.8–1.0 Ga orogenic belts in southwestern and northeastern Laurentia suggests that they once extended farther. We propose that Australia contains the continuation of these belts to the southwest and that Baltica was the continuation to the northeast. The combined orogenic system was comparable in length to the modern American Cordilleran or Alpine-Himalayan systems. This plate reconstruction of the Proterozoic supercontinent Rodinia called AUSWUS (Australia–Southwest U.S.) differs from the well-known SWEAT (Southwest U.S.–East Antarctic) reconstruction in that Australia, rather than northern Canada, is adjacent to the southwestern United States. The AUSWUS reconstruction is supported by a distinctive “fingerprint” of geologic similarities and tectonic histories between Australia and the southwestern United States from 1.8 to 0.8 Ga, and by a better agreement between 1.45 and 1.0 Ga paleomagnetic poles for Australia and Laurentia.

INTRODUCTION

Many recent papers have concluded that a supercontinent called Rodinia existed in the Neoproterozoic between 1.0 and 0.8 Ga. There is speculation that the breakup of Rodinia may have been related to dramatic changes in Earth systems such as diversification of life, multiple low-latitude glaciations, fluctuating ocean

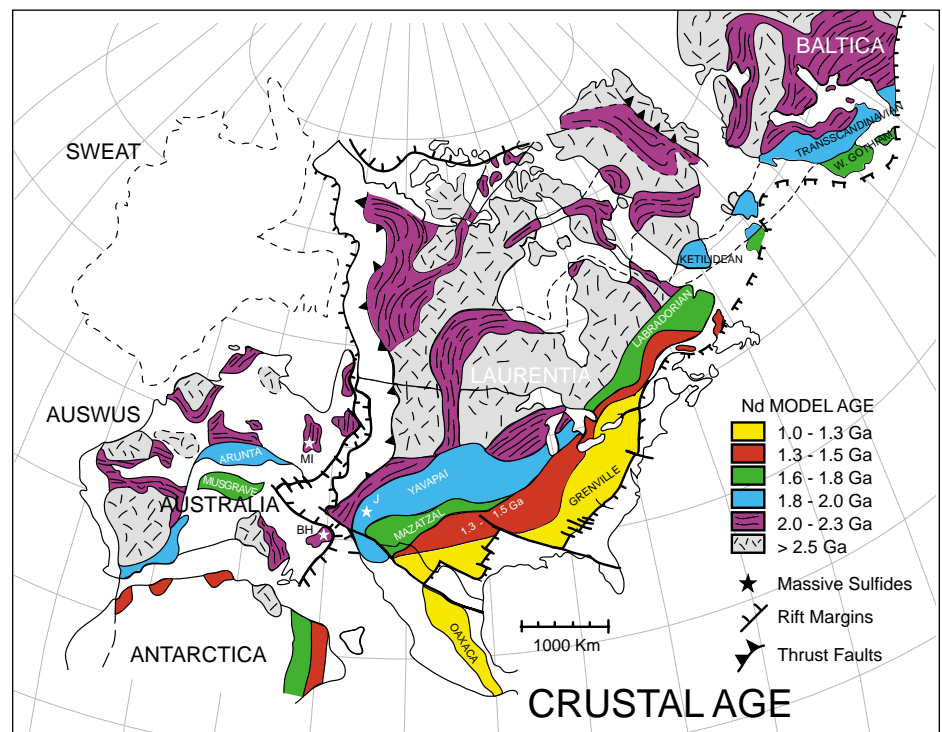


Figure 1. AUSWUS reconstruction for 1.7 to 0.8 Ga, modified from Brookfield (1993). The Tasman line forms the eastern edge of Proterozoic Australia (Myers et al., 1996); the $^{87}\text{Sr}/^{86}\text{Sr} = 0.706$ line marks the west edge of Proterozoic Laurentia. Continents were rotated to this configuration about an Euler pole located at $51.46^\circ\text{N } 106.70^\circ\text{E}$, rotation angle 114.33° . Both continents appear in equal-area projection in North American coordinates. The position of Australia in the SWEAT reconstruction is shown for comparison (from Moores, 1991). Crustal age provinces inferred from Nd data. Massive sulfide deposits of Broken Hill (BH) are similar deposits in Jerome (J) in central Arizona and Mount Isa (MI) is across from the Carlin area of Nevada.

chemistry, and long-lived mantle convection patterns (Dalziel, 1997; Hoffman et al., 1998; Evans, 1998). However, the duration and configuration, and even the existence (Piper and Zhang, 1999), of this late Proterozoic supercontinent remain uncertain. Detailed reconstructions are hindered by absence of a sea-floor record, lack of sufficient geochronologic information to show synchronicity of supercontinent assembly and breakup, lack of high-quality apparent polar wander paths (APW) for Precambrian rocks of many

continents, and later modifications to Precambrian plate margins during the Phanerozoic. Thus, the implications of possible pre-Pangean supercontinents for the evolution of Earth systems in general are difficult to evaluate.

One approach to supercontinent reconstructions is to try to match rifted margins of a given age. Reconstructions of the Mesozoic supercontinent of Pangea account for the shape and length of rift

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Refining Rodinia *continued from p. 1*

margins and also satisfy sea-floor magnetic data from Mesozoic–Cenozoic ocean basins. Earlier Rodinia reconstructions (Dalziel, 1997) have tried to match late Precambrian rift margins that developed during the breakup of Rodinia. Laurentia was nearly circumscribed by late Precambrian rift margins and thus could have had a central position within Rodinia. Sedimentary subsidence curves suggest that rifting took place in the latest Precambrian on many continental margins (Bond et al., 1984). However, uncertainties regarding timing of rifting, evidence for multiple rift events, and the probable presence of continental fragments (e.g., South China; Li et al., 1995) complicate the "rift-budget" approach for Proterozoic supercontinents.

Another reconstruction tool is the use of piercing points (unique points that were adjacent before rifting) between continents. For Pangea, it has been possible to match orogenic belts, fossil assemblages, and glaciogenic sequences. For Rodinia, the most widely used piercing points are segments of the 1.0 Ga (Grenville-age) orogenic belts that record continent-continent collisions during assembly of Rodinia. However, the "Grenville-age" belts themselves remain poorly understood. Most have older (Paleoproterozoic and Mesoproterozoic) and/or younger (Pan-African) histories, such that the proposed continuity of these orogens during assembly of Rodinia and their use as piercing points (Unrug, 1997) may be substantially oversimplified.

Refining Rodinia *continued on p. 3*

In Memoriam

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New London, New Hampshire
August 21, 1999

Gabriel Dengo
Guatemala City, Guatemala
August 4, 1999

Charles D. Masters
East Hampton, Connecticut
August 19, 1999

Paul D. Proctor
Provo, Utah
June 12, 1999

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Refining Rodinia *continued from p. 2*

The approach in this paper is to compare the tectonic evolution of key cratons within Rodinia. For Australia and Laurentia, we evaluate the SWEAT reconstruction of Rodinia and propose an alternate reconstruction, AUSWUS (Fig. 1). For Laurentia and Baltica, we support the reconstruction of Park (1995) and Åhäll and Gower (1997). This approach is not global in scope, but it has global implications. Our proposed long-lived juxtaposition of Australia, Laurentia, and Baltica provides a set of testable implications for the tectonic evolution of these cratons and an alternate hypothesis for Proterozoic supercontinent reconstructions.

Studies of Proterozoic rocks of the southwestern United States over the past few decades have led to a clearer understanding of its tectonic history. This history involves: (1) derivation of the crust from mantle sources from 1.8 to 1.6 Ga; (2) magmatic and metamorphic events from 1.5 to 1.3 Ga; (3) continent-continent collision and failed intracratonic rifting from 1.3 to 1.0; and (4) rifting and margin subsidence from 0.8 to 0.55 Ga, forming the early Paleozoic rift margins of Laurentia. The southeastern edge of Laurentia grew southward from 1.8 to 1.0 Ga, evolving as a long-lived, but episodic, convergent margin that produced a set of northeast-striking orogenic belts. The 800-m.y. orogenic history of these belts can be used as a "fingerprint" to identify the cratons that were adjacent during the Proterozoic.

SWEAT MODEL

The most influential continental reconstruction for the late Precambrian has been the SWEAT hypothesis (Moores, 1991; Hoffman, 1991; and Dalziel, 1991). In this model, the western U.S. is matched to Antarctica, western Canada to Australia, and the truncated 1.0 Ga Grenville orogen in Texas to East Antarctica.

Recent geologic data and a reassessment of the paleomagnetic database raise doubts about the main piercing points used for the SWEAT reconstruction. Moores (1991) and Dalziel (1991) suggested that the truncated Grenville front of west Texas could be matched to the Weddell Sea area of Antarctica. However, Gose et al. (1997) suggested that this part of Antarctica was within west Gondwana (Kalahari) at 1.1 Ga, not east Gondwana, negating this piercing point (Dalziel, 1997, p. 33). All other proposed piercing points are also in question. For example, lithologic and isotopic similarities between the Shackleton Range of Antarctica and the Yavapai province of Arizona are weakened by isotopic data that show Archean crustal components in the Shackleton Range (Helper et al., 1996).

Proposed connections between Australia and northern Canada also are in doubt. The striking lithostratigraphic similarity between Neoproterozoic sequences of the Adelaidean rocks of Australia and the Mackenzie-Windermere sections of Canada (Young, 1992) do not provide piercing points for reconstructions, because these sequences can also be correlated southward along the Cordilleran margin (Link et al., 1993), and perhaps globally (Hoffman et al., 1998). Similarly, the ca. 780 Ma mafic dikes of northwest Canada, Montana, and Wyoming, postulated to be part of a plume-generated radiating swarm (Park et al., 1995), are younger than the 827 Ma Australian Gairdner mafic dikes and are probably not part of a single event (Wingate et al., 1999).

AUSWUS MODEL: AN ALTERNATIVE RECONSTRUCTION

Proposed modifications of the SWEAT reconstruction have placed Australia farther south relative to North America. Ross et al. (1992) suggested that 1580–1600 Ma detrital zircons in the Belt Supergroup were derived from the Gawler Range volcanic rocks of South Australia and indicate that Australia was well south of the original SWEAT position (Fig. 1). Similarly, Borg and DePaolo (1994) speculated that the Ross et al. (1992) reconstruction might explain Nd isotopic provinces in Antarctica, if terranes had been translated southward as allochthonous strike-slip blocks. However, neither these provenance nor Nd province studies provide unique piercing points.

Brookfield (1993) placed Australia adjacent to the western United States by matching inferred rift-transform segments of Proterozoic rift margins. Using a modified version of the Brookfield (1993) reconstruction (Fig. 1), we propose that Australia was adjacent to the southwestern U.S. during much of the Proterozoic. To test this hypothesis, we have rotated

proto-Australia into North American coordinates using an Euler pole at 51.46°N, 106.70°E (angle of rotation of 114°). We evaluate this reconstruction here for four Proterozoic time periods.

Crust Formation and Paleoproterozoic Assembly

The core of Laurentia consists of a mosaic of Archean cratons stitched by 1.9–1.8 Ga orogenic belts (Fig. 1). This is similar to western and northern Australia (Myers et al., 1996) and Baltica (Gorbatshev and Bogdanova, 1993). Nd model ages, often interpreted as the time of derivation of the crust from the mantle, are 2.0–2.3 Ga in northeastern Australia (Ross et al., 1992; Blewett et al., 1998), northwestern Canada, and the Mojave province (Bennett and DePaolo, 1987) and do not readily distinguish between the SWEAT and AUSWUS models. However, south of its Archean core, Laurentia is characterized by juvenile Proterozoic orogens, derived from the mantle at 2.0–1.8 Ga (Yavapai province) and 1.8–1.6 Ga (Mazatzal province; Karlstrom and Bowring, 1993). These belts have potential counterparts (based on Nd model ages) in the Arunta and Musgrave blocks (Zhao and McCulloch, 1995) and the Transscandinavian igneous belt and Gothian terranes of Baltica (Gorbatshev and Bogdanova, 1993). The sequence of orogens gets progressively younger southward and, collectively, could provide a set of piercing points.

Paleoproterozoic rocks in the southwestern U.S. and Australia are similar in composition and tectonic setting. Juvenile arc assemblages are present in both areas (Yavapai in Laurentia and Arunta in Australia), as are quartz arenite-rhyolite cover sequences (Mazatzal in Laurentia and Reynolds-Musgrave in Australia; Dirks and Wilson, 1990). Also, major ore-deposit districts broadly match up (Fig. 1). Proterozoic rocks in both regions record progressive heterogeneous, middle-crustal shortening from 1.8 to 1.6 Ga, compatible with progressive thickening and stabilization of juvenile arc terranes to form new continental lithosphere (Karlstrom and Williams, 1998; Collins and Shaw, 1995). The 1780–1730 Ma Strangeways orogeny in the Arunta Inlier could be broadly correlative with the 1780–1690 Ma accretion of juvenile arcs in the southwestern United States. Likewise, the 1680–1660 Arglke event in the Arunta Inlier could be correlative with the 1650 Ma Mazatzal orogeny.

Intracratonic A-type Magmatism and Related Tectonism

A prominent feature of the Paleoproterozoic orogens in Laurentia-Baltica is a suite of bimodal plutonic and volcanic

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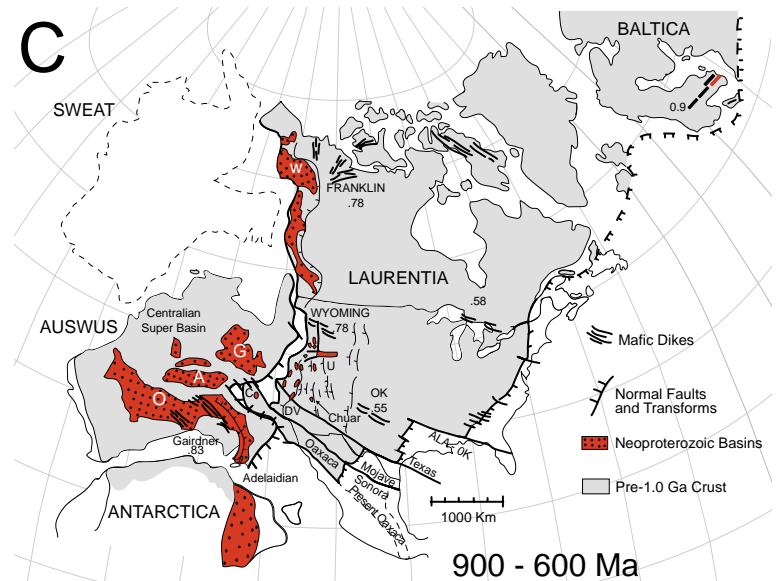
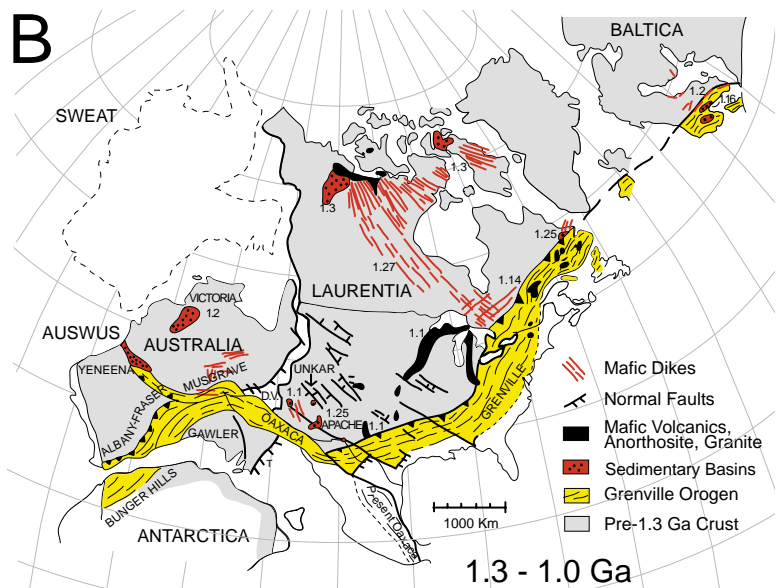
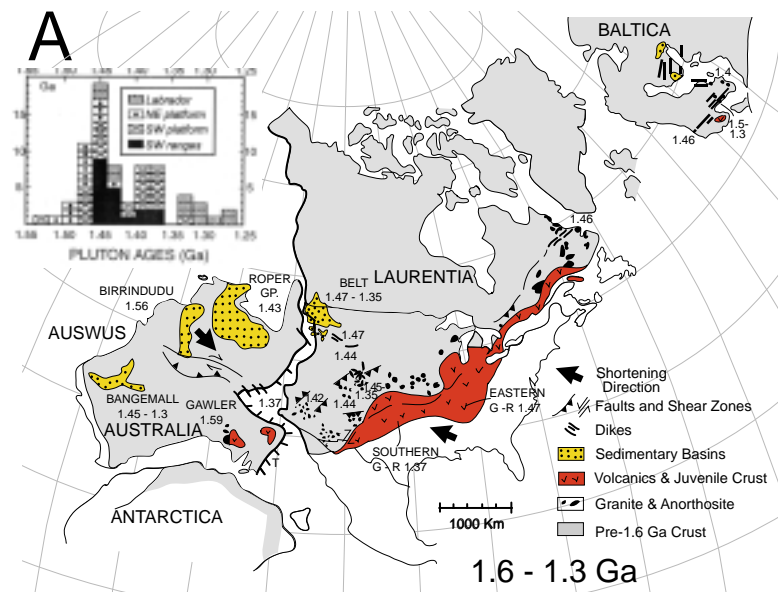


Figure 2. AUSWUS reconstruction for three time slices using the reconstruction of Figure 1. A: Orogenic belts and A-type granites and anorthosites, 1.6–1.3 Ga; G-R = granite rhyolite provinces; histogram shows wide variation in ages of A-type magmatism along the orogen in Laurentia (Hoffman, 1989). B: Grenville orogenic belts (yellow) are shown with foliation trends; temporally-coincident northeast intracratonic extension is recorded by mafic dikes (red) and normal faults. Oaxaca is restored along the Mojave-Sonora megashear. C: Extension and sedimentation prior to and synchronous with supercontinent fragmentation, 900–600 Ma. The Centralian superbasin includes the Officer basin (O), Amadeus basin (A), Georgina basin (G), and Adelaidean basin.

Refining Rodinia *continued from p. 3*

rocks that were emplaced episodically from 1.6 to 1.2 Ga (Fig. 2A). Although their origin is enigmatic, they form distinctive intracratonic units that allow correlation across the Atlantic Ocean—e.g., at 1.46 Ga (Åhäll and Connelly, 1998). Although traditionally termed A-type for “anorogenic,” there is increasing evidence for an orogenic linkage of Mesoproterozoic rocks in eastern Laurentia (Rivers, 1997), Baltica, and the southwestern United States (Nyman et al., 1994). These intracratonic events could have echoed subduction-related and transcurrent tectonism near the plate margin, but much of the plate margin record has been obscured by Grenville tectonism and mid-continent Paleozoic cover sequences.

In Australia, A-type granites of the Gawler craton are older (1.6 Ga) than, but similar in composition and character to, those of southwestern Laurentia, and they could be a continuation of an A-type granite belt. This observation seems incompatible with interpretations that the Gawler craton was “assembled” with northern Australia across the Albany Fraser belt at 1.1 Ga (Myers et al., 1996), but other models suggest Paleoproterozoic connections between Gawler and northern Australia (Teasdale, 1997) and invoke progressive, largely intracratonic deformation from 1.5 to 1.0 Ga in the Albany-Fraser belt.

Sedimentary basins of 1.5–1.3 Ga are also present in each continent. The Belt basin of western Laurentia accumulated tens of kilometers of sediment between 1.47 and 1.35 Ga (Aleinikoff et al., 1997). The Roper Group, Birrindudu Basin, and Bangemall Basin of similar age form a zone parallel to the inferred transpressive orogen in Australia (Myers et al., 1996) and could be a sedimentary response to the 1.4 Ga orogenic event. Inferred shortening directions in Laurentia (west-northwest; Nyman et al., 1994) and Australia (southeast; Myers et al., 1996) are similar in the AUSWUS reconstruction, consistent with intracratonic dextral transpressive deformation in both continents

Grenville Tectonism

Tectonism that took place between 1.3 and 1.0 Ga from Labrador to Mexico (Fig. 2B) is broadly referred to as the Grenville orogeny (e.g., Davidson, 1995). This orogeny culminated (and ended) a nearly 1-b.y. history of tectonism along a convergent margin in southern Laurentia. It included early magmatism, metamorphism, and arc accretion to Laurentia (~1.3–1.17 Ga), intraplate magmatism (Eastern Grenville province; 1.16–1.13 Ga), and finally collisions with masses outboard to the southeast (possibly Amazonia and Kalahari). Grenvillian plutonism and metamorphism are generally imprinted on older (~1.7–1.45 Ga) crust corresponding to the Yavapai and Mazatzal provinces of the southwestern United States (Davidson, 1995). Juvenile Grenvillian crust was added as well (e.g., Rivers, 1997).

Within Australia, orogenic events in the Albany-Fraser and Musgrave belts (Fig. 2B) correspond in style and age to the ~1.3–1.0 Grenville orogeny of Laurentia (Clarke et al., 1995). These belts are almost exclusively underlain by older crust (Ross et al., 1992), generally in the range 1.9–1.6 Ga (Yavapai, Mazatzal). Both the Albany-Fraser and Musgrave belts show evidence of ~1.3 Ga plutonism consistent with arc-related settings, orogeny, and regional high-grade metamorphism between ~1.3 and 1.2 Ga. This, in turn, was followed (1.18–1.14 Ga) by “enriched” (intraplate) granitic magmatism that extends northward into the Arunta block, where alkaline intrusions also occur. Post-1.15 Ga events are well developed only in the Musgrave belt where mafic magmatism (e.g., Giles complex) was accompanied by bimodal volcanism and dike swarms at ~1.08 Ga. Subsequently, the region was overprinted by granulite facies metamorphism at ~1.06 Ga.

In our proposed reconstruction, there is a large gap between Grenville belts in Laurentia and Australia. The Oaxaca terrane of Mexico (Fig. 2B) could have occupied this gap prior to Phanerozoic displacement on the Mojave-Sonora megashear (Anderson and Silver, 1979). The location and facing direction of the Paleozoic miogeocline (west of Oaxaca basement) is compatible with an original position farther to the northwest (Ruiz et

al., 1988), where it could have been part of a continuous rift margin that rimmed North America (Stewart et al., 1984). This restoration implies a continuous Grenville orogen, consistent with cessation of convergent tectonism in both continents after 1.1 Ga.

Northwest-directed contraction in Laurentia was accompanied by northeast-directed intraplate extension resulting in emplacement of mafic dike swarms, sedimentation in failed rifts, and formation or reactivation of northwest-trending extensional faults. Intracratonic deformation in Australia at this time was similar in style. Northwest-trending extensional faults were active along the Torrens Hinge zone between 1.3 and 1.0 Ga (Myers et al., 1996). Mafic dikes, similar in age to the Arizona 1.1 Ga diabase dikes are represented by the Stuart and Kulgera dikes of central Australia (Camacho et al., 1991).

Rift History: Breakup of Rodinia 800–550 Ma

Conflicting lines of evidence suggest fragmentation of Rodinia at either ca. 800–700 Ma or 600–550 Ma. The earlier time of initial continental separation is supported by geologic evidence for the development of rift basins with immature clastic sediments and abundant mafic magmatism on both continents (Fig. 2C; Centralian Superbasin; Walter and Veivers, 1997; Windermere Supergroup and

equivalents; Ross, 1991). New paleomagnetic data from the Mundine Well dikes of Australia (Wingate and Giddings, 1999) also suggest that rifting between the western United States and Australia began before 755 Ma.

PALEOMAGNETIC CONSTRAINTS

Paleomagnetic data provide another way to test the competing Proterozoic plate reconstructions. However, the scarce Proterozoic data set with precise ages and demonstrably primary magnetizations does not unequivocally validate either the SWEAT or the AUSWUS reconstruction.

Paleoproterozoic (2.5–1.6 Ga) data are sparse for North America. Nevertheless, using a reconstruction intermediate between SWEAT and AUSWUS (Ross et al., 1992), Idnurm and Giddings (1995) noted a broad agreement between the Australian and North American APW paths over the entire interval 1.7–0.7 Ga. This conclusion must be viewed with caution because of the overall lack of well-dated primary paleomagnetic poles between 1.7 and 1.5 Ga and 0.9 and 0.7 Ga, especially for Laurentia.

A comparison of Mesoproterozoic poles from Australia and North America qualitatively favors the AUSWUS model. With some uncertainties, the APW path

Refining Rodinia *continued on p. 6*

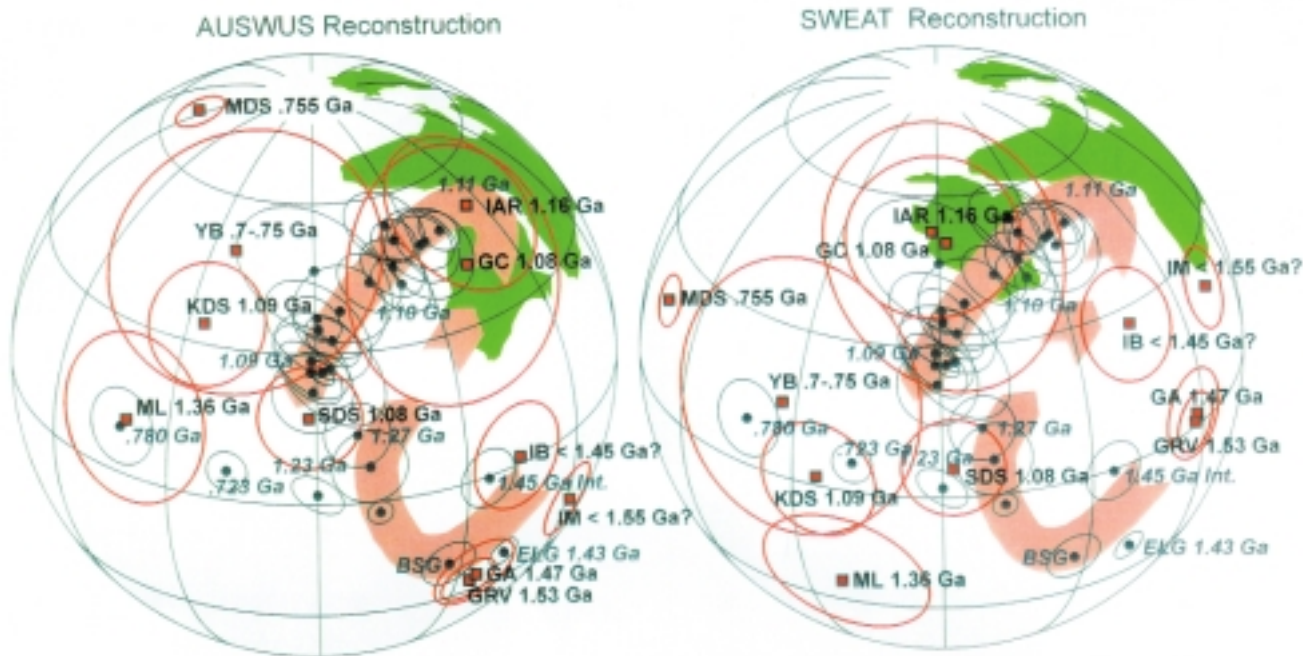


Figure 3. Orthogonal global projections centered on 30°N, 180°E showing comparison of the paleomagnetic poles from Australia with those from North America for the AUSWUS and SWEAT reconstructions. In each projection, Australia and the Australian paleomagnetic poles are rotated into present-day North American coordinates using Euler poles discussed in Table A (see footnote 1). The thick pink lines show the overall track of the ca. 1.45 to 1.1 Ga apparent polar wander path for North America. Solid circles and thin lines denote Paleomagnetic poles for North America and their 95% confidence limits; red squares and red heavy lines denote Australian poles and 95% confidence limits. Blue lettering gives age limits for segments of the North American path; black lettering gives Australian poles and ages. Pole locations for the 1.25 to 1.08 Ma part of the North American apparent polar wander path are tabulated in Harlan et al. (1994); sources for the ca. 1450 Ma poles are from Harlan and Geissman (1998). The 780 Ma North American pole is from Park et al. (1995), as slightly modified by Harlan et al. (1997). The 723 Ma North American pole is from the Global Paleomagnetic Online Database. Sources and rotated coordinates for the Australian poles are in Table A (see footnote 1).

Refining Rodinia *continued from p. 5*
 for North America for the intervals 1450–1400 Ma and 1110–1090 Ma is well defined. Most Australian poles for this period (Fig. 3; Table A¹), although of lower overall quality than their North American counterparts, match the geometry of the North American APW path reasonably well in the AUSWUS reconstruction (Fig. 3). In contrast, the fit of the 1.4–1.1 Ga Australian poles in the SWEAT configuration is less compelling; only one Australian pole (IAR, ca. 1.16 Ga; Fig. 3) is consistent with the North American APW path. Older paleomagnetic poles for Australia (poles GA-1.47 Ga and GRV-1.53 Ga) are in reasonable agreement in either configuration, but there are no high-quality North American data older than about 1.45 Ga with which to be compared.

Neoproterozoic (ca. 800 to 700 Ma) paleomagnetic results from Laurentia and Australia are less informative and do not distinguish between the models. The SWEAT reconstruction arguably shows better consistency of the Australian Yilgarn B pole with available Neoproterozoic poles from North America (780 and 730 Ma; Fig. 3). However, the Yilgarn B pole is poorly determined and questionable in age. A new high-quality paleomagnetic pole for the 755 Ma Mundine Well dike swarm of western Australia (Wingate and Giddings, 1999) is discordant with the Laurentian Neoproterozoic poles in either the SWEAT or AUSWUS reconstructions (Fig. 3). These data suggest that a 50°-wide ocean existed between the two continents at 755 Ma.

CONCLUSIONS

We view the southern margin of Laurentia as a long-lived (1.8–1.0 Ga) Cordilleran-type convergent margin involving several orogenic events or tectonic pulses. This interpretation links a sequence of southward-younging belts along the evolving margin and leads to looking for their continuations outside present-day Laurentia. The approach of using the integrated tectonic evolution of an orogenic system for Precambrian plate reconstructions is a powerful test of the supercontinent concept. We note similar 1.8–0.8 Ga rocks and tectonic histories in Australia, southern Laurentia, and Baltica. In evaluating these three key segments of the global supercontinent puzzle, we argue that the AUSWUS model provides a better explanation for the geologic and paleomagnetic data than does the SWEAT reconstruction. In view of the uncertainty

regarding the configuration, timing, and existence of the Rodinian supercontinent, there is a continuing need to test alternate Proterozoic plate reconstructions.

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For further information or a copy of the application form(s) please contact:

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Redesigning the Geological Map for the Public Audience

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One of the challenges facing the geological community is to effectively communicate to the public geoscience issues relevant to land-use decision making. Geological maps are an essential tool in this regard, but in their traditional form they are technical documents that are unintelligible to most people. The geological map needs to be redesigned to meet the needs of the public user. A redesign is particularly important given the promise of Internet-based map libraries to greatly expand the availability and use of geological map information.

In July 1998, the Geological Survey of Canada (GSC) released *GeoMap Vancouver*, a nontraditional geological map of the Vancouver, British Columbia, metropolitan area. The map has been a success in every way—educators and planners use it, public sales are high, the local media has given it extensive coverage, and it has

received technical awards and favorable reviews. Clearly, there is considerable demand for understandable geological map data.

The Vancouver metropolitan area lies within the Fraser Valley, a broad, triangular-shaped lowland bordered to the north and south by mountains and to the west by the Strait of Georgia, an inland sea of the Pacific Ocean. The Fraser River flows across the Fraser Valley and empties into the sea just south of Vancouver. With a population of about 2 million people, Vancouver is one of the fastest growing metropolitan areas in Canada. The area lies just inboard of the Cascadia subduction zone within the Cascade volcanic arc and is prone to earthquakes, volcanic eruptions, landslides, and floods. These and other geological issues prompted the Geological Survey of Canada to produce a

series of information products targeted at the general public in the Vancouver area.

GEOMAP VANCOUVER

GeoMap Vancouver (see illustration) is a large-format (90 × 150 cm) poster consisting of a central 1:100,000-scale geological map of the Vancouver metropolitan area surrounded by smaller scale companion maps and figures (Turner et al., 1998). It entices the novice map user to consider the landscape while it presents substrate information useful to professional planners, environmental scientists, and engineers who may lack a geoscience background.

Central Map

The central lithologic map emphasizes material properties relevant to land use and engineering, such as bearing strength, drainage, aggregate resources, and groundwater. Geological units are grouped into three major categories that are tied to the three physiographic elements of the Vancouver area: bedrock mountains, Ice Age (Pleistocene) sediments forming the rolling uplands, and modern (postglacial) sediments underlying lowlands. This connection between geological units and their position in the landscape provides the reader with an understandable geographic framework for the geology. The connection has been strengthened by draping the geology on a



shaded relief base map—the map looks something like the landscape it represents. A detailed road grid allows users to navigate the map with streets as their reference.

Each geological unit is described by its physical properties and physiographic setting. Modern sediments are loose, water-saturated materials associated with present-day streams, rivers, and the coast. They include landfill, peat, cohesive silt and clay, noncohesive silt and sand, and sand and gravel. In contrast, surface Ice Age sediments lie above the present drainage and are more compact than modern sediments; Ice Age sand and gravel are also better drained than their modern counterparts. Bedrock units are defined on the basis of lithology, degree of metamorphism, and structural fabric. Units include unmetamorphosed sedimentary rocks, mainly sandstone; unmetamorphosed volcanic rocks; foliated metavolcanic and metasedimentary rocks; and granitic rocks. Two photographs accompany each map unit in the legend, one a landscape scene and the other a close-up. The description of each unit contains few specialized geological terms; those that are used are defined.

GeoMap Vancouver was prepared entirely from published surficial and bedrock geology maps and reports; no field studies were conducted to produce the map. The units on the published maps were recast into new lithologic units.

Companion Figures

A text block below the title introduces the concept of a geological map. It is bordered by a satellite image of southwestern British Columbia that shows the location of the map area. Below this, a small-scale map shows the three major physiographic elements of the area: lowlands below about 15 m elevation, rolling uplands of the Fraser Valley, and mountains, mainly north and south of the Fraser Valley.

Five small-scale maps directly below the main map address the question, "So what?" Each map deals with an important hazard or resource: earthquake ground shaking, liquefaction susceptibility, flood hazard, landslides, and aquifer contamination susceptibility. The reader is told that these maps are generalized, that they only provide a regional perspective on hazards and resources and cannot be used for detailed site assessment. A block diagram shows the distribution of units in the subsurface and their relationship to the surface geology.

On the Web

GeoMap Vancouver is an advertisement for, and a doorway to, additional geoscience information. It provides references to bedrock and surficial geology maps

used to produce it, recent geological reports on the Vancouver area, and the addresses and phone number for the Geological Survey of Canada's Vancouver office. *GeoMap Vancouver* is accessible on the web at <http://sts.gsc.nrcan.gc.ca/page1/urban/geomap/>.

THE MAKING OF GEOMAP

GeoMap Vancouver was produced by four GSC scientists, in collaboration with the GSC digital cartography units in Vancouver and Ottawa. Preliminary drafts of the map were reviewed by educators, geotechnical engineers, land-use planners, and environmental consultants. The final map was translated, prepared for pre-press production, and printed by the GSC in Ottawa. Resources required include: geoscience and graphic design—3 person months; GIS cartography—3 person months; French translation—0.5 person months; printing (3,000 copies) —\$5000; other production costs—\$1000.

REACTIONS

Digital *GeoMap Vancouver* data are being used by regional government planning departments and Emergency Preparedness Canada. The map is used in high schools, colleges, and universities in the Vancouver area, and more than 600 copies have been sold since its release in July 1998. Both major Vancouver newspapers published the four small-scale hazard maps of *GeoMap Vancouver* in color in late 1998. It won first place as the "most communicative map" at the 1998 Environmental System Research Institute (ESRI) Conference, and it has been favorably reviewed by other geoscientists (e.g., Neale, 1998). A similar type of map, modeled after *GeoMap Vancouver*, has just been completed for an area in central British Columbia (Hastings et al., 1999).

OTHER EDUCATIONAL INITIATIVES

GeoMap Vancouver is part of an ongoing effort to improve both public understanding of geoscience issues and the quality of land-use decisions. A primary audience is educators, especially geography and earth science instructors in senior high school, college, and university. A second target group is land-use professionals, including planners and environmental and geotechnical consultants. Other complementary products include: (1) *Geoscape Vancouver*, a poster highlighting geoscience issues in the Vancouver area (Turner et al., 1996a); (2) *Vancouver's Landscape*, a poster explaining Vancouver's physiography (Clague et al., 1999); (3) *Vancouver Rocks*, a poster on rock types of the region (Turner et al., 1999); and (4)

sets of slides, overhead transparencies, and enlarged *Geoscape* poster theme panels (Turner et al., 1996b, 1996c; Clague and Turner, 1998). We have promoted these products through workshops, field trips, talks, popular and technical articles (e.g., Turner et al., 1977; Clague et al., 1997), information booths at community events, and media interviews.

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To Get *GeoMap Vancouver*

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Dialogue

Sara Foland, CEO



Photo taken at Dinosaur Ridge near Morrison, Colorado.

© Paul Abdoo

It's impossible to win the great prizes of life without running risks.

—Teddy Roosevelt

Actively pursuing change always involves an element of risk. Sticking with the familiar is tempting for us mortals who naturally resist the discomforts of change. Yet there are times when opportunity beckons or our environment changes, and we must change in order to respond.

This is one of those times. Our Strategic Plan outlines areas in which we want to grow and evolve as a Society. Now it's time to marshal our resources in a way that will get us there.

Program Review and Fiscal Control

GSA has never had a process that allowed Council to look at the Society and its programs as a whole. The result has been a fantastic proliferation of programs—166 at last count—over which our resources are spread.

Last month, a Programmatic Overview Committee (POC), was instituted to review and evaluate programs, and set priorities. Consisting of the Executive Committee, an additional past GSA president, and high-level staff leadership, the POC met in August and began the process. Results will be reported in the coming months.

We've also instituted a Financial Overview Committee within the staff. Composed of the 15-member leadership team from within headquarters, this committee meets monthly to review GSA financial and budgetary performance, evaluate variances, and initiate corrective action.

Changes in Staff Structure

GSA's headquarters staff was organized along fairly strict departmental lines. Consequently, synergies and economies of scale that could be realized for GSA as a whole were often missed. A more flexible, unified organization, one focused on projects, communication, and teamwork, was needed.

I shared a revamped organizational structure with Council, committee chairs, division chairs, and section chairs and secretaries, in late July. More than 30 people responded with comments and suggestions. Here are highlights of the finalized structure in a condensed, functional chart (see below).

GSA Enterprises gathers together all revenue-generating projects, including publications and meetings. This team is charged

with operating GSA's current functions cost effectively, identifying new opportunities for revenue generation, and maintaining mutually beneficial partnerships with associated societies. A cross-disciplinary Technical Program Coordination team, associated with GSA's Annual Meeting, will draw together all resources needed to support the Annual Program Committee and joint Technical Chairs.

Science and Outreach comprises GSA's education and public policy programs. A new educational officer is charged with identifying emerging trends in geoscience education and assessing the effectiveness of current programs. The Institute for Earth Science and the Environment, as well as government liaison, grant writing and administration, and student services coordination are located here.

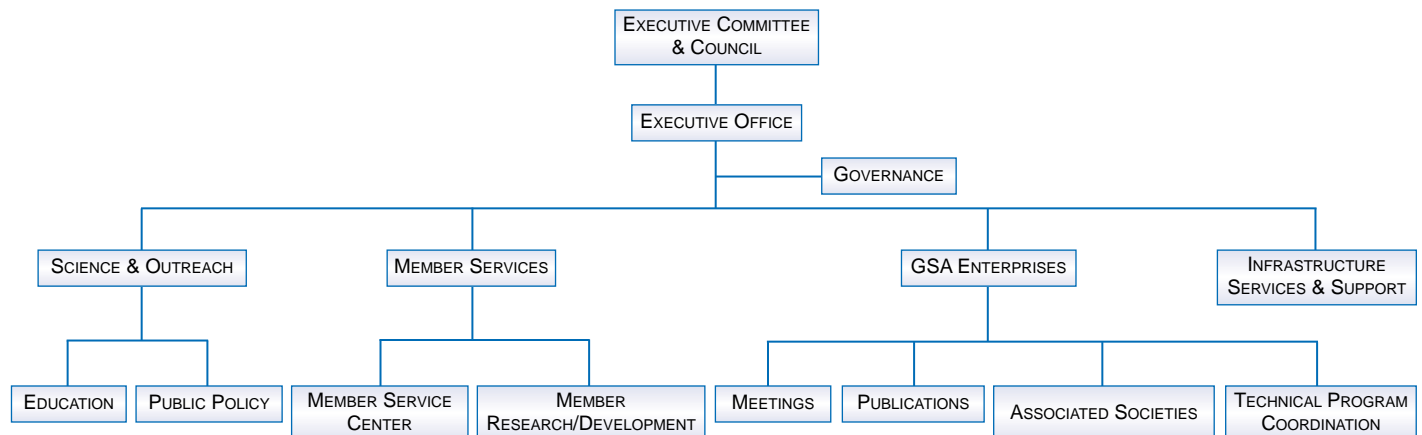
Member Services includes a consolidated "customer service-type" group slated to begin operation in January 2000. This team will handle everything from membership renewal to book purchases and meeting registration. The Member Research and Development team will use the new iMIS database and surveys and other questionnaires to ensure we stay in tune with the needs of members.

Infrastructure Services and Support consists of information technology services, financial services, facilities, and a new centralized purchasing function. We've already realized significant savings with centralized purchasing, through volume purchasing and creation of long-term vendor alliances.

Not pictured on this chart are functions that support all of GSA, reporting to the CEO. These include Marketing, Media, and Communications, Human Resources, General Counsel, and Administrative Services.

How It's Going

Change is never easy, but the staff has done a tremendous job of participating and adapting. We're very excited about moving forward with greater focus and accountability. We trust you'll be pleased with the results. ■



Bruce F. Molnia, *bmolnia@erols.com*

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

Defining a National Environmental Framework Continues

Washington Report for April (*GSA Today*, v. 9, no. 4) described the 10-year effort to establish a National Institute for the Environment (NIE), spearheaded by the Committee for the National Institute for the Environment (CNIE). This CNIE effort was juxtaposed to the ongoing, independent efforts of the National Science Board (NSB) and the National Science Foundation (NSF) to define NSF's place and role in an expanded national environmental context.

On July 28, 1999, the NSB approved and released an interim report, "Environmental Science and Engineering for the 21st Century: The Role of the National Science Foundation," which addresses the question: "What should the environmental portfolio of the Foundation look like, within the context of the larger Federal agency suite of activities, in order to provide and communicate the knowledge required to respond to current and future environmental challenges?" The report is an in-depth analysis of the NSF which focuses on the overall level, balance, and organization of current environmental activities, presents a summary of current and anticipated activities, reviews suggestions and information received by the Board during its analysis, presents three goals to be accomplished in an expanded NSF environmental context, and concludes with findings and recommendations, with nary a mention of the NIE or the CNIE.

For the NSB to reach this goal, its Task Force on the Environment conducted hearings and town meetings; solicited input from scientists, government agencies, and the private sector; reviewed hundreds of reports and documents related to environmental research, education and assessments; and sought suggestions through a public Web site. Hundreds of suggestions and recommendations were received from community groups, local and federal agency officials, professional societies, nongovernmental organizations, and concerned citizens. In addition, the NSB examined a variety of programs at NSF to determine the factors most likely to result in effective research, education, and scientific assessment activities. The board focused on the overall level, scope, robustness, balance, funding, and organization of environmental activities of the NSF.

Guides for NSF

Foremost among the themes that emerged from this diverse input was a strong endorsement of the operating principles of NSF. At the same time, the board heard many ideas that framed ways in which NSF could and should develop its environmental portfolio. The majority of these focus on enhancing the disciplinary and systematic acquisition of data, the analysis and synthesis of these data into useful information, and the dissemination of this information into understandable formats for multiple uses. Running throughout the input process was the message that NSF is poised and is expected to respond vigorously to the new challenges of providing and communicating the fundamental knowledge base and educating and training the workforce to meet the environmental challenges of the next century. A parallel message underscored the requirement for significant new resources to accomplish these goals and an effective organizational structure to implement NSF's total environmental portfolio.

The three goals identified by the NSB to guide the design and implementation of the NSF's environmental portfolio are: (1) discovery across the fields of science and engineering to elucidate the processes and interactions among the atmosphere, biosphere, cryosphere, hydrosphere, lithosphere, and socio-economic systems, thereby providing an integrated understanding of the natural status and dynamics of, and the anthropogenic influences on, Earth's environmental envelope; (2) education and training that enhance scientific and technological capacity associated with the environment, across both the formal and informal educational enterprise; and (3) effective integration and dissemination of research results to multiple audiences, including scientific, public, and policy audiences, and the private sector, via credible scientific assessments of broad environmental phenomena and the transfer of technological knowledge.

The board states that achieving these goals will require a combination of physical, technological, and information infrastructure, and partnerships—specifically, facilities, instrumentation, and other infrastructure that enable discovery,

including the study of processes and interactions that occur over long time scales; research to develop innovative technologies and approaches that assist the nation in conserving and wisely utilizing its environmental assets and services; mechanisms and infrastructure to synthesize and aggregate scientific environmental information and to provide open access to these informational materials; and partnerships with other federal agencies, state and local governments, the private sector and other nations to advance knowledge, understanding and solutions.

Recommendations

The NSB study showed that the NSF supports significantly more environmental research and education than was generally believed. However, the nation's need for fundamental environmental knowledge and understanding requires further attention. To expand and strengthen the NSF environmental portfolio, the NSB developed the following 12 recommendations.

1. *Resources and Funding.* Environmental research, education, and scientific assessment should be one of the highest priorities of the NSF. The current environmental portfolio, an investment of approximately \$600 million, represents only about one-third of the resources necessary. In view of the overwhelming importance and exciting opportunities for progress in the environmental arena and because existing resources are fully and appropriately utilized, new resources will be required. Therefore, the NSB recommends an increase of \$1 billion over the next five years.

2. *Organizational Approach.* NSF management should develop an effective organizational approach that meets all of the criteria required to ensure a well-integrated, high-priority, high-visibility, cohesive, and sustained environmental portfolio within the NSF. These criteria include a high-visibility, NSF-wide organizational focal point with principal responsibility for identifying gaps, opportunities, and priorities, particularly in interdisciplinary areas; budgetary authority for enabling integration across research, education, and scientific assessment, and across areas of inquiry; responsibility for assembling and publicizing, within the context of the NSF's normal reporting, a clear statement of NSF's environmental activities; a formal advisory process specifically for environmental activities; continuity of funding opportunities, in particular in interdisciplinary areas; and integration, cooperation, and collaboration with and across established programmatic areas, within NSF and between NSF and its sister federal agencies.

3. *Disciplinary Research.* Environmental research within all relevant disciplines

Washington Report *continued on p. 12*

should be enhanced, with significant new investments in research critical to understanding biocomplexity (NSF Director Rita Colwell's comprehensive term for biodiversity), including the biological-ecological and social sciences and environmental technology.

4. *Interdisciplinary Research.* Interdisciplinary research requires significantly greater investment, more effective support mechanisms, and strengthened capabilities for identifying research needs, prioritizing across disciplines, and providing for their long-term support.

5. *Long-Term Research.* The NSF should significantly increase its investments in existing long-term programs and establish new support mechanisms for long-term research.

6. *Environmental Education.* The NSF should enhance its formal educational efforts by encouraging submission of proposals that capitalize on the inherent student interest in environmental areas while supporting significantly more environmental educational efforts through informal vehicles. All NSF-supported education activities should at their core recognize potential and develop the capacity for excellence in all segments of society, whether or not they have been part of the scientific and engineering traditions.

7. The NSF should significantly increase its research on the methods and

models that support the scientific assessment process. In addition, NSF should, with due cognizance of the activities of other agencies, enable an increased portfolio of scientific assessments for the purpose of prioritizing research investments and for synthesizing scientific knowledge in a fashion useful for policy and decision-making.

8. *Enabling Infrastructure.* High priority should be given to enhancing infrastructure for environmental observations and collections as well as new information networking capacity. A suite of environmental research and education hubs should be created, on the scale of present Science and Technology centers and Engineering Research centers, that might include physical and/or virtual centers, site-focused and/or problem-focused collaborations, and additional environmental information synthesis and forecasting centers.

9. The NSF should vigorously support research on environmental technologies, including those that can help both public and private sectors avoid environmental harm and permit wise utilization of natural resources.

10. The NSF should enable and encourage the use of new and appropriate technologies in environmental research and education.

11. The NSF should take the lead in enabling a coordinated, digital, environmental information network. In addition, the NSF should catalyze a study to frame a

central source that compiles comparable, quality-controlled time series of measurements of the state of the environment.

12. The NSF should actively seek and provide stable support for research, education, and assessment partnerships that correspond to the location, scale, and nature of the environmental issues. These partnerships and interagency coordination should include both domestic and international collaborations that foster joint implementation including joint financing when appropriate. This NSB report clearly establishes the need for an expanded national portfolio of environmental R&D. The board suggests that the NSTC reevaluate the national environmental R&D portfolio, including identification of research gaps and setting of priorities, and the respective roles of different Federal agencies in fundamental environmental research and education.

The report concluded that scientific understanding of the environment, together with an informed, scientifically literate citizenry, is requisite to quality of life for generations to come. The NSB instructed the NSF to capitalize on the momentum gained in its past support for premium scholarship and emerging new research areas and technologies, as the interdependencies of fundamental and applied environmental research become more evident. ■



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Peter T. Lyttle at 703 648 6943 or <plyttle@usgs.gov>

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Mid-Cretaceous to Recent Plate Boundary Processes in the Southwest Pacific

Conveners: **Suzanne L. Baldwin**, *Geosciences Department, University of Arizona, Tucson, AZ 85721, baldwin@geo.arizona.edu*
Gordon S. Lister, *Australian Crustal Research Center, Monash University, Melbourne 3168 Victoria, Australia, gordon@mail.earth.monash.edu.au*

Since the advent of plate tectonics the southwest Pacific has provided a natural laboratory for the study of plate boundary processes. Breakthroughs in our understanding of plate boundary processes continue to be made in this region, including those resulting from recent technological developments (e.g., swath bathymetry, seismic tomography). A Penrose conference, "Mid-Cretaceous to Recent Plate Boundary Processes in the Southwest Pacific," was convened to assess how far we have come in our understanding of the tectonic evolution of the southwest Pacific and to identify and catalyze potential future research directions.

Held at the Wilderness Lodge, Arthur's Pass, South Island, New Zealand, March 25–30, 1999, the conference brought together 45 geoscientists from seven countries, including seven graduate students. Oral, poster, and discussion sessions addressed plate boundary processes such as subduction rollback, backarc basin evolution, initiation of subduction, the role of arc magmatism in crustal growth, transition from continental extension to seafloor spreading, and mountain building processes at a transpressional plate boundary.

Southwest Pacific Models and Reconstructions

The conference began with a summary of key issues with respect to tectonic reconstructions of the southwest Pacific stretching from Papua New Guinea and parts of Southeast Asia in the north, to Antarctica in the south, and east to the Tonga–Kermadec–New Zealand plate boundary. Rupert Sutherland provided an overview of the many outstanding problems throughout the region, emphasizing that the first-order geometry of the 130–85 Ma plate boundaries is not well understood. Other questions concern the development of Cenozoic subduction zones and backarc basins north of New Zealand and the amount of plate motion taken up between East and West Antarctica during Gondwana break-up.

Robert Hall summarized Cenozoic plate reconstructions of Southeast Asia and the southwest Pacific, outlining three important periods of regional plate boundary reorganization, at 45, 25, and 5 Ma, which can be related to changes in plate motion. He presented evidence for major regional vertical axis plate rotations and stressed the importance of extension in a largely convergent setting during the regional tectonic development. Most subduction hinges have been retreating since 25 Ma (e.g., Tonga, New Hebrides, Izu-Bonin), accompanied by arc volcanism and marginal basin formation, in contrast to periods of hinge advance, which are accompanied by a reduction or cessation of volcanism (e.g., Kermadec, Mariana). Southeast Asia presents special reconstruction problems because so much oceanic lithosphere has been subducted, most of the marginal basins lack well-developed magnetic lineations, and there is evidence for major regional vertical axis rotations. Roll-back of the hinge of the retreating Indian-Australian lithosphere in the Banda arc may have led to the unusual 180° curvature of the arc.

Loren Kroenke discussed how major changes in Pacific absolute plate motions may have triggered tectonic events along the boundary such as the formation of lengthy new subduction zones (e.g., Melanesian arc at 43 Ma) and onset of rifting between Australia and Antarctica at ~95 Ma. He showed how the hot spot reference framework could be used to produce an absolute frame of reference, and then analyzed the polar wander path of the Pacific plate. While some tectonic events result from changes in Pacific absolute plate motion, the late Neogene collision of the Ontong Java Plateau with the northern margin of the Australian plate was used as an example of an event that caused a change in the Pacific plate motion. Dallas Abbott and others provided other examples of plateau and seamount interaction in the Tonga and Izu-Bonin trenches.

Recent work in the Ross Sea, South Tasman Sea, and along the West Antarctic margin now permits more accurate Cenozoic reconstructions of Australia-Pacific-Antarctica plate motion. Joann Stock focused on the seafloor spreading record around the New Zealand region used to constrain major plate boundary changes and reorganizations during and subsequent to Gondwana breakup. Subduction of the Phoenix-Pacific ridge beneath the Antarctic plate, which led to attachment of the Chatham Rise and Campbell Plateau to the Pacific plate, was compared to the breakup of the Farallon Plate and its effects on western North America. Posters with this session focused on specific aspects of plate motion associated with Australia-Pacific-Antarctica plate boundaries.

Computer animations presented by Robert Hall, Loren Kroenke, and Carmen Gaina illustrated how rapidly southwest Pacific plate boundaries change, identified regional events, and provided a framework for discussion of outstanding problems. Laurent Ailleres presented a strategy for an ongoing project to develop a four-dimensional (three-dimensional through time) geodynamic model of the northern part of the Australia–Papua New Guinea region.

Crustal Growth, Breakup, and Dispersal

Richard Arculus provided an overview of the role of magmatism in crustal growth and disruption in the southwest Pacific. Contributions from supra-subduction zone environments and plumes, as well as the importance of accretion and obduction of oceanic plateaus on changes in plate boundary geometries and orientations were outlined. A better understanding of mass fluxes through supra-subduction zones is needed. Distinctions in isotopic (Sr-Nd-Pb) compositions for the asthenospheric source of Pacific and Indian mid-ocean ridge basalts were summarized, and questions concerning discontinuities within the region were raised (e.g., in Vanuatu an Indian-type source is tapped in arc-backarc magmas only where the D'Entrecasteaux ridge–fracture zone is subducted).

Brian Taylor spoke on the mechanics of lithospheric extension during the transition from continental rifting to seafloor spreading in the Woodlark Basin. After ~200 km of continental extension is accommodated along low- and high-angle normal faults, seafloor spreading begins. Considerable along-strike variation in seafloor spreading initiation occurs from east to west; stepwise spreading nucleation begins within rheologically weak zones of continental lithosphere.

Posters presented thermochronologic data from the Papua New Guinea mobile belt that bear on the Neogene evolution of arc-continent collision, geomorphologic evidence for landslide-driven drainage network evolution during rapid surface uplift to form the Finisterre Mountains, and petrologic data from the Moresby Seamount in the western Woodlark Basin. Additional poster presentations provided an overview of ideas concerning the nature and timing of plate boundary processes in Papua New Guinea, and cautioned against the use of interpreting paleotectonics on the basis of clastic sedimentary compositions.

Phil Symonds and others presented results of a deep-seismic transect from the eastern Australian continental margin to the New Hebrides arc which imaged the major tectonic provinces of the southwest Pacific, including zones of extended continental crust, narrow ocean basins, volcanic arcs, and subduction zones. The transition from rifting and breakup to convergence in the Lord Howe Rise–Norfolk region was the topic of another poster by Symonds et al.

Russell Korsch outlined the early Mesozoic continental sedimentary record from the Australian continental record (eastern margin of Gondwana), which set the stage for subsequent events. From Neoproterozoic to 95 Ma, a convergent margin existed along the eastern margin of Australia, but when did subduction cease on the Australian convergent margin, and did the youngest New Zealand Torlesse sediments form at the Australian convergent margin? Ian Duddy discussed mid-Cretaceous–late Miocene tectonothermal events related to uplift and erosion in southern and eastern Australia.

The tectonic evolution of New Caledonia was the focus of several talks (Sebatien Meffre, Christian Picard), posters (Baldwin et al., Cluzel et al., Rawling and Lister), and considerable discussion, as the different data sets for this small sliver of the Australian(?) continental crust were integrated. The tectonic evolution that began when Late Carboniferous to Jurassic basement terranes of New Caledonia originating in an arc-forearc setting were rifted away from Gondwana in Cretaceous time. In latest Eocene time, this continental sliver was overthrust first by an allochthonous basaltic nappe (36–38 Ma) and subsequently by an ultramafic nappe (by 34 Ma). Obduction temporally coincided with rapid exhumation of the high *P-T* terrane of northern New Caledonia (40–34 Ma), which led Baldwin and others to propose that the high *P-T* terrane was not juxtaposed against the pre-Eocene terranes of New Caledonia until post-Oligocene time. The significance of repeated cycles of compressional and extensional deformation as it relates to exhumation of the New Caledonia high *P-T* terrane and high-pressure terranes in general was also discussed, and it was postulated that additional Gondwana fragments should exist east of New Caledonia.

Subduction Rollback and Mantle Convection

Lidia Lonergan described a subduction rollback model to explain the tectonic evolution of the Alboran Sea and Betic-Rif oroclinal. Although aspects of this model remain to be applied to areas of the southwest Pacific, tomographic and deep-focus earthquake studies

may identify the orientation of tears in regions of rapid rollback, while paleomagnetic studies are required to gain insight into the degree of block rotations and tightly arcuate geometries.

Louis Moresi presented results of modeling used to examine the manner in which Earth's lithosphere is mobilized and subducted. The lithosphere was modeled as the cool thermal boundary layer of a convecting fluid with a strongly temperature dependent viscosity. Material properties of the fluid are strongly dependent on composition and strain history. Strain softening yield criteria are used to examine the conditions under which deformation is localized within the lithosphere.

Mountain-Building Processes at a Transpressional Plate Boundary

Kevin Furlong presented geophysical data which suggest that the lithospheric structure beneath Fiordland is significantly different from that beneath the Southern Alps, despite similarities in present-day plate motion vectors. This difference may result from differences in the rheology of the Australian and Pacific lithosphere and plate boundary geometry prior to the onset of transpression. An enigmatic zone of deep earthquakes beneath Fiordland may mark a possible tear in the subducting slab.

John Beavan summarized the present-day motion between the Australia and Pacific plates using GPS data to show that the present-day relative velocity is ~9.7 mm/yr and has been stable for the past 3 m.y. Fred Davey presented seismic profiles across the Pacific-Antarctica plate boundary in New Zealand which image the crustal structure of the westward-subducting Pacific plate in the North Island, the continental collisional orogen in the central South Island, the transition zones in between, and oblique northeastward subduction of Tasman Sea crust beneath Fiordland.


The final poster session of the conference presented results of ongoing studies of the Australia-Pacific plate boundary in New Zealand, including geophysical, structural, and thermochronologic constraints on the evolution of the Southern Alps, geomorphologic constraints on the evolution of the Wairarapa fold-and-thrust belt of the North Island, and structural controls on hydrothermal fluid flow in the Taupo Volcanic Zone. Recent structural studies document the kinematics of distributed ductile deformation at mid-crustal levels (Little et al.) and brittle-ductile shear band structures at higher structural levels within the inferred late Cenozoic brittle-ductile transition zone (Ilg and Little), which together suggest that a significant part of obliquely convergent Pacific-Australia plate boundary deformation in the Southern Alps is accommodated east of the Alpine fault.

New Zealand's pre-Alpine history was the focus of several poster presentations, which presented new thermochronologic and structural data that bear on the timing of shear zone development in central Otago (Forster and Lister), and on Late Cretaceous core complex formation related to opening of the Tasman Sea (Dunlap et al). Other posters examined the response of the lower crust to changes in plate boundary conditions, batholith emplacement in Fiordland, a comparison of the Mesozoic Kula-North America plate boundary evolution with that of the Cenozoic Alpine fault system, and attempts to track the Late Carboniferous to Neogene evolution of New Zealand plate boundaries.

Field Trips


At least 75% of the Australia-Pacific plate boundary motion is accommodated along the narrow high-strain zone associated with the Alpine fault, the rest is distributed across a 150–200-km-wide zone east of the Alpine fault; Jarg Pettinga and John Bradshaw led two field trips to examine aspects of the plate boundary. During the first trip, participants viewed the remarkably uniform sandstones and mudstones of the Torlesse terrane and their schistose equivalents, working westward to the edge of the Pacific plate at the Alpine fault. Other subjects were structures on the Australian plate related to crustal extension and separation of the New Zealand microcontinent from Gondwana, including an inverted rift basin (Paparoa anticline) and the lower plate mylonites and upper plate breccias of the Cretaceous

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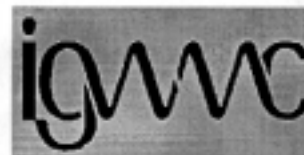
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Penrose Conference *continued from p. 14*

Paparoa core complex. On the second field trip, participants examined the effects of recent deformation (young folds and developing shear zones and evidence for neotectonic uplift) related to movement on the Australia-Pacific plate boundary.

Future Initiatives

Toward the end of the conference, the group, spearheaded by Barry Drummond, began construction of a space-time plot of the southwest Pacific. Suggestions regarding how to improve this database were made and Russell Korsch outlined a database system that could be used for this purpose. Plans were made for the group to reconvene in 2001 in New Caledonia. Those interested in receiving information on the second southwest Pacific plate boundary conference should contact Christian Picard (picard@ufp.nc). For more information on this Penrose Conference, including the abstract volume, please see our Web site at <http://acr.c.earth.monash.edu.au/ACRC/Conferences/PenroseConf.html>.

Acknowledgments

We appreciate support for the conference from the Geological Society of America, the National Science Foundation (Earth Sciences program in Tectonics and Ocean Sciences program in Marine Geology and Geophysics), and the Specialist Group in Tectonics and Structural Geology of the Geological Society of Australia. We thank meeting coordinators Lois Elms (Western Experience, Inc) and Megan Hough (Australian Crustal Research Centre) and the management and staff of the Wilderness Lodge for their help. John Bradshaw and Jarg Pettinga led the group on two superb field trips and provided an accompanying field guide. This report benefitted from reviews by Paul Fitzgerald and Brian Monteleone. We take responsibility for any misperceptions. Finally, we are most grateful to the participants for providing stimulating discussions before, during, and after the conference. ■

Meeting Attendees:

- | | |
|------------------------------|-------------------|
| Dallas Abbott | Kevin Hill |
| Laurent Ailleres | Neils Hovius |
| Richard Arculus | Bill Keller |
| Geoffrey Batt | Keith Klepeis |
| John Beavan | Russell Korsch |
| John Bradshaw | Loren Kroenke |
| Steve Cande | Tim Little |
| Valerie Chamberlain | Lidia Lonergan |
| Dominique Cluzel | Sebastian Meffre |
| James Conder | Brian Monteleone |
| Keith Crook | Louis Moresi |
| Fred Davey | Ian Nicholls |
| Barry Drummond | Grahame Oliver |
| Ian Duddy | Jarg Pettinga |
| Jim Dunlap | Christian Picard |
| Paul Fitzgerald | Chris Pigram |
| Merri-Lisa Formento-Trigilio | Nick Rawlinson |
| Marnie Forster | Julie Rowland |
| Kevin Furlong | Joann M. Stock |
| Carmen Gaina | Rupert Sutherland |
| Robert Hall | Phil Symonds |
| Larry Harrington | Brian Taylor |

Geochemist, Petrologist Named Honorary Fellows

Max-Planck-Institut für Chemie Managing Director Albrecht W. Hofmann and Agency of International Science and Technology (Japan) former Director-General Shunso Ishihara are the 1999 Geological Society of America Honorary Fellows. They will be honored at the Annual Meeting in Denver, October 26–29.



Albrecht W. Hofmann

Albrecht W. Hofmann

Albrecht W. Hofmann's contributions to geoscience include work fundamental to the understanding of the dynamics and evolution of Earth's crust-mantle system, leadership roles in geological associations, and service as editor or associate editor of several journals.

Hofmann, now of Mainz, Germany, attended Duke University (North Carolina, United States) and the University of Freiburg in Germany. He earned his M.Sc. (1965) and Ph.D. (1968) degrees at Brown University (Rhode Island, United States). He was an assistant at the Laboratory for Geochronology in Heidelberg, Germany, and then returned to the United States as a postdoctoral fellow at the Geophysical Laboratory, Carnegie Institution of Washington and later as one of the scientific staff at the institution's Department of Terrestrial Magnetism. Returning to Germany in 1980, he became the director of the Geochemistry Division of the Max-Planck-Institut für Chemie and later an adjunct

professor at the University of Mainz. He currently serves as managing director of the institute.

Hofmann's studies, alone and with colleagues, have demonstrated large-scale heterogeneity in Earth's mantle, eventually attributed to recycling of oceanic lithosphere; this model is now widely accepted. His papers on diffusion are considered critical to understanding scales for isotopic equilibrium in the mantle and how isotopic signatures of lavas can be used to understand the nature of the mantle source.

Among his many honors, Hofmann is a Chevalier de l'Ordre des Palmes Academiques, awardee of the V. M. Goldschmidt Medal of the Geochemical Society, and a Geochemistry Fellow of the European Association of Geochemistry and the Geochemical Society. He is a founding council member (and the current president) of the European Union of Geosciences, a Fellow of the American Geophysical Union, a former council member of the Deutsche Mineralogische Gesellschaft and Geologische Vereinigung, a founder and member of the Forschungskollegium Geochemie, and a member of the Comité Scientifique de France.

His publication work includes editorship of *Chemical Geology* and associate editorships for *Geochimica et Cosmochimica Acta* and *Contributions to Mineralogy and Petrology*.

Shunso Ishihara

Shunso Ishihara has combined scientific and administrative talent in his contributions to granite studies and the Geological Survey of Japan.

Ishihara received his B.Sc. from Hiroshima University (1956), then studied at the Colorado School of Mines for two years. He received his M.A. from Columbia University (New York) before returning to Japan, where he earned a D.Sc. from Tokyo University in 1970.

Ishihara's major scientific contribution has been to draw a distinction between ilmenite- and magnetite-series rocks and their associated ore deposits, in Japan and along much of the circum-Pacific rim. This work has encompassed both the earliest stages of granite development—melting—and the latest stages—mineralization.

Ishihara went to work for the Geological Survey of Japan in 1956. He was named a section chief in 1978, chief of the Research Planning Office in 1983, and head of the Mineral Resources Department in 1985, as well as director of the Government Industrial Research Institute in 1987. He became director of the Japan Survey in 1989. Moving even higher in the administrative ranks, he became director-general of the Agency of International Science and Technology (responsible for much of the govern-

ment-funded Japanese industrial research), in 1991. Upon compulsory retirement in 1994, Ishihara became a professor of geology at Hokkaido University. When he retired from the university, he was appointed advisor to the Geological Survey of Japan.

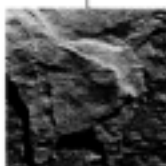
Ishihara's honors include the Japan Society of Mining Geologists Ronbunsho award, the Best Lecture Award at the fifth International Association on the Genesis of Ore Deposits (IAGOD) meeting, the Prof. T. Kato Prize of the Society of Mining Geologists of Japan, and the Society of Economic Geologists Silver Medal. In 1992 he served as director general of the 29th International Geological Congress. ■



Shunso Ishihara

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Penrose Medal

The Penrose Medal was established in 1927 by R. A. F. Penrose, Jr., to be awarded in recognition of eminent research in pure geology, for outstanding original contributions or achievements that mark a major advance in the science of geology. The award is made only at the discretion of the

Council. Nominees are selected by the Council and may or may not be members of the Society. Penrose's sole objective in making the gift was to encourage original work in purely scientific geology, which is interpreted as applying to all scientific disciplines represented by the Society. Scientific achievements should be considered rather than contributions in teaching, administration, or service. Mid-career scientists who have already made exceptional contributions should be given full consideration for the award.



Day Medal

The Day Medal was established in 1948 by Arthur L. Day to be awarded annually, or less frequently, at the discretion of the Council, for outstanding distinction in contributing to geologic knowledge through the application of physics and chemistry to the solution of geologic problems. Day's intent was to recognize outstanding

achievement and inspire further effort, rather than reward a distinguished career. Scientific achievements should be considered rather than contributions in teaching, administration, and service.

Honorary Fellows

Each year this honor is bestowed on non-North Americans who live and work outside of North America and have distinguished themselves in geological investigations or in notable service to the Society. Under exceptional circumstances, North Americans have been named Honorary Fellows. This amendment to the bylaws was made in 1969 when the Apollo II astronauts who first walked on the moon were elected.

The program was established by the GSA Council in 1909, and since then, except during a few war years, one or more Honorary Fellows have been elected annually. Most Honorary Fellows have been elected after many years of outstanding and internationally recognized contributions to the science. At present there are 64 living geologists who have received this honor.

The Council of the Society encourages the membership to submit names of qualified candidates for this honor. In preparing a nomination, it is imperative that the original research and scientific advances of the candidate be stressed. All supporting data, especially degrees received, publications, positions, etc., should also be verified by the nominator.

How to Nominate

To ensure thorough consideration by the respective committees, please submit for each candidate a brief biographical sketch, such as used in *American Men and Women of Science* and *Who's Who in America*, a 200-word-or-less summary of the candidate's scientific contributions to geology that qualify the individual for the award, and a selected bibliography of no more than 20 titles.

A nomination for any one of these three awards *must be supported* by signed letters from each of five (5) GSA Fellows or Members in addition to the person making the nomination. The letters may be attached to the nomination form or may be sent to the Geological Society of America separately. For Honorary Fellow nominations, please verify degrees received, publications, positions held, etc. The names of unsuccessful candidates proposed to the Council by the respective committees will remain for consideration by those committees for three years. For those still under consideration, it is recommended that an updated letter of renomination be sent to the Geological Society of America.

The nomination form (p. 19) and instructions are also available on the GSA Web site at <http://www.geosociety.org/aboutus/admin/pdhfhow.htm>. The deadline for receipt of nominations is February 1, 2000. ■



GSA ON THE WEB

Visit the GSA Web Site at <http://www.geosociety.org>.
From our home page you can link to many information resources.

Search for sessions and abstracts that interest you at the 1999 Annual Meeting.

Make a personalized schedule with the GeoTimer. Watch for meeting highlights as time draws near.

Earth Science Week is October 10-16!

Check out our tips to make sure it's successful. We've also added a list of recommended reading for Earth Science Week.

Need a grant?

Check out Professional Development for information on the 2000 Research Grants Program.

THE GEOLOGICAL SOCIETY OF AMERICA

Nomination for 2000 Penrose Medal, Day Medal, or Honorary Fellowship

(please circle one)

NAME OF CANDIDATE: _____

ADDRESS: _____

Telephone: _____

REQUIRED INFORMATION (Please attach)

BIOGRAPHICAL INFORMATION (Provide in a format similar to that found in suggested services.)

Suggested sources: *American Men and Women of Science, Who's Who in America*
GSA Service Record (obtainable from headquarters)
Other

SUMMARY OF SCIENTIFIC CONTRIBUTIONS TO GEOLOGY

Not more than 200 words.

SELECTED BIBLIOGRAPHY

No more than 20 titles.

LETTERS OF SUPPORT

Nominations for any one of these three awards MUST BE SUPPORTED by signed letters from five (5) GSA Fellows or Members in addition to the person making the nomination. The letters may be attached to this nomination form or may be sent to the Administrative Department separately. Supporting letters must discuss the original research and scientific advances of the candidates. Please also verify all other supporting data.

Name of person making the nomination: _____ Phone: _____

Address: _____

Date: _____ Signature: _____

Letters of support will be submitted by:

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

RETURN TO: GSA Administrative Department, P.O. Box 9140, Boulder, CO 80301-9140, Phone: (303) 447-2020

DEADLINE: Completed nominations must be received by **February 1, 2000**. To be considered, nomination materials must meet the above criteria. Reprints or articles will not be accepted.

Young Scientist Award (Donath Medal)



The Young Scientist Award was established in 1988 to be awarded to a young scientist (35 or younger during the year in which the award is to be presented) for outstanding achievement in contributing to geologic knowledge through original research that marks a major advance in the earth

sciences. The award, consisting of a gold medal called the Donath Medal, and a cash prize of \$15,000 was endowed by Dr. and Mrs. Fred A. Donath.

For the year 2000, only those candidates born on or after January 1, 1965, are eligible for consideration. In choosing candidates for the Young Scientist Award, scientific achievement and age will be the sole criteria. Nominations for the 2000 award must include:

- biographical information,
- a summary of the candidate's scientific contributions to geology (200 words or less),
- a selected bibliography (no more than 10 titles),
- supporting letters from five scientists in addition to the person making the nomination.

The nomination form (p. 21) and instructions are available at <http://www.geosociety.org/aboutus/admin/donhow.htm>. The deadline for receipt of nominations is February 1, 2000. ■

GSA Medalists and Honorary Fellows

Richard A. F. Penrose, Jr., Medalists

1927 Thomas Chrowder Chamberlin	1941 Norman Levi Bowen	1956 Arthur Holmes	1971 Marshall Kay	1986 Laurence L. Sloss
1928 Jakob Johannes Sederholm	1942 Charles Kenneth Leith	1957 Bruno Sander	1972 Wilmot H. Bradley	1987 Marland P. Billings
1929 <i>No award given</i>	1943 <i>No award given</i>	1958 James Gilluly	1973 M. King Hubbert	1988 Robert S. Dietz
1930 Francois Alfred Antoine Lacroix	1944 Bailey Willis	1959 Adolf Knopf	1974 William Maurice Ewing	1989 Warren Bell Hamilton
1931 William Morris Davis	1945 Felix Andries Vening-Meinesz	1960 Walter Herman Bucher	1975 Francis J. Pettijohn	1990 Norman D. Newell
1932 Edward Oscar Ulrich	1946 T. Wayland Vaughan	1961 Philip Henry Kuenen	1976 Preston Cloud	1991 William R. Dickinson
1933 Waldemar Lindgren	1947 Arthur Louis Day	1962 Alfred Sherwood Romer	1977 Robert P. Sharp	1992 John Frederick Dewey
1934 Charles Schuchert	1948 Hans Cloos	1963 William Walden Rubey	1978 Robert M. Garrels	1993 Alfred G. Fischer
1935 Reginald Aldworth Daly	1949 Wendell P. Woodring	1964 Donnel Foster Hewett	1979 J Harlen Bretz	1994 Luna B. Leopold
1936 Arthur Philemon Coleman	1950 Morley Evans Wilson	1965 Philip Burke King	1980 Hollis D. Hedberg	1995 John C. Crowell
1937 <i>No award given</i>	1951 Pentti Eskola	1966 Harry H. Hess	1981 John Rodgers	1996 John Robert Lawrence Allen
1938 Andrew Cowper Lawson	1952 George Gaylord Simpson	1967 Herbert Harold Read	1982 Aaron C. Waters	1997 John D. Bredehoeft
1939 William Berryman Scott	1953 Esper S. Larsen, Jr.	1968 J. Tuzo Wilson	1983 G. Arthur Cooper	1998 Jack E. Oliver
1940 Nelson Horatio Darton	1954 Arthur Francis Buddington	1969 Francis Birch	1984 Donald E. White	1999 M. Gordon Wolman
	1955 Maurice Gignoux	1970 Ralph Alger Bagnold	1985 Rudolf Trümpy	

Arthur L. Day Medalists

1948 George W. Morey	1959 Sir Edward C. Bullard	1970 Gerald J. Wasserburg	1980 Henry G. Thode	1990 William S. Fyfe
1949 William Maurice Ewing	1960 Konrad B. Krauskopf	1971 Hans P. Eugster	1981 Donald L. Turcotte	1991 Ian Carmichael
1950 Francis Birch	1961 Willard F. Libby	1972 Frank Press	1982 Eugene M. Shoemaker	1992 Susan Werner Kieffer
1951 Martin J. Buerger	1962 Hatten Schuyler Yoder	1973 David T. Griggs	1983 Harmon Craig	1993 Hugh P. Taylor, Jr.
1952 Sterling Hendricks	1963 Keith Edward Bullen	1974 A. E. Ringwood	1984 Wallace S. Broecker	1994 David Walker
1953 John F. Schairer	1964 James Burleigh Thompson, Jr.	1975 Allan Cox	1985 Freeman Gilbert	1995 Thomas J. Ahrens
1954 Marion King Hubbert	1965 Walter H. Munk	1976 Hans Ramberg	1986 E-an Zen	1996 Robert A. Berner
1955 Earl Ingerson	1966 Robert M. Garrels	1977 Akiho Miyashiro	1987 Don L. Anderson	1997 Edward Irving
1956 Alfred O. C. Nier	1967 O. Frank Tuttle	1978 Samuel Epstein	1988 Claude J. Allegre	1998 Bruce E. Watson
1957 Hugo Benioff	1968 Frederick J. Vine	1979 Walter M. Elsasser	1989 Dan McKenzie	1999 Donald J. DePaolo
1958 John Verhoogen	1969 Harold C. Urey			

Young Scientist Award (Donath Medalists)

1989 Mark Cloos	1992 John Peter Grotzinger	1995 Ward Earl Sanford	1998 Terry A. Plank
1990 Leigh Handy Royden	1993 Michael Gurnis	1996 Paul R. Bierman	1999 Peter C. Burns
1991 Brian Philip Wernicke	1994 An Yin	1997 Edouard G. Bard	

Honorary Fellows

Edwin "Buzz" Aldrin	Umberto G. Cordani	Emilie Jäger	B. P. Radhakrishna	Boris Sergeevich Sokolov
John R. L. Allen	Bruno d'Argenio	Victor E. Khain	Hans Ramberg	Richard L. Stanton
Shigeo Arimaki	Gabriel Dengo	Ihsan Ketin	Victor A. Ramos	Rashid A. Khan Tahirkheli
Neil Armstrong	Kingsley C. Dunham	Teichi Kobayashi	John G. Ramsay	Paul Tapponnier
Jean A. Aubouin	Stanislaw Dzylinski	Hans Laubscher	Alfred Rittmann	Bernard P. Tissot
Daniel Bernoulli	François Ellenberger	Henno Martin	Alexander B. Ronov	Livio Trevisan
Krzysztof Ludwik Birkenmajer	Hans Füchtbauer	Dan P. McKenzie	Rupert W. R. Rutland	Rudolf Trümpy
Alfonso Bosellini	William S. Fyfe	Michael W. McElhinny	Kristján Sæmundsson	Guangzhi Tu
George Malcolm Brown	Augusto Gansser	German K. Müller	Rushdi Said	Harry B. Whittington
S. Warren Carey	David Headley Green	Mervyn Silas Paterson	Hitoshi Sakai	Alwyn Williams
Maria Bianca Cita	Francisco Hervé	Leo Y. Picard	Mircea Sandulescu	Yang Zun-yi
Michael Collins	Dorothy Hill	Wallace S. Pitcher	Harrison Hagan Schmitt	Shunso Ishihara
William Compston	Ferenc Horvath	Jean Piveteau	Werner-Friedrich Schreyer	Albrecht W. Hofmann
Douglas Saxon Coombs	Kenneth J. Hsü	Isabella Premoli-Silva	Eugen Seibold	
P. G. Cooray	Valdar Jaanusson	Desmond A. Pretorius	Ali Mehmet Celal Şengör	

THE GEOLOGICAL SOCIETY OF AMERICA

Nomination for 2000 Young Scientist Award (Donath Medal)

NAME OF CANDIDATE: _____ Date of birth: _____
For the year 2000, only those candidates born on or after January 1, 1965, are eligible for consideration.

ADDRESS: _____

TELEPHONE: _____

REQUIRED INFORMATION (Please attach)

BIOGRAPHICAL INFORMATION

Provide in a format similar to that found in *American Men and Women of Science, Who's Who in America*.

SUMMARY OF SCIENTIFIC CONTRIBUTIONS TO GEOLOGY

Not more than 200 words.

SELECTED BIBLIOGRAPHY

No more than 10 titles.

LETTERS OF SUPPORT

Nominations for the Donath Medal **MUST BE SUPPORTED** by signed letters from five (5) scientists in addition to the person making the nomination. The letters may be attached to this nomination form or may be sent to the Administrative Department separately.

Supporting letters must discuss the candidate's original research that marks a major advance in the earth sciences. Please also verify all other supporting data.

Name of person making the nomination: _____

Address: _____

Date: _____ Signature: _____

Letters of support will be submitted by:

1. _____

2. _____

3. _____

4. _____

5. _____

RETURN TO: GSA Administrative Department
P.O. Box 9140
Boulder, CO 80301-9140
Phone: (303) 447-2020

DEADLINE: Completed nominations must be received by **February 1, 2000**. To be considered, nomination materials must meet the above criteria. Reprints or articles will not be accepted.

Call For Nominations — National Awards for 2002

(Deadline: April 30, 2000)

Nominations for the national awards described below are being solicited for 2002. Each year GSA members have been invited to participate by recommending possible candidates.

Those who wish to make nominations are urged to do so by sending background information and vitae, and specifying the award for which the candidate is being submitted by April 30, 2000, to the GSA External Awards Committee, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-2020, fax 303-447-1133. The nomination process is coordinated by AGI on behalf of its member societies, and a roster of candidates will be finalized by the AGI Member Society Council at its spring 2001 meeting for nomination to the respective offices sponsoring the national awards.

WILLIAM T. PECORA AWARD

The Pecora Award, sponsored jointly by NASA and the Department of the Interior, is presented annually in recognition of outstanding contributions of individuals or groups toward the understanding of Earth by means of remote sensing.

The award recognizes contributions of those in the scientific and technical community as well as those involved in the practical application of remote sensing. Consideration will be given to sustained or single contributions of major importance to the art or science of the understanding of Earth through observations made from space.

NATIONAL MEDAL OF SCIENCE

The medal is awarded by the President to individuals "deserving of special recognition by reason of their outstanding contributions to knowledge in the physical, biological, mathematical, engineering, or social and behavioral sciences."

There are now many younger American scientists and engineers who may be reaching a point where their contributions are worthy of recognition. The committee is giving increasing attention to these individuals as well as to those outstanding women and minority scientists who deserve recognition.

VANNEVAR BUSH AWARD

The Vannevar Bush Award is presented from time to time to a person who, through public service activities in science and technology, has made an outstanding contribution toward the welfare of mankind and the nation.

The award is given to a senior statesman of science and technology and complements the NSF's Alan T. Waterman Award, which is given to a promising young scientist. The two awards are designed to encourage individuals to seek the highest levels of achievement in science, engineering, and service to humanity.

The nomination should be accompanied by a complete biography and a brief citation summarizing the nominee's scientific or technological contributions to our national welfare in promotion of the progress of science.

ALAN T. WATERMAN AWARD

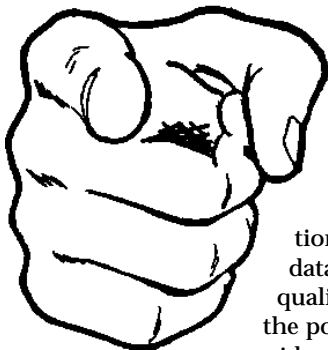
The Waterman Award is presented annually by the NSF and National Science Board to an outstanding young researcher in any field of science or engineering supported by NSF.

Candidates must be U.S. citizens or permanent residents and must be 35 years of age or younger, OR not more than five years beyond receipt of the Ph.D. degree by December 31 of the year in which nominated.

Candidates should have completed sufficient scientific or engineering research to have demonstrated, through personal accomplishments, outstanding capability, and exceptional promise for significant future achievement.

Remember: Background information and vitae of nominated candidates should be sent by April 30, 2000, to the GSA External Awards Committee, P.O. Box 9140, Boulder, CO 80301-9140. ■

YOU Can Help Direct GSA's Future



The GSA Committee on Nominations requests your help in compiling a list of GSA members qualified for service as officers and councilors of the Society. The committee requests that each nomination be accompanied by basic data and a description of the qualifications of the individual for the position recommended (vice president, treasurer, councilor).

Nominations for 2000 officers and councilors must be received at GSA headquarters no later than FEBRUARY 15, 2000.

Please send nominations and back-up material to Administrative Department, Geological Society of America, P.O. Box 9140, Boulder, CO 80301-9140.

Call for Nominations for 2000 GSA Distinguished Service Award

The GSA Distinguished Service Award was established by Council in 1988 to recognize individuals for their exceptional service to the Society. GSA Members, Fellows, and Associates may be nominated for consideration. Any GSA member or employee may make a nomination for the award. Awardees will be selected by the Executive Committee, and all selections must be ratified by the Council. Awards may be made annually, or less frequently, at the discretion of Council. This award will be presented during the Annual Meeting of the Society. Letters of nomination and any supporting information should be addressed to the GSA Administrative Offices, GSA, P.O. Box 9140, Boulder, CO 80301-9140.

Deadline for nominations is March 1, 2000.

Recipients to date:

1988	.....	Campbell Craddock, Robert D. Hatcher, Jr., Eldridge M. Moores, William A. Thomas
1990	.....	William B. Heroy, Jr.
1991	.....	Dorothy M. Palmer
1992	.....	A. R. (Pete) Palmer
1993	.....	Michel T. Halbouty
1994	.....	F. Michael Wahl
1995	.....	John E. Costa, Henry T. Mullins, Arthur G. Sylvester
1996	.....	David M. Fountain, Royann (Gardner) Cygan, Louis C. Pakiser, Jr., Anthony Reso
1997	.....	Robert L. Fuchs, Richard A. Hoppin, Faith E. Rogers, Bennie W. Troxel
1998	.....	June R. Forstrom, Charles J. Mankin, George R. Hallberg
1999	.....	Sue Beggs, Randolph W. Bromery, Lynn M. Walter

GSA DIVISION AND SECTION GRANTS 1999

Leah Carter, GSA Grants Administrator

DIVISION RESEARCH GRANTS

Nine of the twelve GSA divisions offer grants for outstanding student research within the fields of the respective divisions. Recipients of these grants for 1999 are listed below. The three divisions that do not currently offer any awards to students are Geoscience Education, History of Geology, and the International Division.

ARCHAEOLOGICAL GEOLOGY DIVISION

The Archaeological Geology Division awarded the Claude C. Albritton, Jr., Memorial Student Research Award to Jennifer Smith, University of Pennsylvania, for her project "A Cultural and Climatic History of the Oasis Depressions of Western Egypt from Analysis of Deposits of Fossil Spring Tufa." The Claude C. Albritton, Jr., Memorial Fund was established at the GSA Foundation in 1991 with contributions from the family and friends of Claude Albritton. The division continues to seek contributions to the fund in memory of Dr. Albritton to provide scholarships for graduate students in the earth sciences and archaeology.

The Archaeological Division did not award a Student Travel Award this year.

COAL GEOLOGY DIVISION

The Coal Geology Division presented the annual Antoinette Lierman Medlin Research Awards for 1999. The Field Award went to Tom Rozak, University of British Columbia, for his project "Identification of Areas of Enhanced Permeability in Coals using Geophysical Log Interpretation Techniques: Implications on Coalbed Methane Exploration." The Research Award went to Michelle Hawke, University of British Columbia/Geological Survey of Canada, for her project "Mineral Matter, Trace Elements and Organic Petrography of Selected Canadian Peatlands: Implications for Early Diagenesis, Variations in Depositional Environments and Anthropogenic Impact."

ENGINEERING GEOLOGY DIVISION

The student research grant awarded by the Engineering Geology Division for an outstanding research proposal in 1999 was presented to Steve D. Bowman from the University of Nevada, Reno, for his project "Rock Mass Strength Assessment and Implications to Edifice Slope Stability at Mount Adams, Washington."

GEOPHYSICS DIVISION

The Geophysics Division presented the Allan V. Cox Student Research Award this year for an outstanding student research proposal submitted to the GSA Research Grants Program to Patricia Allison Dean, Western Washington University, for her project "The Spieden Group: Baja or B.C.? A Paleogeographic Puzzle."

HYDROGEOLOGY DIVISION

Awards for outstanding student research from the Hydrogeology Division were presented this year to five students: Elizabeth R. James, University of Oregon, for "Mantle-Derived Helium and Carbon in Groundwaters of the Oregon Cascades and Implications for Quantifying the Volcanic Carbon Dioxide Flux"; Kaveh Khorzad, The University of Texas at Austin, for "Land Subsidence Along the Texas Gulf Coast Due to Oil and Gas Withdrawal"; Liz McVay, University of Kansas, for "Geomicrobial Denitrifying and Nitrifying Characteristics of a Kansas Alluvial Aquifer Influenced by Ammonium and Nitrate"; Kristin A. Schultheis, Washington State University, for "Mechanisms of Pesticide Transport to Surface Water at the Field Scale in a Dryland-Agricultural Region"; Timothy Michael White, Washington State University, for "Measuring Effects of Ecosystem Disturbance on the Geological Sink for Atmospheric CO₂: Studies in Experimental Ecosystems in New Hampshire."

PLANETARY GEOLOGY DIVISION

The Planetary Geology Division presents the Stephen E. Dworkin Best Student Paper Awards annually to students who are U.S. citizens and are pursuing advanced degrees in Planetary Sciences. The awards are presented each year for papers given in March at the Lunar and Planetary Science Conference. Recipients of the 1999 awards are William A. Pike, Carleton College, for the best oral presentation for his paper "Melting Temperatures in the Fe-Ni-S System at High Pressures: Implications for the State of the Martian Core," and Geoffrey Collins, Brown University, for the best poster presentation for "Surface Stresses Resulting from Internal Differentiation: Application to Ganymede Tectonics." Recipients of the awards are presented with a citation and a \$500 cash prize in an awards ceremony held at NASA Headquarters in Washington, D.C. early in the summer.

QUATERNARY GEOLOGY AND GEOMORPHOLOGY DIVISION

The Quaternary Geology and Geomorphology Division awarded two J. Hoover Mackin Grants this year. Recipients are Sarah Konrad, University of Wyoming, for "Flow Dynamics of Galena Creek Rock Glacier, Absaroka Mountains," and Stephen Thompson, University of Washington, for his project "Luminescence Dating to Evaluate Hydrologic Change, Fold Growth, and Fault Slip, Tien Shan, Kirgiz Republic." The Arthur D. Howard Research Grant was awarded this year to Robert Burrows, Western Washington University, for "Glacial Chronology and Paleoclimatic Significance of Swift Creek and Shuksan Creek Cirque Moraines, North Cascade Range."

SEDIMENTARY GEOLOGY DIVISION

The Sedimentary Geology Division presented its 1999 award for an outstanding student research proposal to Galen Pippa Halverson, Harvard University, for his project "Dating Cap Dolomites in Svalbard: An Attempt to Constrain the Number of Neoproterozoic Glaciations."

STRUCTURAL GEOLOGY AND TECTONICS DIVISION

The Structural Geology and Tectonics Division presented its 14th annual awards for outstanding student research this year to Rebecca R. Ghent, Southern Methodist University, for "Numerical Modeling of Folds and Ribbons in Venusian Crustal Plateaus"; and Christopher Zahm, Colorado School of Mines, for "Mechanics of Tear Fault Development in Anticlinal Folds, Thermopolis Anticline, Southern Bighorn Basin, Wyoming."

SECTION RESEARCH GRANTS

Four of the six GSA regional sections award grants for research to students attending colleges and universities within each section's respective geographical boundaries. The Cordilleran and Rocky Mountain Sections do not currently offer student research grants. Grants awarded in 1999 by the other sections are listed below.

NORTH-CENTRAL SECTION

The North-Central Section awarded grants for undergraduate research projects to students who attend a college or uni-

Grants continued on p. 24

CALL FOR NOMINATIONS

2000 John C. Frye Environmental Geology Award

In cooperation with the Association of American State Geologists (AASG), GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys. The award is a \$1000 cash prize from the endowment income of the GSA Foundation's John C. Frye Memorial Fund.

Criteria for Nomination

Nominations can be made by anyone, on the basis of the following criteria: (1) paper must be selected from GSA or state geological survey publications, (2) paper must be selected from those published during the preceding three full calendar years, (3) nomination must include a paragraph stating the pertinence of the paper, (4) nominations must be sent to Executive Director, GSA, P.O. Box 9140, Boulder, CO 80301-9140. *Deadline: March 31, 2000.*

Grants *continued from p. 23*

versity within the North-Central Section geographic area. Research proposals are submitted and evaluated competitively. Recipients for 1999 are: Brittany Flokstra, Southwest Missouri State University; Edward Washburn, Illinois State University; Katie Thornburg, University of Wisconsin-Eau Claire; and Chad Wittkop, Winona State University.

SOUTH-CENTRAL SECTION

The South-Central Section has not yet determined the 1999 award recipients. The results will be published in the November issue of *GSA Today*.

NORTHEASTERN SECTION

The Northeastern Section awarded grants to five undergraduate students. The 1999 recipients are: Matthew Chartier, SUNY-Oneonta; Jason P. Gowers, Montclair State University; Hillary Hayworth, Boston University; William Koeppen, Juniata College; Michael C. Rygel, University of Pittsburgh-Johnstown.

SOUTHEASTERN SECTION

GSA's Southeastern Section awarded research grants to ten students this year. Adebola Adesida, University of Georgia; Josh Borella, University of North Carolina at Chapel Hill; Brandon Coates, Auburn University; Eric Davis, West Virginia University; Danita LaSage, University of Kentucky; Dana Miller, University of Tennessee; Amelia Robinson, University of Tennessee; Cynthia Stiles, University of Tennessee; Ivana Stevanovic, Auburn University; William Ware, Auburn University. ■

Basis for Selection

Each nominated paper will be judged on the uniqueness or significance as a model of its type of work and report and its overall worthiness for the award. In addition, nominated papers must establish an environmental problem or need, provide substantive information on the basic geology or geologic process pertinent to the problem, relate the geology to the problem or need, suggest solutions or provide appropriate land use recommendations based on the geology, present the information in a manner that is understandable and directly usable by geologists, and address the environmental need or resolve the problem. It is preferred that the paper be directly applicable by informed laypersons (e.g., planners, engineers).

1999 Award Recipient Named

The 1999 award will be presented at the GSA Annual Meeting in Denver, Colorado, to Ed Lane, and Frank Rupert for their poster, "Earth Systems: The Foundation of Florida's Ecosystems," Florida Geological Survey. This nontraditional approach matches geology with various aspects of the ecology. It is useful and informative for both lay persons and professionals, and touches on environmental aspects related to total earth systems. ■

CALL FOR NOMINATIONS

GSA Public Service Award

The GSA Public Service Award in honor of Eugene and Carolyn Shoemaker was established by Council in 1998 to be awarded for contributions that have materially enhanced the public's understanding of the earth sciences or significantly served decision-makers in the application of scientific and technical information in public affairs and public policy related to the earth sciences. This may be accomplished by individual achievement through:

- ◆ Authorship of education materials of high scientific quality that have enjoyed widespread use and acclaim among educators or the general public,
- ◆ Acclaimed presentations (books and other publications, mass and electronic media, or public presentations including lectures that have expanded public awareness of the earth sciences,
- ◆ Authorship of technical publications that have significantly advanced scientific concepts or techniques applicable to the resolution of earth-resource or environmental issues of public concern,
- ◆ Other individual accomplishments that have advanced the earth sciences in the public interest.

The award will normally go to a GSA member, with exceptions approved by Council. It may be presented posthumously to a descendant of the awardee.

Nominations must include a cover letter and biographical information that clearly demonstrates applicability to the selection criteria. The deadline for receipt of nominations is February 1, 2000. Letters of nomination should be addressed to the GSA Administrative Offices, GSA, P.O. Box 9140, and Boulder, CO 80301-9140.

Recipients to date:

1999 Stephen Jay Gould

CALL FOR GEOLOGICAL PAPERS FOR 2000 GSA SECTIONS AND ANNUAL MEETINGS

NORTHEASTERN SECTION

March 13–15, 2000
Hyatt Regency Hotel,
New Brunswick, New Jersey

Abstract Deadline:
November 29, 1999

Submit completed abstracts to:
Kenneth G. Miller
Dept. of Geological Sciences,
Wright Lab
Rutgers University
610 Taylor Rd.
Piscataway, NJ 08854-8066
(732) 445-3622
kgm@rci.rutgers.edu

SOUTHEASTERN SECTION

March 23–24, 2000
Westin Francis Marion Hotel,
Charleston, South Carolina

Abstract Deadline:
December 8, 1999

Submit completed abstracts to:
June E. Mirecki
Department of Geology
College of Charleston
Charleston, SC 29424-0001
(803) 953-8278
mireckij@cofc.edu

SOUTH-CENTRAL SECTION

April 3–4, 2000
Center for Continuing Education,
Fayetteville, Arkansas

Abstract Deadline:
December 8, 1999

Submit completed abstracts to:
John Van Brahana
Department of Geology
University of Arkansas, Ozark Hall 118
Fayetteville, AR 72701-1201
(501) 575-2570
jbrahana@jungle.uark.edu

NORTH-CENTRAL SECTION

April 6–7, 2000
Indiana State Government Center,
Indianapolis, Indiana

Abstract Deadline:
December 20, 1999

Submit completed abstracts to:
Robert D. Hall
Department of Geology
Indiana University–Purdue University
723 W Michigan St.
Indianapolis, IN 46202-5132
(317) 274-7484
rhall@iupui.edu

ROCKY MOUNTAIN SECTION

April 17–18, 2000
Missoula Community Theater,
Missoula, Montana

Abstract Deadline:
January 15, 2000

Submit completed abstracts to:
Marc Hendrix
Department of Geology
University of Montana
Missoula, MT 59812-1019
(406) 243-5278
marc@selway.umt.edu

CORDILLERAN SECTION

April 27–29, 2000
Robson Square Conference Centre,
Vancouver, British Columbia

Abstract Deadline:
January 10, 2000

Submit completed abstracts to:
Peter Mustard
Department of Earth Sciences
Simon Fraser University
Burnaby, BC V5A 1S5, CANADA
(604) 291-5389
pmustard@sfu.ca

NEW! ELECTRONIC SUBMISSION OF ABSTRACTS

You may now submit your abstracts to section meetings electronically. This is fast, easy, and by far the best way to submit. Visit the GSA Web site at www.geosociety.org to find the form.

Alternatively, you can download a PDF version of the paper abstract form, or contact one of the above technical chairs if you need paper abstract forms sent to you.

GSA ANNUAL MEETING

Reno, Nevada
November 13–16, 2000

Check out the April 2000
issue of **GSA Today** for
Call for Geological Papers.



Call for Nominations

Planetary Geoscience Student Paper Award

The Award

Planetary geologist Stephen E. Dwornik established this award in 1991 to provide encouragement, motivation, and recognition to outstanding future scientists. Two awards are given annually, one for the best oral presentation, the other for the best poster presentation, each winner receiving a citation and \$500. The program is administered through the Planetary Geology Division of the Geological Society of America. The GSA Foundation manages the award fund. For further details, see <http://www.planetary.brown.edu>.

Criteria

The Dwornik Student Paper Award applies to papers presented at the annual Lunar and Planetary Science Conference held each March in Houston. Student applicants must be (1) the senior author of the abstract (the paper may be presented orally or in a poster session); (2) a U.S. citizen; and (3) enrolled in a college or university, at any level of their education, in the field of planetary geosciences. Papers will be judged on the quality of the scientific contributions, including methods and results; clarity of material presented; and methods of delivery, oral or display.

To Apply

The application form and instructions are found in the Call for Papers for the 31st Lunar and Planetary Science Conference, to be held March 13–17, 2000, in Houston, Texas. For further information, contact Program Services Division, Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058-1113, (281) 486-2158, simmons@lpi.jsc.nasa.gov. Only one abstract per student will be considered.

Deadline

Hard copy abstracts are due January 5, 2000; electronic abstracts are due January 12, 2000. ■

The Geological Society of America

2000 Research Grants Program for Students

The primary role of the Research Grants Program is to provide partial support for research in earth science by graduate students at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. Eligibility is not restricted to GSA members. New application forms are available each fall in the geology departments of colleges and universities offering graduate degrees in earth sciences. Forms are mailed to GSA Campus Representatives, department secretaries, and chairpersons in the United States, Canada, and Mexico. Application forms and information is available on GSA's Web page <http://www.geosociety.org>. Applications may be downloaded from the Web but may **not** be submitted by facsimile or e-mail. They are also available upon request from the Research Grants Administrator, Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. *Please use only the current 2000 application and appraisal forms.*

Confidential evaluations from two faculty members are required from candidates for the M.S. or Ph.D. degree and must accompany applications submitted. PLEASE USE THE "APPRAISAL OF APPLICANT" FORMS, WHICH ACCOMPANY THE 2000 APPLICATION FORMS. APPLICATION FORMS WILL NOT BE ACCEPTED BY FACSIMILE OR E-MAIL.

The Geological Society of America awarded over \$395,000 in grants in 1999. The grants went to 212 students doing research for advanced degrees. The average amount awarded was \$1865. The largest grant was \$4500, but there is no predetermined maximum amount. Grants supported 45 percent of the applicants. Funding for this program is provided by a number of sources, including GSA's Penrose and Pardee endowments, the National Science Foundation, industry, individual GSA members through the GEOSTAR and Research Grants funds, and numerous dedicated research funds that have been endowed at the GSA Foundation by members and families.

The Committee on Research Grants will meet soon after the deadline to evaluate applications and award grants. In April, all applicants for grants will be informed of the committee's actions by the Executive Director/CEO of the Geological Society of America.

**ALL APPLICATIONS MUST BE SUBMITTED ON THE 2000 FORMS
AND POSTMARKED BY FEBRUARY 1, 2000**

The Geological Society of America

invites you to join

Sarah Andrews

as she signs her new and classic books

Sunday, Oct. 24, 5:30–7 p.m.

GSA Headquarters near the GSA Bookstore



Andrews has been honored with the prestigious American Association of Petroleum Geologists Journalists Award. Her forensic geology mystery novels enjoy a wide following and have been acclaimed by the New York Times, the Washington Post, Publisher's Weekly, Booklist, and Kirkus Reviews. She teaches geology at Sonoma State University, writing her forensic geology mystery novels, and lecturing on the importance of geologists and geology to modern life.

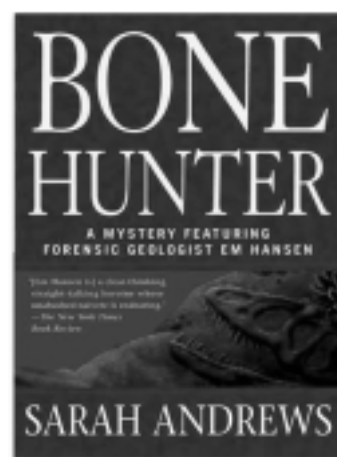
**The author is donating the proceeds from her book sales
to the GSA Foundation's Student Research Grants Program.**

GSA Show Prices

GSA Members: \$17.46

Nonmembers: \$19.96

LIST PRICE: \$24.95



On sale in the GSA Bookstore.

NORTH-CENTRAL SECTION, GSA 34th Annual Meeting

Indianapolis, Indiana, April 6–7, 2000
<http://www.geosociety.org>

The Indiana University–Purdue University at Indianapolis (IUPUI) Department of Geology and Center for Earth and Environmental Science (CEES), Professional Geologists of Indiana, and Indiana Department of Environmental Management invite you to participate in the 34th Annual Meeting of the North-Central Section of the Geological Society of America. The meeting will be held at the Indiana Government Center and the Marriott Courtyard Downtown in Indianapolis.

CALL FOR PAPERS

Papers on all topics listed on the GSA Abstract form are invited from students and professionals for presentation in oral or poster sessions. Presentations that may fit into one of the symposia (invited and volunteered papers) are also solicited. Those interested in presenting a paper or poster in a symposium should contact the symposium convener and indicate on the abstract form that the abstract be included in a particular symposium. Special sessions focused on specific themes or subjects will be arranged by the local program committee after review of the abstracts. Two 35mm carousel projectors, two screens, and an overhead projector will be available for each room.

SYMPOSIA

The mailing address for all at IUPUI is Dept. of Geology, 723 W. Michigan St., Indianapolis, IN 46202-5132, fax 317-274-7966; for all at the Indiana Geological Survey, the address is 611 N. Walnut Grove, Bloomington, IN 47405, fax 812-855-2862.

1. Glacial Hydrological Engineering and Other Perspectives in Urban Settings. Roger Koelpin, Indiana Dept. of Environmental Management, 100 N. Senate Ave., P.O. Box 6015, Indianapolis, IN 46206, (317) 232-8726, fax 317-232-3403, rkoelpin@dem.state.in.us.
2. Dynamic Shallow Groundwater Systems. Paul K. Doss, Dept. of Geosciences, University of Southern Indiana, Evansville, IN 47712, (812) 465-7132, fax 812-465-1052, pkdoss@deepcnet.usi.edu.
3. Records of Post-Glacial Processes. Todd Thompson, Indiana Geological Survey, (812) 855-5412, tthomps@indiana.edu.
4. Geology of Indiana. John Steinmetz, Indiana Geological Survey, (812) 855-5067, jsteinm@indiana.edu.
5. Sedimentology, Geochemistry, and Biology of Tidal Deposits—Modern and Ancient. Erik Kvale, Indiana Geological Survey, (812) 855-1324, kvalee@indiana.edu.
6. Evolutionary Biology of Cincinnatian Invertebrates. Joseph Pachut, IUPUI, (317) 274-7785, jpachut@iupui.edu; Roger Cuffey, (814) 865-1293, fax 814-863-7823, cuffey@ems.psu.edu.

7. Biogeochemistry. Christopher Maples, Dept. of Geological Sciences, Indiana University, Bloomington, IN 47405, (812) 855-5581, fax 812-855-7899, cmaples@indiana.edu.
8. Impact of Geology on Society. Arthur Mirsky, IUPUI, (317) 278-0229, amirsky@iupui.edu.
9. Assessing Contaminant Sources. Eliot Atekwana, IUPUI, (317) 274-7969, eatekwan@iupui.edu; John Mundell, (317) 630-9060, fax 317-630-9065, mundell@indy.net.
10. Lake Records of Biogeochemical Cycling and Climate. Gabriel Filippelli, IUPUI, (317) 274-3795, gfilippe@iupui.edu; James McManus, jmcmanus@d.umn.edu.
11. Wetland Restoration. Lenore Tedesco, IUPUI, (317) 274-8383, ltedesco@iupui.edu.
12. Soil Science and Quaternary Geology: Once and Future Partners? Robert Hall, IUPUI, (317) 274-7154, rhall@iupui.edu.
13. Application of Soil Chemistry to Environmental Issues. William R. Roy, Illinois State Geological Survey, Urbana, IL 61801, (217) 333-1197 or (217) 244-8389, roy@isgs.uiuc.edu.
14. Undergraduate Research Symposium. Andrew Barth, IUPUI, (317) 274-7484, ibsz100@iupui.edu.
15. Geoscience Education. NAGT—Pat DeCaprariis, IUPUI, (317) 274-7732, pdecaprr@iupui.edu.

If submitting a poster, indicate poster session on the GSA abstract form. Each poster booth will contain two attached panels, each 4' x 4'. Poster sessions, in the same area as exhibits, will be available for four hours.

ABSTRACTS

Abstracts must be submitted camera-ready on official GSA abstract forms in accordance with the instructions on the forms. Forms are available from Gabe Filippelli, NC-Section Technical Program Chair, IUPUI Dept. of Geology, 723 W. Michigan St., SL 118, Indianapolis, IN 46204, 317-274-3795, gfilippelli@iupui.edu, and also from GSA Campus Representatives at most colleges and universities in the North-Central Section region. A downloadable PDF version of the abstract form is available on the GSA Web site (www.geosociety.org). Electronic abstract

submission is also available on the GSA Web site. There is no fee for submitting an abstract.

Abstract Deadline December 20, 1999

Send one original and five copies to Robert D. Hall, IUPUI Dept. of Geology, 723 W. Michigan St., SL 118, Indianapolis, IN 46204. Abstracts submitted for inclusion in symposia should be sent directly to the first symposium organizer listed for each symposium. If you want acknowledgement of receipt of your abstract, include a stamped, self-addressed envelope or postcard.

FIELD TRIPS

A final list of trips, schedules, and costs will be available in the January 2000 issue of *GSA Today*. Field trip coordinator is Robert D. Hall, IUPUI, (317) 274-0225, fax 317-274-7966, rhall@iupui.edu.

Premeeting

1. Indiana Dunes National Lakeshore. Todd Thompson, Indiana Geological Survey, (812) 855-5412, tthomps@indiana.edu.

Postmeeting

2. A Vertical Tour through the Classic Cincinnatian Focusing on Bryozoan-rich Intervals. Joseph F. Pachut, IUPUI, (317) 274-7785, fax 317-274-7966, jpachut@iupui.edu; Robert L. Anstey, (517) 388-9009; anstey@pilot.msu.edu; Roger J. Cuffey, (814) 865-1293, cuffey@ems.psu.edu.
3. Pennsylvanian Incised Valley Fills. Erik Kvale, Indiana Geological Survey, (812) 855-1324, kvalee@indiana.edu.
4. Glacial Hydrological Engineering and other Environmental Perspectives in the Indianapolis Area. Roger U. Koelpin, Indiana Dept. of Environmental Management; (317) 232-8726, fax 317-232-3403, rkoelpin@dem.state.in.us.
5. Quaternary Stratigraphy and Sedimentology of Eastern Indiana and Western Ohio. Robert D. Hall, IUPUI, (317) 274-0225, fax 317-274-7966.

STUDENT PAPER AWARDS AND TRAVEL ASSISTANCE GRANTS

The North-Central Section of GSA will award \$100 each for up to eight papers judged best in their respective technical session. The principal author and presenter must be a graduate or undergraduate student. Indicate abstracts of papers submitted for consideration for these awards.

The North-Central Section of GSA, in cooperation with the GSA Foundation, offers grants for travel assistance of up to \$200 (exclusive of field trip fees), available to student members and associates of GSA. Priority will be given to students presenting oral or poster papers. To be eligible for travel assistance grants, students must be currently enrolled in an academic department and certify their student membership in GSA. Applications for travel assistance grants may be

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ROCKY MOUNTAIN SECTION, GSA 52nd Annual Meeting

Missoula, Montana, April 17-18, 2000

<http://www.geosociety.org>

CALL FOR PAPERS

Papers are invited from students and professionals for presentation in oral and poster general sessions and for presentations that may fit into the symposia listed below. Oral technical sessions and symposia provide 15 minutes for presentation and 5 minutes for discussion. Two 35 mm carousel projectors, two screens, and an overhead projector will be provided for each oral session. Slides must fit into a standard carousel tray. Authors must bring their own slide trays. A video projector may be available if sufficient notice is provided.

Poster sessions will allow at least three hours of display time; authors must be present for at least two hours. A single 4' x 8' foot display board will be provided.

ABSTRACTS

Abstracts, limited to about 250 words, must be submitted camera-ready, on the official 2000 GSA section meeting abstract form, and in accordance with instructions on that form. Abstract forms are available from Marc Hendrix, Technical Program Co-Chair, University of Montana, Geology Department (MGLI01), 32 Campus Drive #1296, Missoula, MT 59812-1296. Electronic abstract submission is available. Also, a downloadable PDF version is available on the GSA Web site.

Send one original and five copies of the abstract to Marc Hendrix, (address above), (406) 243-5278, marc@selway.umt.edu. Authors of invited (symposium) papers, and those who think their paper might be suit-

able for inclusion in a symposium, should send an extra copy of the abstract to the first-listed contact person for that particular symposium (see proposed symposia, below).

Only one volunteered paper may be presented by an individual; however, a person may be a coauthor of other papers. Those invited for symposia may present additional papers.

ABSTRACT DEADLINE: January 15, 2000

Additional information concerning registration, lodging, and the meeting program will be provided in the January 2000 issue of *GSA Today*, on the GSA Web site (www.geosociety.org), and as part of the Rocky Mountain Section *Abstracts with Programs*. Address general questions to General Chair Don Hyndman, (406) 243-2241, dhyndman@selway.umt.edu.

SYMPOSIUM

Symposia will include invited papers and selected volunteered papers. Prospective authors are encouraged to contact individual conveners directly. Address requests for general information regarding symposia or suggestions for other symposia to Marc Hendrix, Coordinator for Symposia and Technical Program, University of Montana, Geology Department (MGLI01), 32 Campus Drive #1296, Missoula, MT 59812-1296, (406) 243-5278, marc@selway.umt.edu. The address for U of M conveners is the same.

1. Current Tectonic Research in the Northern Rocky Mountain Region:

New Ideas and Directions. Lee Woodward, (505) 277-5309.

2. Structural Analysis of the Rocky Mountain Fold and Thrust Belt.

Jim Sears, (406) 243-5251, jwsears@selway.umt.edu.

3. Active Tectonics, Tectonic Geomorphology, and Paleoseismology of the Intermountain Seismic Belt (ISB) and Adjacent Regions. J. Ramon Arrowsmith (602) 965-3541, ramon.arrowsmith@asu.edu.

4. Geophysics of the Intermountain West. Posters. Dave Brumbaugh (602) 523-7191, david.brumbaugh@nau.edu.

5. New Perspectives on the Structural Development, Stratigraphy, and Ore Emplacement in the Coeur d'Alene Mining District. Don Winston (406) 243-5511 or 721-1016, winston@selway.umt.edu. Brian White (509) 353-3113 or (208) 664-4282.

6. Magmatism and Orogenic Processes in the Rocky Mountains. David Foster (352) 392-7316, dfoster@geology.ufl.edu.

7. Sedimentary Basin Studies in the Rocky Mountains. Marc Hendrix, (406) 243-5278, marc@selway.umt.edu.

8. Effects of Fractures and Faults on Hydrogeology. Shemin Ge, University of Colorado (303) 492-8323, ges@spot.colorado.edu.

9. Surface-Groundwater Interactions in Fluvial Systems. Bill Woessner (406)243-5698, gl_www@selway.umt.edu. University of Montana, Geology Department (MGLI01), 32 Campus Drive #1296, Missoula, MT 59812-1296.

10. Acid Rock Drainage Associated with Flooded Pit Lakes and Abandoned Mines. Chris Gammons, (406) 496-4207, cgammons@mtech.edu.

11. Critical Geologic Intervals: Mass Extinctions and Recoveries, and Biotic Changes. George Stanley, (406) 243-5693, fossil@selway.umt.edu.

12. Tertiary Extensional Basins in southwestern Montana. Rob Thomas, (406)683-7615, r_thomas@wmc.edu.

13. Late Quaternary Paleocology of the Northern Rockies. Eric Edlund, (406)243-6126, edlund@selway.umt.edu.

14. Biogeochemistry of Yellowstone, including thermal aspects, soils, streams. Nancy Hinman, (406)243-5277, hinman@selway.umt.edu.

THEME SESSIONS

1. Undergraduate Research: Research-based Learning in the Classroom; Teaching Science by Example. Chris Brick (406)549-6939, brick@selway.umt.edu.

2. Distance Education in the Geosciences: Experiences and Strategies for Teaching Geoscience via the Internet. Chris Brick (406)549-6939, brick@selway.umt.edu.

3. K-12 in the Geosciences. Jim Sears (406)243-5251, jwsears@selway.umt.edu.

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obtained from: Robert D. Hall, IUPUI Dept. of Geology, 723 W. Michigan Street, SL 118, Indianapolis, IN 46204, (317) 274-0225, fax 317-274-7966, rhall@iupui.edu. Applications for travel assistance must be received no later than February 25, 2000.

ADDITIONAL INFORMATION:

Registration details will be in the January 2000 issue of *GSA Today* and the GSA Web site. For a printout of the full announcement, write to GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140, or call (303) 447-2020, ext. 113. Pre-registration deadline is February 25, 2000. Cancellation deadline is March 3, 2000. Members pay less! Join GSA now or at the meeting. Contact GSA Headquarters for further information.

GSA's North-Central Section is committed to making all events at the 2000 meeting accessible to all people interested in attending. You can indicate special requirements, such as an interpreter or wheel chair accessibility, on the registration form.

Exhibit space must be reserved by March 19, 2000. For further information, contact Pamela H. Hogue, (317) 274-7104, fax 317-247-7966, phogue@iupui.edu.

Direct inquiries, requests, or suggestions to Robert D. Hall, General Chair, GSA North-Central Section, IUPUI Dept. of Geology, 723 W. Michigan St., SL 118, Indianapolis, IN 46204, (317) 274-0225, rhall@iupui.edu, or Joe Pachut, co-chair, same address, (317) 274-7785, jpachut@iupui.edu. For a complete printout of the full announcement, contact GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-2020, ext. 113. ■

Rocky Mountain *continued from p. 28*

FIELD TRIPS

Contact the trip leader listed for details. Direct any general inquiries to Field Trip Co-Chairs Don Winston (406-243-5511, winston@selway.umd.edu), or Sheila Roberts (406) 683-7017, s_roberts@wmc.edu, Dept. of Geosciences, Western Montana College of the University of Montana, Dillon, MT 59725.

Guidebook

A peer-reviewed *Guidebook to the Geology of Western Montana and Adjacent Areas*, to be published through the Montana Bureau of Mines and Geology, will include field guides and accompanying road logs. Contact Don Winston or Sheila Roberts (see above) or Don Hyndman if you intend to submit a manuscript. Requirements for submittal will be provided upon request. Manuscript deadline was *September 1, 1999*, but special arrangements may be made if you have a manuscript ready for submission and can expedite peer review.

Premeeting

1. Bitterroot Metamorphic Core Complex, Montana: Plutonism, Partial Melting, Compressional and Extensional Deformation. Two days. David Foster (352) 392-7316, dfoster@geology.ufl.edu.
2. Glacial Lake Missoula: Shorelines and Sediments, Giant Ripples and other Features from Multiple Catastrophic Drainages of the Lake. One day. Dave Alt (406) 243-4761 or 543-5070, davealt@selway.umd.edu.
3. Quaternary Geology, Geomorphology, and Hydrogeology of the Upper Flathead Valley, Flathead County, Mon-

tana. Two days. Larry Smith (406) 496-4379, lsmith@mtech.edu.

4. Examination of Impacts to the Surface and Groundwater Systems of the Upper Clark Fork from 100 years of Mining and Smelting. One day. William W. Woessner, (406)243-5698, gl_www@selway.umd.edu.

5. Geology of the Western Lewis and Clark Line and Coeur d'Alene Mining District: New Structural, Stratigraphic, and Ore Genesis Interpretations. Two days. Brian White, Don Winston, (509) 353-3113 or (208) 664-4282.

During Meeting

6. Blackfoot Thrust, Just East of Missoula. Evening, 5-8 p.m., Monday.

Postmeeting

7. Tectonic Inversion and Clockwise Rotation of the Mesoproterozoic Belt-Purcell Basin during Emplacement of the Lewis-Eldorado-Hoadley Thrust Plate. Transect of the Northern Rockies Thrust Belt from Missoula to Great Falls; Overthrust Belt Structure and Sedimentation of the Rocky Mountain Foreland. Two days. Jim Sears (406) 243-5251, jwsears@selway.umd.edu.

8. Shallow Plutonism, Volcanism, and Thrusting in the Sevier Thrust Belt East of the Pioneer Mountains, Montana. Two days. Tom Kalakay, David Foster, and Barbara John (see symposia 6 above).
9. Platinum Group Metal Mines in the Stillwater Complex, Montana; Surface and Underground; Mining Geology and Geotechnical Engineering Practices. Three days. Ennis Geraghty (406) 328-6400, 102503.3557@compuserve.com.

10. Mississippian Lodgepole Formation, Little Belt Mountains, Central Montana: Carbonate Cycles and Waulsortian Mounds. Two days. George Stanley, (406) 243-5693, fossil@selway.umd.edu.

11. Blackfoot Landslide and Debris Slide That Blocked the Blackfoot River, Montana on March 28, 1998, and Its Continuing Evolution. One day. Don Hyndman (406) 243-2241, dhyndman@selway.umd.edu.

12. Geology of the Lewis and Clark Trail in Montana and Idaho. Two or three days. Rob Thomas (406) 683-7615, r_thomas@wmc.edu.

ADDITIONAL INFORMATION

Registration details will be published in the January 2000 issue of *GSA Today* and on the GSA Web site (www.geosociety.org). For a printout of the fall announcement, write to GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140, or call (303) 447-2020, ext. 113. Preregistration by mail will be handled by the Geological Society of America Meetings Department, P.O. Box 9140, Boulder, CO 80301-9140. Preregistration deadline is March 10, 2000. Cancellation deadline is March 17, 2000. Members pay less, so join GSA now or at the meeting. Contact GSA Headquarters for further information (800-472-1988).

GSA is committed to making every event at the 2000 Rocky Mountain Section meeting accessible to all people. Special needs such as a wheelchair will be provided upon request. Contact General Chair Don Hyndman, (406) 243-2241, dhyndman@selway.umd.edu. ■

Preliminary Announcement and Call for Papers

CORDILLERAN SECTION 96th Annual Meeting

Vancouver, British Columbia, April 27-29, 2000

<http://www.eos.ubc.ca/gsaord2000/>; <http://www.geosociety.org>

CALL FOR PAPERS

Papers are invited for presentation at symposia and theme and general sessions in both oral and poster format. Additional general discipline sessions will be scheduled on the basis of submitted abstracts. You may volunteer a paper to be considered for any of the theme sessions listed below or indicate a general discipline from any of those listed on the GSA abstract form. You may submit only one volunteered abstract as first author and/or presenter.

Abstract Deadline: January 10, 2000

Abstracts for all sessions must be submitted camera-ready on official 2000 GSA

Section meeting abstract forms. Forms are available from Abstracts Coordinator, GSA, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-2020, ext. 161, ncarlson@geosociety.org. A downloadable PDF version of the abstract form is available on the GSA Web site (www.geosociety.org). Electronic abstract submission is also available on the GSA Web site.

Send an original and five copies of each abstract to the meeting general chair: Peter Mustard, Earth Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6, Canada.

TECHNICAL PROGRAM

Address general questions to any of the program co-chairs: Bert Struik, (604) 666-6413, bstruik@gsc.nrcan.gc.ca; Diana Allen, (604) 291-3967, dallen@sfu.ca; or Derek Thorkelson, (604) 291-5390, dthorkel@sfu.ca.

Symposium

1. Carboniferous to Recent Geological and Metallogenic Evolution of Central Canadian Cordillera. Bert Struik, (604) 666-6413, bstruik@gsc.nrcan.gc.ca; Don MacIntyre, (250) 952-0440, Don.MacIntyre@gems1.gov.bc.ca.

Theme Sessions

1. Circum-North Pacific Metalotects. Warren Nokleberg, (650) 329-5732, wnokleberg@isdmmn.wr.usgs.gov.
2. Central American Metalotects. Ken Dawson, (604) 984-0102, kdawson@northvan.net.
3. Andes Metalotects. Dick Tosdal, (604) 822-2449, rtosdal@eos.ubc.ca.

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4. Geochronology of Circum-Pacific Mineral Deposits. Jim Mortensen, (604) 822-6208, jmortensen@eos.ubc.ca.
5. Eocene Tectonics and Magmatism of the Cordillera. George Morris, (780) 492-3265, morris@ualberta.ca.
6. Gemstones of the Pacific Rim. Ted Danner, (604) 822-6892; George Simandl, (250) 952-0413, George.Simandl@gems2.gov.bc.ca.
7. Intrusion—Related Gold Systems—Geology and Metallogensis of the Tintina Gold Belt. Craig Hart, (867) 667-8519, Craig.Hart@gov.yk.ca.
8. Harnessing Geothermal Resources. Mory Ghomshei, (604) 822-2540, ghomshei@mining.ubc.ca.
9. Metals and Their Mobility in Mountainous Environments. Steve Cook, (250) 952-0393, Stephen.Cook@gems8.gov.bc.ca.
10. Paleontology of Cordilleran Terranes. Ted Danner, (604) 822-6892; Mike Orchard, (604) 666-0409, morchard@gsc.nrcan.gc.ca.
11. Searching for Bar Codes in the Cordillera: Applications and Limits of New Provenance Methods. Paul Link, (208) 236-3365, linkpaul@isu.edu.
12. Terrane Accretion and Structural Evolution of the Southern Coast Mountains and Cascades Belts. Murray Journeay, (604) 666-1130 mjourneay@gsc.nrcan.gc.ca.
13. Aquifer Management and Protection in Coastal Regions. Allan Dakin, (604) 986-8551, radakin@piteau.com.
14. Environmental Impacts of Mining and Mine Decommissioning Strategies. Leslie Smith, (604) 822-4108, lsmith@eos.ubc.ca.
15. Rehabilitation of Contaminated Sites. Roger Beckie, (604) 822-6462, rbeckie@eos.ubc.ca.
16. Geologic Input to Seismic Hazard Microzonation. Vic Levson, (250) 952-0391, Vic.Levson@gems9.gov.bc.ca.
17. AEG Session: Landslides and Other Slope Hazards in the Cordillera. (AEG Landslide Committee) Mike Hart, (619) 578-4672, mwhart@AOL.com.
18. Terrane Paths: Experiments in Paleogeography. Derek Thorkelson, (604) 291-5390, dtorkel@sfu.ca.
19. Tracer Isotopes: Geology's DNA Figure Print. Rob Creaser, (780) 492-2942, robert.creaser@ualberta.ca.
20. Brave New Worlds: Wrestling with Digital Information Management to Foster Geological Research. Sonia Talwar, (604) 666-1131, stalwar@nrcan.gc.ca.
21. Undergraduate Research Posters (Council on Undergraduate Research). Susan DeBari, (360) 650-3588, debari@cc.wvu.edu. *Poster format only.*

FIELD TRIPS

For additional information, contact one of the field trip chairs: Brent Ward,

Earth Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6, Canada; bcward@sfu.ca; Lionel Jackson, GSC, 101-605 Robson St., Vancouver, B.C. V6B 5J3, Canada; ljackson@gsc.nrcan.gc.ca; JoAnne Nelson, B.C. Geological Survey, P.O. Box 9320 Stn. Prov. Govt., Victoria, B.C. V8W 9N3, Canada, joanne.nelson@gems1.gov.bc.ca.

Multiday Trips

1. A Transect of the Southern Canadian Cordillera—Calgary to Vancouver. Jim Monger, (250) 537-5352, jmonger@saltspring.com.
2. Quaternary and Engineering Geology of the Fraser and Thompson River Valleys, Southwestern B.C. John Clague, (604) 291-4924, jclague@sfu.ca.
3. Quaternary Stratigraphy and Geomorphology of South-Central British Columbia (and Wines of the Okanagan Valley). Bob Fulton, (250) 707-0793, robert_fulton@bc.sympatico.ca.
4. Scraping Up the Mess—Outboard Terranes of Southern Vancouver Island. Nick Massey, (250) 952-0428, Nick.Massey@gems9.gov.bc.ca.
5. Tertiary Geology of the Eastern Flank of the Central Cascade Range, Washington. Eric Cheney, (206) 543-1163, vaalbara@u.washington.edu.
6. The Baja B.C. Boundary? (Search for Ties across Paleomagnetic Domains). Brian Mahoney, (715) 836-4952, mahonej@uwec.edu.
7. Quesnellia—Always There? Bob Thompson, (250) 363-6434, thompson@pgc-gsc.nrcan.gc.ca.
8. North Cascades Cretaceous Crustal Section: Changing Kinematics, Rheology, Metamorphism, Pluton Emplacement and Petrogenesis from 0 to 40 Km Depth. Robert Miller, (408) 924-5025, rmiller@geosun1.sjsu.edu.
9. Teaching Geology along the Nooksack and Skagit Rivers (a primer for secondary and lower-division college field trips). Tracy Furutani, (206) 528-4501, furutani@seaccd.sccd.ctc.edu.
10. Neogene Fault systems of the Northern Cascadia Forearc. Murray Journeay, (604) 666-1130, mjourneay@gsc.nrcan.gc.ca.

One-Day Trips

11. Capsule Geology of the Vancouver Area. Jim Roddick, (604) 666-2378, roddick@gsc.nrcan.gc.ca.
12. Engineering Geology and Natural Hazards of the Fraser River Delta. Pat Monahan, (250) 652-9254, monahan@ampsc.com.

WORKSHOPS

1. Developing On-line Geoscience Courses
A: A Framework for Assembling On-line Geoscience Course Components.
B: Piecing the Puzzle Together: Creating Your Own On-line Geoscience Course Compo-

nents. Michelle Lamberson, (604) 822-0865, mlambers@eos.ubc.ca.

2. Earthquakes and Engineering Geology in Southwest British Columbia: A Workshop and Field Trip. Vic Levson, (250) 952-0391, Vic.Levson@gems9.gov.bc.ca.
3. Roy Shlemon Mentors in Applied Geology Student Workshop (details in final announcement).

STUDENT AWARDS AND SUPPORT

The GSA Cordilleran Section will present cash awards for best and honorable mention graduate and undergraduate papers (both oral and poster). The student must be both first author and presenter and be a student member or associate of the Cordilleran Section.

The GSA Cordilleran Section has \$14,000 available for partial support of Student Members or Associates of the section who are presenting papers. Apply to Cordilleran Section Secretary: Bruce A. Blackerby, Dept. of Geology, California State University, Fresno, CA 93740, (209) 278-2955, bruceb@csufresno.edu. Applications should include certification that the student is presenting a paper and is a GSA Student Associate or Member as of Jan. 31, 2000. Applications must be received by *February 1, 2000*.

EXHIBITS

Exhibit space is extremely limited. The few spaces available will be provided on a first-come basis to nonprofit organizations for the cost of display material rental (tables, booths, etc). Please contact General Chair Peter Mustard (see Detailed Information).

REGISTRATION

GSA headquarters will handle preregistration. Registration details will be in the January 2000 issue of *GSA Today* and at www.geosociety.org. The deadline for preregistration is *March 17, 2000*; the deadline for cancellation is *March 24, 2000*.

The Cordilleran Section is committed to making every event at the 2000 meeting accessible to all persons interested in attending. Please indicate special requirements, such as an interpreter or wheelchair accessibility, on the meeting registration form, or contact conference General Chair Peter Mustard (see Detailed Information).

DETAILED INFORMATION

For further information, see <http://www.eos.ubc.ca/gscord2000/> or www.geosociety.org, or contact conference General Chair Peter Mustard, Earth Sciences, Simon Fraser University, Burnaby, B.C. V5A 1S6, Canada, (604) 291-5389, pmustard@sfu.ca. For a printout of the full announcement, contact GSA Meetings, P.O. Box 9140, Boulder, CO 80301-9140, (303) 447-2020, ext. 113. ■

GSA FOUNDATION UPDATE

Donna L. Russell, Director of Annual Giving



A New Research Fund Established

The generosity of Howard Ross Gould and Marilyn Bradley Gould has made possible a new fund in the Foundation: the Gould Student Research Grant Fund. The recipient will be selected annually by the GSA Committee on Research Grants: "looking

back at my own graduate student days, I recall with delight receiving my first research grant," Gould says. "It not only permitted me to complete my thesis, but provided a solid foundation for a rewarding lifetime career in geology. We want other deserving students to have this same opportunity."

Howard Gould has been a member of GSA since 1950, and served as president in 1981. His time, energy, and influence were instrumental in the success of the Decade of North American Geology Project, the first fund-raising project of the Foundation; it generated over \$4 million.

Gould received his B.A. from the University of Minnesota in 1943 and his Ph.D. from the University of Southern California in 1953, both degrees in geology. While at USC, he met and married Marilyn Bradley, a fellow graduate student, in marine zoology. Gould has worked with the USGS as a geologist, and then as assis-

tant professor of oceanography with the University of Washington, before joining Humble Oil and Refining Company as a geologist in Houston. After Humble Oil became EXXON, he was the manager of geological research, and then was promoted to research scientist at Exxon Production Research Company, where he worked until his retirement in 1986. Gould also served on the advisory committee to USC's Department of Earth Sciences.

Foundation Celebration— 20 Years of Service, 20 Years of Giving

If you attend the GSA Annual Meeting in Denver, please stop by the Foundation booth in the GSA Headquarters Services area. During the Welcoming Party on Sunday evening, October 24, 1999, in the Convention Center, the Foundation will celebrate its 20 years of service and giving with a special cake for all. We hope you will celebrate with us!

Y2K ... YWorry?

By Robert L. Fuchs, Foundation Trustee

Unless you avoided all newspapers, magazines, and TV news for the past two years, you know that a momentous event will occur at midnight, December 31. That is when we will all be shoved involuntarily into the next century and the next millennium. Momentous, yes; cataclysmic, probably not.


The doomsayers have been out in force with their strident messages—lay in supplies, store water, have flashlights and batteries ready, fill up the cash larder, stock the pantry. Sort of like getting ready for a trip to the field. Likewise, the naysayers—don't travel, don't invite your relatives to come visit for the holidays, don't get sick.

The financial world has its share of Cassandras. The bond market will collapse. The stock market will collapse. All markets will collapse. Currencies will be in disarray. Well, maybe the nervousness about Y2K will translate into a downturn in stocks and bonds. Certainly there has been an exceptionally long period of rising prices and increasing wealth, and to many investors a correction seems long overdue.

If your Y2K queasiness extends into your personal investments, the Foundation can be of help. How? If you are concerned about losing those unrealized gains built up over a number of years of rising markets to a Y2K bug or just a market downturn, then perhaps solace can be found in a gift of appreciated securities to GSA before December 31.

Giving appreciated securities to the Foundation is easy to do. If the securities are at a brokerage firm or mutual fund, the shares are generally transferred directly to a Foundation account by your broker. If you personally hold a certificate for the securities, the Foundation will arrange for pickup and paperwork. You may start the process by calling Donna or Julie at (303) 447-2020 and asking for specific instructions.

In addition to circumventing any ephemeral Y2K turmoil, there are some solid benefits from gifts of appreciated securities. There is *no* tax to be paid on your gain, so the gift is made at full market value. And of course, that appreciated value is very much "appreciated" by all of the Society's members, particularly those hard-working research grant recipients. ■



COLBY COLLEGE
**ASSISTANT PROFESSOR OF GEOLOGY –
TENURE TRACK**

Colby College seeks a dynamic teacher-scholar to join the three continuing members of the Department of Geology as a tenure-track Assistant Professor of Geology, beginning September 1, 2000; a candidate with Ph.D. in hand is preferred, but outstanding ABD candidates who will obtain their degree in AY 1999-2000 will also be considered. The successful candidate will be someone who will supplement existing Department strengths in paleontology, sedimentation and stratigraphy; in mineralogy, petrology and economic geology; and in surficial processes and Quaternary environments. Applications from structural geologists and hydrogeologists particularly are encouraged.

Colby's Department of Geology requires all its majors to undertake and complete a meaningful undergraduate research project, and the successful candidate must be willing and able to help design and supervise such capstone experiences. She/he will also be expected to continue a productive personal research program; modest College support to cover start-up and direct research expenses (including research assistants) is available, as well as funding to enable attendance at and participation in scholarly meetings.

Colby College is a highly selective, nationally ranked, private, residential, undergraduate, liberal arts institution with an on-campus enrollment of approximately 1750 full-time students, of whom some 30-35 are declared majors within the Department of Geology at any given time. The College is located within the Maine Slate Belt of the northern Appalachians; Lower Paleozoic sediments, metasediments and intrusives dominate the geologic record of the state, with a surficial blanket of late Quaternary glacial and postglacial sediments.

To apply, please submit (1) a letter expressing interest with complete and up-to-date CV; (2) separate statements of teaching and research interests; and (3) transcripts of all college-level coursework. At least three letters of recommendation addressing the applicant's teaching and research strengths and weaknesses and potential for external research funding should be sent directly to the Search Committee. Address applications to: Chair of Search Committee, Dept. of Geology, Colby College, 5800 Mayflower Hill, Waterville, Maine 04901-8858. The Committee will begin evaluating applications after the national GSA meeting in Denver in late October; two members of the search committee will be available to interview candidates at GSA.

Colby College is an AA/EO employer and especially encourages applications from women and minorities. For more information on the College and Department, please visit the college Web site at <http://www.colby.edu>. Additional information pertaining specifically to this position may be found at <http://www.colby.edu/geology/vacancy.html>.

Donors to the Foundation, July 1999

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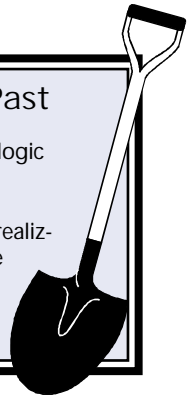
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Most memorable early geologic
experience:

"Visiting Devils Tower and realiz-
ing that it once was the site
of an active volcano."

—Gail M. Ashley



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**GSA
Annual Meeting
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November 13-16
Reno/Sparks Convention Center

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Both at University of Nevada
Department of Geological Sciences,
Mackay School of Mines, MS 172,
Reno, NV 89557-1038

Due date for Pardee Keynote
Symposia and
topical Session proposals:
January 10, 2000

CALL FOR FIELD TRIP PROPOSALS

We are interested in proposals for single-day and multi-day field trips beginning or ending in Reno, and dealing with all aspects of the geosciences. Please contact the Field Trip Co-Chairs, all at the University of Nevada, Dept. of Geological Sciences, Mackay School of Mines, MS 172, Reno, NV 89557-1038. Deadline for proposals is December 1, 1999.

Mary Lahren, (775) 784-6610, fax 775-784-1833, lahren@mines.unr.edu
Paula Noble, (775) 784-6211, fax 775-874-1833, noblepj@unr.edu
Steve Peters, (775) 784-5574, fax 775-874-1833, speters@usgs.unr.edu

CALL FOR SHORT COURSE PROPOSALS

Due December 1, 1999

The GSA Committee on Continuing Education invites those interested in proposing a GSA-sponsored or cosponsored course or workshop to contact GSA headquarters for proposal guidelines. Courses may be conducted in conjunction with all GSA annual or section meetings. We are particularly interested in receiving proposals for the 2000 Reno Annual Meeting or the 2001 Boston Annual Meeting.

Proposals must be received by December 1, 1999. Selection of courses for 2000 will be made by February 1, 2000. For those planning ahead, we will also consider courses for 2001 at that time.

For proposal guidelines or information, contact:
Edna Collis, Continuing Education Coordinator, GSA Headquarters,
1-800-472-1988, ext. 134, ecollis@geosociety.org

RENO MINI-CALENDAR

1999

- November 1 — Theme Proposal Information in November *GSA Today*. Electronic Symposia/Topical Session Proposal Form available on the GSA Web site
- December 1 — Field Trip and Short Course Proposals due

2000

- January 10 — Symposia and Topical Proposals due to Technical Program Chair
- April 1 — Call for Papers published and distributed
- May 1 — Electronic Abstract Submittal Form available on the GSA Web site
- June 1 — Registration and housing information printed in June *GSA Today*
- July 25 — Paper Abstracts Deadline
- August 1 — Electronic Abstracts Deadline

FUTURE MEETINGS

- | | | |
|------|---------------|-----------------------|
| 2001 | November 5-8 | Boston, Massachusetts |
| 2002 | October 27-30 | Denver, Colorado |
| 2003 | November 2-5 | Seattle, Washington |

FIELD FORUMS—Call for proposals

Have a great idea for a Penrose Conference that would be much more effective in a field setting? A field trip that captures the essence of new, exciting discoveries or a controversial topic? **Submit a proposal for a Field Forum!**

Field Forums provide an opportunity for exchange of current knowledge and exciting ideas well expressed by the geology of a specific area. (For more information check our web site http://www.geosociety.org/profdev/f_forum.htm or contact ecollis@geosociety.org.)

Watch for the announcements of the first **Field Forums** starting in 2000!

SECTION MEETINGS—2000

NORTHEASTERN SECTION—March 13-15, 2000, New Brunswick, New Jersey. Information: Robert E. Sheridan, (732) 445-2015, rsheridan@worldnet.att.net

SOUTHEASTERN SECTION—March 23-24, 2000, Charleston, South Carolina. Information: Michael P. Katuna, (843) 953-5589, katumam@cofc.edu

SOUTH-CENTRAL SECTION—April 3-4, 2000, Fayetteville, Arkansas. Information: Doy L. Zachry, Jr., (501) 575-3355, dzachry@comp.uark.edu

NORTH-CENTRAL SECTION—April 6-7, 2000, Indianapolis, Indiana. Information: Robert D. Hall, (317) 274-7484, rhall@iupui.edu

ROCKY MOUNTAIN SECTION—April 17-18, 2000, Missoula, Montana. Information: Donald W. Hyndman, (406) 243-2241, dhyndman@selway.umt.edu

CORDILLERAN SECTION—April 27-29, 2000, Vancouver, British Columbia. Information: Peter S. Mustard, (604) 291-5389, pmustard@sfu.ca



GEOLOGICAL SOCIETY OF AMERICA
BULLETIN

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CALENDAR

Only new or changed information is published in *GSA Today*. A complete listing can be found in the Calendar section on the Internet: <http://www.geosociety.org>.

2000 Meetings

January

January 22–26, China & East Asia Mineral and Energy Resources Symposium, Denver, Colorado. Information: <http://china-resources.net> or Mark Cramer, (303) 771-2000, mrcramer@expomasters.com.

March

March 6–8, Geology of Northwestern Mexico and Adjacent Areas, Hermosillo, Sonora, Mexico. Information: Carlos Gonzalez, Instituto de Geología, UNAM, Hermosillo, Sonora, Mexico, phone 52-62-175019, fax 52-62-175340, cmgleon@servidor.unam.mx, <http://conjuntos.es.fortunecity.com/privada/8/congreso2000.html?nocache=930713664>.

April–May

April 30–May 4, Water Resources in Extreme Environments, Anchorage, Alaska. Information: American Water Resources Association, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626, fax 540-687-8395, info@awra.org. (Abstract deadline: November 1, 1999.)

May

May 12–14, Europe's Major Base Metals, Galway, Ireland. Information: Leo Fusciardi, Irish Association for Economic Geology, c/o Minorco Services Ireland, Ltd. Killoran Moyne, Thurles, Co. Tipperary, Ireland, phone 353-504-45369, fax 353-504-45344, lfusciardi@minorco.ie, <http://www.iaeg.org>.

May 22–26, Desert Soil-Geomorphology Project Field Study Tour, Las Cruces, New Mexico. Information: <http://soil-physics.nmsu.edu/DesertProjectTour/> or Curtis Monger (505) 646-1910, cmonger@nmsu.edu.

June

June 14–16, Management Information Systems, Lisbon, Portugal. Information: Gabriella Cossutta, phone 44-238-029-3223, fax

44-238-029-2853, gcossutta@wessex.ac.uk, <http://www.wessex.ac.uk/conferences/2000/>.

July–August

July 31–August 3, Pacific Rocks 2000, Fourth North American Rock Mechanics Symposium, Seattle, Washington. Information: Mark Cramer, (303) 771-2000, fax 303-843-6232, <http://www.armarocks.org>. (Abstracts deadline: November 1, 1999.)

August

August 6–17, 31st International Geological Congress, Rio de Janeiro, Brazil. Information: 31st International Geological Congress, Casa Brazil 2000, Av. Pasteur, 404, Urca, Rio de Janeiro, RJ, Brazil, phone 55-21-295-5847, fax 55-21-295-8094, 31igc@31igc.org, <http://www.31igc.org>.

August 16–18, Debris-Flow Hazards Mitigation Second International Conference, Taipei, Taiwan. Information: Ko-Fei Liu, Dept. of Civil Engineering, National Taiwan University, No. 1, Sec. 4 Roosevelt Rd., Taipei, 10617 Taiwan, R.O.C., phone 886-2-2365-5405, fax 886-2-2363-1558, kfliu@ccms.ntu.edu.tw.

August 17–21, Environmental Geotechnology and Global Sustainable Development 5th International Symposium, Belo Horizonte, Brazil. Information: 5th International Symposium on Environmental Geotechnology and Sustainable Development, Dept. de Engenharia de Transportes e Geotecnia, Escola de Engenharia da Universidade Federal de Minas Gerais, Ave. do Contorno, 842 sala 104, Belo Horizonte, Minas Gerais, CEP 30 110-060, Brazil, phone 55-31-2381742, fax 55-31-2381793, cassia@etg.ufmg.br, <http://www.5iseggsd.eng.ufmg.br>. (Abstracts deadline: November 15, 1999.)

September

September 17–26, Karst 2000, Mamaris, Turkey. Information: Gültekin Günay, Int. Res. & App. Center for Karst Water Resources (UKAM), Hacettepe University, 06532 Beytepe, Ankara, Turkey, phone 90-312-235-2543, fax 90-312-299-2136, karst@eti.cc.hun.edu.tr, <http://www.karst.hun.edu.tr>.

September 25–29, Land Subsidence Sixth International Symposium, Ravenna, Italy.

Information: Secretariat SISOLS 2000, c/o CNR-IDGM, San Polo 1364, 30125 Venezia, Italy, phone 39-041-5216826, fax 39-041-5216892, jane@isdgm.ve.cnr.it.

Send notices of meetings of general interest, in format above, to Editor, *GSA Today*, P.O. Box 9140, Boulder, CO 80301, E-mail: editing@geosociety.org.

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Positions Open

GEORGE MASON UNIVERSITY FAIRFAX, VIRGINIA, 22030-4444

The Department of Geography & Earth Science invites applications for a tenure-track Assistant or Associate Professor position in GIS for a dynamic PhD with remote sensing experience and background in one or more of the following: environmental modeling, programming, and GIS on the Internet. Successful candidate will be expected to pursue an active externally-funded research program, be an excellent teacher, and to collaborate with other disciplines within the university. Special consideration will be given to candidates with background in earth, atmospheric or environmental science, and whose expertise complements existing strengths in the department. Salary will be commensurate with experience. Position will commence in August 2000.

Department offers undergraduate degrees in Geography, Geology, and Earth Systems Science, MS in Geography, and Ph.D. in collaboration with Environmental Science and Public Policy, Computational Sciences, and the Institute for Public Policy. Our department operates ESRI- and ERDAS-based labs. Our faculty includes geographers and geologists, with strong commitments to both teaching and research.

Candidates should submit CV and letter of intent, including statements of research and teaching interests, and names of three referees to David Wong, Search Committee Chair, Department of Geography & Earth Science, 4400 University Dr., MSN 1E2, George Mason University, Fairfax, VA 22030-4444. Application deadline is 31 October, 1999.

George Mason University is an Affirmative Action/Equal Opportunity Employer. We strongly encourage women and minority candidates to apply.

IOWA STATE UNIVERSITY Stratigrapher/Sedimentologist

The Department of Geological and Atmospheric Sciences, invites applications for a tenure-track position in stratigraphy/sedimentology at the assistant professor level that will begin in mid-August 2000. The position is to complement existing programs in environmental geology, hydrogeology, structural geology/tectonics, economic geology, geophysics, petrology, and geochemistry. Opportunities exist for close interaction with other faculty on campus having strengths in ecology, geology, meteorology, and soil science.

The successful candidate will be expected to develop a vigorous research program, supervise graduate students, attract external funding, and to participate actively in our graduate (M.S. and Ph.D.) and undergraduate teaching programs. He or she will teach modern field methods at

our undergraduate field camp in Wyoming with the long-term goal that the candidate will serve as its director. Preference will be given to individuals with a strong background in the application of one or more of the following fields: sequence stratigraphy, basin analysis, clastic or carbonate petrology, sedimentary tectonics, and sedimentology.

Applicants should send a letter of application, a statement of research and teaching interests, curriculum vitae, transcripts, and the names, addresses, e-mail addresses, and phone and fax numbers of at least three references to: Search Committee Chair, Department of Geological and Atmospheric Sciences, 253 Science I, Iowa State University, Ames, IA 50011-3212. Applicants should hold a Ph.D. in geosciences at the time of appointment. To ensure consideration, applications should be received by December 1, 1999. Information about the Geological Sciences group can be found on the World Wide Web at: <http://www.geology.iastate.edu>.

Iowa State University is an Equal Opportunity/Affirmative Action Employer and encourages applications from women, minorities, and other protected groups.

FACULTY POSITION IN ENVIRONMENTAL BIOGEOCHEMISTRY UNIVERSITY OF WISCONSIN-MADISON

The Department of Geology and Geophysics, UW-Madison, invites applications for a tenure-track faculty position in the area of Environmental Geochemistry at the assistant professor level. We are particularly interested in individuals with expertise in environmental geochemistry, low-temperature aqueous geochemistry and environmental biochemistry. Ph.D. required at the time of appointment. The successful candidate will be expected to develop a vigorous research program, including supervision of graduate students Teaching duties will include undergraduate and graduate courses. Preference will be given to candidates whose expertise would lead to interactions with existing groups in the department, especially those in hydrogeology, sedimentology, surficial processes, mineralogy, economic geology, isotope geology, and geomicrobiology.

Applicants should submit a resume, statement of research and teaching interests, copies of up to five publications, and the names and addresses of at least three references to Professor Jillian Banfield, Geochemistry Search Chair, Dept. of Geology and Geophysics, UW-Madison, 1215 W. Dayton, Madison, WI 53706-1692.

Applications deadline November 15, 1999. For additional information see <http://www.geology.wisc.edu>.

UW-Madison is an equal opportunity/affirmative action employer and encourages applications from women and minorities. Unless confidentiality is requested in writing, information regarding the applicants must be released upon request. Finalists cannot be guaranteed confidentiality.

ASSISTANT PROFESSOR SEDIMENTARY GEOLOGY / ENVIRONMENTAL GEOLOGY

Bryn Mawr College invites applications for a tenure-track assistant professorship beginning in August 2000. Areas of preferred expertise are clastic sedimentology and/or surficial processes. Candidates should also have interests in one or more of the following: low-temperature geochemistry, biogeochemistry, Quaternary geology, modeling of complex systems, marine geology, and remote sensing. We seek a candidate who is committed to excellence in teaching both undergraduate and graduate students. This person will be expected to contribute to our growing, interdisciplinary environmental studies program, to add depth to our joint graduate program with the University of Pennsylvania, and to maintain an active research program. Teaching responsibilities will include sedimentology and an introductory course in the broad area of environmental geology or earth system science as well as undergraduate and graduate courses in the candidate's field(s) of expertise. Demonstrated teaching ability and a Ph.D. at the time of appointment are required.

Applications should include a statement of research and teaching interests, curriculum vitae and a list of at least three professional references (including telephone numbers and e-mail addresses). Applications should be sent to M.L. Crawford, Chairman, Dept. of Geology, Bryn Mawr College, Bryn Mawr, PA 19010. Closing date for applications is December 1. Preliminary interviews will be conducted at the GSA meeting in Denver.

Bryn Mawr College is an equal opportunity/affirmative action employer and wishes to encourage applications from individuals interested in joining a multicultural and international academic community.

THE OHIO STATE UNIVERSITY ENVIRONMENTAL ISOTOPE GEOCHEMISTRY

The Department of Geological Sciences invites applications for one-tenure track position at the assistant professor level, or higher, to begin as early as September 2000. A Ph.D. in geological sciences or a related field is required. Candidates should have a strong record of funded research, refereed publications, a commitment to teaching, and collaboration with colleagues in other areas of specialization.

The successful candidate will be expected to develop an independent research program in paleoclimatic reconstruction, work closely with the Ohio State ice-core paleoclimate research program and participate broadly with the department's research programs. Expertise in stable isotopes of oxygen, hydrogen, and/or carbon is desirable. Teaching will involve courses at the introductory and advanced levels. The successful candidate will be expected to maintain strong research ties with the Byrd Polar Research Center and faculty in geological sciences and other departments and disciplines (e.g. Department of Chemistry and Department of Geography). The successful candidate will also be expected to generally participate in the Ohio State University Environmental Sciences initiative.

The Department of Geological Sciences has 24 full-time faculty and approximately 70 graduate students. The department is well equipped with laboratory and computing equipment and is occupying newly renovated laboratory, classroom and office space. To apply, send a curriculum vitae, statement of research and teaching interests, and names of three referees to search committee Chair: Professor Lonnie G. Thompson, Department of Geological Sciences, 155 South Oval Mall, Columbus, OH 43210. The search committee will begin reviewing applications on January 1, 2000, and will continue until a suitable candidate is hired.

The Ohio State University is an equal opportunity/affirmative action employer. Women, minorities, Vietnam-era veterans, disabled veterans, and individuals with disabilities are encouraged to apply.

THE OHIO STATE UNIVERSITY GENETIC STRATIGRAPHER

The Department of Geological Sciences at The Ohio State University invites applications for a tenure-track position in genetic stratigraphy. The position is at the assistant professor level, although a position at a higher rank will be considered and may begin as early as September 2000. Candidates with interests and demonstrated skills in interpreting the depositional architecture of sedimentary fill in basins are encouraged to apply. Particularly suitable areas of research interest include outcrop and/or subsurface-based sequence stratigraphy, chemostratigraphy, and computer modeling of stratigraphic sequences. A Ph.D. in geological sciences or a related field is required. Candidates should have a strong potential for funded research, have refereed publications, and have a commitment to teaching. The successful candidate can expect to interact closely with existing programs in sedimentology, biostratigraphy, paleobiology, quaternary geology and global change, geophysics, and hydrogeology.

The successful candidate will be expected to maintain an active funded research program, advise graduate students, and contribute to the teaching mission of the Department at both the undergraduate and the graduate levels.

The Department of Geological Sciences is a comprehensive earth sciences department, with 24 regular faculty that maintain close ties with interdisciplinary research centers on campus, including the Byrd Polar Research Center and the Center for Mapping.

To apply, send a curriculum vitae, statements of research and teaching interests, and names of three referees to Search Committee Chair, Department of Geological Sciences, 155 South Oval Mall, Columbus, OH 43210, USA. The search committee will begin reviewing applications on January 5, 2000, and will continue until a suitable candidate is hired. The Ohio State University is an equal opportunity/affirmative action employer. Women, minorities, Vietnam-era veterans, disabled veterans, and individuals with disabilities are encouraged to apply.

ASSISTANT PROFESSOR IN VERTEBRATE PALEONTOLOGY

The Department of Geoscience at the University of Iowa invites applications for a full-time, tenure-track Assistant Professorship in vertebrate paleontology, preferably one specializing in the late Cenozoic. The appointment will begin in August 2000. We seek an outstanding researcher and teacher whose approach is both quantitative and

specimen-based, and who will work with other faculty to improve our strong graduate program in paleontology and quaternary geology. In addition to developing an active, externally funded program of research, the successful candidate will be expected to teach three courses per academic year. These will include: (1) an upper-level undergraduate/graduate course in vertebrate paleontology, (2) a general education course related to fossil vertebrates, and (3) a graduate seminar in paleontology. He/she will also be expected to contribute both to our Paleontology Repository as well as to new departmental initiatives in the environmental sciences and climate change. Applicants should have a Ph.D. in hand by August 16, 2000. Women and minorities are especially encouraged to apply. Applicants should send a complete resume (including a bibliography and statement of teaching and research interests) and have at least three letters of recommendation sent to: Search Committee Chair (Vertebrate Paleontology), Department of Geoscience, University of Iowa, Iowa City, IA 52242-1379 (phone: 319/335-1818; Fax: 319/335-1821). Screening of candidates begins December 1, 1999, and will continue until the position is filled. The University of Iowa is an affirmative action — equal opportunity employer.

The Swiss Federal Institute of Technology (ETH) and the University of Zurich invite applications for the position of a PROFESSORSHIP IN

PHYSICAL SEDIMENTARY GEOLOGY

We are looking for an outstanding candidate who pursues an internationally competitive research program in physical aspects of erosion and processes of clastic sediment production, transport, and deposition. A strong interest in modeling such processes in surficial systems (aquatic, glacial, aeolian) and in investigating their variability with respect to tectonic and climatic processes are expected. Involvement in multidisciplinary research that interfaces with geotechnical (e.g., slope stability and mass movements) and hydrogeological engineering questions is desirable.

The professorship (with its staff) will contribute to a joint earth science teaching program involving ETH and the University of Zurich. We expect dedication to excellence in teaching sedimentology, stratigraphy, basin analysis, alpine geology, mapping, and in the supervision of thesis-related field work. Applicants should submit a detailed curriculum vitae, a statement of research interests, a list of publications, and the names of three potential referees to the President of ETH Zurich, Prof. Dr. O. Kübler, ETH Zentrum, CH-8092 Zurich no later than November 15, 1999. Our schools specifically encourage female candidates to apply with a view towards increasing the proportion of female professors.

TENURE-TRACK FACULTY POSITION IN GEOSCIENCES

The Department of Environmental Sciences at the University of Virginia invites applications for a tenure-track assistant professorship in geosciences. The Department is an interdisciplinary community of process-oriented scientists representing atmospheric sciences, ecology, geosciences and hydrology. The department offers B.A., M.S., and Ph.D. degrees. We strongly encourage prospective candidates to review our departmental web site (<http://www.evsc.virginia.edu/>) prior to applying. We encourage applications from scientists whose research and teaching strengths and interests show promise for capitalizing on the unique interdisciplinary nature of our department, and to build upon our existing strengths in low temperature geochemistry and geomorphology in particular. Examples include, but are not limited to, landscape-scale geomorphic processes, field-oriented coastal and estuarine sedimentary processes, geochemical processes in soils and sediment, environmental geochemistry and geochronology.

The successful candidate will be expected to develop outstanding programs in research and teaching at both the undergraduate and graduate levels and to participate in teaching our undergraduate core course in Physical Geology. Applicants must show demonstrated excellence in their research and a strong commitment to quality teaching.

Applicants should include one-page statements on their research and teaching interests and experience, a curriculum vitae, and names and contact information of three references. The application deadline is December 15, 1999. Applications should be sent to: James N. Galway, Professor and Chair, Department of Environmental Sciences, Geosciences Search Committee, University of

Virginia, Clark Hall, Charlottesville, VA 22903. Tel. 804-924-0561.

We encourage applications from under-represented groups. The University of Virginia is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF FLORIDA

The Department of Geological Sciences invites applications for a tenure-track assistant professor position in the general area of organic geochemistry to begin with the 2000-2001 academic year. Possible areas of specialization include: biogeochemistry, environmental geology, astrobiology, paleoceanography, etc. Preference will be given to quantitative, process-oriented scientists who will develop vigorous, innovative research programs, and who have a strong commitment to teaching. More information on the Department is available at web.geology.ufl.edu.

Applicants should send a letter of interest, including a statement of research and teaching goals, a curriculum vitae, and the names and addresses of three references by December 15, 1999 to: Dr. Paul A. Mueller, Department of Geological Sciences, 241 Williamson Hall, Box 112120, University of Florida, Gainesville, FL 32611 (352)392-2231, fax 352-392-9294 (mueller@geology.ufl.edu). The University of Florida is an equal opportunity employer; qualified women and minorities are especially encouraged to apply.

TWO FACULTY POSITIONS

CALIFORNIA STATE UNIVERSITY, FULLERTON GEOPHYSICIST AND HYDROGEOLOGIST

The Department of Geological Sciences, California State University, Fullerton, invites applications for two tenure-track positions that will be filled at the rank of Assistant Professor, starting August 2000. Applicants must have a primary interest in teaching and achieving excellence in teaching and a commitment to developing an externally-funded research program that includes undergraduate and graduate students. Responsibilities will include limited involvement in professional activities, outreach, and university and community service. Additionally, the successful applicant will have the following credentials and capabilities:

Geophysicist: a Ph.D. in geology or geophysics (degree must be in-hand by August 15, 2000); expertise in the use of geophysical methods to solve geologic problems; an interest and potential for developing intradepartmental collaborative research.

Teaching responsibilities will include, but not be limited to, physical geology, earth's interior, applied geophysics, earthquake seismology, and graduate courses in the new faculty member's area of expertise.

Hydrogeologist: a Ph.D. in geology or hydrogeology (degree must be in-hand by August 15, 2000); a field-based orientation with experience in groundwater modeling; industrial experience and/or a potential for developing working relationships with local hydrogeology consulting firms.

Teaching responsibilities will include, but not be limited to, physical geology, hydrogeology and field hydrology, and graduate courses in the new faculty member's area of expertise. The successful applicant will be expected to teach our summer hydrology field camp at Mammoth Lakes, California. In addition, the department is interested in someone with experience in G.I.S. and/or remote sensing.

Salary and benefits for both positions will be competitive and commensurate with the appointee's qualifications.

CSU Fullerton is a large university dedicated to the preeminence of learning. Located 22 miles southeast of metropolitan Los Angeles, Fullerton is a full-service city renowned for its unique mix of residential, commercial and industrial, educational, and cultural environments which provide residents with an outstanding quality of life. The Department has seven full-time faculty with expertise in stratigraphy, volcanology, igneous petrology, Quaternary geology, structural geology, engineering geology, and earth science education. The nearby Los Angeles Basin, Peninsular and Transverse Ranges, Mojave Desert, Sierra Nevada and Basin and Range geological provinces provide abundant opportunities for field-based research. We have about 50 undergraduate majors and will be implementing a masters degree program soon. Additional information is available through our web page at <http://geology.fullerton.edu/geology/>.

To apply, please send the following: (1) a detailed curriculum vitae; (2) a letter telling us about yourself and detailing how you meet the qualifications outlined above; (3) a statement about teaching that includes a discussion of relevant course work and/or experience in preparation for teaching, a list of courses you would feel comfortable

teaching, and a statement of your teaching philosophy; (4) a statement of your future research plans and goals; and (5) the names, addresses, phone numbers, and e-mail addresses of at least three references familiar with your teaching and research potential. Send application to: Dr. Brady Rhodes, Chair, Search Committee, Department of Geological Sciences, California State University, P.O. Box 6850, Fullerton, California 92834-6850. Applications will be accepted until November 15, 1999. Applications received after this date will be reviewed only if the position is not filled from the original pool of applicants.

California State University, Fullerton is an Affirmative Action/Equal Opportunity Employer. All personnel policies conform with the requirements of Executive Order 11246, the Americans with Disabilities Act (ADA) of 1990, Title IX of the Higher Education Amendments of 1972 and other federal regulations regarding nondiscrimination.

HYDROGEOLOGIST, UNIVERSITY OF WYOMING

The Department of Geology and Geophysics at the University of Wyoming invites applications for a tenure-track position preferably at the assistant professor level starting August 2000. Teaching responsibilities will include undergraduate/graduate courses in hydrogeology, advising undergraduate and graduate students, and participating in the general teaching mission of the department. The successful applicant must show promise of establishing an active research program with the potential for external funding. Preference will be given to applicants with research areas that complement existing departmental strengths. Additional information on the Department can be obtained on our Web page, home.gg.uwyo.edu or visit <http://home.gg.uwyo.edu>. Several faculty members will be available to discuss the position at the GSA meetings in Denver.

Applicants must have a Ph.D. at the time of appointment. To apply, send a curriculum vitae, a statement of research and teaching interests, graduate transcripts, and the names and addresses of three references to: James I. Drever, Search Committee Chair, Department of Geology and Geophysics, University of Wyoming, Laramie, 82071-3006. Review of applications will begin on October 31 and the search will continue until the position is filled. The University of Wyoming is an affirmative action/equal opportunity employer.

TENURE-TRACK FACULTY POSITION

EDINBORO UNIVERSITY OF PENNSYLVANIA

The Department of Geosciences at Edinboro University seeks applications for a Tenure-Track Assistant Professor (Instructor) position for a person with expertise in soils, paleolimnology and/or Quaternary geology beginning August 2000. Responsibilities: Teach Stratigraphy and Sedimentation, introductory geology courses and upper level courses in area of expertise. Preference given to applicant who can integrate field experiences and applied technology into teaching, and develop a research program involving undergraduates. Qualifications: Ph.D. in geology expected (ABD considered). Demonstration of teaching skills is an interview requirement. Salary and benefits are competitive.

In accordance with the terms of the collective bargaining agreement between the State System of Higher Education and APSCUF, you may be assigned to perform work at off-campus sites and/or provide instruction through distance education.

Specify Position #170-0872 and submit a letter of application, resume, copies of transcripts and names/addresses/telephone numbers of three current references to Dr. Eric Randall, Dean of Science, Management and Technologies, Department GSA, Edinboro University of PA, Edinboro, PA 16444. Application Deadline: January 15, 2000. Visit our home page at <http://www.edinboro.edu/cwis/geosci/htdtdcs/geohome.htm> AA/EOE/M/F/V/D

GEOPHYSICIST / PURDUE UNIVERSITY

The Department of Earth and Atmospheric Sciences, Purdue University, invites applications for a tenure-track position in geophysics. We are especially interested in applicants with backgrounds in crustal geophysics and exploration geophysics. Specific areas of interest could include integrated geophysics applied to tectonic problems, 3-D seismology, seismic stratigraphy and basin analysis, reservoir characterization and borehole geophysics.

The position is expected to be at the assistant or associate professor level, although outstanding candidates will be considered at a higher rank.

Applicants will be selected on the basis of their demonstrated ability and potential to develop a high-quality research program and to teach effectively at the graduate and undergraduate levels. A Ph.D. is required and some postdoctoral experience is desirable. Applicants should submit a letter summarizing their research and teaching experience, a curriculum vitae, and names of at least three references to: Chair, Geophysics Search Committee, Department of Earth and Atmospheric Sciences, 1397 Civil Engineering Building, Purdue University, West Lafayette, IN 47907-1397 USA. E-mail: geophys.search@purdue.edu.

The Department of Earth and Atmospheric Sciences currently has 26 faculty members in the areas of atmospheric science, geophysics, geochemistry, hydrogeology, engineering and environmental geosciences, Earth and atmospheric science teaching, and computational science and engineering.

Additional information on the faculty, the department and Purdue University can be obtained on the Web at <http://www.eas.purdue.edu>.

Applications will be considered beginning January 3, 2000, and applications will be accepted until the position is filled.

Purdue University is an equal opportunity/affirmative action employer.

FACULTY POSITIONS IN ATMOSPHERE, OCEAN, CLIMATE DYNAMICS AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University announces a search for several ladder faculty positions in the general area of atmosphere, ocean, and climate dynamics. We seek both junior and senior applicants with records of creative research in subject areas that improve understanding of modern atmospheric and oceanic processes and/or the evolution of the Earth's climate on geologic time scales. Areas of special interest include atmosphere/ocean modeling; climate-system modeling; coupled air-sea interaction; dynamical meteorology and oceanography; glaciology; hydrology; remote sensing; and the physics, dynamics, and chemistry of clouds. New appointments at Yale in these areas will contribute to a broad emphasis in the Department on paleoclimatology, paleo-environments, and global change. Additional appointments in the Department will be made in areas of active tectonics and geomorphology, geochemistry, paleontology, and solid-earth geophysics. Closing date for applications is September 30, 1999.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

AOCD Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITIONS IN GEOCHEMISTRY AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University is starting a new multidisciplinary hiring initiative in earth science, which will include several ladder faculty appointments in the general area of geochemistry, starting as early as January 2000. We invite applications from both junior- and senior-level candidates who will develop internationally recognized research programs in collaboration with present and future Yale geoscientists. The positions will include teaching at both the undergraduate and graduate levels. All subfields will be considered, including, but not limited to: biogeochemistry, earth surface chemical processes, experimental geochemistry, mantle geochemistry, organic geochemistry, radiogenic and stable isotopes, and theoretical geochemistry. Closing date for applications is September 30, 1999.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Geochemistry Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITIONS IN SOLID-EARTH GEOPHYSICS AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University is starting a new multidisciplinary hiring initiative in

earth science, which includes a major expansion in solid-earth geophysics. To this end, we intend to fill several ladder faculty positions in solid-earth geophysics, either at the junior or senior level, starting as early as January 2000. We invite applicants who will develop internationally recognized research programs in collaboration with present and future Yale geoscientists. The positions will include teaching at both the graduate and undergraduate levels. All subfields of solid-earth geophysics will be considered, including, but not limited to: geodesy, geodynamics, geomagnetism, mineral physics, rock and earthquake mechanics, and seismology. Closing date for applications is September 30, 1999.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to: Solid-Earth Geophysics Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITION IN ACTIVE TECTONICS AND GEOMORPHOLOGY AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University announces a ladder faculty position, at either the junior or senior level, in the general area of active tectonics and geomorphology, starting as early as January 2000. This position is part of a broad multidisciplinary hiring initiative in earth sciences at Yale, including the areas of the dynamics of the oceans, atmospheres, and climate; geochemistry; solid-earth geophysics; and paleontology. For the active tectonics and geomorphology search, we are particularly interested in finding candidates who relate the evolution of landforms to the forcing caused by tectonic and climate processes. We also welcome applications from related fields, including but not limited to: geodynamics of landscape evolution, paleoseismology, structural geology, and tectonics. The successful candidate is expected to develop an internationally visible research program and teach at both the graduate and undergraduate levels.

The closing date is September 30, 1999. We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer.

Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Geomorphology Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

FACULTY POSITION IN PALEONTOLOGY AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University is starting a new multidisciplinary hiring initiative in earth science, which includes strengthening of its program in paleontology. To this end, we intend to fill a ladder faculty position in paleontology, at either the junior or senior level, starting September 2000. We invite applicants who will develop an internationally recognized research program in collaboration with present and future Yale geoscientists and bioscientists. The position will include teaching at both the graduate and undergraduate levels. All subfields of paleontology will be considered, including but not limited to: biogeochemistry, biostratigraphy, event stratigraphy, evolutionary processes, functional morphology, macroevolution, origin of major groups/body plans, marine paleoecology, mass extinctions, paleobiogeography, paleoenvironmental analysis, systematics, or taphonomy. Closing date for applications is January 15, 2000.

We encourage applicants from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of professional goals, and the names and addresses of three or more referees to:

Paleontology Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

VISITING FACULTY POSITIONS IN EARTH SCIENCES AT YALE UNIVERSITY

The Department of Geology and Geophysics at Yale University announces the opening of several visiting faculty positions, starting as early as September 1, 1999. Appli-

cants from all areas of earth science and all career levels are welcome to apply. The visiting positions are part of a major hiring initiative in earth sciences at Yale focused on rebuilding the size and strength of the department. We are looking for individuals who would enjoy contributing and interacting in a broad multidisciplinary department that includes active programs in atmospheres, oceans and climate; geochemistry; petrology; solid-earth geophysics; paleontology and evolutionary theory; and tectonics. The successful applicant would be expected to conduct an active research program, to interact with students and faculty, and to teach one course or seminar per semester with the topic to be negotiated. The duration and scope of the visit are negotiable as well. Applications will be considered as they arrive.

We encourage those from historically disadvantaged ethnic, racial, and gender categories. Yale University is an equal-opportunity employer. Applicants should send a curriculum vitae, a statement of objectives for the visit, and the names and addresses of three or more referees to:

Visiting Faculty Search Committee, c/o Professor Danny Rye, Chair, Department of Geology and Geophysics, Yale University, P.O. Box 208109, New Haven, CT 06520-8109.

DIRECTOR BUREAU OF ECONOMIC GEOLOGY THE UNIVERSITY OF TEXAS AT AUSTIN

The University of Texas at Austin seeks a Director of its Bureau of Economic Geology, one of the largest research units of The University and which also serves as the State Geological Survey. Required is a doctorate in the geological sciences, a record of substantial research, and upper-level management and leadership experience. The applicant must have experience working in a university setting, working with policy issues at the state and national level, and obtaining financial support for major research programs. The successful candidate will have credentials suitable for appointment as a full professor in geological sciences.

The Bureau of Economic Geology is a prominent research and service institution with a long history and a reputation for research excellence and scientific leadership. It is a major publisher of geological reports, especially in the fields of energy and the environment. The Bureau operates yearly on an appropriated budget of \$1.2 million, plus \$12 to \$15 million in grants and contracts from State and Federal agencies, industry, and private foundations. Further details of Bureau programs and organization can be obtained by visiting the Web site <http://www.utexas.edu/research/beg> or by requesting a copy of the Bureau's annual report.

Application, including a resume, letter of interest, and names and addresses of at least three references, should be submitted to Prof. William L. Fisher, Chair of the Director Search Committee, Bureau of Economic Geology, University Station, Box X, Austin, TX 78713-8924. Additional position information can be found at www.utexas.edu/admin/ohr/emp/. Refer to Job Number 99-06-21-10-0382. The position is open until filled, with review of applications beginning in early fall of 1999. Anticipated starting date is January 1, 2000. Salary is negotiable. The University of Texas at Austin is an Equal Opportunity/Affirmative Action employer.

STATE UNIVERSITY OF NEW YORK COLLEGE AT ONEONTA — LECTURER

The Department of Earth Sciences at the State University of New York College at Oneonta invites applications for a one-year Lecturer position beginning Fall 1999 pending budgetary approval. This is a full-time position in Surficial Geology/Hydrology. Required qualifications: Ph.D. or ABD; extensive knowledge and experience in environmental applications; emphasis on quality classroom instruction, student mentoring, and the application of instructional technology. Duties include teaching courses in support of undergraduate curricula in Geology, Water Resources, and Environmental Science. To apply: send curriculum vita, statement of interest and qualification for this position, and three current letters of recommendation to: Dr. Jerome Blechman, Search Committee Chair, Earth Sciences Department, Box G, SUNY Oneonta, Oneonta, NY 13820. Review of applications will begin immediately and will continue until the position is filled. SUNY Oneonta is an EEO/AA employer. Women and minorities are encouraged to apply.

ENVIRONMENTAL GEOLOGY

The Department of Geology and Geography at DePauw University invites applications for a three-year term posi-

tion in Environmental Geology at the rank of Assistant Professor (Instructor for ABD) beginning August 15, 2000. We desire a person who is broadly trained in the geosciences with expertise in geochemistry/hydrogeology. The successful applicant will teach a variety of courses for undergraduate students including Physical Geology, Physical Geography, Geochemistry, and Applied Hydrogeology; will develop research projects for undergraduate students; and will possess excellent field and/or computational skills. Applicants should send a letter describing their teaching pedagogy and research interests, vita, transcripts of all academic work, and three letters of recommendation to Dr. Frederick M. Soster, Chair, Department of Geology and Geography, DePauw University, Greencastle, IN 46135. Review of applications will begin October 15 and will continue until the position is filled. We plan to conduct interviews of selected applicants at the 1999 GSA meeting in Denver. DePauw University is an affirmative action, equal opportunity employer. Women and minorities are especially encouraged to apply.

MINERALOGIST / GEOSCIENCE EDUCATION

The Department of Geosciences at the University of Wisconsin-Milwaukee anticipates opening a position in Mineralogy/Geoscience Education at the level of tenure-track Assistant Professor or tenured Associate Professor. Applicants must hold a Ph.D. in geology, and have demonstrated research experience in mineralogy and/or geoscience education. Postdoctoral experience is desirable. The successful candidate is expected to conduct an active research program, and teach undergraduate courses in mineralogy, (on an interim basis) introductory petrology, and related subject areas. Information is available on-line regarding the Department at <http://www.uwm.edu/dept/geosciences/>.

To be considered, a curriculum vitae with a research plan, an outline of teaching philosophy, and three letters of recommendation must be mailed to Mark Harris, Chair, Department of Geosciences, University of Wisconsin-Milwaukee, P.O. Box 413, Milwaukee, WI 53201 (fax: 414-229-5452; E-mail: mtharris@uwm.edu), and postmarked by November 15, 1999. The University of Wisconsin—Milwaukee is an Equal Opportunity/Affirmative Action Employer.

FACULTY POSITION CALIFORNIA STATE UNIVERSITY, HAYWARD

The Department of Geological Sciences at California State University, Hayward, seeks a dynamic faculty member with strengths in applied geophysics, engineering geology or sedimentology. Pending administrative approval, a tenure-track position at the Assistant Professor level will be offered beginning September 2000, conditional upon availability of funds. The individual hired will be expected to have talents in undergraduate and graduate teaching for a diverse student population, and become part of the research program in geology or environmental science. Expertise in GIS and spatial analysis is highly desirable, as is significant field experience. The department offers BA, BS and MS degrees in geology, and plays a major role in the university's environmental science and teacher credential programs. The university and its San Francisco Bay setting offers a rich combination of cultural amenities, renowned geology, and nearly limitless research opportunities. Applicants who will possess the Ph.D. by September 2000, should mail a curriculum vitae and three letters of recommendation to Dr. Nancy Fegan, Search Committee Chair, Department of Geological Sciences, California State University, Hayward, 25800 Carlos Bee Boulevard, Hayward, CA 94542-3088. Review of applications will begin October 15, and continue until a suitable candidate is found. We plan to interview potential candidates at the GSA Annual Meeting in Denver. California State University is an Equal Opportunity Employer.

ASSISTANT PROFESSOR POSITION, TECTONICS AND BASIN ANALYSIS, NORTHERN ARIZONA UNIVERSITY

The Department of Geology at Northern Arizona University solicits applications for a tenure-track, Assistant Professor position to begin in August 2000. Applicants must have a Ph.D. in Geological Sciences.

The successful candidate will teach introductory and majors courses in geology and will participate in teaching the department's field curriculum. He/she will be expected to seek external funding and establish an active research program centered around existing departmental and university missions to the Colorado Plateau and the Southwest. NAU is an equal opportunity/affirmative action employer and strongly encourages applications from

women and minorities. The University is responsive to the needs of dual career couples. The NAU community is drawn from a wide range of cultural backgrounds. Applicants should have the commitment to work with such a diverse population.

The successful candidate will have a field-oriented research specialty in tectonics and basin analysis. She/he must have a strong background in tectonics and basin analysis, and will couple existing departmental strengths in sedimentary geology and structure-tectonics. He/she must have demonstrated expertise in basin formation, filling, and preservation throughout the stratigraphic record. Teaching responsibilities include a major role in the undergraduate field curriculum and graduate courses in evolution of sedimentary basins and depositional systems.

Applicants for this position should send a letter outlining teaching and research interests, curriculum vitae and names, addresses (including e-mail), and telephone numbers of five references. Send to Chair, Screening Committee, Geology Dept., Box 4099, Northern Arizona University, Flagstaff, AZ, 86011. The search will remain open until the position is filled; however, the screening committee will begin reviewing applications on 11/1/99. Visit our web site at <http://vishnu.glg.nau.edu>.

EASTERN MICHIGAN UNIVERSITY

HYDROGEOLOGIST/ENVIRONMENTAL GEOLOGIST

The Department of Geography and Geology announces a tenure-track assistant professor position in Hydrogeology or Environmental Geology, available fall 2000. The successful applicant will participate in the department's Urban Water Resources Center and/or Center for Environmental Information Technology and Applications and will teach introductory earth science or geology courses and advanced courses in the area of expertise. Qualifications include: Ph.D. by time of appointment; expertise in hydrogeology, environmental geology, or fluvial processes; commitment to achieving excellence in teaching; strong computer skills. Additional desired qualities include substantial knowledge in geographic information systems and a record of research, publications, and/or external funding. To apply, please submit detailed curriculum vitae; letter detailing how you satisfy position qualifications; statement of relevant course work and your teaching philosophy; list of courses you are/can be prepared to teach; statement of research plans and goals; names, addresses, phone numbers, and e-mail addresses of at least three references familiar with your teaching and research accomplishments and potential. Review of applications will begin November 1 and continue until position is filled. Reply to Position F0003, 202 Bowen, Eastern Michigan University, Ypsilanti, MI 48197. For information about the department and university visit <http://www.emich.edu/public/geo/welcome.html>. EMU is an affirmative action/equal opportunity employer.

Indiana University

Department of Geological Sciences

MALCOLM & SYLVIA BOYCE PROFESSORSHIP IN GEOLOGICAL SCIENCES

The Department of Geological Sciences at Indiana University invites applications and nominations for the newly created Malcolm & Sylvia Boyce Professorship of Geological Sciences in the field of HYDROGEOLOGY. As a named professorship in Geological Sciences, the position is expected to be filled at the full-professor level. However, under exceptional circumstances, the position may be filled at a tenured, associate-professor level. The Malcolm & Sylvia Boyce Professor should have research interests that complement existing programs in chemical and physical aspects of surface and shallow-subsurface hydrology. We are especially interested in an established scholar with a research focus on water and solute transport (including modeling) at the basin scale, although other areas of expertise will be considered. The successful candidate will provide a link between hydrogeology and sedimentary geology as part of an initiative aimed at developing an interdisciplinary program in the geology of sedimentary basins.

Excellent laboratories exist in the Department for chemical and stable-isotope analyses. The current hydrogeology faculty has strong interactions with a complementary program (Water Resources) at Indiana University in the School of Public and Environmental Affairs (SPEA), and with the Center for Geospatial Data Analysis at the Indiana Geological Survey. Many opportunities exist for collaboration with other on-campus researchers in the Department of Chemistry as well as the Indiana Geological Survey. A Ph.D. or equivalent degree is required. Applications should include a personal statement of vision

for the future of research, a narrative of important research, teaching, and service accomplishments, a detailed curriculum vitae, and names and addresses (including e-mail) of five referees.

Appointment may begin as early as August 2000. Applications should be submitted by November 1, 1999, but the position will remain open until filled. Applications or nominations should be sent to: Boyce Professorship Search Committee, Department of Geological Sciences, Indiana University, 1001 E. 10th Street, Bloomington, IN 47405 USA.

This position is one of two newly endowed professorships in the Department of Geological Sciences at Indiana University. Further information about these positions and the Department can be found at: <http://www.indiana.edu/~geosci/>

Indiana University as an Equal Opportunity/Affirmative Action Employer encourages the candidacies of women and minorities.

Indiana University

Department of Geological Sciences

ROBERT R. SHROCK PROFESSORSHIP IN SEDIMENTARY GEOLOGY

The Department of Geological Sciences at Indiana University invites applications and nominations for the newly created Robert R. Shrock Professorship in Sedimentary Geology. As a named professorship in Geological Sciences, the position is expected to be filled at the full-professor level. However, under exceptional circumstances, the position may be filled at tenured, associate-professor level. The Robert R. Shrock Professor in Sedimentary Geology should be an established scholar with a strong research record that complements our current strengths in water-rock interactions at low temperatures, biogeochemical processes, geobiology, and the relationship between tectonics and facies architecture.

Appointees could teach courses in appropriate specialty at all levels. We encourage collaboration in research across disciplines and teaching within the Department, with the adjoining Indiana Geological Survey, as well as with other departments on campus. A Ph.D. or Equivalent degree is required. Applications should include a personal statement of vision for the future of research, a narrative of important research, teaching, and service accomplishments, a detailed curriculum vitae, and names and addresses (including e-mail) of five referees.

Appointment may begin as early as August 2000. Applications should be submitted by November 1, 1999, but the position will remain open until filled. Applications or nominations should be sent to: Shrock Professorship Search Committee, Department of Geological Sciences, Indiana University, 1001 East 10th Street, Bloomington, IN 47405 USA.

This position is one of two newly endowed professorships in the Department of Geological Sciences at Indiana University. Further information about these positions and the Department can be found at: <http://www.indiana.edu/~geosci/>

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BOOKS: Geology and History of Geology. Used, out-of-print, and rare. Free catalog. Patricia L. Daniel, BS, MS, Geology, 618 W. Maple, Independence, KS 67301, ph. (316) 331-0725, fax: 316-331-0785, e-mail: pldaniel@horizon.hit.net, website: www.hit.net/~pldaniel.

Opportunities for Students

Graduate Student Opportunities. University of Missouri, Rolla. A recent large endowment to the Department of Geology & Geophysics, University of Missouri, Rolla allows us to offer very competitive financial support

to qualified graduate students. Programs leading to the M.S. and Ph.D. degrees include: aqueous & environmental geochemistry, igneous petrology & geochemistry, sedimentary petrology & geochemistry, sedimentology & biostratigraphy, economic & petroleum geology and applied exploration & environmental geophysics. The Department is well equipped and situated in a modern facility. For information about programs, faculty and admissions, please access the Department's home page at: <http://www.umn.edu/~geo-geop/> or write to: Graduate Advisor, Department of Geology & Geophysics, University of Missouri-Rolla, Rolla, MO 65409-0410.

California Institute of Technology. Postdoctoral Fellowships in Geological and Planetary Sciences. The California Institute of Technology announces two fellowships in earth and planetary sciences: The O.K. Earl Postdoctoral Fellowship, and the Texaco Postdoctoral Fellowship.

These awards are from funds endowed by Orrin K. Earl, Jr. and by the Texaco Philanthropic Foundation. Each fellowship carries an annual stipend of \$36,000 and offers a research expense fund of \$1,000 per year and one-way travel to Pasadena. The duration of each appointment will normally be for two years, contingent upon good progress in the first year, and beginning with the 2000-2001 academic year. Fellows are eligible to participate in Caltech's health and dental program.

These fellowships have been established to support the research of scientists typically within two years after receipt of the Ph.D. The intent of the program is to identify and support innovative and creative work in the earth and planetary sciences, with particular emphasis on interdisciplinary work. Applicants with training in physics, chemistry, biology or computer sciences are urged to apply. The Caltech faculty is currently active in geobiology, geochemistry, geology, geophysics, petrology, seismology, and atmospheric and planetary sciences. It is expected that each fellowship holder will be hosted by a division professor (designated by the division chairman) who will contribute to the fellowship support both financially and by providing intellectual guidance.

Application forms may be obtained by writing to Prof. E. M. Stolper, Chair, Division of Geological and Planetary Sciences, Mail Code 170-25, California Institute of Technology, Pasadena, California 91125, or send e-mail to: pmorton@gps.caltech.edu.

Completed applications with references should arrive at Caltech by Wednesday, December 22, 1999.

Fellowship candidates will automatically be considered for other available postdoctoral positions at Caltech in their fields of interest.

Caltech is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans and disabled persons are encouraged to apply.

Graduate Student Support Opportunities in Earth Sciences, Lehigh University.

The Department of Earth and Environmental Sciences of Lehigh University has Graduate Student Fellowships for highly qualified individuals. The department has active research programs in tectonic studies (geochronology, stable isotope geochemistry, low temperature geochemistry, seismology, high resolution geophysics, structural geology, paleomagnetism) and surficial processes (low temperature geochemistry, fluvial and tectonic geomorphology, glacial geology, hydrology, and limnology). Please contact Prof. D. Morris, Dept. of Earth and Environmental Sciences (dpm2@lehigh.edu) or see our Web page for more details (<http://www.ees.lehigh.edu>).

Department of Geosciences, University of Arizona,

announces the availability of Sloan Scholarships for minority Ph.D. students in the geosciences. The Alfred P. Sloan Foundation and the Department of Geosciences are committed to increasing the number of African-American, Hispanic-American, and Native-Americans receiving Ph.D.s in the geosciences. Sloan scholars receive fellowship support, three summers of research support, a research allowance, and peer and faculty mentoring. Additional support through other fellowships, and teaching or research assistantships, is also available. Inquiries and requests for applications to: Graduate Program, Department of Geosciences, The University of Arizona, Tucson, AZ 85721. Or gradapps@geo.arizona.edu and <http://www.geo.arizona.edu>. ■

1999 ANNUAL MEETING AND EXPOSITION

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