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**Magma transport and coupling between deformation and magmatism in the continental lithosphere**

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**ABSTRACT**

The mechanisms by which magma is generated and transported through continental crust and how these processes affect the chemical and mechanical evolution of the lithosphere are some of the least understood issues of continental dynamics. We report here on the evolution of an unusually well-exposed early Mesozoic arc that originally formed along the ancient margin of Gondwana and is now located in western New Zealand. The pre-Cenozoic configuration and deeply eroded character of this arc lead us to the following conclusions about magmatism and deformation at 10–50 km paleodepths: (1) The mafic-intermediate composition of the lower crust and the mineral reactions controlling melt production strongly influenced pathways of melt transfer and controlled the mechanical behavior of the lithosphere during orogenesis. (2) Evolving lithospheric strength profiles during magmatism and convergence produced transient periods of vertical coupling and decoupling of crustal layers. (3) Late orogenic extension was driven by plate interactions rather than by gravitational forces and a weak lower crust.

**INTRODUCTION**

Many of the Mesozoic Cordilleran plutonic complexes located in western North America (Tepper et al., 1993), the Andes (Petford and Atherton, 1996), Antarctica (Wareham et al., 1997), and New Zealand (Muir et al., 1995) contain tonalite to granodiorite batholiths that are thought to originate from the partial melting of mafic lower crust. However, considerable uncertainty surrounds how these magmas are produced and moved through the lower crust, and how these processes influence crustal evolution. Much of this uncertainty arises because Phanerozoic arc systems that allow direct examination of mafic lower crust are rare. There are even fewer field sites where exposures of tilted crustal sections allow us to examine structural and magmatic features that evolved simultaneously at lower, middle, and upper crustal levels.

**Figure 1.** Inset shows present configuration (top) and Cretaceous reconstruction (bottom) of western New Zealand assembled by restoring the Median Tectonic Zone (MTZ) to its pre–late Cenozoic position. Main diagram shows Cretaceous reconstruction. Metamorphic pressures from Fiordland (7–16 kbar) represent the peak of Early Cretaceous metamorphism at ca. 120 Ma. Data show a south-tilted lower crustal section and are from J.Y. Bradshaw (1985, 1989), Clarke et al. (2000), Daczko et al. (2001a, 2001b), and Daczko et al. (2002a). Pressures from Westland show shallower Early mid-Cretaceous (125–105 Ma) pluton emplacement depths (after Tulloch and Challis, 2000). Abbreviations show key locations or features: SP—Separation Point, P—Paparoa Range, V—Victoria Range, M—Milford Sound, E—Mount Edgar, MD—Mount Daniel, G—George Sound, C—Caswell Sound, DS—Doubtful Sound, WFO—Western Fiordland Orthogneiss.

Exposures of early Mesozoic arc crust in western New Zealand allow us to examine directly how deformation interacted with magma generation and transport processes at outcrop to lithospheric scales. The Fiordland part of this belt (Fig. 1) contains >5000 km² of high-pressure (P = 14–16 kbar) migmatites, granulite facies mineral assemblages, and layered mafic-intermediate intrusions that formed in the lower and middle crust of the arc (25–50 km paleodepths) during the Early Cretaceous. The Westland part (Fig. 1) preserves the middle to upper crustal levels of this same arc (10–27 km paleodepths) where sodic, high Sr/Y granitoids were emplaced following partial melting of mafic-intermediate lower crust (Muir et al., 1998; Tulloch and Challis, 2000). This unusual degree of exposure allowed us to examine the evolution of a 50-km-thick column of deforming continental crust over a 35 Ma cycle of orogenesis (Fig. 2). Reconstructing this type of composite crustal column is based on metamorphic pressure data and on inferences about how outcrops can be restored to their original depth-stratified paleogeomety (see also Karlstrom and Williams, 1998, 2002; Miller and Paterson, 2001).
RECONSTRUCTING THE FIORDLAND-WESTLAND OROGEN

On the South Island of New Zealand, a segment of the present-day boundary between the Australian and Pacific plates occurs along an 800-km-long transform called the Alpine fault (Fig. 1). This fault has accommodated ~460 km of dextral strike-slip displacement since the Miocene (Wellman, 1953). By removing this amount of slip, the pre-Cenozoic configuration of western New Zealand can be reconstructed (Tulloch and Challis, 2000). Cretaceous reconstructions (Fig. 1) show a continuous NE-trending belt of calc-alkaline granitoids, layered mafic igneous complexes, and volcano-sedimentary terranes that define an early Mesozoic (247–105 Ma) composite arc (Kimbrough et al., 1994; Mortimer et al., 1999).

Near continuous exposure along coastlines and in the mountainous terrain of Fiordland reveal the three-dimensional structure of the deepest parts of the arc. Fiordland (Fig. 1) contains a layered, dome-shaped mid-lower crustal section where the shallowest paleodepths (~25 km) occur in the center at Caswell Sound (C, Figs. 1, 2A, 2B) and the deepest paleodepths (45–50 km) occur at Milford Sound (M, Figs. 1, 2A, 2B) and Doubtful Sound (DS, Figs. 1, 2C). In Westland, high Sr/Y sodic granitoids of the 125–105 Ma Separation Point Suite (Fig. 1) record Early Cretaceous emplacement depths of 8–27 km (Tulloch and Challis, 2000).

The ages of major intrusive features and of Cretaceous deformation and metamorphism are well constrained by published geochronology (Mattinson et al., 1986; McCulloch et al., 1987; Gibson and Ireland, 1995; Muir et al., 1998; Ireland and Gibson, 1998; Nathan et al., 2000; Tulloch et al., 2000). Published dates and new analyses of zircon (Klepeis et al., 2001; Hollis et al., 2002; G. Gehrels, 2002, personal comm.) from within the section reveal three tectonic phases (Fig. 2): (1) the addition of mafic-intermediate magma into the lower crust (126–116 Ma) and the partial melting of lower crustal host gneisses; (2) contractional deformation and the emplacement of sodic, high Sr/Y granitoids in the middle and upper crust (116–105 Ma); and (3) late orogenic extension, cooling and exhumation (105–90 Ma). This last phase preceded inception of seafloor spreading in the Tasman Sea (ca. 84 Ma) by ca. 15 Ma (Gaina et al., 1998) and was accompanied by the formation of extensional metamorphic core complexes in Westland, New Zealand (Tulloch and Kimbrough, 1989).

MAGMA EMPLACEMENT AND PARTIAL MELTING IN THE LOWER CRUST

During the period 126–116 Ma (Fig. 2A), the lower crust of the Fiordland belt accumulated at least 10 km (thickness) of mafic-intermediate magma (Mattinson et al., 1986). The first phases were gabbroic with minor ultramafic compositions; later phases were dominated by diorite. This intrusion formed a >3000 km2 tabular batholith called the Western Fiordland Orthogneiss (WFO, Figs. 1, 2A) and has been interpreted to have added sufficient

Figure 2. Cartoons illustrating the tectonic evolution of the Fiordland-Westland belt. Abbreviations and color scheme are as in Figure 1. A: During interval 126–116 Ma, mafic-intermediate magma (WFO, yellow) was added to the middle (bottom part of green color) and lower (dark pink and tan) crust. Upper crust was composed mostly of Paleozoic Gondwana margin rocks (green) and granitoid plutons (light blue and light pink). Lower crust was composed of older (>126 Ma) arc-related rocks, including parts of the Median Tectonic Zone (MTZ) and Mount Edgar diorite (E) in tan and Paleozoic gneisses of Gondwana in dark pink. B: Contractional deformation (116–105 Ma) followed magmatism and melt production. C: Late orogenic extension (105–90 Ma) formed metamorphic core complexes (P and V) in mid-upper crust and the Doubtful Sound shear zone (DS) in the lower crust. Schematic strength profiles illustrate variations in the strength of the lower crust during two stages of orogenesis. Lower crust in A was weakened by magmatism. Lower crust in B was strengthened by dehydration and the cooling of the Western Fiordland Orthogneiss (WFO) to T < 700 °C following data presented in Daczko et al. (2002b).
heat to the lower crust to partially melt host gneisses (Daczko et al., 2001b). At the time of this intrusion, the lower crust was composed of older (>126 Ma) vertically stratified mafic-intermediate intrusive phases of the early Mesozoic arc, including the western Median Tectonic Zone (MTZ) and Mount Edgar (E) diorite (Figs. 1, 2; Hollis et al., 2002), and Paleozoic gneisses of Gondwana margin affinity (Tulloch et al., 2000).

Field data show that the spatial distribution of rocks that partially melted following magma emplacement was highly heterogeneous. Above and near the top of the batholith, at Caswell (C, Figs. 1, 2A) and George sounds (G, Figs. 1, 2A), migmatites formed in a narrow zone 200–500 m thick near the batholith-country rock contact. In contrast, below the batholith a region of lower crust at least 10 km thick partially melted (Fig. 2A). Petrologic analyses suggest that the partial melting of mafic-intermediate gneisses below the batholith was patchy and mostly involved hornblende breakdown to form garnet surrounded by leucosome (Daczko et al., 2001b).

To test possible mechanisms of melt generation in gneisses below the batholith, piston-cylinder experiments were performed on an unmelted sample of dioritic gneiss at P = 14 kbar and T = 800–975 °C (Antignano et al., 2001). The mineral assemblage consisted of plagioclase + quartz + hornblende, clinozoisite, and biotite as the hydrous phases. At T = 825 °C, biotite undergoes melting in the absence of free water (fluid-absent), followed by the reaction of hornblende and clinozoisite resulting in garnet + melt as reaction products. Melt compositions initially are granitic due to the scavenging of water that dehydration of the gabbroic gneiss reflected the scavenging of water by migrating, water-poor partial melt sourced from the melted diorite gneiss. These results may explain the low percentage of leucosome observed in mafic lower crust in the field and contrasts with the much higher melt fractions observed in migmatitic paragneiss above the batholith.

**MELT SEGREGATION AND TRANSPORT**

In migmatite formed at paleodepths of 45–50 km (Fig. 3D), diffuse patches of leucosome parallel gneissic layering and feed laterally into vertical (layer-perpendicular), vein-filled extension fractures (Figs. 3E, 3F, 3G). The sharp, straight edges of the veins and curved vein tips are typical of brittle extension fractures. The fracture sets cut across all lithologic boundaries and occur within hundreds of square kilometers of the lower crustal section, including the batholith. These features provide strong geological evidence that melt segregation and transport were aided by diking and fracture propagation following batholith emplacement.

The physical links that occur between leucosome in migmatitic gneiss and the vein-filled fractures and dikes suggest that positive volume changes and the development of high melt fluid pressures during melt production induced brittle failure by lowering effective normal stresses in the lower crust (e.g., Clemens and Mawer, 1992; Davidson et al., 1994). In this scenario, the leucosome observed in the field reflects melt migration along fractures. We tested this hypothesis in the field and laboratory using metamorphic and geochemical relationships that record how partial melts interacted chemically with gabbroic gneiss during their migration. Adjacent to leucosome in gabbroic gneiss, hornblende-bearing assemblages recrystallized to garnet granulite (Figs. 3E, 3F) at conditions of T > 750 °C and P = 14 kbar (Clarke et al., 2000). Early theories (e.g., Blattner, 1976; Bradshaw and Kimbrough, 1989) suggested that these recrystallized zones formed by dehydration as CO₂-rich fluids were introduced along fractures. However, the garnet-bearing dehydration zones only occur in gabbroic gneiss and are physically continuous with leucosome formed in migmatitic diorite. These relationships led Daczko et al. (2001b) to infer that dehydration of the gabbroic gneiss reflected the scavenging of water by migrating, water-poor partial melt and in matrix feldspar and quartz (Fig. 3B) confirms the low water activity of these melts (Antignano, 2002). These results support the interpretation that fluid-absent melting reactions with high dilution can produce fracture networks that allow for interconnectivity and melt transfer. These data combined with the development of vein arrays within large parts of the Fiordland section suggest that fracture networks aided melt segregation and that melt migration was linked to dehydration in the surrounding gabbroic rocks.

Field relationships also show that fracture propagation and diking were not the only mechanisms of melt transfer following intrusion of the batholith. Foliation planes, lithologic contacts, boudin necks, and fold hinges in ductile shear zones that developed after batholith emplacement also contain leucosome. These observations suggest that a combination of fracture networks and deformation in shear zones moved partial melt horizontally and vertically through the crustal column.
CHANGES IN LOWER CRUSTAL STRENGTH AND RHEOLOGY

In Fiordland, magma compositions and the liquidus temperature of basalt indicate that the initial intrusion temperatures of the WFO were likely ≥1200 °C following the estimates of Petford and Gallagher (2001). Mineral assemblages that formed in the batholith and its host rocks following its emplacement record progressive changes in temperature and fluid activities. Partial melting and granulite facies metamorphism occurred at 750 °C < T < 850 °C (Daczko et al., 2001b). With time, kyanite- and paragonite-bearing assemblages replaced older garnet-clinopyroxene-plagioclase assemblages reflecting isobaric cooling of the lower crust to ~650 °C prior to 108–105 Ma (Daczko et al., 2002b). These observations and the well-known dependence of lower crustal strength and rheology on melt fraction, temperature, and fluid activity imply that the lower crust must have had a different mechanical strength at different times between 126 and 105 Ma. These results are consistent with evidence of complex rheological stratifications in sections of arc crust exposed in the U.S. Cordillera (Miller and Paterson, 2001).
During the earliest stages of magmatism (126–116 Ma) suprasolidus shear zones formed at the upper and lower boundaries of the batholith. At Mount Daniel (MD, Figs. 1, 2A) these shear zones contain tightly folded tonalite sheets that are cut by less deformed sheets, indicating that deformation coincided with the periodic emplacement of magma. Coarse biotite in tightly folded layers exhibits radial patterns and tabular plagioclase lacks evidence of subsolidus recrystallization.

These features reflect deformation under magmatic conditions and suggest that the flow of magma participated in, and may have facilitated, the imbrication of crustal slices during crustal thickening.

Inside the batholith all magmatic features are cut by the fracture arrays that have been linked physically and chemically to sites of partially melted host rock (Fig. 3). The fact that these fractures cut the lower contact of the batholith (MD, Fig. 2A) provides direct evidence that by ca. 116 Ma the batholith had mostly crystallized and was strong as it deformed together with its host rocks at high effective viscosities. Finally, ductile shear zones that record subsolidus temperatures of 650 °C < T < 800 °C deform many of the fractures and dikes inside and below the batholith (Daczko et al., 2001a). These transitions suggest that during the period ca. 116–105 Ma, the lower crust initially was weakened by the addition of heat and magma and later strengthened as melt moved out of the lower crust and the lower crust cooled. Experimental data confirmed the relatively high strengths of lower crustal mafic rocks even as they underwent mineral reactions involving partial melting (Fig. 3C). These changes are illustrated qualitatively in the strength-depth profiles showing a weak lower crust in Figure 2A and a stronger lower crust in 2B.

**CHANGING PATTERNS OF DEFORMATION IN THE LOWER CRUST**

One of the most useful features in the study of deformation in Fiordland was the penetrative arrays of extension fractures surrounded by garnet granulite dehydration zones that formed over hundreds of square kilometers of the section, including the batholith. Changes in the angular relationships among these and other vein sets provided a means of defining strain gradients and the kinematic evolution of shear zones from the outcrop to the regional scale (Fig. 3G). Within the westernmost part of the section, a penetrative, SW-dipping gneissic layering also provided a reference frame that facilitated a comparison of structural styles across the belt. In the west, where Early Cretaceous deformation was weakest, thermobarometric data indicate that this layering was oriented close to horizontal during and after batholith intrusion and fracture sets cut across layering at high angles approaching 90°.

Following partial melting of the lower crust, swarms of vertical, ≤1-m-thick, E- and NW-striking shear zones formed at the margins of dikes below the batholith. These shear zones form antiformal (dextral) and synthetic (sinistral) pairs that record arc-parallel (NE-SW) displacements and subhorizontal (layer-parallel) arc-normal (NW-SE) shortening within a dominantly sinistral flow regime (Daczko et al., 2001a). Subsequently, these shear zones were deformed by a series of SE-dipping (avg. 27°), vertically stacked (100 m spacing) shear zones that contain imbricated, asymmetric pods of mylonite. These pods form antiformal stacks that are typical of thrust duplexes and record layer-parallel (subhorizontal) shortening and layer-perpendicular (subvertical) thickening during arc-normal contraction (Daczko et al., 2001a). Mineral assemblages that define foliation planes in these thrusts record metamorphic conditions of P=14 ± 1.2 kbar and T = 674 ± 36 °C (Daczko et al., 2001a). This style of duplex involving simultaneous deformation along steeply and shallowly dipping foliations was also noted by Karlstrom and Williams (2002) as an important mechanism in the middle crust for accommodating strain during synchronous thickening of crust and migration of melt.

As the batholith cooled further and contraction continued, the style of deformation in the lower crust changed. Along the western boundary of the MTZ (below letter M in Figs. 1, 2B), shortening resulted in a vertical, 10–15-km-wide, N-striking transpressional shear zone that cuts across the entire lower crustal section, including the lower and eastern contact of the batholith. This shear zone records an oblique-sinistral sense of shear.

**Figure 4.** Cartoons showing the different possible mechanical responses of continental lithosphere following partial melting of the deep crust. **A:** The Fiordland-Westland belt reflects a strong lower crust during the period 116–105 Ma that promoted vertical coupling of deformation. **B:** The Shuswap range of southern British Columbia, Canada is characterized by a weak middle crust (after Vanderhaege and Teyssier, 1997; 2001). Text below diagrams highlights differences in the characteristics and boundary conditions that influence orogenic styles.

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**Note:** The text above is a natural representation of the document, focusing on the key points and avoiding excessive detail. The reference to diagrams and external figures has been omitted for brevity.
Near vertical foliations that define the shear zone at deep levels (14-16 kbar) gradually flatten upward and merge into a horizontal décollement zone underlying a mid-crustal fold-thrust belt (7-9 kbar) at the top of the batholith (Fig. 2B). On the basis of thermobarometry, this shear zone transsects a crustal thickness of at least 20 km (Fig. 2B). The mid-crustal fold-thrust belt is well exposed at Caswell Sound (C, Figs. 1, 2B) and exhibits features that are common in many upper crustal settings including imbricated thrust splays that sole into flat detachments, fault propagation folds, and conjugate thrusts and back thrusts (Daczko et al., 2002a).

Both the mid-crustal fold-thrust belt and the steep lower crustal shear zone below it cut the 126-116 Ma Western Fiordland Orthogneiss and are deformed by a younger set of upper amphibolite facies shear zones, including the Doubtful Sound shear zone (DS, Figs. 1, 2C). These younger shear zones cut all contractional structures in Fiordland and record decompression and cooling of the granite belt through the closure temperature of hornblende (≈550 °C) by ca. 108-105 Ma and to ≤400 °C by 90 Ma (Gibson et al., 1988; Gibson and Ireland, 1995; Klepeis et al., 1999; Nathan et al., 2000). These relationships and U-Pb geochronology (Tulloch et al., 2000; Hollis et al., 2002) indicate that as the batholith cooled during the period 116-105 Ma, contraction was coupled at different levels of the crust through an interconnected network of steeply and gently dipping shear zones.

DISCUSSION AND CONCLUSIONS

Lithospheric-Scale Interactions Among Deformation and Melt Transfer Processes

The Fiordland-Westland example provides strong geological evidence that diking and melt-enhanced fracturing was an important mechanism for the segregation and initial ascent of melt out of the lower crust. Similar melt-enhanced fracture systems have been observed in other orogenic belts (Davidson et al., 1994; Roering et al., 1995; Yamamoto and Yoshino, 1998) but to our knowledge none show this behavior on such large scales as in the Fiordland belt.

Once the batholith and its host rocks had cooled to subsolidus temperatures (T < 820 °C), structural elements in large vertical shear zones were exploited as pathways for melt transport horizontally and vertically through the crustal column. These observations agree with models that predict the buoyancy of hot felsic magma and the dynamics of transpression can create pressure gradients that help force magma through the crust (e.g., Robin and Cruden, 1994; de Saint Blanquat et al., 1998).

As transpressional shear zones evolved in the lower crust, granitoids were emplaced into the upper crust until ca. 105 Ma (Muir et al., 1995; Waight et al., 1998). The Separation Point batholith represents the final stages of this process. This batholith consists of sodic, alkali-calcic diorite to biotite-hornblende monzogranite that is similar in composition to Cordilleran adakite suites (Muir et al., 1995). The geochemical and isotopic signatures of these granitoids suggest that they were derived either from young, hot subducted oceanic crust or from mafic crust at the root of a thickened (>10 km paleodepths) magmatic arc (Muir et al., 1995, 1998). Our observations support the latter interpretation.

The isotopic (Sr, Nd) composition of the Separation Point Suite also suggests that rising magmas experienced little to no interaction with felsic arc crust (Muir et al., 1995, 1998). This implies that the mixing of mantle and crustal components to form shallow-level plutons occurred in the mafic lower crust. Fiordland provides an example where the mixing of mantle and crust components may have occurred beneath a mafic intrusion (e.g., Petford and Gallagher, 2001), and where the rapid ascent of hybrid magmas through fracture networks and shear zones inhibited crustal contamination at shallower levels. Finally, data from Fiordland reconcile the previously tenuous relationship between crustal melting and high-pressure granulite facies metamorphism. The data show that this metamorphism was related directly to the migration of water-poor partial melts through the lower crust.

Transient Coupling and Decoupling Within the Lithosphere

High melt volumes (>30%) associated with the emplacement of the WFO and the virtual absence of any Cretaceous deformation outside the batholith and its contact aureoles during emplacement indicate that the lower crust probably was decoupled from the upper and middle crust during the interval 126-116 Ma. Structural patterns indicate that subhorizontal (layer-parallel) flow between layers of colder, less deformed host rock characterized this period and reflected the localization of deformation into areas weakened by melt and heat. However, this period of vertical decoupling was transient, occurring only during the ~10 m.y. period before the batholith cooled and crystallized.

By ca. 116 Ma, the melt enhanced shear zones at the base of the batholith were abandoned. The development of granulite facies fracture arrays inside the batholith and its host indicate that decoupling had ended by this time and that these crustal layers were deforming together at similar high effective viscosities. Evidence that a 10-15 km wide transpressional shear zone in the lower crust evolved simultaneously with, and was connected physically to, a mid-crustal thrust system following batholith emplacement and crustal melting also indicates that deformation at these levels was coupled during the interval 116-105 Ma (Fig. 2B). Metamorphic data suggest that strengthening of the lower crust promoted vertical coupling during this phase and was aided by efficient melt extraction, dehydration, and cooling as the batholith crystallized and melt escaped.

Structural features in the upper crust of the arc exposed in Westland also are consistent with a relatively strong, cooling viscous lower crust after ~116 Ma. At shallower levels of the crust contractional deformation occurred within a narrow (50-75 km wide) zone focused along the western side of the MTZ (SP, Fig. 1; Tulloch and Challis, 2000). This narrow, focused structural style (Fig. 4A) supports the predictions of numerical models of orogens where a highly viscous lower crust preferentially transmits stresses vertically through the lithosphere (Royden, 1996; Ellis et al., 1998). The style also contrasts with the distributed style of near surface deformation in orogens characterized by a weak middle or lower crust (Vanderhaeghe and Teyssier, 1997;
In summary, the Fiordland setting provides a natural laboratory within which we can test our understanding of the feedbacks that develop among magmatism, metamorphism, and deformation during cycles of orogenesis. In addition, the approach of using parallel field, laboratory, and experimental studies may be one of the most important tools we have to develop a complete picture of coupled processes in the continental lithosphere. In Fiordland, this approach has revealed the mechanisms by which magma was generated and transported through lower continental crust and how these processes affected the evolution of the lithosphere over a 35 m.y. cycle.

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REFERENCES CITED


Committee Service
Nominations Due January 15, 2003
Candidates are needed for service on the following GSA committees: Annual Program; Arthur L. Day Medal Award; Education; Geology and Public Policy; Honorary Fellows; Joint Technical Program; Membership; Minorities and Women in the Geosciences; Nominations; Penrose Conferences and Field Forums; Penrose Medal Award; Professional Development; Research Grants; and Young Scientist Award. Candidates are also needed for a GSA representative to the North American Commission on Stratigraphic Nomenclature (NACSN). Service begins July 2003 for all positions except NACSN, which begins November 1, 2003, and Joint Technical Program, which begins January 1, 2004.

For complete information on committee service, current vacancies, and required qualifications, see the October 2002 issue of 
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Officers and Councilors
Nominations Due January 15, 2003
The GSA Committee on Nominations requests nominations for officers (vice president and treasurer) and councilors to serve on the GSA Council beginning in 2004. Each nomination should be accompanied by basic data and a description of the qualifications of the individual for the position recommended.

Send materials for committee, officer, and councilor nominations to Ruth Harrison, GSA, P.O. Box 9140, Boulder, CO 80301-9140, (303) 357-1000, ext. 0, 1-800-472-1988, ext. 0, rharrison@geosociety.org.

Congressional Science Fellowship
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For application information for the 2003–2004 GSA–U.S. Geological Survey Congressional Science Fellowship, visit www.geosociety.org/science/csfl, or contact Karlon Blythe, Program Officer, GSA Headquarters, (303) 357-1036, kblythe@geosociety.org.

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Nominations of candidates are requested for the following medals and awards: Penrose Medal, Day Medal, Honorary Fellows, Young Scientist Award (Donath Medal), GSA Public Service Award, and Distinguished Service Award. For details on the awards and nomination procedures, see the October 2002 issue of GSA Today, go to www.geosociety.org, or call (303) 357-1037. Materials and supporting information for any of the nominations may be sent to GSA, Grants, Awards, and Medals, PO. Box 9140, Boulder, CO 80301-9140.

Student Research Grants
Applications Must Be Postmarked by February 1, 2003
For information on 2003 Research Grant Program for Students, see the October issue of GSA Today or visit www.geosociety.org. Application forms are available online, at the geology departments of colleges and universities offering graduate degrees in earth sciences, or from Grants, Awards, and Medals, GSA, P.O. Box 9140, Boulder, CO 80301, lcarter@geosociety.org.

2003 Doris M. Curtis Memorial Fund for Women in Science Award
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This award is given to a woman or group of women who have impacted the field of the geosciences in a major way based on their Ph.D. research. For nomination, eligibility, and award details, see the October issue of GSA Today, or visit www.geosociety.org. Send nominations and supporting material to Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.

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The Committee on Membership requests nominations of members to be elevated to GSA Fellow status. Any GSA Fellow may nominate a member for this honor. Two other supporting signatures are needed, along with a letter stating the member’s qualifications to be evaluated on the basis of eight established criteria. For more information, a list of the criteria, and a nomination form, please see www.geosociety.org/members/fellow.htm or contact Nancy Williams, (303) 357-1017, nwilliams@geosociety.org.

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In cooperation with the Association of American State Geologists, GSA makes an annual award for the best paper on environmental geology published either by GSA or by one of the state geological surveys. For details, see the October issue of GSA Today or visit www.geosociety.org. Nominations must be sent to Program Officer, Grants, Awards, and Medals, GSA, P.O. Box 9140, Boulder, CO 80301-9140.

National Awards
Nominations Due April 30, 2003
Candidate nominations are needed for the following national awards: William T. Pecora Award, National Medal of Science, Vannevar Bush Award, and Alan T. Waterman Award. For details, see the October issue of GSA Today. Nominations should be sent to GSA, Grants, Awards, and Medals, P.O. Box 9140, Boulder, CO 80301-9140.
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  - Houston, Texas
- **Suzanne Mahlburg Kay**
  - Cornell University
  - Ithaca, New York
- **Peter W. Lipman**
  - U.S. Geological Survey
  - Menlo Park, California
- **Gerald M. Ross**
  - Geological Survey of Canada
  - Calgary, Alberta

- **Ronald M. Clowes**
  - University of British Columbia
  - Vancouver, British Columbia
- **David M. Fountain**
  - National Science Foundation
  - Arlington, Virginia
- **Richard E. Gray**
  - G.A.I. Consultants, Inc.
  - Monroeville, Pennsylvania
- **Judith Totman Parrish**
  - University of Arizona
  - Tucson, Arizona

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  - Syracuse, New York
- **Steven M. Stanley**
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- **Michael A. Arthur**
  - Pennsylvania State University
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- **J. Christopher Hepburn**
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The 55th Annual Meeting of the Rocky Mountain Section will be hosted by the Department of Geosciences, Fort Lewis College and will be held on the campus of Fort Lewis College.

Durango is located in southwestern Colorado, in an area commonly referred to as the Four Corners. Known for its spectacular natural beauty and outdoor recreation, Durango is a popular tourist destination. Fort Lewis College sits at an elevation of 6,850 feet on a mesa of glacial outwash with spectacular views of the glacio-fluvial Animas River Valley and the historic mining districts of the La Plata and San Juan mountains. Approximately 16,000 feet of sedimentary rocks are exposed in the Durango area, representing a nearly complete stratigraphic column. Precambrian igneous and metamorphic rocks and Tertiary volcanic rocks can be reached by a short drive. Examples of virtually every type of geological phenomenon can be found within a short distance of Fort Lewis College. Of particular interest to this meeting is the San Juan Basin to the south, which has become one of the nation’s largest coalbed methane-producing districts. Also, recent wildfires have created an opportunity to study the effects of fire on geologic processes (to the dismay of homeowners and the delight of geomorphologists).

GETTING HERE
Durango is approximately 6 hours from Denver and 3½ hours from Albuquerque by car. A regional airport approximately 15 miles from town serves Durango, but flights are limited so make your reservations early. It is also possible to fly into Farmington, New Mexico, about 50 miles from Durango.

Most downtown Durango hotels are within walking distance of campus (20 minutes); however, be advised that there is a difference in elevation of several hundred feet between town and campus. Public transportation also serves the campus from various parts of Durango. Contact www.durangogov.org/resident/services/transit.html for information.

To assist in finding your way around campus, you can download a map at www.fortlewis.edu/about_flc/maps/campusmap.pdf.

REGISTRATION
Preregistration deadline: April 4, 2003
GSA headquarters will handle registration. Preregister to qualify for lower registration fees. To obtain lower registration fees and to assist planning by the local committee, please preregister online at www.geosociety.org/sectdiv/rockymtn/03rmmtg.htm, or download the PDF preregistration form. If you are unable to preregister this way, contact GSA Member Services, 1-888-443-4472, member@geosociety.org.

All requests for registration changes or cancellations must be made in writing and received by April 11, 2003. No refunds will be made after this date.

On-site registration will be in the College Union Building:
Tues., May 6 4:30 p.m.–8 p.m.
Wed. and Thurs., May 7–8 7:30 a.m.–4 p.m.
Fri., May 9 7:30 a.m.–10 a.m.

ACCESSIBILITY
GSA is committed to making its meetings accessible to all people interested in attending. Indicate special requirements (wheelchair accessibility, etc.) on the registration form. Fort Lewis College is ADA compliant.

FIELD TRIPS
For further details on field trips, please contact either the trip leader or the field trip chair, Gary Gianniny, (970) 247-7254, gianniny_g@fortlewis.edu. Complete descriptions are posted at www.geosociety.org/sectdiv/rockymtn/03rmmtg.htm.

1. Geology, Mountains, and Mining History Along the San Juan Skyway. Mon. and Tues., May 6–7. David Gonzales, Department of Geosciences, Fort Lewis College, Durango, CO 81301, (970) 247-7378, gonzales_d@fortlewis.edu; Duane Smith, Southwest Studies, Department of History, Fort Lewis College, Durango, CO 81301, (970) 247-7457, smith_d@fortlewis.edu; Jack Ellingson, Professor Emeritus, Department of Geosciences, Fort Lewis College, Durango, CO 81301, ellingson_j@fortlewis.edu. Max.: 18; min.: 10. Cost: $200 (includes guidebook, two lunches, one night in hotel, and transportation in vans).


4. Investigations of Seeps in the Fruitland Formation, La Plata County, Colorado. Tues., May 6. W.C. Riese and BP America, riese1@bp.com; and Tom Ann Casey, EnerVest Operating, (970) 247-1500, ext. 204, tacasey@enervestdgo.com. Max.: 27; min.: 9. Cost: $60 (includes transportation, box lunch, and guidebook).

Cost: $60professional, $40/student (includes transportation, box lunch, and guidebook). Trip will reach elevations of 10,000 ft and will require participants to be able to walk over uneven terrain.

6. **Proterozoic Rocks of the Tusas Mountains and the Quartzite-Rhyolite Problem.** Sat. and Sun., May 10–11 (leave from Durango on Friday night). Mike Williams, University of Massachusetts, mw@geo.umass.edu; Karl Karstom, University of New Mexico, (505) 277-4346, kekt1@unm.edu; Peter Davis; and Joe Kopera. Max.: 40; min.: 20. Cost: $190 (includes 2 nights accommodation, plus B, L, D on Sat. and B and L on Sun.).

7. **Natural and Prehistoric Human Systems in the Canyons of the Ancients and Durango Areas.** Sponsored by GSA Archaeological Geology Division. Sat. and Sun., May 10–11. Kenneth E. Kolm, Washington State University and Argonne National Laboratory, (303) 986-1140, ext. 251, kkolm@mines.edu; Mark D. Vareni; Mona A. Charles; Mary L. Gillam; Kim Gerhardt. Max.: 27; min.: 10. Cost: $80 (2L, vans). All hikes except the last are suitable for the physically challenged.

**TECHNICAL PROGRAM**

Technical sessions will generally be 12 minutes in length with three minutes for questions. Some sessions may use a longer format. Speakers will have access to two 35mm slide projectors and screens (speakers must provide their own carousels), an overhead projector, and a PC and data projector. Speakers wishing to use digital media are restricted to PowerPoint presentations and must submit CDs prior to their sessions to test for compatibility. Speakers should also bring slides or overhead transparencies as backup. Speakers are not permitted to use their own laptops.

Poster sessions will be held in the Ballroom of the College Union Building. Poster space will be 4 x 8 feet (additional space available by request). Authors will be required to be present for at least two hours.

Complete descriptions are posted at www.geosociety.org/sectdiv/rockymtn/03rmmtg.htm.

**SYMPOSIA**

1. **The San Juan Mountains: A Dynamic Earth System.** Sponsored by the Mountain Studies Institute. Rob Blair, Fort Lewis College, Department of Geosciences, (970) 247-2703, blair_r@fortlewis.edu; and Thomas Casadevall, U.S. Geological Survey, (303) 202-4740, tcasadev@usgs.gov.

2. **Water Resources in the Rocky Mountains: A Holistic View Centered on Coupled Processes.** Jonathan Saul Caine, U.S. Geological Survey, jscaine@usgs.gov, (303) 236-1822; Shemin Ge, University of Colorado, Boulder, GES@spot.colorado.edu, (303) 492-8323.

3. **Relationships of Physical Systems to Archaeological Records and Prehistoric Cultures in the Four Corners Area.** Kenneth E. Kolm, Washington State University, Pullman, Wash., and Argonne National Laboratory, Lakewood, Colo., (303) 986-1140, ext. 251, kkolm@mines.edu; and Mary L. Gillam, independent geologist, 115 Meadow Road East, Durango, CO, (970) 259-0966, gillam@mi.net.

**THEME SESSIONS**

1. **Undergraduate Research Poster Session.** Sponsored by the Council on Undergraduate Research—Geoscience Division. This session will showcase senior theses and other undergraduate research projects. A student must be listed as the lead author and be the major preparer of the poster. For further information, contact Kim Hannula, (970) 247-7463, hannula_k@fortlewis.edu.

2. **Artful Eye in Geology: Imagem and Photography.** Ray Kenny, (970) 247-7462, kenny_r@fortlewis.edu.

3. **National Association of Geoscience Teachers Session: Classroom and Laboratory Demonstrations of Geologic Phenomena.** Fred Lohrengel, lohrengel@asu.edu.

4. **Paleontology Society Session: Regional Topics in Paleontology.**

5. **Geologic Processes in the Post-fire Environment.** Chris Wilbur, (970) 247-1488, wilbureng@frontier.net.

6. **The Western San Juan Volcanic Field, Colorado Structural Setting, Evolution, and Geomorphology.** Allen Stork, Western State College, astork@western.edu; Steve Semken, Dine College, Shiprock, N.Mex., scsemken@shiprock.ncc.cc.nm.us, (505) 368-3630.

7. **Regional Topics in Archaeogeology.** E. Craig Simmons, Department of Chemistry and Geochemistry, Colorado School of Mines, (303) 273-3644, csimmons@mines.edu.

**WORKSHOPS**

1. **Roy J. Shlemon Mentor Program in Applied Geology.** Sponsored by GSA Foundation. Thurs., May 8, 11:30 a.m.–1 p.m. Karlon Blythe, GSA, (303) 357-1036, kbleythe@geosociety.org. Free (includes lunch). This interactive and informal workshop for undergraduate and graduate students is led by practicing geoscientists and covers real-life issues such as the professional opportunities and challenges that await students after graduation. Students will receive in their registration packet a FREE LUNCH ticket to attend the Shlemon Program. However, space is limited. First come, first served.

2. **Processing and Interpretation of Satellite Imagery for Geologic Mapping.** Tues., May 6, 8 a.m.–5 p.m. Room 680, Berndt Hall, Fort Lewis College. John C. Dohrenwend, Southwest Satellite Imaging, Teasdale, Utah, (435) 425-3118, dohrenwend@rfkmtn.com. Cost: $150 (includes course notebook with sample data sets on CD-ROM and one digital Landsat TM scene on CD covering an area of the participant’s choice in the southwest U.S.). Max.: 25.

**Students:** Get a free lunch plus solid career advice. See “Workshops” (this page) for information on the Shlemon Mentor Program.
3. **Mapping Techniques using Garmin GPS and ArcView GIS.** Fri., May 9. Room 680, Berndt Hall, Fort Lewis College. Scott White, Department of Geosciences, Fort Lewis College, (970) 247-7475, white_s@fortlewis.edu. Cost: $100 (includes course notebook with GIS-ready data sets on CD-ROM). No prior experience using GIS is required.

**SPECIAL EVENTS**

- **Ice Breaker.** 6 p.m., Tues., May 6. College Union Building Ballroom.
- **Paleontological Society Luncheon and Business Meeting.** Wed., May 7, noon, College Union Building Colorado Room. Cost: $15/professionals, $12/students.
- **Annual Banquet and Business Meeting.** 7 p.m., Thurs., May 8, College Union Building Memorial Lounge. Cost: $18.
- **Rocky Mountain Section Board Meeting.** 7 a.m., Fri., May 9, Rochester Hotel.

**SPOUSE & GUEST ACTIVITIES**

The Durango area offers a variety of activities including shopping, hiking, mountain biking, white water boating, and archeological tours. Information on these and other activities is obtainable from the Durango Area Chamber Resort Association, (800) 463-8726, www.dacra.com.

**STUDENT TRAVEL**

The Rocky Mountain Section and the GSA Foundation have travel grants available for students who are presenting oral or poster papers. Students must be currently enrolled and must be Rocky Mountain GSA members. Students should contact Kenneth Kolm, Argonne National Laboratories, (303) 986-1140, ext. 251, kkolm@anl.gov.

**STUDENT AWARDS**

Awards will be given for best student oral (undergraduate or graduate) and poster (undergraduate only) presentations. To be eligible, students must be lead author and presenter and should clearly identify their abstracts as student work.

**EXHIBITS**

Exhibit space will be available at $250 per booth for commercial organizations and $100 per booth for non-profits. Contact Scott White, (970) 247-7475, white_s@fortlewis.edu.

**ACCOMMODATIONS**

The Rocky Mountain Section has arranged special rates at the following hotels. Please contact the hotels directly for reservations. Be sure to mention that you wish a Rocky Mountain GSA rate. Because Durango is a popular tourist destination, it is recommended that you make your reservations early.

- **Strater Hotel,** 699 Main Ave., (800) 247-4431. Single $109; double $119; deluxe single $129.
- **Doubletree Hotel,** 501 Camino Del Rio, (970) 247-7254. Single $59; double $69.

Those wishing to stay on campus can reserve student apartments for $16/night by contacting Lynette Mayo, (970) 247-7620, mayo_l@fortlewis.edu. These are single rooms with shared baths. Descriptions and floor plans for student accommodations (West Hall) can be viewed at www.fortlewis.edu/student_services/housing/residence_halls.htm.

**ADDITIONAL INFORMATION**

Still have questions? Contact the general chair, James Collier, (970) 247-7129, collier_j@fortlewis.edu, the technical program chair, David Gonzales, (970) 247-7378, gonzales_d@fortlewis.edu, or the field trip chair, Gary Gianniny, (970) 247-7254, gianniny_g@fortlewis.edu, or visit www.geosociety.org/sectdiv/rockymtn/03rmmtg.htm.

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**2003 GSA Section Meetings**

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<th>Cordilleran Section</th>
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<td>University of Memphis, Memphis, Tennessee</td>
<td>Westin Hotel, Halifax, Nova Scotia</td>
<td>Hotel NH Krystal, Puerto Vallarta, Mexico</td>
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<tr>
<td>Information: Dan Larsen, Dept. of Earth Sciences, University of Memphis, 421 J.M. Smith Bldg., Memphis, TN 38152, (901) 678-4358, <a href="mailto:dlarsen@memphis.edu">dlarsen@memphis.edu</a>.</td>
<td>Information: Jane Barrett, Dept. of Earth Sciences, Dalhouse University, Halifax, NS B3H 3J5, Canada, (902) 494-1473, <a href="mailto:jbarret@is.dal.ca">jbarret@is.dal.ca</a>.</td>
<td>Information: Elena Centeno-García, Instituto de Geología, Universidad Nacional Autónoma de México, Ciudad Universitaria, México, D.F. 04510, México, <a href="mailto:centeno@servidor.unam.mx">centeno@servidor.unam.mx</a>.</td>
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| North-Central Section | | Rocky Mountain Section |
| --- | --- | May 7-9, 2003 |
| March 24-25, 2003 | | Fort Lewis College, Durango, Colorado |
| Kansas City Airport Hilton, Kansas City, Missouri | Abstract deadline: January 30, 2003 | Abstract deadline: January 30, 2003 |
| Information: Raymond M. Covenev Jr., Dept. of Geosciences, 420 Flarsheim Hall, University of Missouri, 5110 Rockhill Rd., Kansas City, MO 64110-2499, (816) 235-2980, covenevyr@umkc.edu. | Information: James Collier, Dept. of Geosciences, Fort Lewis College, 1000 Rim Dr., Durango, CO 81301-3999, (970) 247-7129, collier_j@fortlewis.edu. | Information: James Collier, Dept. of Geosciences, Fort Lewis College, 1000 Rim Dr., Durango, CO 81301-3999, (970) 247-7129, collier_j@fortlewis.edu. |

1. Cordilleran Section
2. Rocky Mountain Section
3. North-Central Section
4. South-Central Section
5. Northeastern Section
6. Southeastern Section
Alternates Receive 2002 Student Research Grants

Each year when the Committee on Research Grants selects student grant recipients, it also selects an alternate group of recipients in the event that some of the grantees return part or all of their funds because they have received funding elsewhere or have changed their research plans. As the returned funds become available, they are re-awarded by the Research Grants Program Officer to the alternates named by the committee.

In 2002, seven alternates received funding following the initial awarding of grants.

They are:

- Sean Sundermann, University of Colorado
- Christopher Lopez, University of Nevada, Reno
- Philip Ong, University of Michigan
- Carl Ozyer, University of Western Ontario
- Charlotte Hedlund, San Francisco State University
- Mark Loewen, University of Utah
- Katherine Boggs, University of Calgary

GeoTrip

July 30–August 14, 2003

Co-Leaders: Timothy F. Lawton, New Mexico State University, Las Cruces, and Brenda J. Buck, University of Nevada, Las Vegas

For complete information on this fabulous GeoTrip, see the December 2002 issue of GSA Today, visit www.geosociety.org (go to “Meetings and Excursion” then to “GeoVentures”), call (303) 357-1034, or e-mail ecollis@geosociety.org.

The focus of this GeoTrip to the Kenya rift is to explore the geologic and natural history of this unique tectonic province and its associated spectacular environments, supporting a variety of bird and wildlife habitats. Participants will have the opportunity to hike and view ice-sculpted landscapes on glaciated Mount Kenya, Kenya’s highest peak, situated squarely on the equator; visit saline internally drained lakes in the rift itself; boat immense Lake Victoria, the second largest freshwater lake in the world in the topographic sag between the rift valleys; traverse the Precambrian shield on the north edge of the Serengeti Plains; explore the spectacular Ngorongoro Crater, an intra-rift caldera; visit Olduvai Gorge, the cradle of humankind; and ponder the great Kilimanjaro, Africa’s highest peak. This will be an unforgettable adventure in exotic geology and wildlife!

Fees and Payment: $5,650 for GSA members; $5,750 for nonmembers. A $500 deposit is due with your reservation and is refundable (less $300 cancellation fee) through June 1. Balance is due June 1. Fee is based on double occupancy. Single supplement, based on availability, is an additional $895. Minimum number of participants (firm): 15; maximum: 40. Included: Accommodations in twin bedded rooms; all meals on tour beginning August 1; flights within East Africa; guidebook; all tips and gratuities to drivers/guides, hotel, and camp staff; temporary membership in the Flying Doctors Service; government taxes and levies. Not included: Airfare to Nairobi and return from Tanzania; optional tours; lunch in Nairobi on August 9; entry visa fees to Kenya and Tanzania (approx. $100); alcoholic beverages; and other expenses not specifically included.
Shlemon Mentor Programs Offer Students Important Career Tips

Karlon Blythe, Program Officer

If you are a geoscience student about to earn your degree and are already worrying about paying back college loans, career tips can be pretty important. Held exclusively for undergrad and graduate students at GSA Section meetings, the Roy J. Shlemon Mentor Programs in Applied Geoscience bring volunteer mentors from various disciplines together with students for informal Q & A luncheons. Free lunches were provided by the program and the GSA Foundation.

Volunteer mentors currently practicing applied geoscience shared insights on interview techniques, professional registration, getting practical summer experience, the potential job market, and much more. This year, 26 mentors met with 284 students at meetings across the nation, exemplifying the spirit of mentoring by generously sharing their personal time, professional experiences, advice, and resources.

At the Northeastern Section Meeting in Springfield, Massachusetts, mentors were Christopher Mitchell, ENSR International, Westford, Mass., Jonathan Child, Fuss & O’Neill, Inc., West Springfield, Mass., and Lyons Witten, Color & Colantonio, South Deerfield, Mass. Thirty-five students filled the meeting room and participated in thought-provoking conversations. “The atmosphere was very relaxed and inviting, making it easy to ask questions,” remarked a student. “Opinions of managerial-level geoscientists gave me a clear perspective on the relative importance of employable skills,” noted another.

The combined Southeastern and North-Central Section meeting had the largest attendance in Shlemon program history, with 100 students attending over the two days of programs. Kitchen staff hustled, but mentors kept pace for a standing-room-only crowd. This event tapped eight mentors: Edward Woolery, John E. Kiefer; William (Drew) Andrews Jr., and John Hickman, all of the Kentucky Geological Survey, Lexington; Peter Goodmann, Kentucky Department of Environmental Protection; Elizabeth Haynes, Haley & Aldrich, Denver, Colorado; James Robertson, Wisconsin Geological Survey, Madison, Wisconsin; and Norm Hester, director of the Association of CUSEC State Geologists, Bloomington, Indiana. While the Kentucky Survey was well represented, students quickly learned that these professionals had a wealth of job experiences to share from previous employment. At meetings’ end, students said: “A rare opportunity to be able to talk to professionals on a one-on-one basis—so much better than lectures!”; “Really interesting to hear about the educational and employment histories of the mentors—learning how they got to where they are and why”; and “I appreciate the encouragement.”

Again, at the Shlemon Program for the South-Central Section Meeting in Alpine, Texas, vanloads of students jammed the meeting room and additional tables and chairs were hastily unfolded for the 63 students. Six mentors rallied to field questions from enthusiastic students: James G. Buchanan, Conoco Energy Ventures, Houston, Texas; Steve Finch, John Shomaker & Associates, Inc., Albuquerque, N.M.; Eddie Collins, Texas Bureau of Economic Geology, Austin; Bob Stottlemyer, USGS, Leverett Bogle, U.S. Army Corps of Engineers, Fort Collins, Colo., and Thomas Fouch, USGS, retired, Lakewood, Colo. Students later said: “I’ve learned a lot about the geo industry and about different options I should consider after school”; and “I appreciate the encouraging and hopeful words.”

At the Rocky Mountain Section Meeting in Cedar City, Utah, classes were out for the semester, and the campus was quiet, yet 34 eager students showed up for the Shlemon Program lunch. Six enthusiastic geoscientist mentors came ready to share advice and experience: Sue Ann Finstick; Bulloch Brothers Engineers, Cedar City, Utah; David B. Simon, Simon Bymaster, Inc., Salt Lake City, Utah; Rick Allis, Utah Geological Survey, Salt Lake City; Darlene Batatian, Salt Lake County Geologist; Janice M. Higgins, Department of Natural Resources, Utah. Students later said: “I’ve learned a lot about the geo industry and about different options I should consider after school”; and “I appreciate the encouraging and hopeful words.”

Looking for a fun experience?

We need mentors from applied geoscience to help maintain the momentum of the Shlemon Mentor Programs for spring 2003. If you’re planning to attend a GSA Section meeting and would be interested in joining enthusiastic students over a free lunch, please contact program officer Karlon Blythe, kblythe@geosociety.org, (303) 357-1036. For more information on the Shlemon Mentor Programs, visit www.geosociety.org/science/shlmindx.htm.
Resources, St. George, Utah; and John W. Rold, a consultant from Lakewood, Colo. Students said: “Great to have such personal attention”; and “Really liked the Q & A format—lots of different viewpoints.”

The Cordilleran Section meeting at Corvallis, Oregon, wrapped up the Shlemon Programs for the year. Mentors Dorian and Tom Kuper of Kuper Consulting LLC, Tualatin, Oregon, led the first day’s Shlemon program, attended by 43 students who eagerly picked up thick, bound copies of handouts provided by the Kupers. The handouts included a wealth of information on academic preparedness, challenges in securing a job, employment opportunities, employer expectations, and professional ethics and registration. The second day, the Kupers and mentor Tim Marshall, Manager of Land Planning for Morse Brothers, Inc., Tangent, Oregon, hosted a vanload of students on a field trip to Morse Brothers’ mining operation for an up-close, hands-on look at applied geoscience. One student remarked: “Not many students have the opportunity to walk onto a mining operation and see reclamation in progress.” Others commented, “The handout is just stuffed with information—thank you!” and “The Kupers alluded to issues of ethics and safety that I’ve never even thought about—what an eye-opener.”

One common refrain heard repeatedly from students was their appreciation of the mentors, Roy J. Shlemon, and GSA for providing them the opportunity to explore the real world of applied geoscience. As for the free lunches, one student succinctly captured the students’ gratitude saying “Roy ROCKS—thanks for the lunch!”

Shlemon Programs for 2003
Don’t Miss Them!

Places and dates for the spring 2003 Shlemon Mentor programs:

South-Central—Southeastern Sections Joint Meeting
Thurs. and Fri., March 13–14, 11:30 a.m.–1 p.m.
University of Memphis, Memphis, Tennessee

North-Central Section
Mon., March 24, 11:30 a.m.–1 p.m.
Kansas City Airport Hilton, Kansas City, Missouri

Northeastern Section
Thurs. and Fri., March 27–28, 11:30 a.m.–1 p.m.
Westin Hotel, Halifax, Nova Scotia

Cordilleran Section
Tues. and Wed., April 1–2, 11:30 a.m.–1 p.m.
Hotel NH Krystal, Puerto Vallarta, Mexico

Rocky Mountain Section
Thurs., May 8, 11:30 a.m.–1 p.m.
Fort Lewis College, Durango, Colorado

NEW GSA Today Schedule for 2003
This year, GSA Today will publish a combined April/May issue, with the issue scheduled to be delivered in the beginning of April. Deadlines for ads: February 20 for display ads; March 3 for classified ads.
Call for Nominations: GSA Division Awards

Funds for the following GSA Division awards are administered through the GSA Foundation.

**Don J. Easterbrook Distinguished Scientist Award**

The Quaternary Geology and Geomorphology Division of GSA seeks nominations for the Don J. Easterbrook Distinguished Scientist Award. This award will be given to an individual who has shown unusual excellence in published research, as demonstrated by a single paper of exceptional merit or a series of papers that have substantially increased knowledge in Quaternary geology or geomorphology. No particular time limitations apply to the recognized research. The recognition is normally extended to an individual, but in the event of particularly significant research by more than one person, two people may share the award. Monies for the award are derived from annual interest income from the Don J. Easterbrook Fund, administered by the GSA Foundation.

Although recognition of extraordinary prior research excellence is the principal goal of this award, it carries with it an opportunity for funding additional research. The Easterbrook Distinguished Scientist is eligible to draw funds from research from the GSA Easterbrook Fund in an amount to be determined by availability of funds. This opportunity for funding additional research by the winner is a secondary consideration of this award.

Members of the Quaternary Geology and Geomorphology Division Award Panel will evaluate nominations for the Easterbrook Award. Because the award primarily recognizes research excellence, self-nomination is not allowed. Nominees need not be members of the division. Nominations are not automatically carried forward to subsequent years, but the same individuals may be renominated.

Nominations must be accompanied by supporting documentation, including a statement of the significance of the nominee’s research, curriculum vitae, letters of support, and any other documents deemed appropriate by the nominating committee. Send nominations by April 1, 2003, to J. Steven Kite, Dept. of Geology & Geography, West Virginia University, 425 White Hall, Morgantown, WV 26506-6300, jkite@wvu.edu.

**Farouk El-Baz Award for Desert Research**

The GSA Quaternary Geology and Geomorphology Division seeks nominations for the Farouk El-Baz Award for Desert Research. This award rewards excellence in research in desert geomorphology worldwide and is intended to stimulate research in desert environments by recognizing an individual whose research has significantly advanced the understanding of the Quaternary geology and geomorphology of deserts. Although the award primarily recognizes achievement in desert research, the funds that accompany it ($10,000 in 2003) may be used for further research.

The award is normally given to one person but may be shared by two people if the recognized research was the result of a coequal partnership. Monies for the award are derived from annual interest income from the Farouk El-Baz Fund, administered by the GSA Foundation.

Any scientist from any country may be nominated for the award. Because the award recognizes research excellence, self-nomination is not permitted. Neither nominators nor nominees need be members of GSA. Nominations must be accompanied by a statement of the significance of the nominee’s research, a curriculum vitae, letters of support, and documentation of published research results that have significantly advanced the knowledge of Quaternary geology and geomorphology of desert environments.

Send nominations by April 1, 2003, to Ellen Wohl, Dept. of Earth Resources, Colorado State University, Fort Collins, CO 80523-1482, ellenw@cnr.colostate.edu.

**Laurence L. Sloss Award for Sedimentary Geology**

The Sedimentary Geology Division of GSA solicits nominations for the 2003 Laurence L. Sloss Award for Sedimentary Geology. This award is given annually to a sedimentary geologist whose lifetime achievements best exemplify those of Larry Sloss—i.e., achievements that contribute widely to the field of sedimentary geology and through service to GSA. Monies for the award are derived from annual interest income from the Laurence L. Sloss Award fund, administered by the GSA Foundation.

Nominations should include a cover letter describing the nominee’s accomplishments in sedimentary geology, contributions to GSA, and curriculum vitae. The management board of the Sedimentary Geology Division will choose the recipient from the two nominees forwarded from the nominations committee, and the award will be presented at the GSA Annual Meeting in Seattle in November.

Send nominations by March 1, 2003, to Paul Karl Link, Treasurer, Sedimentary Geology Division, via e-mail (with attachments) to linkpaul@isu.edu.

**Gilbert H. Cady Award**

The Coal Geology Division of GSA seeks nominations for the 2003 Gilbert H. Cady Award, made for outstanding contributions in the field of coal geology. As defined in the division’s bylaws, “Coal geology refers to a field of knowledge concerning the origin, occurrence, relationships, and geologic characteristics of the many varieties of coal and associated rocks, including economic implications.” The first award, established by the division in honor of Gilbert H. Cady, was presented in 1973.

Monies for the award are derived from annual interest income from the Gilbert H. Cady Memorial Fund, administered by the GSA Foundation. The award (a certificate and an engraved silver tray) will be made for contributions considered to advance the field of coal geology within and outside North America and will be presented at the Coal Geology Division Business Meeting at the 2003 GSA Annual Meeting in Seattle.

Nominations will be evaluated by the Gilbert H. Cady Award Panel and should include: name, office or title, and affiliation of nominee; date and place of birth, education, degree(s), and honors and awards; major events in his or her professional career and a brief bibliography; and outstanding achievements and accomplishments that warrant nomination.

GSA ANNOUNCES NEW GEOLOGY SCIENCE CO-EDITOR

Hugh Jenkyns of the University of Oxford joins David Fastovsky (University of Rhode Island) and Ben van der Pluijm (University of Michigan) as science co-editor for Geology this month.

Jenkyns began his research career in the late 1960s working on drowned carbonate platforms and deep-water pelagic sediments in western Sicily—an area now interpreted as a "starved" continental margin of the Mesozoic Tethys. "In those days, I considered myself a sedimentologist," Jenkyns says. "Participation in Legs 33 and 61 of the Deep Sea Drilling Project introduced me to the science of paleoceanography and my subsequent work has centered on this burgeoning field. In particular, I am interested in using isotopic tracers—particularly carbon isotopes, nitrogen isotopes, oxygen isotopes, strontium isotopes, neodymium isotopes—as both stratigraphic tools and as indicators of major global change, be it climatic, oceanographic or tectonic. I would probably now describe myself as a paleoceanographer or simply as a stratigrapher. I have taught various aspects of ‘soft-rock’ geology at the Universities of Cambridge, Durham, and Oxford."

Jenkyns sees Geology as the most stimulating non-specialist journal in the earth sciences. "During my own career, I have seen several fields within geology change from exciting and active to dull and inactive; some specialist journals have suffered the same fate," he says. "A generalist journal can always potentially fill an important role within the science. The ideal of all three editors is to make Geology the journal that regularly captures the most innovative and thought-provoking developments in our science."

When I worked for the USGS in the 1960s, I had the privilege of meeting Ralph Roberts. We tried to get a joint field-lab project started to study the geology and mineralization of the Bingham district. The project was to be funded and run by USGS personnel, but we needed access to all mining properties in the district. We failed to get agreement from the largest, the Kennecott Co., and the project died in the administrative echelons of that company. I also had the privilege of meeting Roberts’ brilliant son Steve when he was a graduate student at Harvard. With his tragic, accidental death we lost one who was destined to be a leader in our profession.

Ralph Roberts’ story weaves geology, family life, personal experiences, and professional comments in an intriguing manner. The story recounts a grand era when careful work by dedicated USGS geologists laid the groundwork by which the mining industry was maintained. I think it should be read that way—as an account of the work of many, and the role of one who was a major player who has now told his story. As I read the book, I could almost hear Ralph talking about his work and making his passionate point that an understanding of mineralization can only come with a full understanding of the geological territory in which it occurs.

I enjoyed Ralph’s story for its candor and its record of the work of a generation now passing. It’s neither great history nor great literature, but it is a great read.

Brian J. Skinner
Yale University

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GSA ANNU...
### 2003

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<th>Date</th>
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<tr>
<td>June 8-13</td>
<td>24th Annual Conference of the Society of Wetland Scientists: Wetland Stewardship—Changing Landscapes and Interdisciplinary Challenges, New Orleans, Louisiana, USA. Information: <a href="http://www.sws.org/neworleans">www.sws.org/neworleans</a>, Robert R. Twilley, Program Co-chair, Center for Ecology and Environmental Technology, University of Louisiana at Lafayette, P.O. Box 42451, Lafayette, LA 70504, USA; <a href="mailto:ceet@louisiana.edu">ceet@louisiana.edu</a>, (337) 262-1776, fax 337-262-1866.</td>
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<tr>
<td>August 10-12</td>
<td>Silver Jubilee Anniversary Meeting of the Northeastern Science Foundation. Information: Gerald M. Friedman, Northeastern Science Foundation, 15 Third St., P.O. Box 746, Troy, New York 12181-0746, USA, <a href="mailto:gmfriedman@juno.com">gmfriedman@juno.com</a>, (518) 273-3247, fax 518-273-3249, <a href="http://us.geocities.com/northeasterncsfdn">http://us.geocities.com/northeasterncsfdn</a>.</td>
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### 2004

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<tr>
<td>April 14-19</td>
<td>5th International Symposium on Eastern Mediterranean Geology, Thessaloniki, Greece. Information: Alexandros Chatzipetros, Department of Geology, Aristotle University of Thessaloniki, 54124, Greece, Tel: +30 (231) 09-98-512, fax +30 (231) 09-98-482, <a href="mailto:ac@geo.auth.gr">ac@geo.auth.gr</a>, <a href="mailto:5thSEM@geo.auth.gr">5thSEM@geo.auth.gr</a>, <a href="http://www.geo.auth.gr/5thSEM">www.geo.auth.gr/5thSEM</a>.</td>
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### NASA Voyages Online

Voyages is published three times each year and highlights programs, events and products supported by the NASA Office of Space Science, as well as the many and diverse contributions made by the space science community in support of education as a core mission of NASA.
In Memoriam

Duwayne M. Anderson
Hamilton, Washington
October 4, 2002

Donald W. Clay
Yuma, Arizona
September 25, 2002

Clifford Frondel
Winchester, Massachusetts
November 12, 2002

Robert L. Gamer
Portland, Oregon
April 20, 2002

Raymond C. Gutschick
Medford, Oregon
October 22, 2002

Jobst Hulsemann
Wentorf, Germany
November 4, 2002

Robert L. Johnston
Laguna Hills, California
September 24, 2002

Richard H. Mahard
Newark, Ohio
April 2002

Thad G. McLaughlin
Lakewood, Colorado
September 25, 2002

Maurice J. Mundorff
Tacoma, Washington
July 10, 2002

Helen L. Nace
Boise, Idaho
September 28, 2002

Walter J. Pearson
Moose Jaw, Saskatchewan, Canada

John Christian Ruckmick
Laguna Niguel, California
March 19, 2002

John M. Smith
Macon, Georgia
September 27, 2002

Russell G. Wayland
Arlington, Virginia
September 11, 2002

James F. Westcott
Mexico, Missouri
September 10, 2002

Please contact the GSA Foundation for information on contributing to the Memorial Fund.

About People

GSA Council member Richard E. Gray has been elected to Honorary Membership by the American Society of Civil Engineers. Since 1853, only 513 members of this 125,000-member organization have been so recognized.

The American Petroleum Institute bestowed its Gold Medal for Distinguished Achievement to GSA Fellow Michel T. Halbouty. This award is one of the highest and most prestigious in the petroleum industry.

The American Geological Institute (AGI) presented GSA Fellow Robert W. Ridky with the William B. Heroy, Jr. Award for Distinguished Service at the GSA Annual Meeting in Denver. The Heroy Award is presented annually to a geoscientist in recognition of outstanding service to the Institute and to the geoscience profession.

AWG Announces 2002–2003 Executive Committee

The Association for Women Geoscientists announced its 2002–2003 National Executive Committee: GSA member Mary Gillam, president; GSA Fellow Helen Delano, president elect; GSA member Dale Springer, past-president; Donna Carlson, secretary; GSA member Katherine McCarville, treasurer; GSA member Joanne Kluesendorf, editor; Lorraine Manz, assistant editor; GSA member Jane H. Gill, GAEA advertising editor; GSA member Pranoti M. Asher, publicist; and Carol Dicks, business manager.
2002 Marks the Foundation’s 22nd Year

The Foundation raised over $679,847 during fiscal year 2002 (July 1, 2001, to June 30, 2002). Of this, $329,554 were pledges for future payment.

During fiscal year 2002, the Foundation disbursed $621,341 for GSA programs, grants, and awards. These include the Mann-supported mentor programs, GeoCorps America, Shlemon Mentor Program in Applied Geoscience, Earth Science Week, Geoinicators, Geology in Government Mentor Luncheon, the Building Fund, the Student Breakfast at the annual meeting, Field Forums, Geology and Ecosystem Field Course, the BRIDGE Mentor Program, a number of GSA Distinguished Awards, matching student travel grants, Awards for Outstanding Earth Science Teachers, Field publications, Penrose Conferences, support of the Subaru Distinguished Earth Science Educator, the Evolution Conference, and a number of special division awards and programs.

The Foundation has established a long-term plan intended to raise support for the needs as identified by the GSA Council. This plan can be reviewed at www.geosociety.org/gsaf/.

The Foundation utilizes a number of trustee subcommittees to establish and achieve the Foundation’s monetary goal for GSA needs by helping to raise the funds, matching donor intent to a need, and reporting back to donors on results from their support. For example, the trustee subcommittee working on research grants is informing former grant recipients of the present-day value of their grant and asking them to make a donation for the Research Grants Program. Other Foundation subcommittees are working to support GeoCorps America, the Congressional Science Fellows, Field Forums, and the Building Maintenance Fund. To these ends, contacts have been made with potential individual supporters, and proposals for support have been submitted to a number of private and corporate foundations, and to the operating divisions of some companies whose needs could be served in part by supporting GSA.

GSA’s Education and Outreach department has completed a report on activities of the department over the past fiscal year. The Foundation has forwarded this report to our major donors to keep them up-to-date on what their contributions have accomplished.

Need a List of Foundation Funds?

Please contact the Foundation office for a complete listing of Foundation funds. This list includes a description of the purpose for each of our restricted funds. We plan to post the list at www.geosociety.org/gsaf/ very soon.

We would like to express sincere thanks to the following organizations that contributed to the Foundation as of October 2002.

- Academic Press Marketing
- Bechtel, Parsons, Brinkerhoff
- Beta Analytic, Inc.
- Blue Marble Geographics
- Brunton Company
- CARIS—Universal Systems, Ltd.
- Carolina Biological Supply Company
- CH2M Hill, Inc.
- Eakin Press
- EnSafe, Inc.
- EOG Resources, Inc.
- Estwing Manufacturing Company
- ExxonMobil Exploration Company
- Forestry Suppliers, Inc.
- Freeport-McMoRan Foundation, Inc.
- Gems & Crystals Unlimited
- Houghton Mifflin Company
- International Centre for Diffraction Data
- J.L. Darling Corporation
- Kluwer Academic Publishers
- Komodo Dragon
- Lockheed Martin Corporation
- Micromass, Inc.
- Mountain Press Publishing Company
- Panopticon Gallery
- Philips Analytical, Inc.
- Rock Detective Geoscience Education
- S.S. Papadopulos & Associates
- Sheraton Boston Hotel
- Stephany’s Chocolates
- Subaru of America, Inc.
- Thomasson Partner Associates, Inc.
- Trianco Corporation
- Ulrich’s Fossil Gallery
- Unocal Corporation
- Geoscience Laboratories
- Maine Geological Survey
- National Park Service
- New York State Geological Survey
- USDA Forest Service

A complete list of 2002 donors to the Foundation will appear in a future supplement to GSA Today.

Most memorable early geologic experience

When doing my M.S.-thesis field work, I checked on a published section contact reported “covered.” It was covered all right—by poison ivy only!

— Chester L. Dodson
STUDENT? PROFESSIONAL? TEACHER? RETIREE?

YOU CAN WORK IN A NATIONAL PARK OR NATIONAL FOREST

Apply Now for GeoCorps America
2003 Summer Positions

Summer 2003 positions are posted on the GeoCorps Web site http://rock.geosociety.org/geocorps/allJobDescriptions.asp.

Application materials must be sent to GSA and postmarked by Friday, February 7, 2003.

Examples of GeoCorps Projects

■ Research, develop, and present interpretive programs for visitors
■ Develop and lead hands-on educational activities for K–12 students
■ Excavate and prepare fossil specimens
■ Conduct stream surveys and watershed assessments
■ Monitor glacier movement
■ Assess soil compaction, trail conditions, and erosion and sedimentation
■ Map geologic features

What People are Saying About GeoCorps

“Our children did the Junior Geologist program with Angela Coleman. She did a wonderful job teaching them and us about Colorado Plateau geology. It was a highlight of our trip. It’s staff like Ms. Coleman who make trips to our national parks both pleasurable and educational.” Park visitor about Angela Coleman, 2002 participant at Capitol Reef National Park.

“What William compiled an extensive list of geologic references for the Gila National Forest and provided geologic field interpretations. He was a great benefit to the forest’s program and a good reflection of GSA and the GeoCorps America Program.” GeoCorps supervisor about William Leggett, 2002 participant at Gila National Forest.

“I educated visitors from across the nation and around the world on the geologic resources of the park. The GeoCorps Program offers students the opportunity to gain valuable professional experience, professionals a chance to complement their existing skills, and retirees the ability to give back.” 2002 participant Angela Coleman, Capitol Reef National Park.

Learn about the GeoCorps America Program at:
www.geosociety.org/science/geocorps/.
Ads (or cancellations) must reach the GSA Advertising office one month prior. For 2003, the April and May issues will be combined, deadline is March 3. Contact Advertising Department, (303) 357-1053, 1-800-472-1988, ext. 1053, fax 303-357-1073, acrawford@geosociety.org. Please include address, phone number, and e-mail address with all correspondence.

**Classification 1st month (same ad)**

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**Per Line for addt'l month**

| Additional lines | $1.85 |

**First 25 lines**

| Additional lines | $0.00 |

**Additional lines**

| Additional lines | $2.85 |

**Web Only Ads**

| Additional lines | $6.00 |

**Live link: add $25**

Agencies and organizations may submit purchase order or payment with copy. Individuals must send prepayment with copy. To estimate cost, count 54 characters per line, including all punctuation and blank spaces. Actual cost may differ if you use capitals, center, or special characters.

**DEPARTMENT OF OCEANOGRAPHY
UNIVERSITY OF HAWAI'I AT MĀNOA**

The Department of Oceanography within the School of Ocean and Earth Science and Technology at the University of Hawai'i at Mānoa invites applications for two tenure-track, full-time, 9-month positions at the Assistant/Associate Professor level to begin fall 2003, subject to position clearance.

We seek two interdisciplinary ocean/earth scientists interested in physical, chemical, biological, and geological processes, and their coupling at various time and space scales. Fields of interest include, but are not limited to, coastal physical oceanography, particulate transport and sedimentation processes in the coastal ocean, geomicrobiological processes, and global biogeochemical processes and modeling. Duties: Develop outstanding research and teaching/educational programs, including contributing to the undergraduate B.S. Degree Program in Global Environmental Science. Minimum Qualifications: Ph.D. in oceanography or related discipline; excellent communication skills; demonstrated capability/experience for creative, high quality research; demonstrated capability/experience and desire to contribute to teaching and mentoring of undergraduate and graduate students. Salary: Commensurate with qualifications and experience. Applicants should submit vita, statement of research and teaching interests, three representative publications, and addresses of three references to: Professor Fred G. Mackenzie, Search Committee Chair, Department of Oceanography, SOEST, University of Hawai'i at Mānoa, Honolulu, HI 96822, fimack@soest.hawaii.edu. Closing Date: 02/01/03.

For more information about the Department: http://www.soest.hawaii.edu/oceanoigraphy/.

**VANDERBILT UNIVERSITY
ASSISTANT PROFESSOR, DEPARTMENT OF GEOLOGY**

The Department of Geology at Vanderbilt University is accepting applications for a two-year, non-tenure-track position at the rank of Assistant Professor. Duties will include teaching structural geology and possibly one other course, as well as developing and overseeing introductory laboratories. Interested applicants should send curriculum vitae, a teaching statement, course evaluations if available, and names and contact information of three references to: Dr. Fred T. Mackenzie, Search Committee Chair, Department of Geology, 2301 Vanderbilt Place, VU Station B Box 351805, Nashville, TN 37235-1805 (structure@vanderbilt.edu). Review of applications beginning February 15, 2003.

**DEPAUW UNIVERSITY
TENURE TRACK POSITION IN EARTH AND ENVIRONMENTAL SCIENCE
WHITTIER COLLEGE**

The Department of Earth Sciences at Whittier College invites applications for a tenure-track position at the Assistant Professor level beginning August 2003, pending budgetary approval. We seek candidates with specialties in Earth surface or near surface processes and potential for excellent undergraduate teaching within Earth and Environmental Sciences as well as college-wide programs. A Ph.D. in geology or a closely related field is required. For more detailed information see www.earth-sciences.whittier.edu or contact Dr. Allan Vermilye at (562) 907-4913 or vermilye@whittier.edu. Whittier College is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.

**GEOLOGY AND GEOGRAPHY**

**DEPAUW UNIVERSITY**

**GEOLOGY.** Three-year entry-level position in Geology beginning August 2003. Rank and salary commensurate with credentials and experience. Candidates broadly trained in geosciences capable of teaching many courses from among Physical Geology, Physical Geography, Historical Geology, Environmental Geoscience, Sedimentology, Stratigraphy, Oceanography, and a geoscience-related First-Year Seminar preferred. The department is housed in newly renovated Julian Science and Mathematics Center with excellent facilities to support undergraduate teaching and research. For more information about the department, visit http://www.depauw.edu/acad/geol. DePauw has exceptional faculty development programs, including funding for conference travel and professional and curriculum development activities (see http://www.depauw.edu/admin/acadaffairs/facdev.htm). Submit letter of application, curriculum vitae, contact information for three references, transcripts, a statement of teaching interests/philosophy, and a statement of research interests to Dr. James G. Mills, Jr., Search Committee Chair, Department of Geology and Geography, DePauw University, Greencastle, IN 46135. Review of applications begins February 1, 2003 and continues until position is filled. DePauw University is an Equal Opportunity/Affirmative Action Employer. Women and minorities are strongly encouraged to apply.

**EARTH AND ENVIRONMENTAL SCIENCE**

**WHITTIER COLLEGE**

The Department of Earth Sciences at Whittier College invites applications for a tenure-track position at the Assistant Professor level beginning August 2003, pending budgetary approval. We seek candidates with specialties in Earth surface or near surface processes and potential for excellent undergraduate teaching within Earth and Environmental Sciences as well as college-wide programs. A Ph.D. in geology or a closely related field is required. For more detailed information see www.earth-sciences.whittier.edu or contact Dr. Allan Vermilye at (562) 907-4913 or vermilye@whittier.edu. Whittier College is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply.
MODFLOW, MS Excel, fate & transport modeling and ArcView GIS desirable.

Full-time, tenure-track, commencing August 2003. The Department of Earth Sciences of Millersville University of Pennsylvania seeks a qualified, enthusiastic, and engaging individual to enhance a new option in Environmental Geology. The position requires a Ph.D. in Environmental Geology or Geophysics with expertise in environmental geology and/or a closely related field. Teaching responsibilities include teaching courses in environmental geology and research methods in environmental geology. The successful candidate must have experience in teaching courses in environmental systems and the ability to teach in general education, and ability to perform and publish research. Enrolling approximately 7500 students, the University is located in historic Lancaster County within convenient traveling distance to Philadelphia, Washington, New York and the Atlantic Ocean beaches. The Department of Earth Sciences, with its nine faculty and 180 majors, offers degrees in Geology, Geography, Meteorology, and Oceanography. Applications from all qualified individuals are encouraged to self-identify in their application. Applications must include a letter of interest, current curriculum vitae, a statement of research interests, a three-page description of teaching philosophy, and three letters of recommendation. Electronic submission is encouraged. Review of applications will commence on November 15, 2002, and will continue until the position is filled.

Department Chair, Dr. Mitchell Colgan: (843-953-5589), colganm@cofc.edu. RunyonC@cofc.edu.

The College of Charleston Department of Geology is a member of the multidisciplinary Pontchartrain Sciences Alliance, a new initiative created to increase representation of equity groups (women, people of Aboriginal ancestry, visible minorities and/or people with disabilities) in research and educational programs. Interested candidates are encouraged to self-identify in their application.

GANNON UNIVERSITY, ENVIRONMENTAL SCIENCE & ENGINEERING

Gannon University, a Catholic University located in Erie, Pennsylvania, invites applications for a tenure-track position as Assistant Professor for the Environmental Science & Engineering, slated to begin August 2003. The successful candidate is required to have a B.S. in Environmental Engineering or the equivalent, an earned doctorate in Civil/Engineering specializing in geo-environmental engineering; licensure as a Professional Engineer or progress toward licensure is required. Professional experience in the practice of geo-environmental engineering is preferred, and must have training and interest in applied aspects of geo-environmental remediation, soil and groundwater pollution modeling, storm restoration, and/or brown field site characterization. Will teach undergraduate earth science and engineering courses, such as geology, soil science/mechanics, fluid mechanics, hydraulic design, and/or graduate geo-environmental courses. Must hold a Ph.D. when appointed. Appointment will be at the Assistant Professor level. Interested individuals may contact the Search Committee, Department in its participation in a new interdisciplinary initiative in environmental studies. The Department plans to participate in a joint Ph.D. program in environmental science with the Department of Civil and Environmental Engineering to augment an existing Master’s program. The Department and the University emphasize excellence in research and teaching at all levels.

Interested individuals may contact the Search Committee at: EESearch@vanderbilt.edu, or Calvin Miller (Search Chair) at (615) 322-2322 or calvin.miller@vanderbilt.edu. Send applications to: Search Committee, Earth and Environmental Sciences, Vanderbilt University, Station B 351805, Vanderbilt University, Nashville, TN 37235-1803. Applications should include a CV and three letters of reference. Individuals wishing to have their names removed from consideration (inform us if you prefer to make initial contact with Search Committee) are encouraged to self-identify in their application. Applications that encourage diversity and invites women and members of minorities to apply are especially encouraged.

Applications will be accepted until the position is filled. Application screening began 11/4/02 and will continue until the position is filled.

Assistant Professor, Department of Geography, Geology and the Environment

Slippery Rock University is seeking a candidate for a tenure-track position in the Department of Geography, Geology and the Environment at the Assistant Professor rank starting Fall 2003. The Department offers programs in geography, geology, and environmental science and studies with approximately 120 undergraduate majors. The successful candidate is expected to contribute to the undergraduate curriculum in environmental and physical geography, upper level courses in mineralogy and petrology and potential development of advanced courses in hydrology on selected campuses.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. The University of Saskatchewan seeks to increase representation of equity groups (women, people of Aboriginal ancestry, visible minorities and/or people with disabilities) in research and educational programs. Interested candidates are encouraged to self-identify in their application.

Assistant Professor, Environmental Science & Engineering

Gannon University, a Catholic University located in Erie, Pennsylvania, invites applications for a tenure-track position as Assistant Professor for the Environmental Science & Engineering, slated to begin August 2003. The successful candidate is required to have a B.S. in Environmental Engineering or the equivalent, an earned doctorate in Civil/Engineering specializing in geo-environmental engineering; licensure as a Professional Engineer or progress toward licensure is required. Professional experience in the practice of geo-environmental engineering is preferred, and must have training and interest in applied aspects of geo-environmental remediation, soil and groundwater pollution modeling, storm restoration, and/or brown field site characterization. Will teach undergraduate earth science and engineering courses, such as geology, soil science/mechanics, fluid mechanics, hydraulic design, and/or graduate geo-environmental courses. Must hold a Ph.D. when appointed. Appointment will be at the Assistant Professor level. Interested individuals may contact the Search Committee, Department in its participation in a new interdisciplinary initiative in environmental studies. The Department plans to participate in a joint Ph.D. program in environmental science with the Department of Civil and Environmental Engineering to augment an existing Master’s program. The Department and the University emphasize excellence in research and teaching at all levels.

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Assistant Professor, Environmental Science & Engineering

Gannon University, a Catholic University located in Erie, Pennsylvania, invites applications for a tenure-track position as Assistant Professor for the Environmental Science & Engineering, slated to begin August 2003. The successful candidate is required to have a B.S. in Environmental Engineering or the equivalent, an earned doctorate in Civil/Engineering specializing in geo-environmental engineering; licensure as a Professional Engineer or progress toward licensure is required. Professional experience in the practice of geo-environmental engineering is preferred, and must have training and interest in applied aspects of geo-environmental remediation, soil and groundwater pollution modeling, storm restoration, and/or brown field site characterization. Will teach undergraduate earth science and engineering courses, such as geology, soil science/mechanics, fluid mechanics, hydraulic design, and/or graduate geo-environmental courses. Must hold a Ph.D. when appointed. Appointment will be at the Assistant Professor level. Interested individuals may contact the Search Committee, Department in its participation in a new interdisciplinary initiative in environmental studies. The Department plans to participate in a joint Ph.D. program in environmental science with the Department of Civil and Environmental Engineering to augment an existing Master’s program. The Department and the University emphasize excellence in research and teaching at all levels.

Interested individuals may contact the Search Committee at: EESearch@vanderbilt.edu, or Calvin Miller (Search Chair) at (615) 322-2322 or calvin.miller@vanderbilt.edu. Send applications to: Search Committee, Earth and Environmental Sciences, Vanderbilt University, Station B 351805, Vanderbilt University, Nashville, TN 37235-1803. Applications should include a CV and three letters of reference. Individuals wishing to have their names removed from consideration (inform us if you prefer to make initial contact with Search Committee) are encouraged to self-identify in their application. Applications that encourage diversity and invites women and members of minorities to apply are especially encouraged.

Applications will be accepted until the position is filled. Application screening began 11/4/02 and will continue until the position is filled.

Assistant Professor, Department of Geography, Geology and the Environment

Slippery Rock University is seeking a candidate for a tenure-track position in the Department of Geography, Geology and the Environment at the Assistant Professor rank starting Fall 2003. The Department offers programs in geography, geology, and environmental science and studies with approximately 120 undergraduate majors. The successful candidate is expected to contribute to the undergraduate curriculum in environmental and physical geography, upper level courses in mineralogy and petrology and potential development of advanced courses in hydrology on selected campuses.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. The University of Saskatchewan seeks to increase representation of equity groups (women, people of Aboriginal ancestry, visible minorities and/or people with disabilities) in research and educational programs. Interested candidates are encouraged to self-identify in their application.

Assistant Professor, Environmental Science & Engineering

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Applications will be accepted until the position is filled. Application screening began 11/4/02 and will continue until the position is filled.
The University of Pennsylvania is an equal-opportunity employer. Women and minorities are encouraged to apply.

**GEOPHYSICS/REMOTE SENSING/EARTH SYSTEM SCIENCE UNIVERSITY OF ILLINOIS AT CHICAGO (UIC)**

The Department of Earth and Environmental Sciences at UIC seeks a geophysicist for a tenure-track appointment to begin August 2003 at the Assistant Professor level. Specific areas of interest include atmospheric science, bioclimatic modeling, remote sensing, hydrology, oceanography, structural geology, and seismology. Preference will be given to candidates with expertise in the broad area of remote sensing, who can help bridge existing strengths in geochronology, geophysics, geology, meteorology, and surficial processes. The Department is an expanding, dynamic unit with a growing emphasis on integrative research approaches.

The successful candidate will be expected to establish a significant, externally funded research program and to teach effectively at undergraduate and graduate levels. The Department has extensive laboratories for earth-scientific research, including advanced computational resources and electronic visualization capabilities. Further information about programs in the Department of Earth and Environmental Science at the University of Illinois at Chicago may be sought at www.geology.uchicago.edu.

Applicants should submit statements of research and teaching interests, CV, and contact information for four professional references to: S. L. Forman (Search Chair), Department of Earth and Environmental Sciences, University of Illinois at Chicago, 845 West Taylor Street, MC-350, Chicago, IL 60607-7325. Applications should be received by January 15, 2003, although the search will remain open until the position is filled.

**STABLE ISOTOPE RATIO FACILITY UNIVERSITY OF ARKANSAS**

The Department of Geology and Geophysics at Boston College invites applications for the Joseph P. Obering Postdoctoral Fellowship. Applicants should have expertise in mineralogy and petrology. Classroom and field teaching experience is desired. Successful performance in an on-campus interview, including teaching and research presentations, is required.

Applicants must have a Ph.D. at the time of application. Send a letter of interest, curriculum vitae, statement of research and teaching interests, graduate and undergraduate transcripts (official transcripts needed before hiring), and the names, addresses (postal and e-mail) and phone numbers of three references to: Dr. Patricia A. Campbell, Geoscience Search Chair, C/o Dept. of Geology, Geology and the Environment, Slippery Rock University, Slippery Rock, PA 16057, Ph. 724-738-4405, Email: patricia.campbell@sru.edu.

Review of applications will begin Jan. 15, 2003 and continue until position is filled. TTY #711-738-4881 Visit our web site at www.sru.edu. AA/EEO.

**ENVIRONMENTAL GEOSCIENCE UNIVERSITY OF PENNSYLVANIA**

The Department of Earth and Environmental Science at the University of Pennsylvania invites applications for an assistant professorship in environmental geoscience. The research interests of the candidate should complement and broaden established research programs in the Department.

The Department has extensive laboratories for earth-scientific research, including advanced computational resources and electronic visualization capabilities. The successful candidate will be expected to establish an active research program while teaching graduate courses in surface processes and graduate courses in environmental studies, geology, paleobiology, and oceanography.

Further information about programs in the Department of Earth and Environmental Science at the University of Pennsylvania may be sought at www.sas.upenn.edu.

Applicants should submit resumes, statements of research and teaching interests, and a selection of repre- sentative reprints to: Professor Robert Giegerich, Environmental Geoscience Search Committee, Department of Earth and Environmental Science, University of Pennsylvania, Philadelphia, PA, 19104-6316 USA, earth@sas.upenn.edu.

The Search Committee will begin to evaluate applications in January 2003; the search will remain open until the position is filled.

**U.S. GEOLOGICAL SURVEY MENDENHALL POSTDOCTORAL RESEARCH FELLOWSHIP PROGRAM**

The U.S. Geological Survey (USGS) invites applications for the Mendenhall Postdoctoral Research Fellowship Program for Fiscal Year 2004. The Mendenhall Program provides an opportunity to work in association with selected members of the USGS professional staff. Through this Program the USGS will acquire current experience in science to assist in the development of the science strategy of its programs. The Program is also intended to provide research fellows with experiences that advance their personal science skills and accomplishments. Fiscal Year 2004 begins in October 2003.

Opportunities for research are available in a wide range of areas including: microbiological characterization of soils; modeling post-wildfire sediment transport; geo- logic controls on low-rank coal gas; quantifying coastal hazard vulnerability; debris flows; estimation of environmental change using stable isotope and plant morphol- ogy; influence of scales in land surface characterization, process studies and modeling; statistical study of mag- netic field variations for mapping of hazardous effects; remotely triggered seismicity at Alaskan volcanoes; water-organic matter interactions; sea level variations; seismology; influence of scales in land surface characterization, process studies and modeling; statistical study of mag- netic field variations for mapping of hazardous effects; remotely triggered seismicity at Alaskan volcanoes; water-organic matter interactions; sea level variations; seismology; hazard vulnerability; debris flows; estimation of environmental change using stable isotope and plant morphol- ogy; 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Wiess Visiting Professorship
Rice University
Department of Earth Science

We invite applications for the Wiess Visiting Professorship in Earth Science. We particularly encourage scientists in fields allied with our department’s focus areas: computational geophysics, seismology, tectonophysics, tectonics, geochemistry, sedimentology and global change. The visiting professor funds provide one semester of salary for a visitor to conduct research at Rice, and can be used to extend a normal sabbatical leave. A research stipend is also provided. The Professorship is available for the 2003-2004 academic year.

Information on the Department of Earth Science and the Center for Computational Geophysics can be found at http://terra.rice.edu.

Please send a resume to: Chair, Wiess Visiting Professorship Committee, Department of Earth Science, MS-126, Rice University, PO Box 1892, Houston, TX 77251-1892. Rice is an equal opportunity affirmative action employer.

Opportunities for Students
Ph.D. Student Assistantships. Oregon State and Portland State Universities are offering fifteen Ph.D. research assistantships to explore all aspects of the Earth’s subsurface microbial biosphere. Tuition and stipend are provided by the NSF IGERT program and the two universities. Students will work in interdisciplinary teams of engineers, oceanographers, microbiologists, microbial ecologists, geologists, soil scientists, and chemists to solve environmental problems, to understand global chemical cycles, and to determine the impact of subsurface microorganisms on surface ecosystems. More information can be found at: http://oregonstate.edu/dept/igert, or Martin R. Fisk, College of Oceanic and Atmospheric Sciences, Oregon State University, mfsisk@coas.oregonstate.edu. Students from all scientific backgrounds are encouraged to apply to departments represented by IGERT faculty at either institution. U.S. citizens or permanent residents can be supported by IGERT funds, however students of all nations can participate in the program. Review of applications starts 2/1/02. Oregon State and Portland State Universities are committed to equality in education.

Graduate Student Opportunities in Surface Processes, University of Michigan. The University of Michigan, Department of Geological Sciences welcomes applications from students interested in pursuing a M.S. or Ph.D. in the general field of surface processes. The Earth surface processes research group investigates the interaction between climate, tectonics, and topography. Students with interests in the hundred-thousand to million-year time scale topographic and structural evolution of active mountain ranges are encouraged to contact Dr. Todd Ehlers (tehlers@umich.edu). Research in the group provides an opportunity to acquire skills in one or more of the following areas: (1) low-temperature thermochronometry, (2) thermal, mechanical, and surface process modeling, (3) GIS and remote sensing, and 4) field work (mapping and thermal chronometer sample collection). See http://www.geo.lsa.umich.edu/~tehlers for additional information. Students with backgrounds in physics, mathematics, and computer sciences are also encouraged to apply. Tuition waivers, fellowships, and teaching and research assistantships are available to qualified students. The deadline for applications is January 15, 2003.

Environmental and Engineering Geosciences/M.S. The Department of Geology at Radford University has funded opportunities for M.S. students to study a variety of topics in applied geology, including physical and chemical hydrogeology, groundwater modeling, contaminant transport, soil and rock mechanics, engineering geophysics, and geographic information systems. Interested students are encouraged to contact: Dr. Stephen W. Lenhart (lenhart@radford.edu), P.O. Box 6939, Department of Geology, Radford University, Radford, VA 24142-6939. Additional information about this graduate program can be found at http://www.radford.edu/~gsci/web/grad.htm. Radford University is an equal opportunity, affirmative action employer. Minorities and women are encouraged to apply.
ASSISTANT PROFESSOR IN PETROLEUM GEOLOGY  
Department of Earth Sciences

The Department of Earth Sciences at Simon Fraser University (SFU) invites applications for a tenure track faculty position at the Assistant Professor level in Petroleum Geology, commencing September 1, 2003 and subject to final budgetary approval by the University. A PhD is required at the time of the appointment, and previous experience in research, teaching and/or industry is desirable. We are seeking someone with a strong background in geology and geological methods relevant to hydrocarbon exploration and reservoir evaluation. A candidate with skills in the evaluation of carbonate reservoirs would be an ideal addition to our department, although this is not a requirement. Knowledge of petrophysics and multiphase flow would be advantageous.

The successful candidate will be expected to develop and maintain both an innovative, externally funded research program, and an excellent teaching record at both the undergraduate and graduate levels. The successful candidate will also develop strong collaborative ties with the oil and gas industry. Teaching responsibilities will include introductory and advanced undergraduate courses in Petroleum Geology, and a graduate level course in the appointee’s field of expertise. Eligibility for registration as a Professional Geoscientist (P.Geo) with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) is desirable.

For additional information about this position, see http://www.sfu.ca/earth-sciences/

All qualified candidates are encouraged to apply, however, Canadian Citizens and permanent residents will be given priority. Simon Fraser University is committed to an equity employment program that includes special measures to achieve diversity among its faculty and staff. We therefore particularly encourage applications from qualified women, aboriginal Canadians, persons with disabilities, and members of visible minorities.

Applicants are requested to submit a curriculum vitae, a statement of research and teaching interests, and the names, addresses, phone numbers and/or fax numbers, and email addresses of three referees. Applications or requests for further information should be directed to: Dr. D. Stead, Chair, Department of Earth Sciences, Simon Fraser University, 8888 University Drive Burnaby, BC. V5A 1S6. Phone: 604-291-4657. Fax: 604-291-4198. Email: dstead@sfu.ca

Review of applications will begin February 17, 2003. Search will remain open until the position is filled.

ASSISTANT PROFESSOR IN QUATERNARY GEOSCIENCE/ENGINEERING GEOLOGY  
Department of Earth Sciences

The Department of Earth Sciences at Simon Fraser University invites applications for a tenure track Assistant Professor in Quaternary Geoscience or Engineering Geology commencing September 1, 2003 and subject to final budgetary approval by the University. A PhD is required at the time of the appointment, and previous experience in research, teaching and/or industry is desirable. It is expected that the research activities of the successful candidate will complement those of researchers within the Department.

The successful candidate will be a key member of Simon Fraser University’s new Centre for Natural Hazards Research and will develop strong collaborative ties with faculty in the several departments and schools at SFU, with scientists in the federal and provincial government, and with the private sector. Past experience in one or more fields of natural hazard research is desirable. An ability to convey critical geohazard information to the public and government officials is essential. The successful candidate will supervise both graduate and undergraduate students. Teaching responsibilities will include undergraduate level courses in the areas of Quaternary Geology or Engineering Geology, Geomorphology, Natural Hazards, field school, and a graduate course in the appointee’s field of expertise. Eligibility for registration as a professional geoscientist (P.Geo) with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) is desirable.

For additional information about this position, see http://www.sfu.ca/earth-sciences/

All qualified candidates are encouraged to apply, however, Canadian Citizens and permanent residents will be given priority. Simon Fraser University is committed to an equity employment program that includes special measures to achieve diversity among its faculty and staff. We therefore particularly encourage applications from qualified women, aboriginal Canadians, persons with disabilities, and members of visible minorities.

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