Philadelphia 2006 Meeting Wrap-Up, p. 12

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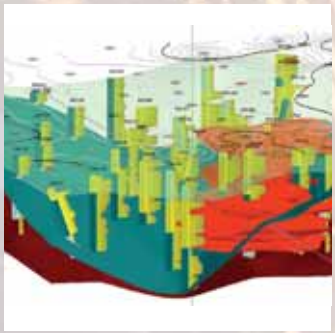

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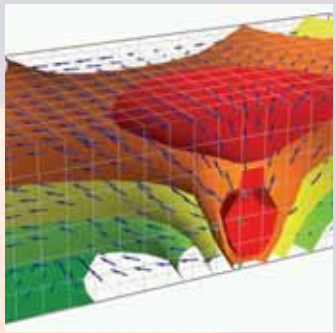

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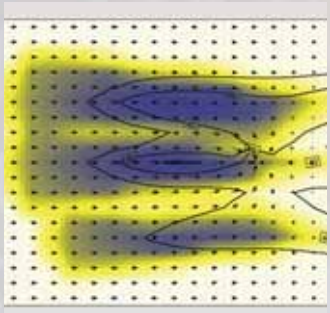

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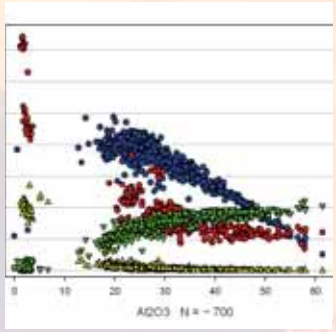

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Cover: Freshly extruded mud at a small mud cone (gryphon) on the surface of a mud volcano near Gobustan, eastern Azerbaijan. Photo by Robert Evans. See "Birth of a mud volcano: East Java, 29 May 2006," by Richard J. Davies et al., p. 4–9.

SCIENCE ARTICLE

Birth of a mud volcano: East Java, 29 May 2006

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ABSTRACT

On 29 May 2006, an eruption of steam, water, and, subsequently, mud occurred in eastern Java in a location where none had been previously documented. This "pioneer" mud eruption (the first to occur at this site) appears to have been triggered by drilling of overpressured porous and permeable limestones at depths of ~2830 m below the surface. We propose that the borehole provided a pressure connection between the aquifers in the limestones and overpressured mud in overlying units. As this was not protected by steel casing, the pressure induced hydraulic fracturing, and fractures propagated to the surface, where pore fluid and some entrained sediment started to erupt. Flow rates remain high (7000–150,000 m^3 per day) after 173 days of continuous eruption (at the time of this writing), indicating that the aquifer volume is probably significant. A continued jet of fluid, driven by this aquifer pressure, has caused erosion and entrainment of the overpressured mud. As a result, we predict a caldera will form around the main vent with gentle sag-like subsidence of the region covered by the mud flow and surrounding areas. The eruption demonstrates that mud volcanoes can be initiated by fracture propagation through significant thicknesses of overburden and shows that the mud and fluid need not have previously coexisted, but can be "mixed" within unlithified sedimentary strata.

INTRODUCTION

Understanding how Earth recycles elements, compounds, minerals, or even sediment is a major scientific quest, which transcends several disciplines, including chemistry, biology, and earth science. In sedimentary geologic systems, the cycle time can be particularly significant. For instance, the burial of sediment (and pore fluid) to depths in excess of 5 km, and their remobilization and transport back to Earth's surface, can take millions to tens of millions of years (e.g., Kopf et al., 2003). One prerequisite for this long-term recycling process is the development of elevated pore fluid pressure (overpressure). The excess fluid provides the required energy for the breach of seals and for the transport of a fluid-sediment mix back to the surface, where it is redeposited as sediment (e.g., Stewart and Davies, 2006; Deville et al., 2006). Mud volcano systems are one of the many expressions of this process, and many have been documented globally (Kopf, 2002; Milkov, 2000). Significant eruptive edifices can develop, which are often grossly similar in form to their more intensively studied igneous counterparts (Stewart and Davies, 2006), although substantially smaller. However, many of the fundamental processes involved in the recycling of buried fluid and sediment through mud volcano systems are poorly understood, and studies are still in their infancy. Elementary questions remain; for instance: (a) Do the fluid and mud come from the same beds, or is the fluid transported from deeper levels into mud source beds where mud is entrained? (b) How is the plumbing system that feeds mud and fluid to the surface initiated and sustained? and (c) What is the three-dimensional architecture of the feeder systems and how do they evolve through time?

On 29 May 2006, a mud eruption was observed in the Porong subdistrict of Sidoarjo in eastern Java (Fig. 1). At the time of this writing, the erupted mud pool (a) has a volume of ~0.012 km^3, (b) covers an area of ~3.6 km^2 and is up to ~10 m thick, (c) has buried 4 villages and 25 factories, and (d) displaced 11,000 people. There have been 13 fatalities as a result of the rupture of a natural gas pipeline that lay underneath one of the holding dams built to retain the mud. The eruption has unofficially been named "Lusi" (**Lu**mpur "mud" **Si**doarjo), and this name is adopted here. It occurred during the drilling of a nearby exploration borehole (Banjar Panji-1); therefore, in this case several factors (e.g., pressure, depth, stratigraphy) that are normally not constrained in natural mud volcano systems are calibrated. Although we propose that Lusi is man-made, it does offer a unique opportunity to address the mechanisms of initiation and maintenance of a mud volcano. The aims of this paper are to consider why the eruption occurred, compare it to other natural examples, and evaluate what we can learn about how mud volcano systems work.

MUD VOLCANO SYSTEMS

Mud volcanoes are common on Earth (Milkov, 2000), but particularly so in compressional tectonic belts (e.g., Azerbaijan:

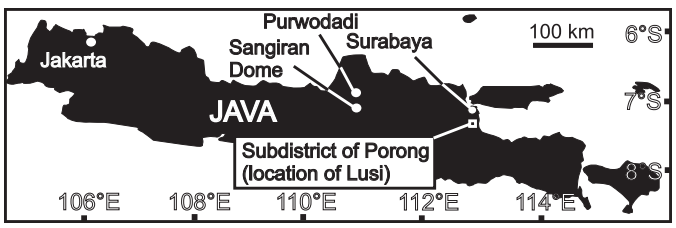

Figure 1. Map of Java, showing the location of the eruption in the Porong subdistrict and Purwodadi and Sangiran Dome, where other mud volcanoes have been documented.

GSA Today: v. 17, no. 2, doi: 10.1130/GSAT01702A.1

Planke et al., 2003; Indonesia: Ware and Ichram, 1997), within deltas (e.g., Mississippi: Neurauter and Bryant, 1990), and submarine slopes undergoing gravitationally driven detachment (e.g., Niger delta: Graue, 2000). The volcanoes can be long-lived features, composed of a series of mud "cones," which indicate a pulsed eruptive history (Evans et al., 2007) that can occur over 10^4–10^6 yr time spans.

The term "mud volcano system" was coined by Stewart and Davies (2006) to describe the set of structures associated with a constructional edifice (mud volcano) and feeder complex that connects the volcano to its source stratigraphic unit (Fig. 2A). The system is driven by pressure and a source of fluid, which may or may not coexist with mud source beds (see Deville et al., 2003). Above the fluid source is a feeder conduit (Fig. 2B), the detailed structure of which is largely unknown. It probably consists of a complex system of fractures and mud-filled dykes (Fig. 2C) that feed a fluid-sediment mix to Earth's surface (e.g., Morley, 2003). The fluid-sediment mix then erupts to form the "mud volcano"—a term we only use to describe the edifice (Fig. 2D).

The plumbing of mud volcano systems is poorly constrained. For instance, the mud and fluid could coexist at the time of initiation, analogous to magma (e.g., Davies and Stewart, 2005), or the fluid could be transported from a deeper source, remobilizing mud at shallower stratigraphic levels (Deville et al., 2003; Kopf et al., 2003; You et al., 2004). Some mud volcano systems are thought to comprise multiple mud chambers at different stratigraphic levels (Deville et al., 2003; Planke et al., 2003) whereas other models propose that mud volcano systems comprise significant masses of mud, in the form of bulbous-shaped diapirs (Brown, 1990; Milkov, 2000).

A "pioneer mud volcano" (e.g., Fig. 2A) is a term used by Davies and Stewart (2005) to describe the first mud volcano that erupts in a location where no mud volcano system previously existed. They envisage that if a substantial mud volcano develops, a positive feedback loop can become established where subsidence of the overburden due to loading, conduit wall-rock erosion, and volume loss at depth causes new fractures and faults to form in the overburden stratigraphy. These structural apertures provide new pathways for a fluid-mud mix.

GEOLOGIC SETTING

The East Java basin is an inverted extensional basin (Matthews and Bransden, 1995). It comprises a series of east-west–striking half-graben that were active in extension during the Paleogene and reactivated in compression during the early Miocene to Recent. The Oligo-Miocene to Recent basin was filled with shallow marine carbonates and marine muds, some of which are known to be "overpressured" (see Osborne and Swarbrick, 1997). As a result of the compressional inversion, these strata are gently folded with normal and reverse faults cutting the inversion anticline crests (see Matthews and Bransden, 1995). A small section of one of these east-west–trending anticlines was targeted by the Banjar Panji-1 exploration well.

Mud volcanoes have been documented before in East Java. For example, they are found within the crest of the Sangiran Dome (part of one of the east-west–trending Neogene folds: Watanabe and Kadar, 1985) and near Purwodadi, which is 200 km west of Lusi (Fig. 1). Overpressured lower Miocene clays probably equivalent to the Tuban or Tawun Formations (similar age to the Kujung limestone—see Matthews and Bransden,

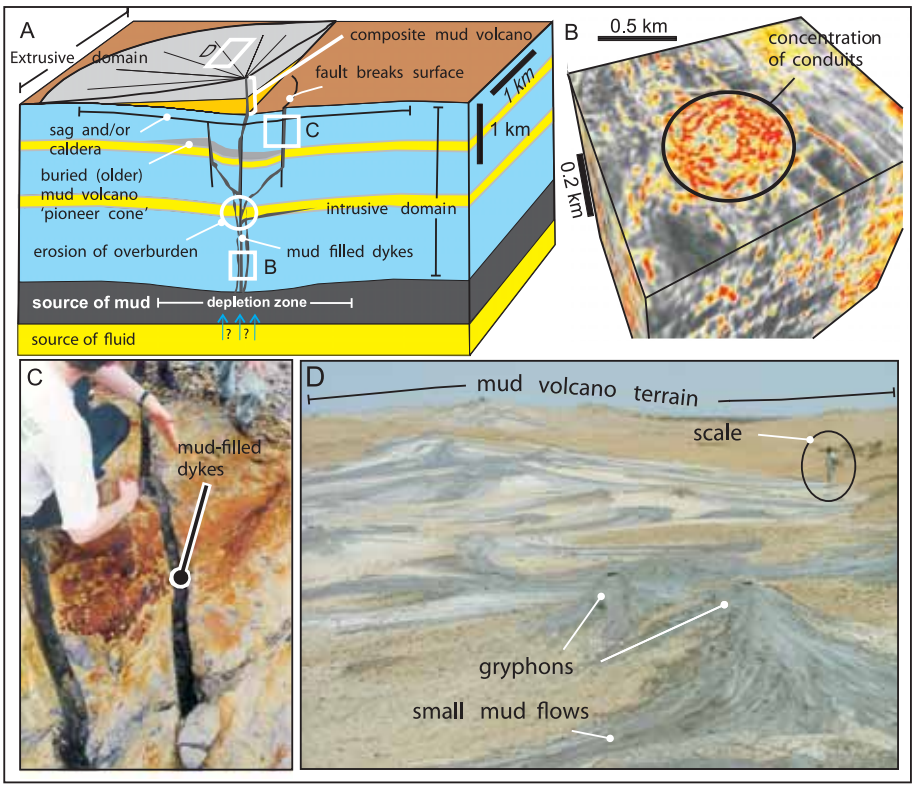

Figure 2. Components of a mud volcano system revealed by three-dimensional seismic data and outcrop. (A) Schematic illustration of the main components of a mud volcano system. Mud volcano systems can be divided into intrusive and extrusive structural domains. Fluid may either coexist with the mud source or enter from a deeper source (blue arrows) causing remobilization of shallower mud and entrainment of other overburden lithologies. The mud-fluid mix is transported through fractures and faults to the surface, where stacked cones form due to episodic eruptive and quiescent periods. (B) Seismic coherency cube (see Bahorich and Farmer, 1995) across the Gunashli mud volcano (South Caspian Sea, from Davies and Stewart, 2005), showing feeder conduits, the detailed internal structure of which is unknown. (C) Mud-filled dykes from the Jerudong anticline in Brunei (see Morley, 2003). These types of mud-filled fractures are potentially what allow for the transport of the mud-fluid mix to the surface. (D) Photograph of mud volcano terrain from Azerbaijan comprising several gryphons from which small mud flows emanate.

1995) and the Upper Kalibeng Formation are considered to be the source of the mud (Watanabe and Kadar, 1985).

OBSERVATIONS

Volumes, Rates, and Dimensions

The typical eruption volume, duration, rate, spatial extent, and aspect ratio of selected naturally occurring mud volcanoes can be compared to Lusi (Tables 1 and 2, respectively). These comparisons show that the Lusi eruption has a significant volume, duration, and spatial extent. The average eruption rate is not particularly high. Lusi has an anomalously high aspect ratio (Table 2). It is also worth noting that long-lived mud volcanoes that consist of several cones that develop as a result of multiple eruptive and non-eruptive developmental stages (Evans et al., 2007) are known to have volumes of up to ~22.5 km^3—dwarfing the current but still highly active Lusi edifice (Stewart and Davies, 2006).

Key Events and Subsurface Data

Banjar Panji-1 was an exploration well that was targeting gas within Oligo-Miocene age Kujung Formation carbonates within the East Java Basin. The well reached a depth of 2834 m, after which an eruption of steam, water, and a minor amount of gas was observed at 5:00 a.m. on 29 May 2006, 200 m southwest of the well. On the second and third of June 2006, two further eruptions started 800–1000 m to the northeast of the well, but both of these stopped on 5 June 2006 (United Nations Final Technical Report, 2006). It is reported by local villagers that the water-mud mix at the surface had a temperature of 70–100 °C; a continuous plume of steam seen on early to recent photographs of the eruption supports such high temperatures. An earthquake of magnitude 6.3 occurred at 5:54 a.m. local time on 27 May 2006, with an epicenter 280 km west-southwest of the Lusi eruption, near Yogyakarta (U.S. Geological Survey, 2006). The eruption of a dilute mud-water mix has persisted from the site of the initial eruption, and mud now covers an area of ~3.6 km^2 (Fig. 3).

Unreleased geologic data (lithological log, biostratigraphic determinations, gamma ray, sonic, density logs) indicate that the well drilled the following (shallowest first): (a) the Pleistocene age Pucangan and Kabuh Formations, (b) then ~1000 m of overpressured muds with some sand interbeds (the Upper Kalibeng Formation [Pleistocene age]), (c) ~1300 m of interbedded sands and muds, and finally (d) the well penetrated a limestone (presumed to be the Kujung Formation), which was also overpressured. There was no casing set between the bottom of the hole (the Kujung Formation) and ~1743 m of the overburden, including part of the 1000 m of overpressured Upper Kalibeng Formation mud and the entire 1300 m of interbedded muds and sands (Fig. 4A). We know that (a) in the Banjar Panji-1, the pore pressures at 2130 m (700 m above the Kujung limestone) are 38 MPa (5500 psi); and (b) that in a well 5 km away called Porong-1, the pressure within the Kujung limestone aquifer was 48 MPa (6970 psi) at 2597 m.

VOLCANO INITIATION

Model

Given the pore pressure of 38 MPa (5500 psi) at 2130 m in the Banjar Panji-1 well, we calculate an overpressure of 16 MPa (2300 psi) at this depth. In the Porong-1 well, we use the pressure of 48 MPa (6970 psi) at 2597 m to calculate an overpressure of 21 MPa within the Kujung limestone. On the assumption that the Kujung limestone is a regional aquifer (which seems likely given the high continuous flow rates at Lusi), we predict the overpressure was ~21 MPa at the base of the Banjar Panji-1 at 2830 m.

We propose that the drilling of the overpressured Kujung limestone caused an influx of pore fluid into the well bore (known as a "kick"). The well bore itself provided the pressure connection from the limestone to any shallower aquifers as well as the overpressured muds of the Upper Kalibeng Formation. The eruption started with steam and water, and this did not come to the surface through the well bore, but instead took place 200–1000 m away (Fig. 4B). Therefore, the transport route for the steam and mud was not through the wellbore but through the surrounding overburden. High pore-pressure causes natural hydraulic fracturing of the sedimentary overburden (see Engelder, 1993) when pore pressures exceed the

TABLE 1. VOLUME, DURATION, AERIAL COVERAGE, AND RATES OF SELECTED LARGE-SCALE MODERN ERUPTIONS FROM THE SOUTH CASPIAN SEA AND TRINIDAD COMPARED TO LUSI*

	Lokbatan (Azerbaijan, 2001)	Koturdag (Azerbaijan, 1950–present)	Piparo (Trinidad, 2001)	Lusi (East Java, 2006)
Volume	0.0003 km^3	0.00045 km^3	0.025 km^3	0.012 km^3
Duration	30 minutes	18,200 days	1 day	173 days
Area	0.098 km^2	0.3 km^2	2.5 km^2	3.6 km^2
Average rate†	0.0144	0.000000025	0.025	0.00007–0.0015

*The duration of the Lusi eruption is at the time of this writing.
†km^3 per day.

TABLE 2. ASPECT RATIOS* FOR MUD VOLCANOES FROM THE SOUTH CASPIAN SEA AND LUSI†

	Gunashli (South Caspian Sea)	Lokbatan (Azerbaijan)	Sangachal (Azerbaijan)	Chirag (South Caspian Sea)	Lusi
Aspect ratio	16:1	30:1	14:1	40:1	250:1

Note: For more detail, see Stewart and Davies (2006) and Evans et al. (2007).
*Width/height.
†The aspect ratio could have been far higher—the mud was contained by man-made dams.

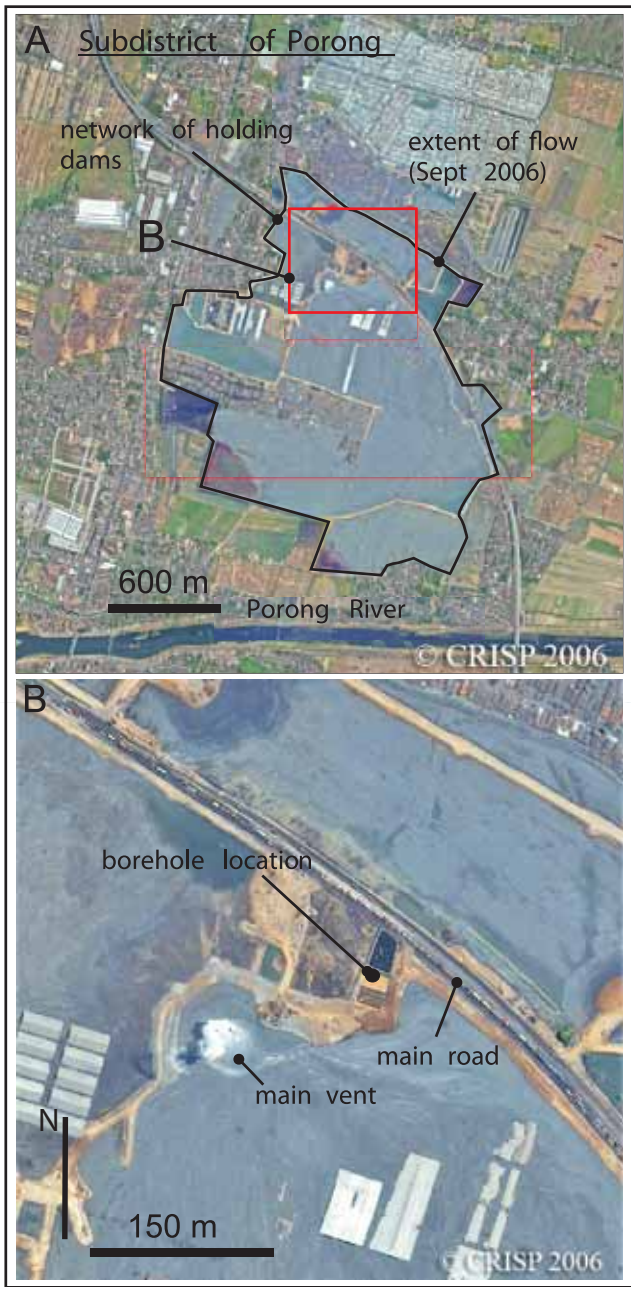

Figure 3. Satellite images of the Lusi eruption taken ~100 days after the eruption started. (A) Entire area of eruption. (B) Close-up of the main vent (marked by clouds of steam [white]), which appeared 200 m southwest of the exploration well. Both images taken September 2006, courtesy National University of Singapore Centre for Remote Imaging, Sensing and Processing (CRISP).

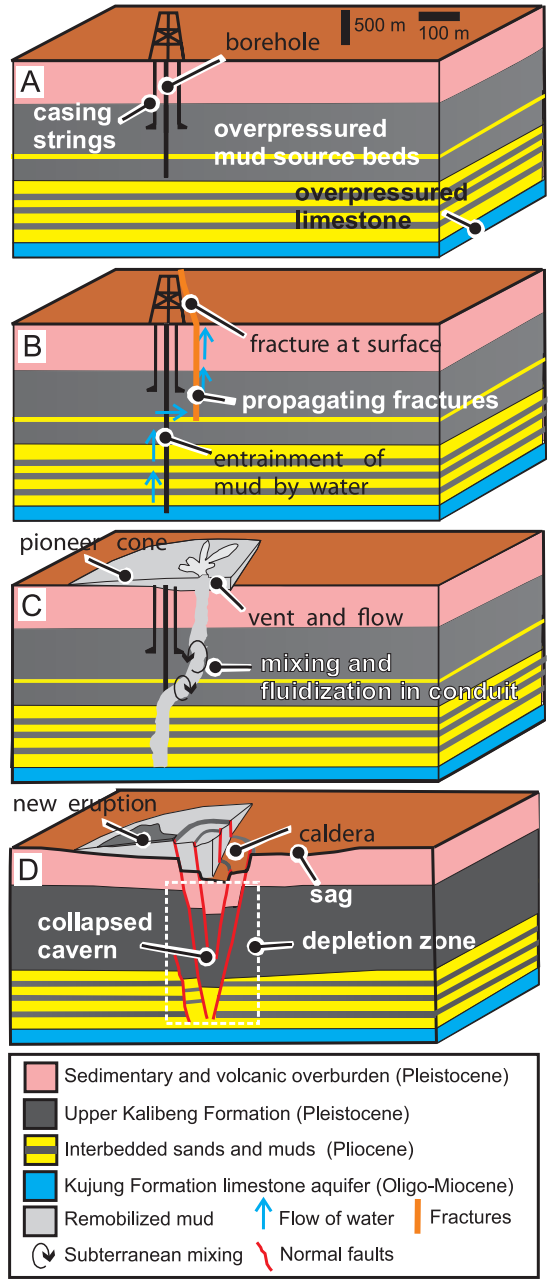

Figure 4. Schematic three-dimensional representations of the Lusi mud volcano showing four main developmental stages. The first three diagrams depict the evolution between May 2006 and Dec. 2006 (A–C), and the fourth diagram (D) shows the predicted next phase of evolution. (A) March to May 2006: Banjar Panji-1 well drills toward Kujung Formation, through overpressured mud (Kalibeng Formation) and interbedded sands and muds. (B) May 2006: Kujung Formation carbonates are penetrated, which leads to a "kick" (influx of fluid into the well bore). The kick causes hydrofracturing of overlying strata (probably initiated within the Kalibeng Formation). Drilling mud and pore-fluid enter the well bore, driven by the excess pressure upward, through porous and permeable strata and the fracture system. Entrainment of overpressured Kalibeng Formation muds occurred. (C) May to December 2006: entrainment of Kalibeng Formation muds causes a subterranean conduit to form, the walls of which undergo period collapse. (D) Post-2006: caldera forms around the vent, and gentle sag-like subsidence of the region where the flow extends. Smaller mud cones may be erupted as a result of conduit establishment due to foundering of the overburden stratigraphy.

fracture strength. These conditions for the creation of hydraulic fractures are most likely to form in the shallowest strata not protected by steel casing. We propose that the fractures probably formed within the Upper Kalibeng Formation and propagated from 1–2 km depth to the surface over a period of hours. The depth is backed by the temperature of the erupted mud-water mix, which is 70–100 °C, indicative of rapid transport from 1.5 to 3 km depth, assuming a geothermal gradient of 25 °C/km and a surface temperature of 28 °C. Such drilling-induced fracture and fluid flow processes, where the well bore provides the

necessary initial pressure communication, has been witnessed elsewhere; for example, in subsurface blowouts that occurred in Brunei in 1974 and 1979 (see Tingay et al., 2005).

At Lusi, the influx of pore water into the well bore may have initially come from the Kujung limestones, but once the heavy drilling mud had been displaced into the new fractures, fluid would have also started to flow from porous and permeable formations in the overburden. The passage of fluid into overpressured (and therefore undercompacted) mud would lead to entrainment of the unlithified sediment (Fig. 4C), which would also contribute its pore water to the mix. Mud is cohesive, and in a similar way to the entrainment of mud in sedimentary settings, the shear stress imposed by the adjacent moving water has to overcome the sediment's cohesive yield strength (e.g., Dade et al., 1992; Kranenburg and Winterwerp, 1997) for it to be entrained. Such an entrainment process has been proposed for mud volcanoes in the UK, for instance, where water from an underlying aquifer passes through mud-rich overburden, causing the formation of a subterranean cavern system (Bristow et al., 2000). The same general process has also been proposed by Deville et al. (2003) for mud volcanoes in Trinidad. We envisage that collapse of the Upper Kalibeng strata will contribute to the mixing process. It is also conceivable that the hot water in large caverns will allow convection cells to develop, which will contribute to the mixing process (e.g., Deville et al., 2003). The resultant dilute water-mud mix is moving up fractures to the surface as a fluidized sediment flow with the mud in suspension.

The mix started to erupt at the surface, driven by the pressure of the pore fluids in the Kujung limestones. Erosion of the walls of the fractures is also likely (it occurs in other mud volcanoes), and therefore a major conduit would grow upward and laterally, periodically collapsing inward. This particular mixing mechanism for mud volcanism has probably led to the very dilute composition of the mud-water mix and the high aspect ratio of the edifice.

Pressure Drive

If a continuous 2830 m column of an erupting mud-water mix has a density of 1.3 gcm^{-3}, based on an assumed water: mud ratio of 80:20, the mud column would exert a pressure of 36 MPa (5225 psi) at the bottom of the Banjar Panji-1 exploration hole. This pressure is 12 MPa less than our estimate of the pressure within the Kujung limestone (48 MPa); therefore, it is most likely that the flow that is being witnessed is driven by this pressure difference. Gas exsolution and expansion (Brown, 1990) are not considered important lift mechanisms at present.

NEXT DEVELOPMENTAL STAGES

Maintenance of flow depends upon one of two factors. If there is a continuous pathway to the surface due to the subsurface erosion of the conduit walls, the influx of the pore fluid and eruption will continue until the aquifer pressure equals the pressure due to the vertical column of erupting mud-water mix (i.e., 12 MPa). Alternatively, if mud gains access to the surface through fractures that remain open against the minimum stress, flow will reduce substantially only when the fracture closure pressure is reached; this pressure will depend on the depth at which the fracture(s) occur. Once the pressure drive abates, the compaction of the extruded and intruded mud can cause low levels of mud-water eruption, potentially for years or decades to come, as noted in other mud volcanoes such as Piparo in Trinidad and many mud volcanoes in Azerbaijan between violent (active) eruptive phases.

If our model of entrainment of the mud within the Upper Kalibeng Formation is correct, then unless the pore pressure drops to allow flow to stop, the subterranean caverns will undergo collapse (Fig. 4D). We predict that the region around the vent will form a caldera and that the area of the mud flow will undergo less significant sag-like subsidence. This subsidence pattern is consistent with the behavior of other mud volcanoes (Stewart and Davies, 2006). The subsidence that caused the fracture of a gas pipeline buried by the mud volcano and dam system indicates that collapse may have already started.

DISCUSSION

Induced by Drilling or Earthquake?

We propose that Lusi is the direct result of connection of a high-pressure fluid at depth with shallow sediments at a depth at which fractures can be initiated. Once initiated, the fractures would have propagated to the surface, driven by the deep pressure. Drilling activity has allowed this connection, and our preferred model is that the earthquake that occurred two days earlier is coincidental. The primary reasons for not considering an earthquake to be the trigger or contributing factor are (a) no other mud volcano eruptions were reported in Java at the same time; (b) the earthquake preceded the eruption by two days; seismogenic liquefaction usually occurs during earthquake-induced shaking of sediment (e.g., Ambraseys, 1988); (c) there are no reports of a "kick" during the earthquake or immediately afterward; and (d) sand, rather than mud, is more conducive to liquefaction due to earthquake shaking because it is a non-cohesive, granular sediment. An earthquake could have generated new fractures and weakened the uncased section of the well, but it would be highly coincidental for an earthquake-induced fracture to form 200 m away from this well and provide the entire fracture network required for an eruption on the Earth's surface.

Initiation and Subterranean Mixing

A fundamental question in mud volcano system studies is how they are initiated. The model proposed by Brown (1990), Van Rensbergen et al. (1999), Davies and Stewart (2005), and Stewart and Davies (2006) is that hydrofractures can penetrate several kilometers of the crust and transport a fluid-sediment mix that erupts to form a pioneer volcano. Because in this case we know that the mud-water mix has been transported ~2 km through the overburden, through new or reactivated fractures, the Lusi eruption supports the models proposed by these authors.

The Lusi eruption also strengthens the concept that rather than the source water and the source mud coexisting in the same stratigraphic unit (mudrocks at 2.0 km depth have strength and not the porosity of 70%–80% required for the Lusi sediment composition), the fluid has a deeper source, and mud is entrained from within the overburden (e.g., Bristow et al.,

2000; Deville et al., 2003; Kopf et al., 2003; You et al., 2004). This subterranean mixing model differs from the concept of mud and fluid coexisting (Davies and Stewart, 2005; Stewart and Davies, 2006) and contrasts with models for the subsurface remobilization of sands where coexistence of sand and fluid is the general assumption. The mud is particularly susceptible to entrainment due to overpressure, which does not allow normal compaction (Osborne and Swarbrick, 1997). The aquifer pressure provides the pressure drive.

Common Phenomena?

Subsurface blowouts are not uncommon events (e.g., Tingay et al., 2005) and can involve sediment entrainment, but this scale of sediment mobilization, triggered by drilling activity, has not been documented before. A combination of factors account for this being so rare: (1) the penetration of an overpressured mud that is susceptible to erosion followed by (2) the penetration of an aquifer that releases large volumes of pore water and (3) the man-made pressure linkage provided by 1.7 km of open hole section.

CONCLUSIONS

It is very likely that Lusi was initiated as a result of access by a high-pressure aquifer at depths in the region of 2.5–2.8 km through an open-hole section of the Bajar Panji-1 well to depths at which fractures could be initiated. Lusi indicates that mud volcanoes can be initiated by fracture propagation from multi-kilometer depths, which triggers fluid flow and the rapid establishment of a subterranean mixing system, into which water is transported from deeper successions.

Prediction of the next developmental stages is fraught with difficulty, but the unabated 173 days of very active eruption indicate a large aquifer has been penetrated, and we can be confident that some sort of eruptive activity (perhaps lower-level) will continue for many months and possibly years to come. A region several kilometers wide should undergo sag-like subsidence over the coming months with more dramatic collapse surrounding the main vent. Modeling and direct measurement of the inevitable land subsidence will help to predict what the future impact the Lusi mud volcano has on the local population.

ACKNOWLEDGMENTS

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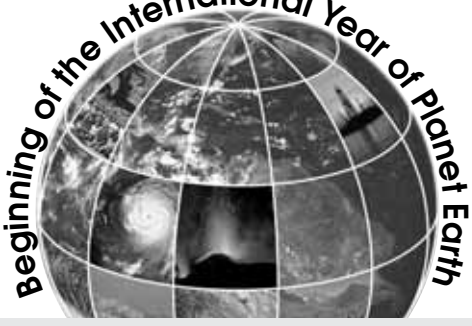

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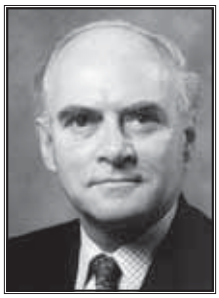

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Sixteenth Annual Biggs Award

for Excellence in Earth Science Teaching for Beginning Professors

GSA established the Biggs Award to reward and encourage teaching excellence in beginning college-level earth science professors.

ELIGIBILITY

Earth science instructors and faculty from all academic institutions engaged in undergraduate education who have been teaching full-time for 10 years or fewer (part-time teaching is not counted in the 10 years) may be nominated for this award.

AWARD AMOUNT

The award of US$750 is made possible as a result of support from the Donald and Carolyn Biggs Fund (maintained by GSA Foundation), the GSA Geoscience Education Division, and GSA's Education and Outreach Programs. In addition, this award includes up to US$500 in travel funds to attend the award presentation at the GSA annual meeting.

DEADLINE AND NOMINATION INFORMATION

Nomination forms (*and updated nomination guidelines*) for the 2007 Biggs Earth Science Teaching Award are posted at www.geosociety.org/aboutus/awards/biggs.htm. Or, contact the Program Officer of Grants, Awards, and Recognition at +1-303-357-1028, awards@geosociety.org. Nominations must be received by **9 June 2007.**

Mail nomination packets to Program Officer, Grants, Awards, and Recognition, Geological Society of America, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140, USA.

Philadelphia 2006: Gary S. Solar of SUNY College at Buffalo receives the 2006 Biggs Award from Beth Wright at the National Association of Geoscience Teachers–GSA Geoscience Education Division Luncheon and Awards Reception.

Seeking Earth Science Fair Judges

HELP GSA Reward Young Geoscientists

VOLUNTEER To Be A Judge

GSA provides three special awards for earth science project excellence at the Intel International Science and Engineering Fair. We are seeking judges for this prestigious event, to be held in Albuquerque, New Mexico, 15–16 May 2007. If you are interested in this fascinating and rewarding volunteer activity, please contact Chris McLelland at educator@geosociety.org, +1-303-357-1082.

FREE K–12 LESSON PLANS!

Need a lesson plan or resource for that earth science project? GSA has loads of free teacher resources. Go to www.geosociety.org/educate/ to view and download quality lesson plans, developed and classroom-tested by your fellow teachers.

Have a lesson plan you want to share? Go to www.geosociety.org/educate/, complete our lesson plan template (Microsoft Word format), then send it via e-mail to Chris McLelland, GSA's Distinguished Earth Science Educator, educator@geosociety.org. GSA will extend the reach of your work by including it in the DLESE (Digital Library for Earth System Education; www.dlese.org) library.

UPCOMING AWARD DEADLINES

Funds supporting all but the national awards are administered by the GSA Foundation.

APPLICATIONS DUE

15 Feb. 2007:	**Antoinette Lierman Medlin Scholarship in Coal Geology.** Coal Geology Division. **Please send applications to** Glenn B. Stracher, Dept. of Geology, East Georgia College, Swainsboro, GA 30401, USA, fax +1-478-289-2050, stracher@ega.edu. For details, see the January 2007 issue of *GSA Today* or go to www.uky.edu/KGS/coal/GSA/awards.htm.

NOMINATIONS DUE

20 Feb. 2007:	**Laurence L. Sloss Award for Sedimentary Geology.**** Sedimentary Geology Division. Send nominations electronically to Paul Link, secretary, Sedimentary Geology Division, linkpaul@isu.edu.
28 Feb. 2007:	**Gilbert H. Cady Award.**** Coal Geology Division. Send three copies of the nomination to Christopher J. Carroll, Colorado Geological Survey, 1313 Sherman St., Suite 715, Denver, CO 80203-2239, USA, +1- 303-866-3501, chris.carroll@state.co.us.
31 Mar. 2007:	**John C. Frye Environmental Geology Award.*** For details, follow the link at www.geosociety.org/aboutus/awards/ or see the October 2006 issue of *GSA Today*.
2 Apr. 2007:	**Don J. Easterbrook Distinguished Scientist Award.**** Quaternary Geology and Geomorphology Division. Send nominations to Jack F. Shroder Jr., Dept. of Geography & Geology, University of Nebraska, Omaha, NE 68182-0199, USA, jshroder@mail.unomaha.edu.
2 Apr. 2007:	**Farouk El-Baz Award for Desert Research.**** Quaternary Geology and Geomorphology Division. Send nominations to Lisa L. Ely, Dept. of Geological Sciences, 400 E University Way, Central Washington University, Ellensburg, WA 98926, USA, +1-509-963-2821, ely@cwu.edu.
30 Apr. 2007:	**National Awards.*** William T. Pecora Award, National Medal of Science, Vannevar Bush Award, and Alan T. Waterman Award. For details, see the October 2006 issue of *GSA Today* or go to www.geosociety.org/aboutus/awards/national.htm.

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*You may also contact Grants, Awards, and Recognition, P.O. Box 9140, Boulder, CO 80301-9140, USA, +1-303-357-1028, awards@geosociety.org.
**Award details are in the January 2007 issue of *GSA Today* and at www.geosociety.org/aboutus/awards/.

George P. Woollard Award

GSA Geophysics Division

GSA's Geophysics Division seeks nominations for the George P. Woollard Award. This annual award recognizes outstanding contributions to geology through the application of the principles and techniques of geophysics. The award is presented at each annual GSA meeting in conjunction with the Geophysics Division and the Structural Geology and Tectonics Division business meetings. A highlight of the presentation is the honorary George P. Woollard Technical Lecture by the recipient before the award ceremony, providing an overview of and musings on his or her work. Nominations should include a description of the nominee's specific contributions and their scientific impact. **Submit nominations online by 15 February 2007 at http://geoscience.unlv.edu/pub/GSA_Geop/woollard.html.**

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ROCKY MOUNTAIN

Section Notice

59th Annual Meeting
Rocky Mountain Section, GSA
Dixie Center, St. George, Utah, USA

7–9 May 2007

CALL FOR PAPERS

Abstracts Deadline: 13 February 2007

Papers are invited from students and professionals for oral and poster presentations. Submit your abstracts via www.geosociety.org. An abstract submission fee of US$15 will be charged. An individual may present only one volunteered paper but may be co-author on other papers. Individuals invited to participate in symposia may present an additional volunteered paper. Depending on time constraints in oral sessions, some submitters may be requested to switch to a poster presentation and vice-versa. Please check the March *GSA Today* for complete meeting information, and go to www.geosociety.org/sectdiv/rockymtn/07rmmtg.htm for symposia and field trip listings.

Mentoring—Don't Miss This Rewarding Experience!

"I have enjoyed volunteering as a mentor and realize the significance of sharing information with students."

"The students' questions were thought-provoking and they made me realize what a satisfying job I've got. I'd like to do this again!"

The **Roy J. Shlemon Mentor Programs in Applied Geoscience** are designed to acquaint advanced undergraduate and beginning graduate students with careers in applied geoscience. Volunteer mentors provide real-world information and insight based on their career experience—wisdom students may not glean from their regular academic training.

The **John Mann Mentor Programs in Applied Hydrogeology** provide a forum for undergraduate and graduate students interested in hydrogeology or hydrology as a career to participate in informal conversations with professionals currently practicing in these fields. These programs are relaxed, small-scale, focused events.

If you are interested in serving as a mentor at one of the GSA Section Meetings, please contact Jennifer Nocerino, jnocerino@geosociety.org. See the program schedule at www.geosociety.org/science/mentors/07programs.htm.

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Call for Geological Papers

2007 GSA Section Meetings

Northeastern Section

12–14 March 2007
University of New Hampshire
Durham, New Hampshire
Information: Wally Bothner, University of New Hampshire, Dept. of Earth Sciences, James Hall, 56 College Rd., Durham, NH 03824-3578, USA, +1-603-862-3143, wally.bothner@unh.edu.

Southeastern Section

29–30 March 2007
Hyatt Regency Savannah on the Historic Riverfront
Savannah, Georgia
Information: Pranoti Asher, Georgia Southern University, Dept. of Geology and Geography, Statesboro, GA 30460-8149, USA, +1-912-681-0338, pasher@georgiasouthern.edu.

Joint Meeting
South-Central and North-Central Sections

11–13 April 2007
Kansas Memorial Union, University of Kansas
Lawrence, Kansas
Information: Greg Ludvigson, +1-785-864-2734, gludvigson@kgs.ku.edu—or—Greg Ohlmacher, +1-785-749-4502, ohlmac@kgs.ku.edu; both at Kansas Geological Survey, University of Kansas, 1930 Constant Ave., Lawrence, Kansas 66047-5317, USA.

Cordilleran Section

4–6 May 2007
Western Washington University
Bellingham, Washington
Abstract Deadline: 6 February 2007
Information: Bernie Housen, Western Washington University, Dept. of Geology, MS 9080, 516 High St., Bellingham, WA 98225-5946, USA, +1-360-650-6573, bernieh@cc.wwu.edu.

Rocky Mountain Section

7–9 May 2007
Dixie Center
St. George, Utah
Abstract Deadline: 13 February 2007
Information: Jerry Harris, Dixie State College, Science Building, 225 South 700 East, St. George, UT 84770-3875, USA, +1-435-652-7758, jharris@dixie.edu.

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2006 OEST AWARD RECIPIENTS NAMED

GSA Congratulates These Outstanding Earth Science Teachers

The National Association of Geoscience Teachers (NAGT) announced the 2006 Outstanding Earth Science Teacher (OEST) Award recipients in December 2006.

OEST awards are earned by outstanding pre-college teachers through their exceptional contributions to the stimulation of interest in the earth sciences. Each NAGT section selects a section winner; sections may also have state winners. For more information about this award and the NAGT, go to www.nagt.org/nagt/programs/oest.html.

The OEST award is administered by the Geological Society of America; GSA awards section recipients US$500 travel money to attend a GSA meeting, and awardees can also apply for up to $500 for classroom supplies. The award includes a certificate and a complimentary membership to GSA for three years for section recipients and one year for state recipients.

2006 OEST SECTION AWARDEES

(No awardees were selected for the North-Central, Southwest, and Midcontinent Sections.)

Aaron Spurr
Central Section
Northern University High School
Cedar Falls, Iowa

Walter "Len" Sharp
Eastern Section
Liverpool High School
Liverpool, N.Y.

David Meade
FarWest Section
New Jerusalem Charter School
Tracy, Calif.

Marguerite (Margo) Murphy
New England Section
Georges Valley High School
Thomaston, Maine

Jodie Harnden
Pacific Northwest Section
Sunridge Middle School
Pendleton, Oreg.

Bryan P. Byrne
Southeast Section
E.A. Cox Middle School
Columbia, Tenn.

Cristopher D. Marshall
Texas Section
The Colony High School
The Colony, Tex.

2006 OEST STATE AWARDEES

Tim Ashley
OEST Alabama
John L. LeFlore Prep
Mobile, Ala.

William Waggener
OEST Georgia
Paulding County High School
Dallas, Ga.

Aaron Spurr
OEST Iowa
Northern University High School
Cedar Falls, Iowa

Janelle Albarez
OEST Louisiana
Brusly Middle School
Brusly, La.

Christa Bowser
OEST Maryland
Southern Barrett High School
Oakland, Md.

Kirk Enzenauer
OEST Minnesota
Coon Rapids Middle School
Coon Rapids, Minn.

Walter Patelunas
OEST New Jersey
Toms River High School East
Toms River, N.J.

Walter "Len" Sharp
OEST New York
Liverpool High School
Liverpool, N.Y.

Carrie A. Jones
OEST North Carolina
Middle Creek High School
Apex, N.C.

Jason Petula
OEST Pennsylvania
Tunkhannock Area High School
Tunkhannock, Penn.

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Congressional Science Fellow Report

A Scientific Sabbatical on Capitol Hill

Nicole Gasparini, *2005–2006 GSA–U.S. Geological Survey Congressional Science Fellow*

When I accepted the GSA–USGS Congressional Science Fellowship, my colleagues had a wide array of responses: some were very supportive of my decision, while others made comments like "you're going to become one of *those* people." I'm not sure what that meant, but I did understand why some people were confused about my choice. I have always bemoaned the lack of women in science, and while I had opportunities that year to continue in more traditional research positions, I chose the Congressional Fellowship, which led me away from a lab bench or, in my case, from rivers. Apparently, it seemed to some that I wasn't going to be the role model of a woman scientist that I had often longed for during my training.

I hope that is far from the truth. I have always loved science, and I never planned to leave research forever, even though I knew the Fellowship could lead me in that direction. As a student, I sometimes found it frustrating that few of my advisors had experience outside of academia. Even though I aspire to a job similar to that of my academic advisors, I know that there are not enough faculty positions for every Ph.D. student. I felt that in order for me to be a good teacher and role model, I needed to have a few more experiences under my belt. As a bit of a politics junky, it seemed to me that the Congressional Fellowship would be an ideal way to broaden my horizons. When GSA selected me as the 2005–2006 Fellow, I jumped at the opportunity.

I'd never had a formal civics class before I arrived in Washington, D.C., but jumping into the fire is often the best way to learn. As a Congressional Fellow, I was given all the responsibilities of a legislative assistant. My portfolio of policy issues included science research and development, climate change, water infrastructure, disaster preparedness, nuclear waste, nuclear nonproliferation, and human rights. Congress members often get information from their staff through memos, and I had never written a memo before last year. I wasn't worried though; I write C++ code, so how hard could it be to write a memo? It turns out that writing computer code was much easier for me than those first few memos. Writing speeches and talking points was also challenging, because I had never written in anyone else's voice but my own. The learning curve on the Hill is steep, but I quickly found my rhythm. I got used to hearing the phrase "that needed to be done ten minutes ago," and I figured out that Congress members do not use the term "order-of-magnitude."

My day-to-day tasks in the office varied widely. When Congress was in session, many of my days were spent frantically finding the last-minute facts that my boss needed for committee hearings, votes, or speeches on the House floor. There are schedules in Congress, but they are often not followed, and last-minute changes always come up. Although the House floor is for members only, I did get to join my boss on the floor when he was debating an amendment I had helped to write. It was a bit nerve-wracking for me, but I also found it fascinating to witness the last-minute politicking and arm-twisting that invariably happens before votes.

As much as I loved the chaos while Congress was in session, I had more time to pursue my own policy interests when Congress was in recess. Learning the ins-and-outs of the legislative process and writing talking points and press releases were very important parts of my Fellowship experience, but most enlightening for me was seeing how science is viewed and used in the policy arena. Before the fellowship, I had been entrenched in academia, and I had forgotten that most people do not understand how scientific funding works and how difficult it is to actually receive grant money. Peer review, of both grants and journal articles, is a black-box process to many outside of research. It was disheartening at times to see that some Congressional staff, who will ultimately advise their bosses on how to fund agencies like the National Science Foundation and the National Institutes of Health, have only minimal understanding of how these agencies actually distribute research funds.

Scientific agencies and scientists themselves are partially to blame for the mystery surrounding how peer review and funding work. Congressional staffers are generally overworked and underpaid, and there is little spare time for reading on federal agencies. However, to my knowledge, the office I worked in never turned away a visit from a constituent, regardless of what he or she wanted to talk about. In my office, I was the person who met with nearly every scientist who walked through the door. I was surprised by how few scientists or representatives of scientific groups actually visited the office. Science will never be integrated into policy if the scientific community does not participate in the policy process.

Even when policy makers intend to meld science into legislation, the results can be tenuous. Last year, a case came before the Supreme Court involving a Michigan landowner who was charged with violating the Clean Water Act (CWA) when he filled wetlands on his property without obtaining a permit. The CWA requires a permit for discharging fill material into "navigable waters." Congress had defined "navigable waters" as "waters of the United States, including the territorial seas." The Army Corps of Engineers includes wetlands "adjacent" to other waters of the United States in "waters of the United States." A lower court ruled that because the landowner's wetlands have "surface connections" to tributaries of waterways that are tradi-

tionally deemed "navigable," the wetlands were thus "adjacent" to navigable waters. The Supreme Court was split on the case with a 4–1–4 vote; ultimately, the Court did not clearly address what waters are and are not protected by the CWA. Justice Antonin Scalia's position, written for himself, Chief Justice John Roberts, and Justices Clarence Thomas and Samuel Alito, states that "the waters" in the CWA refers to water "found in streams and bodies forming geographical features such as oceans, rivers, and lakes," as defined by *Webster's New International Dictionary* (1954). While in a briefing on the details of this case, I thought about my training in hydrology and how I might define "connections" between waterways. Although you don't need a Ph.D. to understand the water cycle, it seems to me that a 1954 definition of water might not fully capture the complexity of connections between waterways. I'm sure that scientists are weighing in at every point of this case as it makes its way through the courts (where it still remains), but I was left wondering if this was the best way to integrate science into policy.

At times during my year on the Hill, I was inspired, yet at other times, I was very frustrated. These feelings led me to contemplate staying in Washington to "make a difference." In the end, however, I decided that the biggest difference I could make was to go back to research and teaching and try to educate the next generation of scientists to be more aware of the science-policy nexus. At some point, I hope to get more involved in policy at the local level, maybe by attending town meetings or even running for a position on the school board. For now, though, I am enjoying my life as a geomorphologist again; I definitely prefer writing manuscripts to writing memos.

This manuscript is submitted for publication by Nicole Gasparini, 2005–2006 GSA–U.S. Geological Survey Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and by the U.S. Geological Survey, Department of the Interior, under Assistance Award No. 05HQGR0141. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government. *Gasparini can be reached at nicgaspar@gmail.com.*

About People

GSA Fellow and past president (2000) **Mary Lou Zoback** has been appointed vice president of Earthquake Risk Applications at Risk Management Solutions, a private, worldwide corporation founded at Stanford University in 1988. Zoback leaves the U.S. Geological Survey (USGS) after 28 years of service, most recently as a senior research scientist with the USGS Earthquake Hazards Team in Menlo Park, California, and regional coordinator for the USGS Northern California Earthquake Hazard Program.

Zoback is a woman of accomplishment. She served as chair of the steering committee for the 1906 Earthquake Centennial Alliance, which helped coordinate the 100th Anniversary Earthquake Conference commemorating the 1906 San Francisco earthquake. She was awarded the American Geophysical Union's Macelwane Award in 1987 for "significant contributions to the geophysical sciences by a young scientist of outstanding ability" and currently serves on the Council of the National Academy of Sciences. Most recently, Zoback was named co-recipient of the Earthquake Engineering Research Institute's Northern California Chapter's 2006 Award for Innovation and Exemplary Practice in Earthquake Risk Reduction.

Donna L. Russell, *Director of Operations*

Including the GSA Foundation in Your Estate Planning

A number of common planned giving instruments are outlined here to guide GSA Members in their estate planning. In all cases, consult your tax accountant and/or attorney in developing any instrument. For details, contact Donna Russell, Director of Operations, GSA Foundation, P.O. Box 9140, Boulder, CO 80301-9140, USA, +1-303-357-1054, drussell@geosociety.org.

- A simple, inexpensive codicil (modification) to your will can create a bequest to the Geological Society of America Foundation (GSAF). You set the amount or percentage of your estate using wording such as "I hereby give, devise, and bequeath to the Geological Society of America Foundation Inc. the sum of $(*name sum*)."
- If you wish, you can specify a purpose for your bequest by adding "It is my desire that this bequest be used for the following purposes: (*specify a Foundation Fund*)."
- Add GSAF as an additional beneficiary or contingent beneficiary to your existing life insurance policy. Other insurance instruments include (1) purchasing a new insurance policy in the name of GSAF, with tax-deductible premiums; or (2) including GSAF as one of the beneficiaries on your company insurance policy.
- Make GSAF the beneficiary of all or part of your retirement plan assets; this would be a tax-free testamentary charitable gift.
- Establish a charitable remainder trust with a minimum of $100,000 in cash, property, or real estate. This provides a lifetime income stream to you or other individuals, followed by a distribution of the principal at the end of the trust period. In addition, there are immediate charitable income tax deductions, capital gains avoidance, and federal estate tax deductions.
- Enter into a charitable gift annuity agreement with the GSAF for as little as $10,000 in cash or securities. This provides a fixed income for life.
- Deed your house to the GSAF and continue to live in it for life. There are current income tax savings.
- Have your surviving spouse include GSAF in her or his estate planning.

New Fund for the QG&G Division

The Quaternary Geology and Geomorphology Division is pleased to announce the establishment of a new scholarship fund named in honor of Marie Morisawa, one of the first women to maintain a high profile in Quaternary geology and geomorphology throughout her career. Marie entered the discipline in 1960, a period when relatively few women engaged in research and in university-level science teaching. She went on to help establish the annual Binghamton Geomorphology Symposia and the journal *Geomorphology*, both of which are thriving today. She was also the first female chair of the QG&G Division. Given that Marie was well known for mentoring younger scientists throughout her career and that she was an active participant of the QG&G Division of GSA, it seems particularly appropriate to establish an award for graduate students in her name through the Division. This award will go to women M.S. or Ph.D. students.

We are working to establish a $25,000 base, which would allow an annual scholarship award of $1,250. You can donate to this fund by sending a check to the GSA Foundation with a brief note earmarking the funds for the Morisawa scholarship or by credit card via the Foundation's Web site, www.gsafweb.org/makeadonation.html.

GSA FOUNDATION
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25 YEARS

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Boulder, CO 80301-9140
+1-303-357-1054
drussell@geosociety.org

www.gsafweb.org

Enclosed is my contribution in the amount of $_____.

Please credit my contribution for the:

☐ Morisawa Fund

☐ Greatest need ☐ Other: _____ Fund

☐ I have named GSA Foundation in my will.

PLEASE PRINT

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City/State/ZIP

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Most memorable early geologic experience:

My first days in the field in Northern Alaska, with my party chief and mentor, Art Bowsher, looking at the limestone ridge from about one-half mile away (no geologist had ever been in this valley before)—Art says "See that bench about one-third of the way up the cliff? We will find fossils there—Mississippi crinoids." And we did!

—John T. Dutro

Apply to Host a Speaker!

JOI/USSSP Distinguished Lecturer Series

The Joint Oceanographic Institutions/U.S. Science Support Program (JOI/USSSP) offers the Distinguished Lecturer Series to bring exciting scientific results and discoveries of the Integrated Ocean Drilling Program to students at the undergraduate and graduate levels and to the geosciences community in general. JOI is currently accepting applications from U.S. colleges, universities, and nonprofit organizations to host talks given by the speakers listed below during the 2007-2008 academic year. Applications are available online at www.usssp-iodp.org/DLS or from: JOI, Inc., 1201 New York Avenue, NW, Suite 400, Washington, DC 20005; tel: 202-232-3900; email: dls_coordinator@joiscience.org. The application deadline is April 6, 2007.

Pore Pressure, Sedimentation, and Submarine Landslides
Peter Flemings, Pennsylvania State University

One Rock to Change the World: The Story of the Chicxulub Impact Crater
Sean P. S. Gulick, University of Texas at Austin

The Earth's Turmoil of the Last Deglacial Period
James Kennett, University of California Santa Barbara

Tales of Deep Ocean Circulation Told by Tiny Fish Teeth
Ellen Martin, University of Florida

Cretaceous Black Shales, Mediterranean Sapropels, and Greenhouse Climate
Philip Meyers, The University of Michigan

Unlocking the Secrets of the Deep Subsurface Biosphere
Andreas Teske, University of North Carolina, Chapel Hill

JOI Joint Oceanographic Institutions

earth scope

An integrated geologic framework for EarthScope's USArray: WESTERN GEOSWATH WORKSHOP

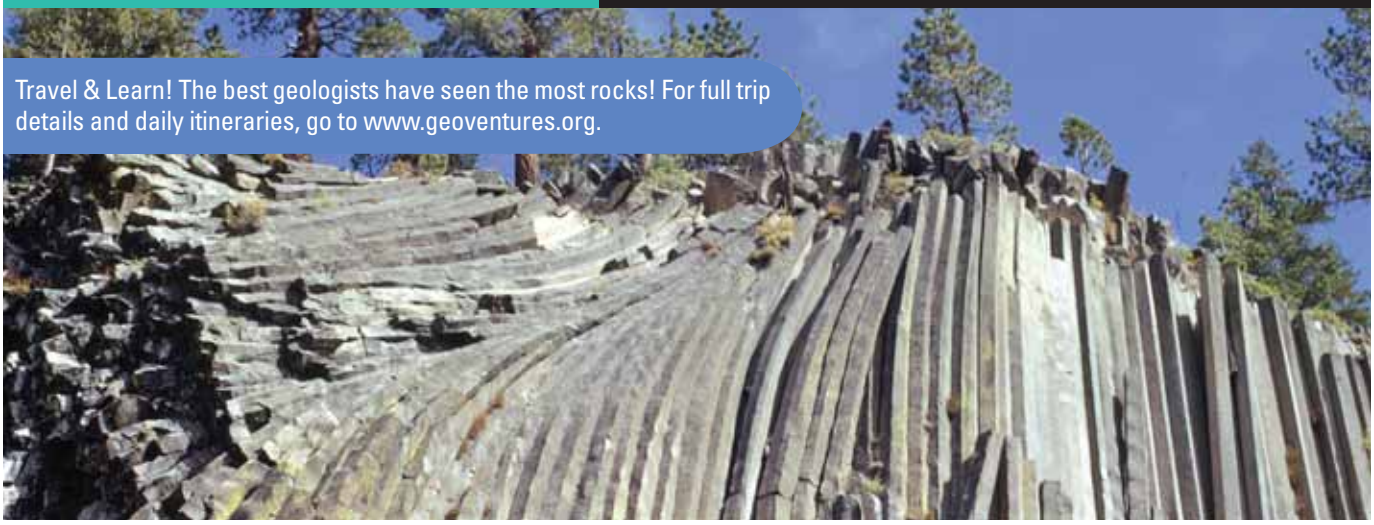
The *GeoSwath* initiative, a geologic activity under EarthScope's USArray, involves integration of geology and geophysical imaging toward understanding the 4-D construction, stabilization and modification of the North American continent. *GeoSwath* uses a continuous coast-to-coast perspective that examines fundamental tectonic processes, the continent's major geologic provinces and their boundaries.

This workshop examines a continuous swath from the northwest coast to the Great Plains ('Lewis and Clark' or Western *GeoSwath*), focusing on Cascadia, Northern Rockies and Black Hills/Great Plains. The workshop, co-sponsored by IRIS, will bring together complementary segments of the U.S. geosciences community, including geologists, geophysicists and geochronologists. Held on April 27-29 in a northern Rockies location; information on website: www.globalchange.umich.edu/ben/geoswath.

Application deadline: March 1, 2007.
NSF's *GeoSwath* funding will support the costs of housing, food and a contribution toward your travel. For more information, contact: R. Keller (grkeller@ou.edu), B. Tikoff (basil@wisc.edu), or B. van der Pluijm (vdpluijm@umich.edu).

2007 GeoVentures

Travel & Tours for Geoscience Enthusiasts



Devils Postpile, Devils Postpile National Monument, California.

GeoHostel: Geology of the Sierra Nevada and White-Inyo Range, California, USA

4–11 August 2007 (8 days); Location: Mammoth Lakes and Crooked Creek Research Station, California, USA
Scientific Leaders: Steve Lipshie and Gary Ernst

Who Should Attend? Professional and amateur geologists interested in geology. A basic background in geology is required. Min.: 10; max.: 25.

Fee: US$1295 for GSA Members and spouses; US$1395 for nonmembers. **Deposit:** US$300, due 2 July 2007.

Included: All hotels, transportation, all entrance fees, most meals, and guidebook. **Not Included:** Airfare to and from Reno, Nevada, and some meals. Find flight info and our cancellation and refund policy at www.geoventures.org.

Trip Overview: We will start and end our tour in Reno, Nevada, USA. For the first three-and-a-half days, we will explore the Quaternary geology of the east-central Sierra Nevada region of California. This region is surrounded by spectacular scenery at the boundary between the Sierra Nevada and the Great Basin. We will see Pleistocene glacial moraines and lakes and volcanic deposits that erupted during and between glaciations. At Mono Lake, we will walk amongst the tufa deposits that are still being formed today. Farther south, we will walk on lava domes and craters that are less than 700 years old and visit the classic columnar jointing at Devils Postpile National Monument. The trip includes stops to view the air-fall ash and ash-flow units within the Bishop Tuff, the product of a cataclysmic eruption 760,000 years ago that produced the Long Valley caldera and spread ash as far east as Nebraska. Within the caldera, we will visit hot springs and look at the resurgent rhyolite dome that formed after its collapse.

The last two-and-a-half days of the trip will focus on the structural, stratigraphic, igneous, and metamorphic geology of the White-Inyo Range, across the Owens Valley from the Sierra Nevada. We will explore the uppermost Proterozoic and lowermost Paleozoic sedimentary rocks and late Mesozoic plutonic rocks of the region and enjoy some magnificent views of the east-facing Sierra Nevada escarpment. At Devils Gate, we will see disharmonic folding and local faulting on an impressive scale. We can also expect to find abundant Cambrian trace fossils, especially abundant worm tracks, and possibly even the ever-elusive, shy, and retiring trilobite. In the White Mountains, we will walk among stands of ancient

2007 GSA GeoVentures

Participants must be 18 or older and in good health. Any physical condition requiring special attention, diet, or treatment must be noted in writing when reservations are made. GSA is committed to accommodating special needs. Deposits and payments are refundable under certain conditions. Please check www.geoventures.org for our refund policy. Please do not make flight reservations until GSA has confirmed that the trip will run. Contact Wesley Hill, whill@geosociety.org, +1-303-357-1005, if you need further information.

bristlecone pines, some of which are as much as 4600 years old, and observe the dolomite on which they preferentially grow. During this part of the excursion, the group will stay for two nights at the University of California research station at Crooked Creek, at an elevation of 10,150 feet in the White Mountains.

Scientific Program and Itinerary: The first half of the trip emphasizes the Quaternary volcanic history of the Long Valley caldera and surrounding areas and addresses the glacial history and geomorphology of the region, including (1) the relationship between the silicic volcanism of the Long Valley magma chamber and the mafic volcanism of the region; (2) the presence of other, younger sources of silicic magma in the region, with visits to examples of these younger silicic lavas, some of them younger than the Magna Carta; (3) we will also visit geothermal features, both ancient and active, including hot springs, fumaroles, and zones of hydrothermal alteration (including a stop at a kaolinite mine—bring your sunglasses!). The second half of the trip emphasizes the pre-Cenozoic structure and stratigraphy of the White-Inyo Range, with observations, study, and review of (1) a number of the uppermost Proterozoic and Lower Cambrian formations in the range; (2) contact relationships between some of the sedimentary formations on the outcrop; (3) intrusive bodies of late Mesozoic granitic magma; (4) the broad structure of the White-Inyo Range along with some of the smaller folds and faults along the way; and (5) geologic and topographic control on the distribution of ancient bristlecone pine groves and other characteristic botanical associations in the White-Inyo Range. More information and a detailed daily itinerary are posted on the GeoVentures Web site, www.geoventures.org.

Scientific Leader: Steve Lipshie. Steve, who has a B.S. degree in geophysics from Caltech and M.S. and Ph.D. degrees in geology from the University of California at Los Angeles, has worked off and on in the eastern Sierra region between Bishop and Mono Lake since 1972. He has taught or co-taught summer field geology camps in California and New Mexico and has done field mapping in California and Alaska. For the past 17 years, he has worked as an engineering geologist with the Los Angeles County Department of Public Works, and he periodically teaches engineering geology at California State University–Northridge. He has also taught geology and geophysics courses at North Carolina State University and Iowa State University. In 1976, he wrote a guidebook to the Long Valley–Mono Craters region; this guidebook, revised in 2001, will be used for the first half of this GeoVentures trip.

Scientific Co-Leader: W. Gary Ernst. Gary received his B.A., M.S., and Ph.D. degrees from Carleton College (1953), The University of Minnesota (1955), and The Johns Hopkins University (1959), respectively. Joining the University of California at Los Angeles (UCLA) in January 1960, he was chair of the Dept. of Geology, 1970–1974; the Dept. of Earth and Space Sciences, 1978–1982; and UCLA director of the Institute of Geophysics and Planetary Physics, 1987–1989. In September 1989, he moved to Stanford for a five-year term as dean of the School of Earth Sciences. Since 1999, he has held the Benjamin M. Page Chair in Stanford's Geological and Environmental Sciences Dept., going emeritus in September 2004. The author of six books and research memoirs, editor of 14 other research volumes, and author of >200 scientific papers, Gary studies petrotectonic relationships of Circumpacific-type and Alpine-type orogens in California and other fine places. He received the Geological Society of Japan Medal in 1998, GSA's Penrose Medal in 2004, and the Mineralogical Society of America's Roebling Medal in 2006.

Questions about the agenda? Concerns about accessibility? Contact Wesley Hill, whill@geosociety.org, +1-303-357-1005. GSA is committed to making this program accessible to all people interested in attending.

Questions about the science? Contact Steve Lipshie at slipshie@ladpw.org.

Check the January issue of *GSA Today* to learn about four other exciting GeoVentures trips (to Alaska, Arizona, China, and Montana), or go to www.geoventures.org to read more.

REGISTER TODAY!

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Positions Open

UNIVERSITY OF NEW ORLEANS
DEPT. OF EARTH AND ENVIRONMENTAL SCIENCES
TENURE-TRACK FACULTY VACANCY
COASTAL PLANT ECOLOGIST

The Department of Earth and Environmental Sciences (EES) at the University of New Orleans invites applicants to fill a tenure-track position as an Assistant Professor in the field of Coastal Plant Ecology starting in the 2007 calendar year. EES is particularly interested in an individual whose work focuses on coastal wetland and barrier island vegetation and plant response to changes in salinity, inundation, and/or fertility.

Applicants with research interest at the landscape scale of the Mississippi River delta plain are highly desirable. Scientists with experience in working with multidisciplinary teams using remote imaging and geospatial tools are also highly desirable. Other desirable talents and expertise include: Coastal plant community's response to changes in physical environment, climate, sea level and wildlife; Coastal restoration ecology; Environmental controls on plant recruitment and succession; Wildlife habitat use, and Seabird habitat and population dynamics.

This position is well-supported with start-up funds commensurate with the successful candidates experience, publication record and funding record. Research facilities will be available for the successful candidate in the UNO Geology Building and/or UNO Research and Technology Park. This position will hold a joint position with the Pontchartrain Institute foe Environmental Sciences. EES is well endowed with research facilities for fieldwork in coastal plant communities as well as laboratory investigations. We seek an individual committed to research, teaching and graduate training. A Ph.D. is required.

Interested applicants should send their résumé, selected publications and three letters of reference to: Dr. Shea Penland, Chair, Department of Earth and Environmental Sciences, University of New Orleans, 2000 Lakeshore Dr., New Orleans, LA 70148, +1.504.280.6325, spenland@uno.edu.

The University of New Orleans, a member of the Louisiana State University System, is an EEO/AA employer.

UNIVERSITY OF NEW ORLEANS
DEPT. OF EARTH AND ENVIRONMENTAL SCIENCES
TENURE-TRACK FACULTY POSITION
PETROLEUM GEOLOGIST

The Department of Earth and Environmental Sciences (EES) at the University of New Orleans invites applicants to fill a tenure-track position as an Assistant Professor in the field of Petroleum Geology anticipating starting in the 2007 calendar year. Commensurate with this position, the successful candidate could also be awarded the Braunstein Professorship in Petroleum Geology reflecting the successful candidate's distinguished career in the petroleum geosciences. The mission of EES is to build a center of excellence in earth and environmental sciences in the heartland of America's energy coast, Louisiana's Mississippi River delta.

UNO is seeking an experienced petroleum geologist with broad experience in the Gulf of Mexico Basin. Previous experience within the oil and gas industry is highly desirable. Other desirable talents and expertise we seek in a candidate include: Structural geology-tectonics, sedimentary basin analysis, subsurface exploration, and reservoir characterization-evaluation.

This position is well-supported with start-up funds commensurate with the successful candidate's experience, publication record and funding record. Research facilities will be available for the successful candidate in the UNO Geology Building and/or UNO Research and Technology Park. EES is well-endowed with field and laboratory resources. We seek an individual committed to research, teaching and graduate training. A Ph.D. is required.

Interested applicants should submit a curriculum vita, a statement of research and teaching interest, selected publications and three letters of reference by 30 March 2007 to Dr. Shea Penland, Chair, Department of Earth and Environmental Sciences, University of New Orleans, 2000 Lakeshore Drive, New Orleans, LA 70148, +1.504.280.6325, spenland@uno.edu.

The University of New Orleans, a member of the Louisiana State University System, is an EEO/AA employer.

SURFICIAL PROCESSES RESEARCH GEOLOGIST
U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey is seeking a full-time, term Surficial Processes Geologist in Tucson, Arizona or Menlo Park, California. The successful candidate will conduct research to advance our understanding of geologic processes at or near the Earth's surface, how such processes create, change, disperse, or destroy mineral deposits, and how such processes may influence their environs. Such research may include geologic studies, resource evaluation, and environmental investigations. The candidate must have a level of experience commensurate with a Ph.D. in one or more of the following fields: geochemistry, sedimentology, stratigraphy, geomorphology, geochronology, geohydrology, pedology, isotope geology, and/or complex systems science.

The position is a four-year term with option to extend to five. Starting salary will range from $62,291 to $110,122 plus benefits, depending on experience and location; moving expenses will not be available. The job will be listed on the USGS Online Automated Recruitment System (OARS) Web site as a Research Geologist GS-1350-12/13 under announcement number WR-2007-0154. The opening date for applications is anticipated to be 1 February 2007; the closing date is 28 February 2007. For additional information about the position, contact Victor Mossotti at mossotti@usgs.gov. For information on how to apply, check the Web site, www.usgs.gov/ohr/oars/, or contact Rob Hosinski at rhosinki@usgs.gov. The USGS is an Equal Opportunity Employer.

POSTDOCTORAL FELLOW
STRUCTURAL DIAGENESIS
BUREAU OF ECONOMIC GEOLOGY
UNIVERSITY OF TEXAS AT AUSTIN

The Bureau of Economic Geology at The University of Texas at Austin, Jackson School of Geosciences, invites applications for a postdoctoral position in structural diagenesis. The successful candidate will, as part of a multidisciplinary team, engage in research focused on the interaction of brittle fracture and diagenesis in sandstone oil and gas reservoirs. This position offers the opportunity to integrate geochemical and structural analyses and state-of-the-art microimaging with structural and diagenetic modeling to address chemical and physical processes of fracture opening and cementation. Applicants must have a Ph.D. in geology or in a related discipline. Preference will be given to applicants with a strong background in clastic diagenesis, with experience in any of the following techniques: sandstone petrography, fluid inclusion analysis of diagenetic minerals, microprobe analysis, and stable isotope analysis.

For a full description of the position and application details, please visit the employment opportunities section on www.beg.utexas.edu. Review of applications will begin 1 February 2007 and will continue until the position is filled.

The University of Texas at Austin is an Equal Opportunity/Affirmative Action Employer. All positions are security-sensitive; conviction verification conducted on applicants selected.

VISITING INSTRUCTOR/ASSISTANT PROFESSOR
ENVIRONMENTAL SCIENCE
SWEET BRIAR COLLEGE

Sweet Briar College seeks a full-time sabbatical replacement in the Environmental Studies department for the 2007–2008 academic year.

Applications are invited from candidates with specialties in environmental science, geography, geology, or related fields. Duties include teaching an introductory course in environmental issues, physical geography/geology with lab, geographic information systems (GIS), and an elective related to the candidate's specialty. Ability to teach climatology or meteorology is a plus. Ph.D. or ABD and demonstrated interest in undergraduate teaching are required.

Sweet Briar College (www.sbc.edu) is a small, selective liberal arts college for women with a beautiful 3250-acre campus in the foothills of the Blue Ridge Mountains of Virginia. For information about the department, see http://environment.sbc.edu/. Submit application letter, curriculum vitae, transcripts, statements of teaching and research interests, and arrange to have three letters of recommendation sent to Dr. Robert Alexander, Dept. of Environmental Studies, Sweet Briar College, Sweet

Briar, VA 24595, USA, ralexander@sbc.edu. Application review begins 16 February 2007. EOE.

POSTDOCTORAL RESEARCH ASSOCIATE
CIAR/UNIVERSITY OF ARIZONA/PENN STATE

We invite applications for a Postdoctoral Research Associate for an interdisciplinary study of wildfire in the geologic record using thermochronology, organic geochemistry, sedimentology, and modeling, applied to critical intervals of earth history. Experience in one or more of these areas and an aptitude for interdisciplinary and quantitative approaches are required. This position is funded in part by the Canadian Institute for Advanced Research (CIAR), and the successful applicant will participate in CIAR meetings and work jointly with researchers in Geosciences and allied programs at the University of Arizona and Penn State, under the supervision of Peter Reiners and Lee Kump, respectively. The position is for two years, starting 1 July 2007; a Ph.D. at the time of appointment is required. Interested applicants please apply online through the University of Arizona Human Resources Web page at https://www.uacareertrack.com/ for job number 36884. In addition to the electronic submission of the letter of interest and CV, please send a statement of research and contact information for at least three references to reiners0@email.arizona.edu. Please refer to Job Number 36884. Review of applications will begin 1 March 2007 and will continue until the position is filled. The University of Arizona is an EEO/AA Employer-M/W/D/V.

KEAN UNIVERSITY
DEPARTMENT OF GEOLOGY AND METEOROLOGY

Department of Geology and Meteorology—to teach introductory and advanced courses in geography and earth system science; to participate in interdisciplinary programs for the Urban Ecosystem Study initiative. Ph.D. in Physical Geography required, with an interest in earth systems science preferred. The Department offers degrees in Geology, Meteorology, Earth Systems Science, and General Earth Science with Teacher Certification. Research and teaching expertise in geovisualization/spatial decision support for the spatial, social and environmental sciences desirable. Position begins 1 Sept. 2007, candidacy begins immediately. Send letter of interest, CV, & 3 letters of reference to Dr. Robert Metz, Chair at rmetz@kean.edu or mail to department, 1000 Morris Ave, Union, NJ 07083, USA.

VISITING YOUNG SCIENTIST
DARTMOUTH COLLEGE

Visiting Young Scientist: A visiting appointment for a young scientist, recent Ph.D., is available at Dartmouth College. The appointment would be for 3 months during late academic 2006–2007 or academic '07–'08. The position would include teaching in one of the following Departments: Physics and Astronomy, Engineering, or Earth Sciences. Extension of appointment is possible for sponsored research projects. To qualify, candidates must be engaged in research related to space science, planetary science, astrophysics, remote sensing, aerospace technology, or technology dependent on space-based platforms. To apply, send a 1–2 page summary of teaching and research goals, curriculum vitae, and the names of three references to: Visiting Young Scientist, c/o Richard W. Birnie, Department of Earth Sciences, Dartmouth College, 6105 Fairchild Hall, Hanover, NH 03755-3571, USA. For more information, e-mail r.birnie@dartmouth.edu. Applications will be reviewed starting 1 March 2007. Position funded by NASA NH Space Grant. Dartmouth College is an equal opportunity/affirmative action employer.

VISITING ASSISTANT PROFESSOR OF GEOLOGY
CENTENARY COLLEGE OF LOUISIANA

Centenary College of Louisiana invites applications for a two-year position at the assistant professor or instructor level in the Department of Geology, beginning August 2007. We are seeking candidates who are interested in teaching geology in a liberal arts environment and involving undergraduate students in research experiences. Recent Ph.D.'s and ABD's are encouraged to apply. The teaching responsibilities will depend on the background of the successful candidate but should involve some subset of Physical Geology, Environmental Geology, Historical Geology, and Sedimentary Geology; a special topics course in the successful candidate's field of interest is also a possibility. Centenary College (**www.centenary.edu**) is a selective liberal arts institution with a student/faculty ratio of 12 to 1 and is a member of the Associated Colleges of the South (www.acs.org). The college has a $100 million endowment and is located in a metropolitan area with a population of more than 350,000. To apply, send a letter of application, statement of teaching philosophy, vita, copies of transcripts, and three letters of recommendation to: Dr. Scott Vetter, Chair, Department of Geology and Geography, Centenary College of Louisiana, P.O. Box 41188, Shreveport, LA 71134-1188, USA. Review of applications will begin 1 March. Centenary College of Louisiana recognizes that diversity is essential to its goal of providing an educational environment where students explore the unfamiliar, invent new approaches to understanding, and connect their work and lives to the world at large. We thus welcome applicants who would add to the college's diversity of ideas, beliefs, experiences, and cultural backgrounds. EOE.

INTERDISCIPLINARY RESEARCH GEOLOGIST
(SPATIAL ANALYST)
U.S. GEOLOGICAL SURVEY
SPOKANE, WASHINGTON, USA

The U.S. Geological Survey is seeking a full-time, term Research Geologist (Spatial Analyst) in Spokane, Washington. The Spokane office conducts interdisciplinary research that includes spatial analysis of geological, mineral resource, mineral-environmental, lithological, biological, climatic, and other data. We are seeking a highly motivated, intellectually-curious individual willing to adapt to new research questions that may be outside their professional training.

The successful candidate will analyze spatial phenomena and construct spatial and temporal models to develop a process-based understanding of earth systems. The candidate must have skill in designing, building, and using spatial and statistical or other mathematical models to analyze spatially-referenced data. A level of experience commensurate with a Ph.D. in earth sciences, spatial analysis, mathematics, physical geography, or other natural sciences is required. Extensive analytical experience using ESRI software is required.

The position is a four-year term with option to extend to five. Starting salary will range from $63,417 to $80,442, plus benefits, depending on qualifications. A recruitment incentive may apply. Must be a U.S. citizen. A complete description and application can be found at www.usgs.gov/ohr/oars/ as announcement WR-2007-0148. The opening date for application is 22 Jan. 2007 and closing is 21 Feb. 2007. For information about the position, contact Tom Frost at tfrost@usgs.gov. For information on how to apply, contact Rob Hosinski at rhosinski@usgs.gov. The USGS is an Equal Opportunity Employer.

ISES

***Announcement:* A Summer School in Integrated Solid Earth Sciences (ISES)**
Topic: Tectonic Exhumation
Sponsored by a grant from the National Science Foundation

Application Deadline: April 1, 2007
Decision date: April 15, 2007
Location: The Colorado College, Colorado Springs, CO.
Dates of school: July 27 to Aug. 3, 2007

A 7-day workshop for advanced graduate students addressing different aspects of tectonic exhumation. A panel of experts will present rapid advances in this topic from many different avenues of geological research (listed on website). The short course will also involve lectures, activities, and fieldtrips. More information is posted on the web site.

Topics: History of Uplift and Exhumation / Tectonic sedimentation / Thermochronology / Structural associations and controls / Metamorphic petrology / Numerical Approaches / Tectonic geomorphology.

Web site & on-line application: http://acad.coloradocollege.edu/dept/gy/ises/ISESSummerProgram.php

Applications will start being accepted on February 1, 2007.

For more information, please contact Basil Tikoff (basil@geology.wisc.edu) or Christine Siddoway (CSiddoway@ColoradoCollege.edu).

UNIVERSITY OF WYOMING

DISTINGUISHED PROFESSORSHIP IN GEOPHYSICS

The Department of Geology and Geophysics at the University of Wyoming invites applications for a Distinguished Professor of Geophysics. This is an Endowed Chair position in the Department and in the newly created School of Energy Resources (SER) at the University of Wyoming, an institute dedicated to energy-related teaching and research in support of state, national, and international energy-related activities. This appointment may be made at any rank, including Associate and Full Professor. The position can begin as soon as July 1, 2007.

We seek an internationally recognized individual who has the potential to develop an externally funded research program in reservoir imaging using 3-D seismic technology and/or reservoir characterization using petrophysical techniques. The successful candidate will be involved in the undergraduate and graduate teaching mission of the Department of Geology and Geophysics, and will complement and expand on departmental strengths not only in geophysics, but also in areas including structural geology/tectonics, sedimentary geology, and environmental geology. We seek a person with the ability to cooperate productively with other SER professors in geology and geophysics, mathematics, chemical and petroleum engineering, economics, and other energy-related fields. The SER is an ambitious, new state-funded institute that requires innovative, forefront researchers with the ability to produce benefits tangible to SER stakeholders and supporters. Information about the School of Energy Resources is available at uwyo.edu/SER. Additional information on the Department Geology and Geophysics can be obtained at home.gg.uwyo.edu.

Applications should include a statement of research and teaching interests and accomplishments, curriculum vitae, and the names and contact information for three individuals who can provide letters of evaluation. Preference will be given to candidates applying before March 1st 2007 and review of completed applications will begin immediately upon receipt; however, applications will be accepted until the position is filled. Send an electronic copy of your application to: Ms. Carol Pribyl at cpribyl@uwyo.edu; if you have additional application materials to send, please direct them to the Geophysics Search Committee, Department of Geology and Geophysics, University of Wyoming, 1000 East University Avenue, Dept. 3006, Laramie, WY 82071-2000.

The University of Wyoming is an equal opportunity/affirmative action employer.

CLASSIFIED ADVERTISING

JOSEPH P. OBERING POSTDOCTORAL FELLOWSHIP
DARTMOUTH COLLEGE

The Department of Earth Sciences seeks outstanding candidates for the Joseph P. Obering Postdoctoral Fellowship in Earth Sciences at Dartmouth College. This competitive fellowship provides two years of full-time salary and a research allowance, with a third year contingent upon performance and funding. In concert with Dartmouth's philosophy that scholarship and teaching are inseparable facets of academic life, this fellowship provides recent Ph.D. recipients the opportunity to pursue independent research as well as develop a teaching portfolio. Candidates will be expected to collaborate with one or more Dartmouth Earth Sciences faculty members, taking advantage of existing resources and facilities, and will teach one course (quarter) per year. The starting date is negotiable, but could be as early as 1 July 2007. Details about our program can be found at www.dartmouth.edu/~earthsci.

Candidates should submit a CV, statements of research and teaching interests, and selected reprints by 1 March 2007. Applications should be sent by mail to Obering Postdoctoral Fellowship Committee, Department of Earth Sciences, Dartmouth College, 6105 Fairchild Hall, Hanover, NH 03755, USA, or by e-mail to earth.sciences@dartmouth.edu. In addition, applicants should arrange for three letters of recommendation to be sent directly to the above addresses. Dartmouth College is an EO/AA Employer.

ECONOMIC GEOLOGIST, ASSESSMENTS (RESEARCH GEOLOGIST)
U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey is seeking a full-time, term Economic Geologist, Assessments in Tucson, Ariz., or Menlo Park, Calif.

The main purposes of this position are to conduct mineral resource and geologic investigations that support mineral resource assessments, and to collaborate with other scientists in planning, organizing, conducting, and reporting mineral resource assessments, both domestic and foreign, that range in scope from local to national. The emphasis in mineral resource and geologic investigations is on improved assessment of concealed mineral resources. A level of experience commensurate with a Ph.D. in earth-sciences is desired.

The position is a four-year term with option to extend to five. Starting salary will range from $62,291 to $84,713 plus benefits, depending on experience and location. No relocation expenses will be available. Candidates must be U.S. citizens. The job will be listed on the USGS Online Automated Recruitment System (OARS) Web site as a Research Geologist GS-1350-12/13 under announcement number WR-2007-0141. The opening date for applications is anticipated to be 15 Jan. 2007. The closing date is 14 Feb. 2007. A complete description of the position and on-line application can be found at www.usgs.gov/ohr/oars/. For additional information about the position, contact Bob Kamilli at bkamilli@usgs.gov. For information on how to apply, contact Rob Hosinski at rhosinki@usgs.gov. The USGS is an Equal Opportunity Employer.

HYDROLOGY FACULTY AT NM TECH
ASSISTANT PROFESSOR OF HYDROLOGY

New Mexico Institute of Mining and Technology invites applications for a tenure-track position in the Hydrology Program. The position is a joint appointment between the Department of Earth and Environmental Science and the Geophysical Research Center, a state-funded research agency.

Applicants should have a Ph.D. in Earth Sciences, Civil or Environmental Engineering, or a related field at the time of appointment. We seek candidates with interest in combining hydrological modeling and field studies. Areas of particular interest include, but are not limited to, hydrogeology, karst hydrology, sedimentary-basin hydrology, and hydrological remote sensing/GIS. Potential for excellence in teaching and research are the most important qualifications. Women and underrepresented minorities are encouraged to apply.

Responsibilities will include developing an active program of extramurally funded research, supervising and supporting graduate students, and teaching two graduate or undergraduate courses per year.

The successful candidate will join a program of six full-time Hydrology faculty, eight adjunct faculty, and 30 graduate students. Hydrology is part of the Department of Earth and Environmental Science, consisting of 21 faculty and 150–120 undergraduate and graduate students. Additional geoscience professionals on campus include over 30 staff members of the Bureau of Geology and Mineral Resources, New Mexico's geological survey. For further information on the position and on New Mexico Tech see www.ees.nmt.edu/professional_ops.html

For detailed inquiries, contact search committee co-chairs, Fred Phillips (phillips@nmt.edu) and/or Enrique Vivoni (vivoni@nmt.edu).

Applicants should submit a letter of interest, resume, a statement of teaching and research interests, and the names of three references to Hydrology Search, Human Resources, Box 96, New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801, USA. College transcripts will be required if selected to interview. Applications will be reviewed as received. Email applications are not accepted. New Mexico Tech is an equal opportunity/affirmative action employer.

TENURE-TRACK PROFESSOR, UNION COLLEGE

The Geology Department at Union College seeks to fill a tenure track line at the Assistant or Senior Assistant Professor level in Petrology/Structure with an anticipated starting date of September 2007. We seek a dynamic teacher and scholar capable of teaching introductory geology courses as well as two or three of the following areas: Petrology, Mineralogy, Geochemistry, Structure, Geophysics, Tectonics, and Economic geology.

The specific area of research is broadly defined as Petrology/Structure. We are interested in candidates with research amenable to undergraduate involvement. Ideally the research focus should include a field component as well as laboratory measurements that can be accomplished in an undergraduate setting by undergraduates. The research statement in the application should clearly and directly state a research plan that would be implemented. A Ph.D. is required at the time of the appointment.

Union College is a selective liberal arts college with a strong tradition of science and engineering at the undergraduate level. The Geology Department is a member of the Keck Geology Consortium, and is very well equipped with analytical instrumentation that includes an ICP-MS, two ion chromatographs, fission track lab, a wide variety of sample prep and geophysical equipment, core analysis lab, and a new SEM system on order (with EDX and CL). The Geology Department has a strong record of student-faculty research. More information about Union College is available on the Web at www.union.edu.

We will begin reviewing applications starting on 1 March 2007. To apply, please send a cover letter along with resume, list of publications, teaching, and research statements, and a list of contact details for three references. Send application material to: John I. Garver, Chair, Department of Geology, Union College, 807 Union St., Schenectady NY 12308-2311, USA.

Union College is an equal opportunity employer and strongly committed to student and workforce diversity

BELOIT COLLEGE
VISITING ASSISTANT PROFESSOR OF GEOLOGY
GEOMORPHOLOGY/PALEOCLIMATOLOGY

Beloit College invites applications for an anticipated full-time, one-year sabbatical replacement, beginning mid-August 2007. Applicants should be environmental geologists, with expertise in geomorphology or paleoclimatology. The successful candidate will teach four laboratory courses over the year. Courses will consist of two offerings of an introductory course in environmental geology, and two courses from the following: geomorphology, paleoclimatology, and interdisciplinary applications of GIS. The successful candidate will also be expected to supervise undergraduate research projects.

Beloit College is a selective undergraduate liberal-arts college with an enrollment of 1250 students. The college emphasizes excellence in teaching, breadth and versatility in its faculty, and collaborative research between students and faculty. The department is a member of the Keck Geology Consortium. The city of Beloit is located in southern Wisconsin, close to Madison, Milwaukee, and Chicago.

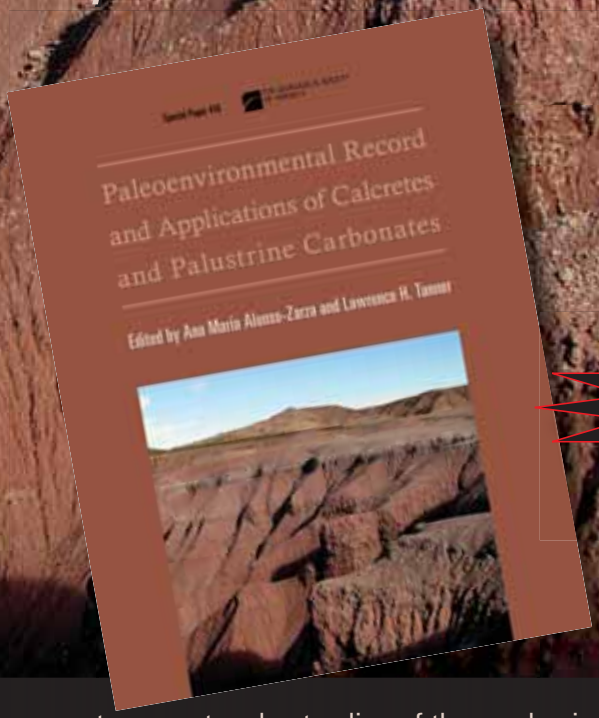
Applicants should have a Ph.D. by the time of appointment. Send a letter of application, a statement of teaching and research interests, a vita, college-level transcripts, and three letters of reference to Carl Mendelson, Geology Search Committee, Beloit College, 700 College St., Beloit, WI 53511, USA. This position will remain open until filled; to ensure full consideration, submit materials by 1 March 2007. Inquiries may be directed to Prof. Mendelson (+1-608-363-2223 or mendelson@beloit.edu). More information about the department may be found at geology.beloit.edu.

Beloit College is committed to the educational benefits of diversity and urges all interested individuals to apply.

AA/EEO Employer.

Paleoenvironmental Record and Applications of Calcretes and Palustrine Carbonates

Edited by Ana María Alonso-Zarza and Lawrence H. Tanner



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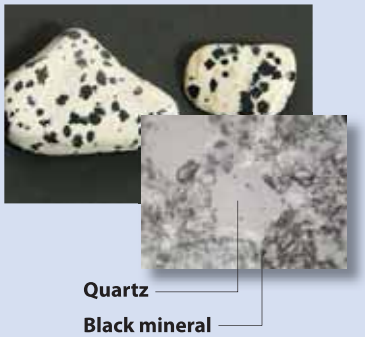

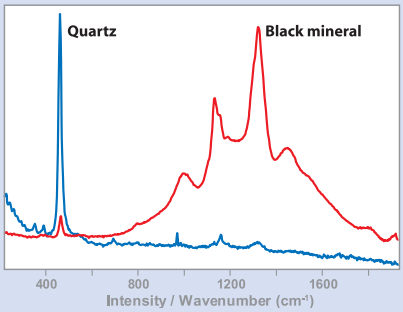

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