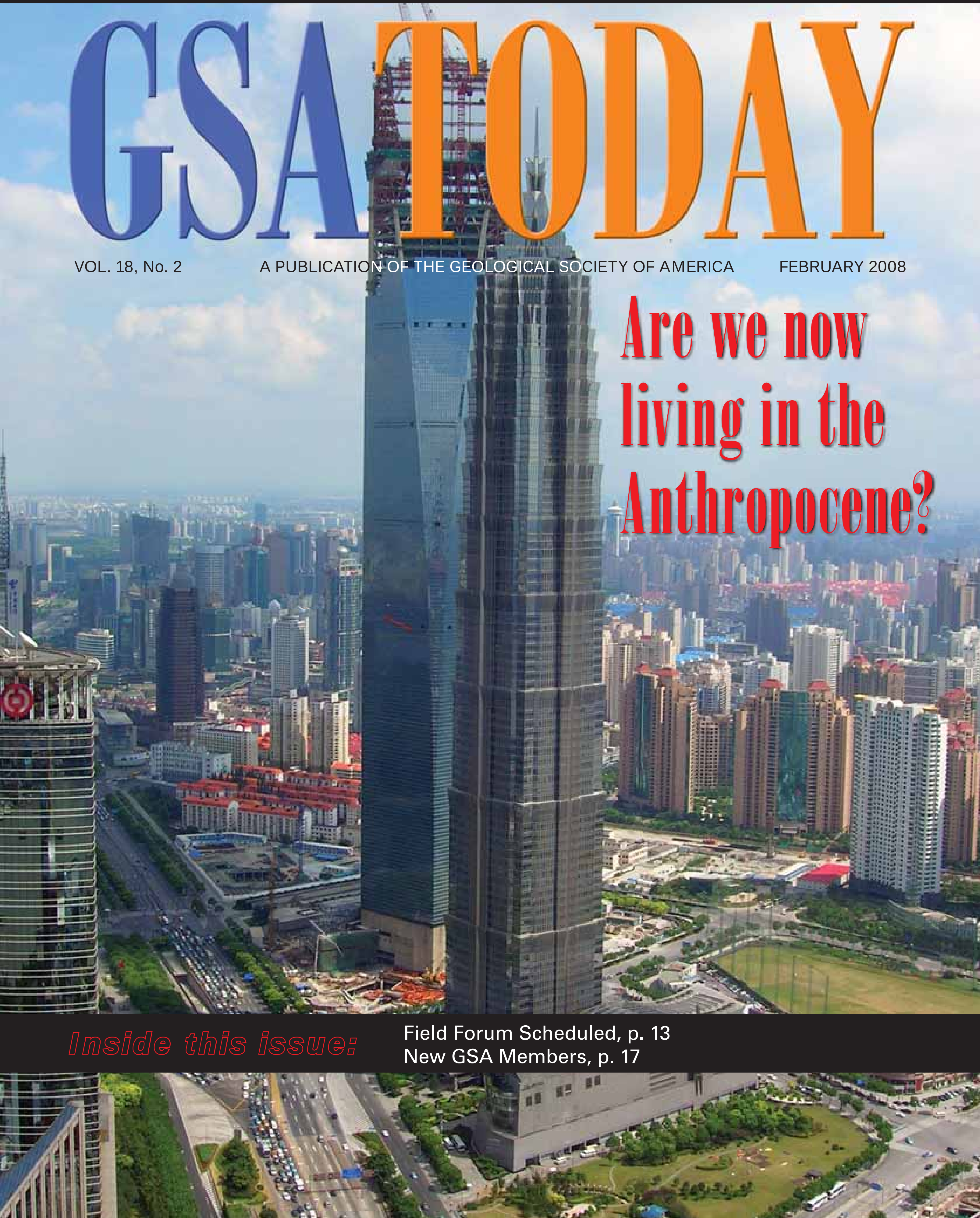
GSA TODAY

VOL. 18, No. 2 — A PUBLICATION OF THE GEOLOGICAL SOCIETY OF AMERICA — FEBRUARY 2008



Are we now living in the Anthropocene?

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GSA TODAY (ISSN 1052-5173 USPS 0456-530) is published 11 times per year, monthly, with a combined April/May issue, by The Geological Society of America®, Inc., with offices at 3300 Penrose Place, Boulder, Colorado. Mailing address: P.O. Box 9140, Boulder, CO 80301-9140, USA. Periodicals postage paid at Boulder, Colorado, and at additional mailing offices. Postmaster: Send address changes to *GSA Today*, GSA Sales and Service, P.O. Box 9140, Boulder, CO 80301-9140.

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VOLUME 18, NUMBER 2 ▲ FEBRUARY 2008

SCIENCE ARTICLE

Cover: Shanghai in September 2007. The world's rapidly growing megacities are highly visible symbols of the transformation of Earth's surface by humankind. Photo by Mark Williams. See "Are we now living in the Anthropocene?" by Zalasiewicz et al., p. 4–8.

Are we now living in the Anthropocene?

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ABSTRACT

The term *Anthropocene*, proposed and increasingly employed to denote the current interval of anthropogenic global environmental change, may be discussed on stratigraphic grounds. A case can be made for its consideration as a formal epoch in that, since the start of the Industrial Revolution, Earth has endured changes sufficient to leave a global stratigraphic signature distinct from that of the Holocene or of previous Pleistocene interglacial phases, encompassing novel biotic, sedimentary, and geochemical change. These changes, although likely only in their initial phases, are sufficiently distinct and robustly established for suggestions of a Holocene–Anthropocene boundary in the recent historical past to be geologically reasonable. The boundary may be defined either via Global Stratigraphic Section and Point ("golden spike") locations or by adopting a numerical date. Formal adoption of this term in the near future will largely depend on its utility, particularly to earth scientists working on late Holocene successions. This datum, from the perspective of the far future, will most probably approximate a distinctive stratigraphic boundary.

INTRODUCTION

In 2002, Paul Crutzen, the Nobel Prize–winning chemist, suggested that we had left the Holocene and had entered a new Epoch—the Anthropocene—because of the global environmental effects of increased human population and economic development. The term has entered the geological literature informally (e.g., Steffen et al., 2004; Syvitski et al., 2005; Crossland, 2005; Andersson et al., 2005) to denote the contemporary global environment dominated by human activity. Here, members of the Stratigraphy Commission of the Geological Society of London amplify and extend the discussion of the effects referred to by Crutzen and then apply the same criteria used to set up new epochs to ask whether there really is justification or need for a new term, and if so, where and how its boundary might be placed.

THE HOLOCENE

The Holocene is the latest of many Quaternary interglacial phases and the only one to be accorded the status of an epoch; it is also the only unit in the whole of the Phanerozoic—the past 542 m.y.—whose base is defined in terms of numbers of years from the present, taken as 10,000 radiocarbon years before 1950. The bases of all other periods, epochs, and ages from the Cambrian onward are defined by—or shortly will be defined by—"golden spikes" (Gradstein et al., 2004), in which a suitable section is chosen as a Global Stratotype Section, the "golden spike" being placed at an agreed point within it, giving rise to a Global Stratigraphic Section and Point, or GSSP.

To bring the definition of the base of the Holocene into line with all other Phanerozoic boundaries, there are intentions to create a GSSP for the base of the Holocene in an ice core, specifically in the North Greenland Ice Core Project (NGRIP) ice core, at the beginning of an interval at which deuterium values (a proxy for local air temperature) rise, an event rapidly followed by a marked decrease in dust levels and an increase in ice layer thickness (ICS, 2006). This level lies very near the beginning of the changes that ushered in interglacial conditions, but is some 1700 yr older than the current definition for the base of the Holocene. One might question whether ice is a suitably permanent material, but in this instance it is important that the GSSP is a tangible horizon within a stratigraphic sequence, a "time plane" marking an elapsed, distinctive, and correlatable geological event rather than an arbitrary or "abstract" numerical age. We note here, though (and discuss further below), that this logic need not *necessarily* be followed in any putative definition of the beginning of the Anthropocene.

The early Holocene was a time of pronounced rises in global temperature, stabilizing at ca. 11,000 cal. yr B.P., and sea level, stabilizing at ca. 8000 cal. yr B.P. (Fig. 1). Temperatures and sea

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level then reached a marked plateau where they have, until very recently, remained. This climate plateau, though modulated by millennial-scale global temperature oscillations of ~1 °C amplitude, represents the longest interval of stability of climate and sea level in at least the past 400,000 yr. This stability has been a significant factor in the development of human civilization.

HUMAN INFLUENCE ON HOLOCENE CLIMATE AND ENVIRONMENT

Prior to the Industrial Revolution, the global human population was some 300 million at A.D. 1000, 500 million at A.D. 1500, and 790 million by A.D. 1750 (United Nations, 1999), and exploitation of energy was limited mostly to firewood and muscle power. Evidence recorded in Holocene strata indicates increasing levels of human influence, though human remains and artifacts are mostly rare. Stratigraphic signals from the mid-part of the epoch in areas settled by humans are predominantly biotic (pollen of weeds and cultivars following land clearance for agriculture) with more ambiguous sedimentary signals (such as sediment pulses from deforested regions). Atmospheric lead pollution is registered in polar ice caps and peat bog deposits from Greco-Roman times onward (Dunlap et al., 1999; Paula and Geraldes, 2003), and it has been argued that the early to mid-Holocene increase in atmospheric carbon dioxide from ~260–280 ppm, a factor in the climatic warmth of this interval, resulted from forest clearance by humans (Ruddiman, 2003). Human activity then may help characterize Holocene strata, but it did not create new, global environmental conditions that could translate into a fundamentally different stratigraphic signal.

From the beginning of the Industrial Revolution to the present day, global human population has climbed rapidly from under a billion to its current 6.5 billion (Fig. 1), and it continues to rise. The exploitation of coal, oil, and gas in particular has enabled planet-wide industrialization, construction, and mass transport, the ensuing changes encompassing a wide variety of phenomena, summarized as follows.

Changes to Physical Sedimentation

Humans have caused a dramatic increase in erosion and the denudation of the continents, both directly, through agriculture and construction, and indirectly, by damming most major rivers, that now exceeds natural sediment production by an order of magnitude (Hooke, 2000; Wilkinson, 2005; Syvitski et al., 2005; see Fig. 1). This equates to a distinct lithostratigraphic signal, particularly when considered alongside the preservable human artifacts (e.g., the “Made Ground” of British Geological Survey maps) associated with accelerated industrialization.

Carbon Cycle Perturbation and Temperature

Carbon dioxide levels (379 ppm in 2005) are over a third higher than in pre-industrial times and at any time in the past 0.9 m.y. (IPCC, 2007; EPICA community members, 2004). Conservatively, these levels are predicted to double by the end of the twenty-first century (IPCC, 2007). Methane concentrations in the atmosphere have already roughly doubled. These changes have been considerably more rapid than those associated with glacial-interglacial transitions (Fig. 1; cf. Monnin et al., 2001).

Global temperature has lagged behind this increase in greenhouse gas levels, perhaps as a result of industrially derived sulfate aerosols (the “global dimming” effect; Coakley, 2005).

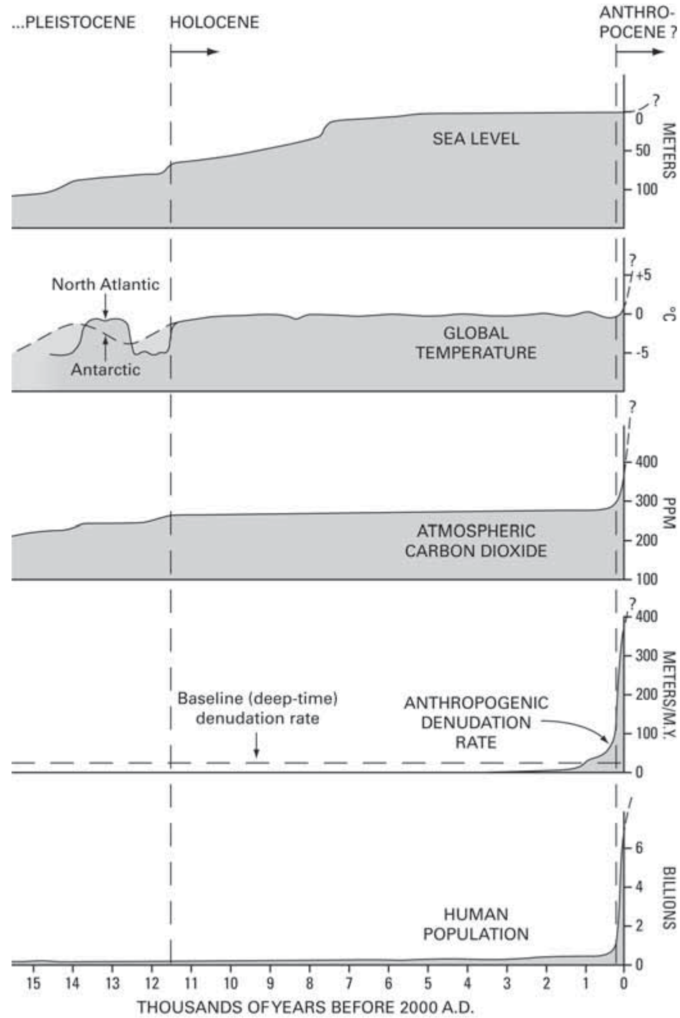

Figure 1. Comparison of some major stratigraphically significant trends over the past 15,000 yr. Trends typical of the bulk of immediately pre-Holocene and Holocene time are compared with those of the past two centuries. Data compiled from sources including Hooke (1994), Monnin et al. (2001), Wilkinson (2005), and Behre (2007).

Nevertheless, temperatures in the past century rose overall, the rate of increase accelerating in the past two decades (Fig. 1). There is now scientific consensus that anthropogenic carbon emissions are the cause (King, 2004; IPCC, 2007). Temperature is predicted to rise by 1.1 °C to 6.4 °C by the end of this century (IPCC, 2007), leading to global temperatures not encountered since the Tertiary. The predicted temperatures are similar to the estimated 5 °C average global temperature rises in the Toarcian (ca. 180 Ma) and at the Paleocene-Eocene thermal maximum (PETM, ca. 56 Ma), which were most probably linked to natural carbon releases into the atmosphere (Thomas et al., 2002; Kemp et al., 2005). While the likely societal effects are clear, in our present analysis we focus on the stratigraphic consequences of increased temperature.

Biotic Change

Humans have caused extinctions of animal and plant species, possibly as early as the late Pleistocene, with the disappearance of a large proportion of the terrestrial megafauna

(Barnosky et al., 2004). Accelerated extinctions and biotic population declines on land have spread into the shallow seas, notably on coral reefs (Bellwood et al., 2004) and the oceans (Baum et al., 2003; Myers and Worm, 2003). The rate of biotic change may produce a major extinction event (Wilson, 2002) analogous to those that took place at the K-T boundary and elsewhere in the stratigraphic column.

The projected temperature rise will certainly cause changes in habitat beyond environmental tolerance for many taxa (Thomas et al., 2004). The effects will be more severe than in past glacial-interglacial transitions because, with the anthropogenic fragmentation of natural ecosystems, "escape" routes are fewer.

The combination of extinctions, global species migrations (Cox, 2004), and the widespread replacement of natural vegetation with agricultural monocultures is producing a distinctive contemporary biostratigraphic signal. These effects are permanent, as future evolution will take place from surviving (and frequently anthropogenically relocated) stocks.

Ocean Changes

Pre-industrial mid- to late Holocene sea-level stability has followed an ~120 m rise from the late Pleistocene level (Fig. 1). Slight rises in sea level have been noted over the past century, ascribed to a combination of ice melt and thermal expansion of the oceans (IPCC, 2007). The rate and extent of near-future sea-level rise depends on a range of factors that affect snow production and ice melt; the IPCC (2007) predicted a 0.19–0.58 m rise by 2100. This prediction does not factor in recent evidence of dynamic ice-sheet behavior and accelerating ice loss (Rignot and Thomas, 2002; Overpeck et al., 2006; Hansen et al., 2007) possibly analogous to those preceding "Heinrich events" of the late Pleistocene and early Holocene, when repeated episodes of ice-sheet collapse (Bond et al., 1992) caused concomitant rapid sea-level rise (Blanchon and Shaw, 1995). Current predictions are short-term, while changes to the final equilibrium state may be as large as a 10–30 m sea-level rise per 1 °C temperature rise (Rahmstorf, 2007).

Relative to pre–Industrial Revolution oceans, surface ocean waters are now 0.1 pH units more acidic due to anthropogenic carbon release (Caldeira and Wickett, 2003), a change echoed in the stable carbon isotope composition of contemporary foraminiferal tests (Al-Rousan et al., 2004). The future amount of this acidification, scaled to projected future carbon emissions, its spread through the ocean water column, and its eventual neutralization (over many millennia) has been modeled (Barker et al., 2003). Projected effects will be physical (neutralization of the excess acid by dissolution of ocean-floor carbonate sediment, hence creating a widespread nonsequence) and biological (hindering carbonate-secreting organisms in building their skeletons), with potentially severe effects in both benthic (especially coral reef) and planktonic settings (Riebesell et al., 2000; Orr et al., 2005). A similar acidification event accompanied the PETM at ca. 56 Ma, and, indeed, its effect in dissolving strata has hindered the precise deciphering of that event (Zachos et al., 2005).

COMPARISON WITH PREVIOUS INTERGLACIALS

The sensitivity of climate to greenhouse gases, and the scale of (historically) modern biotic change, makes it likely that we have entered a stratigraphic interval without close parallel in any previous Quaternary interglacial. The nearest parallels seem to be earlier episodes of high atmospheric pCO_2 and global warming (e.g., Toarcian; the PETM), but the ice volumes then were small, and melting caused only modest sea-level rises (~20 m at the PETM, partly through thermal expansion; Speijer and Marsi, 2002; Speijer and Wagner, 2002). The mid-Pliocene, at 3 Ma, may be a closer analogue: atmospheric pCO_2 levels may have reached 380 ppm, and the polar ice caps were somewhat smaller than present, with global sea level higher by 10–20 m (Dowsett et al., 1999; Dowsett, 2007).

The present interval might evolve into the "super-interglacial" envisaged by Broecker (1987), with Earth reverting to climates and sea levels last seen in warmer phases of the Miocene or Pliocene (Haywood et al., 2005), most likely achieved via a geologically abrupt rearrangement of the ocean-atmosphere system (Broecker, 1997; Schneider, 2004). Such a warm phase will likely last considerably longer than normal Quaternary interglacials. It is not clear that an equilibrium comparable to that of pre-industrial Quaternary time will eventually resume.

STRATIGRAPHIC CRITERIA

Formal subdivision of the Phanerozoic timescale is not simply a numerical exercise of parceling up time into units of equal length akin to the centuries and millennia of recent history. Rather, the geological timescale is based upon recognizing distinctive events within strata. Time may be divided into specific, recognizable phases in Earth's environmental history (in particular as regards biota, climate, and sea level), akin to the use of royal dynasties to denote periods of human history (e.g., the Victorian period of the nineteenth and earliest twentieth centuries). Such concepts of the "naturalness" of boundaries underlie, for example, the current debates on the positioning of the boundary of the Quaternary period (Gibbard et al., 2005) and on subdivision of the Precambrian (Bleeker, 2004).

Geologically, units of equivalent rank do not necessarily have to be of equivalent time span, particularly as the present is approached. Thus, the Quaternary, whether its beginning is placed at 1.8 Ma or 2.6 Ma, is by an order of magnitude the shortest period, while the Holocene, at a little under 12,000 calendar years (ICS, 2006) is, by at least two orders of magnitude, the shortest epoch. This inequality has not been seriously disputed, partly because of its practical usefulness. The preceding discussion makes clear that we have entered a distinctive phase of Earth's evolution that satisfies geologists' criteria for its recognition as a distinctive stratigraphic unit, to which the name Anthropocene has already been informally given.

We consider it most reasonable for this new unit to be considered at epoch level. It is true that the long-term consequences of anthropogenic change *might* be of sufficient magnitude to precipitate the return of "Tertiary" levels of ice volume, sea level, and global temperature that may then persist over several eccentricity (100 k.y.) cycles (e.g., Tyrrell et al., 2007). This, especially in combination with a major extinction event, would effectively bring the Quaternary period to an end. However, given the large uncertainties in the future trajectory of climate and biodiversity, and the large and currently unpredictable action of feedbacks in the earth system, we prefer to remain conservative. Thus, while there is strong evidence to suggest that we are no longer living in the Holocene (as regards the processes affecting the production and character of contemporary strata), it is too early to state whether or not the Quaternary has come to an end.

GOLDEN SPIKE OR YEARS?

For a new epoch to be formally established, either a GSSP needs to be selected or a date for its inception needs to be accepted, which is then ratified by the International Commission on Stratigraphy (ICS). Because it should be possible to select a stratigraphic unit whose age is known in years, the Anthropocene can be defined simultaneously by both criteria, without the uncertainty that bedevils attempts to date older GSSPs. In theory, a point in a section, or a date, that coincides with the end of the pre-industrial Holocene could be selected. However, given that India and China are currently undergoing their own industrial revolution, the selection of a horizon marking the end of pre-industrial (western) history may be inappropriate. Potential GSSPs and ages should allow stratigraphic resolution to annual level, and may be best located in ice cores or stagnant-lake basin cores.

One may consider using the rise of CO_2 levels above background levels as a marker, roughly at the beginning of the Industrial Revolution in the West (following Crutzen, 2002), or the stable carbon isotope changes reflecting the influx of anthropogenic carbon (Al-Rousan et al., 2004). However, although abrupt on centennial-millennial timescales, these changes are too gradual to provide useful markers at an annual or decadal level (while the CO_2 record in ice cores, also, is offset from that of the enclosing ice layers by the time taken to isolate the air bubbles from the atmosphere during compaction of the snow).

From a practical viewpoint, a globally identifiable level is provided by the global spread of radioactive isotopes created by the atomic bomb tests of the 1960s; however, this post-dates the major inflection in global human activity. Perhaps the best stratigraphic marker near the beginning of the nineteenth century has a natural cause: the eruption of Mount Tambora in April 1815, which produced the “year without a summer” in the Northern Hemisphere and left a marked aerosol sulfate “spike” in ice layers in both Greenland and Antarctica and a distinct signal in the dendrochronological record (Oppenheimer, 2003).

In the case of the Anthropocene, however, it is not clear that—for current practical purposes—a GSSP is immediately necessary. At the level of resolution sought, and at this temporal distance, it may be that simply selecting a numerical age (say the beginning of 1800) may be an equally effective practical measure. This would allow (for the present and near future) simple and unambiguous correlation of the stratigraphical and historical records and give consistent utility and meaning to this as yet informal (but increasingly used) term.

CONCLUSIONS

Sufficient evidence has emerged of stratigraphically significant change (both elapsed and imminent) for recognition of the Anthropocene—currently a vivid yet informal metaphor of global environmental change—as a new geological epoch to be considered for formalization by international discussion. The base of the Anthropocene may be defined by a GSSP in sediments or ice cores or simply by a numerical date.

ACKNOWLEDGMENTS

R. Knox, J. Powell, Colin Waters, and P. Stone publish with the permission of the Director, British Geological Survey (National Environmental Research Council). We thank W. Ruddiman, F. Gradstein, and an anonymous referee for useful criticism of an earlier version of this paper.

REFERENCES CITED

Al-Rousan, S., Pätzold, J., Al-Moghrabi, S., and Wefer, G., 2004, Invasion of anthropogenic CO_2 recorded in planktonic foraminifera from the northern Gulf of Aquaba: International Journal of Earth Sciences, v. 93, p. 1066–1076, doi: 10.1007/s00531-004-0433-4.

Andersson, A.J., Mackenzie, F.T., and Lerman, A., 2005, Coastal ocean and carbonate systems in the high CO_2 world of the Anthropocene: American Journal of Science, v. 305, p. 875–918, doi: 10.2475/ajs.305.9.875.

Barker, S., Higgins, J.A., and Elderfield, H., 2003, The future of the carbon cycle: review, calcification response, ballast and feedback on atmospheric CO_2: Philosophical Transactions of the Royal Society of London–A, v. A361, p. 1977–1999.

Barnosky, A.D., Koch, P.L., Feranec, R.S., Wing, S.L., and Shabel, A.B., 2004, Assessing the causes of Late Pleistocene extinctions on the continents: Science, v. 306, p. 70–75, doi: 10.1126/science.1101476.

Baum, J.K., Myers, R.A., Kehler, D.K., Worm, B., Harley, S.H., and Doherty, P.A., 2003, Collapse and conservation of shark populations in the northwest Atlantic: Science, v. 299, p. 389–392, doi: 10.1126/science.1079777.

Behre, K.-E., 2007, A new Holocene sea-level curve for the southern North Sea: Boreas, v. 36, p. 82–102.

Bellwood, D.R., Hughes, T.P., and Nystrom, N., 2004, Confronting the coral reef crisis: Nature, v. 429, p. 827–833, doi: 10.1038/nature02691.

Blanchon, P., and Shaw, J., 1995, Reef drowning during the last glaciation: Evidence for catastrophic sea-level rise and ice-sheet collapse: Geology, v. 23, p. 4–8, doi: 10.1130/0091-7613(1995)023<0004:RDDTLD>2.3.CO;2.

Bleeker, W., 2004, Towards a ‘natural’ time scale for the Precambrian—A proposal: Lethaia, v. 37, p. 219–222, doi: 10.1080/00241160410006456.

Bond, G., Heinrich, H., Broecker, W., Labeyrie, L., McManus, J., Andrews, J., Huon, S., Jantschik, R., Clasen, S., Simet, C., Tedesco, K., Klas, M., Bonani, G., and Ivy, S., 1992, Evidence of massive discharge of icebergs into the North Atlantic Ocean during the last glacial period: Nature, v. 360, p. 245–249, doi: 10.1038/360245a0.

Broecker, W.S., 1987, How to build a habitable planet: New York, Eldigio Press, 291 p.

Broecker, W.S., 1997, Thermohaline circulation, the Achilles heel of our climate system: Will man-made CO_2 upset the current balance?: Science, v. 278, p. 1582–1588, doi: 10.1126/science.278.5343.1582.

Caldeira, K., and Wickett, M.E., 2003, Anthropogenic carbon and ocean pH: Nature, v. 425, p. 365, doi: 10.1038/425365a.

Coakley, J., 2005, Reflections on aerosol cooling: Nature, v. 438, p. 1091–1092, doi: 10.1038/4381091a.

Cox, G.W., 2004, Alien species and evolution: The evolutionary ecology of exotic plants, animals, microbes and interacting native species: Washington, D.C., Island Press, 377 p.

Crossland, C.J., ed., 2005, Coastal fluxes in the Anthropocene: Berlin, Springer, 231 p.

Crutzen, P.J., 2002, Geology of mankind: Nature, v. 415, p. 23, doi: 10.1038/415023a.

Dowsett, H.J., 2007, The PRISM paleoclimate reconstruction and Pliocene sea-surface temperature, *in* Williams, M., Haywood, A.M., Gregory, F.J., and Schmidt, D.N., Deep-time perspectives on climate change: Marrying the signal from computer models and biological proxies: London, The Geological Society, Micropaleontological Society Special Publications, p. 459–480.

Dowsett, H.J., Barron, J.A., Poore, R.Z., Thompson, R.S., Cronin, T.M., Ishman, S.E., and Willard, D.A., 1999, Middle Pliocene paleoenvironmental reconstruction: PRISM2: U.S. Geological Survey Open-File Report 99-535, 19 p.

Dunlap, C.E., Steinnes, E., and Flegal, A.R., 1999, A synthesis of lead isotopes in two millennia of European air: Earth and Planetary Science Letters, v. 167, p. 81–88, doi: 10.1016/S0012-821X(99)00020-5.

EPICA (European Project for Ice Coring in Antarctica) community members, 2004, Eight glacial cycles from an Antarctic ice core: Nature, v. 429, p. 623–628.

Gibbard, P.L., Smith, A.G., Zalasiewicz, J.A., Barry, T.L., Cantrill, D., Coe, A.L., Cope, J.C.W., Gale, A.S., Gregory, F.J., Powell, J.H., Rawson, P.R., Stone, P., and Waters, C.W., 2005, What status for the Quaternary?: Boreas, v. 34, p. 1–6, doi: 10.1080/03009480510012854.

Gradstein, F.M., Ogg, J.G., and Smith, A.G., eds., 2004, A Geological Time Scale 2004: Cambridge, UK, Cambridge University Press, 589 p.

Hansen, J., Sato, M., Kharecha, P., Russell, G., Lea, D.A., and Siddall, M., 2007, Climate change and trace gases: Philosophical Transactions of the Royal Society, v. A365, p. 1925–1954.

Haywood, A.M., Dekens, P., Ravelo, A.C., and Williams, M., 2005, Warmer tropics during the mid-Pliocene? Evidence from alkenone paleothermometry and a fully coupled ocean-atmosphere GCM: Geochemistry Geophysics Geosystems, v. 6, doi: 10.1029/2004GC000799.

Hooke, R.LeB., 2000, On the history of humans as geomorphic agents: Geology, v. 28, p. 843–846, doi: 10.1130/0091-7613(2000)28<843:OTHOHA>2.0.CO;2.

ICS (International Commission on Stratigraphy), 2006, Subcommission on Quaternary

Stratigraphy, Annual Report 2006: http://www.quaternary.stratigraphy.org.uk/about/annualreports/annrepindex.html (last accessed 28 Apr. 2007).
IPCC (Intergovernmental Panel on Climate Change), 2007, Climate change 2007: Synthesis report. Summary for policy makers: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf (last accessed 3 Dec. 2007).
Kemp, D.B., Coe, A.L., Cohen, A.S., and Schwark, L., 2005, Astronomical pacing of methane release in the Early Jurassic Period: Nature, v. 437, p. 396–399, doi: 10.1038/nature04037.
King, D.A., 2004, Climate change science: Science, v. 303, p. 176–177, doi: 10.1126/science.1094329.
Monnin, E., Indermühle, A., Dällenbach, A., Flückiger, J., Stauffer, B., Stocker, T.S., Reynaud, D., and Barnola, J.-M., 2001, Atmospheric CO_2 concentrations over the Last Glacial Termination: Science, v. 291, p. 112–114, doi: 10.1126/science.291.5501.112.
Myers, R.A., and Worm, B., 2003, Rapid worldwide depletion of predatory fish communities: Nature, v. 423, p. 280–283, doi: 10.1038/nature01610.
Oppenheimer, C., 2003, Climatic, environmental and human consequences of the largest known historical eruption: Tambora volcano (Indonesia) 1815: Progress in Physical Geography, v. 27, p. 230–259, doi: 10.1191/0309133303pp379ra.
Orr, J.C., Fabry, V.J., Aumont, O., Bopp, L., Doney, S.C., Feely, R.A., Gnanadesikan, A., Gruber, N., Ishida, A., Joos, F., Key, R.M., Lindsay, K., Maier-Reimer, E., Matear, R., Monfray, P., Mouchet, A., Najjar, R.G., Plattner, G.-K., Rodgers, K.B., Sabine, C.L., Sarmiento, J.L., Schlitzer, R., Slater, R.D., Totterdell, I.J., Weirig, M.-F., Yamanaka, Y., and Yool, A., 2005, Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms: Nature, v. 437, p. 681–686, doi: 10.1038/nature04095.
Overpeck, J.T., Otto-Bliesner, B.L., Miller, G.H., Muhs, D.R., Alley, R.B., and Kiehl, J.T., 2006, Paleoclimatic evidence for future ice-sheet instability and rapid sea-level rise: Science, v. 311, p. 1747–1750, doi: 10.1126/science.1115159.
Paula, A.H., and Geraldes, M.C., 2003, Holocene Pb isotope chronological standard curve: A review of the record of the anthropogenic activity in the last 6,000 years: Short Papers—IV South American Symposium on Isotope Geology, p. 465–468.
Rahmstorf, S., 2007, A semi-empirical approach to projecting future sea-level rise: Science, v. 315, p. 368–370, doi: 10.1126/science.1135456.
Riebesell, U., Zondervan, I., Rost, B., Tortell, P.D., Zeebe, R.E., and Morel, M.M., 2000, Reduced calcification of marine plankton in response to increased atmospheric CO_2: Nature, v. 407, p. 364–366, doi: 10.1038/35030078.
Rignot, E., and Thomas, R.H., 2002, Mass balance of polar ice sheets: Science, v. 297, p. 1502–1506, doi: 10.1126/science.1073888.
Ruddiman, W.F., 2003, The anthropogenic Greenhouse Era began thousands of years ago: Climatic Change, v. 61, p. 261–293, doi: 10.1023/B:CLIM.0000004577.17928.fa.
Schneider, S.H., 2004, Abrupt non-linear climate change, irreversibility and surprise: Global Environmental Change, v. 14, p. 245–258, doi: 10.1016/j.gloenvcha.2004.04.008.
Speijer, R.P., and Marsi, A.-M.M., 2002, Ostracode turnover and sea-level changes associated with the Paleocene-Eocene thermal maximum: Geology, v. 30, p. 23–26, doi: 10.1130/0091-7613(2002)030<0023:OTASLC>2.0.CO;2.
Speijer, R.P., and Wagner, T., 2002, Sea-level changes and black shales associated with the late Paleocene thermal maximum: Organic-geochemical and micropaleontologic evidence from the southern Tethyan margin (Egypt-Israel), *in* Koeberl, C., and MacLeod, K.G., eds., Catastrophic Events and Mass Extinctions: Impacts and Beyond: Geological Society of America Special Paper 356, p. 533–549.
Steffen, W., Sanderson, A., Tyson, P.D., Jaeger, J., Matson, P.A., Moore, B., III, Oldfield, F., Richardson, K., Schnellnhuber, H.J., Turner, B.L., and Wasson, R.J., 2004, Global Change and the Earth System: A Planet under Pressure: Berlin, Springer-Verlag, 336 p. (See also the executive summary at http://www.igbp.kva.se/documents/IGBP_ExecSummary.pdf [4.23 MB]).
Syvitski, J.P.M., Vörösmarty, C.J., Kettner, A.J., and Green, P., 2005, Impact of humans on the flux of terrestrial sediment to the global coastal ocean: Science, v. 308, p. 376–380, doi: 10.1126/science.1109454.
Thomas, C.D., et al., 2004, Extinction risk from climate change: Nature, v. 427, p. 145–148, doi: 10.1038/nature02121.
Thomas, D.J., Zachos, J.C., Bralower, T.J., Thomas, E., and Bohaty, S., 2002, Warming the fuel for the fire: Evidence for the thermal dissociation of methane hydrate during the Paleocene-Eocene thermal maximum: Geology, v. 30, p. 1067–1070, doi: 10.1130/0091-7613(2002)030<1067:WTFFTF>2.0.CO;2.
Tyrrell, T., Shepherd, J.G., and Castle, S., 2007, The long-term legacy of fossil fuels: Tellus B, v. 59, p. 664–672.
United Nations, 1999, The world at six billion: http://www.un.org/esa/population/publications/sixbillion/sixbillion.htm (last accessed 30 Nov. 2007).
Wilkinson, B.H., 2005, Humans as geologic agents: A deep-time perspective: Geology, v. 33, p. 161–164, doi: 10.1130/G21108.1.
Wilson, E.O., 2002, The future of life: New York, Alfred A. Knopf, Random House, 256 p.
Zachos, J.C., Röhl, U., Schellenberg, S.A., Sluijs, A., Hodell, D.A., Kelly, D.C., Thomas, E., Nicolo, M., Raffi, I., Lourens, L.J., McCarren, H., and Kroon, D., 2005, Rapid acidification of the ocean during the Paleocene-Eocene thermal maximum: Science, v. 308, p. 1611–1615, doi: 10.1126/science.1109004.

Manuscript received 17 October 2007; accepted 6 November 2007. -

UPCOMING DEADLINES

FEBRUARY

Geophysics Division: George P. Woollard Award*— Nominations due 15 February 2008 at www.gsageop.org/woollard.html.

Antoinette Lierman Medlin Scholarship Award†— Nominations due 15 February 2008 to Ron H. Affolter, U.S. Geological Survey, P.O. Box 25046, MS 939, Denver Federal Center, Denver, CO 80225-0046, USA, +1-303-236-7752, fax +1-303-236-0459, affolter@usgs.gov.

Sedimentary Geology Division: Laurence L. Sloss Award for Sedimentary Geology*—Nominations due 20 February 2008 via e-mail to Paul Link, secretary, Sedimentary Geology Division, linkpaul@isu.edu.

Coal Geology Division: Gilbert H. Cady Award*—Nominations due 28 February 2008. Send three copies of the nomination to Glenn B. Stracher, Division of Science and Mathematics, East Georgia College, 131 College Circle, Swainsboro, GA 30401, USA, +1-478-289-2073, fax +1-478-289-2080, stracher@ega.edu.

*2008 GSA Division named awards. For more information, see the January 2008 *GSA Today*. Funds for GSA Division awards are administered through the GSA Foundation.
†For more information, see the January 2008 *GSA Today*.
**For details, see the October 2007 *GSA Today*, visit www.geosociety.org/awards, or call +1-303-357-1028.

MARCH

33rd International Geological Congress Travel Grant Program†—Applications due 1 March 2008 at www.geosociety.org/grants/travel.htm, with supplemental material sent to awards@geosociety.org.

John C. Frye Environmental Geology Award—**Nominations due 31 March 2008 to Grants, Awards, and Recognition, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140, USA.

APRIL

Don J. Easterbrook Distinguished Scientist Award (Quaternary Geology and Geomorphology Division)—** Nominations due 2 April 2008 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.

Farouk El-Baz Award for Desert Research (Quaternary Geology and Geomorphology Division)—**Nominations due 2 April 2008 to Marith C. Reheis, U.S. Geological Survey, MS 980, Federal Center, P.O. Box 25046, Denver, CO 80225-0046, USA, +1-303-277-1843, mreheis@usgs.gov.

National Awards: William T. Pecora Award, National Medal of Science, Vannevar Bush Award, and Alan T. Waterman Award—**Nominations due 30 April 2008 to Grants, Awards, and Recognition, GSA, 3300 Penrose Place, P.O. Box 9140, Boulder, CO 80301-9140, USA.

Stephen E. Dwornik Student Research Paper Award†—For papers presented at the 10–14 March 2008 39th Lunar and Planetary Science Conference; see www.lpi.usra.edu/meetings.

Section Meeting & Mentor Program Calendar

CORDILLERAN AND ROCKY MOUNTAIN JOINT MEETING 19–21 March
University of Nevada, Las Vegas, Nevada
www.geosociety.org/sectdiv/cord/08mtg/
General meeting co-chairs: Rod Metcalf, +1-702-895-4442, rod.metcalf@unlv.edu;
Larry Middleton, +1-928-523-2429, larry.middleton@nau.edu.
Shlemon Mentor Program Luncheons:
Thurs.–Fri., 20–21 March, 11:30 a.m.–1:00 p.m.
Mann Mentors in Applied Hydrogeology Program:
Thurs., 20 March, 5–6:30 p.m.

NORTHEASTERN 27–29 March
Hyatt Regency Buffalo, Buffalo, New York
www.geosociety.org/sectdiv/northe/08mtg/
Meeting chair: Gary Solar, +1-716-472-7015, solargs@buffalostate.edu.
Shlemon Mentor Program Luncheons:
Thurs.–Fri., 27–28 March, 11:30 a.m.–1:00 p.m.
Mann Mentors in Applied Hydrogeology Program:
Thurs., 27 March, 5–6:30 p.m.

SOUTH-CENTRAL 30 March–1 April
Hot Springs Convention Center, Hot Springs, Arkansas
www.geosociety.org/sectdiv/southc/08mtg/
Local Committee chairs: Jeff Connelly, +1-501-569-3543, jbconnelly@ualr.edu; Scott Ausbrooks, +1-501-683-0119, scott.ausbrooks@arkansas.gov.
Shlemon Mentor Program Luncheons:
Mon.–Tues., 31 March–1 April, 11:30 a.m.–1:00 p.m.
Mann Mentors in Applied Hydrogeology Program:
Mon., 31 March, 5–6:30 p.m.

SOUTHEASTERN 10–11 April
Hilton Charlotte University Place, Charlotte, North Carolina
www.geosociety.org/sectdiv/southe/08mtg/
Local Committee chair: Andy R. Bobyarchick, +1-704-687-5998, arbobyar@uncc.edu.
Shlemon Mentor Program Luncheons:
Thurs.–Fri., 10–11 April, 11:30 a.m.–1:00 p.m.
Mann Mentors in Applied Hydrogeology Program:
Thurs., 10 April, 5–6:30 p.m.

NORTH-CENTRAL 24–25 April
Casino Aztar, Evansville, Indiana
www.geosociety.org/sectdiv/northc/08mtg/
Local committee chair: Paul K. Doss, +1-812-465-7132, pdoss@usi.edu.
Shlemon Mentor Program Luncheons:
Thurs.–Fri., 24–25 April, 11:30 a.m.–1:00 p.m.
Mann Mentors in Applied Hydrogeology Program:
Thurs., 24 April, 5–6:30 p.m.

Mentor programs are sponsored by the GSA Foundation.

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EarthScope 2008 Speaker Series

EarthScope is a nationwide program to explore the structure and evolution of the North American continent and understand the physical processes that cause earthquakes and volcanic eruptions. The 2008 EarthScope Speaker Series presents scientific results of EarthScope research to faculty and students at colleges and universities. Travel and lodging for EarthScope speakers is provided by funds from the National Science Foundation.

To apply for an EarthScope speaker go to www.earthscope.org/speakers. Applications for speakers in Spring 2008 will be considered as speaker schedules permit. Deadline to request speakers for Fall 2008 is April 1, 2008, although later applications can be considered.

Questions or further information: Robert J. Lillie, EarthScope Education and Outreach Manager. (541) 737-1242; lillier@geo.oregonstate.edu.

2008 EarthScope Speakers

Judith Chester, Texas A&M University, "Structural-petrologic characterization of the San Andreas Fault Zone from the SAFOD deep drill hole"

Matthew Fouch, Arizona State University, "EarthScope explores the depths of western North America"

Tim Melbourne, Central Washington University, "EarthScope imaging of Cascadia megathrust slow-slip events"

Suzan van der Lee, Northwestern University, "Cenozoic history of the western United States: A data integration strategy for EarthScope"

George Zandt, University of Arizona, "Insights on lithospheric foundering from the Sierra Nevada EarthScope Project (SNEP)"

GSA FOUNDATION
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IGC Travel Grant Program

33rd International Geological Congress
Oslo, Norway • 6–14 August 2008

Application deadline: 1 March 2008

The Geological Society of America is accepting applications for the 33rd International Geological Congress (IGC) Travel Grant Program. Travel grants will consist of economy airfare to Norway.

To be eligible, an applicant must be a resident or citizen of the United States, must have a birth date after 31 August 1968, and must have proof of abstract submission to the meeting.

Applications are on the Web at www.geosociety.org/grants/travel.htm. In addition to the online form and proof of abstract submission, all applicants must provide two letters of reference from current or recent supervisors. All supplemental information must be sent as e-mail attachments directly to **awards@geosociety.org.** Online applications and supplemental material must be received electronically no later than **1 March 2008.** Applicants will be notified of results by June 2008. *IGC Travel Grant funds are managed by the GSA Foundation.*

2007 OEST AWARD RECIPIENTS NAMED

GSA Congratulates These Outstanding Earth Science Teachers

OEST (outstanding earth science teacher) awards, recognized by the National Association of Geoscience Teachers (NAGT), are given to outstanding pre-college teachers who have made exceptional contributions to the stimulation of interest in the earth sciences. Each NAGT section selects a section winner, and sections may also have state winners. For more information on 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; section awardees receive US$500 travel money to attend a GSA meeting, and awardees can also apply for up to US$500 for classroom supplies. These outstanding teachers also receive a certificate and a complimentary membership to GSA (three years for section recipients and one year for state recipients).

2007 OEST SECTION AWARDEES

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

CENTRAL SECTION
Paul Varsho
Menomonie Middle School
Menomonie, Wisc.

EASTERN SECTION
Debra Faulkner
Halifax County High School
South Boston, Va.

FARWEST SECTION
Diane Kelsey
Schurr High School
Montebello, Calif.

NEW ENGLAND SECTION
David Eatough
Revere High School
Revere, Mass.

PACIFIC NORTHWEST SECTION
Clay Good
Juneau-Douglas High School
Juneau, Alaska

SOUTHEAST SECTION
Patricia Royle
Camden Junior High School
Camden, Tenn.

SOUTHWEST SECTION
Carol Ticho
Arcadia High School
Scottsdale, Ariz.

2007 OEST STATE AND PROVINCE AWARDEES

ALABAMA
Natalie Lane
Mountain Gap Middle School
Huntsville, Ala.

ALASKA
Clay Good
Juneau-Douglas High School
Juneau, Alaska

BRITISH COLUMBIA
Chris Loewen
W.J. Mouat Secondary
Abbotsford, British Columbia

DELAWARE
Michael Smith
Wilmington Friends School
Wilmington, Del.

FLORIDA
Tonya Camaratta
Buchholz High School
Gainesville, Fla.

GEORGIA
William Witherspoon
Fernbank Science Center
Atlanta, Ga.

IDAHO
Mike Emory
Woodland Middle School
Coeur d'Alene, Idaho

IOWA
Amanda Rae Schiller
Van Buren Middle School
Keosauqua, Iowa

LOUISIANA
Michelle Brand-Buchanan
Alexandria Middle Magnet School
Alexandria, La.

MARYLAND
Linda Murphy
Sykesville Middle School
Sykesville, Md.

MISSISSIPPI
Patti Brooks
D'Iberville Middle School
D'Iberville, Miss.

NEW YORK
David Robison
Wilson High School
Wilson, N.Y.

NORTH CAROLINA
Sam Fuerst
Northern High School
Durham, N.C.

OHIO
Chantelle M. Rose
Graham High School
Paris, Ohio

PENNSYLVANIA
Tiffany Hays
The Baldwin School
Bryn Mawr, Penn.

PUERTO RICO
Julio DeJesus
Radians School
Cayey, P.R.

SOUTH CAROLINA
Ina Eaton
Sangaree Middle School
Ladson, S.C.

TENNESSEE
Patricia Royle
Camden Junior High School
Camden, Tenn.

VIRGINIA
Debra Faulkner
Halifax County High School
South Boston, Va.

WASHINGTON
Sheila Guard
Canyon Park Junior High
Bothell, Wash.

WEST VIRGINIA
Stefan Smolski
Oak Glenn High School
New Cumberland, W.Va.

WISCONSIN
Paul Varsho
Menomonie Middle School
Menomonie, Wisc.

Honorable Mention Certificates

MICHIGAN
Sue Merrill
Hartland High School
Howell, Mich.

MINNESOTA
Cheryl Sill
Coon Rapids Middle School
Coon Rapids, Minn.

THE GEOLOGICAL SOCIETY OF AMERICA®
SCIENCE STEWARDSHIP SERVICE

Field Forum Scheduled

Late Archean Crust: Magmatism and Tectonics of the Abitibi Subprovince, Canadian Shield

19–25 July 2008

Abitibi granite-greenstone belt and Kapuskasing structural zone
Ontario and Québec, Canada

Conveners:

Keith Benn, *University of Ottawa, 550 Cumberland St., Ottawa, Ontario K1N 6N5, kbenn@uottawa.ca*

Phillips C. Thurston, *Laurentian University, Sudbury, Ontario P3E 2C6*

Field Excursion Leaders:

Keith Benn, *University of Ottawa, 550 Cumberland St., Ottawa, Ontario K1N 6N5, kbenn@uottawa.ca;* ***R. Daigneault,*** *Université du Québec à Chicoutimi, 555 boulevard de l'Université, Chicoutimi, Québec G7H 2B1;* ***H. Gibson,*** *Laurentian University, Sudbury, Ontario P3E 2C6;* ***J.A. Percival,*** *Geological Survey of Canada, 600 Booth St., Ottawa, Ontario K1A 0E8;* ***Phillips C. Thurston,*** *Laurentian University, Sudbury, Ontario P3E 2C6*

You are invited to express your interest to participate in a Field Forum that will offer a unique opportunity to study the origins and evolution of one of Earth's major Late Archean terranes. The Field Forum will include visits to exposures of Late Archean lower, middle, and upper crust, ranging from granulite grade to subgreenschist grade. The meeting will also include visits to two major greenstone-hosted mining camps.

Discussions will benefit from the abundant geological, geophysical, geochemical, and geochronological data sets that have been, and continue to be, assembled during the two decades since the Abitibi-Grenville lithoprobe transect.

The ~1.6 × 10^5 km^2 Abitibi granite-greenstone belt is part of the southern Superior Province, a region of the North American craton that was formed during one of Earth's major periods of crustal growth. The principal subjects of this proposed Field Forum are the formative processes and crustal architecture of the Late Archean Abitibi granite-greenstone belt, including its middle and lower crust, as exposed in the Kapuskasing structural zone and within antiformal hinge zones within the greenstone belt. The Field Forum will also provide the geological and tectonic contexts of major precious and base metals deposits.

The five-day forum will take us to key outcrops of different crustal levels and allow us to debate the following issues at the exposures and during the evenings:

- Lower crust: granulite-grade metamorphism and migmatites. Was there more than one granulite event? What tectonic processes were responsible for the metamorphism, and when did the lower crust form?
- Mid-crust: tonalite-trondhjemite-granodiorite (TTG) gneiss and plutons. Evidence for multiple events of TTG magmatism and structural reworking.
- Volcanology, stratigraphy, and structure of the upper crustal greenstones and of the major gold and base metals mining camps hosted by the greenstones.

continued on p. 14

Field Forum Scheduled continued from p. 13

- Geodynamic origins and magmatic evolution of the Late Archean crust. In what geodynamic environment did the crust form? What are the implications of plume-related and subduction-related magmatism in the same belt?
- Production and reworking of TTGs. What do the distinct TTG events tell us about formation of the crust?
- Late Archean orogeny and structural evolution at all crustal levels. How did the 40-km-thick crust form? Is the Abitibi a collage of imbricated tectonic terranes, or does it represent a single, large tectonic terrane? What are the implications for Late Archean crustal accretion arising from each of those two models?

Lectures by the field trip leaders will set the scene for the Field Forum and for each day's field excursion. Invited speakers will present and lead discussions on important topics of Archean geodynamics and tectonics in the evenings as well.

Expression of Interest

You can inform the organizing committee of your interest by sending an e-mail to Keith Benn, kbenn@uottawa.ca. Please indicate your area of specialization and affiliation, and let us know if you are a graduate student. When responding, please indicate your level of interest (i.e., definitely wish to participate, likely participant, possible participant). The forum is limited to 50 participants, and the deadline to indicate interest is 5 March 2008. **Registration and fees are still to be determined.**

Preliminary Program

19 July	Arrival in Sudbury, Ontario. Evening seminar: Overview of the Abitibi Subprovince. Ice breaker.
20 July	Tonalite and granodiorite magmatism and reworking in the middle crust, Kenogamissi complex.
21 July	Lower crust granulites and migmatites in the Kapuskasing structural zone.
22 July	Stratigraphy and structure of the Timmins gold mining camp.
23 July	Porcupine-Destor fault zone, its structure and tectonic significance.
24 July	Volcanology of the Rouyn-Noranda mining camp.
25 July	Participants can fly out from Rouyn-Noranda or travel back to Sudbury.

This Field Forum will immediately follow the Goldschmidt Conference in Vancouver on 13–18 July 2008.

Important Deadlines

5 March 2008	Indication of interest to be received. Invitations to participants will be sent with a request to complete the official registration form.
22 May 2008	Deadline for payment of registration fee.

Cosponsored by The Geological Society of America and Goldcorp Inc.

CLEARANCE!

INTERNATIONAL BOOK SERIES 1–9

Prices as marked

Phase Relations, High-Pressure Terranes, P-T-Ometry, and Plate Pushing: A Tribute to W.G. Ernst

edited by J.G. Liou and Mark Cloos

A two-day symposium titled "Phase relations, high-pressure terranes, P-T-ometry, and plate pushing" was held at the 2003 Geological Society of America Annual Meeting as a tribute to W.G. Ernst. The theme of the sessions reflected his diverse research interests. Up-to-date scientific contributions that resulted from the symposium were published in 2004–2005 issues of *International Geology Review* and are collected in this International Book Series volume. The volume's 36 research papers center on the petrologic and tectonic evolution of convergent plate margins, specifically blueschists, eclogites, and other subduction-zone high-P and ultrahigh-P metamorphic rocks. The book leads off with several general process-oriented papers. It then presents groups of papers combined geographically: Himalayas, Kazakhstan, western China, eastern China, Taiwan, South Korea, Japan, western North America, and the Dominican Republic. In many ways, papers in the volume mirror Ernst's scientific contributions that integrate mineralogy, petrology, geochemistry, regional geology, and plate tectonics. They record the ways our science has moved forward as an outgrowth of the ideas and inspiration of Gary Ernst.

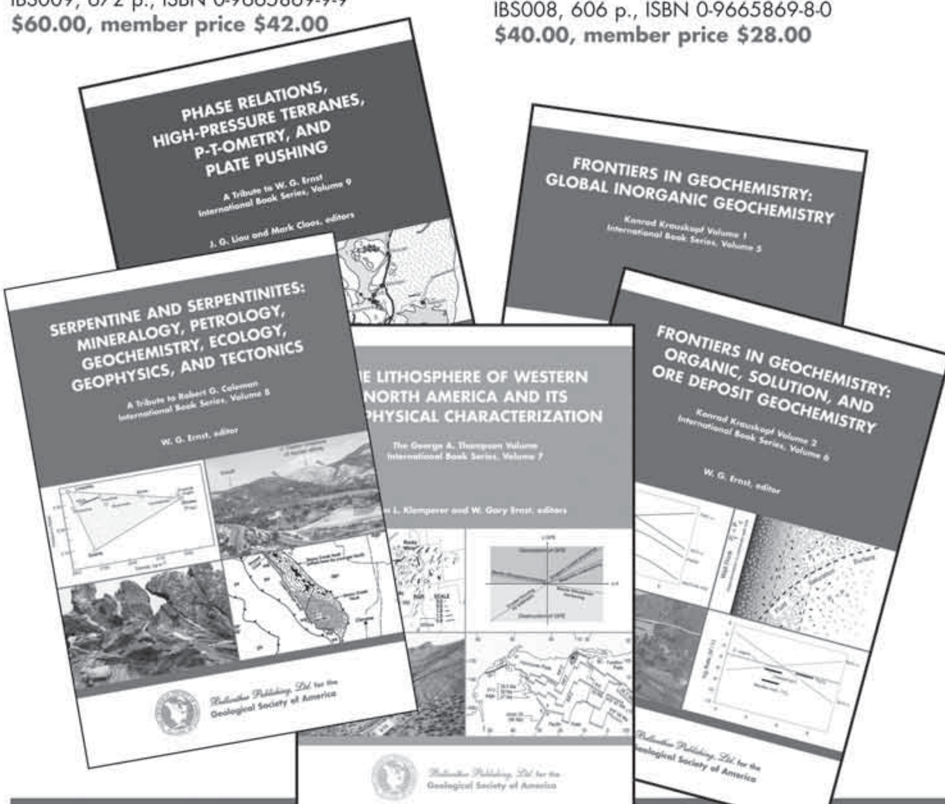
IBS009, 672 p., ISBN 0-9665869-9-9
$60.00, member price $42.00

Serpentine and Serpentinites: Mineralogy, Petrology, Geochemistry, Ecology, Geophysics, and Tectonics: A Tribute to Robert G. Coleman

edited by W.G. Ernst, 2005

A symposium dealing with the plate-tectonic origin, geochemical evolution, and environmental impact of serpentinites was held 6–7 December 2003 at Stanford University, in honor of Professor Emeritus Robert G. Coleman. The technical sessions to some extent reflected his broadly diversified research thrusts. The up-to-date scientific contributions that resulted from the symposium were published in issues of *International Geology Review* and are collected in this International Book Series volume. The volume represents a unique collection of research subjects spanning an unusually broad spectrum of disciplines that overlap chiefly in their focus on hydrated mantle material. The book is divided into topical areas, mirroring some of Coleman's scientific contributions in mineralogy; petrology, regional geology, and plate tectonics; geochemistry; geophysics; and environmental geobotany. In aggregate, it constitutes a scholarly attempt of the scientific community to recognize some of Coleman's lifetime of extraordinary scientific achievements—especially those concerning a fuller understanding of serpentine and serpentinites.

IBS008, 606 p., ISBN 0-9665869-8-0
$40.00, member price $28.00



The George A. Thompson Volume: The Lithosphere of Western North America and Its Geophysical Characterization

edited by Simon L. Klemperer and W.G. Ernst, 2003

IBS007, 544 p., ISBN 0-9665869-6-4
$30.00, member price $21.00

Frontiers in Geochemistry: Konrad Krauskopf Volume 1 (Global Inorganic Geochemistry) *and* Volume 2 (Organic, Solution, and Ore Deposit Geochemistry)

edited by W.G. Ernst, 2002

Volume 1: IBS005, 324 p., ISBN 09665869-4-8
$30.00, member price $21.00

Volume 2: IBS006, 265 p., ISBN 09665869-5-6
$30.00, member price $21.00

Ultra-High Pressure Metamorphism and Geodynamics in Collision-Type Orogenic Belts

co-edited by W.G. Ernst and J.G. Liou, 2000

IBS004, 293 p., ISBN 0-9665869-3-X
$25.00, member price $17.50

Tectonic Studies of Asia and the Pacific Rim: A Tribute to Benjamin M. Page (1911–1997)

co-edited by W.G. Ernst and R.G. Coleman, 2000

IBS003, 328 p., ISBN 0-9665869-2-1
$25.00, member price $17.50

Planetary Petrology and Geochemistry

The Lawrence A. Taylor 60th Birthday Volume

co-edited by G.A. Snyder, C.R. Neal, and W.G. Ernst, 1999

IBS002, 277 p., ISBN 0-9665869-1-3
$25.00, member price $17.50

Integrated Earth and Environmental Evolution of the Southwestern U.S.

co-edited by W.G. Ernst and C.A. Nelson, 1998

IBS001, 502 p., ISBN 0-9665869-0-5
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THE GEOLOGICAL SOCIETY OF AMERICA®

GSA Committees: Progress through Service

The GSA Nominations Committee

Volunteers are the key to GSA's success. Authors of papers in GSA journals and special publications, editors, manuscript reviewers, field-trip leaders, and session chairs are fairly visible as they make their contributions. The Society is bolstered further by a cadre of less-visible volunteers who serve as committee members, councilors, officers, and representatives of GSA. The Nominations Committee helps find these volunteers.

The Search for Candidates

The Nominations Committee includes five GSA members-at-large and three councilors-at-large. The charge to the Nominations Committee is to present candidates to GSA Council for the positions of officers and councilors and for vacancies on standing committees, ad hoc committees, as Society representatives to other permanent groups, and all other appointments on which Council, the president, or the vice president request advice. Council makes the final decisions. Councilors are key volunteers in part because, as the board of directors for the Society, they are asked to serve on several committees and to take on additional tasks throughout their terms.

The Nominations Committee develops a slate of candidates and alternates for the following standing committees:

* Academic & Applied Geoscience Relations
* Annual Program
* Arthur L. Day Medal Award
* Congressional Science Fellow
* Doris M. Curtis Memorial Fund for Women in Science
* Education
* External Affairs
* Finance
* Geology and Public Policy
* GSA Public Service Award
* Honorary Fellows
* Joint Technical Program
* Membership
* Minorities & Women in the Geosciences
* Nominations
* Penrose Conferences and Field Forums
* Penrose Medal
* Professional Development
* Publications
* Research Grants
* Treatise on Invertebrate Paleontology Advisory
* Young Scientist Award (Donath Medal).

Council also directs the Nominations Committee to suggest candidates for GSA representatives to various other organizations, such as the American Association for the Advancement of Science, and the North American Commission on Stratigraphic Nomenclature.

The Nominations Committee seeks diversity in its recommendations to Council. This includes diversity in terms of disciplinary coverage, geographic location (particularly throughout the Americas), gender, ethnicity, experience, employment sector, and other factors that help GSA serve and expand its membership. It is important that the Nominations Committee itself has a fair amount of such diversity and has extensive knowledge of who's who in the geosciences, so that GSA infuses its leadership and committees with vibrancy, enthusiasm, and a breadth of perspectives.

Vital GSA Headquarters Support

Much hard work in support of the committee is done by GSA staff. They gather together biographical data on nominees, including records of past service to GSA and other organizations, and pass this information on to the committee a couple of weeks before it meets. Most committee members spend a day or more reviewing the nominations. The committee generally meets face-to-face for two days, typically in late summer at GSA headquarters in Boulder, Colorado (with GSA covering travel costs). Committee members come ready to evaluate candidates who have volunteered or who have been nominated for specific positions or committee service. The process generally involves frank discussions about past contributions that individuals have made to the profession, voting to provisionally rank nominees, and a final vote to forward the ranked slate of candidates to Council.

Vital GSA Membership Input

The Nominations Committee needs *your* help to find the best candidates to present to Council. Please consider volunteering for membership on one of GSA's committees or nominate a colleague as a councilor, officer, or committee member. GSA makes the volunteering and nomination process easy; see **https://rock.geosociety.org/aboutus/committees/** for details.

Jon Price, Chair, Nominations Committee
University of Nevada–Reno and *State Geologist and Director, Nevada Bureau of Mines*

THE GEOLOGICAL SOCIETY OF AMERICA®

How GSA Chooses its President and Vice President

GSA's president and vice president are traditionally selected from past councilors. Any given councilor has a one-in-three chance of being selected as vice president (and, traditionally, president the following year). Therefore, councilors and vice president should have certain leadership qualities and characteristics, possess good people and management skills, have a vision for GSA and the science of geology, be viewed by GSA members as distinguished and as someone who can speak for them, be a good communicator and more of an extrovert than introvert, and have sufficient vitality to work diligently for GSA for several years.

Councilors are elected by the GSA membership. The Nominations Committee suggests a slate of candidates, from which the Council chooses two to stand for election for each position. GSA elections will be taking place between 13 March and 13 April; see page 21 of this issue for candidate information.

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New Members: GSA Welcomes You!

The following people were elected into membership by GSA Council at its October 2007 meeting.

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GSA Foundation Update

Donna L. Russell, *Director of Operations*

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The individuals and companies that donated to the Foundation's 8th Silent Auction at the GSA Annual Meeting in Denver this past October. We received 355 donations totaling over US$35,000.

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All proceeds from the auction go to the Greatest Needs Fund, which supports research grants, field forums, education and outreach programs, international travel, and much, much more.

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COMMENTARY

Spatial analysis of fossil sites in the northern plains: A unique model for teacher education

***George D. Stanley, Jr.,** The University of Montana Paleontology Center, 32 Campus Drive, Missoula, Montana 59812, USA, and **Heather Almquist,** College of Arts and Sciences and Department of Geography, The University of Montana, Missoula, Montana 59812, USA*

INTRODUCTION

Understanding science and technology is key to our next generation's success. Conveying the excitement of science and effectively melding it with technology in both field and classroom settings can be a challenge for many K–12 educators. Middle school is a critical juncture in a child's educational experience, when interest in science and technology is budding. If this interest is captured, it can lead to a lifetime of learning and, for some, a rewarding profession. At the University of Montana, the Paleo Exploration Project (PEP) was developed to meet these challenges. Now entering its second year, the PEP program aims to motivate school children in the STEM areas (science, technology, engineering, and mathematics). It focuses on both middle school teachers and students in rural parts of Montana and utilizes geospatial technology and paleontology to achieve these goals.

Students investigate a site. Image courtesy http://pep.explore-ed.com/photos/imgpages/.

Funded by the National Science Foundation (NSF), the PEP project is a professional development program for math, science, and technology teachers. The primary goal of the program is to enable middle school teachers to effectively integrate geospatial technologies into the classroom and to create inquiry-based science experiences for students using fossils from key sites in Montana. The PEP project serves teachers and middle school students selected from a large area of eastern Montana, including three Indian reservations. Schools in this region tend to be small (fewer than 50 students) and isolated, with only 49 middle schools in a 50,000 mi^2 area. Most educators in the PEP teach diverse subjects and are over 50 years old. In general, they begin the PEP with little experience in technology and science.

Geographic information system (GIS) technology is valuable for developing practical technology skills. Dinosaurs and diverse terrestrial, fresh water, and marine fossils are natural drawing cards for the program, eliciting both excitement and curiosity. Cretaceous fossils also include turtles, ammonites, and marine reptiles. Layer-cake stratigraphy and the colorful landscapes in northeastern Montana combine to create a naturally attractive backdrop for the project. Several Upper Cretaceous units, such as the Hell Creek Formation and the Bear Paw Shale, contain the richest, most diverse fossil assemblages on the continent and perhaps in the world.

COURSE DESCRIPTION

The PEP funded a series of weekend training workshops for the teachers, held in the Glasgow School District and on the University of Montana campus. Teachers selected to participate in the PEP program had the option to register for university credit at the graduate level. Both teachers and middle school students took part in summer classroom and field experiences near Fort Peck, Montana. During the workshops, teachers were introduced to simple, intuitive geospatial technologies such as Google™ Earth and global positioning systems (GPS). Later, they were introduced to ESRI ArcGIS 9.2 software and learned to add data layers, navigate, select and display features, and conduct queries. Teachers attending the PEP were given hands-on classroom instruction with fossil vertebrates, invertebrates, and plants and were instructed on taxonomy, fossil preservation, preparation techniques, and stratigraphy of Cretaceous units in eastern Montana. They also learned to use a geospatial database with information on geological formations, roads, land ownership, streams, and lakes.

During the summer research institute, hosted at the University of Montana Field Station of Paleontology and Fort Peck Paleontology, PEP teachers were later joined by selected middle school students. Together, they investigated a 14,000 mi^2 area around Fort Peck Dam, Montana, for stratigraphy, paleontology, and sedimentology. Teams of students, accompanied by teachers and PEP staff, learned fossil field survey methods as well as methods for excavation of vertebrate and plant fossils. Participants described the fossils and enclosed rock types and then created geologic maps using GPS, Total Station surveys, and ArcView. The resulting geologic maps and fossil finds were then used by the teachers and students to develop and test scientific hypotheses and to decipher relationships among fossils in time and space.

RESULTS

Results from the first year of this NSF project were positive. Teachers developed inquiry-based projects and later implemented them in their own schools. For example, teachers from Plentywood, Montana, developed a learning unit using GPS and GIS to determine the relationship between an erosion channel and the artifacts found at the Shippe Canyon drainage channel. Another teacher from Whitewater, Montana, challenged her students to determine whether dinosaur fossils found in northern Phillips County were buried in the same stratigraphic layer. To date, 17 such projects involving 22 teachers and over 400 students are being developed across northeastern Montana.

This approach, combining geospatial technology and paleontology to engage middle school teachers and students in a rural field setting, presents a unique model of education. It has the potential to motivate future generations of learners and to steer them toward careers in technology and science. As we begin our second year, readers are invited to gain further information by visiting our Web site for the Paleo Exploration Project: **http://pep.explore-ed.com.**

Aerial view of Fort Peck. Image courtesy http://pep.explore-ed.com/photos/imgpages/.

2008 GeoVentures Travel & Tours for Geoscience Enthusiasts

GSA's GeoVentures take students, teachers, and geology enthusiasts to some of the most exciting destinations around the globe. This year we have trips planned to the Galapagos Islands, Costa Rica, and Iceland for teachers; Hawaii for college students; and Idaho and the Canadian Rockies for everyone. Trips in mind for 2009: Australia and Hawaii. For the very latest information on all our trips, please see our Web site, **www.geoventures.org.**

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Geology on an Active Hot Spot!—Big Island: Hawaii, USA

1 August–10 August 2008

Cost: US$995 (not including flights to Hilo, Hawaii) for GSA Student Members; US$1250 for non-members. *Cosponsored by Subaru America*.

This eight-day field course (excluding two travel days) on the Big Island of Hawaii will introduce you to plate tectonics, hot spot volcanism, and the geologic features and hazards associated with living on an active volcano. We will discuss volcanic edifices, eruption styles, and magma evolution and see various types of lava flows, lava lakes, fault scarps, rifts, craters, and calderas. Eruption and weather permitting, we will also see active lava flows!

This trip is designed for college-level students and/or those wishing for a continuing education experience who have had at least a college-level introductory geology course or who may be interested in pursuing a degree in geology. Go to **www.geoventures.org** for more information and a reservation form.

Leader: Jennifer A. Thomson, Eastern Washington University, jennifer.thomson@mail.ewu.edu, Web page: www.ewu.edu/x17131.xml.

Thomson is a professor of geology at Eastern Washington University in Cheney, Washington, USA. Her specialties are mineralogy, petrology (both igneous and metamorphic), and geochemistry, and her research involves study of granulite facies conditions in New England, the contact metamorphic aureole of the Stillwater Complex, and rare tourmaline in the granulite facies terrane of south-central Massachusetts. She has co-taught numerous summer field courses, including the geology of the North Cascades, the Oregon coast, the Klamath Mountains, Mount Rainier and Mount St. Helens, the Olympic Peninsula of Washington, the Snake River Plain, Craters of the Moon National Monument, and Yellowstone National Park, as well as the natural history of the Lewis and Clark Trail.

Co-Leader: Bart S. Martin, Ohio Wesleyan University, bsmartin@owu.edu.

Martin is a professor of geology at Ohio Wesleyan University in Delaware, Ohio, USA. His specialties are igneous petrology and geochemistry with an emphasis on the evolution of large volcanic provinces, and his research interests focus on the geochemical and volcanological evolution of voluminous lava flows in the Columbia River flood basalt province of Oregon, Washington, and Idaho, as well as the effects of large-scale volcanism on Earth's environment. He has participated in international field conferences on large igneous provinces and has published on the geochemistry of the Roza flows of the Columbia River basalts. Martin is also interested in the petrology and mineralogy of ultramafic rocks in the Blue Ridge of western North Carolina.

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The Department of Geology and Geophysics at Louisiana State University invites applications for an Assistant Professor (Structural Geology/Tectonics/Tenure-track) position to begin Fall semester of 2008. The successful applicant will be expected to teach structural geology at the undergraduate level and to develop strong, externally funded research program. **Required Qualifications:** Completion of the Ph.D. by the beginning of the appointment. **Additional Qualifications Desired:** Postdoctoral experience. The Department currently has 17 tenure-track faculty members and is expected to increase in number in the future. We seek an individual with research interests that complement or add to our existing strengths (http://www.geol.lsu.edu). An offer of employment is contingent on a satisfactory pre-employment background check. Application deadline is February 18, 2008 or until a candidate is selected. Applicants should submit a CV (including e-mail address), a statement of their research and teaching interests, and the names, addresses, and phone numbers of at least three references to: **Professor Louis Thibodeaux, Chair of Search Committee, Department of Geology and Geophysics, Louisiana State University, Ref: Log #1071, Baton Rouge, LA 70803, E-mail: thibod@lsu.edu.**

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Positions Open

FACULTY VISITOR POSTINGS
ONE-YEAR NON-TENURE–TRACK
TEACHING POSITIONS, COLORADO COLLEGE

The Department of Geology announces two one-year, non-tenure track positions, to begin in August 2008. The specialization areas are (1) Surficial Processes/Geomorphology and (2) Petrology/Volcanology/Geochemistry. Ph.D. or ABD is required. Appointments will be at the assistant professor level for candidates holding a Ph.D. The candidate in Surficial Processes will be asked to teach Geomorphology/ Surficial Processes and Introductory Geology courses, together with courses in the candidate's areas of specialty. The Igneous Petrology position will entail teaching Introductory Geology courses, an Introductory Petrology course; a course in Volcanology or Igneous Petrology; and courses in the candidate's areas of specialization.

Undergraduate research is an integral part of the Colorado College Geology curriculum; thus a willingness to advise research in the candidate's areas of expertise may be a distinct advantage. The Geology Dept. contributes to CC's Environmental Sciences program, and possibilities may exist for candidates to also participate. Ability to teach Hydrogeology and/or to integrate GIS into courses is highly desirable. The College is committed to increasing diversity of the community and curriculum. Candidates who can contribute to that goal are particularly encouraged to apply.

Applicants must be committed to high-quality innovative undergraduate teaching, including field-oriented courses. The Block System of education at Colorado College, in which professors teach and students take only one course at a time for 3-1/2 weeks, lends itself to field and project-based teaching. The Department has excellent field equipment and laboratory facilities for teaching and research in all geological disciplines.

Send statement of teaching and research interests, curriculum vitae, and names and addresses of three referees by 15 February 2008 to Christine Siddoway, Chair, Colorado College, 14 E. Cache la Poudre, Colorado Springs, CO 80903, +1-719-389-6717.

The Colorado College welcomes members of all groups, and reaffirms its commitment not to discriminate on the basis of race, color, age, religion, sex, national origin, sexual orientation, or disability in its educational programs, activities, and employment practices.

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DEPT. OF EARTH AND PLANETARY SCIENCES
NORTHWESTERN UNIVERSITY

Applications are invited for a two-year full-time renewable faculty post starting September 2008. This eleven-month appointment is non-tenure-line, but, subject to institutional need and excellent job performance, is a continuing position with career-advancement opportunities. Among other responsibilities: research infrastructure, budgets, and staffs (see full job description at www.earth.northwestern.edu). The department is committed to workplace diversity and welcomes applications from women and members of minority groups. Applicants should send CV and letter, and should have three letters of reference (at least one commenting on competence in area of research infrastructure, and one commenting on administrative abilities) sent independently by their writer to Brad Sageman, Chair, Department of Earth and Planetary Sciences, 309 Locy Hall, Northwestern University, Evanston, IL 60208-2150. Address queries to Professor Sageman at chair@earth.northwestern.edu. Consideration of completed applications will begin 15 February 2008, and continue until position is filled. Hiring is contingent on eligibility to work in the United States.

POSTDOCTORAL RESEARCH ASSOCIATE
GEOSCIENCES, UNIVERSITY OF ARIZONA

The Department of Geosciences is seeking a postdoctoral researcher to conduct research in tectonics, geochronology, and thermochronology, with emphases on technique development and tectonic applications of U-Th-Pb and (U-Th)/He dating through collaboration with George Gehrels and Peter Reiners. A major research emphasis will be the orogenic evolution of the central Andes. Primary activities will include conducting geo/thermochronologic research in collaboration with a large group of faculty and student investigators, and facilitating interpretive aspects of the project through data compilation and synthesis. Additional areas of opportunity include geo/thermochronologic technique development and detrital and bedrock applications to orogenic evolution in Antarctica and the western U.S. A Ph.D. at the time of appointment is required.

Review of applications will begin 4 February 2008 and will continue until the position is filled. Applications should be submitted at https://www.uacareertrack.com for Job Number 39805. The University of Arizona is an equal opportunity, affirmative action organization.

CALIFORNIA INSTITUTE OF TECHNOLOGY
ASSISTANT PROFESSOR OF GEOBIOLOGY

Caltech is seeking qualified candidates for a tenure-track position in the area of geobiology at the Assistant Professor level. Completion of the Ph.D. is required. The initial appointment is for four years. It is possible that a candidate with exceptional qualifications may be considered for a position at a higher level. Candidates of extraordinary ability and potential for innovation and leadership in teaching and research in any area of geobiology, including modern or ancient systems, are encouraged to apply. We shall be especially drawn to individuals whose intellectual interests are engaged over broad, interdisciplinary areas of knowledge, and whose research uses the tools of organismic biology, molecular biology or biochemistry with those necessary for an understanding of the major geobiological innovations in the history of the Earth. Examples (not inclusive) would be an evolutionary biologist who integrates experimental evidence from developmental biology with evidence from paleontology; a biogeochemist using biomarkers to search for the metabolic signatures of select organisms and their traces preserved in geological or fossil materials; a paleontologist who utilizes sequence relationships, functional morphology, or numerical analysis to illuminate systematic or phylogenetic problems; or a sedimentary geochemist who studies the inorganic composition of geological or fossil materials to elucidate global-scale biogeochemical pathways or organism functions.

A curriculum vitae including a list of publications, a brief discussion of proposed research activities, and three letters of reference should be sent to Professor Ken Farley MS 170-25, California Institute of Technology, Pasadena, CA 91125.

The California Institute of Technology is an Equal Opportunity/Affirmative Action Employer. Women, minorities, veterans, and disabled persons are encouraged to apply.

Opportunities for Students

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More information is available at www.agiweb.org/gap/interns/index.html. AGI is an equal opportunity employer.

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The successful candidate will train all users in data acquisition and interpretation, establish standard operating procedures, develop new analytical methods, solicit and oversee work from outside users, and teach a course on electron beam methods. The primary focus of the position is to maintain the facility and to assist UNLV users and outside users. The candidate will be encouraged to conduct research, mentor graduate students, and collaborate on competitive funding proposals with both internal and external faculty.

Applicant must have a Ph.D. in Geoscience, Chemistry, Physics or related field from an accredited college or university and extensive EPMA experience.

Salary competitive; contingent upon labor market and contingent upon funding.

Submit a cover letter, CV, and letter of interest detailing your qualifications and experience, and contact information for four referees. Materials should be addressed to Dr. Adam C. Simon, Search Committee Chair via on-line application at **https://hrsearch.unlv.edu**. Review of application materials will begin immediately. For assistance with UNLV's on-line applicant portal, contact Jen Martens at (702) 895-2894 or **hrsearch@unlv.edu**.

UNLV is an Affirmative Action/Equal Opportunity educator and employer committed to excellence through diversity.

Summer school: A multidisciplinary study of uplift and deformation in the Calabrian Arc

Sept. 1-12, 2008

Università della Calabria, Arcavacata (Cosenza), Italy

As part of a multidisciplinary international project coordinated by the Lamont-Doherty Earth Observatory of Columbia University, we are offering a summer field school on the geodynamics and active tectonics of the Calabrian Arc. Teaching will be undertaken by US, Canadian, and European project scientists and will cover topics ranging from geodynamics and seismology to Quaternary geochronology and geomorphology. Classroom discussion will alternate with field demonstrations. The lectures will review foundations and basic techniques and discuss research activities and results of the Calabria project. The school will offer an opportunity for students to participate in a "live" multidisciplinary research program. The research project and summer school are funded by the Continental Dynamics program of the US National Science Foundation. Additional funds for the summer school are provided by the European Science Foundation, Istituto Nazionale di Geofisica e Vulcanologia, Consiglio Nazionale delle Ricerche, and the University of Calabria.

The school will be an advanced study program aimed at graduate students (doctoral level) and post-doctoral fellows. The school will cover lodging, meals, and field trip costs for all participants. Funds to travel to Calabria will be available for participants from US universities, and we have a limited amount of travel funds for other students. Because of logistic constraints, the number of students is limited to about 30. Priority will be given to applicants with an interest in active tectonic environments and interdisciplinary work.

For more information and to apply, visit

http://www.calabarco.org/education

The application deadline is **March 31, 2008**.

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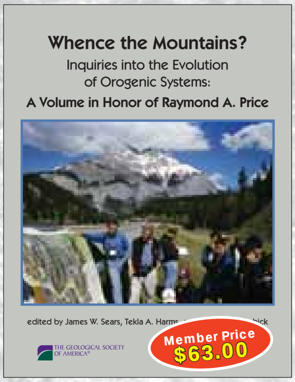

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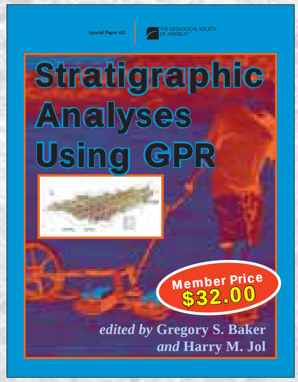

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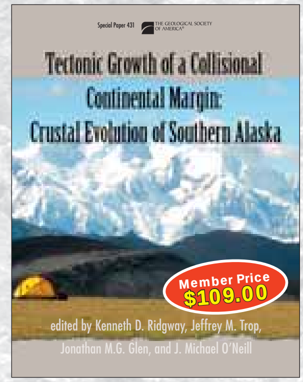

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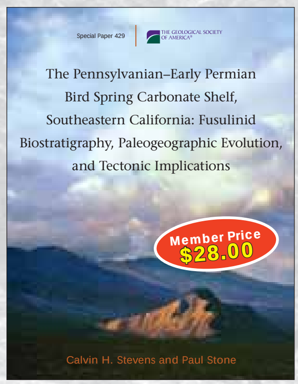

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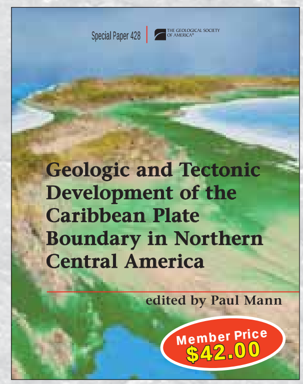

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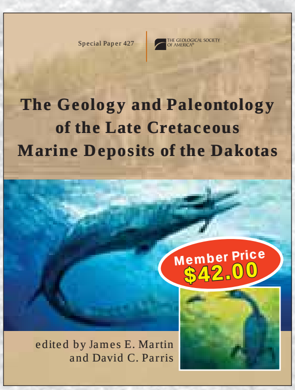

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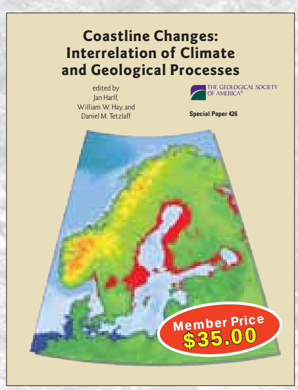

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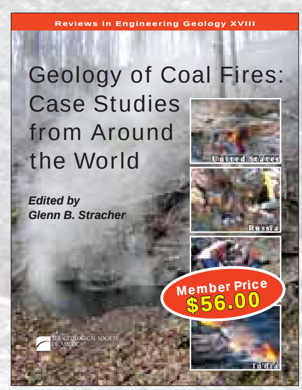

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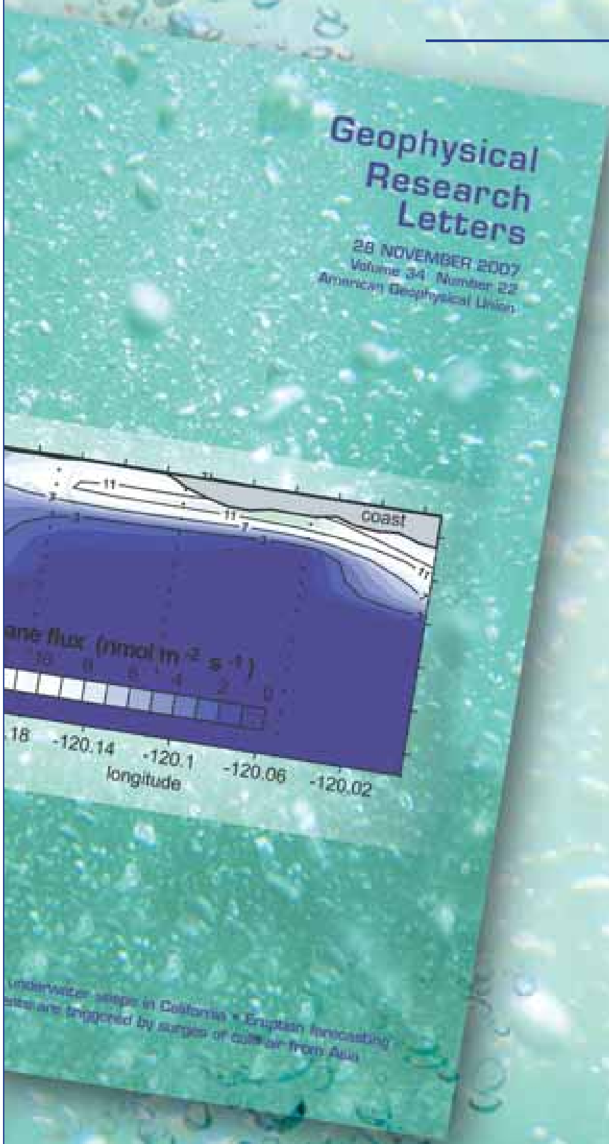

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