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The effects of soil on the taste of wine

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Executive Director and Publisher: Vicki S. McConnell

Science Editors: Steven Whitmeyer, James Madison University Dept. of Geology & Environmental Science, 800 S. Main Street, MSC 6903, Harrisonburg, VA 22807, USA, whitmesj@jmu.edu; Gerald Dickens, Rice University School of Earth Science, MS-126, 6100 Main Street, Houston, Texas 77005, USA, jerry@rice.edu.

Managing Editor: Kristen "Kea" Giles, kgiles@geosociety.org, gsatoday@geosociety.org

Graphics Production: Margo McGrew

Advertising (classifieds & display): Ann Crawford, +1-800-472-1988 ext. 1053; +1-303-357-1053; Fax: +1-303-357-1070; advertising@geosociety.org; acrawford@ geosociety.org

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Featured Article

SCIENCE

4 **The effects of soil on the taste of wine** Gregory J. Retallack and Scott F. Burns

Cover: Soil nutrient status as measured by pH is reflected in acidity and related taste of Pinot Noir wines in Oregon's Willamette Valley. These are Pinot Noir vines on Jory Series soils, which are developed on a middle Miocene intrabasaltic Oxisol in the Bernau Block of Willamette Valley Vineyards, near Salem. Photo courtesy Matt Boyington. See related article, p. 4–9.



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The effects of soil on the taste of wine

Gregory J. Retallack, Dept. of Geological Sciences, University of Oregon, Eugene, Oregon 97403, USA, gregr@uoregon.edu; and **Scott F. Burns**, Dept. of Geology, Portland State University, Portland, Oregon 97207, USA, burnss@pdx.edu

ABSTRACT

The conventional wisdom of vintners is that alkalinity, and thus less sour and more rounded taste, are enhanced in wine and grapes challenged by low-nutrient soils. A common thread here is pH, an objectively measurable variable that is both a part of wine taste and a proxy for soil fertility. The role of low-pH soils is supported by metadata on Oregon wines from different soils in the Willamette Valley of Oregon, USA, which show significant inverse correlations between minimum pH of the soil and pH of finished Pinot Noir wine. There is also a direct correlation between depth of clayey horizons and pH of the finished wine. The minimum pH of these soils is near the base of the clayey (Bw or Bt) horizon and is inversely correlated with depth of the clayey horizon. Low soil pH is found in thick middle Pleistocene soils of bedrock (Jory, Willakenzie, Laurelwood, and Bellpine soil series) and high soil pH in thin soils on late Pleistocene and Holocene Missoula Flood deposits and loess (Hazelair, Woodburn, and Chehulpum soil series). Similar relationships are found between soil pH or depth and the pH of grapes at harvest, which is lower and more varied than pH in finished wine. These relationships are especially notable in years of good harvest, but obscured by winemaking techniques in years of poor harvest. Good harvest years are not necessarily vintages esteemed by wine connoisseurs, which are more strongly correlated with low October precipitation.

INTRODUCTION

The effects of soil on wine are a key component of the French concept of gôut de terroir (taste of soil), first codified in 1905 legislation of Appellation d'origine contrôlée (Trubek, 2008). The French concept of soil at the time was less scientific than romantic and political, as revealed by Emile Zola's (1888) famous novel La Terre (The Soil). An expanded concept of wine terroir, including local climate and winemaking traditions, can be traced back to fifteenth-century Burgundian monks, but the naming of local wines after localities and comparisons of their relative quality were recorded in ancient Rome, Greece, and Egypt, back about 4,980 years ago (McGovern, 2003). Nevertheless, it has been difficult to find a scientific justification for judgements like the following quotation: "The sandy soil will, in general, produce a delicate wine, the calcareous soil a spirituous wine and the decomposed granite a brisk wine" (Busby, 1825, p. 11). In contrast is the opinion of Maltman (2008, p. 1), "The notion of being able to taste the vineyard geology in the wine—a goût de terroir—is a romantic notion that makes good journalistic copy and is manifestly a powerful marketing tactic, but it is wholly anecdotal and

in any literal way is scientifically impossible." Maltman particularly decries descriptions of wines as tasting "slaty" or "earthy." Between these extremes of literally tasting soils in wine and the implausibility of transferring tastes from soil to wine are numerous studies documenting soils' effects on wine quality (Imre et al., 2012; Costantini et al., 2012; Burns, 2012), including this study. Here we address the conventional wisdom of vintners that low-fertility soils produce more profitable wines (Goode, 2014) in a case study of pH as a proxy for soil fertility compared with the pH of Pinot Noir wines produced from that soil in the Willamette Valley of Oregon, USA.

Wine within the usual pH range of 3.4–3.8 tastes pleasantly fresh, brisk or tart, but with too much acid it can be as sour as vinegar, and too little acid leaves it flat and prone to spoilage (Goode, 2014). Wines are 80%–90% water and 0.1%–20% sugar, with pH determined by a balance between 0.3%–1% acids (tartaric, malic, citric, lactic) and mildly alkaline alcohol (8%–20% ethanol, glycerol), organic compounds (0.3%–1% flavor compounds, such as anthocyanins, tannins, and flavonoids), and mineral cations (0.1%–0.3% potassium, sodium, calcium, and magnesium; Jackson, 1994). Pinot Noir wine has more than 800 distinct organic compounds, which determine aroma, color, and flavor (Fang and Qian, 2005).

Soil pH is a convenient proxy for fertility. Moderately acidic soils (pH 4.5–5.8) are low in plant nutrients (Ca^{2+} , Mg^{2+} , Na^+ , K^+) because the exchange complex has high amounts of non-nutrient cations (H⁺, AlOH²⁺, Al(OH)₂⁺). Moderately alkaline soils (pH 8–10) have growth-limiting salts and moisture deficits. The most fertile soils for plant growth are between these extremes (Retallack, 2001).

GEOLOGICAL AND PEDOLOGICAL BACKGROUND

Oregon's Willamette Valley is a tectonic forearc basin on the convergent margin of the northwestern United States, dividing an uplifted subduction complex of the Coast Range from active andesitic volcanoes of the Cascade Range. Much of the valley is underlain by volcaniclastic marine sandstones and siltstones ranging in age from Eocene to Oligocene, but parts of the region were overrun by middle Miocene Grande Ronde and Wanupum Basalts of the Columbia River Basalt Group (Yeats et al., 1996). Large areas of the valley floor are covered by Willamette silts from the 15–18 ka Missoula Floods (O'Connor et al., 2001; Allen et al., 2009). These three geological elements determine three main kinds of soils planted in vineyards (Moore, 2002; Burns, 2012): (1) middle to late Pleistocene soils on Miocene basalt, (2) on Eocene-Oligocene sedimentary rock, and (3) late Pleistocene soils on loess or alluvium (Fig. 1).

The thick Jory silt loam was named the state soil of Oregon for its importance to the wine industry (Oregon State Legislature, 2011). It includes two distinct varieties developed on bauxitic laterite and basalt. At the type locality of Jory Hill south of Salem,



Figure 1. Simplified geological map of the Willamette Valley, Oregon, USA, with distribution of vineyards (modified from Moore, 2002; with bauxite occurrences from Libbey et al., 1945).

these Ultisols are developed on Oxisol paleosol remnants between flows of the Columbia Basalt Group (Libbey et al., 1945; Liu et al., 2013) dated at 15.7 Ma (Martin et al., 2013). Elsewhere the Oxisol bauxites below the Jory clay loam are 18 m thick (Fig. 2). Such Oxisol paleosols required mean annual temperatures of at least 17 °C and mean annual precipitation of at least 1100 mm during the middle Miocene (Retallack, 2008, 2010). In contrast, from 1971–2000, Salem had a mean annual temperature of 11.4 °C and a mean annual precipitation of 1016 mm (National Oceanographic and Atmospheric Administration, 2015), so that Ultisols are the most deeply weathered soils forming in Oregon today (Lindeburg et al., 2013). Elsewhere in the red hills of Dundee Jory, Ultisols are developed on middle Miocene Grande Ronde basalt without the bauxitic paleosol (Otte et al., 1974).

Other wine-producing soils of middle Pleistocene terraces that cut into marine sediments are Bellpine Ultisols and Willakenzie Alfisols, developed on volcaniclastic siltstone and sandstone, such as the Spencer Formation (Otte et al., 1974; Patching et al., 1987; Fillmore et al., 2009). These Alfisols are more nutrient-rich and less acidic than Ultisols, but both have the lowest pH near the base of thick clayey (Bt) horizons. In contrast, soils formed from Missoula Flood deposits and loess are less acidic and more fertile Mollisols of the Woodburn, Hazelair, and Chehulpum Series (Otte et al., 1974; Gerig et al., 1985). The 16 distinct soil series and variants of this study are detailed in the GSA Supplemental Data Repository¹ and provide an array of substrates for wines.

The Willamette Valley is a cool and humid climate viticultural district well suited for Pinot Noir grapes (Jones et al., 2012). Irrigation is not necessary in such climates, and vine vigor is limited by low soil nutrients (Burns, 2012).

METHODS

Our choice of Pinot Noir wines from the Willamette Valley for this study was due to long experience with local vintners and soils, and particularly, the "great debate" about differences in the taste of wines from Jory versus Willakenzie soils (Burns, 2012). To supplement such small-scale studies, we compiled all available metadata from the Web pages of all 177 wineries of the Willamette Valley Wineries Association, whose technical sheets give wine and grape pH and total acidity, grape sugar content, wine alcohol content, harvest dates, recommended price, and vineyard location. Sugar content in weight percent is given by the wine industry term "Brix," and all these commercial data were obtained using twentyfirst-century equipment and industrial standards. By experimental design, as many factors as possible were kept constant: data were limited to a single grape variety (Pinot Noir), a single vinicultural area (Willamette Valley), and grouped by vintage (to equalize climate effects). Blended wines were excluded, and single-vineyard single-clone wines were located using Google Earth and then checked in county soil surveys (Williams et al., 1972; Otte et al., 1974; Knezevich et al., 1975, 1982; Green et al., 1982; Gerig et al., 1985; Patching et al., 1987; Fillmore et al., 2009). These same soil surveys were the source of soil data, which included both maximum and minimum soil pH (determined by pH meter on 1:1 soil:water), cation exchange capacity (by ammonium acetate displacement of Ca2+, Mg2+, K+, Na+), depth to base of clay-enriched (Bt) horizon, and clay and organic matter content (both weight percent) in representative profiles for each county survey. Geological data are from Walker and McLeod (1991). Some wines were excluded because there were multiple soil series in a single vineyard area when checked with county soil surveys. Vintners vary in the extent of data recorded, and few vintners posted archival data back to 1999. In the final database of 267 wines, only the 2008, 2009, 2010, and 2011 vintages had 20 or more wines (see the GSA Data Repository Supplemental [footnote 1]). Uncontrolled in these data were details of viticulture other

¹GSA Supplemental Data Item 2016052, compiled data on wines and soils with graphs of additional vintages, is online at www.geosociety.org/pubs/ft2016.htm. You can also request a copy from *GSA Today*, P.O. Box 9140, Boulder, CO 80301-9140, USA; gsatoday@geosociety.org.



Figure 2. Red Jory Ultisol of Willamette Estate Vineyards in the south Salem Hills, Oregon, USA, where it is developed atop a thick middle-Miocene Oxisol (lateritic bauxite), red in the vineyards (A), and thick in a nearby quarry (B). The Jory soil series is intensely planted in vines, but comes in two distinct varieties parented by bauxite or by basalt. Photo A courtesy of Matt Boyington; photo B courtesy of Marli Miller.

than harvest date (vine age, plant spacing, trellising, rootstocks, fertilization, canopy management) and of viniculture other than blending (crush methods, destemming, sulphite and acid addition).

Other data compilations used in this study were precipitation records from 1999 to 2012 for Rex Station near Newberg (National Oceanographic and Atmospheric Administration, 2015), Oregon vineyard harvest reports (National Agricultural Statistics Service, 2015), and Chehalem Vineyard harvest reports (Chehalem Wines, 2015).

SOIL DETERMINANTS OF WINE ACIDITY

The main result of this study is discovery of an inverse relationship between the pH of wine and the minimum pH of the soil in which it is grown (Fig. 3A). A comparable but direct (not inverse) relationship was found between wine pH and the depth to the base of the clayey (Bw or Bt) horizon in the soil (Fig. 3B). These relationships have a common cause with soil age, because in Oregon, as elsewhere, pH declines and soil depth increases as soils develop through time (Lindeburg et al., 2013). Among the soils studied, there is a significant negative correlation between minimum soil pH and depth to the base of the clayey horizon (Fig. 3C). All these relationships are significant at greater than 99% confidence determined by an ANOVA *F* test, because more than 20 wines are included within each series.

Within the data assembled, wine pH showed no relation with maximum soil pH, perhaps confounded by different practices of mulching, cover crop, or fallow at the surface. Wine pH correlated with neither minimum nor maximum soil clay content, nor minimum nor maximum cation exchange capacity, again perhaps confounded by local vineyard practices. Wine pH also did not show any relation to grape Brix or wine total acidity, alcohol content, price per bottle, or harvest date.

VINTAGE VARIATION

Vintages of wines were kept separate as a part of the experimental design to keep seasonal differences in weather constant for individual series of wines compared, but there is a strong vintage effect in the coefficient of correlation (r^2) of the relationship between wine pH and soil pH or depth. In 2009, soil pH and



depth determined 57%–59% of the variance in wine pH, but in other years, it determined only 11%–30% of the variance. A very strong correlation in 2009 and 2011 was also found between grape and wine pH, with lesser correlations for 2008 and not enough data for 2010 (Fig. 4A). Thus, vintage differences reflect growing conditions and not differences in winemaking techniques.

There is a very strong relationship between the size of the grape harvest and the strength of the correlation between soil and wine pH (Fig. - 4B). The size of the harvest was measured two different ways with similar results: (1) total Pinot Noir harvest from a single



Figure 3. Relationships between wine pH and minimum soil pH (A) and depth to base of clayey (Bt or Bw) horizon (B) in the 2009 vintage Pinot Noir wine from the Willamette Valley, Oregon, USA. These correlations are all highly significant using an ANOVA *F* test. One relationship is inverse and the other direct, because minimum soil pH and depth of clayey horizon are inversely correlated (C). Comparable correlations for three other vintages are in the GSA Supplemental Data Repository [see footnote 1].

Figure 4. Correlation between pH of grapes at harvest and pH of wine in the 2009 vintage Pinot Noir from the Willamette Valley, Oregon (A), between variance of coefficient of correlation between wine-soil pH and grape harvest size for vintages 2008–2011 (B), and between Wine Advocate vintage ranking and local October precipitation for that vintage (C).

group of vineyards (Chehalem Wines, 2015) and (2) yield of Oregon Pinot Noir from the National Agricultural Statistics Service (2015). Terroir pH thus is most strongly expressed in vintages when there are a lot of grapes, perhaps because winemakers impose fewer interventions.

OTHER DETERMINANTS OF WINE QUALITY

The 2009 vintage was excellent (86 points), like that of 2010 (88 points), but not exceptional like 2008 (94 points), as ranked by wine industry appointed connoisseurs (Parker, 2015, who did not rank 2011). Thus, the years of good soil pH expression in wines were not necessarily years of acclaimed and highly profitable wines. The acclaimed vintages show a very clear relationship with lack of precipitation in October (Fig. 4C), one of the reasons why wine production is so successful in regions with dry summer (Mediterranean) climates (Goode, 2014). No correlation was found between mean annual precipitation and either the size of the harvest or quality of the wine vintage.

CONCLUSIONS

This study supports with data two traditional tenets of vineyard management: (1) "treat vines mean to keep them keen," and (2) "deep-rooted vines better express terroir" (Goode, 2014). By these epigrams, vintners mean keen in the sense of more flavorful, and terroir in the sense of soil-related differences. One hardship for vines is lack of moisture before harvest, which is related closely to the quality of vintages (Fig. 4C). Another handicap to vine vigor is low soil pH, and thus fewer mineral nutrients, which has the effect of raising wine pH (Fig. 3A). It is the pH minima of the deep levels of soils in Oregon that appear to most affect both grape and wine pH (Fig. 3B). These stresses may induce vines to invest in future propagation rather than vegetative growth, by producing more fruit than leaves, and within the grapes, less organic acid, and more cations (Ca²⁺, Mg²⁺, K⁺, Na⁺) and flavor, color, or aroma compounds to attract dispersers (Goode, 2014). These organic compounds are complex and beyond the scope of this study (Fang and Qian, 2005), so our study does not address the fruit versus spice flavors of Willamette Valley wine (Burns, 2012), nor perceived "slaty" or "earthy" flavors in wine (Maltman, 2008). Nevertheless, pH is also an important element of the taste of wine. High pH (3.7-4.0) Pinot Noir wines with rounded and complex flavor are produced on low-pH, deep, middle Pleistocene soils, such as the Jory Series. Low pH (3.3-3.7) Pinot Noir wines with brisk and less complex flavor are produced on high-pH, shallow, late Pleistocene to Holocene soils, such as the Hazelair Series. Soil age and nutrient status has also been noted as a factor in wine quality in other regions (Costantini et al., 2012). Soils have a significant effect on the pH and taste of both grapes and wine, but these effects are increasingly obscured by blending and other winemaking techniques (Goode, 2014).

We conclude that one can taste some aspects of soil in wine, especially acidity. For Pinot Noir wines of our region, astringent taste tending toward vinegar comes from vines overfed by fertile Holocene soils, but rounded and buttery taste comes from vines that struggled in infertile mid-Pleistocene soils. However, acidic wines from young soils are less prone to spoilage than less acidic wines from old soils. Wine, like soil, is a living medium with a geological heritage.

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CURRENTS OF DECEIT A CARIBBEAN THRILLER COMPA island expuls before environ reachi A good Ronold Perkins

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Welcome back to Denver



for the 2016 Annual Meeting of the Geological Society of America on 25–28 September. The Technical Program Committee, Division representatives, and GSA staff are hard at work putting together the program for the meeting. We believe the 2016 program will live up to the Society's vision of "supporting the global community in scientific discovery, communication, and application of geoscience knowledge."

With well over 200 topical sessions proposed, ranging from archaeological geology to volcanology, GSA continues to demonstrate its relevance in the geoscience community. We encourage you to submit an abstract to one of these diverse and outstanding sessions.

Over the next few months, we will provide you with updates on the meeting, including information on registration, travel, lodging, and programming. Keep in mind that the meeting is more than a month earlier than last year, so deadlines are earlier as well. The Connected Community (**community.geosociety** .org) is a great way to stay current with meeting information and Division business.

This year, make the best of the meeting. Come early and stay late. Sign up for one or more of the excellent short courses or field trips, which will run before, during, and after the meeting. We look forward to seeing you in Denver this September!

-Paul Baldauf, 2016 Technical Program Chair

ORGANIZING COMMITTEE

Karen Berry, Colorado Geological Survey, General Chair, kaberry@mines.edu

Paul Baldauf, Nova Southeastern University, Technical Program Chair, pb501@nova.edu

Dick Berg, Illinois State Geological Survey, Technical Program Vice-Chair, rberg@illinois.edu

Steve Keller, Colorado Geological Survey, Co-Field Trip Chair, skeller@prodigy.net

Matt Morgan, Colorado Geological Survey, Co-Field Trip Chair, mmorgan@mines.edu

Rick Aster, Colorado State University, Education & Outreach Chair, rick.aster@colostate.edu

Samantha Richards, Denver Museum of Nature & Science, K–12 Chair, samantha.richards@dmns.org

Action Dates

| Housing opens | Early May |
|------------------------------------|--------------|
| Registration opens | Early May |
| Student travel grants opens | Early May |
| Student volunteer system opens | Early May |
| Space request deadline | 5 May |
| Abstract deadline | 12 July |
| Speaker notification | Early August |
| Housing cancellation fees begin | 23 August |
| Early registration deadline | 22 August |
| Registration cancellation deadline | 29 August |
| Housing deadline | 31 August |

Call for Papers

Abstracts deadline: 12 July

SUBMITTING AN ABSTRACT

- Submission deadline: Tuesday, 12 July.
- To begin your submission, go to community.geosociety.org/ gsa2016/science/sessions.
- An abstract submission fee of US\$50 for professionals and US\$25 for students will be charged.
- Information of preparing an abstract is online at https:// gsa.confex.com/gsa/2016AM/categorypreparation.cgi.
- Please review the two-abstract rule on p. 45.

GSA ABSTRACT SUBMISSION GUIDELINES

Abstract Content and Presentation

- · Please familiarize yourself with and adhere to the GSA Code of Ethics for abstract publication and meeting presentation (this page).
- · Abstracts must describe recent findings in the realms of science, pedagogy, or their applications.
- · All abstracts undergo peer review. Common reasons for rejection include dubious conclusions, questionable methodologies, poorly written prose, and incomplete or outdated information.
- The Joint Technical Program Committee (JTPC) will attempt to honor the authors' designations of topical session, discipline, or presentation mode (oral or poster). Final assignments remain at the discretion of the Technical Program Chair. Session scheduling and presentation modes are firm once assigned.

Authors

- Again, please adhere to the Code of Ethics (this page) describing content, authorship, and scholarship.
- PRESENTERS: Presenting authors can deliver two abstracts during the meeting, which can consist of one volunteered oral presentation and one volunteered poster presentation, or two poster presentations. The only exemption to this policy is if an author is also invited to give a presentation in either a Pardee Keynote Session or a Topical Session, because invited abstracts are not counted. Invited presenters will receive a PIN to exempt that abstract. If the session to which a presenting author is invited is cancelled, that abstract will lose its exempted status.
- · CO-AUTHORS: You may be listed on additional abstracts as a non-presenting co-author. There is no limit to the number of abstracts one can co-author.
- · All presenting authors, including invited speakers, are responsible for paying their abstract submission fee.
- All authors must pay their registration fees, plus any other expenses they might incur associated with the GSA meeting.
- · Acceptance notifications will be delivered within three weeks after the abstract deadline to allow sufficient time to make travel arrangements.
- · Enhance your professional reputation by submitting a refined abstract. Then, deliver an admirable presentation.

When submitting an abstract, you will be asked for your agreement to the following:

GSA Code of Ethics for Abstracts Publication and Meeting Presentation

Working together as a community of geoscientists, we will continue to advance the finest science in a respectable, professional manner. Authors will display integrity in disseminating their research. Presentations will adhere to the content and conclusions of abstracts, as submitted and reviewed. Listed co-authors will have made a bona fide contribution to the project. Conversely, the presenter should remain gracious by offering collaborators the opportunity for recognition as a co-author. All co-authors must be aware of their inclusion and have accepted that recognition. Presenters must be diligent in preparing a polished product that conveys high-quality scholarship. Submission of an abstract implies a sincere intent to attend the meeting.



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Pardee Keynote Symposia

Pardee Keynote Symposia are named in honor of GSA Fellow and benefactor Joseph Thomas Pardee (1871–1960) via a bequest from Mary Pardee Kelly. Pardee is perhaps best known for his work on Glacial Lake Missoula. These symposia consist of invited presentations covering a broad range of topics.

P1. Mastery of the Subsurface: The Challenge to Improve Subsurface Energy Systems

Sun., 25 Sept., 2–5:30 p.m., Mile High Ballroom 2A/3A

Advocates: Claudia I. Mora; George Guthrie; Susan S. Hubbard; Marianne Walck

Subsurface energy sources satisfy more than 80% of total U.S. energy needs. The economic, sustainable, and environmentally sound utilization of our subsurface resources poses crosscutting research and technology challenges: Can we understand, monitor, image, and ultimately predict the behavior of subsurface injected fluids, the state of stress and seismicity in the subsurface, and the integrity of a wellbore? Can we build the knowledge and tools needed to allow us adaptive control of subsurface fractures and fluid flow? Speakers will present geological challenges, state of the art, and research goals to meet the subsurface energy challenge. An open discussion will explore how research activities across federal labs, universities, and industry can be integrated to resolving these key challenges in subsurface science.

P2. When Oil and Water Mix: Understanding the Environmental Impacts of Shale Development

Mon., 26 Sept., 8 a.m.-5:30 p.m., Mile High Ballroom 2A/3A

Cosponsors: GSA Hydrogeology Division; GSA Environmental and Engineering Geology Division; GSA Energy Geology Division; GSA Geology and Health Division

Advocates: Daniel J. Soeder; Michael Focasio; Douglas B. Kent

Geoscientists have faced questions from the public for many years about the potential impacts of oil and gas production on the environment. This has been ratcheted up with the advent of shale gas development and high-volume hydraulic fracturing. Sparse data and few studies initially caused a great deal of uncertainty, but an avalanche of investigations in recent years have been providing solid information. Researchers will present findings on the future development of oil and gas resources, advances in extraction, and improvements in understanding the potential human and environmental health impacts.

P3. Exploring the Third Zone: The Geology of Pluto, Charon, and the Kuiper Belt

Tues., 27 Sept., 1:30–5:30 p.m., Mile High Ballroom 2A/3A **Cosponsors:** *GSA Planetary Geology Division; AGU Planetary Sciences Section*

Advocates: William B. McKinnon; S. Alan Stern; Jeffrey M. Moore NASA's *New Horizons* mission has revealed surprisingly

complex geology on the surfaces of Pluto and Charon. This

symposium explores the geological diversity and ongoing activity on present members of the Kuiper belt (the Solar System's "Third Zone"), such as Pluto, and former members, such as Triton, widely viewed as an icy dwarf planet captured by Neptune. Saturn's midsize satellite Phoebe and the largest asteroid, Ceres, have also been hypothesized to come from the Kuiper belt. This symposium will address, and a panel will discuss, the geological commonalities between these worlds and the future exploration of the Third Zone.

P4. Geologic Evolution of Cuba

Wed., 28 Sept., 8 a.m.-noon., Mile High Ballroom 2A/3A

Advocates: Robert Stern; Manuel Antonio Iturralde-Vinent; Antonio Casco-Garcia;^{*}Yamirka Rojas-Agramonte; J. Brendan Murphy; Darrel S. Cowan

Cuba, the largest island in the Greater Antilles, has a complex geology that is key for understanding North American and Caribbean plate interactions, including Mesozoic passive margin sediments, Mesozoic ophiolites, volcanic-arc rocks and subduction/collision metamorphic complexes, and Cenozoic synorogenic basins related to collision with North America. This session will bring together geoscientists from Cuba, the U.S., and Europe to better constrain and understand the geologic evolution of Cuba and its surroundings. This is a joint event between the geological societies of the two nations, the first one in many years and a new start to what we hope will become a strong relationship.

P5. The High Plains Aquifer: Can It Be Managed for Today and the Future?

Tues., 27 Sept., 8 a.m.-noon, Mile High Ballroom 2A/3A

Cosponsors: GSA Geology and Society Division; GSA Geology and Public Policy Committee; GSA Hydrogeology Division; National Ground Water Association; GSA Sedimentary Geology Division; Society for Sedimentary Geology (SEPM); GSA Soils and Soil Processes Interdisciplinary Interest Group

Advocates: Susan Stover; Rex C. Buchanan

The High Plains aquifer provides water to portions of eight states, supporting irrigation, feedlots, dairies, ethanol plants, and communities. For decades, geoscientists have measured, modeled, and communicated the declines of this primary source of water to help society make informed decisions on its use and management. The documentary examines the conflicts, politics, economics, and scarcity that irrigators and residents of west Texas are facing. Are we making an impact?

*Editor's note post publication:

The name of one of the symposium P4's conveners was listed incorrectly. It should be Antonio Garcia-Casco.

Topical Sessions

ARCHAEOLOGICAL GEOLOGY

T1. Pluvials, Atmospheric Rivers, Monsoons, and Water Availability in Western North America from the Quaternary into the Future: Modeling, Observations, and Paleo Reconstructions of Hydroclimate Extremes

Cosponsors: GSA Limnogeology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); GSA Archaeological Geology Division

Disciplines: Archaeological Geology, Paleoclimatology/ Paleoceanography, Limnogeology

Advocates: Ingrid Hendy; Aradhna Tripati; Matthew E. Kirby

Water availability in western North America has been critical for human populations through prehistory and will be into the future. This session showcases instrumental observations, modeling, and paleoenvironmental reconstructions of hydroclimate regimes.

T2. Reconstructing Environmental Controls on Societal Change from Prehistory to Present Day

Cosponsors: GSA Limnogeology Division; GSA Archaeological Geology Division; American Quaternary Association; GSA Sedimentary Geology Division; GSA Geology and Society Division

Disciplines: Archaeological Geology, Paleoclimatology/ Paleoceanography, Quaternary Geology

Advocates: Susann Stolze; Michelle F. Goman

This session welcomes papers reconstructing the nature and degree of environmental change and its influence on societal change through the Holocene. It will bring together researchers across disciplines in the Earth and archaeological sciences.

ECONOMIC GEOLOGY

T3. Economic Geology of the Extensional Terrains

Cosponsors: Society of Economic Geologists; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Economic Geology, Tectonics/Tectonophysics, Structural Geology

Advocates: Alvis L. Lisenbee; Zeynep O. Baran

This session is focused on the extensional tectonics and associated structures and their significance to the formation, distribution, exploration, and production of economic mineral deposits on Earth.

T4. Geology and Mineral Potential at High Latitudes

Cosponsor: Society of Economic Geologists

Disciplines: Economic Geology, Geophysics/Geodynamics, Geochemistry

Advocates: Garth Graham; Raymond F. Kokaly

This session examines novel methods applied to geologic mapping and mineral exploration in arctic regions.

T5. Magmatic-Hydrothermal Ore Deposits: Metal Transport from Source to Sink

Cosponsors: Society of Economic Geologists; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Economic Geology, Geochemistry, Petrology, Igneous

Advocates: Thomas Monecke; Karen Kelly

This session examines how metals are transported and deposited in hydrothermal systems powered by large magmatic intrusions emplaced in the upper crust and reviews the geological characteristics of magmatic-hydrothermal base and precious metal deposits.

T6. Micro-Analytical Techniques in Ore Deposit Research

Cosponsors: Society of Economic Geologists; Microanalysis Society (MAS); GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Economic Geology, Mineralogy/Crystallography, Geochemistry

Advocates: Katharina Pfaff; Julien M Allaz

This session highlights advances in methods development of micro-analytical techniques and their application to ore deposit research.

T7. Mineral Resources for Society: Honoring the Career and Contributions to Economic Geology of Jean S. Cline

Cosponsors: Society of Economic Geologists; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Economic Geology, Geochemistry, Petrology, Igneous

Advocates: R.J. Bodnar; John L. Muntean

This session honors the many contributions of Jean S. Cline in mineral deposits research. Abstracts related to all mineral deposit types are welcome, especially those related to Carlin and porphyry type systems.

T8. Practical Applications of Fundamental and Innovative Technology Utilized in the Geoscience Industry and Secondary Education

Cosponsor: GSA Environmental and Engineering Geology Division

Disciplines: Economic Geology, Structural Geology, Geoscience Education

Advocate: Maureen Moore Roth

LiDAR scanning and three-dimensional technology is used to resolve practical challenges in the geoscience industry. Showcase such applications that are used to improve productivity, safety, geologic understanding, and potentially economics of an ore deposit.

T9. Rare Earth and Critical Elements in Ore Deposits

Cosponsor: Society of Economic Geologists

Disciplines: Economic Geology, Geochemistry

Advocates: E.E. Marsh; Philip L. Verplanck

This session will focus on our current understanding of where, how, and why individual critical elements occur. This session should be of use to a variety of geoscientists as well as public policy analysts.

ENERGY GEOLOGY

T10. Advances in Reactive Transport Modeling of Deep Saline Groundwater and Hydrocarbon Systems

Cosponsors: GSA Energy Geology Division; GSA Hydrogeology Division

Disciplines: Energy Geology, Hydrogeology, Geochemistry

Advocates: Tina L. Roberts-Ashby; Madalyn S. Blondes

This session includes reactive transport and deep reservoir modeling in saline or brackish waters, for the evaluation of CO₂-storage or enhanced oil recovery operations; injection of hydraulic fracturing, produced, or waste-disposal fluids; and/or water resource investigations.

T11. Environmental Geology Studies of Energy Impacts

Cosponsors: GSA Energy Geology Division; GSA Environmental and Engineering Geology Division

Disciplines: Energy Geology, Environmental Geoscience, Geochemistry

Advocates: Marc L. Buursink; J. Fred McLaughlin; Brett J. Valentine

This session will explore research relating to environmental issues associated with energy geology, including exploration practices, extraction of resources, and waste disposal.

T12. Evaporite Deposits and Efflorescent Crusts: How Do They Influence Radionuclide, Heavy Metal, and Other Constituent Transport in the Environment?

Cosponsors: GSA Energy Geology Division; GSA Geology and Health Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Energy Geology, Geology and Health, Geochemistry

Advocates: Anthony J. Ranalli; Douglas B. Yager; Raymond H. Johnson

Evaporite deposits and efflorescent crusts and their role as sources of uranium ore and as sources of various contaminants to groundwater and surface water at various types of mines and milling sites will be addressed.

T13. Fracture, Faulting, and Reactive Fluid Flow in Tight Rocks: Coupled Processes in Shale, CO_2 Sequestration, and Geothermal Energy

Disciplines: Energy Geology, Structural Geology, Hydrogeology **Advocates:** J. William Carey; Jason Heath New research on fluid flow in fractured media will advance understanding of coupled geomechanics, hydrology, and reactive transport that allow utilization of the subsurface in a safe and effective manner.

T14. Geologic Energy Research

Cosponsors: GSA Energy Geology Division; GSA Sedimentary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Energy Geology, Stratigraphy, Mineralogy/ Crystallography

Advocates: J. Fred McLaughlin; Marc L. Buursink; Brett J. Valentine

This is the general session of GSA's Energy Division. Topics include research on coal, petroleum geology, geothermal systems, uranium and REEs, sedimentary and structural geology of energy resources, and energy utilization.

T15. Geology and Geochemistry of Carbon Dioxide, Helium, and Other Low-BTU Natural Gas Systems

Cosponsors: GSA Energy Geology Division; GSA Sedimentary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Energy Geology, Geochemistry, Stratigraphy

Advocates: Matthew D. Merrill; Marc L. Buursink

Low-BTU natural gases rich in CO_2 or helium are important economic commodities, and their accumulation can be analogs to storage of anthropogenic CO_2 . We seek studies on the systematics of these non-hydrocarbon gases.

T16. Mudstone Evolution: From Deposition through Diagenesis

Cosponsors: GSA Limnogeology Division; GSA Sedimentary Geology Division

Disciplines: Energy Geology, Limnogeology, Sediments, Clastic **Advocates:** Sven Egenhoff; Neil Fishman

Deposition and post-depositional modification of mudstones remain enigmatic. Nevertheless, their economic significance is universal as a source of energy or as household or industry raw material. This session will review all aspects of mudstone geology.

T17. Research and Development on the Technical Bases for Radioactive Waste Disposal in Mined Geologic Repositories: Geoscience Data and Models

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Energy Geology, Environmental Geoscience, Hydrogeology

Advocates: David C. Sassani; Florie A. Caporuscio

Within the U.S. DOE Used Fuel Disposition Program, activities focus on generic geologic mined repositories for safe disposal of radioactive wastes. Geoscience data are essential technical bases of safe disposal here and around the globe.

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T18. The Application of the Geostatistical Inversion in Shale Lithofacies Prediction

Disciplines: Energy Geology, Geophysics/Geodynamics, Marine/ Coastal Science

Advocate: Xiaochen Liu

This session aims to predict the spatial distribution of shale lithofacies in the Fuling Jiaoshiba area using geostatistical inversion.

T19. Unconventional Energy Resources

Cosponsors: GSA Energy Geology Division; GSA Sedimentary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Energy Geology, Geochemistry, Stratigraphy

Advocates: J. Fred McLaughlin; Marc L. Buursink; Brett J. Valentine

This session will showcase research relating to unconventional hydrocarbon resources, which can be complex systems to understand and develop. This session provides a venue for researchers looking to share new research on unconventional plays.

ENGINEERING GEOLOGY

T20. Advances in Data Collection and Delivery for Geohazards: Reaching Out to Stakeholders

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Geoinformatics Division; Association of Environmental and Engineering Geologists; GSA Geology and Society Division

Disciplines: Engineering Geology, Environmental Geoscience, Geomorphology

Advocates: John Wall; Matthew M. Crawford; Norman Levine; Douglas C. Curl

This session will highlight developing, new, and existing approaches to integrating digital geohazards data into decisionmaking processes for stakeholders (e.g., other agencies, governments, the public, etc.). Field collection standards, integration into existing/future datasets, and data dissemination will be presented.

T21. Bridging the Gaps on Subaerial, Lacustrine, and Submarine Landslide Research

Cosponsors: GSA Environmental and Engineering Geology Division; S4SLIDE; Marine/Coastal Science Discipline; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Engineering Geology, Marine/Coastal Science, Geomorphology

Advocates: Lesli Wood; Lorena Moscardelli

Submarine landslides are never witnessed, but the aftermath is clear: destruction of seafloor infrastructure, disruption of biota, and tsunamigenic coastal threats. This session looks at researchers attempting to bridge between subaerial and submarine landslide processes.

T22. DAM Stability and Safety—The Importance of Engineering Geology

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Geology and Society Division

Disciplines: Engineering Geology, Geomorphology, Soils

Advocate: Rennie B. Kaunda

This session presents the latest advances in addressing challenges for risk assessment in levees, dams, and other embankments with emphasis on engineering geology, soils, and hydrogeology. Case studies are welcomed and encouraged.

T23. Environmental and Engineering Division Geology Student Research Competition (Posters)

Cosponsors: GSA Environmental and Engineering Geology Division; Association of Environmental and Engineering Geologists

Discipline: Engineering Geology

Advocates: Matthew M. Crawford; Thad A. Wasklewicz; Jessica E. Witt; Stephen L. Slaughter

We encourage students to submit for the poster presentation on topics related to applied research in environmental and engineering geology. Monetary awards will be given to the top presenters at the division dinner and awards ceremony.

T24. Landslide Hazards: Inventories, Hazard Maps, Risk Analysis, and Warning Systems (Posters)

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Geology and Society Division

Disciplines: Engineering Geology, Geomorphology

Advocates: William J. Burns; Stephen L. Slaughter; Matthew M. Crawford

This session is designed to highlight landslide hazards information especially as related to landslide inventories, hazard maps, risk analysis, and warning systems.

T25. Landslides, Debris Flow, and Rock Fall: Processes and Hazards

Cosponsors: GSA Environmental and Engineering Geology Division; U.S. Geological Survey Landslide Hazards Program

Disciplines: Engineering Geology, Geomorphology, Geoscience and Public Policy

Advocates: Rex L. Baum; Benjamin B. Mirus

This session will explore new insights about landslide processes and hazards. Contributions that address novel field and instrumental observations, analysis, and hazard assessments or that introduce tools and techniques applicable to any of these are especially welcome.

ENVIRONMENTAL GEOSCIENCE

T26. Biogeochemical Redox Cycling of Metals and Radionuclides

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Environmental Geoscience, Geochemistry, Geomicrobiology

Advocates: Karrie A. Weber; Kate M. Campbell

This session will explore natural and engineered abiotic and biotic redox cycling of metals and radionuclides in paleo- and modern environments.

T27. Find Your Park (and Other Public Lands)—One Internship at a Time: Two Decades of Providing Career Development Opportunities in Public Lands for Students and Recent Graduates

Cosponsor: GSA Geology and Society Division

Disciplines: Environmental Geoscience, Geoscience Education, Geoscience Information/Communication

Advocates: Elizabeth Norby; Matthew Dawson; Krista Rogers

The Geoscientists-in-the-Parks and GeoCorpsTM America Programs provide professional development and resource management opportunities on public lands for geoscience students and others pursuing careers in STEM fields. This session highlights the scientific accomplishments of these internship programs.

T28. Interdisciplinary Approaches to Assessing Environmental Impact of Mining

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Geology and Society Division; GSA Hydrogeology Division; Geochemical Society; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Environmental Geoscience, Hydrogeology, Geochemistry

Advocates: JoAnn M. Holloway; Kate M. Campbell; Suzette A. Morman

This session explores interdisciplinary approaches to assessing environmental and human health effects of historical and projected mining activity.

T29. Intersections of Sustainability and Geosciences

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Geology and Society Division

Disciplines: Environmental Geoscience, Geoscience Education, Geoscience Information/Communication

Advocates: Leslie North; Robert Brinkmann

Papers are sought for this session on sustainability and the geosciences. This session seeks to highlight works that combine the fields of sustainability and geoscience to examine or educate about environmental and/or societal problems.

T30. Sigma Gamma Epsilon—Undergraduate Research (Posters)

Cosponsor: Sigma Gamma Epsilon

Disciplines: Environmental Geoscience, Paleontology, Biogeography/Biostratigraphy, Hydrogeology

Advocates: Aaron W. Johnson; James C. Walters

The goal of this session is to highlight recent and on-going undergraduate research in a student-friendly forum. The session is open to students and faculty co-authors working in any area of the geosciences.

T31. Water Quality and Aqueous Contaminants

Cosponsor: *GSA Environmental and Engineering Geology Division* **Disciplines:** Environmental Geoscience, Geochemistry, Hydrogeology

Advocates: James Besancon; Rudolph Hon; Jessica E. Witt

Water quality protection depends on knowledge of how contaminants enter the water supply. We seek contributions from those analyzing the sources and transport of contaminants in agricultural and public water supplies.

T32. Water Treatment and Beneficial Reuse of Produced Water from Oil and Gas Operations

Cosponsor: GSA Environmental and Engineering Geology Division

Disciplines: Environmental Geoscience, Geoscience and Public Policy, Engineering Geology

Advocates: Andrea C. Blaine; Tzahi Y. Cath; Terri S. Hogue; Karl D. Fennessey

To help minimize the impacts of energy production on water resources, produced water from oil and gas operations can be treated for beneficial reuse. To achieve this, economic, liability, regulatory, and social barriers must be addressed.

GEOCHEMISTRY

T33. Beyond EARTHTIME: Accuracy and a Multi-Chronometer Time Scale

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Paleontology, Diversity, Extinction, Origination, Volcanology

Advocates: Matthew T. Heizler; Brad S. Singer; Mark D. Schmitz

EARTHTIME has entered ultra-high precision geochronology, seeking to unravel complex earth-system processes. Our challenge is to improve the accuracy of each dating method. We will gather to evaluate these challenges and highlight new opportunities.



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T34. Characterization and Modeling of Biogeochemical Redox Processes

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geobiology & Geomicrobiology Division

Disciplines: Geochemistry, Geomicrobiology, Soils

Advocates: Guoping Tang; Jennifer Pett-Ridge; Christine O'Connell

We aim to bring together experimentalists and modelers from multiple disciplines to communicate new ideas and methods in obtaining predictive understanding of and developing integrated models for biogeochemical redox processes across scales.

T35. Contamination and Human Impact Records from Lake and Estuarine Sediment

Cosponsors: GSA Limnogeology Division; Marine/Coastal Science Discipline; Paleontological Society

Disciplines: Geochemistry, Limnogeology, Sediments, Clastic

Advocate: Johan C. Varekamp

Lakes and estuaries carry archival information in their sediment on contaminant fluxes and changes in landscape and hydrology commonly caused by human activities. Reconstruction of pre-anthropogenic conditions aids in evaluating the severity of human impacts.

T36. Environmental Effects Related to Unconventional Oil and Gas Resources

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Geology and Society Division

Disciplines: Geochemistry, Hydrogeology, Environmental Geoscience

Advocates: Anna K. Wendt; David A. Yoxtheimer; Stephen G. Osborn; Owen A. Sherwood

The development of unconventional resources has led to concern for the environment and public health. Research on potential impacts is required because unconventionals are projected to be the largest source of natural gas in the U.S.

T37. Excursions, Extinctions, and Environmental Change: New Advances in Geochemical Tools Linked to Critical Intervals of Environmental and Biotic Change in Earth History

Cosponsors: GSA Sedimentary Geology Division; GSA Geobiology & Geomicrobiology Division; SEPM (Society for Sedimentary Geology); Geochemical Society; Paleontological Society; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Paleontology, Diversity, Extinction, Origination, Stratigraphy

Advocates: Cole T. Edwards; Seth A. Young; Jeremy Owens; Benjamin C. Gill

This session will highlight emerging research that broadens our understanding of the links between paleoenvironmental change, recorded in traditional vs. non-traditional isotopic/elemental proxies, with the paleontological record of extinction and biodiversification within the sedimentary record.

T38. Fluid Flows, Chemical Reactions, and Transport in Nanopores of Geologic Media

Cosponsors: GSA Energy Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Energy Geology, Hydrogeology

Advocates: Mei Ding; Yifeng Wang

This session will focus on the effects of nanopore confinement on geofluid properties, mineral-fluid interface chemistry, fluid phase and transport behavior, overall fluid-rock interactions, and their implications to energy-related subsurface science and engineering.

T39. Go Small or Go Home: Microbeam Techniques Applied to Igneous, Metamorphic, and Sedimentary Petrology of Earth and Planetary Materials

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division; GSA Planetary Geology Division

Disciplines: Geochemistry, Planetary Geology, Tectonics/ Tectonophysics

Advocates: Kate Souders; Paul J. Sylvester

We highlight method development and novel application of in-situ microbeam techniques (e.g., EPMA, SEM/TEM/FIB, 3D CT, EBSD, SIMS, LA-[MC]-ICPMS) in Earth and planetary sciences. Presentations on chemical mapping and elemental/ isotopic analyses are welcome.

T40. Non-Traditional Stable Isotope Fractionation at Extreme Conditions: In Honor of Anat Shahar, 2016 MSA Awardee

Cosponsors: *Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division*

Disciplines: Geochemistry, Petrology, Igneous, Planetary Geology

Advocates: Edward Young; Craig Manning

This session is devoted to the continuing development of nontraditional stable isotope systems as tracers of planet formation, differentiation, and subsequent evolution. Studies of stable isotope fractionation applicable to mantle geochemistry, igneous processes, and planetary interiors are appropriate.

T41. pXRF in the Geosciences: Applications to Environmental, Regional, and Exploration Geology

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geology and Health Division; GSA Limnogeology Division

Disciplines: Geochemistry, Environmental Geoscience, Economic Geology

Advocates: Lawrence D. Lemke; Ross D. Knight; Samuel Mutiti; Bruce Kjarsgaard

Significant advances in portable X-ray fluorescence spectrometry during the past decade provide a cost-effective tool for the rapid generation of geochemical data. This session will assemble presentations on pXRF applications, including environmental studies, chemostratigraphy, and mineral deposit exploration.

T42. Shallow and Deep, Hot and Cold: The Diverse Environments of Black Shale Formation

Disciplines: Geochemistry, Paleoclimatology/Paleoceanography, Sediments, Clastic

Advocates: Michael Tuite Jr.; Alex Bartholomew

The diversity of black shales reflects the broad range of tectonic, climatic, biogeochemical, sedimentological, and geographic conditions under which they form as evidenced by paleontology, geochemistry, sedimentology, and stratigraphy.

T43. Sources, Transport, Fate, and Toxicology of Trace Elements and Organics in the Environment

Cosponsors: International Association of GeoChemistry; GSA Environmental and Engineering Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Environmental Geoscience, Geology and Health

Advocates: LeeAnn Munk; David T. Long; W. Berry Lyons

Basic and applied research on trace elements and organics in the environment are encouraged. Topics include those that relate to understanding and modeling sources, transport, and fate; human and ecosystem health; and environmental assessment and remediation.

T44. The Holistic Approach to Landscape Evolution: Incorporating Chronometric Data into the Geologic History of a Region

Cosponsors: GSA Quaternary Geology and Geomorphology Division; Boulder Creek Critical Zone Observatory; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Geochemistry, Geomorphology, Quaternary Geology

Advocates: Dylan Ward; Claire E. Lukens; Melissa A. Foster

Geochronometers are powerful tools used to quantify rates of landscape evolution, but careful consideration must be given to geologic context and applicable timescales. We encourage contributions that interpret geochronometer results within broader geologic history.

T45. Urban Geochemistry

Cosponsors: International Association of GeoChemistry; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geochemistry, Environmental Geoscience, Geology and Health

Advocates: Joel Moore; David T. Long; W. Berry Lyons

This session encourages presentations that qualify and quantify the geochemical and biogeochemical impacts (temporal and spatial) of urbanization and urban activities on soil, water, and air resources as well as on human and ecosystem health.

GEOINFORMATICS

T46. Advanced Information Systems and the Geosciences: Visioning the Future

Cosponsors: GSA Hydrogeology Division; GSA Geology and Society Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Geoinformatics, Geoscience Information/ Communication

Advocates: Mary C. Hill; Suzanne A. Pierce; Basil Tikoff

This session explores how advanced computing tools, architectures, algorithms, and visualization are transforming geoscience practice and research, making issues that range from hydrology to geologic hazards to planetary science more accessible, understandable, pervasive, and compelling.

T47. Big Data in the Geosciences

Cosponsor: GSA Geoinformatics Division

Disciplines: Geoinformatics, Geoscience Information/ Communication

Advocates: M. Lee Allison; Leslie Hsu

Big Data, including small data sets of great variety, complexity, variability, open access, is changing the scientific paradigm and breaking down barriers to discovery, access, and integration of data, thus reshaping the scientific practice.

GEOLOGY AND HEALTH

T48. Current Medical Geology Research on Natural Materials, Outreach, and Education Activities

Cosponsors: GSA Geology and Health Division; GSA Environmental and Engineering Geology Division; GSA Geology and Society Division; GSA Geoscience Education Division

Disciplines: Geology and Health, Environmental Geoscience, Geoscience and Public Policy

Advocates: Saugata Datta; Robert B. Finkelman; Nurdan S. Duzgoren-Aydin; Karen Johannesson

Inhaled and ingested geologic materials have been causing a major human health impact recently. Contributions are welcome from social activists, medical practitioners, public health disciplines, and medical geologists, among others.

GEOMICROBIOLOGY

T49. Geobiology of Earth-Life Systems

Cosponsors: GSA Geobiology & Geomicrobiology Division; Paleontological Society

Disciplines: Geomicrobiology, Paleontology, Paleoecology/ Taphonomy, Paleontology, Diversity, Extinction, Origination

Advocates: Marc Laflamme; Simon A.F. Darroch; James D. Schiffbauer

This session seeks to assemble research of graduate students, postdoctoral researchers, and early career faculty with focuses on disentangling the drivers of complex geobiological interactions in both shallow and deep time.

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T50. Geomicrobiology and Hydrology of Lava Tube Caves

Cosponsors: GSA Geobiology & Geomicrobiology Division; GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geomicrobiology, Hydrogeology, Geochemistry **Advocates:** Jennifer G. Blank; Saugata Datta; Richard J. Leveille

We seek contributions about the mineralogy, hydrogeology, and microbiology of lava tube caves, especially studies of microbial diversity, biomarkers, and assessment of energy available to support life there and in lava tube caves on other planets.

GEOMORPHOLOGY

T51. CRevolution 2.5: Origin and Evolution of the Colorado River System and Cenozoic Landscape Evolution of the Colorado Plateau–Rocky Mountain Region

Disciplines: Geomorphology, Tectonics/Tectonophysics, Geophysics/Geodynamics

Advocates: Ryan S. Crow; L. Sue Beard; Rebecca Dorsey; Andres Aslan; Eric Kirby; Brandon Schmandt; Lijun Liu; Richard A. Young; P. Kyle House; David L. Shuster; Karl Karlstrom

Papers are sought that present recent advances on the origin and evolution of the Colorado River system, including the overall Cenozoic tectonic and geomorphic evolution of the western U.S. orogenic plateau and dynamic topography in general.

T52. Deep Weathering, Ancient Landscapes, and Regolith-Dominated Terrains

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group

Disciplines: Geomorphology, Geochemistry, Economic Geology

Advocate: Ignacio Gonzalez-Alvarez

Regolith-dominated terrains are extensively preserved across many continental regions, especially in the tropics and sub-tropics. The complex weathered profiles in these regions, which reach depths of 30 m to more than 100 m, are the products of multiple weathering events occurring over geologically long timescales.

T53. Floodplain Hydrogeomorphology: Dynamics of Sediment, Vegetation, and Organic Matter in Altered and Unaltered Systems

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division; GSA Geobiology & Geomicrobiology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Geomorphology, Environmental Geoscience, Soils

Advocates: Derek M. Schook; Katherine B. Lininger; Nicholas A. Sutfin

We encourage abstracts that investigate the timing, distribution, and mechanisms of floodplain creation and reconfiguration with a focus on feedbacks between hydrologic connectivity, floodplain features, and the distribution of vegetation, organic matter, and sediment.

T54. Geomorphology and Hydrology of Wildland Fires

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division; GSA Geology and Society Division

Disciplines: Geomorphology, Environmental Geoscience, Quaternary Geology

Advocates: Daniel Cadol; Francis K. Rengers; Luke McGuire; Joel B. Sankey

This session seeks to bring together researchers studying the processes by which wildland fires affect the timing and magnitude of water, sediment, and pyrogenic debris fluxes and the resulting impacts on downstream communities.

T55. Heterogeneity in Geomorphic Systems: Driving Forces and Landscape Response

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Geomorphology, Quaternary Geology, Sediments, Clastic

Advocates: Charles M. Shobe; Rachel C. Glade

This session explores landscape evolution in the face of spatially and temporally variable forcings (e.g., tectonics, climate) and heterogeneous rock and sediment properties (e.g., lithology, grain size). We welcome field, modeling, and experimental approaches.

T56. Insights into the Regional Geology of Michigan: From Glaciers to Mid-Continental Rifting

Disciplines: Geomorphology, Stratigraphy, Economic Geology

Advocates: Erik B. Larson; Jonathan B. Sumrall

This session welcomes topics related to the great variety of regional geology in Michigan, including geomorphology, glacial history, hydrology, karst, mid-continental rifting, mining geology, paleontology, petroleum geology, sedimentology, soils, and stratigraphy.

T57. Management and Restoration of Fluvial Systems: Rehabilitating or Accommodating Altered Hydrologic and Sediment Regimes

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Environmental and Engineering Geology Division

Disciplines: Geomorphology, Environmental Geoscience

Advocates: Sara L. Rathburn; L. Allan James; Bruce Rhoads

This session explores the temporal dynamics and spatial breadth of river management and restoration. Historical reconstructions of long-term change, short-term remote sensing change detection, predictive modeling, implementation strategies, and monitoring effectiveness are encouraged.

T58. Morphodynamics and Stratigraphy of Meandering Rivers

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Geomorphology, Sediments, Clastic, Stratigraphy **Advocates:** Kory Konsoer; Jessica Ann Zinger; Douglas Edmonds

This session welcomes investigations of meandering rivers across all spatial and temporal scales using field-based, numerical, or experimental approaches, as well as studies that focus on the stratigraphy of ancient or modern meandering river systems.

T59. Paleofloods and Related Fluvial Processes during the Late Quaternary: Reconstructions and Causes

Cosponsors: GSA Quaternary Geology and Geomorphology Division; American Quaternary Association; Past Global Changes (PAGES)– Floods Working Group; GSA Sedimentary Geology Division

Disciplines: Geomorphology, Quaternary Geology, Paleoclimatology/Paleoceanography

Advocates: Matthew Therrell; Lisa Davis; Samuel Munoz

This session aims to bring together scientists with interests in developing and applying a broad array of reconstruction techniques for characterizing the magnitude, frequency, geographic distribution, and causes of paleofloods.

T60. Quantifying and Interpreting the Role of Climate, Tectonics, and Autogenic Processes in Landscape Dynamics

Disciplines: Geomorphology, Quaternary Geology, Paleoclimatology/Paleoceanography

Advocates: Kerry Riley; Tammy Rittenour

This session investigates the interplay between allogenic forcing (climate, tectonics) and autogenic processes (slope/ transport thresholds) when interpreting alluvial records. Fieldbased and experimental studies across time and spatial scales are encouraged.

T61. Quantifying Geomorphic Processes and Rates of Landscape Evolution

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geomorphology, Geochemistry, Quaternary Geology

Advocates: Arjun M. Heimsath; Nathaniel A. Lifton; Darryl E. Granger

This session explores how methods such as cosmogenic nuclides, apatite (U-Th)/He thermochronometry, U-series geochemistry, luminescence, and chemical mass balances quantify relationships between climate, tectonics, and erosion.

T62. Quantifying Geomorphic Response to Floods: From Geochronologic Methods to High-Resolution Data and State-ofthe-Art Models

Cosponsor: GSA Quaternary Geology and Geomorphology Division

Disciplines: Geomorphology, Engineering Geology, Public Policy

Advocates: Joel Sholtes; Nicholas A. Sutfin; John Pitlick

Application of traditional and novel approaches for characterizing the geomorphic impacts of floods within river corridors: advances in science and flood hazard management.

GEOPHYSICS/GEODYNAMICS

T63. From Mantle to Landscape: Cenozoic Evolution of the Rocky Mountain

Cosponsors: GSA Geophysics Division; GSA Structural Geology and Tectonics Division

Disciplines: Geophysics/Geodynamics, Tectonics/ Tectonophysics, Geochemistry

Advocates: Robert Moucha; Jolante W. van Wijk; Majie Fan

This session encourages multidisciplinary studies ranging from mantle to surface processes, from numerical modeling to data collection and analysis to understand the tectonic and landscape evolution of the Rocky Mountains.

T64. Injection-Induced Earthquakes: Geologic and Operational Constraints, Seismic Hazard, Mitigation, and Societal Impact

Cosponsors: GSA Geophysics Division; GSA Environmental and Engineering Geology Division

Disciplines: Geophysics/Geodynamics, Hydrogeology

Advocates: William Luther Yeck; Matthew Weingarten

This session encourages studies of injection-induced earthquakes, including cases related to wastewater disposal, hydraulic fracturing, and CO_2 sequestration. Of particular interest are case studies that relate geologic and operational constraints to earthquake characteristics or hazard.

T65. Precambrian Evolution and Mineral Resources of the Midcontinent Rift Region: In Honor of William J. Hinze

Cosponsors: GSA Geophysics Division; Society of Economic Geologists; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Geophysics/Geodynamics, Economic Geology, Precambrian Geology

Advocates: Benjamin J. Drenth; Joyashish Thakurta; William F. Cannon

Contributions are sought from broad-ranging multidisciplinary studies at various scales that relate to the development of the Midcontinent Rift, surrounding Precambrian rocks, and mineral resources in the region.

T66. Structure and Tectonics of the South-Central United States: Craton to Gulf of Mexico

Cosponsor: GSA Geophysics Division

Disciplines: Geophysics/Geodynamics, Structural Geology, Tectonics/Tectonophysics

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Advocates: Jay Pulliam; Harold Gurrola; Kevin L. Mickus; Gregory Dumond; Melanie A. Barnes; G.R. Keller

We welcome contributions that shed light on, or formulate important questions regarding, the structure and tectonics of the south-central United States, including results from new data, syntheses of previous studies, and proposals for new studies and data acquisition.

T67. Under Cover: Exploration for Concealed Mineral Deposits, Mapping Concealed Terranes, and Relating Crustal Architecture to Concealed Mineralizing Systems

Cosponsors: GSA Geophysics Division; GSA Structural Geology and Tectonics Division; Society of Economic Geologists

Disciplines: Geophysics/Geodynamics, Tectonics/ Tectonophysics, Economic Geology

Advocates: Mark Bultman; Mark E. Gettings

Geophysical or integrated geoscientific techniques and interpretations aimed at identifying concealed lithologic terranes, locating covered mineral deposits, creating geophysical models of ore deposits, and delineating crustal architectures and their relationships to deep mineralizing systems.

GEOSCIENCE AND PUBLIC POLICY

T68. Geoscience and Engineering Research Applied to the Concept of Deep Borehole Disposal of Radioactive Waste in Continental Basement Rocks

Cosponsors: GSA Environmental and Engineering Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geoscience and Public Policy, Environmental Geoscience, Hydrogeology

Advocates: Frank Perry; Kristopher Kuhlman

Borehole disposal of radioactive waste in crystalline basement offers the potential to maximize waste isolation. A planned borehole in the U.S. provides an opportunity for the geosciences to test the feasibility of the disposal concept.

T69. Geoscience, Society, and the Law: Exploring the Legal Problems Entailed with Geologic Research and Practice

Cosponsors: GSA Geology and Society Division; Geology and Public Policy Committee

Disciplines: Geoscience and Public Policy, Public Policy, Geoscience Information/Communication

Advocate: James Heller

An overview of relevant legal issues pertaining to geologic research, the possible implications for the public, and the means by which the applied professional can mitigate potential problems in the course of their duties.

T70. The Animas River and Beyond: Balancing Science and Policy in Cleaning up America's Abandoned Mine Lands

Cosponsors: GSA Geology and Society Division; GSA Environmental and Engineering Geology Division; GSA

Hydrogeology Division; Geochemical Society; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Geoscience and Public Policy, Environmental Geoscience, Geology and Health

Advocates: Katie Walton-Day; Robert L. Runkel; Brent Lewis

This session merges scientific assessment with policy implications of historical hard-rock mining, with emphasis on the 2015 Gold King Mine event. Abstracts related to the Animas River Basin and other abandoned mine lands are encouraged.

GEOSCIENCE EDUCATION

T71. A Centennial Celebration of Geology and Hydrology in the National Parks: Research, Mapping, and Resource Management

Cosponsors: GSA Hydrogeology Division; GSA Geology and Society Division

Disciplines: Geoscience Education, Hydrogeology, Geoscience Information/Communication

Advocates: Bruce Heise; F. Edwin Harvey; Jason P. Kenworthy

This session addresses the roles of geology and hydrology in national parks. We seek presentations on geologic and hydrologic research, paleontology, past research experience, and geologic and water resource management in units of the U.S. National Park System.

T72. Advances in In-Service and Pre-Service K–12 Earth Sciences Teacher Preparation and Professional Development

Cosponsors: GSA Geoscience Education Division; National Association of Geoscience Teachers; NAGT Teacher Education Division

Discipline: Geoscience Education

Advocates: Suzanne T. Metlay; Mark Abolins

Innovative approaches in teacher preparation and professional development by two-year and four-year colleges and universities may successfully address the needs of earth-science educators, especially in rural or traditionally underserved areas.

T73. Bringing Outside In: Incorporating Field Experiences and Project-Based Learning into the Geoscience Classroom

Cosponsors: GSA Geoscience Education Division; GSA Geology and Society Division

Discipline: Geoscience Education

Advocates: Stephanie Shepherd; Jamie S.F. Levine

This session focuses on the challenges and successes of integrating field experiences, research opportunities, and projectbased learning into the curriculum. Contributions focusing on enhancing student learning through experiences demonstrating the process of science are encouraged.

T74. Climate Literacy in Formal and Informal Education, for Policy Makers and the Public, and Measures of Impact

Cosponsors: GSA Geoscience Education Division; CLEAN Network; National Association of Geoscience Teachers; GSA Geology and Society Division; GSA Limnogeology Division

Disciplines: Geoscience Education, Geoscience Information/ Communication, Geoscience and Public Policy

Advocates: Tamara Shapiro Ledley; Anne U. Gold; Suzanne O'Connell; Mark A. Chandler; Katya Hafich

The session will focus on activities (formal and informal education, engagement with decision makers, networks, and the public) and research (education, social, and cognitive) that can extend the reach and effectiveness of climate literacy efforts.

T75. Developing Geoscience K–12 Education-Focused Outreach Programs: Civic Engagement and Science Communication Training

Cosponsors: GSA Geoscience Education Division; GSA Geology and Society Division

Disciplines: Geoscience Education, Geoscience Information/ Communication

Advocate: Peter Anderson

Evaluating the effectiveness and overall merits of K–12 educational outreach in earth science, with a focus on science-communication skill development.

T76. Digital Poster Session: Training Preservice Teachers to Apply Digital Technology across the Geoscience Curriculum (Posters)

Disciplines: Geoscience Education, Geoinformatics, Geoscience Information/Communication

Advocates: Declan G. De Paor; Steven J. Whitmeyer; Callan Bentley

To attract students into geoscience, we need to spark interest at school. This digital poster session will focus on ways of training pre-service teachers to make effective use of digital technology in geoscience education.

T77. Disseminating Best Practices and Resources Developed in Education Projects Funded by the National Science Foundation or by Other Federal/State Agencies (Posters)

Discipline: Geoscience Education

Advocates: Jill Singer; Jeffrey G. Ryan

This session seeks to share best practices, lessons learned, and resources developed from geoscience education projects funded by NSF or other agencies. Projects supported by NSF's Improving Undergraduate STEM Education program (IUSE) are encouraged.

T78. Encouraging K9–16 Partnerships in the Geosciences to Maximize Recruitment and Retention Efforts (Posters)

Cosponsors: GSA Geoscience Education Division; GSA Sedimentary Geology Division; GSA Environmental and Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Science and Society Division **Disciplines:** Geoscience Education, Environmental Geoscience, Geoscience Information/Communication

Advocate: Nazrul I. Khandaker

K9–12 and undergraduate students involved in hands-on general geology, field-based environmental related research and improving content knowledge by incorporating experiential learning techniques are encouraged to submit their work. This session is aimed at furthering geoscience education and ensuring recruitment and retention.

T79. Graduate Student Preparation for STEM Workforce

Cosponsors: GSA Geology and Society Division; GSA Geoscience Education Division; GSA Environmental and Engineering Geology Division; International Association for Geoscience Diversity; GSA Student Advisory Council; National Earth Science Teachers Association

Disciplines: Geoscience Education, Public Policy, Geoscience Information/Communication

Advocates: Marilyn J. Suiter; Lina Patino

How do we measure outcomes of investment in graduate research and education regarding STEM workforce? What is suitable preparation for workers' specific skills? This session is a forum for the exploration of STEM education and workforce.

T80. Implementing Discovery-Based Research Experiences in Undergraduate Geoscience Courses and Curricula

Cosponsors: Council on Undergraduate Research Geosciences Division; GSA Geoscience Education Division

Discipline: Geoscience Education

Advocates: Laura A. Guertin; Jeffrey G. Ryan; Preston Lee Phillips; Patricia Manley; Jay Labov; Kerry Brenner

This session builds on a 2015 convocation report from the National Research Council to address models, evidence, approaches, and challenges with students and university leadership for promoting discovery-based research experiences in the geosciences

T81. Increasing Engagement and Improving Learning Outcomes for Geology Students: Using Cognitive Science to Inform Geoscience Teaching and Learning

Disciplines: Geoscience Education, Geoscience Information/ Communication

Advocates: Shondricka Burrell; Allison J. Jaeger

Research findings in cognitive science can inform the development of effective teaching and learning strategies in the geosciences in three key areas fundamental to the discipline: evidence-based reasoning, conceptual change, and spatial visualization.

T82. Methodological Decision Making in Geoscience Education Research

Cosponsors: GSA Geoscience Education Division; National Association of Geoscience Teachers

Disciplines: Geoscience Education, Geoscience Information/ Communication

Advocates: Katherine Ryker; Nicole LaDue; Todd D. Ellis; Kim A. Cheek

Geoscience education research uses quantitative, qualitative, and mixed-methods approaches. Presenters are encouraged to highlight the rationale for methodological decisions and how decisions about research methods impact conclusions that can be drawn from their results.

T83. Place as an Organizing Principle in Geoscience Education

Cosponsor: GSA Geoscience Education Division

Disciplines: Geoscience Education, History and Philosophy of Geology, Geoscience Information/Communication

Advocates: Sadredin C. Moosavi; Steven Semken; Diana Dalbotten

This session will explore the use of place as an organizing principle for teaching geoscience content while enhancing learner connections to locations in which they live. K–16 and informal educators welcome!

T84. Planning to Make a Difference through the Next Generation Science Standards: Part 1: K–12 Initiatives

Cosponsors: National Earth Science Teachers Association; GSA Geoscience Education Division; GSA Geology and Society Division

Disciplines: Geoscience Education, Geoscience and Public Policy

Advocates: Michael J. Passow; Belinda E. Jacobs; Carla McAuliffe; Cheryl L.B. Manning

As states and school district prepare to adopt/adapt the Next Generation Science Standards (NGSS), it becomes important to consider how changes in Earth and Space Science will be different this time from past educational initiatives.

T85. Planning to Make a Difference through the Next Generation Science Standards: Part 2: Undergraduate and Teacher Training Initiatives

Cosponsors: National Earth Science Teachers Association; GSA Geoscience Education Division; GSA Geology and Society Division

Disciplines: Geoscience Education, Geoscience and Public Policy

Advocates: Michael J. Passow; Belinda E. Jacobs; Carla McAuliffe; Cheryl L.B. Manning

What adaptations should higher education and informal educational institutions create to facilitate implementation of the NGSS? How best can teacher preparation programs empower preand in-service educators with skills to succeed under the NGSS?

T86. Supporting Geoscience Student Transfer between Institutions and Transitions into the Workforce: Pathways for Success

Cosponsors: GSA Geoscience Education Division; National Association of Geoscience Teachers; National Association of Geoscience Teachers Geo2YC Division; GSA Geology and Society Division

Disciplines: Geoscience Education, Geoscience and Public Policy

Advocates: Eric M.D. Baer; Norlene R. Emerson; Allan Ludman

Topics might include advising/support strategies; bridge programs; cross-institutional collaborations including recruitment and student research projects, field trips, and 2YC–4YCU faculty interactions; articulation agreements; curricular and extra-curricular experiences, transfer patterns, and impact on broadening access.

T87. Supporting Students with Disabilities: Innovations and Strategies for Geo-Success

Cosponsors: International Association for Geoscience Diversity; GSA Geoscience Education Division; National Association of Geoscience Teachers; National Earth Science Teachers Association; National Association of Geoscience Teachers Geo2YC Division; NAGT TED (Teacher Education Division)

Disciplines: Geoscience Education, Geoscience Information/ Communication

Advocates: René A. Shroat-Lewis; Wendi J.W. Williams

This session is aimed at sharing effective geology classroom (fully face2face, hybrid, online formats), laboratory, and field experience strategies for students with disabilities (to include Universal Design applications, too).

T88. Technological Innovation in Geoscience in Two-Year Colleges

Cosponsors: GSA Geoscience Education Division; International Association for Geoscience Diversity; National Association of Geoscience Teachers

Disciplines: Geoscience Education, Geoscience Information/ Communication

Advocates: Callan Bentley; Joshua Villalobos; Peter J. Berquist

This session explores the successful application of technology in geoscience courses at two-year colleges. Topics may include virtual field experiences, drones, facilitating access for students with disabilities, infusing technology into fieldwork, and mobile apps.



GEOSCIENCE INFO/COMMUNICATION

T89. Bringing the Horse to Water and Getting It to Drink: Obstacles and Innovative Ways of Getting the Religious Public to Consider Scientific Evidence

Cosponsors: GSA Geology and Society Division; GSA Geoscience Education Division

Disciplines: Geoscience Information/Communication, Geoscience Education, Geoscience and Public Policy

Advocates: Carol A. Hill; Gregg R. Davidson

New ways of thinking and approaches to outreach are needed to overcome entrenched science-skepticism among the religious public. Presentations are welcome that go beyond "trying the same thing harder" to make inroads or that provide new insights into the culture.

T90. Earth Science as the Inspiration for Creative Endeavors

Cosponsors: GSA Hydrogeology Division; GSA Geology and Society Division

Disciplines: Geoscience Information/Communication, Geoscience Education, Geology and Health

Advocates: F. Edwin Harvey; Donald I. Siegel

This session celebrates earth science as the inspiration for original creative endeavors, such as music, poetry, painting, dance, and sculpture. Presenters will describe the source of their inspiration and then present the resulting creative product.

T91. Geologic Maps and Their Derivatives (Posters)

Cosponsor: Association of American State Geologists

Discipline: Geoscience Information/Communication

Advocates: Richard Berg; Holger Kessler; Hazen A.J. Russell; David Soller; Harvey Thorleifson

This poster session will highlight new geologic maps, mapping programs, and innovations in geological mapping, including data management, Web accessibility, 3D, and applications in water and land management.

T92. Open Data, Open Access: Trends in Geoscience Publications and Data Sources

Cosponsor: Geoscience Information Society

Disciplines: Geoscience Information/Communication, Geoscience and Public Policy, Geoscience Education

Advocate: Christopher A. Badurek

Open data and open access policies are changing the landscape of geoscience publications as well as sources of geoscience data. This session addresses these impacts on researchers, government agencies, and academic libraries.

T93. Use of Geoscience Data Resources in Education and Research (Posters)

Cosponsor: Geoscience Information Society

Disciplines: Geoscience Information/Communication, Geoscience Education

Advocate: Christopher A. Badurek

This poster session examines the effective use of geoscience data resources in successful teaching or research activities, including repositories, federal data centers, academic research centers, and/or commercial sources for data visualization, mapping, or analysis.

T94. Women and Geology: Who Are We, Where Have We Come From, and Where Are We Going?

Cosponsors: Association for Women Geoscientists; GSA Geology and Society Division

Disciplines: Geoscience Information/Communication, History and Philosophy of Geology

Advocate: Beth A. Johnson

This session explores the roles of women in geology, perceptions on their positions and their work, the challenges faced professionally and personally, and those steps designed to encourage diversity and success among incoming geology students.

HISTORY AND PHILOSOPHY OF GEOLOGY

T95. Museums at the Forefront of the History and Philosophy of Geology

Cosponsors: GSA History and Philosophy of Geology Division; GSA Geology and Society Division; GSA Geoscience Education Division; History of Earth Sciences Society; Paleontological Society; Paleontological Research Institution

Disciplines: History and Philosophy of Geology, Geoscience Education, Geoscience Information/Communication

Advocates: Gary Rosenberg; Renee M. Clary

Presentations explore the unique influence of museums on the geosciences and on their place in Western culture since the 17th century, through exhibits for the general public, museum expeditions, collections, and research.

T96. The Geology of Art: The Use of Earth-Derived Materials in the Manufacture of Modern and Ancient Art Forms (Posters)

Cosponsors: GSA Geology and Society Division; GSA Archaeological Geology Division

Disciplines: History and Philosophy of Geology, Archaeological Geology

Advocate: Douglas W. Haywick

This topical session will focus on geological materials used in the production of modern and historical art forms including ceramics, glass, castings, sculptures, and paint pigments.

T97. Unearthing the History of Women in Geosciences

Cosponsors: GSA History and Philosophy of Geology Division; History of Earth Sciences Society; GSA Geology and Society Division

Disciplines: History and Philosophy of Geology, Geoscience Education, Geoscience and Public Policy

Advocates: Joanne Bourgeois; Kathleen Lohff; Renee M. Clary

This session encourages contributions from the full range of topics concerning the history of women in the geosciences, with examples of the use of this history in classrooms, exhibitions, and social media.

HYDROGEOLOGY

T98. 3D Printing in Groundwater Research

Cosponsor: GSA Hydrogeology Division

Disciplines: Hydrogeology, Karst, Sediments, Carbonates

Advocates: Franciszek Hasiuk; Michael C. Sukop; Lee J. Florea

Case studies of how 3D printing was employed to produce labtestable models that were used to test hypotheses about the flow, mechanical, or electrical properties of reservoir rocks.

T99. A Showcase of Undergraduate Research in Hydrogeology

Disciplines: Hydrogeology, Geoscience Education

Advocates: Kallina M. Dunkle; Christopher S. Lowry; Susan Swanson

This session is designed for undergraduates presenting research and senior theses in the field of hydrogeology. Prizes will be awarded for top presentations. Session concludes with information for undergraduates interested in hydrogeology research.

T100. Approaches to Characterizing Groundwater Flow Systems at the Watershed-Scale for Water Management and Regulation

Cosponsors: GSA Hydrogeology Division; International Association of Hydrogeologists, Regional Groundwater Flow Commission; GSA Geology and Society Division

Disciplines: Hydrogeology, Environmental Geoscience

Advocates: Brian Smerdon; W. Payton Gardner

This session will explore characterization techniques and modeling methods to better understand groundwater systems in the context of the watershed-scale hydrologic cycle, with an emphasis on integrating surface water, shallow groundwater, and deep basin-scale groundwater.

T101. Can't Take the Heat? Temperature as an Indicator and Tracer of Environmental Change

Cosponsor: GSA Hydrogeology Division

Disciplines: Hydrogeology, Environmental Geoscience

Advocates: Jeffrey M. McKenzie; Barret L. Kurylyk; Laura K. Lautz; Dylan J. Irvine

This session examines the use of temperature in environmental geoscience research, including thermal investigations of hydrological processes, cold regions, ecological studies, and climate-change impacts. Both fieldwork and modeling studies will be presented.

T102. Cycling of Arsenic and Other Associated Trace Elements in Global Geohydrological Systems and Management

Cosponsors: GSA Hydrogeology Division; GSA Geology and Society Division; GSA Geology and Health Division; International Society of Groundwater for Sustainable Development (ISGSD)

Disciplines: Hydrogeology, Geology and Health, Environmental Geoscience

Advocates: Prosun Bhattacharya; Abhijit Mukherjee; Karen Johannesson; Saugata Datta; Mohammad Alauddin

Drinking waters worldwide are contaminated with arsenic and other associated trace elements of geogenic origin and contaminate soils and crops; thus, a comprehensive approach for risk assessment is necessary for sustainable mitigation and management.

T103. Emerging Contaminants in Water Supplies

Cosponsors: GSA Hydrogeology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geology and Society Division

Disciplines: Hydrogeology, Environmental Geoscience, Geochemistry

Advocate: Madeline E. Schreiber

Emerging contaminants include compounds that have not been historically considered contaminants. In this session, we welcome abstracts that address analytical issues, fate, and transport behavior, as well as the human and environmental impacts of emerging contaminants.

T104. From Pores to Mountains, and Minutes to Millennia: Session Dedicated to the Contributions of Rob Bowman, Fred Phillips, and John Wilson

Disciplines: Hydrogeology, Environmental Geoscience, Geochemistry

Advocates: Jesus Gomez-Velez; M. Bayani Cardenas; Marty D. Frisbee

This session is a celebration of the careers of three eminent New Mexico hydrogeologists: Fred Phillips, John Wilson, and the late Rob Bowman.

T105. Groundwater Temperature and Impacts of Anthropogenic Forcing—Monitoring and Modeling

Cosponsors: GSA Hydrogeology Division; GSA Environmental and Engineering Geology Division

Disciplines: Hydrogeology, Environmental Geoscience, Geophysics/Geodynamics

Advocates: Rodney A. Sheets; Jack R. Eggleston

Activities such as land-use modification and use of geothermal energy can affect long-term air temperature and groundwater temperatures. This session will focus on measurements or modeling of groundwater temperatures to assess the impacts of anthropogenic forcing.

T106. Hydrogeological Responses to El Niño and Extreme Weather Events

Cosponsors: GSA Hydrogeology Division; U.S. National Chapter of the International Association of Hydrogeologists

Disciplines: Hydrogeology, Karst, Public Policy

Advocates: Abraham E. Springer; Victor M. Heilweil; David A. Stonestrom; Andrew H. Manning

Climate change models predict an increasing magnitude of climate cycles and extreme weather events. Presentations are encouraged on the response of groundwater systems to such extreme events as El Niño, atmospheric rivers, and super storms.

T107. In-Situ Technologies for Energy Resource Extraction: The Role of Water

Cosponsor: GSA Hydrogeology Division

Disciplines: Hydrogeology, Energy Geology, Environmental Geoscience

Advocates: Carleton R. Bern; Tanya J. Gallegos

This session explores water-related issues and research on insitu technologies (e.g., in-situ recovery [ISR], borehole hydraulic mining, in-situ retorting, in-situ steam heating, hydraulic fracturing) for recovering oil, gas, bitumen, uranium, or coal.

T108. Interaction of Physical and Biogeochemical Processes at Groundwater–Surface-Water Interfaces in Rivers, Lakes, Estuaries, and Coastal Marine Settings

Cosponsor: GSA Limnogeology Division

Disciplines: Hydrogeology, Geochemistry, Limnogeology

Advocates: Richard L. Smith; Sung Pil Hyun; Douglas B. Kent; J.K. Bohlke

Presentations are solicited that identify, quantify, and (or) characterize fluxes across groundwater–surface-water interfaces and the processes that alter or influence water and solute exchange.

T109. Karst Hydrology: New Insights of Dynamic Aquifer Systems

Cosponsors: GSA Hydrogeology Division; GSA Karst Division; National Cave and Karst Research Institute; Karst Waters Institute

Disciplines: Hydrogeology, Karst, Environmental Geoscience

Advocates: Andrew Luhmann; Carol Wicks

Karst aquifers are dynamic hydrological systems because of conduits and fractures, responsible for producing large physical, chemical, and biological gradients. We welcome studies that improve characterization and insight of hydrological processes in these systems.

T110. Landscape Disturbance in Coupled Hydrologic, Ecologic, and Geomorphologic Systems

Cosponsor: GSA Hydrogeology Division

Disciplines: Hydrogeology, Environmental Geoscience, Geomorphology

Advocates: Brian A. Ebel; Benjamin B. Mirus

This session focuses on investigations of hydrologic, ecologic, and geomorphologic systems that have been impacted by landscape disturbances. We seek to bridge gaps between disciplines to reveal non-intuitive positive and negative system feedbacks.

T111. Polar Changes

Cosponsor: GSA Limnogeology Division

Disciplines: Hydrogeology, Geochemistry, Geomorphology

Advocate: W. Berry Lyons

Polar environments are undergoing rapid changes that include cryosphere loss, with important geomorphological, hydrological, biogeochemical, and ecological consequences. This interdisciplinary session will explore these changes in both the Arctic and Antarctic.

T112. Quantifying Groundwater/Surface Water Interactions in the Field and on the Computer

Cosponsor: GSA Hydrogeology Division

Disciplines: Hydrogeology, Environmental Geoscience, Geochemistry

Advocates: Andrea E. Brookfield; Christopher S. Lowry; Mark B. Hausner

This session encourages the submission of abstracts discussing the quantification of water, heat, and/or solute fluxes between surface water and groundwater, with an emphasis on innovative field and modeling-based techniques and unique case studies.

T113. Remote Sensing Applications in Hydrology and Geology

Cosponsors: GSA Hydrogeology Division; GSA Geoinformatics Division; GSA Geology and Society Division

Disciplines: Hydrogeology, Geoinformatics, Geoscience and Public Policy

Advocates: R.H. Becker; Mohamed Ahmed

Understanding hydrology and geology on regional scales depends upon consistent regional observations. We seek research presentations on applications integrating remote sensing observations with traditional methods in hydrology and geology, especially in data-sparse regions.

T114. Vapor Intrusion: Research, Regulation, and Practical Applications for the Movement of Subsurface Gases into Buildings

Cosponsor: GSA Hydrogeology Division

Disciplines: Hydrogeology, Environmental Geoscience, Geology and Health

Advocates: Stephen J. Van der Hoven; Tissa H. Illangasekare

This session explores the process of vapor intrusion where subsurface volatile organic compounds and other gases enter the breathing space in buildings. Topics include current research, regulatory and legal perspectives, human health, and case studies.

KARST

T115. Advances in Cave and Karst: A Tribute to the Distinguished Career of E. Calvin Alexander Jr.

Cosponsors: GSA Karst Division; GSA Geobiology & Geomicrobiology Division; GSA Hydrogeology Division; GSA Environmental and Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Planetary Geology Division; International Association of Hydrogeologists; Karst Waters Institute; Minnesota Groundwater Association; National Cave and Karst Research Institute; National Ground Water Association

Disciplines: Karst, Hydrogeology, Environmental Geoscience

Advocates: Yongli Gao; J.M. Feinberg; Daniel H. Doctor

This session honors Dr. Calvin Alexander Jr. and his contributions in many aspects of cave and karst studies, ranging from hydrogeology, geomorphology, geochemistry, microbiology, resource management, hazard assessment, and extraterrestrial karst.

T116. Karst Critical Zone Evolution: The Rapid Responses of Carbonate Systems to Changes in Climate, Sea Level, Groundwater Pumping, and Land Cover/Land-Use

Cosponsors: GSA Karst Division; GSA Environmental and Engineering Geology Division; Karst Waters Institute; International Association of GeoChemistry

Disciplines: Karst, Geochemistry, Hydrogeology

Advocates: Pamela L. Sullivan; G.L. Macpherson; Jonathan B. Martin; René M. Price

Karst Critical Zones are governed by rapid carbonate mineral reaction rates; as such, climatic or anthropogenic disturbances that change salinity, vegetation, precipitation, temperature, residence time, and/or flow patterns can significantly alter their structure and function.

T117. Karst Investigations in the Digital Age

Cosponsors: GSA Karst Division; National Cave and Karst Research Institute; GSA Environmental and Engineering Geology Division; GSA Geoinformatics Division; GSA Hydrogeology Division

Disciplines: Karst, Geoinformatics, Engineering Geology

Advocates: Cory W. BlackEagle; Douglas R. Gouzie

This session will examine the use of digital data and methods to study karst features in scientific, engineering, planning, and cave exploration projects, including GIS, spatial analysis, remote sensing, and other emerging digital methods.

T118. Karst Systems in Arid and Semi-Arid Environments

Cosponsors: GSA Karst Division; National Cave and Karst Research Institute; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Karst, Geomorphology, Hydrogeology

Advocates: Lewis Land; Victor J. Polyak

Karst in arid environments is distinctly different from karst phenomena formed in more humid regions. We welcome papers on karst-related topics including geomorphology, hydrology, paleoclimatology, geohazards, and resource development in arid and semi-arid settings.

T119. Pseudokarst: "Ain't Nothin' Like the Real Thing..."

Cosponsors: GSA Karst Division; National Cave and Karst Research Institute

Disciplines: Karst, Geomorphology, Planetary Geology

Advocates: Patricia N. Kambesis; Jason Polk; Max Cooper

Documentation and study of pseudokarst, a landscape resembling karst in morphology and sometimes function, lags behind that of traditional karst studies. This session provides a venue for research on all aspects of pseudokarst.

T120. Sinkholes, Cave Collapses, and Closed Depressions: Exploring the Mechanisms and Consequences of Sinkholes

Cosponsors: GSA Karst Division; NCKRI

Disciplines: Karst, Geomorphology, Geoscience and Public Policy

Advocates: Jason Polk; Patricia N. Kambesis

This session is intended to explore sinkholes (dolines) around the globe, including, but not limited to, cover collapses, cave collapse, subsidence, urban sinkhole formation, and other processes, mechanisms, and remediation techniques in karst and non-karst terrains.

T121. Voids and Their Resources: Intersections of Research and Policy in Karst Terrains

Cosponsors: GSA Karst Division; GSA Geology and Society Division; National Cave and Karst Research Institute; U.S. Forest Service

Disciplines: Karst, Geoscience and Public Policy, Hydrogeology

Advocates: Benjamin W. Tobin; Johanna Kovarik

We encourage abstracts on studies illustrating the relationship between research and policy or management in karst and pseudokarst terrain.

LIMNOGEOLOGY

T122. A Celebration of Lakes—Past and Present

Cosponsors: GSA Limnogeology Division; GSA Quaternary Geology and Geomorphology Division; GSA Sedimentary Geology Division; Paleontological Society

Disciplines: Limnogeology, Stratigraphy, Paleontology, Paleoecology/Taphonomy

Advocates: Scott W. Starratt; Johan C. Varekamp

This session celebrates lake science for and from a worldwide audience. Lakes are important freshwater reservoirs, and their sediments are archives of global change, pollution, and ecological succession.



T123. From Outcrop to Core: Integrating Paleoenvironmental and Paleoclimatic Records across Time and Space

Cosponsors: GSA Limnogeology Division; GSA Archaeological Geology Division; GSA Sedimentary Geology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group

Disciplines: Limnogeology, Sediments, Clastic, Quaternary Geology

Advocates: Catherine C. Beck; Emily J. Beverly; Nathan Rabideaux; Mona Stockhecke

Scientific drilling of terrestrial sediments presents new opportunities for paleoenvironmental and paleoclimatic research. The goal of this session is to address the challenges of integrating core and outcrop studies, particularly those associated with paleontological or paleoanthropological records.

T124. Lake Deposits on Earth and Mars

Cosponsors: GSA Limnogeology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Limnogeology, Sediments, Clastic, Sediments, Carbonates

Advocate: Elizabeth H. Gierlowski-Kordesch

Lake deposits are the focus of geologic studies on Earth and have now been recognized on Mars. They are crucial for exploration and records for climate change and evolution of life and landscape.

MARINE/COASTAL SCIENCE

T125. Experimental Approaches and Technology in Service of Micropaleontology

Cosponsors: Paleontological Society; Cushman Foundation; Paleoclimatology/Paleoceanography Discipline; SEPM (Society for Sedimentary Geology); GSA Limnogeology Division

Disciplines: Marine/Coastal Science, Paleoclimatology/ Paleoceanography

Advocates: Benjamin J. Ross; Caitlin M. Hanley

From geochemical approaches to novel imaging techniques, molecular genetics to laboratory experiments, and in situ observations, micropaleontologists utilize many technologies and techniques. We encourage papers demonstrating such methods, especially in understanding recent species.

T126. Geological Effects of Extreme Storm Events on Small Tropical Island Nations

Cosponsors: GSA Sedimentary Geology Division; STEPPE; SEPM (Society for Sedimentary Geology); Marine/Coastal Science Discipline

Disciplines: Marine/Coastal Science, Sediments, Carbonates, Geomorphology

Advocates: Lisa E. Park Boush; Michael Savarese; Bosiljka Glumac; Ilya V. Buynevich; H. Allen Curran

This session focuses on the sedimentological, geomorphological, and ecological effects of extreme storm events such as Hurricane Joaquin in the Bahamas and Bermuda (fall 2015) and similar examples from other tropical island nations.

T127. Geoscience Applications of Diatom Micropaleontology: Celebrating the Career of John A. Barron

Cosponsors: Paleontological Society; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Limnogeology Division

Disciplines: Marine/Coastal Science, Paleontology, Biogeography/ Biostratigraphy, Paleoclimatology/Paleoceanography

Advocates: Scott W. Starratt; Jason Addison

This session is dedicated to honoring the career of John Barron of the USGS and celebrating his contributions to Earth science. It will highlight advances in micropaleontology, paleoceanography, and paleoclimatology, and the training of future scientists.

MINERALOGY/CRYSTALLOGRAPHY

T128. Gemological Research in the Twenty-First Century: Characterization, Exploration, and Geological Significance of Diamonds and Other Gem Minerals

Disciplines: Mineralogy/Crystallography, Economic Geology, Geoscience Information/Communication

Advocates: James E. Shigley; Dona Dirlam; Wuyi Wang; Barbara L. Dutrow; Rodney C. Ewing; Jeffrey E. Post; Steven B. Shirey; William B. Simmons; John Valley

Gemstones are the most recognized, sought after, and highly valued of all minerals. This session focuses on multiple aspects of gems, including exploration, conditions of formation, properties, means of identification, and their intrinsic research value to understanding Earth's geologic evolution.

T129. Mineralogical Evidence for the Co-Evolution of the Geosphere and Biosphere: In Honor of Robert M. Hazen, 2016 Roebling Medalist

Cosponsors: Mineralogical Society of America; Deep Carbon Observatory; GSA Geobiology & Geomicrobiology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Geochemical Society

Disciplines: Mineralogy/Crystallography, Planetary Geology, Geomicrobiology

Advocates: Edward S. Grew; John M. Hughes; Nancy L. Ross; Daniel Hummer

In honor of Robert M. Hazen, 2016 Roebling Medalist of the Mineralogical Society of America, this session emphasizes Earth's rich mineralogical record through deep time as key to understanding the co-evolution of the geosphere and biosphere.

PALEOCLIMATOLOGY/PALEOCEANOGRAPHY

T130. Influence of Volcanism on the Evolution of Cretaceous and Paleogene Marine Ecosystems and Climate

Cosponsors: Cushman Foundation; Paleontological Society; Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Paleontological Research Institution

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Diversity, Extinction, Origination, Volcanology

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Advocates: Brian T. Huber; Pincelli M. Hull; Kenneth G. MacLeod

This session brings together experts from the marine micropaleontology, marine biogeochemistry, global volcanism, and modeling communities to discuss how volcanism influenced changes in past ecosystems, biotic evolution, and global climate during the Cretaceous and Paleogene.

T131. Marine and Terrestrial Records of Extreme Climates and Extinction: Making Sense of Similarities and Differences

Cosponsors: GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Limnogeology Division; Paleontological Society; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Diversity, Extinction, Origination, Geochemistry

Advocates: Julio Sepúlveda; Kathryn E. Snell

Paleoclimate records that span extinction events provide insight into the role of global environmental perturbations on marine and terrestrial ecosystems. We welcome studies that explore the mechanisms behind global perturbations and/or records of ecosystem response.

T132. Microfossil Proxies in Earth History (Posters)

Cosponsors: Cushman Foundation; Geochemical Society; Paleontological Research Institution; Paleontological Society; GSA Limnogeology Division

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Biogeography/Biostratigraphy, Paleontology, Paleoecology/ Taphonomy

Advocates: Miriam E. Katz; Laurel S. Collins

This session brings together marine and terrestrial microfossil proxy-based research (assemblages, geochemistry, modern analogs) to improve our understanding of evolving oceans, land, and climate through Earth history and the floral/faunal responses to those changes.

T133. New Views of the Paleocene-Eocene Thermal Maximum

Cosponsors: Cushman Foundation; Geochemical Society; Paleontological Society; Paleontological Research Institution; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Paleoclimatology/Paleoceanography, Geochemistry, Volcanology

Advocates: Kenneth G. Miller; Miriam E. Katz

This session explores new evidence for the rate and cause of the Paleocene Eocene thermal maximum and attendant carbon isotopic excursion, focusing on intriguing links between impact events and volcanism and geochemical and paleontological responses.

T134. The North American Terrestrial Record of Climatic Change across the Eocene-Oligocene Boundary

Cosponsors: GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Paleoecology/Taphonomy, Sediments, Clastic

Advocates: Emmett Evanoff; Jason R. Moore; Dennis Terry Jr.

This session highlights the evidence for paleoclimatic change across the Eocene-Oligocene boundary in the North American terrestrial record and the complexity of the continental response to the transition from the Greenhouse to Icehouse worlds.

T135. Timing, Drivers, and Marine and Terrestrial Ecosystem Responses to the Cretaceous-Paleogene Extinction Event

Cosponsors: Paleontological Society; GSA Sedimentary Geology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; Society of Vertebrate Paleontology

Disciplines: Paleoclimatology/Paleoceanography, Paleontology, Diversity, Extinction, Origination, Stratigraphy

Advocates: Andrew Flynn; Caitlin E. Leslie; Daniel J. Peppe

This session will focus on Late Cretaceous and early Paleocene marine and terrestrial ecosystems, paleoclimate, paleoecology, sedimentology, and stratigraphy, and how they were affected by the Cretaceous-Paleogene extinction event.

PALEONTOLOGY

T136. Across Space and through Time: Understanding Evolution and Ecology Using Biogeography

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Biogeography/Biostratigraphy, Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy.

Advocates: Alexander M. Dunhill; Erin E. Saupe

This session will explore the impact of a dynamic planet on biogeography, with topics including the maintenance and origin of biodiversity, the influence of plate tectonics on diversification, and dynamics of species' distributions through time.

T137. Conodonts from Shallow Water and Related Environments

Cosponsors: Paleontological Society; The Pander Society

Disciplines: Paleontology, Biogeography/Biostratigraphy, Paleontology, Paleoecology/Taphonomy, Paleontology, Diversity, Extinction, Origination

Advocates: F. Nicole Peavey; Steven J. Rosscoe

This Pander Society topical session and meeting is open to all conodont-related talks, with particular attention paid this year to paleobiologic and sequence biostratigraphic characteristics of conodonts of shallow water environments.

T138. Fossil Specimens 0's and 1's: Databases, Standards & Mobilization

Cosponsors: Paleontological Society; iDigBio; STEPPE; University of Colorado Museum of Natural History; Smithsonian National Museum of Natural History; Paleontological Research Institution Department of Paleobiology

Disciplines: Paleontology, Biogeography/Biostratigraphy, Geoinformatics, Paleoclimatology/Paleoceanography

Advocates: Talia S. Karim; Holly Little; Amanda Millhouse; Gil Nelson; Shelley James

This session will focus on innovations and best practices related to paleontology/geology digitization and data transcription efforts. Talks on databases, data management, standards, schemas, and mobilization of research-quality data through online aggregators are welcome.

T139. High-Precision Geochronological Constraints on the Geologic History of Dinosaur Evolution

Cosponsors: Paleontological Society; SEPM (Society for Sedimentary Geology); GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Paleontological Research Institution

Disciplines: Paleontology, Biogeography/Biostratigraphy, Stratigraphy, Geochemistry

Advocates: Jahandar Ramezani; David E. Fastovsky

This will be an interdisciplinary session highlighting recent advances in high-resolution geochronology (radioisotopes, cyclostratigraphy, magnetostratigraphy) applied to the Mesozoic origin, radiation, and extinction of Dinosauria, the temporal calibration of its fragmented fossil record, and their evolutionary implications.

T140. Evolution, Development, and Paleogenomics

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleontology, Phylogenetic/Morphological Patterns

Advocates: David J. Bottjer; Jeffrey R. Thompson

This session will address recent advances in the integration of developmental, genomic, and paleontological approaches to address evolutionary questions. Topics will include interdisciplinary projects combining paleontology with molecular biology, development, and genomics.

T141. How to Talk Science: Effective Communication Strategies for the Sedimentary Crust

Cosponsors: Paleontological Society; SEPM (Society for Sedimentary Geology); STEPPE; GSA Limnogeology Division; GSA Sedimentary Geology Division; GSA Geology and Society Division

Disciplines: Paleontology, Diversity, Extinction, Origination, Sediments, Clastic, Limnogeology

Advocates: Lisa E. Park Boush; Phoebe Cohen; Danielle Serratos

This session focuses on best practices and applications for communicating science related to Earth's sedimentary crust,

including areas of deep-time climate change and evolution. Emphasis on broader impacts will also be made.

T142. Past and Present Global Biotic Crises: From Microbes to Megafauna

Cosponsor: Paleontological Society

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleontology, Paleoecology/Taphonomy, Geochemistry

Advocates: Elsbeth E. van Soelen; Richard J. Twitchett; Wolfram Michael Kürschner

This session will explore biodiversity changes associated with major extinction events, including the present one. We welcome contributions addressing ecological changes in marine and terrestrial ecosystems, including studies of macro- and micropaleontology, palynology, and organic geochemistry.

T143. The Early Paleozoic World: Radiations, Extinctions, and Paleoenvironmental Change

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleoclimatology/Paleoceanography, Geochemistry

Advocates: Matt Saltzman; Stephen Leslie; Erik A. Sperling

This session will examine the Early Paleozoic world: Radiations, extinctions, and paleoenvironmental change.

T144. The Permian-Triassic Crisis and Its Aftermath: Biotic, Climatic, and Environmental Upheavals

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleoclimatology/Paleoceanography, Geochemistry

Advocates: Hugo Bucher; Thomas J. Algeo; Peter Roopnarine

This multidisciplinary session aims at a better understanding of the nature of environmental perturbations and of the evolutionary responses of repeatedly and profoundly disturbed ecosystems during the Permian-Triassic transition.

T145. Volcanism, Mass Extinctions, and Environmental Change

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Diversity, Extinction, Origination, Stratigraphy, Volcanology

Advocates: Thierry Adatte; Stephen E. Grasby; Gerta Keller; Blair Schoene

Important new data and observations increasingly link four of the five major mass extinctions directly to LIPs, as well as PETM and OAEs, particularly based on the fields of paleontology, stratigraphy, geochronology, geochemistry, climate, sedimentology, mineralogy, and volcanology.

T146. What Causes Mass Extinctions? High-Resolution Records of Catastrophic Environmental Change

Cosponsors: Paleontological Society; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); Paleontological Research Institution

Disciplines: Paleontology, Diversity, Extinction, Origination, Paleontology, Biogeography/Biostratigraphy

Advocates: David P.G. Bond; Paul B. Wignall

This session explores the paleontology, stratigraphy, and geochemistry of mass extinctions, high-resolution records of catastrophic environmental change, and their mechanistic links to the potential ultimate drivers of change, large igneous province eruptions and bolide impacts.

T147. Height, the Elusive Third Dimension of Terrestrial Ecosystems: New Approaches for Determining the Structure and Complexity of Ecosystems on Land in Deep Time

Cosponsors: GSA Geobiology & Geomicrobiology Division; The Paleontological Society; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); Paleontological Research Institution

Disciplines: Paleontology, Paleoecology/Taphonomy, Geochemistry, Paleontology, Biogeography/Biostratigraphy

Advocates: Richard S. Barclay; Heather V. Graham; Regan E. Dunn

We will gather a diverse set of scientists who apply novel approaches to the fossil record of plants and animals, stable isotopes, and sediments to assess the structure of vegetation in forests in deep time.

T148. Making Paleoecology Relevant to the Twenty-First Century

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Paleoecology/Taphonomy, Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Biogeography/Biostratigraphy

Advocates: Larisa R.G. DeSantis; Samantha S.B. Hopkins

The study of ancient ecosystems is critical to our understanding of the present. Paleoecological studies of broad relevance to understanding biotic responses to environmental and climate changes are explicitly discussed.

T149. Mesozoic Ergs of the Colorado Plateau and Adjacent Areas: Genesis, Paleoenvironments, Paleogeography, Paleontology, and Paleoclimate

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division; Paleontological Society

Disciplines: Paleontology, Paleoecology/Taphonomy, Sediments, Clastic, Paleoclimatology/Paleoceanography

Advocates: Judith Totman Parrish; Stephen M. Rowland; Marjorie A. Chan; Stephen T. Hasiotis

The large-scale ergs and related environments of the Mesozoic Colorado Plateau have been a source of controversy and interest for decades. The session focuses on advances in sedimentology/ stratigraphy, paleoclimate, paleoecology, and paleogeography of these features.

T150. Topics in Paleoecology: Modern Analogues and Ancient Systems

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Paleoecology/Taphonomy, Paleontology, Diversity, Extinction, Origination, Paleontology, Phylogenetic/Morphological Patterns

Advocates: Carolyn M. Furlong; Gary J. Motz; Amelinda E. Webb

Highlighting the diversity of paleoecological research, this session is organized within the framework of biotic interactions/ predation, community/organismal ecology, and fidelity/conservation paleobiology to showcase insights into the co-evolution of Earth and life.

T151. New Approaches to Phylogenetic Paleobiology

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Phylogenetic/Morphological Patterns, Paleontology, Diversity, Extinction, Origination, Paleontology, Biogeography/Biostratigraphy

Advocates: David W. Bapst; Melanie Hopkins; April Wright; David F. Wright

This session will highlight novel methods, statistical approaches, and research that infer phylogenies of fossil taxa, date divergences between clades, or utilize branching relationships among fossil lineages to test evolutionary hypotheses.

T152. Troubles and Triumphs with Fossil Phylogenies

Cosponsors: Paleontological Society; Paleontological Research Institution

Disciplines: Paleontology, Phylogenetic/Morphological Patterns

Advocates: Jennifer E. Bauer; Adriane R. Lam; Sarah L. Sheffield

The objective of this session is to highlight the advances made in recent years in fossil phylogenetics and to discuss the difficulties and successes in overcoming implementation of deep-time phylogenies in new statistical methods.



PETROLOGY, IGNEOUS/METAMORPHIC

T153. Alkaline Rocks: In Honor and Memory of Daniel S. Barker

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Petrology, Igneous, Mineralogy/Crystallography, Geochemistry

Advocates: Don F. Parker; John C. White; Kevin M. Urbanczyk; Leon E. Long

Daniel S. Barker was an enthusiastic and long-term contributor to our knowledge concerning the origin, evolution, geochemistry, and mineralogy of alkaline rocks. This session will honor his achievements.

T154. Recent Advances in Understanding Magmatism along and within the Northern North American Cordillera

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Geochemical Society; GSA Structural Geology and Tectonics Division

Disciplines: Petrology, Igneous, Tectonics/Tectonophysics, Structural Geology

Advocates: Matthew E. Brueseke; Jeff Benowitz; Jeffrey M. Trop; Paul W. Layer

Magmatism in the northern Cordillera is the result of diverse tectonic phenomena, including subduction, strike-slip, and extensional processes along convergent and transform margins. This session highlights research in the northern Cordillera aimed at understanding links between magmatism and plate tectonic processes.

T155. Fifty Years of Innovation in Petrology and Orogenic Systems: A Tribute to Lincoln Hollister

Cosponsors: GSA Structural Geology and Tectonics Division; Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Petrology, Metamorphic, Petrology, Igneous, Tectonics/Tectonophysics

Advocates: Harold Stowell; Bernardo Cesare; Lukas Baumgartner

This session highlights new developments in metamorphic petrology and tectonics that build on fundamental contributions made by Dr. Lincoln Hollister. We seek contributions that enhance our understanding of metamorphic rocks, orogenic systems, and crustal growth.

T156. Heat and Mass Transfer through Earth's Crust during Metamorphism

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Petrology, Metamorphic, Tectonics/Tectonophysics

Advocates: Andrew J. Smye; Mark J. Caddick

This session will consider the mechanisms responsible for heat and mass transfer through Earth's crust during metamorphism.

T157. Mineral Equilibria, Fluid Flow, and Metamorphism: A Celebration of John Ferry's Career

Cosponsor: Mineralogical Society of America

Disciplines: Petrology, Metamorphic, Geochemistry, Mineralogy/ Crystallography

Advocates: Sarah Penniston-Dorland; Gregory Dipple; Douglas Rumble III; Sarah K. Carmichael

This session will focus on mineral equilibria, the composition of metamorphic fluids, determination of fluid fluxes in metamorphic environments, and the pathways taken by metamorphic fluids.

T158. Partitioning of Chlorine and Associated Halogens between Minerals, Melts, and Brines

Cosponsors: Mineralogical Society of America; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Petrology, Metamorphic, Petrology, Igneous, Planetary Geology

Advocates: David M. Jenkins; Eric L. Johnson; James D. Webster; Francis McCubbin

This session encourages abstracts dealing with the interaction of chlorine and associated halogens between minerals, melts, and brines toward understanding the concentrations, cycling, and evolution of chlorine-bearing fluids and melts in terrestrial and planetary settings.

PLANETARY GEOLOGY

T159. Ceres' Surface Composition as an Indication of Interior Evolution

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Planetary Geology, Geochemistry, Geophysics/ Geodynamics

Advocates: Jennifer E.C. Scully; Thomas B. McCord; Debra L. Buczkowski; David A. Williams

The aim of this session is to weave together geochemical, mineralogical, geological, and geophysical studies into a coherent evolutionary history of dwarf planet Ceres.

$\rm T160.\ Friends$ of Hoth: Satellites of the Outer Solar System

Cosponsors: GSA Planetary Geology Division; GSA Structural Geology and Tectonics Division

Discipline: Planetary Geology

Advocates: D. Alex Patthoff; Emily S. Martin

We seek abstracts relating to surface, structural, and tectonic processes; interior and thermal evolution; and planetary analogs as they pertain to solid bodies in the outer solar system. This includes experimental, observational, and theoretical approaches.

T161. From Bouncing Grains to Cemented Sandstones: Aeolian Processes and Stratigraphy in the Solar System

Cosponsors: GSA Planetary Geology Division; GSA Sedimentary Geology Division

Disciplines: Planetary Geology, Geomorphology, Sediments, Clastic Advocates: Mathieu G.A. Lapôtre; Christy Swann; R. Aileen Yingst

Wind is an important agent of sediment transport on many planetary bodies. This session seeks contributions to our understanding of aeolian processes and how they inform our interpretation of sedimentary rocks in the Solar System.

T162. From Stardust to Planets: A Geological Tour of the Career of Harry Y. McSween Jr.

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Planetary Geology, Petrology, Igneous, Geochemistry

Advocates: Tasha Dunn; Rhiannon Mayne

This session will highlight the career of Hap McSween and his contributions to the field of planetary geology. Topics of interest include meteorites (chondrites, HEDs, and SNCs), small bodies (Vesta), and Martian surface petrology.

T163. Frontiers in Geochronology: Ancient Systems and Planetary Environments

Cosponsor: GSA Planetary Geology Division

Disciplines: Planetary Geology, Geochemistry, Precambrian Geology

Advocate: Dina M. Bower

Geochronology, the calibration of the timing of geologic processes or events, encompasses a wide range of analytical techniques. This session explores the most current advances in geochronology with applications to ancient Earth and exoplanetary systems.

T164. Geology of the Pluto System

Cosponsor: GSA Planetary Geology Division

Disciplines: Planetary Geology, Geochemistry, Geophysics/ Geodynamics

Advocates: William B. McKinnon; Jeffrey M. Moore

The New Horizons mission has revealed surprisingly complex geology on the surfaces of Pluto and Charon. This session highlights the geological diversity of both bodies, as well as evidence for vigorous, ongoing activity on Pluto.

$\rm T165.$ Impact Cratering on Earth and throughout the Solar System

Cosponsors: GSA Planetary Geology Division; GSA Geophysics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Quaternary Geology and Geomorphology Division

Disciplines: Planetary Geology, Geochemistry, Tectonics/ Tectonophysics

Advocates: Christian Koeberl; Jeffrey Plescia

This session focuses on the nature of impact craters and processes on Earth and other planets. We solicit contributions regarding shock processes, modeling, geology, and airbursts. Comparisons among different size and composition bodies are encouraged.

T166. Large Igneous Provinces (LIPs) in the Solar System

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Large Igneous Provinces Commission of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)

Disciplines: Planetary Geology, Volcanology, Petrology, Igneous

Advocates: Tracy K.P. Gregg; Richard E. Ernst

Large Igneous Provinces (LIPs) are common on Earth and the terrestrial planets. This session explores the differences and similarities of LIPs throughout the Solar System.

T167. Mineral Spectroscopy—Harnessing Energy to Probe Solid Bodies in the Solar System: The G.K. Gilbert Award Session

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Planetary Geology, Mineralogy/Crystallography, Geochemistry

Advocates: Debra L. Buczkowski; Rachel L. Klima

We encourage abstract submissions related to mineral spectroscopy, from fundamental laboratory work and modeling through applications using remotely sensed data from orbiters, telescopes, or landers.

T168. Past and Present Biosignature Recognition on Earth, Mars, and Beyond

Cosponsors: GSA Planetary Geology Division; GSA Sedimentary Geology Division; Paleontological Society

Disciplines: Planetary Geology, Geochemistry, Sediments, Carbonates

Advocates: Sally L. Potter-McIntyre; Tom M. McCollom; Charity Phillips-Lander

Diagnosing and interpreting biosignatures is dependent on whether the biota is extant or preserved in the rock record. This forum will discuss advances in the search for life on Earth, Mars, and other planetary bodies.

T169. Planetary Geologic Mapping: Exploring the Solar System

Cosponsor: GSA Planetary Geology Division

Discipline: Planetary Geology

Advocates: Debra L. Buczkowski; David A. Williams

We encourage abstract submissions related to the description of the geologic mapping (and subsequent analysis) of solid solar system bodies, including the terrestrial planets, moons, and asteroids.

T170. Sedimentary Records in the Solar System

Cosponsors: GSA Planetary Geology Division; GSA Sedimentary Geology Division

Disciplines: Planetary Geology, Sediments, Clastic, Stratigraphy

Advocates: R. Aileen Yingst; Melissa S. Rice; Sanjeev Gupta

This session explores analysis of sedimentary records to decipher surface processes and geological evolution to better understand how reading the sediment record can inform on particulate and fluid flow on planetary surfaces.

T171. Small-Scale Records of Impact

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Planetary Geology, Petrology, Igneous, Petrology, Metamorphic

Advocate: Aaron J. Cavosie

Microstructural and geochemical investigations of impact records at microscopic and smaller scales are providing unprecedented insights on impact histories. This session welcomes contributions describing new approaches to unraveling smallscale records of impact processes.

T172. Tectonic, Volcanic, and Volcanotectonic Processes on Rocky Planetary Bodies

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Planetary Geology, Tectonics/Tectonophysics, Volcanology

Advocates: Paul K. Byrne; Christian Klimczak

This session solicits abstracts on tectonic, volcanic, or volcanotectonic landforms or processes on Solar System rocky bodies, and encompasses surface geology, interior and thermal evolution, and comparative planetary studies with observational, experimental, or theoretical approaches.

T173. The Evolution of Mars from Mantle through Crust: New Views from Petrology and Geochemistry

Cosponsors: GSA Planetary Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Planetary Geology, Petrology, Igneous, Geochemistry

Advocates: Arya Udry; Juliane Gross

This session solicits abstracts addressing magmatic processes involving the evolution of the martian mantle and crust through petrological and geochemical analyses of martian meteorites, laboratory experiments, and spacecraft data.

T174. The Geology of Dwarf Planet Ceres

Cosponsor: GSA Planetary Geology Division

Discipline: Planetary Geology

Advocates: Debra L. Buczkowski; Jennifer E.C. Scully; Thomas B. McCord; David A. Williams

We encourage abstract submissions related to geomorphic, geophysical, and topographic studies of Ceres, including analyses of *Dawn* data, telescopic observations, and/or numerical models.

QUATERNARY GEOLOGY

T175. Aeolian Processes in Time and Space: Evidence from Landforms and Sediments

Cosponsors: GSA Quaternary Geology and Geomorphology Division; International Society for Aeolian Research; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Quaternary Geology, Geomorphology, Sediments, Clastic

Advocates: Alan F. Halfen; Nicholas Lancaster; William C. Johnson; Tammy M. Rittenour; Ryan Ewing

This session will explore research focused on all aspects of aeolian processes and landforms including, but not limited to, geochronological studies and other empirical, theoretical, and applied perspectives.

T176. Hydrologic Response to Abrupt Climate Change in the Southwestern U.S.

Cosponsor: GSA Sedimentary Geology Division

Disciplines: Quaternary Geology, Paleoclimatology/ Paleoceanography

Advocates: Jeffrey S. Pigati; Kathleen B. Springer

This session focuses on the response of various hydrologic systems, including lakes, rivers, wetlands, and caves, to episodes of abrupt climate change during the late Quaternary.

T177. Insights and Challenges for Geomorphic, Geologic, and Paleoseismic Investigations in the Rocky Mountain–Central U.S. Transition Region (New Mexico, Colorado, Wyoming, and Montana)

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics Division; GSA Environmental and Engineering Geology Division; Association of Environmental and Engineering Geologists; Association of Environmental and Engineering Geologists–Rocky Mountain Section; Colorado Geological Survey; Colorado Scientific Society

Disciplines: Quaternary Geology, Geomorphology, Tectonics/ Tectonophysics

Advocates: Mark S. Zellman; Dean Ostenaa; Richard W. Briggs; Will Levandowski

We look for submissions to highlight new findings and approaches related to the Quaternary tectonics and geomorphology in the Rocky Mountain–CEUS transition region of inherited structure, neo-tectonic transition, low fault-slip rates, and geomorphic diversity.

T178. LoessFest Part II

Disciplines: Quaternary Geology, Soils, Geomorphology

Advocates: Randall Schaetzl; Daniel R. Muhs

This session focuses on loess and related eolian systems. Participants of the 2016 INQUA LoessFest are especially welcome to present in this session.

T179. Quaternary Geochronometers: Applications of Multi-Technique Approaches in Geomorphology and Archaeology

Cosponsors: GSA Quaternary Geology and Geomorphology Division; GSA Archaeological Geology Division

Disciplines: Quaternary Geology, Geomorphology, Archaeological Geology

Advocates: Harrison Gray; Kerry Riley; Michelle Summa Nelson

This session investigates the use of multiple geochronometers to reconstruct the timing of Earth's surface processes. We encourage research that applies Quaternary geochronologic dating techniques and discusses concordance and inconsistencies in the data.

T180. The Legacy of Herbert E. Wright Jr.: Seminal Contributions toward Understanding Interactions among Quaternary Climate, Landscape Processes, Vegetation, and Human Society

Cosponsors: American Quaternary Association; GSA Archaeological Geology Division; GSA Limnogeology Division; GSA Quaternary Geology and Geomorphology Division

Disciplines: Quaternary Geology, Limnogeology, Archaeological Geology

Advocates: Emi Ito; Daniel R. Engstrom; Cathy Whitlock; Julie K. Stein

This session honors the contributions of Herbert E. Wright Jr. (1917–2015) to our understanding of Quaternary environments and climate. Wright helped establish Quaternary science as a viable and important discipline in North American universities.

T181. Undergraduate Research Talks: The Next Step in Student Research Projects

Cosponsors: Council on Undergraduate Research Geosciences Division; GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics Division; GSA Limnogeology Division; GSA Geoscience Education Division

Disciplines: Quaternary Geology, Structural Geology, Environmental Geoscience

Advocates: Jacqueline A. Smith; Bradley G. Johnson; Edward C. Hansen

This session provides a venue for undergraduate students and recent graduates to present talks on completed research projects. Students may submit abstracts for research projects in any subdiscipline of geology, earth science, or environmental science.

SEDIMENTS, CARBONATES/CLASTIC

T182. Evolution of the Phanerozoic Carbonate Factories: A Pan-Tropical Perspective of Environmental Change

Cosponsors: GSA Sedimentary Geology Division; International Association of Sedimentologists; SEPM (Society for Sedimentary Geology), American Association of Petroleum Geologists; Paleontological Society

Disciplines: Sediments, Carbonates, Paleoclimatology/ Paleoceanography, Stratigraphy

Advocates: Juan Carlos Silva-Tamayo; Moyra Wilson; Juan Carlos Laya-Pereira; Simon Mitchell

We welcome contributions that investigate the effects of global environmental change on ancient/recent carbonate systems. This includes investigations/modeling of the effects of global environmental change on the biogeochemistry/biologic activity in past, present, and future oceans.

T183. Microporosity—What We Know and What We Don't

Cosponsor: GSA Sedimentary Geology Division

Disciplines: Sediments, Carbonates, Energy Geology, Engineering Geology

Advocates: Franciszek Hasiuk; Stephen Kaczmarek

Microporosity is an important component of carbonate pore systems that affects rock properties. This session provides a forum for researchers to present their latest insights into the origin and diagenesis of carbonate micropores.

T184. New Insights to the Dynamics of Stratigraphy and Sedimentation (Posters)

Cosponsors: GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Sediments, Carbonates, Sediments, Clastic, Marine/ Coastal Science

Advocates: Gary L. Gianniny; Vitor Abreu

This session welcomes student scientific contributions on sedimentary geology. Topics can range broadly from studies of ancient to modern sediments, carbonates to clastics, and sedimentary processes and their products in the geologic record.

T185. Autogenic and Allogenic Controls and Morphodynamic Responses of Large Fluvial Fans (Fluvial Megafans)

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division

Disciplines: Sediments, Clastic, Stratigraphy, Geomorphology **Advocates:** Jianqiao Wang; Andrew Leier

We welcome contributions from ancient and modern datasets as well as experiments and mathematical modeling to explore the relative role of autogenic and allogenic controls on formation of large fluvial fans, their morphodynamics, and sedimentary evolution.

T186. Combining Sedimentology, Ichnology, and Paleontology to Refine Spatiotemporal (Paleo)Environmental Interpretations and Clarify Salinity-Discharge Fluctuations along Modern and Ancient Complex Coastlines

Cosponsors: Paleontological Society; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Sediments, Clastic, Paleontology, Biogeography/ Biostratigraphy, Stratigraphy

Advocates: Peter P. Flaig; Stephen T. Hasiotis

This session brings together sedimentologists, ichnologists, and paleontologists engaged in collaborative research that benefits from the refinement of paleoenvironmental interpretations across the marine-continental transition. Discussions of both deep-time successions and modern environments along complex coastlines will be considered.

T187. Deep-Marine Sedimentary Environments: Linking Depositional Processes, Geomorphology, and the Sedimentary Record

Cosponsors: SEPM (Society for Sedimentary Geology); Marine/ Coastal Science Discipline; GSA Sedimentary Geology Division

Disciplines: Sediments, Clastic, Stratigraphy, Geomorphology

Advocates: Zane R. Jobe; Lauren E. Shumaker; Katherine Coble

We solicit contributions over diverse spatiotemporal scales (bedforms to continental margins) using field data (outcrop, seafloor, subsurface) and/or modeling approaches that investigate linkages between submarine geomorphology, depositional processes, and stratigraphy in a source to sink framework.

T188. From Paralic to Deep-Marine Tidal Depositional Systems: New Insights and Advances

Cosponsors: GSA Sedimentary Geology Division; Marine/Coastal Science Discipline; SEPM (Society for Sedimentary Geology)

Disciplines: Sediments, Clastic, Stratigraphy, Sediments, Carbonates

Advocates: Sergio Longhitano; Donatella Mellere; Valentina Marzia Rossi

This session focuses on paralic to deep-water tide-influenced and tide-dominated depositional systems. We encourage submission of works related to the study of modern and ancient systems, based on outcrop, subsurface data as well as modeling.

T189. Living in a Super-Greenhouse World: Processes and Deposits of the Late Cretaceous Thermal Maximum

Cosponsors: SEPM (Society for Sedimentary Geology); Paleontological Society; GSA Sedimentary Geology Division

Disciplines: Sediments, Clastic, Paleoclimatology/ Paleoceanography, Marine/Coastal Science

Advocates: Lesli Wood; Piret Plink-Bjorklund

The late Cretaceous super-greenhouse was a time of unique conditions. This session will provide researchers with an opportunity to share ideas on what it was, and will be like to live in a super-warm global climate.

T190. Modern and Ancient Sediment Transport on Earth and Planetary Surfaces

Cosponsors: GSA Sedimentary Geology Division; GSA Planetary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Sediments, Clastic, Stratigraphy, Planetary Geology

Advocates: Robert C. Mahon; Sheila Trampush; Thomas Ashley

Sediment transport systems are intrinsically coupled to the evolution of earth and planetary surfaces. This session seeks presentations on sediment transport in both modern and ancient settings—from theoretical, experimental, and field investigations.

T191. Mud, Mud, Glorious Mud: Advances in Stratigraphic, Sedimentologic, Geochemical, and Geomechanical Analyses of Fine-Grained Lithologies

Cosponsors: GSA Sedimentary Geology Division; GSA Energy Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Sediments, Clastic, Stratigraphy, Geochemistry

Advocates: Bryan W. Turner; Roger M. Slatt; Harry Rowe

Recent advances in technology have enabled workers to efficiently and accurately analyze mudrock properties with increasingly fine-scale resolution. This session highlights new avenues of research that further demonstrate the inherent variability within so-called "homogenous" mudrocks.

T192. Quantification of Surficial Processes Applied to Stratigraphic Predictions and Forward Models

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division

Disciplines: Sediments, Clastic, Quaternary Geology, Stratigraphy

Advocates: Kristy T. Milliken; Mike Blum; Jacob A. Covault

Surficial process geoscientists can provide valuable tools, such as quantitative metrics, for sedimentary basin stratigraphers and stratigraphic forward modelers. This timely session can elucidate valuable synergies between the subdisciplines.

T193. Sedimentary Basins

Disciplines: Sediments, Clastic, Stratigraphy, Tectonics/ Tectonophysics

Advocate: Diane L. Kamola

Current research associated with a broad spectrum of topics relating to sedimentation, stratigraphy, and tectonics of sedimentary basins.

T194. The Context of Our Origins: Geological Studies of Old World Fossil Primate and Hominin Sites

Cosponsors: GSA Sedimentary Geology Division; GSA Limnogeology Division; GSA Archaeological Geology Division; SEPM (Society for Sedimentary Geology); GSA Quaternary Geology and Geomorphology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Paleontological Society

Disciplines: Sediments, Clastic, Quaternary Geology, Soils

Advocates: Cynthia M. Liutkus-Pierce; Christopher J. Campisano; Christopher J. Lepre

This session will showcase research that reconstructs the context (age, climate, environment, etc.) of primate, hominin, and human sites with particular emphasis on the Old World.

T195. The Effects of Discharge Variability and Seasonality on Fluvial Morphodynamics

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division

Disciplines: Sediments, Clastic, Geomorphology, Stratigraphy

Advocates: Mark Hansford; James Syvitski

This session aims to explore the effects of variable river discharge on river morphodynamics and resultant deposits, as well as on river output into deltaic or deepwater systems.

T196. The Other Red Planet: Terrestrial Environments and Climates from the Permian and Triassic

Cosponsors: GSA Sedimentary Geology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; SEPM (Society for Sedimentary Geology)

Disciplines: Sediments, Clastic, Paleoclimatology/ Paleoceanography, Soils

Advocates: Kathleen C. Benison; Jonathan Knapp

This session aims to bring together geoscientists applying diverse methodologies to the study of Permian-Triassic terrestrial sedimentary rocks and to serve as a catalyst for collaboration and discovery about Pangean environments and climates.

T197. Transition Zones in Sediment Transport Systems

Cosponsors: SEPM (Society for Sedimentary Geology); STEPPE; GSA Sedimentary Geology Division

Disciplines: Sediments, Clastic, Stratigraphy, Geomorphology

Advocates: Anjali M. Fernandes; Man Liang

We solicit contributions that use modern/ancient field datasets, experimental observations, numerical modeling, and statistical methods to characterize changes in surface dynamics across transition zones in transport systems at a range of spatio-temporal scales, emphasizing their impact on the stratigraphic record.

SOILS

T198. Beneath Da Vinci's Feet: The Multidisciplinary World of Soil Science

Cosponsors: GSA Hydrogeology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group

Disciplines: Soils, Hydrogeology, Environmental Geoscience

Advocates: Emma Jayne Harrison; Madelyn S. Percy

An exploration of new, interdisciplinary approaches to the study of soil formation and the distribution of soil nutrients in a variety of climates, biomes, and parent material types.

T199. Modeling Soil Processes in the Geological Sciences: Status, Gains, and Opportunities

Cosponsors: GSA Soils and Soil Processes Interdisciplinary Interest Group; Soil Science Society of America; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Soils, Hydrogeology, Environmental Geoscience

Advocates: Michael Young; Harry Vereecken; Todd G. Caldwell

We seek research presentations that use numerical and conceptual models of soil processes (runoff, recharge, biogeochemical reactions, root water uptake, etc.) and how those models can be connected to the atmospheric, hydrologic, and biologic communities.

T200. The Rhizosphere: Processes at the Bio-Geo Interface

Cosponsors: GSA Soils and Soil Processes Interdisciplinary Interest Group; Geobiology and Geomicrobiology Division

Disciplines: Soils, Geochemistry, Geomicrobiology

Advocates: Zsuzsanna Balogh-Brunstad; Marjorie S. Schulz

The rhizosphere is the most active part in soils where biology and geology interact and facilitate many biogeochemical processes. These reactions control soil development, nutrient and water availability, etc. We welcome submissions from all scales, laboratory, field, and modeling studies.

STRATIGRAPHY

T201. Cenozoic Geology of the Great Plains: Toward an Integrated Understanding of a Sedimentary, Paleoecologic, and Geohydrologic System

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Geology and Society Division; GSA Hydrogeology Division; GSA Sedimentary Geology Division; GSA Soils and Soil Processes Interdisciplinary Interest Group; National Ground Water Association

Disciplines: Stratigraphy, Sediments, Clastic, Hydrogeology

Advocates: David L. Fox; Greg A. Ludvigson

This session examines the stratigraphy, sedimentology, geochronology, hydrogeology, and environmental evolution of the Cenozoic Great Plains succession in the context of sediment sources in the Cordillera and sinks in the Gulf of Mexico.

T202. Detrital Zircons on the North American Continental Interior

Cosponsors: GSA Sedimentary Geology Division; GSA Structural Geology and Tectonics Division; SEPM (Society for Sedimentary Geology)

Disciplines: Stratigraphy, Sediments, Clastic, Tectonics/ Tectonophysics

Advocates: William A. Thomas; George Gehrels; Emily S. Finzel; Brian A. Hampton

Detrital zircons document the tectonic components of sediment sources, as well as dispersal pathways across the North American continental interior during the last 1.3 billion years. Contributions will address various scales, ages, and locations of dispersal systems.

T203. Dynamics of Continental Margin Sedimentation

Cosponsors: GSA Sedimentary Geology Division; Marine/Coastal Science Discipline; Paleoclimatology/Paleoceanography Discipline; SEPM (Society for Sedimentary Geology)

Disciplines: Stratigraphy, Sediments, Clastic, Energy Geology

Advocates: Fabien J. Laugier; Jeremiah D. Moody

This session will present studies on modern and ancient continental margin systems with a focus on deposition on continental margins, dynamics controlling sediment storage and distribution, and stratigraphic response to changes in climate.

T204. Regional to Global Cenozoic Continental Stratigraphy: Advancements in Chronologic, Sequence, Chemical, Lithologic, and Paleontologic Approaches

Cosponsors: SEPM (Society for Sedimentary Geology); Paleontological Society; GSA Sedimentary Geology Division

Disciplines: Stratigraphy, Sediments, Clastic, Paleontology, Biogeography/Biostratigraphy

Advocates: Debra L. Hanneman; Emmett Evanoff; Ryan A. Portner

This session highlights advancements in various stratigraphic approaches to Cenozoic continental rocks for both regional and global scales.

T205. The Colorado Scientific Society III: From the Mountains to the Plains—New Concepts and Discoveries in Colorado and the Rocky Mountain Region

Cosponsors: Colorado Scientific Society; Colorado Geological Survey; GSA Quaternary Geology and Geomorphology Division; GSA Structural Geology and Tectonics Division

Disciplines: Stratigraphy, Structural Geology, Geomorphology

Advocates: Lisa Rae Fisher; Libby Prueher

Colorado and the surrounding Rocky Mountain region is a geology wonderland. The region is rich in geologic history, yet there is always something new. Join us for presentations and discussion to find out what's happening.

T206. The Effects of Discharge Variability on Alluvial Stratigraphy: Toward a New Facies Model

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division

Disciplines: Stratigraphy, Sediments, Clastic, Soils

Advocates: Evan Jones; Peter P. Flaig; Brady Z. Foreman

Submissions focusing on the stratigraphic expression of strong discharge variability ranging from geochemical variability at the lamination-scale in paleosols to changes in depositional architecture at the scale of the entire fluvial system are welcomed.

T230. Sedimentary, Paleobiologic, and Geochemical Studies of Deep Time Ocean-Climate Perturbations: Honoring the Scientific Contributions of Michael A. Arthur

Cosponsors: SEPM (Society for Sedimentary Geology); GSA Sedimentary Geology Division; Paleontological Society **Disciplines:** Stratigraphy, Geochemistry, Paleoclimatology/ Paleoceanography

Advocates: Bradley B. Sageman; Matthew T. Hurtgen; Christopher K. Junium; Mark Pagani

This topical session will celebrate the scientific contributions of Professor Michael Arthur through a series of talks on topics to which Arthur made pioneering contributions, including ocean anoxia, stable isotopic biogeochemistry, and Milankovitch climate cycles.

STRUCTURAL GEOLOGY

T207. Best Student Geologic Mapping Competition (Posters)

Disciplines: Structural Geology, Stratigraphy, Geomorphology

Advocates: Douglas Howard; Michael Marketti

Students will present their research through geologic mapping projects that have a significant field component that addresses scientific or societal issues. The top three geologic maps will be awarded.

T208. Deconstructing Damage: Holistic Perspectives on the Spatiotemporal Evolution of Brittle Fault Zones

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Geophysics Division; U.S. Geological Survey; Geological Survey of Israel

Disciplines: Structural Geology, Tectonics/Tectonophysics, Geophysics/Geodynamics

Advocates: James Kirkpatrick; Alexis K. Ault; Ram Weinberger; John P. Craddock; Jonathan Saul Caine

This session highlights interactions among mechanical, thermal, and chemical processes as brittle fault zones grow and mature. Contributions integrating field, analytical, geophysical, numerical, and experimental studies providing holistic views of fault zones are encouraged.

T209. Earth History in the Broadest Context—Ophiolites, Global Tectonics, and Public Awareness of Earth Science: Celebrating the Contributions of Eldridge Moores

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Geophysics Division; GSA International/International Interdisciplinary Interest Group; GSA History and Philosophy of Geology Division; GSA Geology and Society Division; GSA Geoscience Education Division

Disciplines: Structural Geology, Tectonics/Tectonophysics, History and Philosophy of Geology

Advocates: John Wakabayashi; Yildirim Dilek

Honoring the distinguished career of Eldridge Moores, we encourage the international geoscience community to contribute original overview and policy papers in global tectonics, Earth history, science for society, public awareness, and geoscience education.

3SA TODAY | MAY 2016

T210. Folds and Folding: Form, Process, and Consequences

Cosponsor: *GSA Structural Geology and Tectonics Division* **Disciplines:** Structural Geology, Geomorphology, Energy Geology **Advocates:** Juliet G. Crider; Andreas Eckert

We seek contributions examining the form of folds and processes of folding, including studies that investigate the causes and consequences of folding in the contexts of tectonic history, crustal deformation, landscape evolution, or fluid migration.

T211. Large-Scale Continental Extensional Tectonics

Cosponsor: GSA Structural Geology and Tectonics Division

Disciplines: Structural Geology, Tectonics/Tectonophysics, Geophysics/Geodynamics

Advocates: Ibrahim Çemen; Spyridon Pavlides

This session will bring together researchers studying extensional tectonics and associated structures in different parts of the world and provide a formal discussion for understanding many important questions related to tectonic evolution of extended terrains.

T212. Multifaceted Approaches to Understanding Fluid-Fault Interactions in Natural Resources and Geologic Hazards

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Hydrogeology Division; GSA Energy Geology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; Society of Economic Geologists; GSA Geology and Society Division

Disciplines: Structural Geology, Hydrogeology, Energy Geology

Advocates: Randolph T. Williams; Elizabeth S. Petrie; Kelly Bradbury; Nick M.W. Roberts

We welcome abstracts focused on multifaceted research related to fluid flow, deformation, and mineralization associated with crustal faulting and fracturing. Research related to groundwater, hydrocarbons, sequestration, mineral deposits, landslides, and seismicity is particularly encouraged.

T213. Structure and Tectonics of Mesoproterozoic Basins

Disciplines: Structural Geology, Tectonics/Tectonophysics, Precambrian Geology

Advocates: James W. Sears; John S. MacLean

Mesoproterozoic basins provide important windows into Earth evolution. The session will highlight recent research into these basins in the USA, Canada, and worldwide.

TECTONICS/TECTONOPHYSICS

T214. Along-Strike Variations in Mountain Belts: Why Are They Important and What Causes Them?

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division

Disciplines: Tectonics/Tectonophysics, Structural Geology

Advocates: Yvette D. Kuiper; Steven J. Whitmeyer; Christopher M. Bailey; H. Daniel Gibson; Jonathan S. Caine

Mountain belts, including the Appalachians and the Cordillera, typically display orogen-parallel variations in tectonic style that are important in the evolution of continental lithosphere. Contributions from orogenic to local scales are encouraged.

T215. Applications of Geochronology and Thermochronology for Understanding the Tectonic Mechanisms and Surface Processes of the Tibetan Plateau

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; GSA Quaternary Geology and Geomorphology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Tectonics/Tectonophysics, Geomorphology, Sediments, Clastic

Advocates: Devon A. Orme; Lydia Staisch; Alex Pullen

We seek contributions on applications of geochronologic and thermochronologic analyses towards understanding tectonic, sedimentary, and surface processes of the Tibetan Plateau. Presentations on advances in plateau evolution from the mantle to the surface are encouraged.

T216. Cenozoic Evolution of the Southern Rocky Mountains and Northern Rio Grande Rift: Exploring Linkages between Geologic History, Processes, and Landscape Change

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Quaternary Geology and Geomorphology Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Tectonics/Tectonophysics, Quaternary Geology, Volcanology

Advocates: Scott A. Minor; Ren A. Thompson

The southern Rocky Mountains–Rio Grande rift has experienced diverse tectonism, magmatism, surface processes, and landscape change in the Cenozoic. Presentations are sought on research in this region exploring linkages between these processes at multiple scales.

T217. Earth History in the Broadest Context—Tectonics, Impacts, Mass Extinctions, and Big History: Celebrating the Contributions of Walter Alvarez

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Planetary Geology Division; GSA Sedimentary Geology Division

Disciplines: Tectonics/Tectonophysics, Planetary Geology, Stratigraphy

Advocates: David H. Shimabukuro; Philippe Claeys

This session honors the distinguished career of Walter Alvarez. We encourage a broad and interdisciplinary set of contributions from the fields of tectonics, impacts, stratigraphy, paleomagnetism, the history of geology, and Big History.

T218. Evidence for Neotectonic Earthquakes and Their Driving Mechanisms in the Intraplate Region of Central and Eastern North America

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Geophysics Division; GSA Environmental and Engineering Geology Division; GSA Quaternary Geology and Geomorphology Division; EarthScope; U.S. Geological Survey

Disciplines: Tectonics/Tectonophysics, Geophysics/ Geodynamics, Quaternary Geology

Advocates: J. Wright Horton Jr.; Christine A. Powell; Robert A. Williams

This session presents evidence for intraplate neotectonic earthquakes in central and eastern North America and their driving mechanisms in relation to lithospheric structure, and invites novel multidisciplinary field, laboratory, and modeling approaches.

T219. In Honor of Chuck Kluth: The Pennsylvanian–Permian Ancestral Rocky Mountains and its Links to the Texas and Southern California—Northwestern Mexico Continental Margins of North America (Posters)

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Tectonics/Tectonophysics, Structural Geology, Stratigraphy

Advocates: Paul J. Umhoefer; Gary L. Gianniny; Ron Blakey

This session explores the tectonics and basins within the Ancestral Rocky Mountains and their link to the west Texas Permian basin and South American collision and to the west and southwest to the Pacific margin.

T220. Physical and Numerical Modeling of Geologic Processes

Cosponsor: GSA Structural Geology and Tectonics Division

Disciplines: Tectonics/Tectonophysics, Geophysics/ Geodynamics, Structural Geology

Advocates: Raphaël Gottardi; Suzon Jammes; Lijun Liu; Gabriele Morra; Mélody Philippon; Jacqueline E. Reber; Jolante W. van Wijk

This cross-disciplinary session will foster synergies between the experimental and numerical modeling communities to quantify and improve the incorporation of geological processes in models from the mineral to plate-tectonic scale.

T221. Plate Tectonics, Arc-Trench Systems, Cordilleran Tectonics, Sedimentary Basins, Sandstone Provenance, and Geoarchaeology: A Celebration of William R. Dickinson's Career

Cosponsors: GSA Sedimentary Geology Division; GSA Publications; GSA Archaeological Geology Division; GSA Structural Geology and Tectonics Division

Disciplines: Tectonics/Tectonophysics, Sediments, Clastic, Archaeological Geology

Advocates: Raymond V. Ingersoll; Stephan A. Graham; Timothy F. Lawton

This session will honor William R. Dickinson for his leadership in the diverse fields of plate tectonics, arc-trench systems, Cordilleran tectonics, sedimentary basins, sandstone provenance, and geoarchaeology.

T222. Proterozoic Accretion of the North American Continent—United Plates of America Revisited

Cosponsor: GSA Structural Geology and Tectonics Division

Disciplines: Tectonics/Tectonophysics, Precambrian Geology

Advocates: M.L. Williams; Karl E. Karlstrom; David Corrigan; Jeffrey Amato; Deanne van Rooyen

This session will focus on the Proterozoic accretion and stabilization of the North American continent, particularly the timing and orogenic processes including the stitching of Archean blocks and the subsequent southward growth of continental crust.

T223. Rates in Metamorphism and Tectonism: From Mineral Growth to Orogenesis

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division

Disciplines: Tectonics/Tectonophysics, Petrology, Metamorphic, Structural Geology

Advocates: Thomas M. Etzel; Eric D. Kelly; Kyle T. Ashley; Elizabeth J. Catlos

This session focuses on rates of processes associated with metamorphism and orogenesis, specifically the connections and dependencies among various rates. We encourage submissions on rates of diffusion, crystallization, heating/cooling, fault/plate motion, and other orogenic processes.

T224. Records of Subduction Initiation in Modern and Ancient Settings

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Tectonics/Tectonophysics, Volcanology, Sediments, Clastic

Advocates: Nancy Riggs; Kathleen M. Marsaglia; Andrew P. Barth; M. Robinson Cecil

Geodynamic models for subduction initiation are testable in a few ancient and modern examples (e.g., Cordilleran Permo-Triassic, Izu-Bonin-Mariana). The session explores subduction initiation from rock record, temporal, and geodynamic perspectives, emphasizing the need for integrative studies.

T225. Tectonics of North American Cordillera and the Alps: Celebrating the Telling-It-Like-It-Is Scientific Career of Tim Wawrzyniec

Cosponsor: GSA Structural Geology and Tectonics Division

Disciplines: Tectonics/Tectonophysics, Structural Geology, Geophysics/Geodynamics

Advocates: Basil Tikoff; J.W. Geissman

This session is dedicated to tectonic studies of the U.S. Cordillera and Alps. Work associated or inspired by Tim Wawrzyniec is particularly appreciated. Following Wawrzyniec's approach to science, controversial and non-paradigm conforming ideas are welcome.

T226. The Rest of the Story! Late Paleozoic Assembly of and Tectonics in the Western U.S. to Canada Using Structural Geology, Sedimentology, Biochronology, and Geochronology

Cosponsors: GSA Structural Geology and Tectonics Division; GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology)

Disciplines: Tectonics/Tectonophysics, Structural Geology, Paleontology, Biogeography/Biostratigraphy

Advocates: Wanda J. Taylor; Patricia H. Cashman; James H. Trexler Jr.; Daniel M. Sturmer

New evidence from western North America suggests that tectonism occurred during the 100 m.y. between two recognized Late Paleozoic orogenies: the Antler and Sonoma. This session promotes information exchange and discussion of Late Paleozoic tectonism.

T227. Time Matters: Celebrating the Scientific Legacy of Samuel A. Bowring

Cosponsors: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division; GSA Structural Geology and Tectonics Division; Smithsonian Institution; GSA International/International Interdisciplinary Interest Group

Disciplines: Tectonics/Tectonophysics, Paleontology, Diversity, Extinction, Origination, Precambrian Geology

Advocates: Robert S. Hildebrand; Anke Friedrich; Gregory Dumond; Marion E. Bickford

In his EarthTime program and throughout his career, Samuel A. Bowring made a reality of the vision that precise U-Pb geochronology could elucidate the processes responsible for crustal development and faunal evolution.

VOLCANOLOGY

T228. Field Geology to Inform Volcanic Processes: A Tribute to the Distinguished Career of Don Swanson

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Volcanology, Petrology, Igneous, Geophysics/ Geodynamics

Advocates: Michael P. Poland; B.F. Houghton

Don Swanson, recipient of the 2016 Distinguished Career GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division (MGPV) Award, is recognized for his pain-staking, field-oriented approach to volcanology across a range of scales and compositions. This session will feature research inspired by Swanson's contributions.

T229. New Perspectives on Volcanic Collapse Systems: Advances in Recognizing and Understanding Styles of Catastrophic Structural Failures and Landslide Emplacement Mechanisms in Volcanic Terrains

Cosponsor: GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division

Disciplines: Volcanology, Structural Geology, Tectonics/ Tectonophysics

Advocates: David B. Hacker; Robert F. Biek; Peter D. Rowley

This multidisciplinary session focuses on new insights pertaining to rapid mass movements found in ancient to modern volcanic terrains. We encourage submissions from field-based, microstructural, geophysical, experimental, and modeling studies of landslide structures and deposits.



Exhibit with GSA

Interested in exhibiting at this must-attend geoscience event for academics, scientific organizations,

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community.geosociety.org/gsa2016/expo/exhibitorinfo



Discipline Categories

Can't find a topical session that fits your abstract? No problem! In addition to topical sessions, we offer the following discipline categories. Discipline sessions are equally vital to our technical program and are an essential addition to the fulfillment of the overall meeting. Encourage your friends to submit a discipline abstract too.

2016 Joint Technical Program Committee

GSA Technical Program Chair, Paul Baldauf, pb501@nsu.nova.edu GSA Technical Program Vice-Chair, Dick Berg, rberg@illinois.edu Technical Program Manager, Nancy Wright, nwright@geosociety.org

| REVIEW GROUP DISCIPLINE | | JTPC CONTACT(S) | | |
|--|--|---|--|--|
| | | | | |
| GSA Archaeological Geology Division | archaeological geology | Cynthia Fadem, cfadem@gmail.com; Richard Dunn, rdunn@norwich.edu | | |
| Association of Earth Science Editors | geoscience information/ communication | Monica Easton, monica.easton@ontario.ca | | |
| GSA Energy Geology Division | energy geology | J. Fred McLaughlin, derf1@uwyo.edu; Marc L. Buursink, mbuursink@usgs.gov | | |
| GSA Environmental and Engineering Geology Division | engineering geology | Thad A. Wasklewicz, wasklewiczt@ecu.edu; Jessica E. Witt, jewitt@bechtel.com | | |
| GSA Geobiology & Geomicrobiology Division | geomicrobiology | Lydia Tackett, lydia.tackett@ndsu.edu | | |
| Geochemical Society | geochemistry, geochemistry, other | Matthew Brueseke, brueseke@ksu.edu | | |
| GSA Geoinformatics Division | geoinformatics | M. Lee Allison, lee.allison@azgs.az.gov | | |
| GSA Geology and Health Division | geology & health | Saugata Datta, sdatta@ksu.edu | | |
| GSA Geology and Society Division | geoscience and public policy | Christopher P. Carlson, ccarlson@fs.fed.us; Alan Benimoff, alan.benimoff@csi.cuny.edu | | |
| GSA Geophysics Division | geophysics/tectonophysics/ seismology | Nicholas C. Schmerr, nschmerr@umd.edu; Lisa Tauxe, ltauxe@ucsd.edu | | |
| GSA Geoscience Education Division | geoscience education | Shane V. Smith, shanesmi@kean.edu; Natalie Bursztyn, nbursztyn@mac.com | | |
| Geoscience Information Society | geoscience information/ communication | Chris Badurek, cab484@drexel.edu | | |
| GSA History and Philosophy of Geology Division | history of geology | Renee Clary, rclary@geosci.msstate.edu; Joanne (Jody) Bourgeois, jbourgeo@u.washington.edu; Dorothy Sack, sack@ohio.edu | | |
| GSA Hydrogeology Division | hydrogeology | Mark Engle, engle@usgs.gov; Kallina Dunkle, dunklek@apsu.edu | | |
| GSA Karst Division | karst | Cory BlackEagle, cory.blackeagle@gmail.com; Jason Polk, jason.polk@wku.edu | | |
| GSA Limnogeology Division | limnogeology | Tim Cook, tcook3@worcester.edu; Scott Starratt, sstarrat@usgs.gov | | |
| GSA Mineralogy, Geochemistry, Petrology, and Volcanology Division | mineralogy/crystallography; geochemistry; petrology, volcanology | Wendy A. Bohrson, bohrson@geology.cwu.edu; Anita L. Grunder, grundera@geo.oregonstate.edu | | |
| Marine/Coastal Geology | marine/coastal science | Joe Kelley, jtkelley@maine.edu | | |

| REVIEW GROUP DISCIPLINE | | JTPC CONTACT(S) | | |
|--|--|---|--|--|
| Mineralogical Society of America | mineralogy/crystallography; petrology, experimental; petrology, igneous; petrology, metamorphic; volcanology | James S. Beard, jim.beard@vmnh.virginia.gov; Philip Brown, pbrown@geology.wisc.edu | | |
| National Assoc. of Geoscience Teachers | geoscience education | Don Duggan-Haas, dugganhaas@gmail.com | | |
| Paleoceanography/Paleoclimatology | paleoclimatology/ paleoceanography | Miriam E. Katz, katzm@rpi.edu | | |
| Paleontological Society | paleontology, biogeography/ biostratigraphy; paleontology, diversity, extinction, origination; paleontology, paleoecology/tapho- nomy; paleontology, phylogenetic/ morphological patterns | Marc Laflamme, marc.laflamme@utoronto.ca; Matt Clapham, mclapham@ucsc.edu | | |
| GSA Planetary Geology Division | planetary geology | Danielle Wyrick, dwyrick@swri.org; Debra Buczkowski, debra.buczkowski@jhuapl.edu; James J. Wray, jwray@ eas.gatech.edu; Bradley Thomson, bjt@bu.edu | | |
| Precambrian Geology | Precambrian geology | Michael Williams, mlw@geo.umass.edu | | |
| GSA Quaternary Geology and Geomorphology Division | geomorphology; Quaternary geology | Anne Chin, anne.chin@ucdenver.edu; Glenn D. Thackray, thacglen@isu.edu | | |
| GSA Sedimentary Geology Division | sediments, carbonates; sediments, clastic; stratigraphy | Ryan F. Morgan, rmorgan@tarleton.edu; Piret Plink- Bjorklund, pplink@mines.edu | | |
| Society for Sedimentary Geology | sediments, carbonates | Piret Plink-Bjorklund, pplink@mines.edu | | |
| Society of Economic Geologists | economic geology | Garth Graham, ggraham@usgs.gov | | |
| Soils and Soil Processes (GSA Interdisciplinary Interest Group) | soils | Steven G. Driese, Steven_Driese@baylor.edu; Neil J. Tabor, ntabor@smu.edu | | |
| GSA Structural Geology and Tectonics Division | structural geology; tectonics | Mary S. Hubbard, mary.hubbard@usu.edu; Juliet Crider, criderj@uw.edu | | |

Two-Abstract Rule

- You may submit two volunteered abstracts, as long as one of the abstracts is for a poster presentation;
- · Each submitted abstract must be different in content; and
- If you are invited to submit an abstract in a Pardee Keynote Symposium or a topical session, the invited abstracts do not count against the two-abstract rule.

Event Space Requests

Deadline for first consideration: 5 May

Please let us know about your non-technical events via our online event space & event-listing database. Space is reserved on a first-come, first-served basis; in order to avoid increased fees, you must submit your request for meeting rooms by 5 May.

Event space & event listing requests should be used for meeting rooms to hold events (i.e., business meetings, luncheons, receptions, etc.):

• At the Colorado Convention Center (CCC); Hyatt Regency Denver at CCC; or Grand Hyatt—with no food/beverage

minimum or room rental fee from the facility/hotel; and/or

Por off-site events (events that are not being held at the CCC, Hyatt Regency Denver at CCC, or Grand Hyatt).

Ensure that your event is listed in the meeting program book, in the personal scheduler, and the mobile app, as well as on the GSA website.

If your event is private or "invitation only" indicate that and limit who has access to the information. For example, for private events, you simply check the "private" box and the information won't be included in any of our listings. If your event is invitationonly, please indicate that in the *Notes to GSA* section.

Registration

- **Early registration deadline:** 22 August
- Cancellation deadline: 29 August

REGISTRATION FEES (all fees are in U.S. dollars)

| | EARLY | STANDARD/ ONSITE |
|--|--------------|---------------------|
| | June–22 Aug. | after 22 Aug. |
| Member: Professional, full meeting | \$399 | \$485 |
| Member: Professional, one day | \$245 | \$285 |
| Member: Professional, 70+, full meeting | \$285 | \$370 |
| Member: Professional 70+, one day | \$185 | \$210 |
| Nonmember: Professional, full meeting | \$575 | \$650 |
| Nonmember: Professional, one day | \$350 | \$425 |
| Member Early career professional, full meeting | \$250 | \$320 |
| Member Early career professional, one day | \$150 | \$190 |
| Member: Student, full meeting | \$125 | \$160 |
| Member: Student, one day | \$79 | \$89 |
| Nonmember: Student, full meeting | \$175 | \$215 |
| Nonmember: Student, one day | \$115 | \$130 |
| High school student | \$45 | \$45 |
| K–12 Professional, full meeting | \$55 | \$65 |
| Field Trip or Short Course only | \$40 | \$40 |
| Guest or spouse | \$85 | \$90 |
| Low Income Country* | 50% | 50% |



Don't forget to...

- Register for tours, special events, field trips, and short courses;
- Bring a copy of your meeting confirmation with you;
- **STUDENTS:** Be sure to apply for the travel grant program by 22 August;
- Make your hotel reservation; and
- Book your travel.

*Participants from countries classified as "Low or Lower Middle Income Economies" by the World Bank need only pay 50% of the category fee for full meeting or one day registration. Online registration is not available for "Low or Lower Middle Income Economy" registrants. Please fill out a printable version of the registration form and mail it to GSA, 3300 Penrose Place, Boulder, CO 80301, USA. IMPORTANT: Fees for onsite registration will be collected in U.S. dollars and credit cards only.

GSA strives to create a pleasant and rewarding experience for every attendee. Let us know in advance of the meeting if you have needs that require further attention. Most dietary considerations can be met without any extra charge. Be sure to check the box when registering online and describe your need in the space provided.



Travel Grants

Need help getting to the Annual Meeting? GSA Sections, Divisions, and Associated Societies are ready to help! Various groups are offering grants to help defray your costs for registration, field trips, travel, etc., at the GSA Annual Meeting. Go to **community.geosociety.org/gsa2016/attendeeinfo/ travel** to learn more. Note: Eligibility criteria and deadline dates may vary by grant.

For meeting attendees who reside outside of North America, check the International Travel Grant webpage at **www.geosociety.org/GSA_International/travelGrants.htm.** The deadline to apply is **17 June.**

Interested in helping students participate in the meeting?

Every year, a large percentage of students who apply for travel grants do not receive them because funds are limited. You can help by donating as little as US\$10 via your registration form; 100% of the money goes to student attendees.





5th International EarthCache Event

Saturday, 24 Sept. 2016 | Denver, Colorado, USA

EarthCaching gets people out in the field to learn about their planet first-hand. Participants in this annual event will learn all about EarthCaching, interact with EarthCachers from around the globe, meet EarthCache developers and reviewers, find local EarthCaches, and engage in many other exciting and educational activities. The 2016 event will be held in conjunction with the GSA Annual Meeting, which provides a unique opportunity for GSA members to connect with the EarthCaching and Geocaching communities! For details, go to community.geosociety.org/earthcache/home, www.facebook.com/earthcache, or contact Matt Dawson at mdawson@geosociety.org.

Let the Earth be your teacher!



On To the Future (OTF)

Travel Awards

► Application deadline: 27 May

Students from underrepresented groups in the geosciences are invited to apply for OTF travel awards to attend their first GSA Annual Meeting. Students will have special opportunities to be paired with meeting mentors and attend morning sessions connecting students with key GSA leaders. Learn more and apply at **community.geosociety.org/OTF/home/.**

Make an Impact—Be a Mentor

OTF is recruiting mentors to guide program participants through their first GSA Annual Meeting. Whether you are an undergraduate or graduate student, a professional, or retired, OTF offers great opportunities for you to share your knowledge and experience with someone else. Learn more and apply at **community.geosociety.org/otf/annualmeetingprogram/mentors.**





Accommodations

GSA has selected a range of hotels in terms of proximity, rate, and style to meet your needs and preferences. Please check the GSA website for the housing map and room reservation procedures. Below is the list of hotels and group rates for our block. Rates are in U.S. dollars and do not include the current applicable tax of 14.85%. Complimentary Internet will be provided in all guest rooms booked through GSA/Orchid Event Solutions.

ALERT: The official GSA housing bureau is **Orchid Event Solutions.** To receive the GSA group rate at each hotel, reservations must be made through Orchid Event Solutions and not directly with the hotels. GSA/Orchid Event Solutions will NOT contact attendees directly to solicit new reservations. If you are contacted by a vendor that claims to represent GSA, please notify the GSA Meetings Dept. at meetings@geosociety.org or +1-303-357-1041. Please do not make hotel arrangements or share any personal information through any means other than a trusted, reliable source.

| Hotel | Rate (single/double) | More than 2 adults | Distance to CCC | Parking Daily/24-hr** |
|--|-------------------------|-----------------------|-----------------|--------------------------|
| Hyatt Regency Denver at CCC (HQ Hotel) | \$223 | \$25 | Adjacent | \$29 self/\$39 valet |
| Grand Hyatt (co-HQ Hotel) | \$205 | \$25 | 3 blocks | \$37 valet |
| Crowne Plaza Denver Downtown | \$179 | \$10 | 2 blocks | \$27 self |
| Denver Marriott City Center | \$199 | \$15 | 3 blocks | \$37 valet |
| Hampton Inn & Suites Denver/Downtown- Conv. Ctr.* | \$199 | \$10 | 1 block | \$30 valet |
| Hilton Garden Inn Denver Downtown | \$195 | \$10 | 1 block | \$39 valet |
| Holiday Inn Express Denver Downtown | \$161 | \$10 | 5 blocks | \$35 valet |
| Homewood Suites Denver/Downtown- Conv. Ctr. | \$199 | \$10 | 1 block | \$39 valet |
| Hyatt House Denver/Downtown* | \$199 | \$10 | 2 blocks | \$39 valet |
| Hyatt Place Denver/Downtown* | \$199 | \$10 | 2 blocks | \$39 valet |
| Sheraton Denver Downtown Hotel | \$199 | \$15 | 3 blocks | \$37 self/\$45 valet |

*Breakfast included in rate (check hotel websites for specifics regarding breakfast menu) **Parking rates subject to change; additional fees for oversized vehicles



Travel & Transportation

Denver International Airport (DIA; **www.flydenver.com**) services more than 1,500 daily domestic and international flights. DIA is about 35 minutes from downtown Denver. Light rail ("RTD University of Colorado A Line") runs from the airport to downtown Denver's Union Station. Learn more at **www.rtd-denver.com/a-line.shtml.**





Amtrak arrives at Union Station daily via the California Zephyr enroute to and from Glenwood Springs, Salt Lake City, Reno, San Francisco, Omaha, and Chicago. The California Zephyr is among the most scenic train routes in the United States. Connecting Amtrak thruway bus service is also provided for Amtrak's Southwest Chief for rail service to Los Angeles, Grand Canyon, Flagstaff, and Albuquerque. For more information, go to www.amtrak.com or call +1-800-USA-RAIL. Union Station is about 1.3 miles from the convention center.

International Attendees

If you are visiting the United States from outside of the country and are not a U.S. citizen, you may require a visa. Go to **https://travel.state.gov/content/visas/en.html** to learn more. You can obtain and print out the GSA Invitation Letter to the meeting at community.geosociety.org/gsa2016/attendeeinfo/travel.



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ANALOGS FOR Planetary Exploration

Edited by W. Brent Garry and Jacob E. Bleacher

Where on Earth is it like Mars? How were the Apollo astronauts trained to be geologists on the Moon? Are volcanoes on Earth just like the ones on other planets? Geologic sites on this planet are used to better understand the extraterrestrial worlds we explore with humans, robots, and satellites. Analogs for Planetary Exploration is a compilation of historical accounts of astronaut geology training, overviews of planetary geology research on Mars, field guides to analog sites, plus concepts for future lunar missions. This Special Paper provides a great overview of the science, training, and planning related to planetary exploration for students, educators, researchers, and geology enthusiasts. | SPE483, 567 p., ISBN 9780813724836 | original list \$100.00 | **now only \$10.00**

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Scientific Field Trips

Descriptions and leader bios are online.

Before the Meeting

401. **GSA International Student Field Trip to National Parks in the Western U.S.** Fourteen days: Mon.–Sat., 12–24 Sept. Cosponsor: GSA International. Leader: Anke Friedrich.

402. A Visit to the Regional Aluminum Silicate Triple-Point Metamorphic Rocks of Northern New Mexico: A Field Trip to Honor the Career Contributions of Lincoln Hollister to Petrology and Tectonics. Four days: Wed.–Sat., 21–24 Sept. Cosponsors: GSA Structural Geology & Tectonics Division; GSA Mineralogy, Geochemistry, Petrology and Volcanology Division. Leaders: Christopher G. Daniel; Christopher L. Andronicos.

403. **Transect of Mesoproterozoic Belt Basin, Glacier National Park, Montana.** Three days: Wed.–Fri., 21–23 Sept. Leaders: James W. Sears; John S. MacLean.

404. Dynamic Topography, Regional Uplift, and Integration History of the Colorado–Green River Systems. Four days: Wed.–Sat., 21–24 Sept. Cosponsor: GSA Quaternary Geology and Geomorphology Division. Leaders: Andres Aslan; Karl E. Karlstrom; Eric Kirby.

405. Sequence Stratigraphy, Stratal Patterns, and Hydrodynamics of the Upper Cretaceous Iles (Mount Garfield) and Williams Fork (Hunter Canyon) Formations, Grand Junction Area, Colorado. Four days: Wed.–Sat., 21–24 Sept. Leaders: Diane L. Kamola; Jesse Thompson; Benjamin Campanaro.

406. Getting to the Bottom of the High Plains Aquifer: New Insights into the Depositional History, Stratigraphy, and Paleoecology of the Cenozoic High Plains. Three days: Thurs.– Sat., 22–24 Sept. Cosponsors: GSA Sedimentary Geology Division; SEPM (Society for Sedimentary Geology); GSA Soils and Soil Processes Interdisciplinary Interest Group; GSA Geology and Public Policy Committee; GSA Geology and Society Division. Leaders: Jon J. Smith; Anthony L. Layzell; William E. Lukens; Matthew L. Morgan; Stephen M. Keller.

407. Exploring the Ancient Volcanic and Lacustrine Environments of the Oligocene Creede Caldera and Environs, San Juan Mountains, Colorado. Three days: Thurs.–Sat., 22–24 Sept. Leaders: Daniel Larsen; Peter W. Lipman.

408. **Depositional Systems of the Rockies.** Three days: Thurs.– Sat., 22–24 Sept. Cosponsor: Energy and Geoscience Institute, University of Utah. Leaders: R. William Keach II; Tom Anderson.

409. From Terraces to Terroir: Exploring Geology and Wineries on Colorado's Western Slope. Three days: Thurs.–Sat., 22–24 Sept. Leaders: Terri L. Cook; Lon D. Abbott.

410. Geomorphic Evolution of the San Luis Basin and Rio Grande. Three days: Wed.–Fri., 21–23 Sept. Cosponsor: GSA Quaternary Geology and Geomorphology Division. Leaders: Cal Ruleman; Michael N. Machette; Ren Thompson.

411. **Geoheritage along the Gold Belt Byway, Colorado: Initiatives to Promote the Legacy of Geologic History for Local Communities.** Two days: Fri.–Sat., 23–24 Sept. Cosponsors: William Smith Bicentenary Committee; GSA History and Philosophy of Geology Division. Leaders: Herb Meyer; Melissa Smeins.

412. Cretaceous Ocean-Climate Perturbations Revealed in Cenomanian-Campanian Strata of Colorado: Field Trip Associated with Symposium Honoring the Scientific Contributions of Michael A. Arthur. Two days: Fri.–Sat., 23–24 Sept. Leaders: Bradley B. Sageman; R. Mark Leckie; Richard Barclay; Christopher M. Lowery.

413. Stromatolite Variability in the Nash Fork Formation, Southeastern Wyoming: A Walking Tour across a Paleoproterozoic Carbonate Shelf. Two days: Fri.–Sat., 23–24 Sept. Leaders: David R. Lageson; Donald W. Boyd.

414. Overview of the Eocene Castle Rock Conglomerate, East-Central Colorado: Remapping the Fluvial System and Implications for the History of the Colorado Piedmont and Front Range. One day: Sat., 24 Sept. Cosponsor: Colorado Geological Survey. Leaders: Stephen M. Keller; Matthew L. Morgan.

415. Unconventional Reservoirs and Stratigraphy of the Southern Denver Basin: Graneros, Greenhorn, Carlile, and Niobrara Formations. Two days: Sat.–Sun., 24–25 Sept. Cosponsor: GSA Energy Geology Division. Leaders: Jeffrey Allyn May; Russell "Tofer" Lewis.

416. Geology along the Colorado Front Range near Morrison and Golden. One day: Sat., 24 Sept. Cosponsor: GSA Members of the Friends of Dinosaur Ridge. Leaders: Norb Cygan; Tim Connors; Lou Taylor.

417. **An Accessible Journey through Geologic Time in Central Colorado.** One day: Sat., 24 Sept. Cosponsors: GSA Geoscience Education Division; International Association for Geoscience Diversity. Leaders: Christopher L. Atchison; Brett H. Gilley; Cheryl L.B. Manning; Julie Maxson; Carla McAuliffe; Aisha R. Morris; Leilani Arthurs; Wendi J.W. Williams.

418. Geology, Hydrology, Water Rights, and History of the Mineral Waters of Manitou Springs. One day: Sat., 24 Sept. Leaders: Ralf Topper; Christine Siddoway; Melissa A. Peterson.

419. **Management of Acid Mine Drainage in the Colorado Mineral Belt.** One day: Sat., 24 Sept. Cosponsor: Hatch Associates Consultants, Lakewood, Colorado, USA. Leaders: Devin Castendyk; Kato T. Dee; Garret Rue.

420. **Pinedale Glacial History of the Upper Arkansas River Valley: New Moraine Chronologies, Modeling Results, and Geologic Mapping.** One day: Sat., 24 Sept. Cosponsor: GSA Quaternary Geology and Geomorphology. Leaders: Avriel D. Schweinsberg; Jason P. Briner; Ralph R. Shroba; Joseph M. Licciardi; Eric M. Leonard; Keith A. Brugger.

421. Restoring the Headwaters of the Arkansas River: A Bike and Underground Tour of the Leadville Mining District and Modern Reclamation Efforts to Minimize the Effects of Acid Mine Drainage. One day: Sat., 24 Sept. Cosponsor: Colorado Mountain College, Leadville, Colorado, USA. Leader: Jacob Mohrmann.

422. **Roadside Faults, Folds, Fossils, Crystals, and Diamond Pipes—Sampling the Geologic Diversity of Northern Colorado.** One day: Sat., 24 Sept. Leaders: Uwe Kackstaetter; Barbara EchoHawk.

423. **The Consequences of Living with Geology.** One day: Sat., 24 Sept. Cosponsors: American Institute of Professional Geologists; Association of Engineering and Environmental Geologists. Leaders: David M. Abbott Jr.; David C. Noe.

During the Meeting

424. Kirk Bryan Field Trip: Quaternary Landslides, Fluvial Terraces, and Recent Geomorphic Events along the Colorado Front Range. One day: Tues., 27 Sept. Cosponsors: GSA Quaternary Geology and Geomorphology Division; Boulder Creek Critical Zone Observatory; Colorado Scientific Society. Leaders: Melissa A. Foster; Robert S. Anderson.

After the Meeting

425. Late Holocene Landscape Evolution in the White River Badlands. Four days: Fri.–Sun., 29 Sept.–2 Oct. Leaders: Patrick Burkhart; Paul Baldauf.

426. **Middle to Late Cenozoic Geology and Geomorphology of the Laramie Mountains, Wyoming.** Two days: Thurs.–Fri., 29–30 Sept. Cosponsor: Colorado Scientific Society. Leader: Emmett Evanoff.

427. Progressive Development of Basement-Involved Foreland Thrust Belts: Results from the NSF/EarthScope Bighorn Project Applied to the Laramide Orogeny in the Colorado Front Range. One day: Thurs., 29 Sept. Leaders: Eric A. Erslev; Karen Aydinian; Laura E. Kennedy.

428. South Park: Complex Structure and Stratigraphy Create One of Colorado's Crown Jewels. One day: Thurs., 29 Sept. Cosponsors: Colorado Geological Survey; Colorado Scientific Society; Coalition for the Upper South Platte. Leaders: Peter Barkmann; Marieke Dechesne; Edward J. Sterne; Karen J. Houck.

429. Large Hydrothermal Systems above the Yellowstone Magma Chamber. Five days: Thurs.–Mon., 29 Sept.–3 Oct. Leaders: Lisa A. Morgan; W.C. Pat Shanks; Robert A. Sohn. 430. New Perspectives on a 140-Year Legacy of Mining and Abandoned Mine Cleanup in the San Juan Mountains, Colorado. Four days: Thurs.–Sun., 29 Sept.–2 Oct. Cosponsors: U.S. Geological Survey Central Mineral and Environmental Resources Science Center; Navarro Research and Engineering Inc. (contractor to the U.S. Department of Energy Office of Legacy Management). Leaders: Douglas B. Yager; Raymond H. Johnson; David L. Fey.

431. **Slime, Redbeds, and Evaporites in an Eolianite Sandwich: The Permian-Triassic of Colorado & Southeastern Wyoming.** One day: Thurs., 29 Sept. Leaders: James W. Hagadorn; Karen R. Whiteley; Bonita L. Lahey; Woods J. Alee.

432. Conodonts and Early Fish in Colorado's Shallow, Early Paleozoic Seas. One day: Thurs., 29 Sept. Leaders: F. Nicole Peavey; Ivan J. Sansom Sr.

433. Sandstones and Utah's Canyon Country: Deposition, Diagenesis, Exhumation, and Landscape Evolution. Four days: Thurs.–Sun., 29 Sept.–2 Oct. Cosponsor: SEPM (Society for Sedimentary Geology). Leaders: David B. Loope; Richard M. Kettler; Peter W. Reiners; Kendra Murray; Joel L. Pederson.

434. U.S. Geological Survey Collections: Understanding the Past to Create a Future—Tour Three Federal Repositories, Paleontological Collections, Core Research Center, National Ice Core Laboratory. One day: Thurs., 29 Sept. Cosponsor: U.S. Geological Survey. Leaders: Natalie E. Latysh; Kevin C. McKinney.

435. How to Make the Lights Turn on with a Clap—A Tour of Colorado's Energy Grid. One day: Thurs., 29 Sept. Cosponsors: Colorado School of Mines Energy and Minerals Field Institute; Colorado Geological Survey. Leaders: Barry Martin; Tom Sladek; Karen A. Berry.

436. Contrasting Structural Setting for 1.4 Ga Granites in the Southern Sangre De Cristo Mountains, New Mexico: Evidence for Partitioned Intracratonic Deformation. Three days: Thurs.– Sat., 29 Sept.–1 Oct. Leaders: Jennifer Lindline; Howell Bosbyshell.

Associated Society Field Trip

Society of Economic Geologists (SEG)

Pre-meeting: Mineral Deposits and Geology of the Silver City Mining District and Owyhee Mountains, Southwestern Idaho. Three and a half days: arrive Tuesday evening, 20 Sept., in Silver City, Idaho, USA; depart 9 a.m. Saturday, 24 Sept. Note: This field trip begins and ends at the Boise, Idaho, USA, airport (BOI). Leaders: Jim Saunders, saundja@ auburn.edu; Matt Brueseke; Virginia Gillerman. **Register** via the **SEG** website at www.segweb.org/events.



FACULTY

3D geological models Analyzing active tectonics with LiDAR Estimating rates of groundwater recharge Ethics GPlates GPS Ground penetrating radar High-resolution site characterization InTeGrate Laser ablation split stream geochronology Matlab Microbially induced sedimentary structures pXRF, stable isotope geochemistry STEM learning and public engagement in paleontology Structure from motion (SfM) photogrammetry Teaching about climate change Temperature as a tracer Terrestrial laser scanning Tips for publishing success U-Th-Pb geochronology

PROFESSIONALS

Acid rock drainage characterization Advanced sequence stratigraphy Field perspectives on vapor intrusion GIS-based mathematical modeling

STUDENTS AND EARLY CAREER PROFESSIONALS

Preparing for a career in the geosciences Scientific integrity and geoethics Seismic methods Sequence stratigraphy Structure and stratigraphy of basin exploration

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K–12 TEACHERS

Anthropocene Evolution of life and Earth Teaching tectonic motions and earthquakes Using digital technology in the classroom

Details and course descriptions: community.geosociety.org/gsa2016/science-careers/courses



This is a great opportunity to earn continuing education credits!



Impact the Future of Geoscience: Volunteer for Service on a GSA Committee

Deadline: 15 June 2016

Terms begin 1 July 2017 (unless otherwise indicated)

If you are looking for the opportunity to work toward a common goal, give back to GSA, network, and make a difference, then we invite you to volunteer (or nominate a fellow GSA member) to serve on a Society committee or as a GSA representative to another organization.

Key: B—meets in Boulder or elsewhere; E—communicates by phone or electronically; M—meets at the Annual Meeting; T— extensive time commitment required during application review period (15 Feb.–15 Apr. 2017).

Learn more and access the nomination form at **www.geosociety. org/aboutus/committees/.** Use the online form or download a hard copy and mail it to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA; fax: +1-303-357-1074; pfistell@ geosociety.org.

ACADEMIC AND APPLIED GEOSCIENCE RELATIONS COMMITTEE

Vacancies: Two members-at-large (industry-related field) three-year terms (E, M)

What it does: Strengthens and expands relationships between GSA members in the applied and academic geosciences and proactively coordinates GSA's effort to facilitate greater cooperation between academia, industry, and government geoscientists. **Qualifications:** Volunteers should work in academia, industry, or government and be committed to developing a better integration of applied and academic science in GSA meetings, publications, short courses, field trips, and education and outreach programs. Members must also be active in one or more GSA Division. Professional interests: environmental and engineering geology; hydrogeology; karst; Quaternary geology and geomorphology; structural geology and tectonics; and sedimentary geology.

ANNUAL PROGRAM COMMITTEE

Vacancies: One member-at-large three-year term; one student member-at-large two-year term (B, E, M)

What it does: Develops a plan for increasing the quality of the Annual Meeting and other Society-sponsored meetings in terms of science, education, and outreach; evaluates the technical and scientific programs annually to identify modifications necessary for accomplishing GSA's long-range goals; conducts short and long-range planning for the GSA meetings as a whole; and develops a long-term logistical plan/strategy for the technical programs of all GSA meetings and other Society-sponsored meetings.

ARTHUR L. DAY MEDAL AWARD COMMITTEE

Vacancies: Two member-at-large three-year terms (E, T) **What it does:** Selects candidates for the Arthur L. Day Medal **Qualifications:** Volunteers should have knowledge of people who have made distinct contributions to geologic knowledge through the application of physics and chemistry to solve geologic problems.

DIVERSITY IN THE GEOSCIENCES COMMITTEE

Vacancies: Two member-at-large three-year terms; one student member-at-large three-year term (E, M)

What it does: Provides advice and support to GSA Council; initiates activities and programs that will increase opportunities for people of ethnic minority, women, and persons with disabilities; raises awareness in the geosciences community of the positive role these groups play within the geosciences; and recruits and promotes positive career development for these groups. **Qualifications:** Volunteers must be familiar with the employment issues these groups face; expertise and leadership experience in such areas as human resources and education is helpful.

EDUCATION COMMITTEE

Vacancies: One graduate student two-year term; one member-atlarge four-year term; one two-year college faculty member fouryear term; and one pre-college educator (K–12) four-year term (B, E, M)

What it does: Works with GSA members representing a wide range of education sectors to develop informal, pre-college (K–12), undergraduate, and graduate earth-science education and outreach objectives and initiatives.

Qualifications: Volunteers must have the ability to work with other interested scientific organizations and science teachers' groups.

GEOLOGIC MAPPING AWARD COMMITTEE

Vacancy: One member-at-large (industry-related field) three-year term (E)

What it does: Generates, receives, and evaluates candidates for the Geologic Mapping Award. This award acknowledges contributions in published, high-quality geologic mapping that led the recipient to publish significant new scientific or economicresource discoveries, and to contribute greater understanding of fundamental geologic processes and concepts. The objective is to encourage training and support toward the production of excellent, accurate, detailed, purposeful geologic maps and cross sections.

GEOLOGY AND PUBLIC POLICY COMMITTEE

Vacancies: Two member-at-large three-year terms; one international representative (citizen outside of the U.S.) three-year term (B, E, M)

What it does: Provides advice on public policy matters to GSA Council and GSA leadership by monitoring and assessing international, national, and regional science policy; formulating and recommending position statements; and sponsoring topical white papers. This committee also encourages the active engagement in geoscience policy by GSA members.

Qualifications: Members should have experience with publicpolicy issues involving the science of geology; the ability to develop, disseminate, and translate information from the geologic sciences into useful forms for the general public and for GSA members; and familiarity with appropriate techniques for the dissemination of information.

JOINT TECHNICAL PROGRAM COMMITTEE

Vacancy: One member-at-large (marine coastal geology field) two-year term starting 1 Dec. 2016 through 30 Nov. 2018 (E) What it does: Helps finalize the technical program for GSA's annual meetings by participating in the Web-based selection and scheduling of abstracts, as well as topical session proposal review. Qualifications: Members must have access to computers and the Web, be a specialist in one of the specified fields, and be available in late July to mid-August for organization of the annual meeting technical program.

MEMBERSHIP COMMITTEE

Vacancies: One member-at-large (academia); one member-atlarge (industry-related field); and one student member-at-large; three-year terms (B)

What it does: This committee draws its members from academia, industry, and government; contributes to the growth of GSA membership; and attends to the changing needs of Society members by focusing on attracting and retaining students, professionals working in industry, and those studying and working outside the United States. This committee also reviews and makes Fellow recommendations to Council.

Qualifications: Members should have experience in benefit, recruitment, and retention programs.

NOMINATIONS COMMITTEE

Vacancies: Two member-at-large three-year terms (B, E) What it does: Recommends nominees to GSA Council for the positions of GSA Officers and Councilors, committee members, and Society representatives to other permanent groups. Qualifications: Members must be familiar with a broad range of well-known and highly respected geoscientists.

PENROSE CONFERENCES AND THOMPSON FIELD FORUMS COMMITTEE

Vacancy: One member-at-large three-year term (E) What it does: Reviews and approves Penrose Conference and Thompson Field Forum proposals and recommends and implements guidelines for the success of these meetings. Qualifications: Committee members must be past conveners of a Penrose Conference or Thompson Field Forum.

PENROSE MEDAL AWARD COMMITTEE

Vacancies: Two member-at-large three-year terms (E) **What it does:** Selects candidates for the Penrose Medal Award. Emphasis is placed on eminent research in pure geology that marks a major advance in the science.

Qualifications: Members should be familiar with outstanding achievers in the geosciences worthy of consideration for the honor.

PROFESSIONAL DEVELOPMENT COMMITTEE

Vacancies: Two member-at-large three-year terms (E) What it does: Directs, advises, and monitors GSA's professional development program; reviews and approves proposals; recommends and implements guideline changes; and monitors the scientific quality of courses offered.

Qualifications: Members must be familiar with professional development programs or have adult education teaching experience.

GSA PUBLIC SERVICE AWARD COMMITTEE

Vacancy: One member-at-large three-year term (E) **What it does:** Generates, receives, and evaluates candidates for the GSA Public Service Award and the AGI Outstanding Contribution to the Public Understanding of the Geosciences Award, which are given in recognition of outstanding individual contributions to either public awareness of the earth sciences, or the scientific resolution of earth-science problems of significant societal concern.

PUBLICATIONS COMMITTEE

Vacancy: One member-at-large four-year term (B, E, M) **What it does:** Nominates candidates for editorship when positions become vacant; reviews the quality and health of each GSA publication; and provides an annual report to Council that includes recommendations for changes in page charges, subsidies, or any other publishing matter on which Council must make a decision.

RESEARCH GRANTS COMMITTEE

Vacancies: Nine member-at-large three-year terms (B, T) **What it does:** Evaluates student research grant applications and selects grant recipients.

Qualifications: Members should have experience in directing research projects and in evaluating research grant applications. **Extensive time commitment required** 15 Feb.–15 Apr. 2017.

RESEARCH GRANTS COMMITTEE—ALTERNATES

Vacancies: Ten alternate member-at-large three-year terms (B, T) **Why:** The alternate member will be called upon to review research grant applications on an "as-needed" basis if the number of submitted grant applications increases significantly in any given year.

YOUNG SCIENTIST AWARD (DONATH MEDAL) COMMITTEE

Vacancy: One member-at large three-year term (E) **What it does:** Investigates the achievements of young scientists who should be considered for this award and makes recommendations to GSA Council.

Qualifications: Members should have knowledge of young scientists with outstanding achievement(s) in contributing to geologic knowledge through original research that marks a major advance in the earth sciences.

GSA INTERNATIONAL

Vacancies: Coordinator, International Travel Grants and Awards Program; International Representative to Geology & Public Policy Committee; International Representative to the Joint Technical Program Committee; Chair, International Distinguished Lectureship; and Chair, International Interest Group; all are 4-year terms (E, M)

What it does: GSA International is GSA's coordination and communication resource seeking to promote, create, and enhance opportunities for international cooperation related to the scientific, educational, and outreach missions shared by GSA and likeminded professional societies, educational institutions, and government agencies. Members will help build collaborative relationships with GSA Divisions and Associated Societies on international issues and serve as channel for member generated proposals for international themes.

GSA REPRESENTATIVE TO AAPG PUBLICATION PIPELINE COMMITTEE

Vacancy: One GSA Conferee three-year term (M, B) **What it does:** Collects a broad spectrum of geological reference materials from the U.S. and Canada and distributes them overseas to universities in developing nations where they will be put to good use.

Committee, Section, and Division Volunteers:

Council Thanks You!

GSA Council acknowledges the many member-volunteers who, over the years, have contributed to the Society and to our science through involvement in the affairs of the GSA. Your time, talent, and expertise help build a solid and lasting Society.



Why GSA Membership Is Important to Me



Catherine Smith on the *RV/IB Nathaniel B. Palmer* offshore of the Sabrina Coast, East Antarctica.

Being a member of GSA has been integral to my professional development as a graduate student at the University of South Florida–College of Marine Science (USF-CMS). The 2014 GSA Annual Meeting in Vancouver was my first scientific meeting, and it really opened my eyes to the importance of networking with other geoscientists in sessions, in the poster hall or in the coffee line.

The next year, I was able to meet fellow palynologists at the poster session at the 2015 Annual Meeting in Baltimore as I presented the preliminary results from my master's project. I had fruitful discussions at my poster with multiple palynologists and got to enjoy dinner and a beer with other geoscientists who have helped me and will help me academically and professionally.

GSA has provided me with more than just the opportunity to attend annual meetings; I've also benefitted from various funding and volunteer opportunities. As a GSA member, I applied for and received a GSA Graduate Student Research Grant, which funded additional palynology slides that are essential to my master's thesis. Furthermore, I recently became the GSA Campus Representative for USF-CMS, which allows me to serve as a source of information for students and faculty about GSA membership, meetings, funding, and volunteer opportunities.

My advice to all geoscience students is to attend GSA annual and sectional meetings, apply for student and conference travel grants, and be an active member. You never know when you are going to meet someone who can help you—I talked to someone in the coffee line at the 2015 meeting and now I am writing this testimonial!

Catherine Smith

Master's Student, University of South Florida–College of Marine Science GSA Member Since 2013



Gullfoss, an amazing EarthCache site in Iceland.

EarthCaching—How You Can Get Involved

Matt Dawson, Program Officer, GSA Education & Outreach

Engaging the public in geoscience can be a challenge. What is even more of a challenge is having them experience geology in the field with nothing more than a few pages of notes. Yet EarthCaching has them doing exactly that at more than 20,500 sites around the globe.

We want to add more sites and we can do that best with your help.

EarthCache[™], a program developed and coordinated by The Geological Society of America (GSA), is part of the highly successful worldwide treasure-hunt phenomenon known as geocaching. The game is based around the use of a GPS receiver to find a location where other people have hidden a container. Participants will find a log book and many small treasures inside the container—they sign the log book, trade trinkets, then put the container back in the same place. Afterward, they log the experience online.

In EarthCaching, however, there is no container—Earth itself provides the treasure. Visitors to EarthCaches are asked to undertake an educational geology–based task to both expand their own knowledge and to prove that they visited the site. They then log their visit on the geocaching website.

EarthCaching started in 2003 when a GSA member mentioned during the annual meeting that GSA should somehow get involved in geocaching. Within a few months, GSA partnered with the geocaching company Groundspeak, Inc., and the National Park Service established a set of guidelines for the creation of EarthCaches, setting up three trial sites. From these three, one in Australia and two in Colorado, and with the help of many hundreds of individual cachers, there are now well over 20,500 EarthCache sites in more than 167 countries. These sites have been visited by more than 6.3 million people, and the number is rising exponentially.

EarthCaches can be developed by anyone in the community through the geocaching website **www.geocaching.com** using a set of guidelines found at **community.geosociety.org/ earthchache/home.** The ideal sites are ones that laypeople can visit to learn about some interesting geological phenomenon not only by observing it but also by undertaking a task that gets them more involved in the science. For example, people might be taken to a road cut that shows a dramatic normal fault. The geocacher could be asked to work out the fault displacement by observing a distinctive layer that is offset. Another example might be to ask a visitor at a fossil location to measure the size of the fossils and work out an average size.

How can you help?

We are looking for GSA members who would like to get involved by developing EarthCache sites for the general public and in other EarthCache-related projects. To get started, just complete the simple online form at http://bit.ly/1PnwSxl and we'll email our booklet "EarthCaching—A Guide for GSA Members" to you. It outlines how to help us make this program grow.

GSA will host the 5th International EarthCache Event (5IEE) on Saturday, 24 Sept. 2016, at the Colorado Convention Center in Denver, Colorado, USA. This event is just before the GSA Annual Meeting, so we invite you to come and learn even more about EarthCache.

National Park Service Geoscientists-In-the-Parks (GIP) Opportunities

FALL/WINTER 2016-2017

The NPS GIP program places college students and early career professionals (18–35 years old) in National Park Service units for three months to one year to assist with geology and integrated science projects. This program is a partnership between the National Park Service, the Geological Society of America, and Environmental Stewards. Opportunities for fall/winter are posted online and open for applications. **Deadline: 1 July.**

http://rock.geosociety.org/ g_corps/index_gip.htm









GeoCorps[™] America



FALL/WINTER 2016-2017

The next GeoCorps America fall/winter season runs from September 2016 through May 2017. All fall/winter GeoCorps positions are posted on the GeoCorps website and open for applications. **Deadline: 1 July.**

GeoCorps provides paid geoscience opportunities in partnership with government agencies and other organizations committed to science and stewardship, including the U.S. Forest Service and the Bureau of Land Management (BLM). All levels of geoscientists—students, educators, professionals, retirees, and others—are encouraged to apply.

www.geosociety.org/geocorps





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Geoscience Jobs & Opportunities

 Ads (or cancellations) must reach the GSA advertising office no later than the first of the month, one month prior to the issue in which they are to be published. Contact advertising@ geosociety.org, +1.800.472.1988 ext. 1053, or +1.303.357.1053.
All correspondence must include complete contact informa-

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Positions Open

RESEARCH ASSISTANT PROFESSOR MICROPALEONTOLOGY, DEPARTMENT OF GEOLOGICAL SCIENCES UNIVERSITY OF FLORIDA

The Department of Geological Sciences, University of Florida in association with the Florida Museum of Natural History, invites applications for a Research Assistant Professor with expertise in micropaleontology, especially Foraminifera. The successful candidate will be expected to improve the stratigraphic and systematic microfossil collections at the Florida Museum of Natural History, develop independent research projects utilizing those collections, and teach one undergraduate paleontology course and one other course as appropriate per academic year. This is a twelve-month, full-time, non-tenure track position. It is renewable annually upon successful review, with an expected maximum term of three years. A Ph.D. in geology or a closely related field is required. The salary is competitive and commensurate with qualifications and experience, and includes a full benefits package.

For additional information, please contact Dr. John Jaeger, Department of Geological Sciences, University of Florida, P.O. Box 112120, Gainesville, FL 32611-2120. Review of applications will begin immediately and will continue until the position is filled. Candidates must apply online at http:// explore.jobs.ufl.edu/cw/en-us/listing/ Job Requisition #496762. For full consideration, the application should include: (1) cover letter, (2) curriculum vitae, (3) statement of research and teaching experience and goals; and (4) the names of three colleagues who might be contacted for letters of recommendation.

The selected candidate will be required to provide an official transcript to the hiring department prior to employment. A transcript will not be considered "official" if a designation of "Issued to Student" is visible. Degrees earned from an educational institution outside of the United States must be evaluated by a professional credentialing service provider approved by the National Association of Credential Evaluation Services (NACES), which can be found at http://www.naces.org/.

The University of Florida is an Equal Opportunity Institution. If an accommodation due to a disability is needed to apply for this position, please call (352) 392-2477 or the Florida Relay System at (800) 955-8771 (TDD). The selection process will be conducted under the provisions of Florida's "Government in the Sunshine" and Public Records laws. Check out the Job Board for the latest recruitment postings.





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Geoscience Jobs

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Late Jurassic Margin of Laurasia— A Record of Faulting Accommodating Plate Rotation

edited by Thomas H. Anderson, Alexei N. Didenko, Cari L. Johnson, Alexander I. Khanchuk, and James H. MacDonald Jr.

Fast-paced and complex extensional and contractional deformation, between 170 and 148 Ma, along the margin of Laurasia coincides with ocean-floor formation within basins, such as the central Atlantic, the Gulf of Mexico, the Great Valley of California, the Mediterranean Sea, and the southern Caspian Sea. Along the western margin of North America, numerous basins that formed in the Middle Jurassic and continued throughout the Late Jurassic, contemporaneous and co-genetic with igneous activity, are kinematically compatible with sinistral strike-slip fault movement, suggesting a transtensional origin. Comparable basins are postulated to have developed in Russia, Mongolia, China, and Iran. Domains of contractional deformation, attributed to transpression, such as the Blue Mountains (Oregon, USA), the Chersky collision belt (Siberia, Russia), and the early Yinshan foldthrust belt (northern China), interrupt the belt of Late Jurassic basins. The tectonic evolution that is characterized by linkages among faults and fault-related structures along the margin of the Laurasian plate may be interpreted as recording plate rotation during the breakup of Pangea.

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EXECUTIVE DIRECTOR, AMERICAN GEOSCIENCES INSTITUTE

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The Search Committee invites applications for the position of Executive Director for the American Geosciences Institute (AGI).

The Executive Director conducts the affairs of the Institute, with direction from the Executive Committee, including administering all planning and policies, supervising AGI staff and coordinating the various activities, projects and programs of the Institute. The Executive Director maintains and fosters relationships with the officers and administrators of the 51 AGI member societies, international and regional associates, and with other geosciences and science-related organizations in addition to academia, government agencies, and industry representatives.

The ideal candidate will be an established scientist who has demonstrated leadership and vision in their field; possesses proven senior management and budgetary experience and excellent interpersonal skills; and has a record of success as a fundraiser for not-for-profits. The successful applicant must have the ability to communicate effectively across the scientific community, academia, industry, government and the public.

An earth sciences background is highly desirable. An advanced degree is preferred. The successful candidate must be willing to relocate to the Washington DC area and to fulfill the demands of frequent travel.

A Position Description is available at http://www.americangeosciences. org/executive-director-search/ position-description.



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Interested persons are invited to submit a resume, an expression of interest, and a list of five references. Submission may be made via email to **executive-director**search@americangeosciences.org or by mail to the address below. Review of applications will begin April 2016.

Chair, Search Committee American Geosciences Institute 4220 King Street Alexandria, VA 22302

Applications and inquiries will receive confidential consideration. AGI is an equal-opportunity employer.



Special Paper 513



CALL FOR NOMINATIONS

2017–2018 GSA OFFICERS & COUNCILORS

Deadline: 15 June

The GSA Committee on Nominations requests your recommendations for GSA Officers (Vice President/President-Elect and Treasurer) and Councilors to serve beginning in 2017. Each nomination should be accompanied by basic data and a description of the individual's qualifications.

You can access the online nomination form at **www.geosociety.org/aboutus/ officers.htm** or you may send nomination materials to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA, pfistell@geosociety.org.



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GSA FOUNDATION

John W. (Jack) Hess, GSA Foundation President

Update

Encouraging Diverse Young Geoscientists

In just three years since its launch, GSA's On To the Future Program (OTF) has attracted students and mentors and created an ongoing community of past participants who remain engaged with GSA and persevere in the geosciences. OTF affirms GSA's commitment to involve groups who are underrepresented in the geosciences through partial travel grants to graduate and undergraduate students to attend their first Annual Meeting, covering the costs of meeting registration and one-year GSA membership.



Gift Ntuli, 2013 OTF recipient.



Kayla Salazar, 2014 OTF participant.



Timothy Shin, OTF donor.

Gift Ntuli was eager to attend the Annual Meeting to learn about geoscience research and explore career options but had been nervous to do so. At the meeting, he was able to explore graduate programs and career opportunities without the added cost of visiting institutions, and he felt prepared thanks to the OTF student gatherings each day of the meeting. "The program coordinators continue to send informative newsletters with new opportunities. Therefore, OTF is not a one-time program. Instead, it is a continual process, which commences by attending the meeting and proceeds throughout one's professional development in the geosciences." Gift graduated from Colby College and went on to receive the ExxonMobil/GSA Bighorn Basin Field Camp Award. He is now at Baylor University in the geophysics master's program and spent last summer as an intern with Sandridge Energy. We are eager to watch the continued progression for this young, successful geoscientist.

Kayla Salazar did not know of another geology major in her community college and was seeking career guidance. Her experience at GSA led her to engineering geology and after attending the meeting, she says, "I am now able to captivate job interviewers with my newly gained confidence and professionalism. I have realized that being a woman in geology truly is possible with hard work and perseverance. I was able to gain an internship working for the city of Sacramento in their engineering department. The OTF program sets up for nothing less than success and my newly gained internship is proof of that." **Timothy Shin** received GSA travel grants and awards to present research at the meeting before On To the Future existed; he was also impacted by his attendance at the meeting and invited to speak to GSA's Diversity in the Geosciences Committee on how to improve minority participation. He strongly recommended research and travel grants for students who could not otherwise come to the meeting. From this discussion, OTF was born. We are proud and honored that upon graduation, when Shin was hired as a geologist at Hess and his wife at ExxonMobil, they "felt it was our duty to give back to GSA and make sure other students got the opportunities we did."

We invite you to join the meaningful example of Timothy and his wife in their committed, generous support of On To the Future.

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Initiated in 2013 On To the Future celebrates the growing diversity of the GSA community and the importance of GSA's student membership



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