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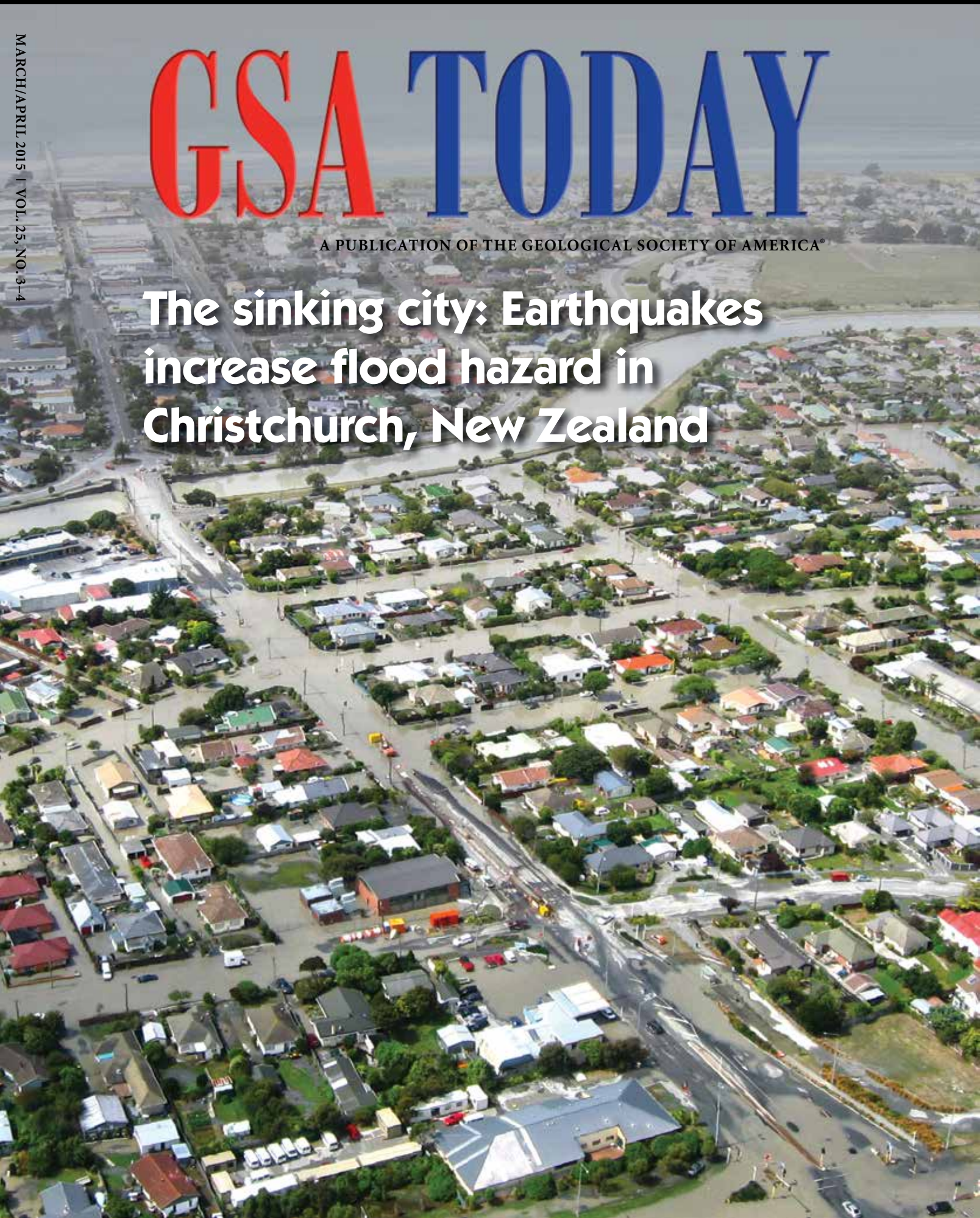
The sinking city: Earthquakes increase flood hazard in Christchurch, New Zealand



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Featured Article

SCIENCE ARTICLE:

Cover: Aerial view of the suburbs of Bexley and New Brighton in eastern Christchurch, New Zealand, looking east to the Pacific Ocean on the day after the 22 February 2011 M_w 6.2 Christchurch earthquake. Expulsion of sand and groundwater during earthquake-induced liquefaction and related surface subsidence of >30 cm caused flooding in this area and increased long-term flood hazard. Residential dwellings built in Bexley until 2005 (shown in foreground) are being demolished, and the land has been purchased and "Red Zoned" by the New Zealand central government. Photo by M.C. Quigley. See related article, p. 4–10.

GSA News

The sinking city: Earthquakes increase flood hazard in Christchurch, New Zealand

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ABSTRACT

Airborne light detection and ranging (LiDAR) data were acquired over the coastal city of Christchurch, New Zealand, prior to and throughout the 2010 to 2011 Canterbury Earthquake Sequence. Differencing of pre- and post-earthquake LiDAR data reveals land surface and waterway deformation due to seismic shaking and tectonic displacements above blind faults. Shaking caused floodplain subsidence in excess of 0.5 to 1 m along tidal stretches of the two main urban rivers, greatly enhancing the spatial extent and severity of inundation hazards posed by 100-year floods, storm surges, and sea-level rise. Additional shaking effects included river channel narrowing and shallowing, due primarily to liquefaction, and lateral spreading and sedimentation, which further increased flood hazard. Differential tectonic movement and associated narrowing of downstream river channels decreased channel gradients and volumetric capacities and increased upstream flood hazards. Flood mitigation along the large regional Waimakariri River north of Christchurch may have, paradoxically, increased the long-term flood hazard in the city by halting long-term aggradation of the alluvial plain upon which Christchurch is situated. Our findings highlight the potential for moderate magnitude (MW 6–7) earthquakes to cause major topographic changes that influence flood hazard in coastal settings.

INTRODUCTION

Approximately 10% of the world's population inhabits low-lying (≤10 m above sea level) coastal areas, and most of this population is contained within densely populated urban centers (McGranahan et al., 2007). Cities constructed on low-lying coastal and river plains are highly vulnerable to ocean-sourced hazards (e.g., sea-level rise, storm surges, tsunamis) and terrestrial hazards (e.g., surface subsidence and compaction, flooding, erosion, sediment supply changes, groundwater table changes) induced by natural and/or anthropogenic processes (Syvitski et al., 2009; Nicholls and Cazenave, 2010). Coastal population growth and concentration, economic development, and urbanization are expected to greatly increase exposure and loss to the impacts of relative sea-level rise (Nicholls and Cazenave, 2010; IPCC, 2014) and coastal flooding (Hanson et al., 2011; Hallegatte et al., 2013) through the next century, defining one of society's greatest challenges. Geospatial data, such as satellite-based synthetic aperture radar and airborne light detection and ranging (LiDAR), are increasingly being used to measure surface subsidence and delineate areas prone to flood and sea-level rise hazards (Dixon et al., 2006; Wang et al., 2012; Webster et al., 2006), thereby assisting land-use planning and management decisions (Brock and Purkis, 2009).

Great (MW ≥ 8.5) earthquakes on subduction zones may cause abrupt and dramatic elevation changes to coastal environments. The 1964 MW 9.0 Alaska earthquake caused tidal marshes and wetlands to subside up to 2 m (Shennan and Hamilton, 2006); the 2005 MW 8.7 Nias earthquake caused up to 3 m in coastal uplift proximal to the trench and 1 m of more distal coastal subsidence (Briggs et al., 2006); and the 2011 MW 9.0 Tohoku earthquake caused subsidence up to 1.2 m along the Pacific Coast of northeastern Japan (Geospatial Information Authority of Japan, 2011, cited in IPCC, 2014). However, the influence of moderate magnitude (i.e., MW 6–7) earthquakes, which can occur in both interplate and intraplate settings, on coastal flood and sea-level hazards is not well characterized and not typically included in studies that assess the future vulnerability of coastal populations (McGranahan et al., 2007).

In this paper, we summarize differential vertical and horizontal ground movements in Christchurch, New Zealand, using airborne LiDAR survey data captured prior to, during, and after the 2010 to 2011 Canterbury Earthquake Sequence (CES). Differential LiDAR applications in earthquake studies have been used to map deformation along fault zones (e.g., Duffy et al., 2013; Oskin et al., 2012); however, this is the first differential LiDAR study showing the cumulative surface effects of earthquake shaking and faulting on an urban environment. Here we show that earthquakes sourced from blind and/or previously unrecognized faults, in addition to those from known seismic sources, have the ability to create profound landscape changes that impact current and future flood hazards associated with urban rivers and relative sea-level

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rise. We also highlight the complex interactions within coexisting natural and built environments, where anthropogenic activities designed to mitigate regional flood hazard may deprive subsiding coastal areas of replenishing sediment that would have provided natural mitigation of coastal and flooding hazards.

GEOLOGY AND GEOMORPHOLOGY OF CHRISTCHURCH, NEW ZEALAND

Christchurch (population ~350,000 at latest census) is located on the eastern coast of New Zealand's South Island, adjacent to the Pacific Ocean. Previously a seasonal resource-gathering area for Maori, development of the built environment began with English colonial settlement in the 1850s. Most of the city resides upon late Quaternary alluvial sediments derived from Mesozoic quartzo-feldspathic metasediments (graywackes and argillites) in source catchments in the Southern Alps. The city is bounded to the south by Banks Peninsula, comprised largely of Neogene volcanic rocks, and to the north by the large, braided Waimakariri River. Two smaller spring-fed tidally influenced rivers, the Avon and Heathcote, flow through the city into the Avon-Heathcote Estuary and out to Pegasus Bay via an inlet to the south (Fig. 1).

Following the last deglaciation, marine transgression reached its furthest inland extent ~10 km west of the modern coastline ca. 6.5 ka (Brown and Weeber, 1992). Since 6.5 ka, the coastline in the vicinity of central Christchurch has prograded through episodic coastal and alluvial deposition, fed by sediments from the continental shelf and Waimakariri River. Basher et al. (1988) give a comprehensive geomorphologic overview of Waimakariri alluvial fan evolution over the Holocene. The lower floodplain comprises a set of nested alluvial fans with each fanhead lower and farther downstream than the previous one. Fan-building occurred in response to channel incision of older fans upstream and by sediment from basin headwaters. Significant river avulsion has occurred periodically as a result of river sediment bed-load overtopping natural channel levees, leading to the river mouth using the Avon-Heathcote Estuary at least several times over the past 6.5 ka. This includes avulsion north and south of Banks Peninsula several times through the Holocene, with the latest northward migration commencing in the last millennium (Soons et al., 1997; McFadgen and Goff, 2005) (Fig. 1). The co-evolution of floodplain and coastal landscapes produced significant spatial heterogeneity in Holocene sediments underlying Christchurch, with alluvial gravels dominating the west of the city and coastal dunes and estuarine/tidal wetland sediments dominating the east, with finer alluvial overbank deposits from the Avon and Heathcote Rivers superimposed on these accumulations (Brown and Weeber, 1992).

Pre-CES subsidence rates across Christchurch are poorly constrained, but the dominant processes would have been long-term sediment loading and periodic settling through local and regional earthquakes. Minimum earthquake peak ground accelerations (PGA) required to initiate liquefaction manifestations at the ground surface and surface subsidence (0.1–0.2 g) have estimated return periods of 40 to 170 years for Christchurch shallow soil sites (Stirling et al., 2008). A local earthquake (M_W 4.7–4.9) in 1869 caused pervasive damage in parts of Christchurch consistent with PGA ≥0.2 g shaking (Downes and Yetton, 2012) and may have caused surface subsidence; it was reported after the earthquake that "the tide runs higher up the Heathcote River than formerly" (Weekly News, 26 June 1869).

Subsidence in the Christchurch region has been counteracted over geological time scales by sediment delivery from Waimakariri

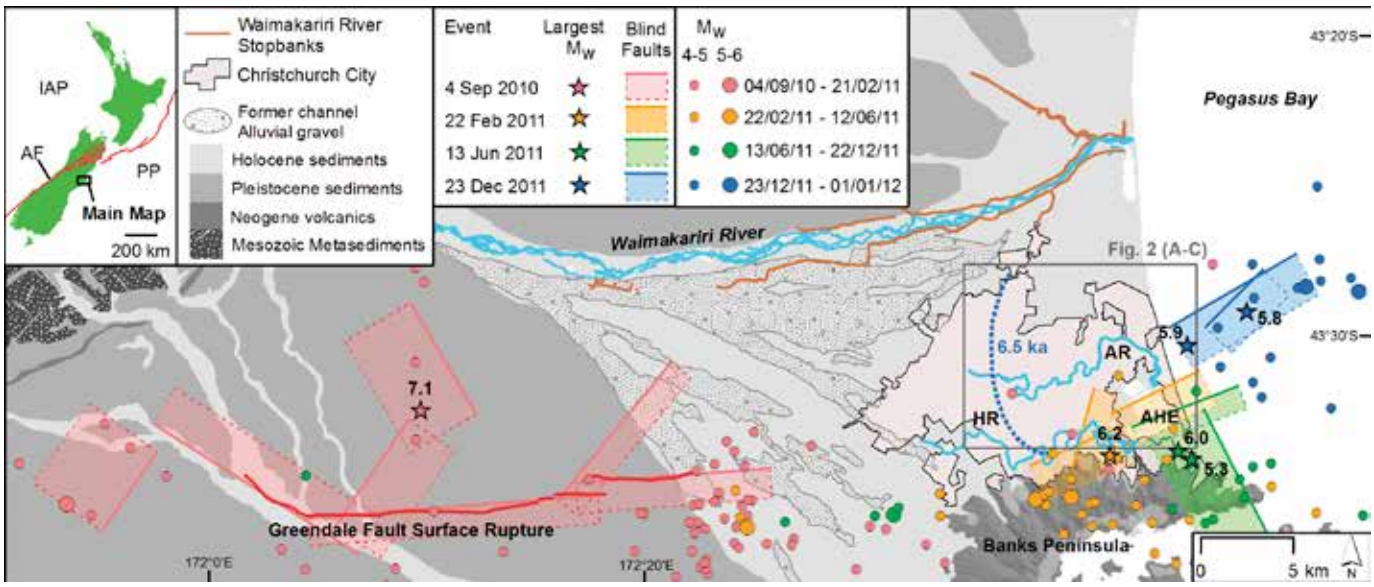

Figure 1. Geologic and seismic context of Christchurch through the 2010–2011 Canterbury Earthquake Sequence (CES). Shown are inferred causative fault planes and associated largest moment magnitudes (M_W) for events on 4 Sept. 2010, 22 Feb. 2011, 13 June 2011, and 23 Dec. 2011. Also shown are M_W 4–6 epicenters in the months following each major event. The Greendale Fault surface rupture coincident with the 4 Sept. 2010 events is shown, after Quigley et al. (2012). Also shown are the Waimakariri River with adjacent stopbanks and former channel locations evidenced by alluvial gravels, Avon River (AR), Heathcote River (HR), and Avon-Heathcote Estuary (AHE). The blue dashed line is the 6.5-ka maximum inland extent of postglacial marine transgression, after Brown and Weeber (1992). Inset map shows location of the study region in New Zealand, the Alpine Fault (AF), and wider tectonic boundary (red lines) between the Indo-Australian plate (IAP) and Pacific plate (PP).

avulsions. This natural sediment replenishment entails the rapid advance of coarse alluvium along relict and newly excavated channels, driven by high river flows and accompanied by extensive flooding. Such avulsions pose a severe physical threat to the built environment. Extensive flood protection works, including gravel extraction, were first established in 1928, with three subsequent flood events breaching the primary stopbank (levee) system, resulting in floodplain inundation. Throughout the majority of European settlement, the city has been spared from major floods from the Waimakariri, although stopbank failure remains a hazard. Christchurch has also long been vulnerable to localized flooding from its urban rivers, exacerbated by low-lying, relatively flat terrain with low gradients and high groundwater levels, extreme tides, and storm surge. Urban expansion since the 1880s imparted distinct anthropogenic signatures on local hydrology. Widespread drainage works undertaken for urban development caused ground surface subsidence due to reduction of the groundwater levels, leading to historical surface flooding and ponding in low-lying areas. In parallel, separate underground storm water and waste water systems were established, with the latter long recognized as being "leaky" —that is, allowing infiltration into pipes with associated draining of groundwater and suppression of local water tables (Wilson, 1989). The storm water system, originally integrating open channels and buried pipes and then incorporating roadside gutters, was developed to manage overland flow runoff exacerbated by expansion of impermeable surfaces through suburban development.

THE CES AND URBAN LANDSCAPE EVOLUTION

Between September 2010 and December 2011, Christchurch was damaged by six earthquakes: 4 Sept. 2010 (M_W = 7.1); 22 Feb. 2011 (M_W = 6.2, 185 fatalities); 13 June 2011 (two earthquakes: M_W = 5.3 at 1 p.m. and M_W = 6.0 at 2:20 p.m.) and 23 Dec. 2011 (two earthquakes: M_W = 5.8 at 1:58 p.m. and M_W = 5.9 at 3:18 p.m.) (Fig. 1; for detailed reviews of the geologic and seismic aspects of the CES, see Beavan et al., 2010, 2011, 2012a, 2012b; Duffy et al., 2013; Quigley et al., 2012; Bradley et al., 2014). The close proximity of causative faults to Christchurch generated strong ground motions (Bradley and Cubrinovski, 2011; Bradley, 2012) that caused extensive damage to residential and commercial properties (Bech et al., 2014; Fleischman et al., 2014; Moon et al., 2014) and infrastructure lifelines, particularly potable water, waste water, and road networks (Cubrinovski, et al., 2014a, 2014b, 2014c; O'Rourke et al., 2014). Much of the damage to the city's built environment was caused by widespread soil liquefaction that occurred predominantly in saturated, unconsolidated alluvial and marine fine sediments in east Christchurch, in the region of late Holocene coastal progradation. In susceptible soils with high water tables (e.g., suburbs adjacent to the Avon River), liquefaction was manifested at the ground surface in earthquakes as low as M_W 5.0 and PGAs as low as 0.08 g (Quigley et al., 2013). Less-susceptible soils required higher shaking intensities for liquefaction initiation (Tonkin & Taylor, 2013; van Ballegooy et al., 2014b). Liquefaction caused significant ground deformations, ejection of groundwater and sediments on to the ground surface, and lateral spread around rivers (Cubrinovski et al., 2014c; Quigley et al., 2013; Green et al., 2014; van Ballegooy et al., 2014b). In some areas, loadings from structures and preferential ejecta pathways through roads and buried infrastructure imparted distinct anthropogenic signatures on surface ejecta patterns.

In 2003, the Christchurch City Council commissioned an aerial LiDAR survey for hydrological modeling purposes. Following the 4 Sept. 2010 Darfield earthquake, another LiDAR survey was commissioned and flown on 5 Sept. 2010 by the New Zealand Ministry of Civil Defense and Emergency Management to quantify property subsidence and to facilitate insurance assessments and reconstruction work. Further LiDAR campaigns were flown typically one month after each subsequent major CES earthquake to provide time for ejected sand and silt to be removed from most properties and streets, so that measurements recorded ground surface level. LiDAR capture equipment had a horizontal accuracy of 0.44 to 0.55 m, with a vertical accuracy of ±0.15 m for the 2003 survey and ±0.07 m for the post-earthquake surveys. These errors exclude Global Positioning System network error and approximations within the New Zealand Quasigeoid 2009 reference surface, which has an expected vertical accuracy of ±0.07 m. From each LiDAR dataset a bare-earth 5-m-resolution Digital Elevation Model (DEM) was generated; the 5-m-resolution was determined to be optimal for interpolation of pre- and post-earthquake LiDAR ground returns in the urban environment. The accuracy of LiDAR data and bare-earth DEMs were assessed against reference geodetic survey control benchmarks and topographic surveys conducted pre-CES on roads and subdivisions at suburb-level in August 2011 and on residential properties in January 2012. These assessments showed reasonable accuracy as a whole, with hard surfaces providing smaller standard deviations of errors for roads than for residential properties, reflecting the differing roughness of the two types of terrain. Here we show total vertical elevation changes (ΔE_{Tot}), elevation changes due to liquefaction (ΔE_{Liq}), lateral ground movements due to liquefaction (ΔX_{Liq}), and vertical tectonic changes (ΔE_{Tec}) (Fig. 2). Tectonic movements were determined using satellite interferometry synthetic aperture radar data (see Beavan et al., 2011, 2012b), which we subtracted from ΔE_{Tot} as determined by LiDAR-derived DEMs to produce ΔE_{Liq}.

We also present pre-/post-earthquake differential elevation analysis (ΔE_{Tot}) for the Avon-Heathcote Estuary, based on 1-m-resolution DEMs interpolated from LiDAR data (area of bed exposed above water surface during survey), supplemented by ground survey and depth-sounder survey data for areas covered by estuarine waters during LiDAR surveys (Measures et al., 2011; Measures and Bind, 2013). Pre-/post-earthquake ground surveys and echo-sounder surveys were conducted using Real-Time Kinetic Global Navigation Satellite System positioning, on foot or with a boat-mounted depth sounder, and calibrated to local benchmarks.

The 4 September 2010 Darfield earthquake caused 74% of central and eastern Christchurch to subside; 60% of this area subsided up to 0.2 m (Fig. 2A). Vertical tectonic displacements of 0.8 to 1.8 m along the associated surface rupture ~50 km west of Christchurch caused partial river avulsion and flooding (Duffy et al., 2013). The 22 February 2011 Christchurch earthquake caused 83% of eastern and central Christchurch to subside further; 78% subsided up to 0.3 m, with localized areas exceeding 1 m. This event also caused a clear signature of tectonic uplift (~0.45 m) around the Avon-Heathcote Estuary caused by blind faults (Fig. 2A and 2E). Compared to pre-earthquake elevations, 86% of central and eastern Christchurch subsided through the CES; 10% subsided more than 0.5 m, with some localized locations exceeding 1 m. Cumulative tectonic subsidence through the CES reached 0.18 m (Fig. 2E). Both

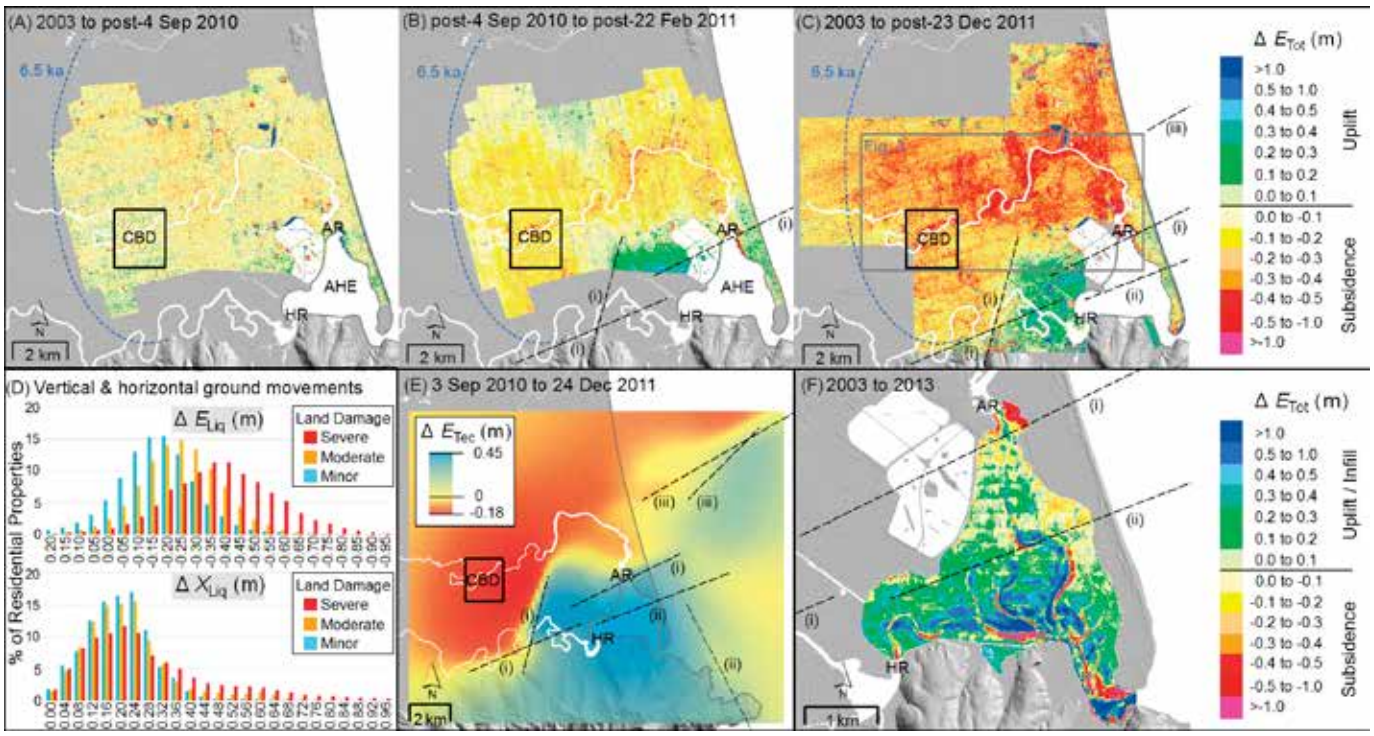

Figure 2. (A–C) Differential LiDAR models illustrating total vertical ground movements (ΔE_{Tot}) in Christchurch through the Canterbury Earthquake Sequence (CES). (A) Vertical movement from the initial 4 Sept. 2010 event. (B) Further vertical movement resulting from the 22 Feb. 2011 event. (C) Total vertical movements through the entire CES. Also shown are location of Avon River (AR) and Heathcote River (HR) mouths, the Avon-Heathcote Estuary (AHE), the Central Business District (CBD), the 6.5-ka maximum inland extent of postglacial marine transgression (blue dashed line) after Brown and Weeber (1992), and blind fault locations (black dashed lines) for 22 Feb. 2011 (i), 13 June 2011 (ii), and 23 Dec. 2011 (iii). Linear artefacts evident in (A)–(C) are due to minor elevation errors along LiDAR flight lines. (D) Histograms of LiDAR vertical (ΔE_{Liq}) and horizontal (ΔX_{Liq}) displacements classified according to observed land damage classes: ΔE_{Liq} was calculated by subtracting tectonic vertical movements (Beavan et al., 2012b) from ΔE_{Tot}. (E) Cumulative tectonic vertical movements (ΔE_{Tec}) through the CES, with blind fault locations shown. (F) Cumulative vertical movements through the CES for the AHE (ΔE_{Tot}), with blind fault locations shown. Note that linear artefacts in (F) are due to minor elevation errors due to interpolation between ground survey and depth-sounder survey transects.

vertical and horizontal ground movements evident in LiDAR-derived DEMs correlated strongly with detailed ground-based land damage observations conducted by Tonkin & Taylor Ltd. for New Zealand Earthquake Commission insurance assessments (Fig. 2D). Horizontal ground movements were recorded across the city, and areas adjacent to the Avon River experienced severe lateral spread, particularly on current and former inner meander bends and tidal wetland sediments, in places exceeding 2 m (Beavan et al., 2012a) (Fig. 3). A comparison of pre-CES and post–13 June 2011 river and floodplain cross sections, derived from a combination of direct river bed depth measurements and LiDAR data, shows floodplain subsidence and river channel narrowing and shallowing (Fig. 3, inset panels i–v) resulting from lateral spread and sedimentation from liquefaction ejecta entering waterways. Smaller cross-sectional channel areas and lower flood plains collectively reduced channel cross-sectional areas and increased flood hazard. The upper reaches of the Heathcote River are located in an area of net tectonic subsidence through the CES, and its lower reaches are in an area of uplift (Fig. 2E) that reduced river gradients. Differential elevation analysis for the Avon-Heathcote Estuary (Fig. 2F) shows that 76% of its area was uplifted during the CES, 60% of the area is in the 0–0.4 m uplift range corresponding to the cumulative CES tectonic signature, and subsidence >1 m at the Avon River mouth results from combined tectonic down-throw and liquefaction/lateral spread (Fig. 2F). In other areas, Avon-Heathcote Estuary subsidence of more than 1 m reflects natural widening or deepening of estuarine tidal channels since pre-CES surveys, and comparable upward movements reflect channel infilling. Using a calibrated hydrodynamic model (Measures and Bind, 2013), neap and spring tidal prism volumes are calculated to have reduced by 17.6% and 12.4%, respectively, with an average tidal prism reduction of 14.6%.

EARTHQUAKES, FLOODING, AND SEA-LEVEL RISE: THE PRESENT AND FUTURE

Prior to the CES, flooding was perceived as Christchurch's primary hazard (Center for Advanced Engineering, 1995). Contributors included urban rivers and streams, localized ponding of overland flow on the developed coastal plain, and drainage-induced ground settlement. In 2010 to 2011, seismically induced landscape changes significantly increased the city's flood risk. Key factors in this increase were the widespread tectonic and liquefaction-induced subsidence and alteration of the longitudinal and cross-sectional profiles and sediment regimes of urban waterways. Lowering of surface elevations relative to water tables (van Ballegooy et al., 2014a) is likely to have increased the liquefaction and flood hazard. With groundwater levels (i.e., fully saturated soils) now closer to the ground surface, there is less soil above the

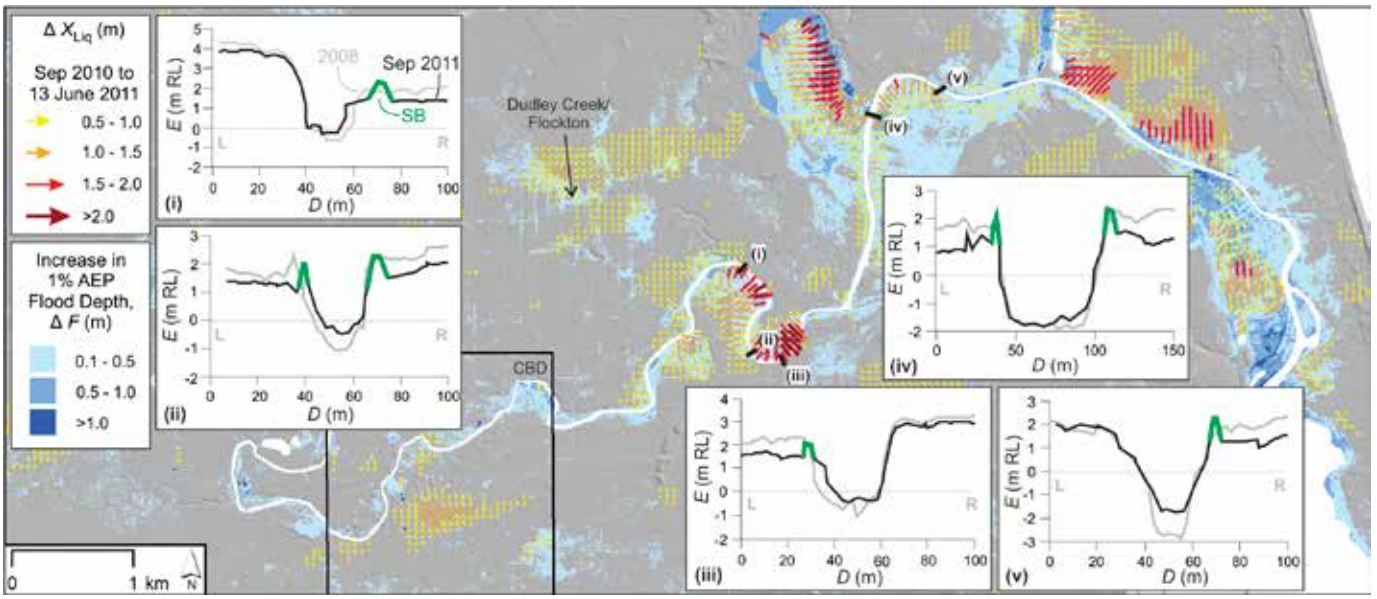

Figure 3. Main map: Cumulative horizontal movements (ΔX_{Liq}) in Christchurch in the vicinity of the Avon River from Sept. 2010 to 13 June 2011, derived from LiDAR offset analysis (Beavan et al., 2012a). Also shown: Increased 1-in-100-year storm event (1% Annual Exceedence Probability [AEP]) flood depths (ΔF) due to subsidence caused by the Canterbury Earthquake Sequence using current sea level, rainfall, and urban extent. The Christchurch Central Business District (CBD) is shown, as is the Dudley Creek/Flockton area where recent flooding of residential properties has been problematic. Inset panels: Floodplain and river cross sections (i–v) obtained from field survey and LiDAR analyses, with elevation (E) changes shown as relative level in meters (m RL) from 2008 (solid gray lines) to Sept. 2011 (black lines). Transect distance (D) is in meters (m). The locations of stopbanks (SB) constructed after the 22 Feb. 2011 Christchurch earthquake are shown in green.

water table and therefore less capacity to absorb water during storm events. Leakage of underlying artesian aquifers through breached aquitards may also have influenced local hydrologic conditions (Cox et al., 2012) and thus impacted on surface water infiltration. Another significant contributor to the increased flood hazard is widespread earthquake damage of the urban storm water network, much of which is yet to be repaired, including open channels and underground pipes that were compromised by breakages, liquefaction blockages, and gradient changes. The post-earthquake flood-scape may also have been influenced by New Zealand statutory resource management framework changes, instituted in the early 1990s, which were locally translated into a new approach of naturalizing urban waterways and reducing engineered river widening and dredging programs. Pre-1990s development of the urban floodplains that are now experiencing enhanced flood hazards was facilitated by the earlier engineering approach to the urban rivers (Canterbury Regional Council, 1993, 1997; Wilson, 1989).

In 2013, the Christchurch City Council released revised flood extents for projected 1-in-50-yr and 1-in-200-yr rainfall events using post-earthquake LiDAR-derived DEMs (CCC, 2014). The city subsequently experienced several intensive rainstorms in March 2014, resulting in widespread flooding of properties in river suburbs that in some instances exceeded historical flooding depths and spatial extents due to floodplain subsidence through the CES. Although the 1-in-50-yr models were good predictors of flooding at higher elevations, they over-predicted coastal flooding because they incorporated a future 0.5 m increase in relative sea level, a 16% increase in annual rainfall, and maximum probable urban development impacts on storm water runoff. Here we present the latest assessments of increased flood depths for a 1-in-100-yr event based on current sea level, rainfall, and urban development (Fig. 3). These flood depths were modeled using independent hydraulic modeling for watercourses and rain-on-grid for overland flows based on pre- and post-CES DEMs; our ongoing research is assessing the ability of these models to quantitatively hindcast the March 2014 flooding. The documentation of large, loss-inducing flood events following the CES has prompted an urgent and intent governmental focus on appropriate infrastructure and urban planning responses; at present, the city's post-quake flood-scape is cited as the primary concern of city authorities.

Relative sea-level rise of 0.5 to 1 m occurred in suburbs adjoining the lower Avon River and Avon-Heathcote Estuary that experienced tectonic down-throw and significant liquefaction/lateral spread subsidence through the CES. These areas have thus experienced the equivalent of several centuries of projected relative sea-level rise in the absence of land elevation changes at the current global rate of sea-level rise of 3.3 ± 0.4 mm yr^{-1} (Cazenave et al., 2014) and thus provide useful analogues for the potential impacts of sea-level rise in other settings globally. In this instance, gravel stop-banks were constructed along much of the Avon River in 2011 to temporarily mitigate the post-earthquake flood hazard (Fig. 3, inset panels i–v). More thorough measures are required, including locally tailored cost-benefit analyses of climate adaptation options (e.g. Aerts et al., 2014) and investigative analysis of urban wetlands e,cosystems (Kirwan and Megonigal, 2013) and their potential role in soft-engineering flood mitigation (Temmerman et al., 2013). Probabilistic approaches that consider future impacts from natural phenomena, including tropical and extra-tropical cyclones (Woodruff et al., 2013), earthquakes (Gerstenberger et al., 2014), and liquefaction (Quigley et al., 2013),

are important. Investigations addressing the dynamic geomorphic responses of urban rivers and coastal plains to relative sea-level rise, shoreline retreat, groundwater responses, liquefaction, subsidence, and coastal aquifer resources are all urgently required. In parallel with these scientific considerations, there also needs to be a focus on how current policies, planning, and socio-economic contexts will influence trajectories of urban form, and to what degree these will influence the exposure of current and future communities to continued flooding and sea-level rise.

The anthropogenic intervention of long-term geologic processes that previously enabled sediment aggradation to rebuild topography in this area means that subsidence will continue to dominate the topographic evolution of Christchurch. Similar scenarios, where prograding sediment has been diverted from subsiding areas, are likely to plague coastal settlements worldwide. Strong earthquakes sourced from previously unidentified and/or blind faults and their impacts on flood and relative sea levels add to the myriad of short- to long-term challenges facing coastal environments throughout the world.

Future investigations of the impacts of relative sea-level rise on coastal populations should consider the role of earthquakes, including those that may be sourced from unknown and/or proximal faults, in reshaping coastal topography and thus influencing the dynamics of coastal and flood hazards. As shown here, this is particularly important for densely populated, low-lying, and tectonically active regions built upon youthful and liquefiable alluvial and marine sediments.

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New Publication Calendar for *GSA Today*

GSA Today is published 11 times per year, and this won't change. But beginning with this issue, March and April are combined, and the May issue will stand on its own (not combined with April as in the past). *GSA Today* is making this change in order to provide more, and more up-to-date, information to you about GSA's Annual Meetings.

GSA Today is hosted and archived online at
www.geosociety.org/gsatoday/.

ELECTIONS: GSA OFFICERS and COUNCILORS

GSA ELECTIONS BEGIN 6 MARCH 2015

GSA's success depends on you—its members—and the work of the officers serving on GSA's Executive Committee and Council. Members will receive a postcard with instructions for accessing an electronic ballot via our secure website, and biographical information on the nominees will be online for you to review at that time. Paper versions of both the ballot and candidate information will also be available. Please help continue to shape GSA's future by voting on these nominees.

2015 OFFICER NOMINEES

PRESIDENT
(July 2015–June 2016)

Jonathan G. Price
Jonathan G. Price LLC
Reno, Nevada, USA

We congratulate our incoming president!

VICE PRESIDENT/PRESIDENT-ELECT
(July 2015–June 2017)

Claudia I. Mora
Los Alamos National Laboratory
Los Alamos, New Mexico, USA

TREASURER
(continuing term, July 2015–June 2016)

Bruce R. Clark
The Leighton Group Inc.
Irvine, California, USA

2015 COUNCIL NOMINEES

COUNCILOR POSITION 1
(July 2015–June 2019)

Frank Pazzaglia
Lehigh University
Bethlehem, Pennsylvania, USA

Mark Little
University of North Carolina
Chapel Hill, North Carolina, USA

COUNCILOR POSITION 2
(July 2015–June 2019)

Chuck Bailey
College of William & Mary
Williamsburg, Virginia, USA

Shuhai Xiao
Virginia Polytechnic Institute and State University
Blacksburg, Virginia, USA

COUNCILOR POSITION 3
(Divisions Liaison)
(July 2015–June 2019)

Scott Burns
Portland State University
Portland, Oregon, USA

Mary Kraus
University of Colorado
Boulder, Colorado, USA

Ballots must be submitted electronically or postmarked by 5 April 2015.

How to Successfully Apply to GSA Education & Outreach Programs

GSA offers many programs and opportunities for students and recent graduates to gain important geoscience research and career experiences. By participating in GSA's Education & Outreach (E&O) programs (listed below), you can acquire the skills, networks, and research opportunities that will prepare you for a successful career in the geosciences.

The following E&O programs are competitive and require an online application that includes a cover letter or answers to application questions along with grades and one or two letters of recommendation.

- **GeoCorps™ America** offers paid, short-term volunteer geoscience positions in public lands throughout the United States.
- **Mosaics in Science** offers paid, short-term volunteer STEM (Science, Technology, Engineering, and Mathematics) positions at National Park Service sites.
- **The GSA/ExxonMobil Bighorn Basin Field Award** is a one-week, all-expenses-paid field seminar in the Bighorn Basin of north-central Wyoming, USA, emphasizing multidisciplinary integrated basin analysis for undergraduate students, graduate students, and faculty.
- **The GSA/ExxonMobil Field Camp Scholars Program** provides twenty undergraduate students with US$2,000 each to attend the field camp of their choice based on diversity, economic/financial need, and merit.
- **On To the Future** provides partial travel assistance to diverse students who are underrepresented in the geosciences to attend their first GSA Annual Meeting.

Please visit the GSA Education & Outreach department's application home page, **https://rock.geosociety.org/eo/index.asp** (or use the QR code below), for details about all of these programs, including deadlines. Some programs are currently accepting applications, so GSA encourages you to get started on an application now.

Each of these programs offers a unique experience, and GSA encourages you to apply to and participate in as many programs as you'd like. The following are some general tips to help you with the online application processes:

1. **Before applying, carefully read through the program's eligibility requirements** to see if you are a good fit. Applications are screened, and only those that meet the eligibility guidelines are forwarded to the selection committee.
2. **Apply early!** Your application will take some time because you will need to request recommendation letter(s). Aim to complete your application at least two weeks before the deadline to avoid last-minute complications. Of course, all applications completed before the deadline are given equal consideration regardless of when they are received.
3. **You will be required to obtain one or two letters of recommendation.** This is done through the online application system. Consider who might be a good fit to write a positive recommendation for you. Once you decide whom to ask, tell him or her a bit about the opportunity and the deadline. Allow the person sufficient time to compose and submit the letter. It may be necessary to send a reminder as the deadline approaches. Even if you complete all other fields in the online application, your submission is not considered complete until your recommendation is received.
4. **Be prepared** to answer a question about how you can add to the diversity of the program.
5. **If it has been five years or fewer since you last completed a degree,** have a copy of your transcript(s) handy, because you will need to enter your relevant courses and grades into the online application. If you are chosen as an awardee, you may need to provide original transcripts to verify the information you submitted.
6. **Thoroughly review your application** for errors before you submit it and consider it complete. Make sure that you have completed every required field, check for correct spelling, and verify e-mail addresses and phone numbers. Read through your cover letter(s) to make sure all your text was saved. Each part of the application, including the cover letter, has a character limit that you should note before composing your responses.
7. **After your application is submitted,** review the program's Web page for the timeline of what comes next. You do not need to follow up with GSA; if you are selected for an interview, position, award, etc., GSA will contact you directly by e-mail to make the offer.
8. **Be persistent!** If you are not offered an award the first time you apply, GSA encourages you to apply again. GSA's E&O programs are very competitive, and many awardees are selected after applying two or more times, so don't give up!
9. **Contact the designated program officer listed on the following page** if you have questions or encounter a problem with your application. Conversely, if you won't be able to participate in the program or you decide not to participate, please contact the program officer immediately. GSA may be able to offer your spot to someone else.

On To the Future (OTF) 2015

Deadline to apply: 29 May

Diverse and underrepresented students in the geosciences are encouraged to apply to receive a travel award to attend their first GSA Annual Meeting in Baltimore, Maryland, USA, on 1–4 Nov. 2015. As an OTF scholar, you will gain exposure to an array of geoscience research, career options, and networking opportunities at GSA's Annual Meeting. You will also have the opportunity to interact with GSA leadership.

Check the OTF website for eligibility guidelines and application information: **http://community.geosociety.org/OTF/home/myhome** (or use the QR code above). If you have questions, please contact Tahlia Bear at tbear@geosociety.org.

GeoCorps™ America Fall/Winter 2015–2016

The next GeoCorps™ America fall/winter season runs from September 2015 through May 2016. All fall/winter GeoCorps positions will be posted on the GeoCorps website. Jobs will open for applications starting 1 May 2015, with an application deadline of 1 July.

GeoCorps America provides paid, short-term geoscience opportunities on public lands managed by the National Park Service, the U.S. Forest Service, and the Bureau of Land Management. All levels of geoscientists—students, educators, professionals, retirees, and others—are encouraged to apply.

Learn more at **www.geosociety.org/geocorps** (or use the QR code above) and on Facebook at **www.facebook.com/GeoCorps.**

Tahlia Bear, On To the Future, tbear@geosociety.org

Matthew Dawson, GeoCorps™ America and Mosaics in Science, mdawson@geosociety.org

Allison Kerns, GeoCorps™ America and Mosaics in Science, akerns@geosociety.org

Jennifer Nocerino, GSA/ExxonMobil Programs, jnocerino@geosociety.org

Get into the Field: GSA/ExxonMobil Awards

The importance of field schools to practicing geologists is unquestionable, yet the opportunities to experience field geology are dwindling. The Geological Society of America (GSA), in cooperation with ExxonMobil, is currently offering three programs to support and encourage field geology. This non-profit/industry collaboration has proven very successful; in 2014, more than 250 geology students and professors applied for these awards.

GSA/EXXONMOBIL BIG HORN BASIN FIELD AWARD

Application deadline: 17 April

This one-week field seminar offers 20 undergraduate and graduate students and five faculty members a chance to receive a high-quality educational experience in the spectacular Bighorn Basin of north-central Wyoming. The course is free to accepted participants, and all transportation, meals, and living expenses are covered.

The seminar is team-taught by several ExxonMobil professionals. These geoscientists represent years of research in integrated basin analysis, with specific skills in tectonics, geochemistry, structure, sequence stratigraphy, sedimentology, paleontology, hydrocarbon systems analysis, and integrated play analysis. GSA's role is to select awardees and to handle all logistics.

The seminar focuses on multidisciplinary, integrated basin analysis and enables awardees to study exposures of individual hydrocarbon system play elements, such as source, seal, reservoir, and structure, within a prolific hydrocarbon basin. For more than a century, the Bighorn Basin has been studied by academic, industry, and government geoscientists, who have focused on the exceptional outcrop exposures, as well as subsurface borehole and seismic data. Our current understanding of the basin derives from both industry and academic perspectives.

This is not, however, a course on the detailed geology of the Bighorn Basin. Instead, our objectives are to introduce the concepts of integrated basin analysis, including evaluation, prediction, and assessment of play element distribution and quality, using the Bighorn Basin as a natural laboratory. Via this laboratory, we explore the concepts, methods, and tools of petroleum geoscience that we use on a day-to-day basis in the energy industry. Our discussions on the outcrop and in the classroom focus on how we make decisions with limited data and how critical information is identified in order to evaluate risk vs. uncertainty. We also use the excellent field setting to teach fundamental geoscience skills in structure, stratigraphy, geochemistry, etc. By the end of the seminar, the teams will generate play element maps, play summary charts, cross sections, and play fairway maps. The highlight of this course is the presentation of these ideas to the group and the ensuing discussions about how these ideas and play assessments could be further developed.

Feedback we have received:

"I'd like to express my gratitude once again for excellent organization, course content and quality of the material, amazing instructors and professors at the Bighorn Basin trip! I am very impressed and truly inspired! Great thanks to all the people who made this trip possible."

"The week long field course afforded me the opportunity to learn about integrated basin analysis from top industry professionals while improving my field geology skills. Not only was the trip a highly valuable academic experience, it also introduced me to fellow students, faculty, and industry workers from across the world who share my same interest in the geosciences."

"I just wanted to thank the GSA and ExxonMobil for such an amazing experience. It is hard to explain how much last week meant to me, the time we spent in Wyoming is something I will remember for the rest of my life. The seminar has motivated me to work even harder over the next couple of years to realize my goal of being a geologist."

GSA/EXXONMOBIL FIELD CAMP SCHOLAR AWARD

Application deadline: 17 April

This award provides 20 undergraduate students with US$2,000 each to attend the field camp of their choice, based on diversity, economic/financial need, and merit. Funds for this award have been provided by ExxonMobil. Selection of awardees is completed by GSA.

Feedback we have received:

"I thank the GSA and ExxonMobil for providing funds that allowed me to attend such a life-changing camp. I am truly an enriched and better person because of it."

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Scholar Awards continued…

"I am very grateful for the generosity of GSA and ExxonMobil. The transition from a full time employee to a full time student was not as intimidating with the support and encouragement of GSA and ExxonMobil."

"Thank you for this opportunity, not only because I learned a whole new method, but also because I made many important connections that will help me to achieve a master's degree in geophysics with a scholarship."

GSA/EXXONMOBIL FIELD CAMP EXCELLENCE AWARD

Application deadline: 17 April

This award provides one geologic field camp with US$10,000 to assist with their summer program based on safety awareness, diversity, and technical excellence.

Feedback we have received:

"We are ever so thankful to GSA and ExxonMobil for thinking of us as worthy recipients of this award, and for thinking of field camps in general, and valuing what we do enough to give us praise, and money. Goodness knows most of us can use both of those!"

To apply for these awards, please visit **https://rock.geosociety.org/ExxonMobilAward/** (or use the QR code at left). Students and recent graduates must submit an online application form, two letters of recommendation and a cover letter. **Questions?** Please contact Jennifer Nocerino, jnocerino@geosociety.org, +1-303-357-1036.

COMING SOON!

GeoCareers Corner

Check out the May issue of *GSA Today* for new career development articles.

Looking for more information on a career in industry?

Want tips on how to network at national conferences?

GSA is always open to ideas about the career-related information you would like to see. Send an e-mail to **Tahlia Bear** at tbear@geosociety.org to submit your ideas.

Second Announcement

CORDILLERAN SECTION

11th Annual Meeting of the Cordilleran Section, GSA
Anchorage, Alaska, USA
11–13 May 2015

www.geosociety.org/Sections/cord/2015mtg/

View of Redoubt Volcano at sunset taken from hillside above Eagle River, Alaska, USA. A small steam plume can be seen rising from the 2009 lava dome. Photo by R.G. McGimsey, USGS-AVO.

LOCATION

The 111th annual meeting of GSA's Cordilleran Section will be held on the University of Alaska–Anchorage campus, in Anchorage, Alaska's largest and most diverse city. Situated at the base of the Chugach Mountains, Anchorage is built on glacial deposits associated with the last major ice age. The waters of Cook Inlet, a major marine embayment, surround the city on its north, west, and south sides. Turnagin Arm to the south experiences the second highest tides in North America. To the west of Anchorage, across Cook Inlet, are the Tordrillo Mountains and Mount Spurr Volcano, the closest active volcano to Anchorage. To the north are the high peaks of the Alaska Range, including Mount McKinley, the highest mountain in North America. Because of its location, Anchorage is a key international air hub in the North Pacific region as well as one of the primary gateways to the Alaskan wilderness.

REGISTRATION

Early registration deadline: 6 April 2015
Cancellation deadline: 13 April 2015

REGISTRATION FEES (all fees are in U.S. dollars)

	Early		Standard	
	Full mtg.	**1 day**	**Full mtg.**	**1 day**
Professional Member	$200	$100	$220	$105
Professional Member 70+	$115	$105	$120	$110
Professional Nonmember	$240	$200	$250	$220
Student Member	$35	$25	$40	$30
Student Nonmember	$55	$45	$80	$65
K–12 Professional	$40	$30	$45	$35
Guest/Spouse	$40	n/a	$40	n/a
Field Trip Only	$40	n/a	$40	n/a

ACCOMMODATIONS

A block of rooms has been reserved at the Hilton Anchorage, which is located in downtown Anchorage. Rate: US$129 plus tax. To make your reservation, please call +1-907-272-7411. Be sure to mention that you are attending the GSA Cordilleran Meeting, or use code **GSAC15.** Shuttle transportation to and from the meeting venue on the University of Alaska–Anchorage campus will be provided.

FIELD TRIPS

GSA invites you to join your colleagues on one or more of the following field trips. Descriptions for all field trips are online at **www.geosociety.org/Sections/cord/2015mtg/fieldTrips.htm.**

1. **Geology of the Chugach–Prince William Sound Accretionary Complex and Resurrection Ophiolite.** Cameron Davidson, Carleton College, cdavidso@carleton.edu; John Garver, Union College, garverj@union.edu. US$345.
2. **Backstage Tour of the New Alaska Geologic Materials Center.** Kenneth R. Papp, Alaska Division of Geological and Geophysical Surveys, kenneth.papp@alaska.gov; Jean Riordan, Alaska Division of Geological and Geophysical Surveys, jean.riordan@alaska.gov; Kurt Johnson, Alaska Division of Geological and Geophysical Surveys, kurt.johnson@alaska.gov. US$25.
3. **Cretaceous-Paleogene Bedrock Geology of the Matanuska Valley Area.** Ron Cole, Allegheny College, rcole@allegheny.edu; Dave Sunderlin, Lafayette College, sunderld@lafayette.edu; Jeff Trop, Bucknell University, jtrop@bucknell.edu. US$112.
4. **Stratigraphy and Sedimentology of Neogene Coal-Bearing Strata on the Kenai Peninsula, Cook Inlet, Alaska.** David LePain, Alaska Division of Geological and Geophysical Surveys, david.lepain@alaska.gov; Ken Helmhold, Alaska Division of Oil and Gas, ken.helmold@alaska.gov; Richard Stanley, USGS, rstanley@usgs.gov. US$346.
5. **Transect of the Mesozoic Subduction Complex, South-Central Alaska.** Sue Karl, USGS, skarl@usgs.gov. US$210.
6. **Volcanic Mass-Flow Deposits of the Copper River Lowland near Chitina, Alaska.** Chris Waythomas, USGS, cwaythomas@usgs.gov; Kristi Wallace, USGS, kwallace@usgs.gov. US$408.
7. **1964 Alaska Earthquake: Rebuilding Anchorage and the Choices We Made.** Kristine J. Crossen, University of Alaska–Anchorage, kjcrossen@uaa.alaska.edu. US$100.

OPPORTUNITIES FOR STUDENTS

The Roy J. Shlemon Mentor Program in Applied Geoscience, Mon., 11 May, lunchtime. Students will have the opportunity to discuss career prospects and challenges with professional geoscientists from multiple disciplines over a FREE lunch.

The John Mann Mentors in Applied Hydrogeology Program, Tue., 12 May, lunchtime. Students interested in applied hydrogeology or hydrology as a career will have the opportunity to network with professionals in these fields over a FREE lunch.

On To the Future (OTF)

Stop by the GSA Foundation booth at the welcome reception to ask an on-site representative about applying to OTF. Travel support is provided to students underrepresented in the geosciences to attend their first GSA Annual Meeting (the next one is 1–4 Nov. 2015 in Baltimore, Maryland, USA).

Travel Grants

The GSA Foundation has funds available for student travel grants. To qualify, you must be (1) the senior author and presenter of the paper; (2) a current student member of the Cordilleran Section; and (3) registered for the meeting. The application form will be available from the Corilleran Section website during the early registration period.

Volunteers

Deadline to apply: 6 April

Students are encouraged to volunteer to assist with different meeting activities including assistance in the Speaker Ready Room and at technical sessions. Students will receive free registration if they commit to their given work assignment (max. of 6 hours). Learn more on the meeting website.

Best Student Papers

The Cordilleran Section recognizes the high quality of science being presented at our meetings in general, and by our student members in particular. The section acknowledges this excellence by presenting Best Paper and Honorable Mention awards to students in each of the following four categories: Undergraduate Poster, Undergraduate Oral, Graduate Poster, and Graduate Oral. If you are a professional member and are interested in participating in evaluating these presentations, please contact the Section Chair or the Local Organizing Committee Chair (see below).

LOCAL COMMITTEE

Chair: Chris Waythomas, cwaythomas@usgs.gov

Technical Program Co-Chairs: Janet Schaefer, janet.schaefer@alaska.gov; Cheryl Cameron, cheryl.cameron@alaska.gov

Field Trip Chair: Kristine Crossen, kjcrossen@uaa.alaska.edu

Posters and Exhibits: Keith Torrance, keith.torrance@uicumiaq.com

GSA Education & Outreach Programs

2015 Section Meetings

On To the Future (OTF)

Stop by the GSA Foundation booth at your Section Welcome Reception to ask an onsite representative about applying to OTF, which provides travel support to students underrepresented in the geosciences to attend their first GSA Annual Meeting (the next one is 1–4 Nov. 2015 in Baltimore, Maryland, USA).

Career Workshops

Geoscience Career Workshop Part 1: Career Planning and Informational Interviewing

Your job-hunting process should begin with career planning, not when you apply for jobs. Part 1 of this workshop will help you begin this process and will introduce you to *informational interviewing*. This course is highly recommended to freshmen, sophomores, and juniors—The earlier you start your career planning, the better.

Geoscience Career Workshop Part 2: Geoscience Career Exploration

What do geologists in various sectors earn? What do they do? What are the pros and cons to working in academia, government, and industry? Workshop presenters, and when possible, professionals in the field, will address these issues.

Geoscience Career Workshop Part 3: Cover Letters, Résumés, and CVs

How do you prepare a cover letter? Does your résumé need a good edit? Whether you are currently on the job market or not, it's important to learn how to prepare the best résumé possible. You will review several examples to help you to learn important dos and don'ts.

Mentor Programs

Enjoy a free lunch while meeting with geoscience mentors working in the applied sector. The popularity of these programs means that space is limited, so plan to arrive early, because lunch is first-come, first-served. For further information, contact Jennifer Nocerino at jnocerino@geosociety.org.

SOUTH-CENTRAL SECTION

Stillwater, Oklahoma, USA
Shlemon Mentor Program Luncheon:
Thurs., 19 March

Mann Mentors in Applied Hydrogeology Luncheon:
Fri., 20 March

SOUTHEASTERN SECTION

Chattanooga, Tennessee, USA
Shlemon Mentor Program Luncheon:
Thurs., 19 March

Mann Mentors in Applied Hydrogeology Luncheon:
Fri., 20 March

NORTHEASTERN SECTION

Bretton Woods, New Hampshire, USA
Shlemon Mentor Program Luncheon:
Mon., 23 March

Mann Mentors in Applied Hydrogeology Luncheon:
Tues., 24 March

CORDILLERAN SECTION

Anchorage, Alaska, USA
Shlemon Mentor Program Luncheon:
Mon., 11 May

Mann Mentors in Applied Hydrogeology Luncheon:
Tues., 12 May

NORTH-CENTRAL SECTION

Madison, Wisconsin, USA
Shlemon Mentor Program Luncheon:
Tues., 19 May

Mann Mentors in Applied Hydrogeology Luncheon:
Wed., 20 May

ROCKY MOUNTAIN SECTION

Casper, Wyoming, USA
Shlemon Mentor Program Luncheon:
Thurs., 21 May

Mann Mentors in Applied Hydrogeology Luncheon:
Fri., 22 May

CALL FOR NOMINATIONS

GSA DIVISION AWARDS

COAL GEOLOGY

Antoinette Lierman Medlin Scholarship in Coal Geology

Applications due 15 March 2015

This scholarship provides monetary support and recognition to deserving students in coal science, to be used toward successful completion of their research projects. Each year, one award is presented for the completion of laboratory/analytical research (US$2,000) and a second award is presented for the completion of fieldwork (US$1,500). Application materials should include a five-page summary of the research and an explanation of how the stipend would enhance that research, along with a one-page letter from the student's immediate supervisor that verifies the need for funding. Submit applications to Brett Valentine at bvalenti@vt.edu. For more information, go to **www.uky.edu/KGS/coal/GSA/awards.htm.**

HISTORY AND PHILOSOPHY OF GEOLOGY

History and Philosophy of Geology Student Award

Nominations due 15 June 2015

This award in the amount of US$1,000 recognizes excellence in a student paper to be given at the national GSA meeting; oral presentations are preferred. Students should submit an abstract of their proposed talk and a 1,500–2,000-word prospectus for consideration. The proposed paper may be (1) on the history or philosophy of geology; (2) a literature review of ideas for a technical work or thesis/dissertation; or (3) some imaginative aspect of the history or philosophy of geology we have not thought of before. Submit nominations to Kathleen Lohff at kathylohff.msn.com. For more information, go to **www.gsahist.org/hapg_award/awards.htm.**

MINERALOGY, GEOCHEMISTRY, PETROLOGY, AND VOLCANOLOGY (MGPV)

MGPV Distinguished Geologic Career Award

Nominations due 15 July 2015

This award goes to an individual who, throughout his or her career, has made distinguished contributions in one or more of the following fields of research: mineralogy, geochemistry, petrology, volcanology, with emphasis on multidisciplinary, field-based contributions. Submit nominations to J. Alex Speer, Mineralogical Society of America, 3635 Concorde Pkwy, Ste 500, Chantilly VA 20151-1110, USA; jaspeer@minsocam.org. For more information, go to **www.geosociety.org/divisions/mgpv/awards.htm.**

MGPV Early Career Award

Nominations due 15 July 2015

This award will go to an individual near the beginning of his or her professional career who has made distinguished contributions in one or more of the following fields of research: mineralogy, geochemistry, petrology, volcanology, with emphasis on multidisciplinary, field-based contributions. Nominations are restricted to those who are within eight years past the award of their final degree. Extensions of up to two years will be made for nominees who have taken career breaks for family reasons or because of serious illness. Submit nominations to J. Alex Speer, Mineralogical Society of America, 3635 Concorde Pkwy, Ste 500, Chantilly, VA 20151-1110, USA; jaspeer@minsocam.org. For more information, go to **www.geosociety.org/divisions/mgpv/awards.htm.**

QUATERNARY GEOLOGY AND GEOMORPHOLOGY

Farouk El-Baz Award for Desert Research

Nominations due 1 April 2015

This award is intended to stimulate research in desert environments by recognizing an individual whose research has significantly advanced the understanding of the Quaternary geology and geomorphology of deserts worldwide. Monies for the award are derived from the annual interest income of the Farouk El-Baz Fund, administered by the GSA Foundation. For more information and to submit nominations, contact Anne Chin at anne.chin@ucdenver.edu.

Distinguished Career Award

Nominations due 1 April 2015

This award recognizes a Quaternary geologist or geomorphologist who has demonstrated excellence in his or her contributions to science. For more information and to submit nominations, contact Sarah Lewis at sarah.lewis@oregonstate.edu.

STRUCTURAL GEOLOGY AND TECTONICS

Career Contribution Award

Nominations due 10 March 2015

This award recognizes an individual who, throughout his/her career, has made numerous distinguished contributions that have clearly advanced the science of structural geology or tectonics. Submit nominations to Jane Gilotti at jane-gilotti@uiowa.edu. For more information, go to **http://rock.geosociety.org/sgt/CareerAward.htm.**

CALL FOR NOMINATIONS

John C. Frye Environmental Geology Award

Deadline: 31 March

What's the best paper on environmental geology you've read lately?

This US$1,000 cash award recognizes the best paper on environmental geology published by GSA or by a state geological survey within the past three years. To nominate a report, please submit a letter describing its importance, with up to three letters from users of the publication, along with three copies of the publication, to GSA Membership Recruitment and Programs, The Geological Society of America, P.O. Box 9140, Boulder, CO 80301-9140, USA, awards@geosociety.org. For more information, go to **www.geosociety.org/awards/fryhow.htm.**

New and Revised GSA Position Statements

GSA Council has approved a new position statement and a major revision to an existing statement. In addition to the summary statement below, full versions of these and all position statements are available online at **www.geosociety.org/positions/.** GSA members are encouraged to use the statements as geoscience communication tools when interacting with policy makers, students, colleagues, and the general public.

The Role of the Geoscientist in Building and Maintaining Infrastructure (New)

Geoscientists have a fundamental role in the engineering and architectural design, planning, construction, and maintenance of infrastructure systems with respect to their relationship to local geology, hazards, and the environmental setting.

Integrating Geoscience with Sustainable Land-Use Management (Revised)

To ensure sustainable land-management practices that meet present and future needs of people and the natural systems on which they depend, GSA advocates the use of comprehensive earth-science information in land-use planning and decision making. The geosciences address the origin, character, and interconnection of natural resources, as well as the natural and human-induced processes that affect these resources. Earth-science information is critical to addressing natural and human-induced hazards, such as landslides, earthquakes, subsidence and sinkholes, floods, or droughts; natural resource availability, such as energy, water, soils and mineral resources; and environmental issues, such as soil erosion, surface water quantity and quality, groundwater supply and contamination, and wetland destruction. Therefore, earth science should be incorporated into all land and natural resources management decisions to enhance their integrity and sustainability.

THE GEOLOGICAL SOCIETY OF AMERICA®

Help Shape the Future of Geoscience— Serve on a GSA Committee!

2016–2017 COMMITTEE VACANCIES

Deadline to apply or submit nominations: 15 June 2015

If you are looking for the opportunity to work toward a common goal, a way to give back to GSA, networking opportunities, or a place to make a difference, then you should volunteer (or nominate a fellow GSA member) to serve on a Society committee or as a GSA representative to another organization.

To learn more about the committees and access the nomination form, visit **www.geosociety.org/aboutus/committees/.** You can also download the form and send a hardcopy nomination to Pamela Fistell, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA; fax: +1-303-357-1074; phone +1-303-357-1044 or +1-800-472-1988, ext. 1044; pfistell@geosociety.org. **Terms begin 1 July 2016** (unless otherwise indicated).

COMMITTEE	Number of Vacancies	Length of Term
Academic and Applied Geoscience Relations (M, E)	three	3 years
Arthur L. Day Medal Award (T)	two	3 years
Diversity in the Geosciences (M, E)	three	3 years
Education (M, B, E)	one	2 years
Geologic Mapping Award (E)	two	3 years
Geology and Public Policy (M, B, E)	one; one	3 years; 2 years
GSA International (M, E)	two	4 years
Joint Technical Program (E)	two	2 years, starts 1 Dec. 2015
Membership (B)	two	3 years
Nominations (B, E)	two	3 years
Penrose Conferences and Thompson Field Forums (E)	two	3 years
Penrose Medal Award (E)	two	3 years
Professional Development (E)	two	3 years
Research Grants (B, T)	seven	3 years
Young Scientist Award (Donath Medal) (E)	two	3 years
GSA REPRESENTATIVES TO OTHER ORGANIZATIONS	**Number of Vacancies**	**Length of Term**
GSA Representative to the AAAS Consortium of Affiliates for International Programs (CAIP) (T)	one	3 years, starts 1 Jan. 2016
North American Commission on Stratigraphic Nomenclature (NACSN) (M, possibly B)	one	3 years, starts 1 Nov. 2015

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.)

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.

THE GEOLOGICAL SOCIETY OF AMERICA

Penrose Conference Announcement

Extensional Reactivation of Thrust Faults, Coseismic Surface Rupture, and Crustal Evolution in the Eastern Basin and Range Transition Zone

22–27 June 2015 · Evanston, Wyoming, USA

Application deadline: 13 March · **Registration deadline:** 17 April

CONVENERS

Co-Chair ***Michael W. West,*** *Michael W. West & Associates, Inc., mwest@m-west-assoc.com*

Co-Chair ***Stephen A. Sonnenberg,*** *Colorado School of Mines, ssonnenb@mines.edu*

Paul M. Santi, *Colorado School of Mines, psanti@mines.edu*

Tarka Wilcox, *Pacific Lutheran University, wilcoxtt@plu.edu*

Rare geologic terranes exist in intraplate areas of the North American continent that illuminate nascent crustal-scale tectonic processes, fault nucleation/evolution, interaction of geologic structures in changing stress fields, tectonic effects on topography and fluvial systems, and issues in seismic hazard/risk assessment. These terranes, if recognized, are ideally suited to multidisciplinary research, leading to greater understanding of crustal evolution from the crust-mantle interface to surface geomorphology. Conference participants will have the opportunity to examine and assess active crustal deformation in an area encompassing the Laramide Uinta Mountains uplift; the Absaroka and Darby/Hogsback thrust plates of the Sevier orogenic belt (Wyoming and Utah); the late Holocene Bear River fault zone (BRFZ); and the transition between the contemporary margin of the Basin and Range province and the adjacent Laramide Green River Basin. The BRFZ exhibits the largest reported paleodisplacements in the Basin and Range province, indicating that the terrane encompassing the BRFZ and extensionally reactivated thrust faults is among the most tectonically active in the transition zone.

Specific conference topics include (1) crust/mantle interaction in the eastern Basin and Range transition zone, 100+ km east of the Wasatch Front; (2) stress, strain, and rheology at the intersection of the Uinta Mountains, Sevier thrust belt, Green River Basin, and active Basin and Range extension; (3) kinematics and evolution of crustal-scale structures from compression through contemporary extension; (4) relation of late Holocene co-seismic fault ruptures to preexisting Sevier and Laramide thrust faults; (5) refinement of seismogenic fault histories and surface-rupture parameters; (6) seismogenesis and hazards related to surface rupture along low-angle faults; (7) tectonic effects on glacial and fluvial geomorphic systems; (8) glacial loading/unloading effects on fault surface-rupture; (9) geophysical imaging of structures from the near subsurface to the crust/mantle interface; (10) applications of geodesy, LiDAR, and INSAR to crustal deformation and comparison to paleoseismological methods; and (11) relation of hydrocarbon occurrence to active, extensional tectonism.

The conference area provides an important, largely untapped field laboratory in which to study the interaction of contemporary extensional tectonic processes with older structures, reflected in modern topography and geomorphology. We suggest that this part of the eastern Basin and Range transition zone may be a "Rosetta" terrane, highlighting tectonic interactions in a complex geologic setting. Late-onset extension illuminates subsurface structural relations, reflected in surface deformation, which would likely not be recognized either in unextended terranes or, conversely, in highly extended terranes where initial structural relations may become indecipherable. Moreover, the juxtaposition of active extension against the relatively stable geomorphology of the Green River basin provides an opportunity to assess the timing and effects of late-onset extension on landscape development. We expect that the conference will yield new insights related to the region's crustal evolution with applications transferable to other terranes affected by changing stress fields. Conference participants will be tasked with determining if the project area should be designated as a prototype "national field laboratory" to encourage focused research on crustal-scale tectonic processes. A proposal to NSF to support the conference under the EarthScope program is pending.

The conference, including focused technical presentations, field trips, and workshops, will be held in Evanston, Wyoming, USA, at the historic Union Pacific Railroad Roundhouse Conference Center. As currently planned, the conference will encompass five days:

- Day 1—Focused technical presentations introducing the conference area;
- Day 2—Field trip to the Bear River fault zone from southeast of Evanston to the north flank of the Uinta Mountains;
- Day 3—Field trip to view evidence for extensional reactivation of the Absaroka and Darby/Hogsback thrust faults at the contemporary margin of the Basin and Range province, 130 km east of the Wasatch Front;
- Day 4—Focused technical recommendations and workshop to discuss conference topics and to identify priorities for future research;
- Day 5—Summary session.

ATTENDEES AND ESTIMATED COST

Participants are responsible for their own travel arrangements and should plan to arrive in Evanston by 5 p.m. on the afternoon of Monday, 4 August 2014. Transportation will be arranged from the Salt Lake City airport to Evanston by shuttle and/or a possible field trip. An "icebreaker," the first scheduled conference dinner, and a brief introduction to the conference program and field trips is planned for Monday evening.

The registration fee will cover airport transfers, hotel lodging for five nights (4–8 August), meals, field trips, guidebooks, and transportation while in Evanston. The exact registration fee, to be determined, is expected to be less than US$1,000. Financial assistance may be available for conference speakers and field trip leaders. Students are encouraged to attend, and financial assistance (to be determined) will be available for student support.

REGISTRATION APPLICATIONS

Registration deadline: 17 April

If you are interested in attending, please send an e-mail to Michael W. West, mwest@m-west-assoc.com, providing a brief statement of your research interests and the relevance of those interests to the focus of the conference. If you would like to present a technical paper on a topic relevant to the conference, please provide the proposed title and an informal abstract. A copy of the Penrose Conference proposal (PDF format), containing details on the planned program, conference topics, and field trips is available on request. Presentations should focus specifically on the eastern Basin and Range transition zone or analogs that illuminate conference topics. A downloadable application form (Word .doc) is available at **www.geosociety.org/penrose/15wyoming.htm.**

CALL FOR PROPOSALS

PENROSE CONFERENCES bring together multidisciplinary groups of geoscientists and facilitate an open and frank discussion of ideas in an informal atmosphere that also stimulates individual and collaborative research: **www.geosociety.org/penrose/.**

THOMPSON FIELD FORUMS offer both the opportunity to get out into the field and to bring together experts on the topic at hand to exchange current knowledge, ideas, and theories: **www.geosociety.org/fieldforums/.**

THE GEOLOGICAL SOCIETY OF AMERICA®

2014–2015 GSA-USGS Congressional Science Fellow Report:

A Geoscientist on "The Hill"

Susanna W. Blair

I am honored to serve as the 2014–2015 GSA-USGS Congressional Science Fellow. I learned of this fellowship in 2013 via the Science Outside the Lab summer workshop offered by Arizona State University's Consortium for Science Policy and Outcomes. During this "Orientation to Science Policy," we were able to engage with people who regulate, critique, study, and lobby at the intersection of science and policy. Because of this orientation, or disorientation as it sometimes felt, I recognized that there was an intellectual and useful space for scientists at science policy institutions. Specifically as geoscientists, we bring an interesting perspective to this space—an understanding of both the long-term scale of earth-system functions and of the rapid alteration of this function by anthropogenic influences. My hope is that within science policy, both scales will be part of the conversation.

As this year's GSA-USGS Congressional Science Fellow, I join the group of American Association for the Advancement of Science (AAAS) Congressional Science and Technology Fellows. We began our year in D.C. at the beginning of September with an invaluable two-week orientation. Sessions during the orientation included networking, negotiation, the role of science in the three branches of government, and how the budget process works. One highlight of our two-week orientation was a lecture from the Honorable John Holdren, Assistant to the President for Science and Technology, who spoke about the President's genuine interest in science and his commitment to young scientists.

Following this orientation, I took part in extensive interviews all over "The Hill" to determine my placement for the year. One of my key considerations in choosing a placement was the committees on which the senator or representative served, because this determines a large portion of the legislation introduced by the member and the primary work of the legislative team in that member's office.

In early October, I was honored to accept a post with Senator Kirsten Gillibrand (D-NY), with a focus on environment and energy issues. Sen. Gillibrand is a member of the Environment and Public Works Committee and is very interested in the health of the Great Lakes and the resiliency of the Atlantic coastline. These, along with many other environment and energy concerns, make my background in geology, science education, and environmental consulting useful. My work began during the long pre-election recess, which gave me the chance to research energy and environment issues specific to New York and to review the energy and environment bills that were already introduced during the 113th Congress. Since the end of the recess, I have staffed the Senator at two oversight hearings: the Environmental Protection Agency's ground level ozone standards and the Nuclear Regulatory Commission's safety recommendations and implementation post-Fukushima. I have also worked with constituent groups, researched potential legislative ideas, and written memos for the Senator concerning pending issues.

I would be remiss not to mention the November mid-term elections, which resulted in a change in Senate leadership and a concomitant change in Senate *committee* leadership. The chair of a committee has control over nearly every aspect of committee action, most notably what bills are introduced and debated. The Environment and Public Works Committee, on which Senator Gillibrand serves, was previously chaired by Senator Boxer (D-CA) and is now chaired by Senator Inhofe (R-OK), the author of the book, *The Greatest Hoax: How the Global Warming Conspiracy Threatens Your Future.* As a Fellow working in Gillibrand's office, I plan to support her in pursuing continued constructive science-based discussion within this committee and making gains where consensus can be found.

Among the many things I have been exposed to so far is the staggering amount of information available to staffers. It is clear a staffer could fill the majority of his or her time purely going to briefings. Briefings are offered on nearly every subject of legislative interest. Already I have attended briefings related to the Clean Power Plan, nuclear energy, ocean health, EPA rules, and climate change. Along with the briefings around the Hill, there are countless webinars and lectures around D.C. In addition, I have found the Congressional Research Service (CRS) to be one of the most remarkable services provided to Congress. This government entity works solely for Congress as its primary public policy and analysis support agency. With a staff of nearly 600 analysts, attorneys, informational professionals, and support personnel, they provide the most up-to-date, credible, and objective research and analysis possible in a very timely manner. What I cannot find, they already know. Thankfully, all of the correspondence with CRS is confidential, so the naive questions of new Fellows about the political process are off the record.

This year is off to a whirlwind start, and my learning curve is pretty much straight north. The 114th Congress is sure to be interesting, but potentially concerning to the scientific community. During the 113th Congress, the House of Representatives introduced hundreds of bills primarily designed to limit government, with a potential for detrimental effects for environmental protection. These have included bills to weaken and de-fund the Environmental Protection Agency and block funding for the Intergovernmental Panel on Climate Change (IPCC). It is expected that these bills will come up for a vote again this year and, with the change in leadership, may now be introduced and voted on in the Senate. On a slightly more positive note, the 114th Congress will likely bring a much needed discussion of national energy policy. Hopefully this will incorporate stronger environmental protection, along with securing energy supplies and keeping costs low. I look forward to reporting on these and other developments as my time on "The Hill" continues. Please feel free to contact me if you have questions.

The manuscript is submitted for publication by Susanna W. Blair, 2014–2015 GSA-USGS Congressional Science Fellow, with the understanding that the U.S. government is authorized to reproduce and distribute reprints for governmental use. The one-year fellowship is supported by GSA and the U.S. Geological Survey, Department of the Interior, under Assistance Award No. G14AP00161. The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. government.
Blair works in the office of Senator Kirsten Gillibrand (D-NY) and can be contacted by e-mail at Susanna_Blair@gillibrand.senate.gov.


AAPG
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Positions Open

ASSISTANT PROFESSOR
CONTINUING (TENURE-TRACK) POSITION
DEPARTMENT OF EARTH SCIENCES
THE UNIVERSITY OF NEW
BRUNSWICK, FREDERICTON

http://www.unb.ca/fredericton/science/depts/earth-sciences/index.html

The University of New Brunswick, Department of Earth Sciences, invites applications for a continuing (tenure-track) position at the Assistant Professor level to commence July 1, 2015, or as soon as possible thereafter.

The Department of Earth Sciences offers degrees in Earth Science, Environmental Geochemistry and Geological Engineering. We seek a candidate with teaching interests that will support at least two of the Geological Engineering undergraduate program options of geoenvironmental, geotechnical and mineral resource geological engineering. Qualifications required include a Ph.D. and postdoctoral experience. Demonstrated excellence in research and excellent potential for teaching at the undergraduate and graduate levels are required.

The successful candidate is expected to develop an externally funded research program that complements the research in the Department of Earth Sciences and fosters faculty-student collaboration.

The successful candidate must have a PhD in Earth Sciences or Geological Engineering and must be registered, or be eligible to register, as a Professional Engineer in the province of New Brunswick.

A letter of application including CV, statement of teaching and research interests, and the names of three referees should be sent to: Dr. Cliff Shaw, Chair, Department of Earth Sciences, University of New Brunswick, P. O. Box 4400, Fredericton, NB, E3B 5A3, cshaw@unb.ca.

The deadline for receipt of applications is March 27th 2015. Interviews will occur on or before April 23rd 2015.

All qualified candidates are encouraged to apply, however, Canadians and permanent residents will be given priority. Applicants should indicate current citizenship status. The University of New Brunswick is committed to the principle of employment equity. This position is subject to budgetary approval.

ASSISTANT OR ASSOCIATE PROFESSOR
IN PETROLEUM GEOCHEMISTRY
CONOCOPHILLIPS SCHOOL OF
GEOLOGY AND GEOPHYSICS
THE UNIVERSITY OF OKLAHOMA

The University of Oklahoma invites applications for a tenure-track position in Petroleum Geochemistry at the assistant or associate professor level. The ConocoPhillips School of Geology and Geophysics has a long and distinguished history in Petroleum Geochemistry. We are seeking a creative, dynamic person to help us move forward into new and exciting areas of petroleum geochemical research, in particular, with respect to biomarker and stable isotope studies, and an effective teacher who will educate students so they can move into successful careers. The successful applicant will hold a Ph.D., have an academic background in the geosciences, develop an externally funded research program, and teach undergraduate courses in geology in addition to graduate-level courses in petroleum geochemistry.

The ConocoPhillips School of Geology and Geophysics is housed in the Sarkeys Energy Center. The Petroleum Geochemistry research facilities include wet chemistry laboratories for sample preparation and experimentation, all of which are equipped with fume hoods, chemical and solvent storage facilities, microbalances, ovens, water purification facilities, etc. Instrumentation is state of the art, including 7 gas chromatographs, gas chromatography/mass spectrometry instruments (a Thermo TSQ 8000 GC/MS/MS and two 5975 MSD systems), pyrolysis/gas chromatography instrumentation and high performance liquid chromatographic equipment. Our stable isotope laboratories are equipped with conventional facilities for the off-line combustion, isolation, and purification of gases for stable isotope analysis. The laboratory houses 5 stable isotope ratio mass spectrometers, including a Thermo Delta V Plus, a MAT 252, a MAT 253, a Delta Plus XL and a Delta E for bulk and compound specific stable isotope analyses of organic and inorganic materials via dual inlet and in continuous flow modes using elemental analyzers and gas chromatographs interfaced to the instruments.

Review of applications will begin April 1, 2015. The search will continue until the position is filled. The anticipated start date for the position is August 15, 2015. Applicants are requested to submit a vita/resume, statement of research and teaching interests, and a list of five references who can be contacted, including telephone numbers, e-mail addresses, and mailing addresses. Questions or information requests should be addressed to the Chair of the Petroleum Geochemistry Search Committee, at +1-405-325-3253 or ougeochemistrysearchchair@ou.edu. Applications should be addressed to Petroleum Geochemistry Search Committee, ConocoPhillips School of Geology and Geophysics, The University of Oklahoma, 100 East Boyd St., Room 710, Norman, OK 73019-1008.

The University of Oklahoma is an Affirmative Action, Equal Opportunity Employer. Women and minorities are encouraged to apply. Protected veterans and individuals with disabilities are encouraged to apply.

ASSISTANT PROFESSOR NEOTECTONICS
(TENURE-TRACK)
NEVADA BUREAU OF MINES AND
GEOLOGY (NBMG) AT THE
UNIVERSITY OF NEVADA, RENO

The Nevada Bureau of Mines and Geology (NBMG) at the University of Nevada, Reno seeks applicants with expertise in neotectonics and Quaternary geology. Nevada is one of the most exciting regions in the world to conduct research in the geosciences, particularly in the fields of neotectonics and geologic hazards.

Position Responsibilities: The primary responsibilities of this position will be to develop programs in research and education in the field of neotectonics with emphasis on paleoseismic and earthquake hazard research in Nevada and the surrounding region. Research will focus on landscape evolution primarily as it relates to Quaternary faulting, utilizing innovative approaches, such as LiDAR, to conduct detailed geologic mapping and dating of Quaternary units and surfaces. The successful candidate will also be expected to contribute to the development of datasets and reports on Nevada's Quaternary faults and seismic activity, including periodic assessments and syntheses of hazards facing its major cities and infrastructure. Education will include teaching courses in the successful candidate's area of expertise, such as neotectonics, geologic hazards, and Quaternary geology in the Department of Geological Sciences and Engineering and supervising graduate students. Research and educational efforts will involve integrated multi-departmental (e.g. Nevada Seismological Laboratory) and multi-institutional efforts, with scientists from academia, industry, other institutions, and government labs. The successful candidate will be asked to communicate effectively with the public and community leaders regarding natural hazards in Nevada and coordinate mitigation and response efforts with local and federal emergency management agencies.

Qualifications: Applicants must have a doctorate in geology or a related geoscience field by the time of hire and a demonstrated record of research on topics related to neotectonics as indicated by dissertation research, industry experience, and/or peer-reviewed publications. Excellent communication skills, as demonstrated in written application materials; commitment to public service; potential for, or established record of publications; and ability to attract funding are essential. The successful candidate must also have the ability to develop and coordinate programs and work in teams to accomplish major goals.

Preference will be given to candidates with academic or industry experience in neotectonics. Expertise in paleoseismology (e.g. trenching), surficial processes, Quaternary dating techniques, LiDAR, and/or InSAR will be valued. Preference will be given to candidates who have demonstrated research productivity with publications in peer-reviewed literature. The successful candidate will compete for funding from a variety of sources, including federal agencies interested in fundamental and applied geoscience research (e.g., NSF, USGS, Department of Energy, and Bureau of Land Management) and industry. Therefore, preference will be given to candidates who explain achievable plans for funded research on Nevada-focused topics in neotectonics in their letters of interest. In addition, preference will be given to candidates who understand the role of NBMG as the state geological survey of Nevada and can articulate how NBMG can better serve stakeholders (citizens, government, and industry) on issues related to geologic hazards.

Salary and Date of Appointment: The position will be a tenure-track faculty appointment at the assistant professor level with an academic-year base salary that is competitive with other research universities. Starting date will be July 1, 2015, or shortly thereafter, depending on availability of the successful candidate.

To apply, please visit https://www.unrsearch.com/postings/16813. Please submit a letter expressing your interest in the position and research plans;

names, e-mail addresses, postal addresses, and telephone numbers of at least three references; a complete curriculum vitae; and electronic copies of up to three of your publications to http://jobs.unr.edu/. Application deadline is **March 10, 2015.** For further information about NBMG, please consult our website (http://www.nbmg.unr.edu).

The University of Nevada, Reno is committed to Equal Employment Opportunity/Affirmative Action in recruitment of its students and employees and does not discriminate on the basis of race, color, religion, sex, age, creed, national origin, veteran status, physical or mental disability, and sexual orientation. The University of Nevada employs only United States citizens and aliens lawfully authorized to work in the United States. Women and under-represented groups are encouraged to apply.

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John W. (Jack) Hess, *GSA Foundation President*

Education & Outreach Career and Mentor Programs

Presenting an abstract, poster, or map at a Section Meeting is often the first formative experience students have with GSA. It is also essential for students to understand how to align their academic path with professional expectations. I'm pleased to profile new and proven programs you will see at Section meetings with the goal of helping students expand their awareness and skills via networking and career development possibilities. We invite you to stop by the GSA Foundation booth at your section meeting to learn more about volunteering, supporting, or promoting these programs.

New to Section Meetings this year: The GSA Education and Outreach program will host a three-part Geoscience Career Workshop series. Each segment of the series will assist participants with developing skills and knowledge necessary to explore, identify, and apply to geoscience positions. The workshop series will cover skill development and career planning strategies essential for success, including

- Career planning and informational interviewing;
- Geoscience career exploration; and
- Cover letter, résumé and curriculum vitae development.

Would you consider hosting 5,000 for lunch? The Roy J. Shlemon Mentor Program in Applied Geoscience luncheons bring students and geoscience professionals together to discuss geoscience careers in a unique way. Students enjoy a sponsored lunch and exchanging questions with several different volunteer mentors. The program is generously funded by Roy J. Shlemon and has engaged 5,390 students and 820 mentor volunteers since its inception in 1996.

The John Mann Mentors in Applied Hydrogeology luncheons are designed to acquaint undergraduate, graduate, and recently graduated students with careers in applied hydrogeology through mentoring with practicing hydrogeologists. Mentors associated with GSA's Hydrogeology Division, as well as non-GSA members, meet with students over lunch. The John Mann Mentor program engaged 330 students and 183 mentors in 2014, and is supported through funds provided by John and Carol Mann.

The On To the Future Program (OTF) will have a representative in the GSA Foundation booth at all Section Meetings to answer questions about this innovative travel assistance program. OTF is a grassroots initiative of GSA that addresses the organization's overall strategic commitment to building a diverse geoscience community by engaging groups traditionally underrepresented in the geosciences. OTF awards partial travel scholarships to diverse undergraduate and graduate students and recent graduates studying the geosciences to attend their first GSA Annual Meeting. OTF is also seeking mentor volunteers for the 2015 Annual Meeting in Baltimore.

Thank you for your support of proven and innovative programs like these, designed to serve our members.

2015 Section Meeting Calendar

Chattanooga, Tennessee, USA.
Photo courtesy of the Chattanooga Convention and Visitors Bureau.

SOUTHEASTERN

19–20 March

Chattanooga, Tennessee, USA

Karston Creek, Oklahoma, USA.
Image courtesy Stillwater Convention and Visitors Bureau.

SOUTH-CENTRAL

19–20 March

Stillwater, Oklahoma, USA

Mount Washington Resort, Bretton Woods, New Hampshire, USA.
Image courtesy Mount Washington Resort.

NORTHEASTERN

23–25 March

Bretton Woods, New Hampshire, USA

Anchorage, Alaska, USA. Photo by Jody Overstreet, courtesy Visit Anchorage.

CORDILLERAN

11–13 May

Anchorage, Alaska, USA

Early registration deadline: 6 April

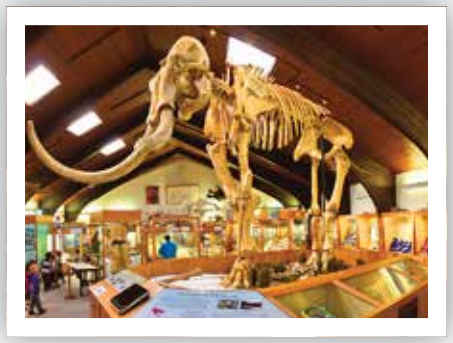
Madison, Wisconsin, USA. Photo courtesy GMCVB.

NORTH-CENTRAL

19–20 May

Madison, Wisconsin, USA

Early registration deadline: 13 April



Dee the Mammoth, Casper College Tate Museum. Photo courtesy Visit Casper.

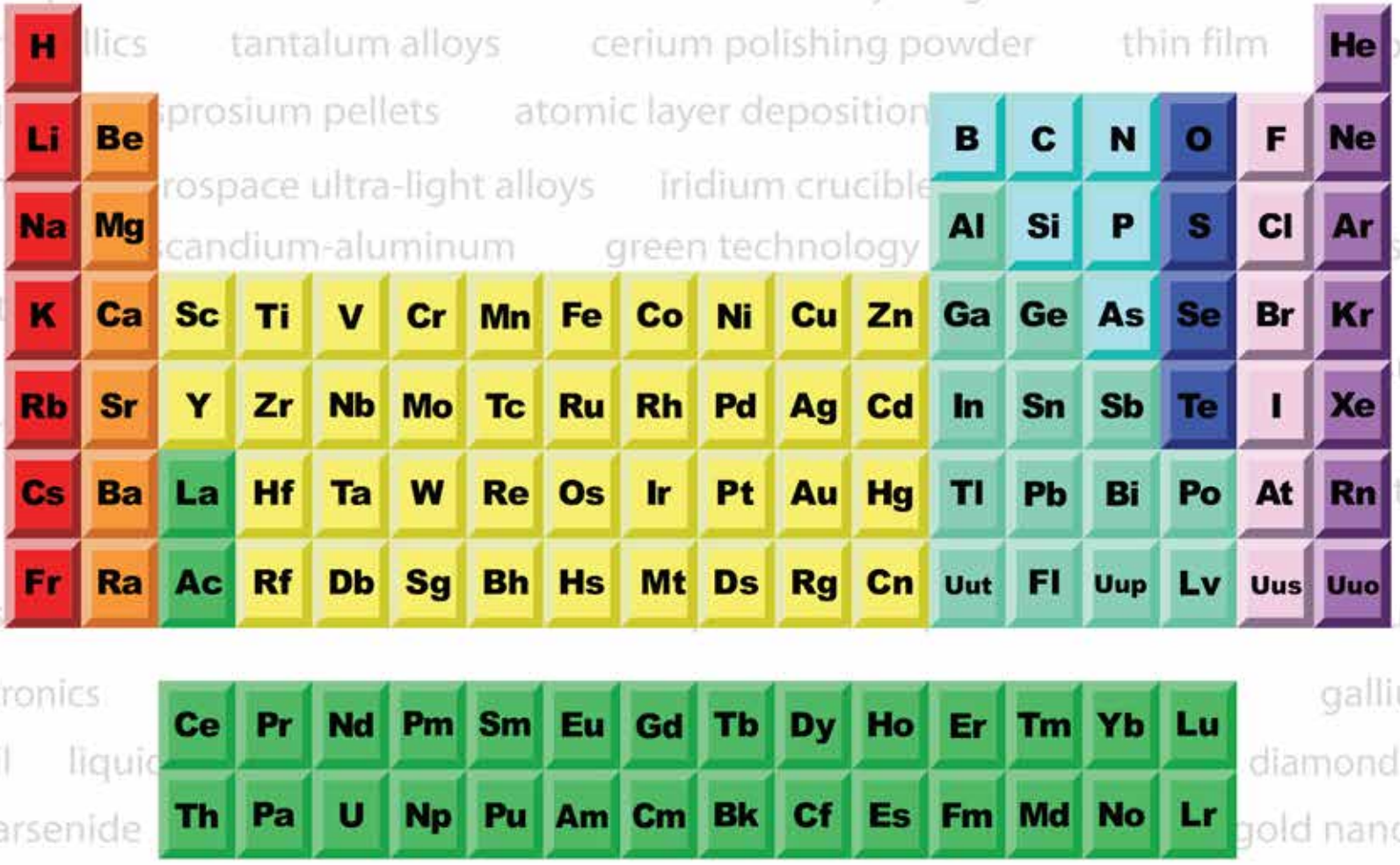
ROCKY MOUNTAIN

21–23 May

Casper, Wyoming, USA

Early registration deadline: 20 April

www.geosociety.org/Sections/meetings.htm



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