

The objective of the Society is to promote the knowledge and understanding of Earth science, and its application to human needs

CSS Newsletter, January-February 2022

CSS February Meeting, Thursday, Feb. 17, 6:45 p.m.

Colorado Scientific Society's 2022 World Rock Tour

CSS February Meeting Thursday, February 17, 2022

CSS has two talks this month:

Drivers, Disassemblers and Implications of flat slab subduction, Peru, by Nadine McQuarrie, University of Pittsburgh

and

Mesa Verde and Machu Picchu – Ancient Water Management in Differing Climates, by Andrew Earles, Wright Water Engineering

All are welcome – no admission charge 6:45 pm – Join Zoom meetings 7:00 pm – Meeting and Program begin ~ 7:45 pm – Start of second presentation Link to Join CSS February Zoom Meeting

Click to Join CSS Zoom Meeting from PC, Mac, Linux, iOS or Android

Other options to Join Zoom meeting: Topic: Colorado Scientific Society Thursday February 17th 6:45 PM Time: Feb 17, 2022 18:45 Mountain Time (US and Canada) Join Zoom Meeting <u>https://us02web.zoom.us/j/89564697430?pwd=SmRJVjl5b1htdHFreDZ5VGtWM204dz09</u> Meeting ID: 895 6469 7430 Passcode: 925734 One tap mobile +16699006833,,89564697430#,,,,\*925734# US (San Jose) +12532158782,,89564697430#,,,,\*925734# US (Tacoma) Dial by your location +1 669 900 6833 US (San Jose) +1 253 215 8782 US (Tacoma) +1 346 248 7799 US (Houston) +1 929 205 6099 US (New York) +1 301 715 8592 US (Washington DC) +1 312 626 6799 US (Chicago) Meeting ID: 895 6469 7430 Passcode: 925734 Find your local number: https://us02web.zoom.us/u/kdGU3EMnDv

**Drivers, Disassemblers and Implications of flat slab subduction, Peru** by **Nadine McQuarrie**, University of Pittsburgh



Peruvian valley

**Abstract:** Geophysical images of Andean flat slabs are natural laboratories in which to understand the existence and potential drivers of ancient flat slabs along the North and South American cordilleras. Near or fully flat slab subduction occurs along  $\sim 10$  % of all subduction zones. The causes of flat slab subduction, the strength of coupling between the downgoing and overriding plates as well as the resulting effects on the upper plate continue to be debated. Two of the major drivers of modern flat slabs are thought to be, a) subducted buoyant oceanic

plateaus/ ridges and/or b) trench retreat and resulting hydrodynamic suction within the mantle wedge that lifts and supports the subducting slab. Which of these two processes is dominant, depends strongly on the architectural (existence or not of buoyant oceanic ridges) and tectonic drivers (rate of overriding plates) present within the subduction system. While buoyant ridges are associated with both modern Andean flat slabs, they are missing from ancient Andean examples. Tectonic reconstruction of the Andes, constructed in a mantle reference frame illustrates the westward advance of the trench and retreat of the Nazca slab at ca. 2 cm per year since ca. 50 Ma. In the flat slab portions, trench retreat without rollback has occurred since their formation at ca. 12 Ma. This result lends strong support that advancing (towards the trench) upper plate motion creates an overpressured sub-slab mantle supporting the weight of the slab. Slab tears release pressure and allow for rollback. In southern Peru, directly south of the modern flat slab, patterns of magmatism argue for flat slab subduction from 45 to ca. 15 Ma, concurrent with the majority of shortening in the region. The return to steeper dips is associated with a marked slowing of shortening rates, and the propagation of the dramatic ca. 2-3 km deep canyons that are carved into the eastern Andean plateau.



**Nadine McQuarrie** is a Professor at the University of Pittsburgh. She received her Ph.D. at the University of Arizona in 2001 with an emphasis in Structure and Tectonics. She was a Post-Doctoral Scholar at California Institute of Technology from 2001-2004 and an Assistant Professor at Princeton University before accepting a position at the University of Pittsburgh in 2011. Dr. McQuarrie spent a year at Tuebingen University in Germany as an Alexander von Humboldt Research Fellow (2011-2012). She studies the geometric, kinematic and erosional evolution of mountain belts particularly in the Himalaya and the Andes. Current research focuses on linking the geometry and kinematics of mapped structures to thermochronometer cooing ages and landscape evolution models to examine the interplay

between tectonics and erosion on deformation, exhumation and the resulting morphology of mountain ranges

## Second presentation:

Mesa Verde and Machu Picchu – Ancient Water Management in Differing Climates, by Andrew Earles, Wright Water Engineering



Machu Picchu

**Abstract:** Mesa Verde and Machu Picchu are iconic ancient sites in the Americas that tell stories of the sophistication of water management techniques of the Ancestral Puebloans and the Inca. Mesa Verde in Southwestern, Colorado saw centuries of occupation and societal evolution in an arid environment in part due to water systems that collected and stored water during wet periods for use during dry periods. Machu Picchu, on the other hand, has a much wetter climate and milder fluctuations in seasonal temperatures than Mesa Verde; however, it is set on a graben high above the Urubamba River and relies on groundwater as a primary source for canals and fountains in dry weather.

Dr. Earles will present some of the highlights of ancient water management systems at Mesa Verde and Machu Picchu and discuss similarities and differences in water management techniques and the role of water in these societies. The presentation will show examples including several reservoirs and a cistern at Mesa Verde and the Inca Spring and canal and fountain system at Machu Picchu.



**Dr. Andrew Earles, P.E.** is the Vice President of Water Resources with Wright Water Engineers in Denver Colorado. He is a Professional Hydrologist and Diplomate of the American Academy of Water Resources Engineers. Andrew's professional practice evolves around hydrology, hydraulics, drainage, water quality, and water resources. Andrew is a Research Associate with the Wright Paleohydrological Institute and has conducted work around the world in Peru, Cambodia, Thailand, Myanmar, China, and Iraq related to understanding and preserving cultural and historical resources. Andrew earned his bachelor's degree in engineering at

Stanford University and master's and doctoral degrees at the University of Virginia.





Where's That Rock? Back by popular demand!



How about these vertical beds of sandstone and conglomerate! Who can guess where (and what) they are?

A hint, this was on a CSS field trip... but it was "a while ago". Send your answer to the newsletter editor, Pete Modreski, at pmodreski@aol.com, and let's see who can be the first (or, the closest) to correctly identify it!

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Officers and Councilors for 2022 were elected at the 2021 CSS Annual Meeting, Dec. 16, 2021:

**President Elect**: Cal Ruleman, Research Geologist, USGS, Geosciences and Environmental Change Science Center

Secretary: Lisa Rae Fisher, Executive Vice President, Escalante Resources

Note: Patrick Sullivan will be working with Lisa Fisher, in order to smoothly transition to Secretary in 2023. There is no formal designation for a "Secretary Elect", therefore there is not a place on the slate per se.

**Treasurer**: James C. Paces, Scientist Emeritus, USGS, Geology and Environmental Change Science Center *Note: current Treasurer Don Sweetkind will aid in the transition.* 

## Councilors for 2022-24:

Lesli J. Wood, Colorado School of Mines, Weimer Distinguished Chair and Professor, Geology and Geological Engineering

Julie A. Herrick, Geologist/Geologic Map Editor, USGS Office of Communications and Publishing

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**Upcoming CSS meetings:** Our meetings are normally held on the 3<sup>rd</sup> Thursday of each month. You can read more about all CSS upcoming programs on our website, <u>https://coloscisoc.org/</u>. We are hoping to resume in-person meetings soon in 2022, but for the moment, they will still be virtual, via Zoom. Our planned schedule of programs:

• March 17<sup>th</sup> lecture: Katie Joe McDonough (consultant): "Uruguay to Namibia seismic surveys – rejoining the Atlantic continental margins"; Tom Casadevall (USGS): "Atlantic volcanoes"

• April 21<sup>th</sup> lecture: Jim Granath (consultant): "Petroleum exploration in newly discovered basins of Namibia"; Bob Raynolds (DMNS): "Seeking ancient man in the Turkana Basin"

• May 19th lecture: Dan Schelling (consultant) "Structure of Kurdistan and Oman"

• September 15<sup>th</sup>: Past Presidents Dinner lecture: Kathleen Springer (USGS) and Jeff Pigati (USGS): "The White Sands footprints -- humans in North America 23,000 years ago"

• October 20<sup>th</sup> Emmons lecture: Gerta Keller (Princeton): "India's Deccan Traps and the KT Boundary"

• November 17th: Europe or Central Asia, to be determined

• December 15<sup>th</sup> Annual Business Meeting lecture: Ned Sterne (independent): "Who owns the Arctic? – the politics of plate tectonics in a melting world"

• **Possible special lecture by Joy Dunn**, Chief Operating Officer for Commonwealth Fusion Systems (CFS) and past chief of manufacturing for SpaceX. Present this in conjunction with the CSM chapter of the American Institute of Aeronautics and Astronautics (Jarod Spencer).

Recent CSS presentations are recorded on Zoom. Follow the links on the website for each presentation to see abstracts, biographies of the speakers and video recordings of our meetings.

We invite you to pay your dues for 2022 to CSS! You may pay dues online, or print out a pdf of the membership form and mail it to us with a check. Continuing your membership in CSS will enable us to continue all our ongoing programs, including our field trips, virtual meetings, Student Research Grants, and more. Please consider making an extra donation to one of our Memorial or Endowment Funds!

See <u>https://coloscisoc.org/join-donate/</u> for the online link to our membership & dues form. Regular CSS dues are \$25 (\$20 if paid prior to Jan. 31); Corresponding Membership (outside of the Front Range area) \$10; Student Membership (any level) \$5; Life Membership, \$395. It's easiest to pay online through our website; or, send your membership payment to Colorado Scientific Society P.O. Box 150495 Lakewood, CO 80215-0495.

Thank you!

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## **Colorado Scientific Society 2022 Officers and Council:**

Ned Sterne – President	Lew Kleinhans – Councilor 2021-2023					
Cal Ruleman – President Elect	Karen Berry – Councilor 2021-2023					
Bruce Trudgill – Past President	Joe Sertich – Councilor 2020-2022					
Lisa Fisher – Secretary	Warren Day – Councilor 2020-2022					
Patrick Sullivan – Secretary Elect	Lesli Wood – Councilor 2022-2024					
Jim Paces – Treasurer	Julie Herrick – Councilor 2022-2024					
Chris Morrison – Chair, Webmaster	Pete Modreski - Newsletter					

**A recap of our CSS January Meeting:** (since there was not a separate January newsletter) *This same material can be found on the CSS website*, <u>https://coloscisoc.org</u>.

Antarctica, at the juncture of bedrock geology and dynamic ice sheet Part I : Continental growth along Gondwana's active margin Part II: Cores to Continent: New clues to the future "Pliocene world" that awaits us Thursday, January 20, 2022 by Christine Siddoway, Professor of Geology and Chair of the Geology Department at Colorado College The meeting was streamed remotely, via Zoom



Antarctica



Antarctica (NASA imaging lab)

**Abstract:** What better way to begin the Scientific Society's 2022 "World Rock Tour" than with a geological journey to the Southern Continent – a place that's become less distant, owing to dire climate news from West Antarctica that arrives almost daily. The rapid decline of West Antarctic ice might cause an earth scientist to wonder, "What are the geological underpinnings of this continental ice sheet? Are there tectonic or terrain factors that contribute to ice dynamics? Has rapid deglaciation happened in the past, and if so when? under what conditions?"

This month's seminar, presented in two parts, first explores the tectonic evolution, terranes, and topography of West Antarctica, then shares new perspectives on the origins of the West Antarctic Ice Sheet and fluctuations in ice sheet extent. Field photos and outcrop shots will illuminate the narrative.

In **Part I**, I'll offer a geological account of continental crust formation, stabilization, then breakup along Gondwana's active margin, drawing upon field-based studies of mid-crustal rocks of Marie Byrd Land, West Antarctica. MBL crust, and most of the continental crust of West Antarctica, formed entirely in the Phanerozoic, along the convergent margin of Gondwana that spanned Australia, Zealandia, West Antarctica and Patagonia. When the Gondwana supercontinent broke up, the final segment to open was West Antarctica – Patagonia, allowing the circum-Antarctic ocean to form, and placing the Southern continent in its icy state.



West Antarctica in Gondwana

Part II of the seminar will share discoveries from current work on deep-sea sediment cores obtained by International Ocean Discovery Program Expedition 379 to the Amundsen Sea in 2019 (Siddoway participated). The sediments span from Pliocene to Present, and are yielding detailed climate records. The cores contain astonishing intervals of ice-rafted debris: coarse materials that can be linked to their sites of origin in the subglacial bedrock of West Antarctica. Some notable clasts signify an icesheet that was drastically reduced in extent, in mid-Pliocene time.... when the Earth's climate last was as warm as it's become, today. Knowledge of the geology of subglacial bedrock of West Antarctica is critical for tests of the "open interior seaway" hypothesis for Pliocene Antarctica.



Christine Siddoway in Antarctica

**Bio: Christine Siddoway** has travelled to Antarctica 15 times, thanks to numerous grants from the National Science Foundation and invitations from two European programs. A majority of her field work has been conducted in West Antarctica – a stormy region that has been avoided by most land-based geologists (volcanologists, excepted). She is Professor of Geology and Chair of the Geology Department at Colorado College. She's been involved in the US Antarctic Research Program since 1989.