

# ALASKA GEOLOGY

Newsletter of the  
*Alaska Geological Society*



## Links between Phanerozoic Large Igneous Provinces (LIPs), Petroleum Systems, and Source Rocks

Steven Bergman

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Large Igneous Provinces (LIPs) represent one of the most extreme magmatic events on Earth (perhaps exceeded by large bolide impacts) in which large volumes of mainly mafic silicate melts (> several to hundreds of million cubic kilometers) are intruded in the crust and erupted at the surface as flood basalt provinces within geologically short periods of time, typically <0.5–2 Myr (million years). During the last five hundred million years the Earth has experienced over a dozen LIP eruption events on the continents and in ocean basins, several of which are preserved in Alaska. LIPs result from partial melting (15–25 volume %) of the upper mantle caused by upwelling of anomalously hot and buoyant asthenosphere most likely associated with mantle plume heads derived from the core-mantle boundary or possibly influenced by shallower mantle processes near the edges of subducted lithospheric slabs. No active LIPs are erupting on Earth's surface. Extinct LIPs are variably preserved in the geological record. LIPs are distinct from Late Cenozoic (<5 Ma) erupting hot-spot chains caused by mantle plume tails such as Hawaii, Canary, St. Helena, Tristan, Bouvet, Reunion, and other islands in the oceanic domain, and Yellowstone in the continental domain. LIPs have had significant impacts on many parts of the Earth systems, including plate boundary evolution, plate reorganizations, continental breakup, lithosphere evolution, atmosphere and ocean chemistry, climate, and biosphere extinction and primary productivity events. Nearly every Phanerozoic LIP event coincided with and contributed to Earth System processes that caused periods when ocean waters experienced extremely low oxygen levels allowing preservation of organic-rich sediments on the seafloor with anomalous stable Carbon isotope ratios; the organic matter would have decomposed under higher oxygen levels. LIPs directly impact several elements of the petroleum system, such as source rock, charge/maturation/uplift and erosion, trap structure, and reservoir. The source rock-LIP link is mainly related to the nutrients added to the atmosphere and hydrosphere systems during LIP peak eruption phases promoting biotic hyper-productivity, and the resulting ocean anoxia promoting source rock preservation. This talk provides an overview of Phanerozoic LIPs and their links to petroleum systems.

### AGS Meeting

Date & Time:	Thursday, December 17; doors open 11:30 am, announcements 11:45 am, talk 12:00 – 1:00 pm	
Program:	Links between Phanerozoic Large Igneous Provinces, Petroleum Systems, and Source Rocks	
Speaker:	Steven Bergman	
Place:	Virtual online presentation	
Reservations:	Reservations are not required	
Login:	To log in to the presentation see the instructions at: <a href="http://www.alaskageology.org/events.html">http://www.alaskageology.org/events.html</a>	
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## **About the Speaker:**



Steve Bergman is a gentleman geologist (retired), lives on Vashon Island, WA and is a local geo-activist. He currently serves on the Board of Directors of two not-for-profits: Zero Waste Vashon and Vashon Makerspace and participates in local geo-activities, such as the Antiques Rockshow, building a native rock garden and geo-exhibit for the Heritage Museum Wild Wonders exhibit, and VUG (Vashon Union of Geologists). Until 2016, Steve was a Principal Regional Geologist in the Global Geology Upstream Exploration Research team at Shell International Exploration & Production Co. (Houston, Texas). Prior to joining Shell in 2005, he taught at UT Dallas and SMU for 5 years and was Principal Research Geologist with ARCO R&D for 20 years in Dallas; ARCO funded his Visiting Scholar sabbatical at Bullard Laboratories, Cambridge University in 1996–1997 just prior to the BP buyout. Steve has had the pleasure of studying the tectonics, regional structure, field geology, basin analysis, hard rock petrology, volcanology, and geochronology of many worldwide basins and terranes and the good fortune of spending more than two years on the ground in the Alaska wilderness banging on rocks and also contributing to our understanding of Chukchi Sea subsurface. He served on the National Academies Roundtable on Science and Technology for Sustainability from 2012-2017, the NRC STS Landscape Analysis Committee in 2015, and as an advisor to the U.S. State Department on Arctic Geology Matters. He received a B.S. in Geology from the University of Dayton (1977) and Ph.D. degree in Geology from Princeton University (1982).

## **From the President's Desk:**

For almost 75 years, the [Juneau Icefield Research Program](#) (JIRP) has been one of the longest uninterrupted glaciological research programs in the world. As documented by Dr. Cathy Connor, the subject of the AGS Scientist Profile this month, the funding for this research was first motivated by the US military's interest in north polar military operations. Today, JIRP is most distinguished by the [six-week educational and expeditionary experience](#) it provides students. Please read further to learn more about Dr. Cathy Connor and this world-class icefield research program.

A handwritten signature in black ink, appearing to read 'Cathy Connor'.

From 1996 to 2014, Cathy Connor was the Coordinator of the Environmental Science Program, which she helped to establish in 1996, in the [Department of Natural Sciences at the University of Alaska Southeast](#) (UAS). She is presently an Emerita Professor of Geology in the Natural Sciences Department (B.S.) Programs at UAS. She began her academic training in the geology at Stanford University, completing a BS and MS through the School of Earth Sciences coterminal program (5 year program 1970-1975). At this time, she also worked as a student technician at the nearby USGS in Menlo Park, California in the Geochemistry and Geochronology lab. There she contributed to the radiometric age dating of Alaska rocks using a solid source mass spectrometer. Following a 2-year stint in the U.S Peace Corps (1975-1977) as a Geology Instructor in the Department of Soils Science at the Agricultural University of Malaysia, she returned to the USGS, joining the Branch of Alaskan Geology as a physical science technician and worked on field mapping projects throughout Alaska (1978-1983). During this time she completed a PhD program in the Geology Department at the University Montana, Missoula, working jointly with the USGS on her dissertation in Alaska. In 1982 she transferred to the Branch of Alaskan Geology in Anchorage before moving to Juneau, in 1983. After a pause for marriage and motherhood, she resumed her pursuit of Earth Science in 1991 as an instructor at the University of Alaska Southeast in Juneau, where she enjoyed her academic career.

While following her geologic path, Cathy's interests have been primarily in modern surface sedimentation processes in lacustrine, estuarine and glacial fjord systems and the records they have left in Quaternary deposits. An added fascination with active tectonic processes led to her authorship of [Roadside Geology of Alaska](#) (published originally in 1988 and revised in 2014) by her graduate school professors at Mountain Press in Missoula, Montana. More recently she has put her experience to work training USFS Naturalists, Alaska's science teachers and their students. She supports K-12 experiential science education in Juneau, AK through her work with [Discovery Southeast](#), a non-profit Nature Education Organization.

### **Would you explain how you first became associated with JIRP and then a little about the unique student program?**

Beginning in 1983 when I moved to Juneau from Anchorage, my family and I would watch the Juneau Icefield Research Program students march in our annual 4th of July parade, often performing precision ice-axe routines and distributing chopped berg ice from nearby Mendenhall Lake, to the crowd. In 1994, JIRP founder [Maynard Miller](#), came to my office at UAS and invited me to join the program. I have been a JIRP faculty ever since then, and a board member of the Foundation for Glacier and Environmental Research, which supports the JIRP Program, since 2010.

JIRP undergrad students are receiving a NOLS course, as well as glaciology, climate, bedrock and glacial geology, mountain ecology, firn pack hydrology, isotope geochemistry, and geophysics training over their 6 weeks, climbing from sea level in Juneau, up to about 4,000' on the icefield and for the next 200+ miles or so, ski-traversing the Coast Range Batholith across the Taku and Llewelyn Glaciers to Atlin, BC. During this time, in addition to their academic training, students partake in data collection and data reduction of focused icefield research questions and present their results to the communities of Atlin and Juneau. Many of them refine their work further and present it later at the American Geophysical Union Meetings in San Francisco. This is JIRP's 21st century version of the Emersonian Triangle (Nature, Books, and Action), a beloved model of Maynard Miller who graduated from Harvard, in R.W. Emerson's old neighborhood.

Along with teaching geologic field mapping techniques on JIRP camp outcrops, I have enjoyed guiding JIRPers in making geologic maps of far flung nunataks, the Coast Range Batholith peaks, that provide the stunning bedrock interludes across the Taku and Llewelyn glaciers.

### **How did you get started in the geosciences?**

I grew up in the warm and sunny Mediterranean climate of the SF Bay Area and my parents took us clamming for geoducks in the Limantour Lagoon before the Point Reyes National Seashore was created. My brothers and father made a semicircle around me with shovels at the ready, as I lay prone in the mud holding onto the clam's siphon/neck. These clams can disappear quickly into the sediments so our strategy worked well. The resultant clam chowder was delicious. I bonded with fine-grained sediments at an early age.

I had an excellent 8th grade science teacher Mr. Richards, who continually asked us interesting questions like: was [Mount Tamalpais](#) a volcano? A few of my classmates were grinding mirrors for their own telescopes in his prep room. I remember he tasked me with helping younger kids learn about photosynthesis...hands-on science exploration did the trick.

### **How did your two-year experience in Malaysia change your perspective?**

The person who inspired me to join Peace Corps Malaysia was also from Stanford and he had worked as a Peace Corps Volunteer for the Malaysian Geological Survey. I learned a lot about teaching university students from my Indian, Chinese, and Malay undergrads and I organized some amazing field trips to coral reefs. An unexpected useful skill of mine enabled me to teach the female fisheries students there how to swim so they could graduate (too many crocodiles in their village rivers had prevented their learning). I met my husband during this time, he was a Peace Corps Volunteer studying the Sumatran rhinoceros in the Peninsular Malaysia tropical rainforests.

### **Can you explain how geology is organized and taught at UAS?**

Geology is taught as part of an Earth Systems style Environmental Science program at UAS. Our emphasis is on surficial geology, geomorphology, hydrology, ecology, snow science, geochemistry, and glaciology—topics that enable us to guide undergraduates in research projects that are pertinent to our temperate rainforest environment.

The Environmental Science program began in 1995-1996 with the support of Chancellor Marshall Lind, Dean John Pugh, and Prof Richard Marston who was visiting at the time and a JIRP faculty. We wanted to expand the physical science offerings in Juneau and enable our students to obtain rigorous training so we could work on our local glaciers and rivers. UAF Faculty emeritus Roman Motyka was also a big help. The Geography Program came into being a bit later, led by faculty Eran Hood.

### **What one paper would you like to share as an example of your research?**

One of my favorites was the "fusion" study we did with UAS and National Park Service Anthropologists working with the Hoonah Tlingit Elders who were descended from Glacier Bay Clans and Quaternary geologists in Glacier Bay NP. Together we tracked HUNA Tlingit oral traditional knowledge with the glacial geology record in the Beardslee Formation. This interdisciplinary approach gave us a better understanding of human occupation of the area between 5,000 and 250 years ago.

C Connor, G Streveler, A Post, D Monteith, 2009, The Neoglacial landscape and Human History of Glacier Bay, Glacier Bay National Park and Preserve, southeast Alaska USA, *The Holocene*, journals.sagepub.com

<https://doi.org/10.1177/0959683608101389>

### **What are some things that are important to you outside your professional/academic life?**

Before this week's atmospheric river hit SEAK and washed away much of our snow (and Haines' surficial geology!), my husband and I have been nordic skiing daily with the help of an army of volunteer trail groomers through the Juneau Nordic Ski Club. I am also an avid supporter of Discovery Southeast, a nature education organization that gets all of Juneau's elementary students outdoors and actively investigating the natural world outside of their classrooms through each of our seasons.

I am very grateful that our son and his wife moved from Seattle back to Juneau during these pandemic times, bringing their portable jobs with them. Our two daughters, their husbands, and our 2 granddaughters live in San Francisco and I can't wait for the COVID vaccine so we can go visit them again.

# My Pet Rock

Joseph Kurtak



A “mushroom rock” formation in the Eastern Alaska Range near the town of Delta Junction. This unique formation is probably the result of emplacement of Iron-rich ground waters into a zone of otherwise unconsolidated Quaternary gravels. Iron-bearing minerals eventually cemented the surrounding gravels into a resistant layer several feet thick.

Subsequent erosion left portions of the resistant layer which provided an erosional shield over the directly underlying gravel. The rest was eroded to a lower level, leaving a pillar-like formation. The photographer was fortunate that an earthquake did not occur during his examination.

Send a photo of your pet rock to: [ken.helmold@alaska.gov](mailto:ken.helmold@alaska.gov)



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The Alaska Geological Society is an organization which seeks to promote interest in and understanding of Geology and the related Earth Sciences, and to provide a common organization for those individuals interested in geology and the related earth sciences.

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## MEMBERSHIP INFORMATION

AGS annual memberships expire November 1. The annual membership fee is \$25/year (\$5 for students). You may download a membership application from the AGS website and return it at a luncheon meeting, or mail it to the address above.

Contact membership coordinator Kirk Sherwood with changes or updates (e-mail: [membership@alaskageology.org](mailto:membership@alaskageology.org); phone: 907-334-5337)

All AGS publications are now available for on-line purchase on our website. Check to see the complete catalogue:

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## Alaska Geological Calendar of Events

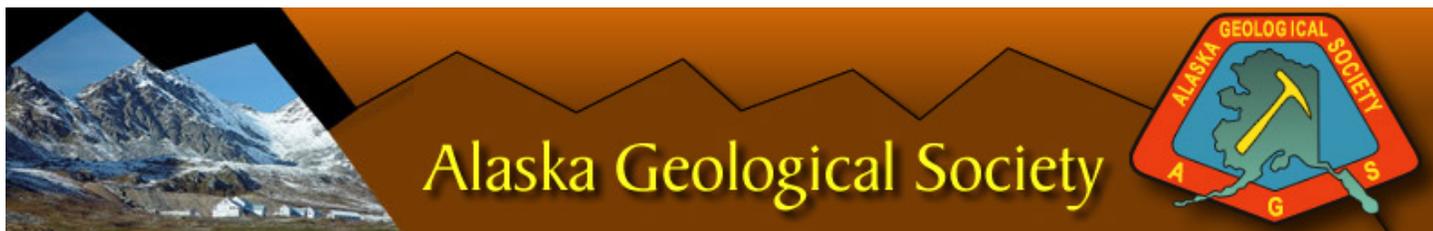


Date	Time	Organization	Event	Location
Nov 19, 2020	11:45 am	AGS	Carl Tape, UAF, Recording the aurora at seismometers across Alaska	Google Meet
Dec 17, 2020	11:45 am	AGS	Steven Bergman, Retired, "Links between Phanerozoic Large Igneous Provinces (LIPs), Petroleum Systems, and Source Rocks"	Google Meet
Jan 21, 2020	11:45 am	AGS	Michael West, Alaska Earthquake Center, "The 2020 M7.8 Simeonof Earthquake and the end(?) of the Shumagin Islands Seismic Gap"	Google Meet
Feb 18, 2021	11:45 am	AGS	Elyse Gaudreau, University of Victoria, "Imaging active tectonics in the remote Brooks Range, Alaska: the 2018 Kaktovik earthquakes"	Google Meet
March 18, 2021	11:45 am	AGS	Brandon Browne, AK DGGS, Stratigraphic and petrologic aspects of a large (1980 Mt St Helens size) eruption from Aniakchak volcano 400 yrs ago	Google Meet
April 15, 2021	11:45 am	AGS	Palma Botterell, USGS, New North Slope oil geochemistry work	Google Meet
May 20, 2021	11:45 am	AGS	Montana Hodges and others, various organizations, Jurassic arc rocks near Seldovia	Google Meet

**AMA:** Alaska Miners Association; **AGS:** Alaska Geological Society; **GSA:** Geophysical Society of Alaska

**AAEP:** Alaska Association of Environmental Professionals; **SPE** Society of Petroleum Engineers;

**UAA** University of Alaska Anchorage.



# Alaska Geological Society

## Seeking new members for AGS Scholarship Committee

This is a challenging year for students at all levels, and geoscience students in the universities need our support more than ever. When you pay your membership dues this fall, please consider a contribution to an AGS scholarship fund. AGS is a 501c3 nonprofit organization and all contributions are tax deductible.

The scholarship committee will be meeting virtually this year -- which means you can participate from any remote corner of the earth. It is exciting to learn about all the new geological projects going on around Alaska, and very rewarding to support these up and coming young geoscientists. It's a small time commitment: scholarship applications are due February first, and the committee meets the last week of February to choose candidates.

If you have time and are interested in participating on the scholarship committee this year, please contact Sue Karl; you can find her contact information on the AGS website under the scholarship tab.

### Membership Note

Membership renewal is November 1; annual dues are:

*Full member - \$25*

*Student member - \$5*

*Lifetime membership - \$250*



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