LOS ANGELES BASIN GEOLOGICAL SOCIETY

March 2023 Meeting Announcement

A Source to Sink Understanding of Sediment Transport in Southern California: Landslides, Beaches, Coastal Cliffs, and Organic Carbon Jargon

Thursday, March 23rd, 11:30 start
Signal Hill Petroleum, 2633 Cherry Ave., Signal Hill, Conference Room, 2nd floor
The LABGS extends their sincere appreciation to Brady Barto and SHP for their continued support with the provision of a venue!

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General Abstract

The Critical Zone is a living, breathing, constantly evolving boundary layer where rock, soil, sediment, water, air, and living organisms interact. To the geomorphologist, these complex interactions regulate the shape and evolution of the landscape; and are primarily governed by climate, tectonics, lithology, and time. To the ecologist and the engineer, sediment provides natural habitat and determines the availability of life-sustaining resources, which include our food production and water quality. It is an important resource globally. Moreover, Coastal lands host a disproportionately large fraction of the global population, with 2.4 billion people living within 100 km of the coastline. Half of the world's coastlines are backed by coastal cliffs—a number that is significantly higher (72%) for California. Cliff-backed coastlines are popular tourist destinations that bolster economies and livelihoods, provide habitat for diverse plants and animals, encode information about past sea level, tectonics, and store organic carbon that can be rapidly exported to the marine environment. These regions are, however, prone to sediment-related hazards, which are being accentuated by climate change and human activities.

The post-wildfire debris flows in Montecito, CA, (in 2018) evacuated ~1 million m^3 of sediment and boulders from mountain canyons to the highly urbanized fan and coastline while causing an estimated ~$1 billion in damages and economic losses, in 20 minutes. In this talk, I will use the Montecito debris flows and 100 years of beach and cliff data along the Santa Barbara coastline as a case study to investigate sediment transport, landscape evolution, and assess natural hazards. Specifically, I will explain how debris flows are constructed and shape the landscape, how beaches and the lithology regulate the rate of coastal retreat, and how sediment transport processes affect the long-term

transport and storage of organic carbon, which in turn, regulates the Earth's climate over longer timescales. I will also attempt to explain how sediment transport and storage over long-timescales (decades – millennia) highly influences landscape form and processes over timescales from minutes to decades. How was the largest debris flow in recent California constructed and what can we learn from these types of high-magnitude events? How do beaches and the lithology regulate the rate of cliff retreat and, in turn, play a role in regulating Earth's climate? Stay tuned to find out.

Beach-Cliff Abstract

Retreating coastal cliffs also present a major coastal hazard that is likely to be accentuated by climate change and human interference. Theory and physical experiments indicate that beach width could play a crucial role in regulating cliff retreat; however, we lack field testing of this hypothesis because of the scarcity of natural observations. Here, we show that, for a given rock type, cliff-retreat rates may increase linearly with beach width up to a critical value (~5-10 m). Beyond this critical beach width, retreat rates decline exponentially, and the maximum retreat rate is set by the compressive strength of the cliff-forming material at the cliff base. The results highlight the role of beach width in regulating coastal cliff retreat, with implications for future hazard mitigation and assessment of the impacts of beach nourishment strategies.

Debris Flow Abstract

In California, the number of deaths from natural hazards has declined over the last three decades, however, the cost of these types of hazards (post-wildfire debris flows and flooding) has been increasing. Most recently, moderate rates of precipitation have caused localized flooding, landslides, flood warnings, and road damage around the state. For example, Since December 2023, the state has faced an exceptionally wet winter after being plagued far more by drought in recent years, and the Governor declared state of emergency in 52 counties. Landsliding and other mass wasting events have led to a risk of catastrophic flooding and evacuation of nearly 200,000 residents and has left ~350,000 residents without power. How, as geologists, can we use our understanding of geomorphology, sediment transport, and landscape evolution to live sustainably and comfortably within our environment?

We used lidar differencing and field observations to map volumes, and interpret the origins of, sediment mobilized from mountain canyons by large post-wildfire debris flows near Montecito, CA, USA in 2018. The debris flows progressively entrained and partially redeposited 550,000 m^3 of previously stored channel sediments throughout the canyon networks. The observations that scour depths and volumes were highest where the largest volumes of bouldery colluvium and debris-flow deposits had accumulated, and that scour persisted beyond the mountain front, indicates that debris-flow volumes in this extreme event were ultimately controlled by the coarse sediment reservoir available for scour. Because the volumes of available stored sediment result from the stochastic interaction of colluvial mass wasting, the magnitude and frequency of previous debris flows, and the accommodation space provided by valley morphology, the study reinforces the importance of estimating stored sediment volumes when developing debris-flow hazard assessments.

Speaker's Biography

Paul Allesio is a Postdoctoral Scholar at the University of California Santa Barbara, where he recently completed his PhD in coastal geomorphology. Before starting graduate school, he worked for the US Geological Survey and earned a BS in Geology at CSULB in 2013.

Paul's research is focused on understanding how the Earth's surface is sculpted by a suite of erosional processes that vary with land use, climate, tectonics, and time. He conducts fieldwork, uses remote sensing, and implements modeling to test theoretical relationships and understand the rates and mechanics of processes that transport rock and sediment from hillslopes, stream channels, and coastal cliffs over various timescales. He is interested in how these erosional processes contribute to the global carbon cycle and how to utilize this information to assess and mitigate the geologic hazard potential from storm-driven landslides, post-wildfire debris flows, and sea-level rise.

Luncheon Prices, cash or check

Lunch and Talk (pre-registered)	$25.00
Retired:	$20.00
Student:	$10.00
Walk-ins:	$35.00

Logistics

Location: Signal Hill Petroleum, 2633 Cherry Ave., Signal Hill, 2nd floor conference room.

Reservations are required by noon, Monday, March 20th at labgs.org/meeting_info.html. Alternatively, contact LABGS Secretary Joseph Landeros at (626) 497-1710 or landerosjd@gmail.com.

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"All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident."

- *Arthur Schopenhauer (1788 – 1860)*

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