PROJECT TITLE: **Tracking the topographic evolution of the Sierra Nevada, California**
DTP Research Theme(s): Dynamic Earth
Lead Institution: University of Bristol
Lead Supervisor: Dr Frances Cooper, University of Bristol, School of Earth Sciences
Co-Supervisor: Dr Byron Adams, University of Bristol, School of Earth Sciences
Co-Supervisor: Dr Simon Tapster, British Geological Survey, Geochronology and Tracers Group
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Project keywords: Tectonics, Landscape evolution, Petrology, Geochemistry, Geospatial Analysis

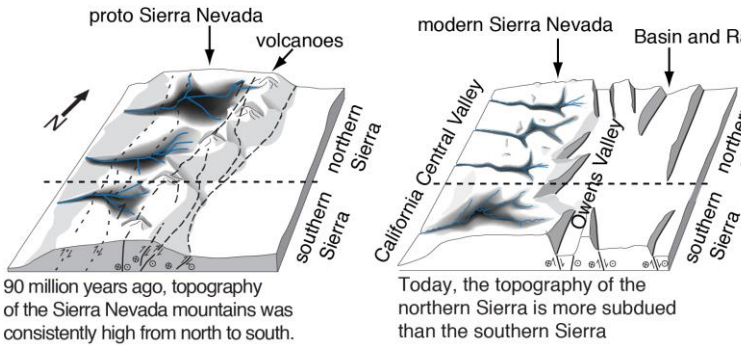

Fig. 1. Possible topographic evolution of the Sierra Nevada from the Cretaceous proto Sierra Nevada to today [1].

Fig. 2. Yosemite Valley in the western Sierra Nevada, Central California.

Project Background

The Sierra Nevada mountains in California are an enormous granitic batholith created in the late Cretaceous during subduction of the Farallon Plate beneath North America. Forming part of the North American Cordillera, the Sierras stretch for 600 km and increase in elevation continuously from north to south, reaching peaks of >4,000 m. However, the reason for this variation in elevation, and when it evolved, is unclear [e.g. 1,2]. It is thought that the range originally had a consistent peak elevation of ~1500 m [2], but subsequent differential uplift and erosion created the more complex landscape seen today. This PhD project will place new constraints on the topographic evolution of the Sierra Nevada by combining a new calibration of the aluminium-in-hornblende barometer developed at Bristol [3] with U-Pb zircon geochronology, geomorphology, and geospatial analysis. These elements will be integrated to derive new insights into the controls on topographic evolution.

Project Aims and Methods

The primary aim of this project is to determine the topographic history of the Sierra Nevada from Cretaceous emplacement of the Sierra Nevada batholith until the formation of an extensive, preserved Eocene erosional surface. The research will include fieldwork to collect samples for barometry and geochronology, laboratory analyses, and geospatial analysis. There are three main objectives:

1: Constrain emplacement depths and ages of granitic intrusions across the Sierra Nevada

Samples will be collected from locations across the range, targeting appropriate mineral assemblages for aluminium-in-hornblende barometry and U-Pb zircon geochronology. **Mineral compositions will be determined via electron microprobe analysis at Bristol. U-Pb zircon ages will be determined via mass spectrometry at the British Geological Survey (BGS) in Keyworth.**

2: Map the Eocene relict landscape of the western Sierra Nevada

Mapping of the Eocene relict landscape will be carried out with quantitative topographic analysis using ArcGIS and Matlab. This mapped surface will provide a datum to which the emplacement ages and depths will be referenced.

3: Determine the topographic evolution of the Sierra Nevada

By combining the outputs of objectives 1 and 2, the student will determine the Cretaceous–Eocene topographic history of the Sierra Nevada and test existing hypotheses for the evolution of the range.

Candidate Requirements

This project would suit a quantitative geoscientist with a strong interest in tectonics and landscape evolution who is keen to develop laboratory skills and integrate them with fieldwork and mapping. Programming or GIS experience is desirable but not essential. The student will be required to carry out fieldwork in the rugged and often remote Sierra Nevada mountains so independence, physical fitness, and an ability to drive will be important.

CASE or Collaborative Partner

The project is cross-institutional and international between the University of Bristol, the BGS and California State University, Fullerton. The BGS will provide up to £11,000 of additional research costs to support fieldwork, conference attendance, access to analytical facilities, or travel and subsistence whilst at the BGS. The student will spend at least 1 month per year at the BGS during the course of the project.

Training

The student will receive training in field work, laboratory analyses, and computer programming. Dr Frances Cooper will support the student in field work, sample preparation, and geochemical analysis. Dr Byron Adams will train the student in quantitative topographic and data analysis in GIS and Matlab. Dr Simon Tapster will train the student in U-Pb zircon geochronology. Dr Vali Memeti will provide support in the field and expertise in Sierra Nevada geology. Combined, the supervisory team will supervise the candidate in project design, data synthesis and hypothesis testing.

References / Background reading list

[1] Wakabayashi, 2013, Paleochannels, stream incision, erosion, topographic evolution, and alternative explanations of paleoaltimetry, Sierra Nevada, California, Geosphere, v. 9, doi: doi.org/10.1130/GES00814.1.
[2] Clark et al., 2005, The non-equilibrium landscape of the southern Sierra Nevada, California, GSA Today, v. 15, no. 9, doi: 10:1130/1052-5173(2005)0152.0.CO;2.
[3] Mutch et al., 2016, An Experimental Study of Amphibole Stability in Low Pressure Granitic Magmas and a Revised Al-in-Hornblende Geobarometer, *Contributions to Mineralogy and Petrology*, v. 17, doi: 10.1007/s00410-016-1298-9.

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The application deadline is 1600 hours GMT Monday 6 January 2020 and interviews will take place between 10 and 21 February 2020

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