

# **PS Petrographic Analysis and Provenance of Ground Stone Tools from the Northern Channel Islands and Coastal Southern California\***

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## **Abstract**

Eighteenth century Spanish explorers observed and documented the exchange of tools and goods between various Chumash tribes in Southern California. Mortar, pestle, and matate samples from documented archeological sites on the northern Channel Islands and within the northern California Bight Regions consist of a range of lithologies, including sandstone, volcanic rocks, and sedimentary concretions. By identifying where stone tools were produced in relation to the locations where they were ultimately found, our study attempts to provide constraints on the reconstruction of trade relationships of the indigenous people. Petrographic analyses and detailed descriptions on a sample set of these tools will aid in determining the correlative source lithologies from the area, providing insights to the extent of Chumash trade networks within the late Holocene. Exposures of volcanic rocks and resistant sandstones located throughout the northern Channel Islands are known resources and stone tool production sites used by the Chumash. Archaeologists and geologists have rapidly progressed the understanding of many cultures throughout the world by determining provenance of implement artifacts. The Chumash have an extensive history, and by applying petrographic analysis and detailed descriptions of these samples, we can further grasp the culture of these prominent and important peoples.

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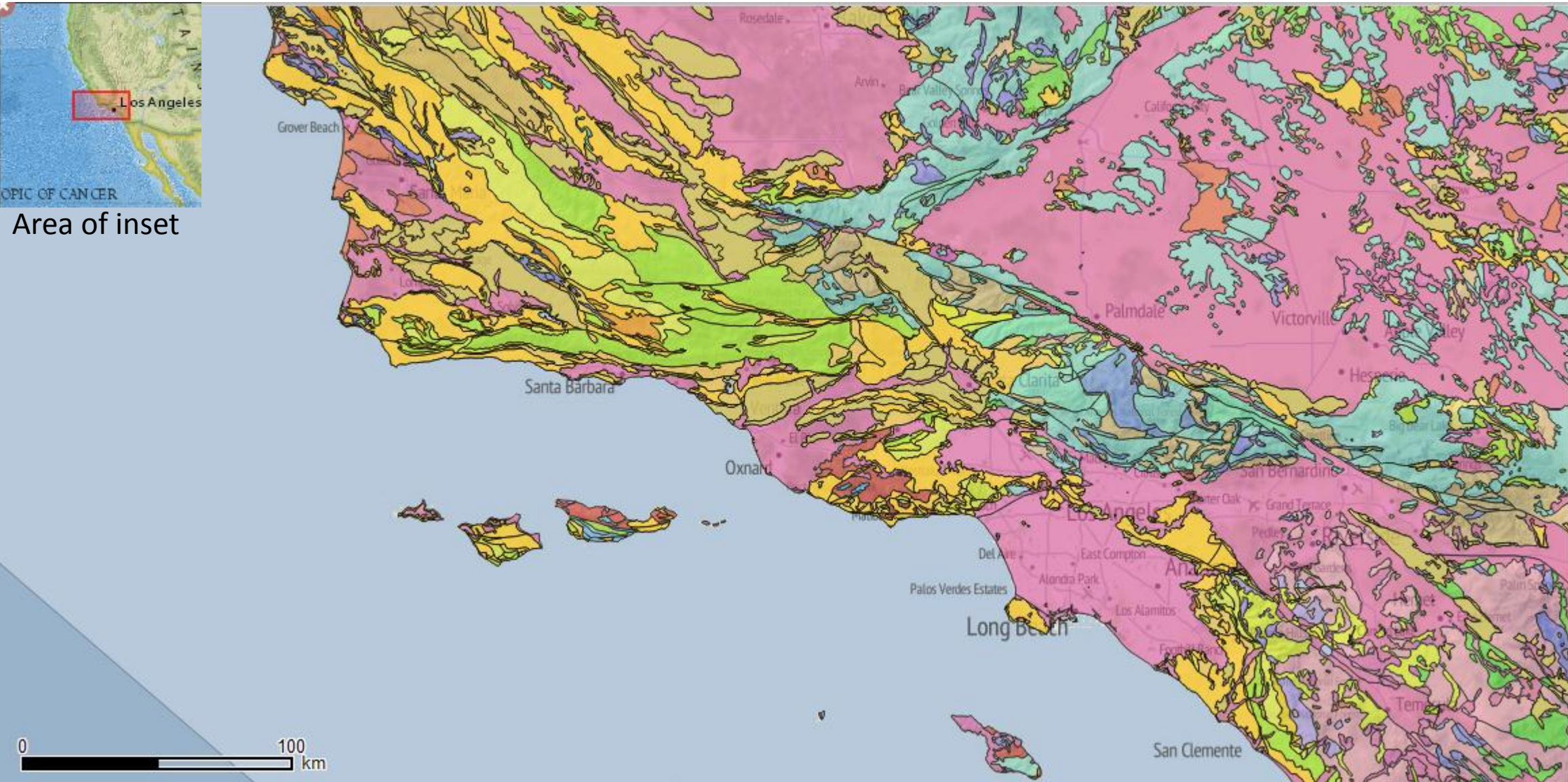


## -Abstract-

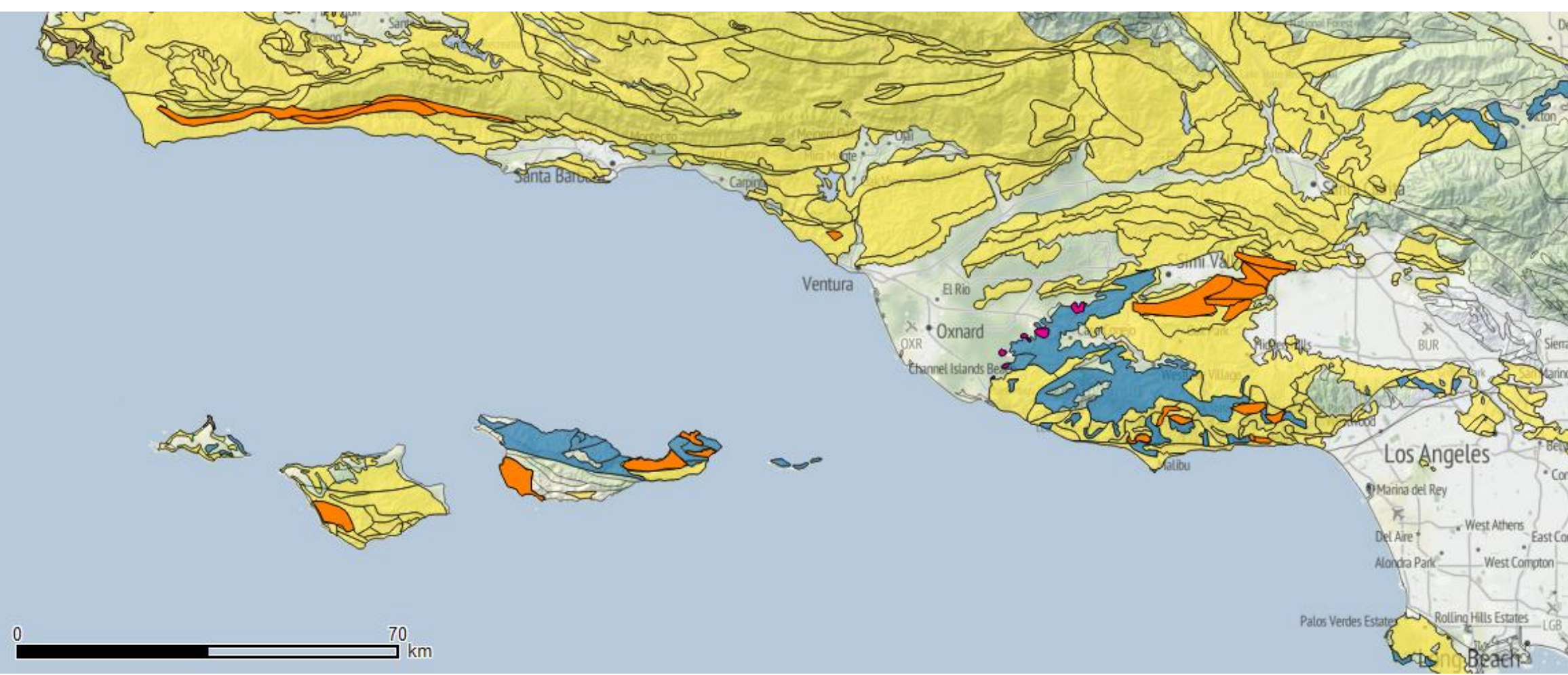
Mortar and matate samples from documented archaeological sites on the northern Channel Islands and the northern California bight region consist of a range of lithologies, including sandstone, volcanic rocks, and sedimentary concretions. Eighteenth century Spanish explorers observed and documented the exchange of tools and goods between various Chumash tribes in southern California. By identifying where stone tools were produced in relation to the locations that they were ultimately found, our study attempts to provide constraints on the reconstruction of trade relationships of the indigenous people. Petrographic analysis and detailed descriptions on a sample set of these tools will aid in determining the correlative source lithologies from the area, providing insights to the extent of Chumash trade networks within the late Holocene. Exposures of volcanic rocks and resistant sandstones located throughout the northern Channel Islands are known resources and stone tool production sites exploited by the Chumash. By identifying potential source outcrops, we have found that sources for this set of tools are in some cases relatively limited. Archaeologists and geologists have rapidly progressed the understanding of many cultures throughout the world by determining provenance of implement artifacts. The Chumash have an extensive history, and by applying petrographic analysis and detailed descriptions of these samples, we can further grasp the culture of their unique society.

## Sample types and site localities

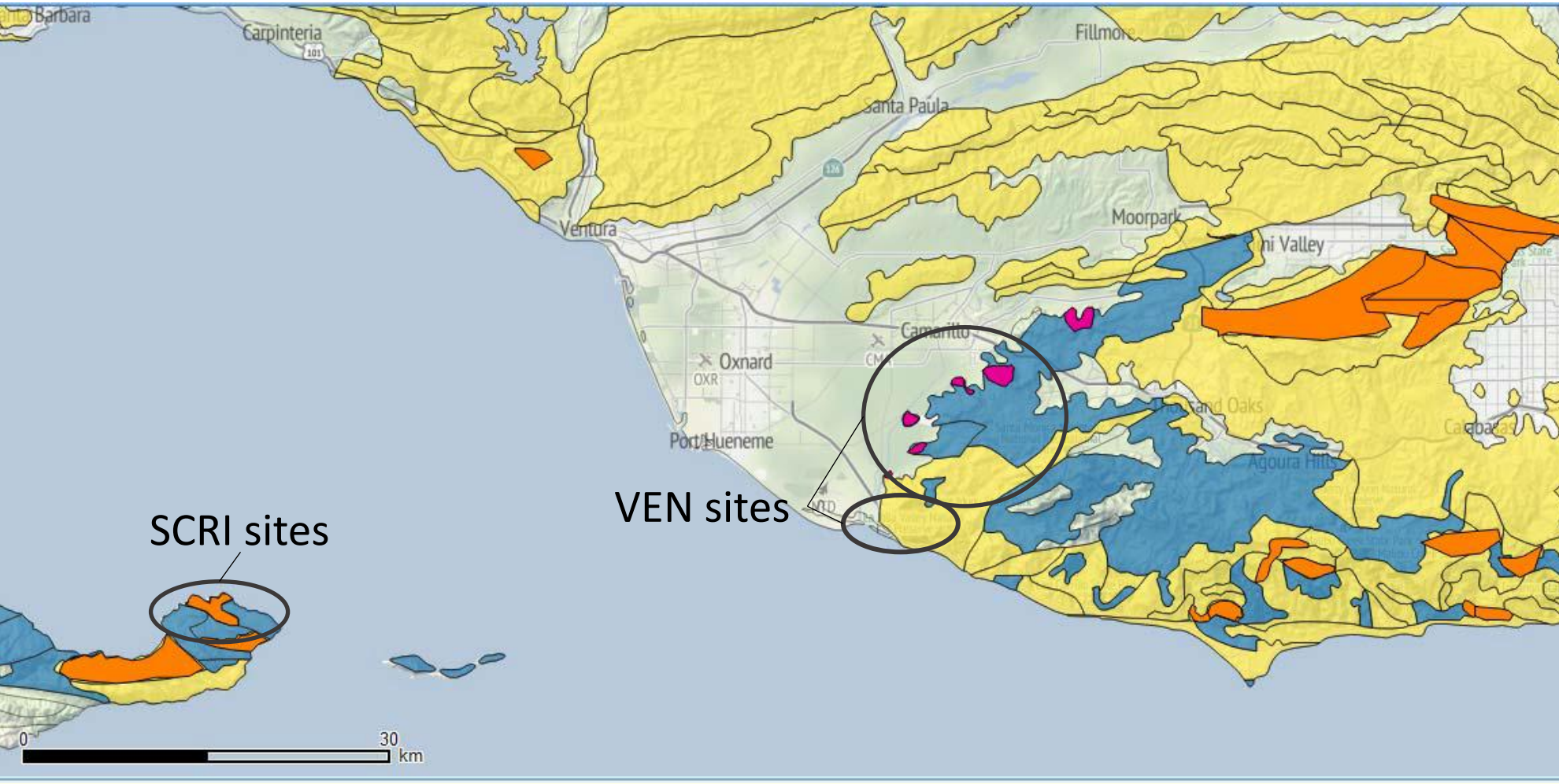
	Sandstone	Basalt	Dacite/Dacitic	Mafic Volcanic
SCRI sites	5			
VEN-863	4		1	
VEN-24	1		1	
VEN-1429	2			
VEN-110	1			
VEN-249			1	1
UnKn VEN			1	
UnKn	1	1	1	



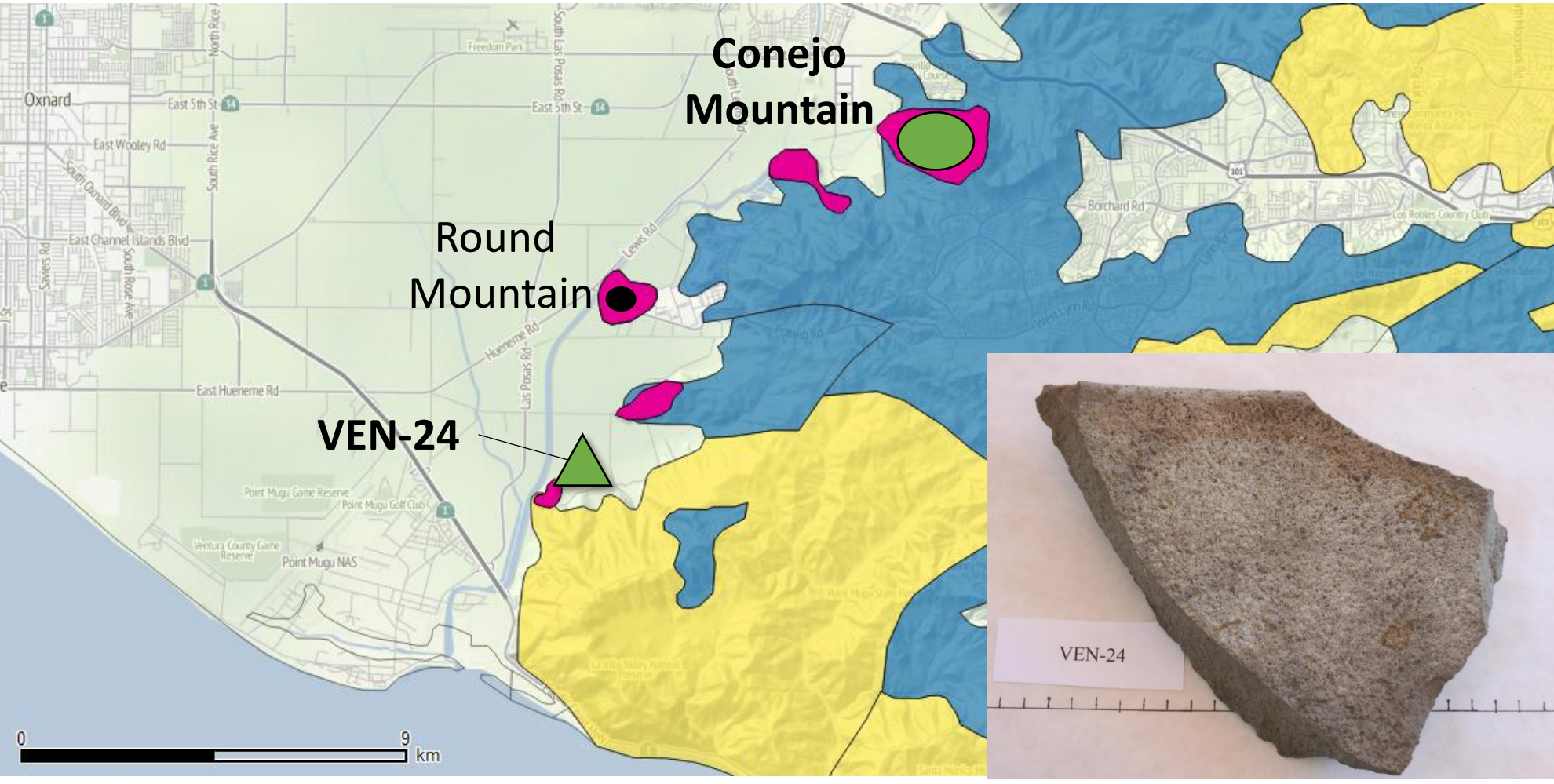
Regional geology map produced using QGIS 2.6.1-Brighton. Colors designate lithology by age.



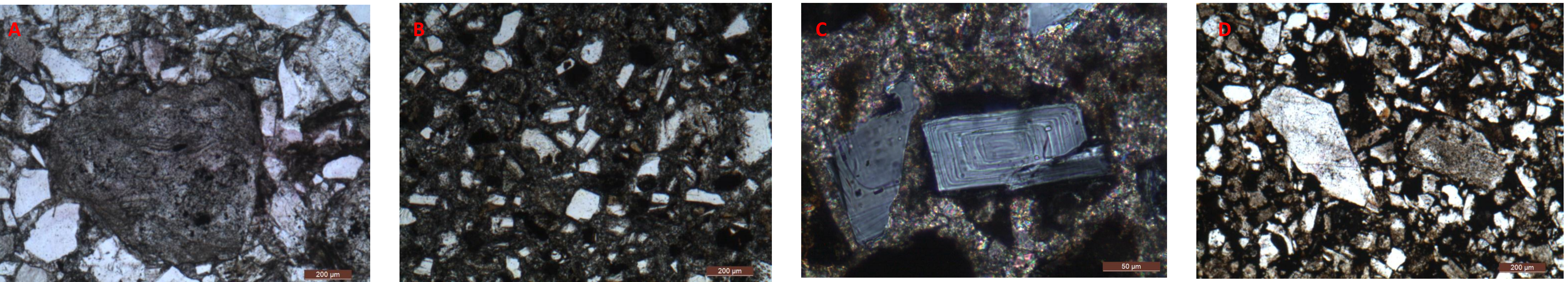
‘Potential Source’ map. Specified rock types by color. I have designated viable outcrops based on lithology (for sandstones: coherent, non-friable, well indurated samples are considered viable. For volcanics: dacite and dacite breccia are considered viable based on hand sample and thin section descriptions).



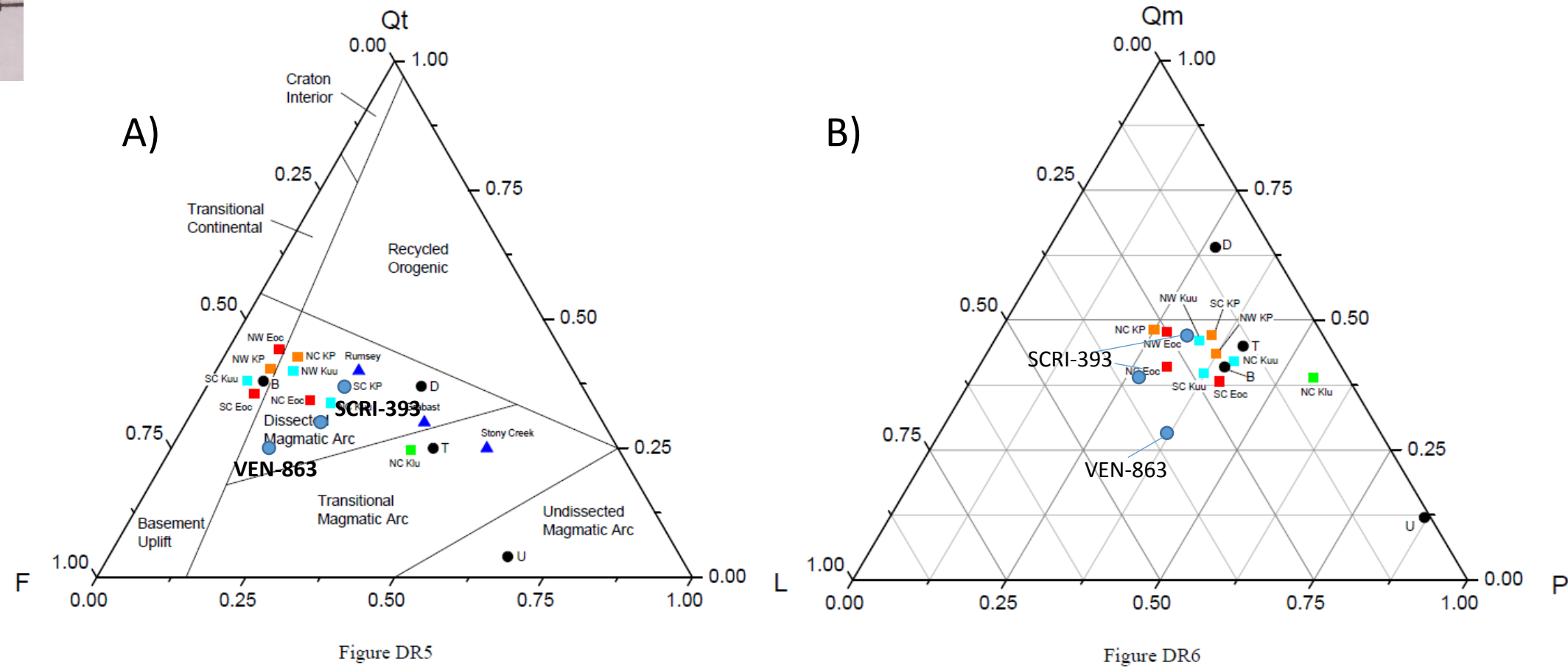
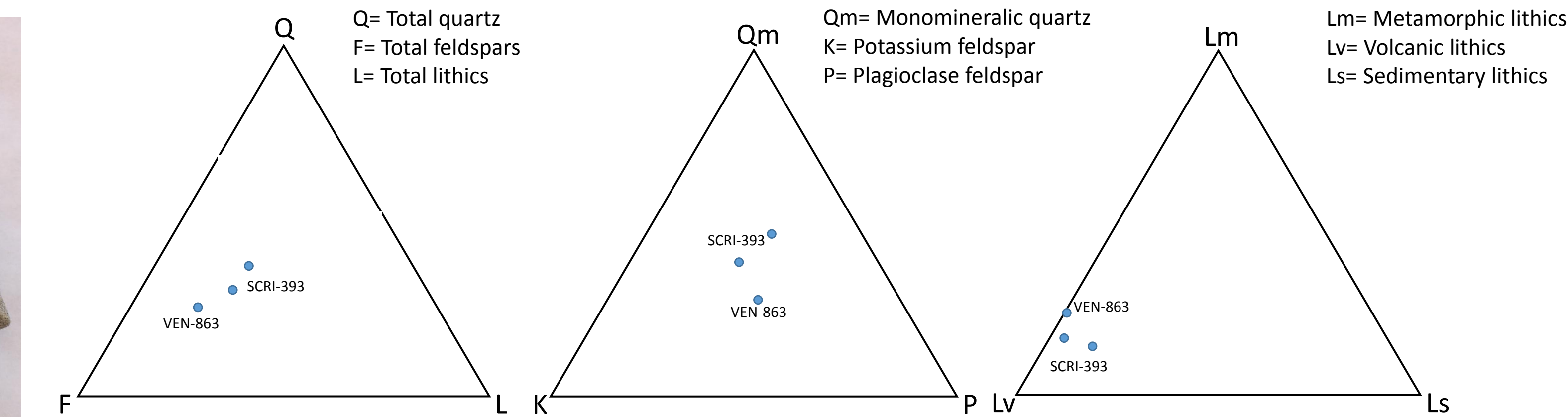
Zoomed in area showing localities of archaeological sites where samples were originally collected.



Further zoomed in area showing locality of site VEN-24. The nearest source of viable dacite is Conejo Mountain. All other magenta dacitic outcrops are dacite breccia, which is not viable for this particular sample (see inset image). This map illustrates that local natives were willing to transport stone resources at least up to 8km in distance for desired properties. This particular sample is what is known as a “flower pot mortar”, given its size and resemblance to a large flower pot. These mortars were used ceremonially and have been documented to have been traded between tribes (Gamble, 2008).



These unique features and mineralogy may help distinguish between sandstones. A: Ignimbrite grain (PPL). B: Zoned (volcanic) plagioclase grains in dark calcite cement viewed in PPL. C: Higher magnification of a zoned plagioclase from the same sample as B, viewed in XPL. D: Bimodal nature of sample, with dark Fe-oxide rich cement (PPL).



Ternary plots from point counted data. The top three plots contain data from this study in an attempt to determine provenance of samples.

A) QFL plot modified from Jacobson et al., 2011 with QFL data from this study overlain. These particular samples plot within the Dissected-Magmatic-Arc zone, with the other southern California sandstones.  
B) QmKP plot from the same reference with data from this study overlain.

## -Methods-

A set of groundstone mortars and matates was compiled from collections from the Anthropology departments of CSUN and CSUCI. The samples were carefully cleaned and photographed prior to destructive analysis for thin section production. The hand samples were described using classification schemes after Williams et al. (1982) for sedimentary samples, and Le Maitre et al. (2002) for igneous samples. Using unit descriptions on geologic maps, such as those by Dibblee et al. (largest scale 1:24,000), a ‘potential source’ map was created using an open source GIS system. The potential units that have viable sandstone and volcanic units based on the sample descriptions show the limits of outcrop sources. Thin sections of each sample were made and stained for identification of calcium, sodium and potassium feldspars. Thin section descriptions followed, and artifacts were grouped based on their components and characteristics (i.e. grain size, sorting, cementation, etc.). While describing the thin sections, careful attention was paid to unique mineralogy and textural features that were used to group the samples. In cases where sandstones are particularly ambiguous, the Gazzi-Dickenson point counting method has been implemented to constrain source lithologies and to either differentiate or assemble such sandstones.

## -Preliminary Results & Discussion-

- Volcanic samples appear to be locally sourced
- Sandstones may be ambiguous, but by point counting, we can determine the provenance and link them to appropriate units

The native Americans of the region had an incredibly complex chiefdom society. Tribes were specialized in craft skills which resulted in the trading of goods between groups (Gamble, 2008; Glassow et al., 2007). This is especially interesting considering the trade of goods between natives of the Channel Islands and the mainland. It is known that secretive island tribes specialized in crafting canoes known as ‘Tomols’, and that they were capable of carrying heavy loads as well as many passengers (Arnold, 1992). It is known that obsidian was a traded good to the islanders, and is sourced from the mainland, and until recently petrographic sourcing of tools on the islands has been focused on chert and obsidian (Braje 2010; Jew et al, 2013). By petrographically analyzing the stone implements used by the native peoples, we can infer trade or movement of goods between individual tribes on the mainland and Channel Islands.

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