

## Application for a 2008 GSA Research Grant

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**Name:** John Abeid  
5500 Campanile Dr., San Diego  
San Diego State University  
Master's in Geological Sciences  
Structural history of western North America

**Project Title:** Provenance study of Eocene fluvial drainage patterns and topographic evolution of the southwest U.S. Cordillera

**Project Supervisor:** Kimbrough

**Academic Info (Department Address):** SDSU – Dept. of Geological Sciences

**Clearly state the problem(s) to be addressed, the hypothesis or hypotheses to be tested, and the overall objectives of your proposed project. (1,000 character limit):**

Eocene fluvial deposits of the Ballena and Las Palmas gravels in southern and Baja California (Minch, 1972; Abbott, 1979) constrain the topographic evolution of the Cordilleran orogen. Recent work shows that integration of the modern Colorado River at ~5 Ma marked the final stage in a protracted process that shifted the continental divide of North America 100's of km east to the eastern margin of the Rocky Mountains (Spencer, 2007). During the early Tertiary the Maria fold-thrust belt and Mogollon rim apparently formed the divide in the SW Cordillera. Provenance and paleohydrologic study of the Ballena river indicate it was sourced in northern Sonora at 2500 to 4000 meters elevation (Steer & Abbott, 1984), presumably near or at the paleo-continental divide to the south of the Mogollon rim. If this is correct, then Paleocene-Eocene "Rim Gravels" of Arizona that flowed N and E across the southern Colorado Plateau (Elston & Young, 1991), likely represent a complementary drainage system to the Ballena and Las Palmas rivers on the opposite side of the continental divide. This project will test this hypothesis by detailed provenance analysis of the Ballena, Las Palmas, and Rim Gravels.

**Discuss the previous work on your problem(s) that (1) places the project in a disciplinary and, if appropriate, regional context and (2) documents the importance of your project. (2,500 character limit):**

The "elevated erosion surfaces" and distinctive exotic "Poway" conglomerate clasts are outstanding features of northern Peninsular Ranges geology that have received enormous attention (e.g. Minch, 1972, 1979; Abbott, 1979). The erosion surface (Ballena-Las Palmas surface) was exhumed by late Cenozoic Peninsular Ranges rifting associated with opening of the Gulf of California, and developed initially in response to distinct phases of erosional denudation culminating in latest Cretaceous-early Tertiary Laramide time (Grove et al., 2003). The Poway

clasts include resistant reddish rhyolitic to dacitic metavolcanic rocks and lesser quartzite that are part of west-flowing fluvial systems that established themselves across the erosion surface (e.g. Kennedy, 1975). The source of these clasts is controversial and has received much attention (DeLisle et al., 1965; Woodford et al., 1968; Minch, 1972). The distribution of Poway clasts has been used to constrain tectonic reconstructions of the California continental borderland (e.g. Howell and Link, 1979). Based on clast size Kennedy (1973) inferred that the conglomerates were probably derived from a now eroded source terrain within 150 km of San Diego. Steer and Abbott (1984) and McDonough and Abbott (1989) in contrast concluded that the source was in northern Sonora approximately 300 km away from the San Diego region during the Eocene.

Most of the interest and work on Eocene Ballena and Poway river systems in San Diego and northern Baja relates to the extent of the drainage systems and implications for borderland geology. The focus on this study concerns their significance within the broader context of changes in the physiography of southwestern North America. Spencer (2007) emphasizes major eastward shift in the continental drainage divides in the Cenozoic. The scale of the Ballena and Eocene river systems suggest the headwater may have been at or near the continental divide at this time.

***Concisely state how you plan to address your problem(s) and test your hypothesis or hypotheses (2,500 character limit):***

This is a provenance study that will focus on conglomerate clast composition. Field work will focus on collecting conglomerate clast suites for thin section and analytical work. Careful study of conglomerate clasts in outcrop supported by detailed clast counts at each locality will allow for collection of representative clasts from different areas. Conglomerates obtained from the Poway conglomerates of San Diego, the Rim Gravels of Arizona and the Ballena and Las Palmas gravels of Southern and Baja California will be studied petrologically, chemically by X-ray fluorescence to determine whole rock major and trace element compositions, and dated using the U-Pb ratios of zircon. Point counting of thin sections will compare clasts with potential source rocks for provenance analysis.

Because we're comparing these "gravels" to the Eocene Poway conglomerates, understanding these clasts initially is fundamental in recognizing similar conglomerates that may be present within the Rim Gravels. Preparation of samples will include cutting billets for thin section and powdering samples for zircon separation and XRF chemical analysis. Aliquots from bulk zircon separates will be analyzed at the University of Arizona LaserChron Center for U-Pb dating by Multicollector Inductively Coupled Plasma Mass Spectrometer, determining age distributions. Only four U-Pb zircon ages of Poway conglomerate clasts exist right now (Abbott and Smith, 1978) and these vary over a range of ~20 Ma.

***Duration of investigation (dates):*** late March - early April 2008

**Budget: LIST IN ORDER OF PRIORITY AND JUSTIFY IN DETAIL, for example, funding of chemical and isotopic analysis, equipment, technicians and expendable laboratory supplies is necessary for consideration. Grants are made for one year only.**

Food	survive field trip	\$ 150
Gas	2400 mi * 0.33/ mi (AZ)	\$ 792
Mexican Vehicle Insurance	One Vehicle	\$ 100
Tools	2 Wedges * \$12	\$ 24
Thin Sections	~120 thin sections * \$12 per =	\$1440
U-Pb Laser Ablation ICPMS	16 samples	\$1280
XRF Chemical Analysis	Provided by SDSU	0

**Total \$3786**

**Available funds, facilities, materials, etc.**

Facilities, XRF chemical analysis, and the majority of available research materials will be provided by the Department of Geological Sciences at San Diego State University. Sample obtaining tools (sledge hammers, chisels) will be provided by the department and John Abeid.

**\*References cited in proposal (2,500 character limit):**

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