Scott E.K. Bennett - NGEN 6&6 Scientist

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I am a geologist, tectonicist, and earthquake scientist. My interdisciplinary, collaborative, international research focuses on quantifying natural Earth processes that yield insight into plate tectonic systems. I study the crustal deformation of continents, collecting data that allow me to reconstruct past tectonic movements over a large range of temporal and spatial scales, from individual earthquakes to millions of years of plate motion.

I combine observations and measurements from field-based geologic mapping with those from remote sensing datasets. I integrate these findings with precision analytical laboratory techniques, such as isotopic dating and paleomagnetism, to quantify and visualize rates of geologic processes such as tectonic plate motion, fault slip, and the formation of large seaways such as the Gulf of California.

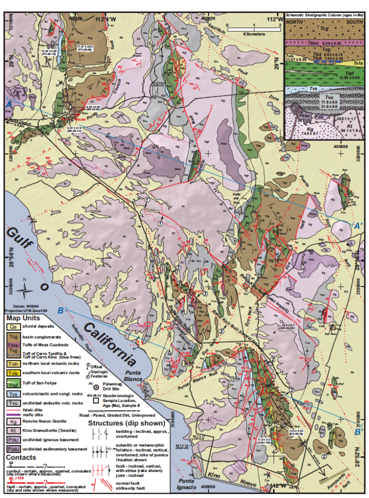
My Gulf of California and Sonoran Desert research can be classified at 3 scales:

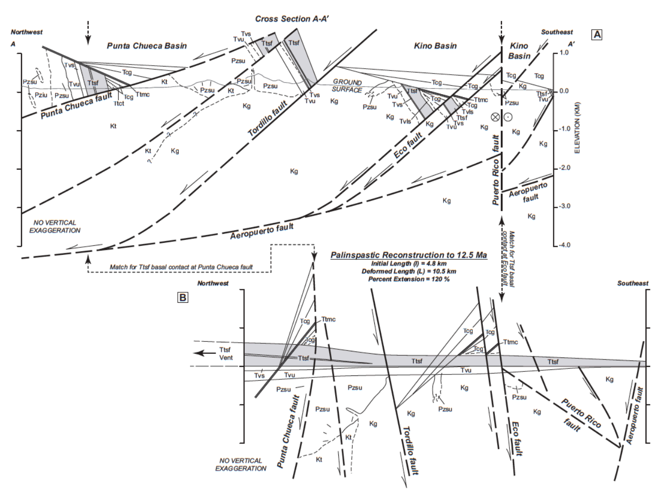
(1) THE FAULT ZONE

The nitty gritty questions about any fault zone typically include:

When was it active? Is it still active?
What is the sense (strike-slip, normal, reverse) of relative fault motion?
How much relative motion occurred on this fault?

The answers to these questions require detailed geologic-tectonic mapping of an area and geochronology and/or biostratigraphy to determine the age of the exposed rocks. I use high-resolution satellite imagery (Quickbird) and topographic maps and contours (SRTM) as my base maps, drawing an intricate array of faults and geologic contacts (lines!) on an overlay of transparent mylar. I collect rock and/or fossil samples that are later used to determine the age of the rocks. Usually, older rock units are faulted and younger rock units are not faulted, and knowing the age of these units helps determine the timing and duration of fault activity. Final products include geologic maps, geologic cross-sections, and data plots for rock ages. I have studied fault zones in central Sonora, on Isla Tiburón, and in the Sierra Cucapah San Pedro Martír of northeast Baja California.

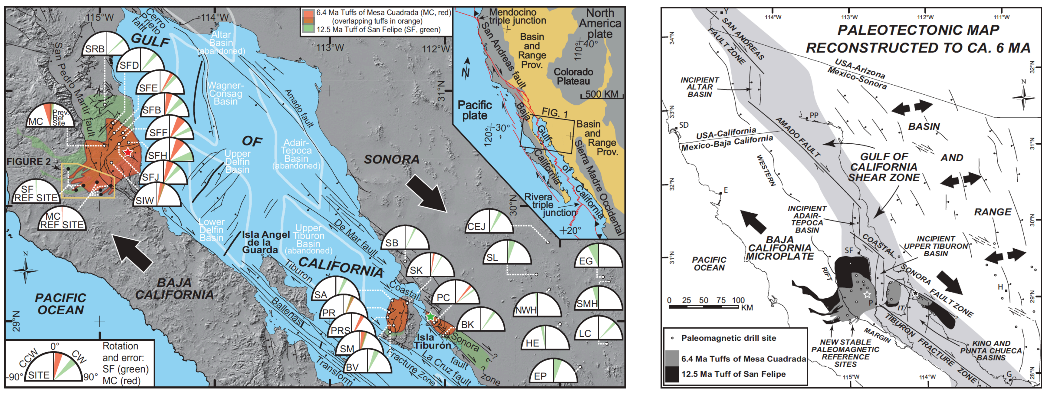




(LEFT) Geologic map of coastal Sonora, near Bahía de Kino. (RIGHT) Geologic cross-section (above) and restored cross-section (below) of the region. (Bennett et al., 2013, Geological Society of America Bulletin).

(2) THE RIFT

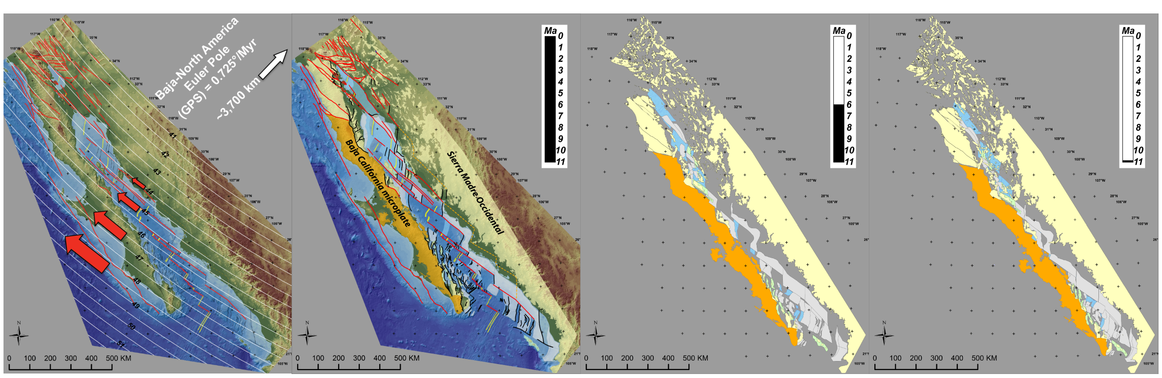
A rift, geologically speaking, commonly leads to continental break up: think of the supercontinent Pangea breaking up into smaller continents such as Africa and South America. This same rifting process is in its infancy in the Gulf of California, a process that allowed the sea to flood into the Gulf of California only ~8 to 6 million years ago, starting forming oceanic crust ~4 million years ago, and continues to widen the Gulf of California today with every earthquake. A common attribute to rifts is that you can match their edges (or rift margins) by reversing plate tectonic motion. I study correlative volcanic deposits exposed in northeastern Baja California and on Isla Tiburón and in coastal Sonora. These deposits were once adjacent to each other, portions of a once-continuous pile of hot ash and pumice from enormous volcanic eruptions that occurred 6 to 12 million years ago. I use a combination of geologic mapping (described above) and paleomagnetism of these volcanic rocks to determine the best reconstructed position of these regions before the Gulf opened, and to estimate the distribution of faulting across the rift margins.



(LEFT) Map of volcanic rocks and paleomagnetic sites on both rift margins of the northern Gulf of California. (RIGHT) Map-view restoration of the northern Gulf using matching volcanic rocks from both rift margins (Bennett & Oskin, 2014, Geology).

(3) THE TECTONIC PLATE BOUNDARY

At the largest tectonic scale, the plate boundary, the Baja California peninsula is being wrenched to the northwest, obliquely away from mainland Méxcio. Baja California is part of the Pacific plate and mainland México is on the North America plate, the same plates that grind past each other along the San Andreas fault in California. I am co-leading collaborative research to create tectonic reconstruction maps and digital animations of the Gulf of California and Salton Trough regions in one million year increments back to 12 million years ago (Miocene time). These animations show the details of how Baja California restores to its original position adjacent to mainland México several million years ago. I have also participated in interdisciplinary research with biologists and geneticists exploring the geologic and climatic forcing of species diversity around the Gulf. This project aimed to merge the earth science and biological science fields in their parallel investigations of long-term scientific processes.



(LEFT) Tectonic map of the Gulf of California region, showing isolines of Pacific-North America relative plate motion in mm/yr (or km/Myr). (RIGHT 3 PANELS) Tectonic reconstruction maps at 0 Ma, 6 Ma, and 11 Ma (modified from Bennett et al., 2013, AGU talk). Tectonic animation available [HERE](#).