To Brownbag, Tuesday Feb 7, 2012
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Siting of Large Volcanic Centers at Releasing Fult stepovers, Walker Lane Rift

Abstract:

The transtensional eastern boundary of the Sierran microplate (Walker Lane rift) represents the northernmost extension of the Gulf of California rift, and it forms an onland analog in several ways. It formed at the same time (about 12 Ma), by a similar mechanism: transtension within the thermally- and structurally-weakened axis of a subduction-related arc. The two segments show similar structural trends: NE oblique slip normal faults (Walker Lane) or seafloor spreading centers (Gulf of California), connected by long NNW strike slip faults. However, the process of continental rupture has not yet been completed in the Walker Lane, so the structural controls on transtensional rift volcanism can be directly observed on land. The Walker Lane segment also differs from the Gulf of California segment by showing a northward time-transgressive transition from arc rift magmatism to continental rift magmatism, following the northward migration of the Mendocino triple junction (MTJ). The effect of MTJ migration has been previously recognized in arc to rift geochemical transitions, but not in the timing of development of large arc volcanic fields.

For the past ~11-12 Ma, the biggest arc rift and continental rift volcanic centers or fields have been sited on major releasing fault stepovers on the trailing edge of the Sierran microplate. Additionally, major transtensional arc rift centers or fields appear to have progressively migrated northward with time, in advance of the TMJ, although gaps exist in detailed map and age data. These large transtensional arc volcanic fields/centers are, from south to north (oldest to youngest):
(1) A ~11 – 9 Ma arc volcanic field that lies along the Sierran crest and rangefront in the Sonora Pass – Bridgeport area of the central Sierra Nevada. Its transtensional structural setting and its size (~ 50 X 50 km) had not been appreciated prior to my field efforts with students, although a modest-sized caldera in this volcanic field had long been recognized ("Little Walker caldera" of Priest, 1979). At this center, "flood andesites" were erupted from 6–8 km long fault-controlled fissures and ponded in grabens, to thicknesses of 400 m, with single flows up to 25 km3 in volume. Total volume is difficult to estimate due to Pleistocene glacial erosion, but it is >200 km3.
(2) The Ebbetts Pass center, which formed at ~5–4 Ma (dating in progress with Paul Renne, BGC). This large center had not been recognized prior to our mapping; it appears to be a complex central volcano with a large footprint (>16 km diameter, glacially eroded). Its original volume may be better estimated after its collapse deposits are mapped and dated, because it appears to have repeatedly collapsed into range-front half grabens.

(3) The active Lassen arc volcanic center, which formed at <3.5 Ma in a transtensional environment “favorable to the development of major volcanic centers” (Muffler et al., 2008, EOS 8-53).

The active Long Valley rift volcanic field south of the MTJ also formed in a releasing bend in the Walker Lane transtensional rift (since ~4.5 Ma); the structure of this field (Jayko and Bursik, in press) is remarkably similar to that of the ~11-9 Ma arc rift volcanic field at Sonora Pass (Busby, in press; both in Tectonics of Sedimentary Basins, Wiley Blackwell, 2012).