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Character and significance of volcanism in the lower Colorado River extensional corridor; insight into extensional tectonics

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The Colorado River extensional corridor (CREC) is a superb natural laboratory for exploring the relationship between continental magmatism and extension. Stretching from southern Nevada to northern Mexico, this ~100-150 km wide region experienced both large magnitude extension and voluminous volcanism during the Miocene. Volcanic successions in Whipple Mountains and surrounding ranges in the lower CREC provide key insight into the evolution of this highly extended area. Volcanic units were dated by the 40Ar/39Ar and U/Pb methods, Sr and Nd isotopes were measured by ID-TIMS, and major and trace elements were collected by XRF and LA-ICP-MS respectively.

Eruption of a high-K calc-alkaline volcanic suite ranging from basalt and trachybasalt to rhyolite commenced at approximately 21 Ma with the effusion of primarily olivine and basalt rich basaltic andesites in the eastern part of the corridor. This was followed by the growth of a voluminous dacite lava-dome and flow field between ~20 and 19.5 Ma. First, hornblende-biotite dacite lava domes erupted primarily in the west, with continued effusion of aphyric to sparsely porphyritic andesite in the flanking regions. These were followed by effusion of tabular, high temperature two-pyroxene dacite lavas, which gradually gave way to hornblende-rich dacite lava domes. This early (pre-extensional) episode of volcanism concluded with small volume eruptions of olv-cpx basalt at ~19.3 Ma.

At approximately 19.3 Ma this 1-1.5 km thick succession of lavas was broken up by a system of NW-trending normal faults and extended NE-SW by at least a factor if two. Extensional block rotation tilted the older volcanic successions ~55˚ to the SW and formed local basins (half-grabens) that accumulated coarse clastic sediments. By 18.8 Ma, the Peach Springs Tuff flowed across this irregular landscape and was followed by small volume local eruptions of olivine basalt and basaltic andesite.

87Sr/86Sr(i) values range from 0.706093 to 0.711527 while εNd(i) values range from -1.23 to -12.37. Negative correlation of these two isotope ratios and increasing 87Sr/86Sr(i) and decreasing εNd(i) with increasing SiO2, indicate that crustal melting and assimilation played an important role in the evolution of these lavas. Along with field observations, this geochemical data supports the hypothesis that magmatic activity triggered extensional collapse of the lower CREC.