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Deposits of the ~6 to 4.8 Ma Bouse Formation and the earliest Colorado River Bullhead alluvium (~4.5 Ma) occur at variable elevations along the length of the lower Colorado River corridor. Well data indicate that the deepest and thickest Bouse deposits occur in the subsurface of successive basins, while patchy eroded remnants extend to between 330 and 360 m above sea level in southern basins, stepping up abruptly to 560 m above sea level in northern basins. The dominant model posits these variations in outcrop position reflect highstand lake levels. Alternatively, some of the variation can be explained by syn- and post-Bouse tectonism, which is suggested by Bullhead Alluvium below sea level in the southern basin. It is also supported by subtle (1 m) to significant (20 m) displacement of Bouse Formation in scattered localities. However, few discrete post-Bouse faults have been recognized, and the region is often considered to have been largely aseismic since cessation of Miocene extension. This work aims to better understand the importance of tectonics, and focuses on field mapping, kinematic analysis, and a compilation of faults. Fault orientations dominantly display NW-SE and N-S orientations, which are manifested as diffuse NW-SE zones of dextral shear and N-S trending extensional structures. E-W trending contractional structures (Chocolate Mountains) and a minor population of NE-SW (sinistral?) orientations are also observed. Northern basins exhibit dominantly N-S structures, while NW-SE structures become more prevalent to the south. Through integration of diverse datasets such as subsurface geometric constraints, stratigraphic relationships, and 3D geospatial analysis of outcrops, we interpret these structures to be compatible with far-field strain controlled by San Andreas plate margin processes and extensional reactivation of an inherited Miocene structural fabric. Miocene extension is indeed a viable mechanism for basin formation prior to Bouse deposition, but the aforementioned observations and our results suggest that a tectonic component, and therefore a more dynamic history for the Bouse Formation, should be considered. This hypothesis of distributed deformation has implications for Bouse deposition in particular, as well as plate margin deformation and models for Colorado Plateau uplift.

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