Rates of crustal deformation in the Southern Basin and Range (SBR) and Colorado Plateau (CP) provinces are relatively low in the context of the Pacific-North America plate boundary; however, the accumulation of small amounts of strain over long periods of time can lead to large earthquakes such as the M_w 7.5 1887 Sonoran earthquake in northern Mexico. These low rates of deformation in the SBR and CP have been difficult to quantify for three reasons. First, there is little geomorphic expression of active tectonics in the landscape, and seismicity is generally low magnitude, sparse, and infrequent. Second, the rate of strain accumulation is so low that it requires very high precision geodetic measurements to reveal the strain rate signal with sufficient confidence. Third, deformation from the plate boundary zone to the west, including co- and post-seismic deformation from earthquakes, as well as interseismic elastic strain accumulation from the greater San Andreas fault system is relatively large in Arizona, masking the background strain rate field associated with SBR and CP tectonics. With data from an enhanced continuous GPS network, we remove co- and post-seismic and ephemeral elastic deformation arising from California fault systems from the SBR and CP GPS velocity field. We use cluster analysis and geologic data to separate the GPS velocity field into regions with distinct strain rate fields. We calculate block rotation and uniform strain rates for each region, finding the lowest strain rates in the Colorado Plateau interior. We find the highest strain rate in western Arizona, in an area of very sparse Quaternary faults and relatively low seismicity. Despite the dearth of Quaternary faults, we know from well-preserved fault scarps that two magnitude ~M7 earthquakes occurred in this zone roughly 100,000 years ago. This anomalous strain rate may reflect residual, unmodeled strain seeping into the Arizona study area from the plate boundary to the west, but it may also represent potential for one or more rare, future, large-magnitude earthquakes in southern Arizona.