Supergene jarosite, a pyrite weathering product, preserved in ferricretes and weathered veins in the Red River valley (RRV) NM, records the timing of alteration scar formation and compositions of pyrite-oxidizing fluids. Weathering and subsequent erosion of pyrite-enriched hydrothermally-altered bedrock along the Red River, a Rio Grande tributary in Taos County, NM, forms alteration scars. \(^{40}\)Ar/\(^{39}\)Ar (jarosite) dates range from 4.45 + 0.70 Ma at the highest elevations of a weathering profile to 0.31 + 0.23 Ma at lower elevations in a scar ferricrete. Although supergene jarosite does not always yield well-behaved plateaus with precise \(^{40}\)Ar/\(^{39}\)Ar (jarosite) ages, RRV jarosite ages consistently preserve “inverse superposition” relationships typical of incised landscapes. Alteration scar formation probably began ~4.5 Ma, which is consistent with weathering dates found by previous workers at nearby Creede, CO.

\(\delta^{34}\)S\(_{\text{jarosite}}\) values (-12.1 to -0.8‰) that overlap \(\delta^{34}\)S\(_{\text{pyrite}}\) (-13.6 to +2.7‰) and \(\delta^{18}\)O\(_{\text{SO}_4}\) that range from -4.6 to +2.3‰ confirm that RRV jarosite formed from supergene alteration of pyrite rather than hypogene fluids. As at Creede, CO, \(\delta^{D}\)\(_{\text{jarosite}}\) decreases in younger samples and may provide a continental climate record. However, this trend toward isotopically-lighter fluids is not reflected in the narrow \(\delta^{18}\)O\(_{\text{SO}_4}\) range.

The average RRV alteration scar incision rate calculated based on elevation differences between stranded, dated ferricretes and alteration scar drainages is 77 m/my. This rate is consistent with published incision rates for the Rio Grande in northern New Mexico. Incision rates suggest that alteration scar erosion, which began when the Rio Grande had its headwaters in the RRV, began in response to base level changes in the Rio Grande as it became an integrated stream as far south as northern Mexico during the Pliocene.