

Abstract

The late Paleogene White River Formation/Group in the western United States is a substantial geologic unit that covers a vast area. It consists primarily of well-sorted siltstone and fine-grained sandstone. The exact origin of these sediments remains uncertain, with some earlier studies suggesting they are mainly composed of volcanic ash. This study first identified pure volcanic ash, loess, and fluvial deposits from the White River Formation/Group at Flagstaff Rim in central Wyoming and Toadstool Geologic Park in western Nebraska; then examined their mineralogical and geochemical characteristics to test this long-lasting hypothesis. The mineralogy data indicate that the loess (n=15) contains less volcanic glass, but more potassium feldspar and calcite compared to pure volcanic ashes (n=9). The major element data reveal that loess samples from Flagstaff Rim (n=9) exhibit lower Na₂O + K₂O and higher CaO + MgO contents relative to local ash samples (n=4), consistent with the mineralogy data. Trace element and provenance analyses using Th, Zr, Sc, La, and Th/ Sc and Ti/Nb ratios further differentiate loess and fluvial deposits from volcanic ashes at both locations. Compared with fluvial samples, the loess samples are characterized by higher quartz content, elevated SiO₂, and lower total FeO and Al₂O₃ in Flagstaff Rim. Our results demonstrate that the White River Formation/Group in this region comprises some recycled volcanic ash but dominated by clastic sediments derived most likely from Phanerozoic rocks and Archean basement rocks distributed in the adjacent Laramide mountain ranges. This finding lays the foundation for further research into the sediment provenance and recycling mechanism between fluvial and eolian sediments within the White River Formation/Group.

