Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9667

Minimal Cenozoic denudation in the southern and central Appalachians revealed by $^{40}Ar/^{39}Ar$ dating of supergene manganese oxides

WILLIAM E. ODOM III[1], DANIEL H. DOCTOR[1], RYAN J MCALEER[1] AND DARRYL E. GRANGER[2]

[1]United States Geological Survey
[2]Purdue University
Presenting Author: wodom@usgs.gov

Manganese oxide deposits are found throughout the world and commonly form via near-surface weathering processes. Given that many such deposits are unconsolidated and therefore easily eroded, their presence at the surface may be used to infer relatively low physical erosion since their formation. $^{40}Ar/^{39}Ar$ geochronology of K-rich manganese oxides has been demonstrated to be an effective tool for dating relict surfaces in multilevel landscapes, identifying periods of increased chemical weathering, and estimating denudation rates, particularly during the Cenozoic.

In the Appalachian Mountains, the erosional history of this era remains disputed. Early workers posited that scattered manganese oxides in the southern and central Appalachians are remnants of an erosional surface that formed during extended weathering in the early Tertiary and was subsequently uplifted and incised. While the majority of geologic evidence points to the most recent uplift having primarily occurred in the Alleghenian orogeny >200 million years ago, recent geomorphologic and seismic studies have hypothesized that the southern and central Appalachians may have been uplifted during the Neogene. One way to estimate uplift rates is with river incision and erosion rates, which are expected to respond to base level lowering. Cosmogenic nuclides have been used to date Pliocene-Pleistocene river incision and measure basin-averaged erosion rates in the New, Cumberland, Green, and Tennessee River basins; however, the relatively short half-lives of ^{26}Al and ^{10}Be necessitate a different geochronometer to extend these histories of weathering and erosion into the Miocene and earlier epochs.

We dated supergene manganese oxide deposits in the Appalachian Mountains of Virginia using $^{40}Ar/^{39}Ar$ geochronology. The ages of these deposits span much of the Cenozoic, including the Eocene, Oligocene, Miocene, and Pleistocene, and may correspond to intervals of intensified weathering. Given the antiquity of these deposits and their inferred supergene origin, we approximate that parts of the Virginian Valley and Ridge have been eroding at <10 m/My for much of the Cenozoic. Taken together, these deposits indicate that no major Cenozoic uplift likely occurred in the southern and central Appalachians. During this time, chemical weathering has continued to dissolve, transport, and reprecipitate manganese oxides to form multigenerational, morphologically diverse deposits.