Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20343

$^{40}Ar/^{39}Ar$ and (U-Th)/He constraints on landscape evolution in alkaline-carbonatite complexes

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Alkaline-carbonatite complexes in the South Atlantic margin of Brazil provide information on the evolution of West Gondwana before, during, and after break-up. Importantly, their emplacement and weathering histories produced numerous hypogene and supergene concentrations of critical metals. $^{40}Ar/^{39}Ar$ geochronology of biotite crystals show that two of those alkaline-carbonatite complexes, Araxá and Catalão I, were shallowly emplaced simultaneously at 86.6 ± 0.3 to 85.1 ± 0.2 Ma, Araxá; and 86.7 ± 0.7 to 85.6 ± 0.7 Ma, Catalão I. After crystallization, they were rapidly exhumed. The oldest weathering ages, $^{40}Ar/^{39}Ar$ Mn oxide ages of 66.4 ± 0.4 Ma at Araxá and 45.0 ± 0.8 Ma at Catalão I, determine when the complexes arrived at the surface. The timing between emplacement and arrival at the surface yields exhumation rates: ~ 56 $m.Ma^{-1}$ for Araxá between 85 and 66 Ma, and ~ 28 $m.Ma^{-1}$ between 85 and 45 Ma for Catalão I. Fast exhumation under arid to semi-arid climates favored physical weathering and erosion, producing the sediments now deposited as the Bauru group in the adjacent Paraná basin, and in analogous formations in the São Sanfranciscana basin. Wetter climates and subdued tectonic conditions after exhumation favored reduced erosion and deepening of weathering profiles. After 66 Ma, the Araxá complex denuded at rates of 3.4 m/Ma; at Catalão I, denudation rates reduced to 4.7 m/Ma after 45 Ma. These relatively low rates of denudation combined with favorable climatic conditions promoted the formation of deep, chemically stratified lateritic weathering profiles, producing important supergene Nb, P, Ti, and REE deposits.