
Variable paleoprecipitation in the Early Devonian Xujiachong Formation of Yunnan, China

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Abstract

Elemental analyses of paleosol B horizons in the Lower Devonian Xujiachong Formation of Yunnan, China provide estimates of mean annual precipitation (MAP) and allow determination of humidity regimes. The chemical index of alteration minus potassium (CIA-K) and other proxies (CIA, CALMAG, Base/Al) were used to estimate paleorainfall. CIA-K values of the paleosols with high carbonate content indicate MAP estimates between 300 and 500 mm yr⁻¹, with an average of 350 mm yr⁻¹. CIA-K values of the paleosol with no or little carbonate indicate MAP estimates between 900 and 1400 mm yr⁻¹, with an average of 1200 mm yr⁻¹. Humidity provinces inferred from geochemical proxy-based estimates of evapotranspiration and energy influx from precipitation range from subhumid to perhumid, suggesting wetter conditions than the MAP estimates. Mass-balance reconstructions evaluate physical and chemical variations in the soil of the Xujiachong Formation, showing patterns of soil volume change (strain) and transport functions (translocation) of many major and trace elements. The upper portions of most pedons are characterized by net removal of K, Al and Si. Modest increases in Ca and Al are noted in the lower portions of the pedons. Quantitative estimates of paleoprecipitation and humidity provinces, together with mass-balance reconstruction, provide a deeper understanding of the paleoenvironment of the Lower Devonian Xujiachong Formation, which may provide insights into the habitat ecology of early vascular plants.

Keywords: South China, Lower Devonian, Xujiachong Formation, paleosol, paleoprecipitation

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