

Investigating Camelid Utilization among Andean Cultures using Fecal Stanols

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The altiplano of central Peru is characterized by high aridity and unpredictable precipitation regimes. Throughout the region, camelid husbandry developed, in part, as an adaptation and risk management strategy to supplement agricultural yields during periods of low precipitation. Just after the first millennium AD, cultural groups shifted away from raised-field agricultural systems and towards mixed agro-pastoralism. This shift coincided with a prolonged, centennial scale drought and the collapse of the Tiwanaku civilization. Subsequently, many Andean settlements shifted from valley sites that would be beneficial for agriculture to ridgetop sites that provide more immediate access to grazing territory for camelid herds.

In this study, we investigated the relationship between camelid fecal stanol concentrations and societal change among Andean civilizations. Camelid and human fecal stanols, as well as terrestrial *n*-alkanes, were extracted from thirty Peruvian lacustrine sediment samples whose ages span 3,000 BP to the present. Coprostanol and 5 β -stigmastanol concentrations were measured as biomarkers for human and camelid fecal inputs, respectively. Additionally, the carbon ($\delta^{13}\text{C}$) and hydrogen ($\delta^2\text{H}$) isotope signatures of plant biomarkers, extracted from coterminous sediments, were analyzed to measure shifts in plant community abundances and precipitation regimes. Together, the sterol and hydrocarbon data demonstrate that camelid utilization increased after 1,000 BP during a period of higher aridity and *n*-alkane $\delta^{13}\text{C}$ and $\delta^2\text{H}$ values. Increased camelid fecal stanol concentrations are synchronous with lower lake levels and the shift from raised field agriculture to camelid pastoralism in the altiplano region.