Geophysical Research Abstracts
Vol. 19, EGU2017-11441, 2017
EGU General Assembly 2017

Pedoarchaeology of Early Agricultural Period Irrigation Systems in the Tucson Basin of the American Southwest

Jeffrey Homburg (1) and Fred Nials (2)

(1) Catena Affiliates, University of Arizona, and SRI, Tucson, United States (jhomburg@msn.com), (2) Desert Archaeology, Inc., Phoenix, Arizona (fnials@earthlink.net)

Pedoarchaeological studies were conducted at the Las Capas and Sunset Road sites in the Tucson Basin of Arizona in order to document and evaluate soil productivity and hydraulic soil properties of ancient agricultural irrigation systems. These ancient irrigated fields are on the margin of the Santa Cruz River floodplain, between two alluvial fans where high water tables and stable to aggrading geomorphic conditions facilitated diverting water from drainages and directing it to fields by gravity-fed canal irrigation. Archaeological investigations at these sites recently provided opportunities for documenting the configuration and evolution of the oldest irrigation systems yet identified in the United States, the earliest dating to more than three millennia in age. This research is significant archaeologically because of: (1) the antiquity (∼575–1225 B.C.) of the Early Agricultural period irrigation systems at these sites, (2) the fact that irrigation systems dated to different times are separated stratigraphically within the sites, and (3) the fact that extensive, well-preserved gridded irrigation features were identified using mechanical stripping, with nearly 100 ancient footprints preserved on a buried agricultural surface at Sunset Road. The stratigraphic separation of buried surfaces that were irrigated and the abundant cultivated irrigation plots facilitated soil sampling so that field, border, and uncultivated control samples could be compared in order to measure the anthropogenic effects of agriculture on soil quality in the irragric soils. Long-term indicators of agricultural soil quality such as organic carbon, nutrient content, and hydraulic soil water properties such as available water capacity and saturated hydraulic conductivity, indicate that soil changes were generally favorable for agricultural production and that these ancient irrigation systems were sustainable. Canals regularly supplied water to the fields, but they also supplied nutrient-rich sediments that continually renewed soil fertility, enough to counter nutrient losses resulting from crop uptake, volatilization, leaching, and oxidation. Cultivated soils tend to have significantly elevated organic carbon, nitrogen, and available phosphorus levels. Sodium and sodium adsorption ratios are slightly elevated, but not to high levels that indicate a serious detrimental effect on crop production. Soil textures in cultivated contexts are dominated by silt loams, silty clay loams, and silty clays, all textures with high moisture-and nutrient-holding properties. The complex alluvial history of Las Capas is reconstructed by identifying cycles of geomorphic stability, soil formation, erosion, and aggradation over seven centuries. Natural floodplain sediments at the site are highly dispersive and prone to subterranean erosion (piping) that may have contributed to field abandonment. A model of prime farmland in the Tucson Basin is presented in relation to ancient agricultural features (e.g., canals and terraces) that have been identified by archaeological surveys, showing that the Las Capas and Sunset Road sites are located in a large expanse of prime farmland along an ancient floodplain of the Santa Cruz River.