Farming the Rock: Biogeochemical Controls on Intensive Agriculture in Polynesia

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The Anthropocene came late to the Pacific Islands now known as Polynesia. Most of Polynesia has been populated by humans for around a thousand years. As Polynesians radiated across the Pacific they encountered basaltic islands that presented many different local environments. They brought with them an agricultural starter kit, but from their arrival onwards they adapted in often unique ways to their new surroundings. They practiced two major types of intensive agriculture: non-irrigated dryland farming and flooded-field irrigated farming. Typically young high volcanic islands had soils with rich nutrient stores whereas older islands had depleted soils that were minimally productive. By contrast, young islands had few large valleys to support irrigated agriculture, whereas the older ones were dissected allowing development of highly productive irrigation systems. Thus cultivators on young volcanoes brought their rainfed crops to areas where rock was supplying nutrients via weathering, whereas on old ones they irrigated them with flowing water that brought the products of weathering to crops. The contrast in labor inputs and surplus production had profound implications for the development of culture across Polynesia. The distinct patterns of soil properties found on volcanic islands are produced by non-linear responses to environmental forcing (i.e. pedogenic thresholds). The Polynesians recognized the significance of these thresholds to their efforts to intensify agriculture; we in turn interpret the patterns as biogeochemical responses to differing environments, that then feedback into island carrying capacities, human land use decisions, and cultural evolution. In this talk, I will synthesize material accumulated by our multidisciplinary team over two decades. I will do it through the lens of a biogeochemist, but with a focus on pre-industrial human land-use decisions and how these features played out on islands with different geographical properties. The synthesis presented here is grounded in Hawaii, and expanded to islands in French Polynesia and to Easter Island.