

Using PPSL to obtain a time scale for soil accumulation and erosion within archaeological terraces in the Judea Mountains, Israel

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The fate of mountain bench terraces which have been abandoned in ancient times is puzzling. On the one hand current observations indicate that abandoned terraces undergo rapid degradation by walls crumbling, leading to soil being washed by rain water out of breaches in the walls, suggesting that within a short time all soil would be washed down-slope. On the other hand slopes with degraded terraces appear to still retain much soil even though only faint remains of the terraces exist. Furthermore, if soil is rapidly eroded down-slope when terraces are no longer maintained, where do subsequent terrace builders find the soil to fill behind the refurbished stone walls?

Previous OSL dating of terrace soils in the Judea Mountains, Israel, showed that the majority of maintained terraces were constructed during the past 700 years, and only occasionally older ages were obtained for the soil at the very base of these terraces. This could possibly result from soil erosion that caused earlier events of terrace construction to be erased from the soil record.

To check if terraces and soils indeed erode entirely and how long this might take, we selected a relatively smooth hill slope showing small patches of limestone bedrock as well as remains of highly degraded sets of terraces. Three pits were excavated in soils within three different terrace remains down to bedrock, some to a depth of 2 m. Samples for OSL dating were collected from the exposed soil sections at 0.6-0.7 m intervals. Additionally, in two pits samples for PPSL were taken every 0.1 m, as well as surface samples.

In all three pits the lowermost samples gave ages OSL of 3000-4500 years before present, possibly corresponding to the natural soils existing before any human intervention. However samples from a depth of 35-45 cm gave ages of 350-200 yr, providing the last time the soil at that depth was exposed to sunlight. PPSL results show gradual soil accumulation of the top 1-1.2 m in the past ~700 yr, an underlying mixing zone and a much older lowermost soil. This suggests that the terraces were first built ~700 years ago and maintained until ~200 years when they were abandoned and subsequently degraded. However the thick soil present on most of the slope suggests that after the first stage of rapid degradation the slope reaches equilibrium, probably due to coverage by native shrubs that reduce direct soil erosion, so most of the soil is retained on the slope. The portable OSL allows for a much more nuanced understanding of soil history.

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