Lagar Velho Rock Shelter (Leiria, Portugal) is a key locality for understanding the early Upper Palaeolithic history of Southwest Europe as it preserves the near-complete skeleton of a 5 year-old buried child originally reported as exhibiting a mosaic of early modern human and Neanderthal features, and a ~5m infill sequence containing successive Gravettian to Middle Solutrean occupations. The existing site chronology is based on 14C dating of charcoal and bone, suggesting the archaeological sequence spans 24.8–23.8 to 43.1–29.9 ka cal. BP. While the 14C dataset is stratigraphically consistent, several geoarchaeological complexes are undated or imprecisely constrained, and all of the 14C ages are based on standard (acid-base-acid) pre-treatment procedures, which may not necessarily ensure complete removal of organic contaminants compared to more rigorous (e.g., ultrafiltration, ABOx-SC) 14C extraction procedures. Stratigraphic correlations between the eastern and western sectors of the site, including the child burial complex, also remain tentative owing to lateral variations in the sedimentary succession and partial truncation of the longitudinal profile by pre-discovery terracing activities. There is thus a need to expand and complement the existing chronological framework at Lagar Velho Rock Shelter using a broader suite of dating methods.

In this paper we present results of a new optical dating programme at the site, which aims to obtain depositional ages on all major geoarchaeological complexes, independently evaluate the reliability of the existing 14C chronological framework, and combine all reliable dating evidence within OxCal Bayesian models to examine the chronological viability of stratigraphic correlations across different sectors of the site. Single-grain OSL analysis of twelve samples spanning the full sedimentary sequence reveals generally low D\textsubscript{e} scatter indicative of suitable daylight exposure, and yields ages in broad agreement with the published 14C dataset. However, a few OSL samples from the lower and intermediate slope deposits exhibit minor age offsets (up to several ka older) compared to associated 14C estimates. The suitability of the OSL ages is examined via replicate extended-range luminescence measurements (single-grain TT-OSL) and combined U-series/ESR dating of a red deer tooth from the basal alluvial complex. These semi-independent dating comparisons, plus insights from available 14C sample quality indicators (organic preservation and contamination proxies), are used to examine if there is any merit in cross-checking some of the bone and charcoal 14C ages using more rigorous pre-treatment procedures in the future.

Bayesian modelling of the combined chronological dataset provides improved temporal constraint on the basal fluviatile and slope geoarchaeological complexes, new insights into temporal correlations of the transitional fluviatile–slope, slope, and breccia deposits found across different sectors of the site, and helps place the entire occupation sequence in a firmer regional climatic context. Our results confirm the chronological significance of Lagar Velho Rock Shelter for assessing Late Pleistocene anthropogenic histories and early Upper Palaeolithic cultural transitions on the Iberian Peninsula, with the site spanning at least 12 ka and recording at least three periods of human activity between late MIS 3 and early-mid MIS 2. The study highlights the significant role that OSL and ESR dating can play in refining early Upper Palaeolithic histories of the region, particularly when undertaken as part of multi-technique comparisons that target complementary dating materials.

**Keywords:** single-grain OSL, combined U-series/ESR, Gravettian, Solutrean, Iberian Peninsula