



Mobility of populations in the transition from Muslim world to Portuguese Kingdom in the Algarve, South Portugal, 11th–13th centuries

Anne-France Maurer¹ · Rebecca MacRoberts¹ · Judith Margarita López-Aceves² · Alvaro Felipe Ortega-González² · Claudia Relvado³ · Teresa Fernandes^{4,5} · Francisco Curate⁴ · João Teixeira^{6,7,8} · Xavier Roca-Rada^{6,9,10,11} · Bastien Llamas^{6,12,13,14} · Isabel Luzia¹⁵ · Alexandra Pires¹⁵ · Luis Filipe Oliveira¹⁶ · Cristina Tété Garcia¹⁷ · Cristina Barrocas Dias^{1,18} · Bernd R. Schöne¹⁹ · Sara Ribeiro²⁰ · Jose Francisco Santos²¹ · Maria João Valente²²

Received: 12 October 2024 / Accepted: 9 September 2025

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2025

Abstract

This study investigates mobility during the transition from Muslim to Christian rule in the Algarve, southern Portugal (11th–13th centuries), using multi-isotope analysis to understand population dynamics during this complex conquest period. Skeletal remains from two key populations were analysed: the final Muslims buried in Loulé before the Christian conquest (necropolises of Quinta da Boavista and Hospital da Misericórdia) and the earliest Christians buried in Cacela-velha following the Order of Santiago's capture in 1240 (necropolis of Poço Antigo). Contemporary faunal remains from trash pits and storage silos were also examined (Loulé: Oficina do Senhor Carrilho; Cacela: Silo 7 of Largo da Fortaleza). Strontium, oxygen, and sulphur isotope analysis of human and animal remains were combined with plant sampling for environmental baselines. Machine learning algorithms integrated this data with published Iberian Peninsula plant isotope ratios to create updated strontium isoscape maps, enabling probabilistic geographic assignment of non-local individuals. Ancient DNA analysis of selected Muslim individuals provided additional mobility insights. Results reveal strikingly different mobility patterns. Muslim individuals were largely local (~95%) with a few non-local likely from the Maghreb or eastern Spain. Conversely, the Christian population displayed extensive mobility, greater for males than females, with nearly 50% non-local to the Algarve. Potential origins were diverse and included regions along the Guadiana River and N/NE areas. While Muslims showed no sex-based isotope mobility patterns, paleogenetic analysis suggested patrilocal social structures and highlight the complex genetic landscape of the region. The overall data showcase a colonisation process poorly documented in other sources.

Keywords Sulphur oxygen and strontium isotopes · Machine learning · Medieval mobility · Provenance

Introduction and objectives

Throughout Medieval times, the Iberian Peninsula witnessed two major transitions: one from the 8th century onwards, with the establishment of Islamic dominance, the other during the 13th century, when the Christians took over and the Kingdom of Portugal gained thrust. Both arrived with paramount changes in society. The former came with an influx of oriental values, techniques and traditions and stronger connections with the Mediterranean (Guichard 1995), while

the latter renewed the influence of European Christianity, bringing deeper contacts with the occidental world. Both were times of increased mobility, triggered by a complex interplay between political, economic and religious variables. Written sources narrate the Islamic conquest of Iberia, the Arabisation and Islamisation process of the Peninsula, as well as the subsequent Christian conquest and governance. Although they bring wealth of information regarding life and territorial dispute in medieval Iberia (Constable & Zurro, 2012), the chronicles need to be taken cautiously, as they

Extended author information available on the last page of the article