

edited volume, *Metals, minds and mobilities* (Armada *et al.* 2018), *Circuits of metal value* provides an excellent insight into the present research of European scholars on early metals.

## References

- ARMADA, X-L., M. MURILLO-BARROSO & M. CHARLTON (ed.) 2018. *Metals, minds and mobility: integrating scientific data with archaeological theory*. Oxford: Oxbow.
- DAY, P.M. & R.C.P. DOONAN (ed.) 2007. *Metallurgy in the Early Bronze Age in the Aegean* (Sheffield Studies in Aegean Archaeology 7). Oxford: Oxbow.
- PARE, C. (ed.) 2000. *Metals make the world go round: the supply and circulation of metals in Bronze Age Europe*. Oxford: Oxbow.

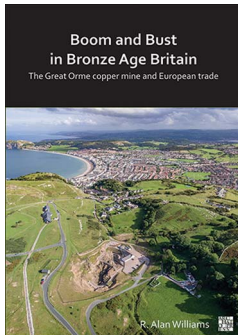
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R. ALAN WILLIAMS. 2023. *Boom and bust in Bronze Age Britain: the Great Orme copper mine and European trade*. Oxford: Archaeopress; 978-1-80327-378-5 paperback £60.



The book is based on the doctoral thesis of Alan Williams, a former mining geologist, completed after an intense career in the mining industry and a long-term interest in prehistoric mining and metallurgy (e.g. Williams 1985).

This 343-page book about the Great Orme Bronze Age copper mine in north Wales is organised in 10 chapters, with an up-to-date bibliography. It also includes appendices with the analytical results of published ore and metal analyses for the following: British and Irish Bronze Age mines (Appendix I); Cornish (Appendix II); and Great Orme copper ores (Appendix III); chemical analyses of Group-1 palstaves (Appendix IV); and a compilation of isotope results of British and Irish Bronze Age copper mines (Appendix V). The book ends with a useful subject/geographical index. Some of the core results contained in this book were previously synthesised (Williams & Le Carlier de Veslud 2019) and incorporated into broader Atlantic research projects such as ‘Moving Metals’ (e.g. Melheim *et al.* 2018) and ‘Maritime Encounters’ (<https://www.gu.se/en/research/maritime-encounters>), on which I am a collaborator.

The Introduction (Chapter 1) presents the state of research and the new concept of a ‘mine-based metal group’ to establish the chemical and isotopic relationship between the Great Orme mine and the metal artefacts. Chapter 2, ‘The Bronze Age research context’, deals with metal production in the Bronze Age and its archaeological sequence from the Early to Late Bronze Age; from the initial role of Ross Island in Ireland; and the ‘bronzization’

at the end of the third millennium BC. Based on this an independent western discovery of this alloy is proposed, supported in the existence of alluvial deposits of cassiterite in Cornwall and Devon.

Chapter 3, 'Bronze Age mining and smelting', emphasises the importance of the geochemical characterisation of the mineral deposits and its relationship with the metal produced. This includes the lead isotopic composition, with a review of the development of its research and the current situation in Great Britain and continental Europe. 'The Great Orme mine site and Pentrwyn smelting site' (Chapter 4) explains the extensive archaeological and dating work that was undertaken in the mine. It estimates the extent of copper production and gives details on the excavation of the limited remains of the rare smelting site of Pentrwyn, with just a hundred grams of Cu smelting residues.

Chapter 5 is a 'Review of metal characterisation and provenance techniques' and focuses on trace element chemistry and lead isotopes techniques to characterise and source metals. In Chapter 6, 'Methodology, materials and analytical methods', the analytical techniques for the characterisation of ores and artefacts are discussed, in addition to the sampling strategy for the Great Orme—only made possible after decades of excavations—and the inclusion of bits of bronze picks and copper prills from the Pentrwyn site as well as from smelting experiments.

Chapters 7 and 8 reveal the results on 'Defining the Great Orme mine-based metal group' and 'Great Orme ore mineralogy and Pentrwyn slag studies'. The chemical components forming the Great Orme mine-based metal group are specified, which establishes a characteristic range of composition that is consistent with Bronze Age metal assemblages (specifically Acton Park) and metal types from Britain (Group I palstaves) as well as from continental Europe (e.g. the Hönö hoard, Sweden). The 'unusual' lead isotopic field (or fields) for the Great Orme mine, with its 'long radiogenic tail', is defined and the book explains how it is distinguishable from other copper mineral deposits—with the exception of Alderley Edge, Cheshire—exploited in Irish/British Bronze Age. In Chapter 9, 'Discussion and interpretation', the Great Orme is considered to be the major copper source for Britain during a relatively short period of time covering the demand (source for Acton Park metal assemblages, c. 1600–1400 BC). The mine was probably controlled by regional north-east Wales elites, and specific metal types were exported to the continent through exchange/trade networks, with a sudden collapse of production, substituted by foreign sources, of which southern Spain is one.

In 'Conclusions and future work' (Chapter 10), the convenience of the use of the new 'mine-based metal group' proposal is highlighted, and moreover, the need for further investigation on copper mineralisation (also continental), smelting sites, metal ingots and objects, absolute dating of mining works (which means through archaeological excavations) is pointed out.

To sum up, the book presents a new and solid interpretation of the role of the Great Orme mine and is an inspiring lesson for those of us involved in prehistoric mining and metallurgy research. Based on a doctoral thesis, nothing is taken for granted, everything is explained, and the training and experience of Williams, in addition to the precise study of the Great Orme mine and its regional and European context, allow us to consider this work, with its controversial hypothesis, as a new reference book on prehistoric mining and metallurgy investigation.

## References

- MELHEIM, L., L. GRANDIN, P.O. PERSSON, K. BILLSTRÖM, Z. STOS-GALE, J. LING, R.A. WILLIAMS, I. ANGELINI, C. CANOVARO, E. HJÄRTHNER-HOLDAR & K. KRISTIANSEN. 2018. Moving metals III: possible origins for copper in Bronze Age Denmark based on lead isotopes and geochemistry. *Journal of Archaeological Science* 96: 85–105.  
<https://doi.org/10.1016/j.jas.2018.04.003>
- WILLIAMS, R.A. 1985. *The old mines of the Llangynog District* (British Mining 26). Sheffield: Northern Mine Research Society.
- WILLIAMS, R.A. & C. LE CARLIER DE VESLUD. 2019. Boom and bust in Bronze Age Britain: major copper production from the Great Orme mine and European trade, c. 1600–1400 BC. *Antiquity* 93: 1178–96.  
<https://doi.org/10.15184/aqy.2019.130>

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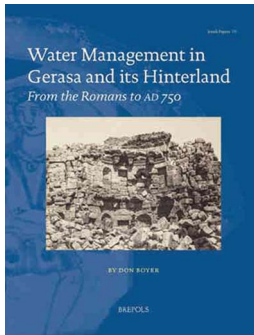
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DAVID DONALD BOYER. 2022. *Water management in Gerasa and its hinterland: from the Romans to AD 750* (Jerash Papers 10). Turnhout: Brepols; 978-2-503-59862-8 paperback €125.



This hefty and amply illustrated volume provides the reader with a fresh and in-depth examination of the water supply and management of the Decapolis city of Gerasa (also known as Jerash or Jarash) in modern-day Jordan. The book is an impressively detailed exploration with a commanding control of complex evidence and a large, yet patchy, dataset comprising nineteenth-century records of European visitors, early excavations and new survey data. The study has a wide scope both geographically and temporally, taking in an area of 180km<sup>2</sup> and spanning the Hellenistic period through to the tenth century AD, and was completed as a PhD project by trained geologist Don Boyer.

The book opens with an Introduction (Chapter 1) and is then divided into four parts: methodology and context; the hydraulic system; the urban network; and a set of technical appendices. Part 1 provides the reader with a wealth of background information about the city and its hinterland. Chapter 2 lays out the existing data and previous studies. Boyer supplements these limited data with extensive new survey work to record water-related installations and infrastructure. This includes an excellent programme of high-quality and well-considered archaeometry to refine our understanding of the dating of elements of the water supply network. Chapter 3 delivers a comprehensive discussion of the changing physical landscape in which the water-management systems are situated. This particularly