

# Persisting in the face of challenge: the choice of raw materials in prehistoric ceramic production along the Eastern Adriatic coast

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## Introduction

Studying the operational sequence of ancient craft practices provides valuable data for both technological considerations and socially oriented interpretations. Following this premise, the research aims to investigate Bronze Age pottery practices in the relatively unexplored area of the eastern Adriatic coast and hinterland. The assumption that variability in the choice of raw materials and production techniques can indicate socioeconomic changes has encouraged us to consider prehistoric communities within a broader social context. The research focuses on ceramics from fourteen Bronze Age archaeological sites (155 samples) along the eastern Adriatic coast and the hinterland of central Dalmatia, forming four case study areas.

Area	Sites	Number of
		samples
Central Dalmatia coast	Trogir, Bristivica Šupljak, Vinišće Oriovišćak,	51
	Marina Drid, Sutilia, Plano-Kraljeva ograda, Biranj	
Central Dalmatia hinterland	Dugiš-Otok near Sinj, Gala-Gacko, Otišić Vlake,	47
	Znojilo	
Lika	Lower Cerovac cave	27



Istria

### Old Rakalj and Šiljar

30

# Aims and Methods

By applying a multi-analytical approach (optical microscopy, XRPD, p-XRF, SEM-EDS, and ICP-MS, ICP-ES), the goal is to determine the characteristics of paste recipes and the type and proportion of non-plastic tempers intentionally added to the clay. Field sampling of clay was also conducted in the areas of Istria and central Dalmatia for comparative analysis and to understand the provenance of the raw materials. The aim of the research is to consider the variability in pottery practices from the Early to the Late Bronze Age, to better understand the wide range of behaviours directly related to ancient pottery produced within specific social environments.

## **Pottery recipes**



Thin section microphotographs of the Early and Middle Bronze Age pottery (left) and Middle and Late

Location of the archaeological sites: Old Rakali (1), Šiljar (2), Lower Cerovac cave (3) sites in Trogir area (4-9), Znojilo (10), Biranj (11), Dugiš (12), Gala Gacko (13), Otišić Vlake (14)

# Results

The results from the multi-analytical methods applied to the ceramics and raw materials from the surrounding environment indicate that the pottery raw materials were of local origin and sourced near the production sites, typically in karst cavities and near watercourses where clay could be found. Current results indicate that sandy clay was preferred at all sites; however, in the areas of Lika and Istria, clay with pellets was also used, while inclusions-poor clay seemed more frequently used during the Early and Middle Bronze Age in Dalmatia and Lika.

Regarding tempering materials, potters consistently added non-plastic inclusions such as crushed calcite, sporadically limestone, and grog. Analysis of the collected data suggests that the choice of inclusions is primarily related to chronological/cultural factors and, to a lesser extent, environmental factors. Calcite tempering, with the addition of a small amount of grog, is characteristic of Early and Middle Bronze Age communities, whereas during the Late Bronze Age, communities exclusively used calcite tempering.

Geochemical variations measured on the grog and the ceramic matrix of Early Bronze Age pottery from Biranj show marked variety indicating that the grog did not originate from the clay used to make the vessel.





#### Bronze Age pottery (right)

**Types of clayey material** used from the Early to the end of the Late Bronze Age for 4 case study areas (EBA – Early Bronze Age, MBA: Middle Bronze Age; LBA: Late Bronze Age; EIA: Early Iron Age). **Tempering material** used by potters from the Early to the end of the Late Bronze Age for 4 case study areas (EBA – Early Bronze Age, MBA: Middle Bronze Age; LBA: Late Bronze Age; EIA: Early Iron Age).



## **Discussion and Conclusion**

The results indicate that during the second half of the 3rd millennium BC, at the end of the Copper Age and during the Early Bronze Age, no specific preference for the type of clay was recorded. However, as a tempering material, potters chose only grog. From the Middle Bronze Age onwards, potters began to add additional tempering material, crushed calcite. This practice appears to have first occurred in the Dalmatian hinterland by the end of the Middle Bronze Age. Elsewhere, a complete transition to calcite as the sole tempering material took place during the Late Bronze Age and continued into the Iron Age.

Nevertheless, the use of grog in Lika and the northern Adriatic peninsula of Istria persisted until the end of the Bronze Age, often in combination with calcite. Grogtempered pottery is characteristic of Pannonia and northern Italy during the Middle and Late Bronze Age (Kreiter 2007; Cannavò et al. 2012; Cannavò, Levi 2014; Kudelić et al. 2018; Kudelić, Sirovica 2022; Karavanić, Kudelić 2022; Neral et al. 2023). Therefore, the continued use of grog in Istria and Lika until the late Bronze Age can be interpreted as reflecting strong cultural influences distinct from those in Dalmatia (Kudelić, Paraman, Neral 2023).

These results suggest complex mechanisms involved in the selection of pottery raw materials, particularly added materials; a correlation between the selection of tempering materials and both spatial and chronological frameworks. It is posited that differences in paste recipes arise not only from the availability of raw materials or their mechanical properties but also from more complex social and cultural contexts. To that extent, it is extremely important to understand the selection of these two different types of pottery raw materials, that could be interpreted as the maintenance of an older tradition transitioning to a new one. This dual use may also symbolize a symbiotic social organisation or a compromise period during the transition from one system to another i.e., persistence in the face of challenge.

**Bibliography:** Cannavò et al. – V., Cardarelli, A., Levi, S. T., Lugli, S., Vezzalini, G. 2012, Pottery production in Bronze age settlements of the Modena area (northern Italy), Atti di convegno AIAR 2012, VII congresso nazionale di Archeometria, Modena. ISBN 978-88555-3166-5; Cannavò, V., Levi, S.T. 2014, Analisi archeometriche delle ceramiche di Casinalbo in: A. Cardarelli (ed.) La necropoli della terramara di Casinalbo, Grandi contesti e problemi della Protostoria italiana 15, 821–832; Karavanić, Kudelić 2019 – S. Karavanić, A. Kudelić, *Kalnik-Igrišče – Late Bronze Age Settlement*, Monographiae Instituti Archaeologici 14, Zagreb; Kreiter 2007 – A. Kreiter, *Technological Choices and Material Meanings in Early and Middle Bronze Age Hungary: understanding the active role of material culture through ceramic analysis*. BAR International Series 1604, Oxford, 2007; Kudelić, Sirovica 2022 – A. Kudelić, F. Sirovica, *Kurilovec-Belinščica – Tracing the Bronze Age of Turopolje*, Monographiae Instituti Archaeologici 11, 2022, Zagreb; Kudelić *et al.* 2018 – A. Kudelić, M. Mileusnić, A. Grzunov, K. Wriessnig, F. Ottner, Bronze Age pottery from Turopolje and Podravina region – archaeometric analysis, *Opuscula archaeologica* 39–40 (2015–2016), 2018, 37–52; Kudelić, A., Neral, N., Paraman, L. 2023. Archaeometry of Bronze Age Ceramics from the Area of Trogir. *Vjesnik arheološkog muzeja u Zagrebu*, 56(2). 10.52064/vamz.56.2.1; Neral et al. – Neral, N. Kudelić, A., Maričić, A., Mileusnić, M. 2023. Pottery technology through time: Archaeometry of pottery and clayey raw material from the multi-period site in eastern Croatia. *The Mining-Geology-Petroleum Engineering Bulletin*, 38(2), 1–21. https://doi.org/10.17794/rgn.2023.2.1



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