Forging relationships: Identifying prehistoric social network dynamics with modern algorithms

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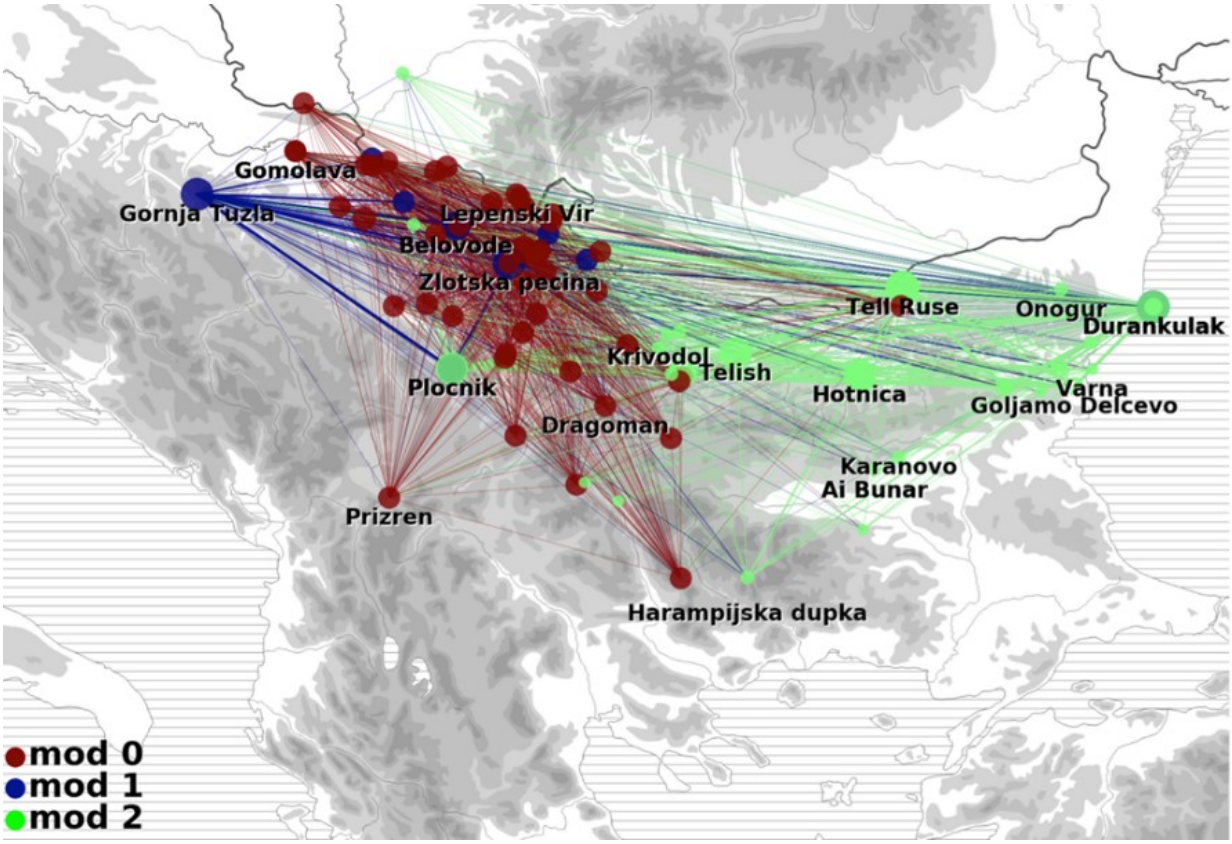

Modularity analysis reveals three densely connected modules/communities that produced and exchanged copper in the Balkans between c. 6200 BC and c. 3200 BC. They are also significantly correlated with the distribution of archaeological cultures at the time, providing archaeologists with the breakthrough method to mathematically model archaeological phenomena. Credit: Miljana Radivojevic

In the first ever archaeological study of its kind, two researchers have combined the chemical analyses of dozens of the world's earliest copper artefacts and modularity approach in order to identify prehistoric networks of co-operation during the early development of European metalmaking. This study has led them one step further: the communities that co-operated the most largely belonged to the same archaeological culture, thus revealing a novel method for an independent evaluation of the archaeological record.

Archaeological systematics, particularly in prehistory, use the accumulation of similar material traits or dwelling forms in archaeological sites to designate distinctive 'archaeological cultures'; however, what these expressions of similarity represent and at what resolution remain a major problem in the field of archaeology.

The study, published this week in the *Journal of Complex Networks*, takes an alternative approach by measuring the strength of links between archaeological sites instead and produces pioneering models of human interaction and cooperation that can be evaluated independently of established archaeological systematics. It focuses on a comprehensive archaeological database of copper artefacts from the Balkans, dated from c. 6200 BC to 3200 BC—the first 3,000 years of known copper mineral and metal use in Europe.

Chemical composition of these artefacts is the sole information used for modularity analysis, hence isolated from any archaeological and spatiotemporal information. The results are, however, archaeologically and spatiotemporally meaningful for the evolution of the world's earliest copper supply network.

Dr Jelena Gruji?, physicist from the Vrije University in Brussels, explains the novelty of this method for archaeological research: "Although there are a few approaches that archaeologists use to infer

models of circulation of metals in the past, and hence indicate prehistoric economic and social ties, the modularity analysis offers for the first time an option to test the significance of our results, and hence a method that is mathematically reliable and replicable".

Dr Miljana Radivojevi?, lead author and researcher at the McDonald Institute for Archaeological Research, University of Cambridge commented, "Being able to infer social groups with strong spatial and temporal significance in archaeological data using this network property is a real game changer. This study is major step towards evaluating technological, economic and social phenomena in the human past - anywhere".

The original article is accessible here.

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