

## The early stages of metallurgy and metal exchange in northwestern Turkey

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The project 'From mines to graves: metallurgy and metal exchange in northwestern inland Anatolia, ca 3700–1500 BCE', the pilot study of which has been sponsored by a British Institute at Ankara Small Grant, aims to shed light onto the mechanisms of metal production and exchange during the early stages of metallurgy in western Turkey. It builds upon several decades of research indicating that, during the Chalcolithic and Bronze Age (ca 6000–1200 BC), the Anatolian highlands was one of the most important metallurgical centres in the Old World. This region not only provided copper, lead, silver and gold to surrounding metal-lacking areas, but was also at the cutting edge of metalworking technologies. For the early historical period, some 23,000 Old Assyrian cuneiform tablets (ca 1950–1700 BC) supply incredibly accurate textual accounts of interregional metal exchanges between central Anatolia and Upper Mesopotamia. There is, however, increasing archaeological evidence that this trade network is only the mature phase of a process which started during the mid to late fourth millennium BC. Furthermore, textual sources are almost entirely silent with regards to the infrastructure of metal production, as well as the extent and complexity of local and regional trade networks within Anatolia.

Thus, 'From mines to graves' intends to open a new perspective into archaeo-metallurgical research in Anatolia by attempting to reconstruct the different stages of the Late Chalcolithic and Bronze Age metallurgical *chaîne opératoire* (i.e. extraction, refinement, object manufacture) at the regional level. It also aims to understand the mechanisms of the exchanges of finished products within local and regional networks, and the diachronical changes thereof, by investigating the relationship between highland sites (close to mines and refinement facilities) and lowland sites (close to major trade routes). The project focuses on an area (the Eskişehir, Afyon and Kütahya regions) that has witnessed dense archaeological research, is rich in metal deposits and evidence for pre-modern mining, and is intersected by important natural routes connecting the Aegean with the central Anatolian plateau (see figure). It targets a large dataset (ca 800 metal samples) from 14 sites with different occupation spans (covering ca 3700 to 1500 BC), thus allowing a diachronic perspective about continuity and change in the use of specific technologies, alloys and shapes, as well as the ability to identify potential differences at the regional scale.

During the project's first stage, functional and technological typologies of metal objects and metallurgical tools will be employed to highlight differences in manufacturing traditions both diachronically and between sites. In order to understand alloying practices, chemical

composition analysis will be conducted via a portable x-ray fluorescence spectrometer (pXRF). In the following stages, microscopic analysis (with SEM) and destructive chemical analysis (with ICP-MS) of slag and ore will allow a more detailed insight into metallurgical technologies (for example firing conditions, additives and trace elements). Lead isotope analysis will target selected ore, slag and objects to sketch the possible origins of raw materials and artefacts. Finally, an archaeo-metallurgical survey will explore known and potential pre-modern mining sites, providing data on the scale and level of organisation of metal extraction in different periods.

Preliminary results indicate that all analysed settlements (starting at ca 3700–3500 BC) have evidence for in-site metal production in the form of tools and/or manufacturing debris, witnessing the widespread availability of raw materials in the region. This is confirmed by earlier research that has identified numerous metal deposits in the region, as well as at least two Bronze Age mines. Analysis of slag and ore from two sites also hints at the presence of two more Early Bronze Age mines within the study area (at Emet 3 and Bakır Tepe, see figure). Second, based on the available evidence, products made with sophisticated manufacturing techniques (for example bivalve casting, lost-wax technique, metal plating) and more specialised metallurgical workshops seem to occur exclusively in lowland sites with easier access to exchange networks. On the other hand, excavated metal workshops within highland sites are characterised by small-scale and low-level specialisation activities, suggesting metal extraction and production from local sources and probably limited to local consumption. Third, bronze objects (partly composed of tin, a rarer metal) seem restricted to lowland sites with direct access to interregional routes, a situation that only changes at the very end of the third millennium BC when tin becomes more readily accessible. This phenomenon is likely correlated with intensified relations with areas further to the southeast, approximately at the time of the establishment of the Assyrian trade network that introduced significant amounts of tin, likely from Afghanistan and beyond.

