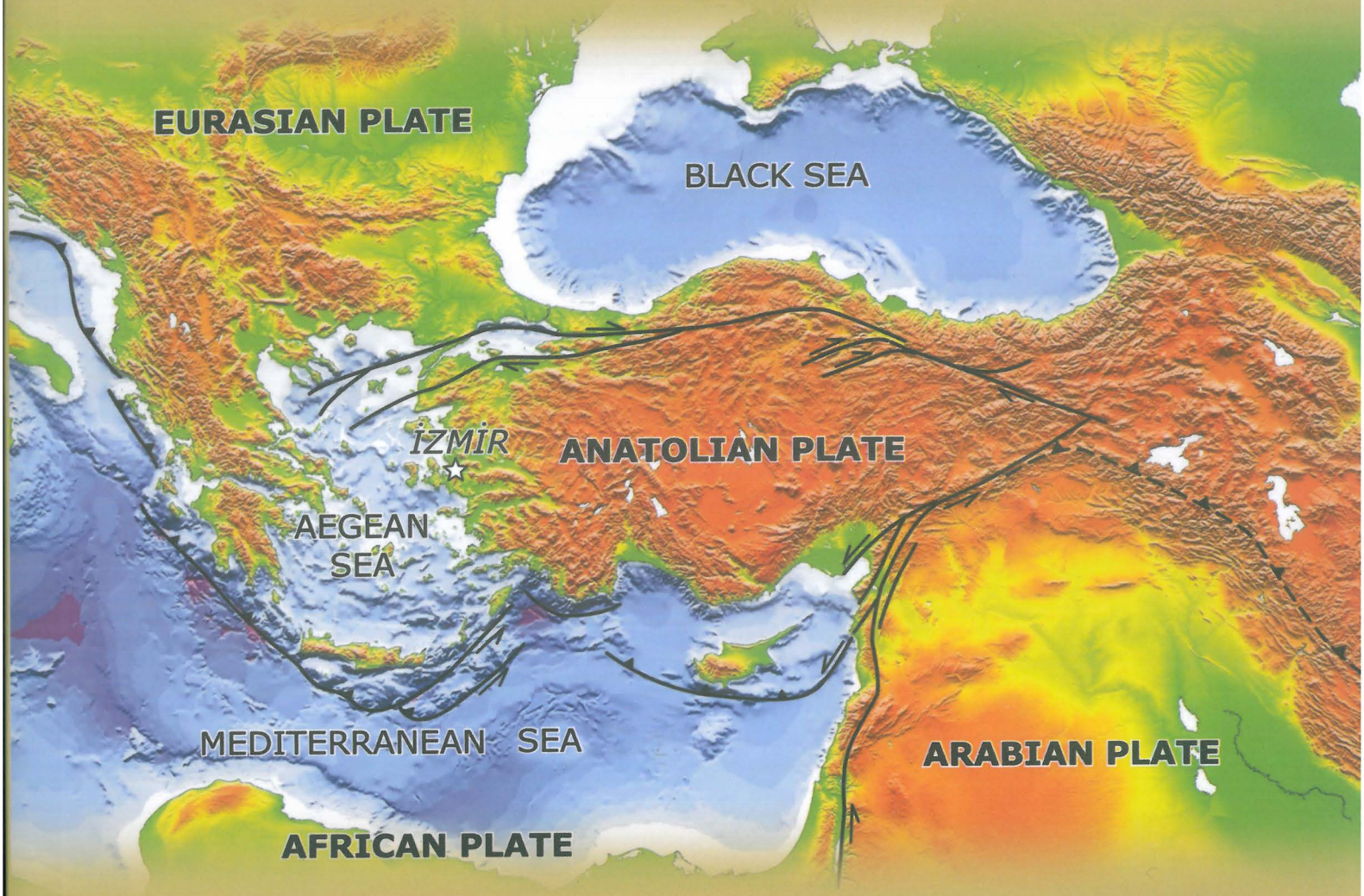
INTERNATIONAL EARTH SCIENCE COLLOQUIUM ON THE AEGEAN REGION



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ABSTRACTS

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Systematic differences between prehistoric and modern metal provinces in Western Turkey as a result of supergene modification – implications for archaeological provenance studies

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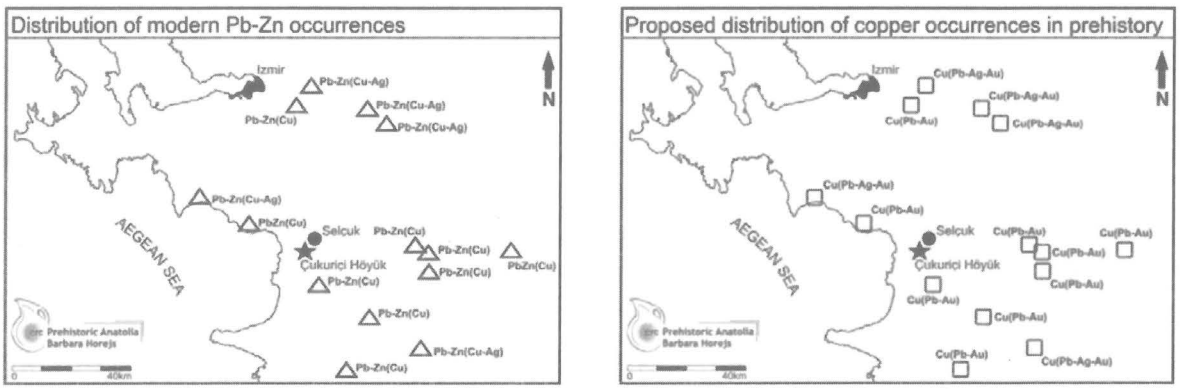
The prehistoric, Neolithic to Bronze Age settlement of Çukuriçi Höyük, situated adjacent to the antique town of Ephesos, has been the subject of recent archaeological excavations as well as of geological studies. Finds from the Early Bronze Age (excavation phases III and IV) include a relatively large number of furnaces, metallurgical tools, copper artifacts, and even a few fragments of low-grade copper ore. The settlement has apparently been an important metallurgical center, which required the complex logistics of sufficient raw materials supply, such as Cu-ore, and a exchange system of distributing metal products, as suggested by "standardized" molds for the production of arsenic copper ingots.

The environs and hinterland of Ephesus and Çukuriçi Höyük are geologically well-studied and documented and – according to modern metallogenic maps – represent a metal province dominated by polymetallic vein-type Pb-Zn-(Ag) as well as by meso- and epithermal Au occurrences. Thus it appeared rather surprising that Çukuriçi Höyük, as a substantial copper producing site, should be located far from the rich copper districts in northeastern and northwestern Turkey. Our preliminary study includes detailed field observations as well as general considerations on the influence of supergene modification of vein-type ore deposits. The differential solubility and mobility of base and precious metals in the surface and near-surface meteoric depth range suggests that modern distribution maps do not reflect the prehistoric situation adequately.

Modern maps generally document metal occurrences and deposits of current economic and geological interest at a tested depth; many of them having been explored, drilled, and (many of them) mined. As a consequence, these hypogene, typically polymetallic Pb-Zn-Ag (Cu-Au) sulphide vein systems make up the majority of the documented occurrences in publications and metallogenic maps of this region. However, supergene processes (including "weathering") by meteoric water will drastically modify the relative metal abundances and mineralogical compositions of the ores in this surface and near-surface depth range. Zn will, almost invariably, be remobilized and lost due to its highly soluble nature under oxidizing conditions. Pb will be mobilized and partly lost but will also be partly preserved as galena due to armoring by anglesite. Cu is typically oxidized and forms secondary non-sulphide minerals (e.g. malachite, azurite, and cuprite) or secondary Cu-sulphides such as chalcocite. These near-surface secondary copper minerals are particularly amenable to early smelting and "co-smelting" techniques.



As a consequence, a prehistoric mining landscape with the above mentioned endowment with polymetallic veins would have been characterized predominantly by near-surface Cu-(Pb-Ag-Au) deposits. This is in marked contrast to the impression from modern maps, which may not fully appreciate the metal districts available to and exploited by the earliest Anatolian miners.

Keywords: Çukuriçi Höyük; supergene processes, non-sulphide minerals; Early Bronze Age