The importance of polymetallic ores for ancient metallurgical products

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Mineralogical expertise in general and knowledge in the petrology and geochemistry of mineral deposits in particular is far under-represented in the applied field of Archaeometallurgy. From the historical point of view, most metallurgical models as used in Archaeometallurgy until today were developed by "modern" metallurgists [1], and base on most theoretical expectations and simplified starting material without respecting the geological variety of material. This becomes most obvious in the discussion of the smelting of ores to gain metals, which typically start out with the assumption, that pure minerals with ideal stoichiometry were used rather than natural sulphide/oxide intergrowth or polymetallic ore. Such complex ores have rather variable geochemistry, and result in quite unpredictable elemental composition of archaeological metal objects. Further, many high-grade minerals are only documented in former mineralogical textbooks but are no longer existent or out of interest to modern mineralogy [2]. This is especially problematic if ancient mineral resources are discussed. There are many examples for this discrepancy in Archaeometallurgy such as the idea, that silver was invariably smelted from galena, the criteria for intentional or deliberate alloying of arsenic and tin bronzes, or the proceeding uncritical use of the lead isotope reference data for raw metal provenancing. Returning to the natural situation that is found in mineral deposits in combination with the geochemical information, an attempt is made to better understand the complexity of mineral deposits in context of Archaeometallurgy.

References: [1] Rammelsberg (1859) *Lehrbuch der chemischen Metallurgie.* Berlin; [2] Maucher, Rehwald, Ramdohr (1961), *Bildkartei der Erzmikroskopie*.