Analysis of bronze droplets formed during casting at the Urnfield period mining site of Prigglitz-Gasteil in Lower Austria

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Introduction

In 1955 the Urnfield period copper mining site “Gasteil Cu I” was discovered in the cadastral area of Prigglitz (district of Neunkirchen) in the southeast of Lower Austria. The results of excavation campaigns in 1956 and 1958 were reported by Hampl and Mayrhofer in 1963. The place was characterized “not so much a settlement but rather a huge work site”. Until 2010 the research at this site stagnated, but in 2010, the Lower Austrian Museum of Prehistory resumed systematic archaeological fieldwork. During five excavation campaigns many mining tools, bronze artefacts, copper ore, slag and corroded metallic droplets were discovered.

Two droplets were investigated by Light Optical Microscopy (LOM) after metallographic preparation. At the droplets surface tin was observed by Scanning Electron Microscopy (SEM) and Energy Disperse X-ray Analysis (EDX) indicating that the droplets are not from the copper smelting process but from the bronze casting.

One droplet is corroded severely but in its centre the metallic bronze is still present. The elemental analysis showed about 10 wt.% Sn. The microstructure is characterized by Cu-Sn solid solution and a Cu-Sn intermetallic phase which was formed during a peritectic reaction. Additionally small amounts of CuS were observed in the metallic core. At the rim the corrosion products contain oxides and hydroxides of Cu and Sn and other elements like Ca, P, Si, S, Fe were observed. Surprisingly the other droplet has a corroded core and metallic bronze remained locally at the rim. The alloy compositions of both droplets are similar. The microstructures of the corrosion products reflect the casting microstructures of the bronze.

Conclusion

- The droplets are formed during a bronze casting but not during a copper smelting process. The discovery of a casting mould confirms bronze metallurgy in Prigglitz.
- Metallic bronze, containing about 10 wt.% Sn, was observed partially in the core, partially at the surface of the droplets. Additionally small amounts of sulphides were observed.
- During corrosion of the bronze the Sn is enriched whilst the copper is reduced in the corrosion products. Copper salts are transported away by water.