Petrology and provenance of prehistoric slags from the Kiechlberg/Thaur (Tyrol, Austria)

Krismer, Matthias[1] Goldenberg, Gert[2] Töchterle, Ulrike[2] Lutz, Joachim[3] Tropper, Peter[1] Vavtar, Franz[1]
[1]University of Innsbruck, Institute of Mineralogy and Petrology, Innrain 52, A-6020 Innsbruck [2]University of Innsbruck, Institute of Archaeology, Langer Weg 11, A-6020 Innsbruck [3] Curt-Engelhorn-Zentrum Archäometrie, D6, 3, D-68159 Mannheim

The Kiechlberg is a small inconspicuous hill on the south face of the Karwendel mountain range a few kilometres to the northeast of Innsbruck. During the winter months the 1028 40m a.s.l. situated Kiechlberg is heavily exposed to avalanches. However the isolated position above the the Inn valley and steep and rocky slopes made this site interesting for prehistoric settlement. Superficial finds of artefacts and metallurgical slags by Franz Brunner led to first archaeological excavations in the frame of the special research program HiMAT (University of Innsbruck and international partners, financed by FWF) during summer 2007.

Large amounts of ceramic and flint tools as well as some metal objects made of copper and bronze were collected during the archaeological excavation of a garbage dump, indicating a Neolithic to Early Bronze Age occupation of the site. Radiocarbon dating of charcoal and animal bones confirms this chronological approach and yielded data between 4000 and 2000 BC calibrated.

Together with the archaeological finds and almost in the upper layers of the studied stratigraphy, various slags and copper rich semi-products (unrefined copper) occur and prove primary copper metallurgy at the site, using local copper-ores for smelting. This metallurgical work has not yet been dated exactly. The composition of the raw copper point at Late Copper Age / Early Bronze Age, but older phases of metallurgy can not be excluded.

This metallurgical finds generated questions on the ore provenance and prehistoric smelting technologies. Chemical phase and bulk analyses and the comparison of major and trace element patterns between finds and ores from mining areas in the lower Inn valley gave preliminary information about the origin of ores, smelting conditions and smelting processes.

Slags from Kiechlberg are primary made up of an oxidic matrix with various contents of sulfidic agglomerations and inclusions of pure Cu beads as well as Cu-antimonides or/and arsenides. The oxidic phase assemblage consists of olivin, spinel (magnetite), clinopyroxene, leucite and melt. In nearly all samples olivine, clinopyroxene and magnetite contain up to 2 wt% Zn, melt phases contain up to 5 wt% Zn.

Pb bearing barite (hokutolite) and Bi phases were rarely identified. In some samples also Ag bearing antimonides and metallic Ag was verified. The common occurring anitmonides in unrefined copper cakes reflect the high Sb, As and Ag content of the bulk analyses. As and Sb occur also in copper artefacts. One fragment of a copper cake and one ring exhibit uncommon high Co and Ni concentrations.

The phase and element content of slags and unrefined copper suggest fahlores or related sulfosalts as raw material. In two samples this phases could be additionally associated with Co and Ni bearing sulfides generating high Co and Ni contents in the metal phase. Smelting temperature estimates yield approx. 1100°C and an oxygen fugacity of 10^{-10} to 10^{-8} ($LOGfO_2$).

→

Abs. No. **181**
Meeting: **DMG 2008**
submitted by: **Krismer, Matthias**
email: **matthias.krismer@uibk.ac.at**
date: **2008-05-29**
Req. presentation: **Poster**
Req. session: **S17**