Mining archaeological and mineralogical surveys in western Tyrol: Evidence for prehistorically exploited copper resources?

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Premisses
The institutional mining archaeological research in Tyrol of the last years was focused on the “big players” like Schwaz-Brixlegg and Kitzbühel area. Beside these there are more than 70 base metal mineralizations in western North Tyrol - some of them in vicinity of huge prehistoric hoard finds. Therefore the project pursued three main goals in this area: 1) locating any evidence for prehistoric mining 2) mineralogical and geochemical characterization of the copper ores 3) providing a basis for archaeological excavations.

Surveys
On economic geological, topographical and mining based criteria 27 out of over 70 known ore occurrences have been selected. More than 30 surveys were carried out. At 21 sites relevant copper mineralizations could be found and sampled. In addition GPS points of the sampled places and photographs were taken.

Archaeology
Fire-setting and/or stone tools indicated potentially prehistoric workings at Rotenstein and Masneralpe/Serfaus, Knappenkuchl/Navis, Wildgrube/Obernberg and Knappenlöcher/Hotting. At Navis and Hotting small sondages were carried out, but no further evidence for prehistoric mining appeared. Additional surveys (also for smelting sites) and more extensive excavations to gain exact datings for the fire setted sections in all four mines should be the next steps of procedure.

Mineralogy
More than 50 polished sections of selected ore samples were studied by ore microscopy and electron microprobe analysis. In addition trace element analysis and determination of lead isotope ratios have been carried out on selected samples.

In the studied area four different types of copper mineralizations can be distinguished:

• In the Verrucano sediments of Permian age fahlore is predominant. Smelting this ore would result in a "fahlore-type"-copper (As, Sb) additionally characterized by varying amounts of Ag and Bi and occasionally Ni/Co (Tab. 1: 1-4).
• The mineralizations in the dolomites of the Brenner Mesozoic and the North Tyrolean Calcareous Alps are characterized by fahlores associated with lead ores. Smelting this ore would result in a "fahlore-type"-copper (As, Sb, Ag, Bi) additionally characterized by a certain amount of Pb (Tab. 1: 5-10).
• Fahlore mineralizations in association with chalcopyrite were found in the Tux Alps and the Silvretta Crystalline Complex. Smelting this ore would result in a somewhat diluted "fahlore-type"-copper (As, Sb, B), further characterized by less Ag and occasionally Ni (Tab. 1: 11-13).
• In the Ötztal Crystalline Complex a chalcopyrite -pyrite-mineralization is predominant. Smelting this ore would result in a relatively pure copper occasionally comprising impurities of As and Ni similar to "Kelchalm"- or "Mitterberg-copper" (Tab. 1: 14-21).

Tab. 1: Site names and the mineralogical and geochemical characterization of the sampled ores.
Graph: K.-P. Martinek, C.O. Grutsch

Chemical composition of stoter copper ingots from the Moosbruckschrofen hoard (Middle Bronze Age) and ores from western North Tyrol. The data shows that only one sample from Navis matches the ingots.
Graph: J. Lutz

Lead isotope data comparing the copper ores from western North Tyrol with the ores from Mitterberg and Kelchalm and the raw metal finds of the Middle Bronze Age hoard from Moosbruckschrofen/Tyrol.
Graph: K.-P. Martinek, J. Lutz

Outcrop at Masneralpe/ Serfaus.
Photo: K.-P. Martinek

Ancient copper mine with fire-setting, in part reworked by blasting, Knappenkuchl/ Navis.
Photo: K.-P. Martinek

Photo: C. O. Grutsch

Polished ore samples:
1. Tetrahedrite and cobaltite-Rotenstein/Serfaus
2. Tetrahedrite and galenite Wildgrube/Obernberg
3. Tetrahedrite and chalcopyrite Knappenhösl/Landek
4. Chalcopyrite and gersdorffite Muttalpjä/Haundau

Photo: K.-P. Martinek

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