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

Premises

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 pursues 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 indicate potentially prehistoric workings at Rotenstein and Masserfeld/Serfaus, Knappenkogel/Navis, Wildgrube/Oberberg and Knappenklöcher/Hötting. At Navis and Hötting 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 faehore is predominant. Smelting this ore would result in a "faehore-type"-cooper (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 faehores associated with lead ores. Smelting this ore would result in a "faehore-type"-cooper (As, Sb, Ag, Bi) additionally characterized by a certain amount of Pb (Tab. 1: 5-10).
- Faehore 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 "faehore-type"-cooper (As, Sb, Bi) 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).

Table 1: Site names and the mineralogical and geochemical characterization of the sampled ores.

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Mineral</th>
<th>Composition</th>
<th>Trace Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotenstein</td>
<td>Faehore</td>
<td>Cu, Ag, Bi</td>
<td>As, Sb</td>
</tr>
<tr>
<td>Masserfeld/Serfaus</td>
<td>Faehore</td>
<td>Cu, Ag, Bi</td>
<td>As, Sb</td>
</tr>
<tr>
<td>Knappenkogel/Navis</td>
<td>Faehore</td>
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</tr>
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<td>Wildgrube/Oberberg</td>
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</tbody>
</table>

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 Moosbruckshofen Tyrol.

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Tirol