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Towards a strontium isoscape for the determination of provenance of prehistoric wooden findings

Monika Horsky (1), Johannes Tintner (2), Monika Bolka (2), Michael Grabner (2), Kerstin Kowarik (3), Hans Reschreiter (3), Anton Kern (3), Micha Horacek (4), and Thomas Prohaska (1)

(1) University of Natural Resources and Life Sciences, Vienna, Department of Chemistry, Division of Analytical Chemistry, VIRIS Lab, Tulln, Austria (monika.horsky@boku.ac.at), (2) University of Natural Resources and Life Sciences, Vienna, Department of Material Sciences and Process Engineering, Institute of Wood Science and Technology, Tulln, Austria, (3) Natural History Museum Vienna, Department of Prehistory, Vienna, Austria, (4) BLT Wieselburg, Lehr- und Forschungseinrichtung Francisco-Josephinum, Wieselburg, Austria

Prehistoric wood artefacts have been excavated from ancient salt mine galleries in Hallstatt, Austria. These findings present a unique archive of information on Bronze and Iron Age mining and trade relations, as for certain tools a production elsewhere and transport to the mine is assumed. These wooden artefacts contain the geochemical information of their growth location, though masked by secondary salts due to the storage conditions. Consequently, the analysis of the biogenic $^{87}Sr/^{86}Sr$ isotope ratios of the findings was carried out in comparison to the respective signatures of trees from possible regions of origin, in order to draw conclusions on prehistoric trade routes.

Thus - in addition to Hallstatt - seven regions in the Alpine region of Austria as well as in the Northern and Southern lowlands were selected based on known settlements in the time period of interest. Within all regions, the geological bedrock variability was considered for the definition of sampling spots, which resulted in a total of 26 locations. Four tree species represented in the archaeological finds (i.e. *Picea abies*, *Abies alba*, *Fagus sylvatica* and *Quercus sp.*) were sampled upon availability. Wood sample digests from eight replicate trees per location were analysed using multicollector-inductively coupled plasma-mass spectrometry (MC-ICP-MS).

In order to reveal the biogenic signatures of the prehistoric findings, a decontamination method based on acid leaching was developed. We could successfully separate biogenic from secondary Sr and adopted a mixing theory to account for possibly incomplete removal of the latter.

The Sr isotope ratio data obtained from modern trees (i.e. bioavailable Sr) reflect the geological heterogeneity of the Alps, which challenges the creation of an isoscape and its applicability to distinct provenance determination. Different geologic bedrock types can be clearly distinguished by their $^{87}Sr/^{86}Sr$, e.g. marine sedimentary and igneous rocks. Furthermore, the data indicate that the spread of isotope ratios within one geological substrate also varies strongly depending on its type: it is much narrower for trees grown on e.g. carbonate than for those on silicate bedrocks. The results highlight the importance to consider even small scale geological variability for a reliable application of Sr isotope ratio measurements to the determination of origin of biogenic material.