

Unveiling the prehistoric salt mines of Hallstatt

Visualizing a hidden world heritage

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Basics

One of the main reasons for the declaration of Hallstatt as UNESCO World Heritage Site (Fig 1.) in 1997 were the prehistoric salt mines with their unique, perfectly conserved finds. The insight into prehistoric life, provided by these finds reaches impressive amount of detail like on very few other sites worldwide (Reschreiter/Kowarik 2019). By modern salt mining about 100 archaeological sites were discovered inside the mountain incidentally. Stimulated by the sensational finds in the prehistoric cemetery, archaeological research at such find spots began already in the second half of the 19th century. But compared to other prehistoric mines the situation in Hallstatt is very special. With one exception no prehistoric cavities are preserved, because most of the prehistoric mines were filled up with surface material during recurring large scale landslides. Furthermore, due to the characteristics of the Haselgebirge, the saliferous geological unit, all hollow cavities are closed up over time. Therefore, besides some small scale openings, most of the prehistoric mining works is not visible at all. The systematic research carried out by the Natural History Museum of Vienna beginning in the 1960ies, by digging large cross-sections through the filled up mining works, showed the impressive size of the prehistoric mining chambers dating to the Late Bronze and Early Iron Age (Barth/Reschreiter 2019), which were amongst the biggest man-made cavities of their time.

The Idea

The main methods for researching these enormous mining chambers are driving narrow research tunnels through the production waste on the floor of the mining works and the filling material above it as well as core drilling. The discrepancy between the small scale openings and the large size of the prehistoric mining works, hence the lack of an overview of the archaeological structure, is one of the main challenges of the research inside the mountain (Fig. 2). Therefore the decision was made to transfer the whole geometry into a digital environment for a better understanding of the relative position of the different sites to each other and to allow the integration of a wide array of 2D data like geological maps, historic mine plans and archaeological documentation. The combination

of various data should, for the first time, enable a detailed, 3D-reconstruction of the prehistoric mining works.

Method

In course of the Interreg project VirtualArch in a first step all accessible archaeological sites were documented by using photogrammetry (image based modelling) producing more than 55000 single pictures. To meet the special requirements in the mine custom built lighting systems were developed and the workflow improved (Brandner 2018). Four kilometers of modern tunnels, accessing the prehistoric openings were scanned with the GeoSLAM Zab Revo in cooperation with the surveying unit of the Salinen Austria AG (Fig. 3). For displaying the surface, the digital terrain model, provided by the federal government of Upper Austria was included. In a next step in this 3D environment a large number of 2D plans was integrated. In combination with further information about the prehistoric mining works, found in historic mine plans (Fig. 4), geological survey data, exploration wells and archaeological data of over 130 years of underground research, the corner stones for the reconstruction of the prehistoric salt mining chambers were defined.

Result

Through this effort it was for the first time possible to create a comprehensive reconstruction of the still accessible prehistoric mining works (Late Bronze and Early Iron Age) in the salt mine of Hallstatt. The visualisation of all single sites in combination with georeferenced 2D plans in a 3D-environment and in addition the highly precise dendrochronological data did not only lead to a new level of understanding of the prehistoric mines and their operating phases but also enabled to demonstrate size, characteristic and significance to the public. This way it was possible to visualize the unique archaeological landscape that lies almost invisible under the surface of the Hallstatt High Valley (Fig. 5).

Perspective

With the presented method a detailed documentation of prehistoric findings as well as a reconstruction of the mining works could be achieved. The focus in future work is now to increase the level of detail, and use the generated 3D models as basis for further integration of data (i.e. finds). Through the combination with semantic networks in the future it should be possible to display the entanglements of different single elements in the current interpretation model (Abstract "Integration of Information and Interpretation of findings into 3D and GIS in Hallstatt").

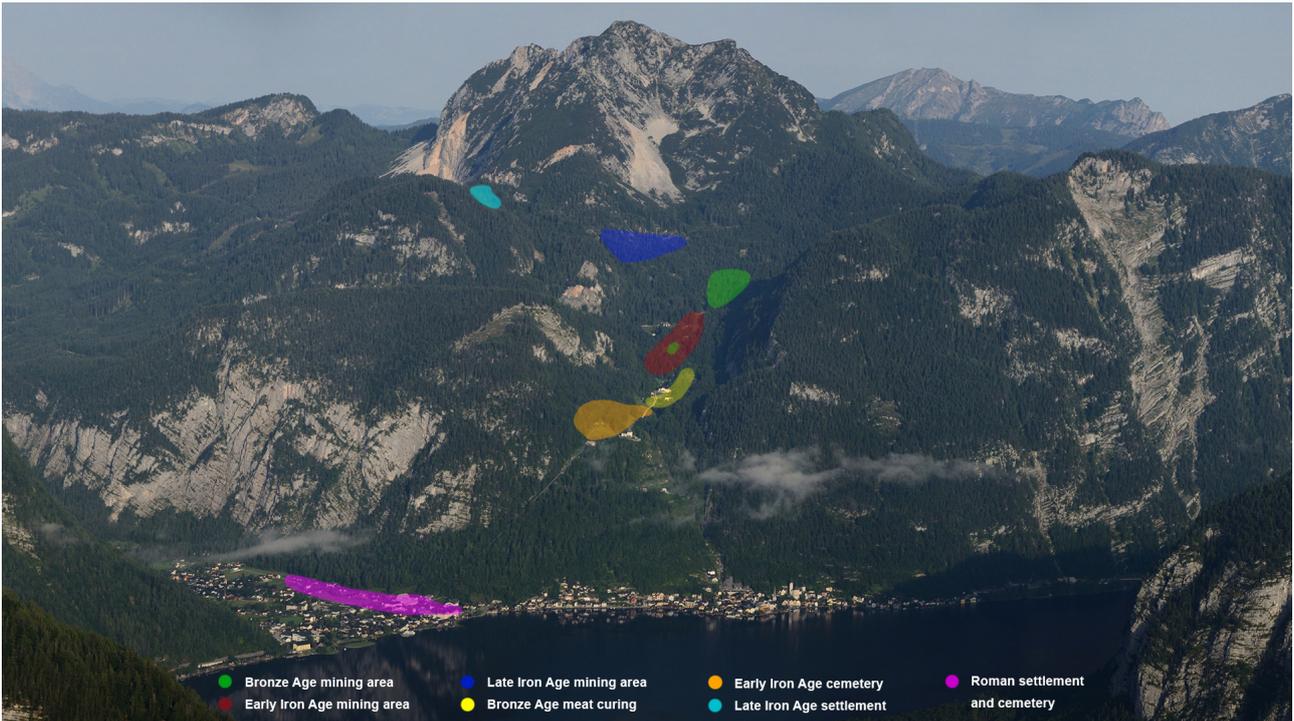


Fig. 1. Hallstatt and the High Valley with main archaeological areas (© D. Brandner).



Fig. 2. Excavation and documentation at a Bronze Age site (© D. Brandner, H. Reschreiter)



Fig. 3. System of modern mining tunnels accessing prehistoric sites (© D. Brandner, H. Reschreiter, S. Simentschitsch, Th. Leitner)

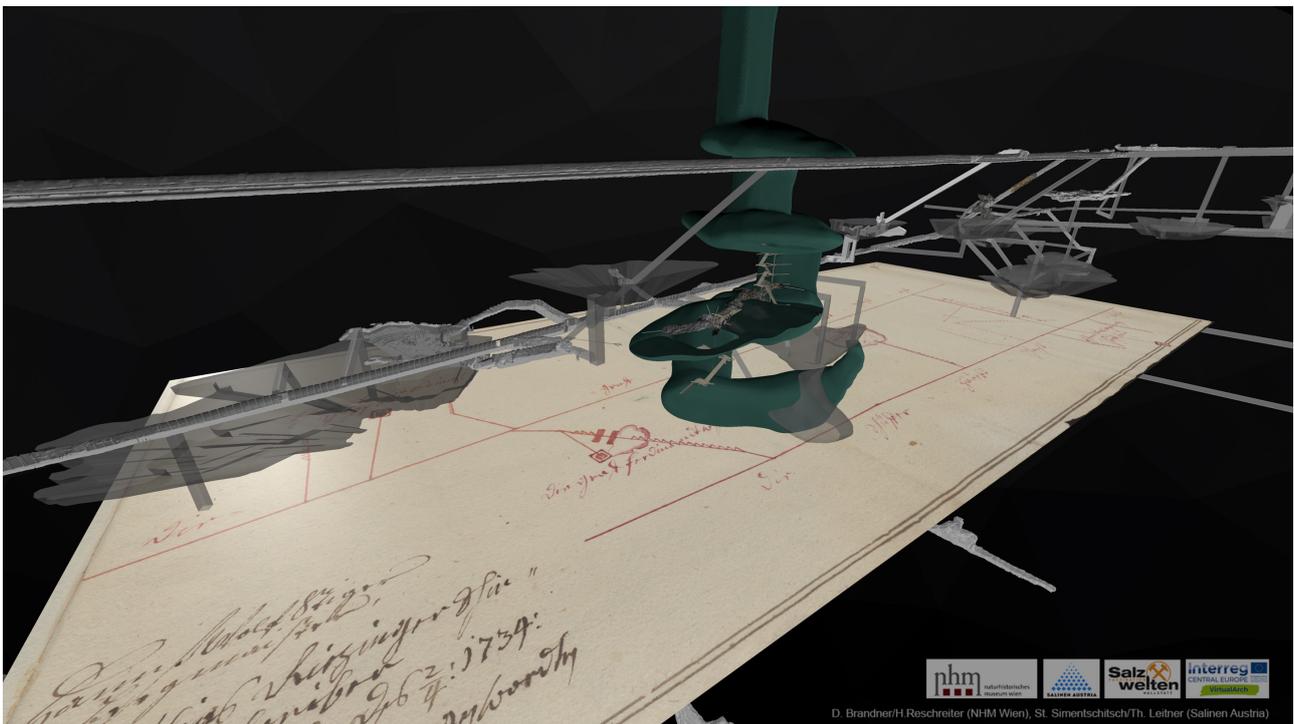


Fig. 4. Up to 300 year old mine plans were embedded into the 3D-model to reconstruct the location of inaccessible sites (© D. Brandner, H. Reschreiter, S. Simentschitsch, Th. Leitner)

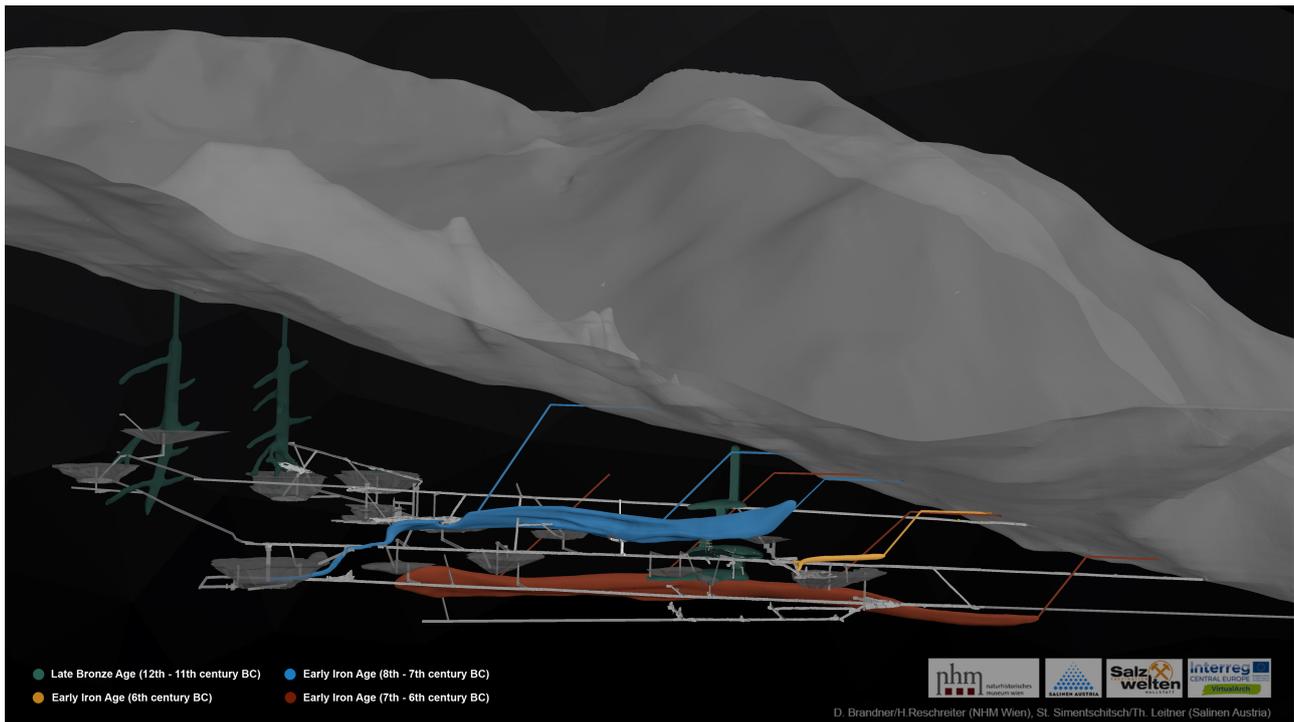


Fig. 5. Modern tunnels and reconstructed prehistoric mining works (© D. Brandner, H. Reschreiter, S. Simentschitsch, Th. Leitner)

References (max 2-3)

- Barth, F. E., Reschreiter H. (2019). Prähistorische Bergbauspuren im Kernverwässerungswerk des Salzbergwerkes Hallstatt, ArchOn Hallstatt 1.
- Brandner, D. (2018). Mit Fotos zum 3D-Höhlenmodell. Leitfaden zur dreidimensionalen Höhlendokumentation mit Structure-from-Motion, Die Höhle 69 (1-4), pp. 71-83.
- Reschreiter, H., Kowarik, K. (2019) Bronze Age Mining in Hallstatt. A New Picture of Everyday Life in the Salt Mines and Beyond, Archaeologia Austriaca 103, pp. 99-136.