eTopoi Journal for Ancient Studies

Special Volume 3 (2012), pp. 271–278

Astrid Röpke

Past Land-Use and Fire Management in the Montafon Valley (Northern Alps): An Integrated Palaeoenvironmental Approach

in Wiebke Bebermeier – Robert Hebenstreit – Elke Kaiser – Jan Krause (eds.), Landscape Archaeology. Proceedings of the International Conference Held in Berlin, 6th – 8th June 2012

Edited by Gerd Graßhoff and Michael Meyer,
Excellence Cluster Topoi, Berlin

eTopoi ISSN 2192-2608
http://journal.topoi.org

Astrid Röpke

Past Land-Use and Fire Management in the Montafon Valley (Northern Alps): An Integrated Palaeoenvironmental Approach

Northern Alps; multidisciplinary approach; past human-fire-environment interactions; charcoal layers in soils.

Introduction

The role of fire in the prehistoric complex land-use history of European mountain areas has long been underestimated. Previous palaeoenvironmental studies focussing on long-term fire ecology indicate that in the Alps most disturbances since ca. 4000 yr BC were of human origin and fire was the decisive tool.[1] These palaeo fire reconstructions are available from an array of natural archives that register fire at different scales and resolutions.[2] While the abundance of microscopic charcoal particles in lakes, peat bogs and marine deposits can be used as a proxy for past regional fire activities, more local information can be derived from soils.

In the Northern Alps wild fires are very rare and therefore most signs of past fires can be regarded as anthropogenic. Various charcoal layers in the high montane-subalpine soils (1000–1800m a.s.l.) above the village Bartholomäberg (Montafon, Austria) point to a close correlation between fire, land-use history and soil development. According to the palaeoecological and archaeological research, different phases of land-use and settlement activity from Early to Middle Bronze Age (1800–1550 BC), Iron Age (800–15 BC) and the High Middle Ages (9th–13th century) could be detected so far.[3] In order to record past fire activity, the fire history will be reconstructed by means of microscopic charcoal particles from a peat bog and macroscopic charcoal layers in soils. Combining geoarchaeological, palaeoecological and archaeological results should offer more detailed insight into the temporal and spatial distribution of fire activity and its consequences in high mountain regions.

Study Site and Archaeology

The Montafon valley is located in the southern part of Vorarlberg (Austria). It is enclosed within the mountainous ridges Verwall, Silvretta and Rätikon. The small village Bartholomäberg (900–1400m a.s.l.) is situated on the south exposed slopes of the Itonskopf

This geoarchaeological project was supported by the German Foundation (DFG, RO 3889/1–1) and program Junior Scientists in Focus (Goethe University, Frankfurt, Germany). I would like to thank all members of the "Montafon project" led by Prof. Dr. Rüdiger Krause (Goethe University, Frankfurt, Germany) and am grateful to the Mayor of Bartholomäberg Martin Vallaster, the community and all the landowners, who allowed us to undertake extensive field studies.

1 Tinner et al. 2005; Rius, B. Vannière, and Galop 2009; Conedera and Tinner 2010.
2 Gavin et al. 2007.
3 Oeggl, Kofler, and Wahlmüller 2005; Krause 2007; Würfel et al. 2010.

(2089m a.s.l.) above the town of Schruns (689m a.s.l.). This region belongs to the northern edge of the crystalline zone which consists mainly of phyllite gneiss and mica schist at the base and sand, clay and marl limestone in the upper section.[4] The climate of the Montafon Valley is temperate with an intermediate position between sub-oceanic and subcontinental conditions. In Schruns the annual mean temperature is 7.4°C and precipitation reaches 1243mm.[5] The present vegetation is dominated by subcontinental, interalpine spruce-fir forest with meadows and pastures in the subalpine region. According to palaeoecological and archaeological investigations Bartholomäberg has been settled since the Early Bronze Age.[6] Settlement activity resumed from the Later Hallstatt Period to the Early La Tène Period.[7] Evidence for Bronze Age exploitation of copper is lacking so far, but first traces of Late Iron Age mining activity were found in association with heaps and mining debris. In the historical source *Churrätisches Reichsurbar* (842 AD) smelting furnaces in this region are mentioned. In Bartholomäberg it is assumed that medieval mining started in the High Middle Ages and extended into the Late Middle Ages.[8]

Material and Methods

In the former mining zone (1300–1450m a.s.l.) and pasture zone "Allmein" (1450–2000m a.s.l.) a total of 55 soil profiles were dug down, excluding five exposures from heaps, mining debris and a smelting place. Colours were described according to Munsell,[9] soil types, horizons and layers according to the German classification Ad-hoc AG BODEN.[10] Additionally soil samples were anlysed for standard parameters (pH, total organic carbon, particle size distribution and pedogenic oxids). Micromorphological analyses were implemented to differentiate colluvial layers and palaeo surfaces. So far, 21 samples have been radiocarbon dated by AMS (acceleration mass spectrometry) and conventional analyses by Curt-Engelhorn-Zentrum Archäometrie (Mannheim/Tübingen, Germany), Cologne AMS Centre for Accelerator Mass Spectrometry and Beta Analytic (London, Florida), including 9 samples from the pasture zone and 12 from the former mining zone (Tab. 1). They were calibrated via OxCal v 4.17.[11] Bearing in mind that charcoal can be transported by post-depositional mixing, only *in situ* layers were radiocarbon dated.[12] The palynological data and microscopic charcoal counts have been worked out by Prof. Dr. Klaus Oeggl and his team (University of Innsbruck, Austria).

Results and Interpretation

Soils

In Bartholomäberg the high montane-subalpine climax soil podzol was eroded and buried by several colluvial layers (M). These layers evidence different phases of human activity (Fig. 1). It was possible to differentiate them by micromorphological analyses and physical

4 Wolkersdorfer 2005.
5 Werner 2005; Walter and Lieth 1967.
6 Schmidl et al. 2005; Krause 2007.
7 Würfel et al. 2010.
8 Scheibenstock 1996; Krause 2009.
9 MSCC 2000.
10 Ad-hoc-AG Boden 2005.
11 Bronk Ramsey 2010.
12 e.g., Carcaillet 2001.

Soil profile	Sample code	Elevation (m a.s.l.)	Depth (cm)		Location
Pasture zone "Allmein"					
Bart 1	MAMS-11731	1500	227-230	3307 ±25	Footslope, pasture
Bart 2	Hd-29535_2	1487	25-30 (fine fraction)	1161±18	Mid slope, pasture
Bart 2	Hd-29535_1	1487	25-30 (coarse fraction)	1192±22	Mid slope, pasture
Bart 2	MAMS 11146	1487	45-47	1576 ±26	Mid slope, pasture
Bart 3	Hd-29536	1585	60-63	1524 ± 19	Depression, wood pasture
Bart 3	MAMS 10901	1585	60-63	3565±30	Depression, wood pasture
Bart 4	MAMS 10902	1760	59-60	1252±27	Footslope, pasture
Rell 2	MAMS-11731	1500	25-27	2224± 23	Mid slope, pasture
Rell 3	MAMS-11730	1660	6-10	1108± 23	Mid slope, pasture
Former mining zone (Krause 2007; Krause 2009)					
Knappa Gruaba district (Ref 1)	Beta-250352	1330	18-21	3290 ± 40	Depression, spruce forest
Knappa Gruaba district	MAMS 10920	1330	55-59	2470 ± 29	Footslope, pasture
Goritschang district (Rell 1)	MAMS 10903	1410	30-33	2212±29	Footslope, wood pasture
Goritschang district	Beta-236430	1400	52-56	2010 ± 40	Close to open mining pit
Goritschang district	Beta-238712	1400	35-49	900±40	Open mining pit
Roferweg "Zum Wurm"	COL1283.1.1.	1330	106-108	2245±24	Mining heap
Roferweg "Zum Wurm"	COL1284.1.1.	1330	124-126	2219±24	Mining heap
Roferweg "Zum Wurm"	COL1282.1.1.	1330	55	611±23	Mining heap
Knappa Gruaba district 8	COL1278.1.1.	1364	45-48	908±21	Mining heap
Knappa Gruaba district 8	COL1279.1.1.	1364	55-58	2269±22	Mining heap
Roferweg	COL1299.1.2.	1280	70	3620 ± 47	Buried by colluvia and smithing place
Roferweg	MAMS-11738	1280	20	418 ± 22	Smithing place

Tab. 1 | Radiocarbon dates of charcoal fragments from Bartholomäberg (Montafon, Austria).

and chemical parameters such as soil organic matter content (SOM) and soil texture.[13] All colluvial layers reach relatively high percentages of SOM (average of 2.9 weight-%) and include charcoal particles. In general the oldest M1 layer contains less organic matter (average 2.34 weight-%), whereas M layers above 5 weight-% are considered as former palaeo surfaces or upper parts of a colluvial layer. They can be recognised in thin section by the high amount of burnt/unburnt roots and numerous plant residues. Additionally the diverse geology leads to textural differences, e.g. weathered sedimentary rock is transported downwards into the crystalline zone.

In many cases charcoal layers separate the colluvial layers. These signs of past fires can be regarded as man-made, because in the humid climate of the Northern Alps wild fires are neglectable.[14] They imply a close correlation between fire, land-use history and

13 Further details in Röpke 2012; Röpke and Krause 2012.
14 Tinner et al. 2005.

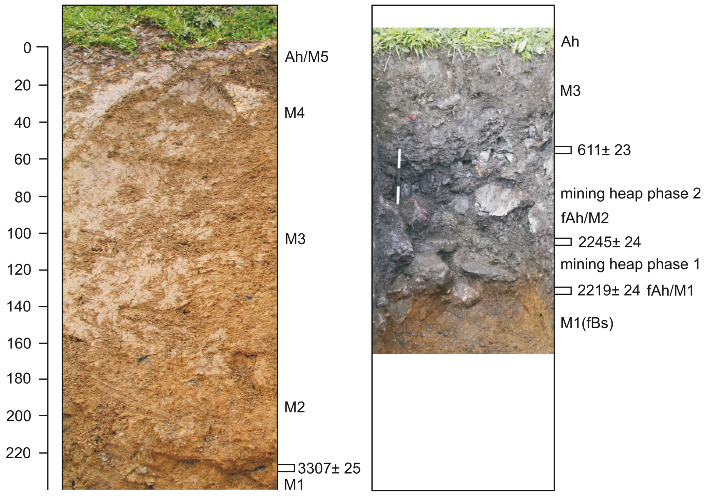

Fig. 1 | Soil profiles Bart 1 from the pasture zone "Allmein" and the heap "Zum Wurm" above the village of Bartholomäberg (Montafon, Austria).

soil development. According to the radiocarbon dates obtained (Tab. 1) in the pasture zone "Allmein" and the former mining zone, the oldest evidence of fire reaches back to the Early and Middle Bronze Age, located in depressions or covered by thick colluvia in footslope positions. This burning was resumed during the Iron Age, documented in the soils of the "Allmein" as well as charcoal being found in connection to mining heaps and debris. The heap "Zum Wurm" (length: 70m, breadth: 40m, height: 2–4m) was built up in two phases (Fig. 1). The palaeo surface of the La Tène Period (379–203 BC) was buried by waste rock materials from the same period (390–208 BC) covered by a small fAh. Renewed activity can be proved for the Late Middle Ages (AD 1297–1401) on top of it. A smaller heap (length: 10m, breadth: 4m, height: 1m) consists of La Tène Period mining debris and a younger phase from the High Middle Ages (1297–1401 AD). The occurrence of five charcoal layers in the most favourable area of the pasture zone indicates rising fire activity during the Early and High Middle Ages. From the end of the High Middle Ages till the Late Middle Ages evidence of burning merely took place in connection with mining activity.

Synthesis

Together with palaeoecological and archaeological investigations, it is possible to evaluate past human-fire-environment interactions. Charcoal layers in soils from different altitudes (1300–1550m a.s.l.) evidence the first extensive use of fire in the high montane-subalpine forest during the transition Early-Middle Bronze Age. The forest was cleared to gain pasture land and settlement areas as showed in the pollen record by a decrease of spruce and fir with a simultaneous increase in settlement and grazing indicators and microscopic charcoal.[15] At lower elevations a hillfort and associated settlement existed.[16] A geoarchaeological and archaeological hiatus at the beginning of the Late Bronze is illustrated in the pollen diagrams by an increase of woodland and a decline of settlement indicators.[17] During the Iron Age soil charcoal documents further burning to obtain or maintain pasture land. It is remarkable that during that time radiocarbondated charcoal layers from different heaps and mining debris indicate first mining impacts in the Knappa Gruaba district (former mining zone) (1300–1450m a.s.l.). It can be assumed that from

15 Oeggl, Kofler, and Wahlmüller 2005; Schmidl et al. 2005.
16 Würfel et al. 2010.
17 Schmidl et al. 2005.

that time on, the lower part of the former pasture zone was changed into a mining region. From the Early Middle Ages to the High Middle Ages, an increase of charcoal layers in soils of the pasture zone (1450–1800m a.s.l.) occurs. This impact is not reflected palynologically for the Early Middle Ages, but for the High Middle Ages. In general during the High Middle Ages and Late Middle Ages (immigration of the Walser people) increasing land-use in this region is shown in various pollen diagrams.[18] During this period there is no charcoal evidence in the soils of the pasture zone, and the microscopic charcoal record from the investigated peat bog Tschuga shows very low fire intensity.[19] Either grazing pressure was sufficiently high to keep the areas open and forests were cleared at a greater distance or the wood was cut without burning. However, evidence of fire is related to the mining zone. In this zone human activity is unambiguously documented by mining heaps, debris, a shaft and a smithing place.[20]

18 Heitz 1975; Kostenzer 1996; Oeggl, Kofler, and Wahlmüller 2005, Röpke et al. 2011.
19 Schmidl et al. 2005.
20 Krause 2009.

Bibliography

Ad-hoc-AG Boden 2005
Ad-hoc-AG Boden, ed. *Bodenkundliche Kartieranleitung*. Stuttgart: Schweizerbart, 2005.

Bronk Ramsey 2010
C. Bronk Ramsey. "OxCal v 4.17" (2010).

Carcaillet 2001
C. Carcaillet. "Are Holocene Wood-charcoal Fragments Stratified in Alpine and Subalpine Soils? Evidence from the European Alps Based on AMS 14C dates". *The Holocene* 11 (2001), 231–242. DOI: 10.1191/095968301674071040.

Conedera and Tinner 2010
M. Conedera and W. Tinner. "Langzeit-Feuerökologie der Schweiz". *Schweizerische Zeitschrift für Forstwesen* 161 (2010), 424–432.

Gavin et al. 2007
D.G. Gavin et al. "Forest Fire and Climate Change in Western North America. Insights from Sediment Charcoal Records". *Frontiers in Ecology and the Environment* 5 (2007), 499–506.

Heitz 1975
C. Heitz. "Vegetationsentwicklung und Waldgrenzschwankungen des Spät- und Postglazials im Oberhalbstein (Graubünden/Schweiz) mit besonderer Berücksichtigung der Fichteneinwanderung". *Beiträge zur geobotanischen Landesaufnahme der Schweiz* 55 (1975), 1–63.

Kostenzer 1996
J. Kostenzer. "Pollenanalytische Untersuchungen zur Vegetationsgeschichte des Montafons (Vorarlberg, Österreich)". *Berichte des naturwissenschaftlichen-medizinischen Verein Innsbruck* 83 (1996), 93–110.

Krause 2007
R. Krause. "The Prehistoric Settlement of the Inner Alpine Valley of Mention in Vorarlberg (Austria)". *Prehistoria Alpina* 42 (2007), 119–136.

Krause 2009
R. Krause. "Zur Montanarchäologie im Montafon, Vorarlberg (Österreich) – Ein Beitrag zur Wirtschafts- und Siedlungsgeschichte der Alpen". In *Alpen, Kult und Eisenzeit: Festschrift für Amei Lang zum 65. Geburtstag*. Ed. by J.M. Bagley. Internationale Archäologie : Studia honoraria 30. Rahden/Westf.: Verlag Marie Leidorf, 2009, 509–534.

MSCC 2000
MSCC. *Munsell Soil Color Charts*. Baltimore Maryland: Munsell Color Company, 2000.

Oeggl, Kofler, and Wahlmüller 2005
K. Oeggl, W. Kofler, and N. Wahlmüller. "Pollenanalytische Untersuchungen zur Vegetations- und Siedlungsgeschichte im Montafon". In *Das Montafon in Geschichte und Gegenwart. 1. Mensch – Geschichte – Naturraum. Die lebensweltlichen Grundlagen*. Ed. by J.-M. Rollinger and R. Rollinger. Schruns: Stand Montafon, 2005, 19–207.

Rius, B. Vannière, and Galop 2009
D. Rius, B. B. Vannière, and D. Galop. "Fire Frequency and Landscape Management in the North-western Pyrenean Piedmont (France) Since the Early Neolithic (8000 cal. BP)". *The Holocene* 19 (2009), 847–859. DOI: 10.1177/0959683609105299.

Röpke 2012
A. Röpke. "Feuer- und Landnutzungsgeschichte im Montafon (Vorarlberg, Österreich). Geoarchäologische Untersuchungen von Almböden oberhalb der Gemeinde Bartholomäberg". In *Festschrift Verzweigungen. Eine Würdigung für A. J. Kalis und J. Meurers-Balke*. Ed. by A. Stobbe and U. Tegtmeier. Bonn: Rudolf Habelt, 2012, 207–224.

Röpke and Krause 2012
A. Röpke and R. Krause. "High Montane-subalpine Soils in the Montafon Valley (Austria, Northern Alps) and their Link to Land-use, Fire and Settlement History". *Quaternary International* (2012).

Röpke et al. 2011
A. Röpke et al. "Late-Holocene Land Use History and Environmental Changes at the High Altitudes of St. Antönien (Switzerland, Northern Alps). Combined Evidence from Pollen, Soil and Tree Ring Analyes". *The Holocene* 21 (2011), 485–498. DOI: 10.1177/0959683610385727.

Scheibenstock 1996
E. Scheibenstock. "Bergknappen, Stollen, Erze. Zur Geschichte des Bergbaus im Montafon". *Bludenzer Geschichtsblatt* 31 (1996), 1–63.

Schmidl et al. 2005
A. Schmidl et al. "Land Use in the Eastern Alps During the Bronze Age. An Archaobotanical Case Study of a Hilltop Settlement in the Montafon (Western Austria)". *Archaeometry* 47 (2005), 455–470.

Tinner et al. 2005
W. Tinner et al. "Fire Ecology North and South of the Alps Since the Last Ice Age". *The Holocene* 15 (2005), 1214–1226. DOI: 10.1191/0959683605hl892rp.

Walter and Lieth 1967
H. Walter and H. Lieth. *Klimadiagramm-Weltatlas*. Jena: Gustav Fischer Verlag, 1967.

Werner 2005
R. Werner. "Klima und Wetter im Montafon". In *Das Montafon in Geschichte und Gegenwart. 1. Mensch – Geschichte – Naturraum. Die lebensweltlichen Grundlagen*. Ed. by J.-M. Rollinger and R. Rollinger. Schruns: Stand Montafon, 2005, 57–92.

Wolkersdorfer 2005
C. Wolkersdorfer. "Geologische Verhältnisse des Montafons und angrenzender Gebiete.". In *Das Montafon in Geschichte und Gegenwart. 1. Mensch – Geschichte – Naturraum. Die lebensweltlichen Grundlagen*. Ed. by J.-M. Rollinger and R. Rollinger. Montafon: Stand Montafon, 2005, 25–55.

Würfel et al. 2010
F. Würfel et al. "Prähistorische Siedlungsdynamik und Landschaft in einer inneralpinen Siedlungskammer. Archäologische, geoarchäologische, archäo-metallurgische und archäobotanische Untersuchungen im Montafon in Vorarlberg (Österreich)". *Archäologisches Korrespondenzblatt* 40 (2010), 503–52.

Astrid Röpke, Institut für Archäologische Wissenschaften, Goethe University, Grüneburgplatz 1, 60323 Frankfurt am Main, Germany, A.Roepke@em.uni-frankfurt.de