Fire walk with me. Human induced fire activity in the Montafon Valley (Northern Alps, Austria) a geoarchaeological approach

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Introduction

The control of fire played an important role in the course of human evolution. Its intentional use for woodland clearances, warmth, cooking or pyrotechnology (production of pottery, plaster, metals, glass etc.) leaves various marks on the geoarchaeologic and archaeologic record (Berna & Goldberg 2008, Brown et al. 2010).This study was motivated by the observation that at the Bartholomäberg in the Montafon Valley (800 - 2000 m asl) fire was used frequently for different purposes: wood land clearances, maintaining ecotones and settlement and mining activity. Because of its cool humid climate, fire signals are considered to be mainly man made. Evidence from different settings such as subalpine colluvisols rich in charcoal, occupation layers, fire- and smithing places and burnt pits from Early Bronze Age till the late Middle Ages will be presented. Combined analyses from pedology, geomorphology and micromorphology allow a detailed interpretation of individual anthropogenic fire activity.

The results will be compared with archaeological and palaeoecological data including microscopic inferred fire history (Schmidl et al.2005). They detect several distinct settlement phases from Early Bronze Age (18/17th c. BC) till the beginning of the High Middle Ages (around 800 AD) (Krause 2007, Würfel et al. 2010).

	Long-term fire ecology/ fire- and vegetation history	Identification of local fire activity
natural archives	lakes/peat bogs	soils
discipline/ method	Palaeoecology (pollen analysis, microscopic charcoal analysis)	Geoarchaeology (pedological and geomorphological examinations, thin section analysis)
evidence	reconstructing natural or anthropogenically induced forest fires, regional fire frequency, paleoecosystem dynamics	reconstructing fire associated activities: landscape changes (soil erosion) use of pyrotechnology (hearths, oven, pits, burnt remains etc.)

Fig. 2: Palaeo fire reconstructions

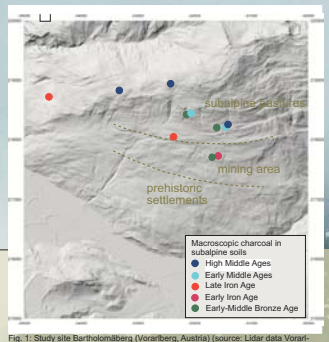


Fig. 1: Study site Bartholomäberg (Vorarlberg, Austria) (source: Lidar data Vorarlberg, modified by Arctron GmbH).

Study site

The Montafon Valley is located in the southern part of Vorarlberg in the Northern Alps. It is bordered by the mountains chains Verwall, Silvretta and Rätikon. In the north it meets the Walgau, lowlands of the river Ill. The small village Bartholomäberg is situated above the town Schruns (689 m a.s.l.). It is scattered at the south-faced slope (900 to 1400 m a.s.l.) of the Itonskopf (2089 m a.s.l.). The climate of the Montafon is temperate, with an intermediate position between sub-oceanic and subcontinental. In Schruns the annual mean temperature is 7.4 °C and precipitation reaches 1243 mm (Walter and Lieht 1967). The slopes of the Itonskopfs belong to the northern edge of the crystalline zone, which consists mainly of phyllite gneise and mica schist. The present vegetation is dominated by subcontinental, interalpine spruce-fir forest (Mayer 1974).

Fig. 3: Subalpine pastures at the southexposed slope of the Itonskopf (Bartholomäberg, Montafon).

Methods

Pedology/Geomorphology
At the south exposed slope of the Itonskopf about 50 exposures were dug down to the parent material. In the field colluvial layers were identified by colour and the occurence of charcoal. Colours were described according to the Munsellsystem (Munsell, 2000). Soil types, horizons and layers were described according to Food and Agriculture Organisation (FAO, 1998) and the protocal of the AG Boden (2005). Soil samples were analysed for standard parameters: particle size distribution, pH total organic carbon (TOC), pedogenic oxids etc.

Radiocarbon dating
So far 47 samples from charcoal layers in soils and in context with the archaeological excavations were radiocarbon dated by AMS (acceleration mass spectrometry) and conventional analyses.

Micromorphology
Samples for thin sections were air-dried, impregnated with polyester resin and made into thin sections. They were described at magnification > 800 under a Leica DM750P microscope using plane polarized (ppl) and cross-polarized light (xpl). The description follows the terminology of Stoops (2003) and Bullock (1985).

Palynology
Palaeological investigations were carried out by Prof. Dr. K. Oeggl and his team (University of Innsbruck).

Results Pedology/Geomorphology

Subalpine colluvisols resulting from man made forest fires
Most of the subalpine soils are affected by strong human influence and can be named subalpine colluvisols. Fire was widely used to burn the forest and create pastures. After the clearances soil erosion took place and charcoal layers were embedded in the soils (Fig. 4).

Fig. 4: Macroscopic charcoal from charcoal layers in subalpine colluvisols.

According to radiocarbon dates (fig. 1, fig. 4) four different phases of anthropogenic induced fire events could be detected so far: First signals of fire activity in the soils are evidenced for the Early/Middle Bronze Age. During the Iron Age further use of fire to open the forest can be recognised. However Roman charcoal is still missing. The youngest soils contain charcoal layers from the Early and High Middle Ages indicating the last prominent phase of fire activity in th subalpine area of the Bartholomäberg. Apart from the frequent occurence of charcoal colluvial layers could be differentiated by its chemical and physical characteristics.

Labor-Nr.	conv. ^{14}C Age BP	calibr. Ages Zeigma
Hd-29933_1	1161±18 (Konv.)	cal AD 779- 961
Hd-29933_2	1192±22 (Konv.)	cal AD 775- 891
MAMS 10902	1252±27 (AMS)	cal AD 675-864
MAMS 11146	1576±26 (AMS)	cal AD 421-548
Hd-29536	1524±19 (Konv.)	cal AD 437- 599
MAMS 10903	2212±29 (AMS)	cal BC 375-201
MA-103613	2224±23 (AMS)	cal BC 382-205
MAMS 10930	2470±29 (AMS)	cal BC 761-415
Hd-29535	3420±40 (AMS)	cal BC 1827-1623
Ma-103612	3307±25	cal BC1663-1516
Hd-29536	3450±40 (AMS)	cal BC 1886-1666
MAMS 10901	3565±30 (AMS)	cal BC 2018-1777

Fig. 5: Macroscopic charcoal from charcoal layers in subalpine colluvisols.

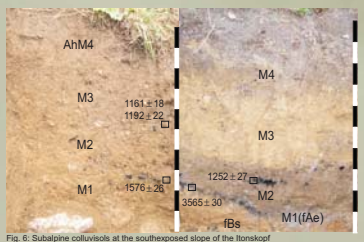
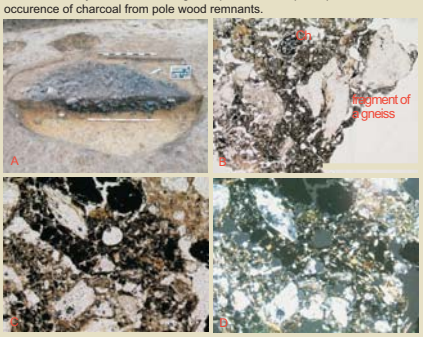


Fig. 6: Subalpine colluvisols at the southexposed slope of the Itonskopf (Bartholomäberg, Montafon).

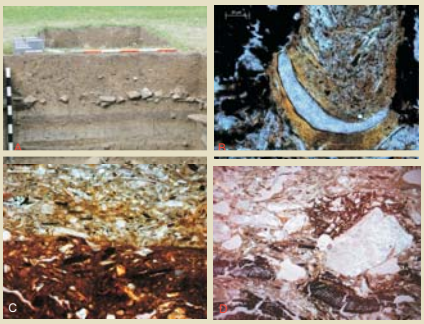
Results Micromorphology

Burnt pits
During the late Bronze Age burnt pits occur frequently in the settlement area (Fig. 1).They mainly consist of charcoal and heated cobbles. The infilling processes are not yet understood. High temperatures are prerequisite for the occurence of charcoal from pole wood remnants.



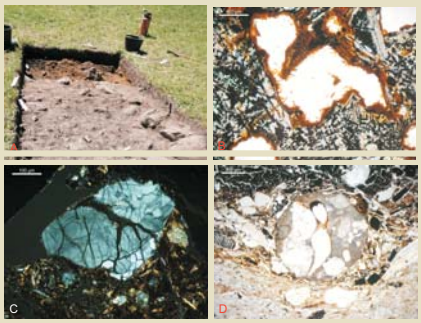
A :Late Bronze Age burnt pit rich in charcaol and cobbles; B: overview microphotograph of the infilling, C:Spherolith, probably "lapillus" due to high temperatur regime of the infill (ppl, 2,5 mm wide); D: under xpl the lapillus appears isotropic pointing to its glassy nature (melt).

Bronze/Iron Age settlement site "Dünglers Ebni"
The settlement site is situated at 1020 m a.s.l. Southwest of the Bartholomäberg church. Different layers of occupation are buried by a stone layer. The micromorphologic features of the occupation layers will be described below.



A: sequence of occupation layers (Bronze/Iron Age) under stone layer; B: clay coating indicates trampeling on the occupation layer (xpl); C: horizontally aligned mica due to trampeling, iron staining caused by changing ground water table ; D: charcoal bands as evidence of former palaeosurface.

Smithing place
In the former mining area (fig. 1) at the upper Roferweg close to a huge mining dump a smithing place from the Late Middle Ages was excavated. Huge amounts of slages were retrieved.



A: archaeological excavation of a Late Middle Age smithing place (Roferweg, Bartholomäberg) B: skeletoidal magnetite within a fayalitic matrix, typical product of smelting activity, hematite needles rimming the irregular vesicles; C: quartz affected by high temperatures (probably above 1200°C) disected by numerous microcracks (xpl); D: Lapillus with inclusions of fayalite, quartz and vesicles.

Results Palaeoecology

Four distinct phases of human impact can be detected: Early Bronze Age, Middle Bronze Age, Late Iron Age/Roman Times and Middle Ages (Schmidl et al. 2005) (Fig. ?).

The first phase of human activity takes place at the end of the Early Bronze Age. The forest was opened to gain pastures and settlements (decreasing AP, especially *Picea* and *Abies* and rising pasture and settlement indicators). The subalpine forest was cleared by fire as shown by a distinct increase of microscopic charcoal influx.

During the Middle Bronze Age settlement and land use activity increased, which is evidenced by high values of anthropogenic indicators (especially *Plantago lanceolata)*, which are accompanied by maximum microscopic charcoal influx. Subsequently a decline of human influence and a comeback of coniferous forest (rising pollen of *Picea* and *Abies*) occur during the Late Bronze Age till the Early Iron Age. During Late Iron Age and Roman Times human activity inclined again, although not supported by high microscopic charcoal influx.

The Middle Ages are characterized by renewed and expanded forest clearances (decline of AP, in particular *Abies* and rise in NBP and anthropogenic indicators). This activity is not reflected by the microscopic charcoal influx curve, probably due to changing land use practices.

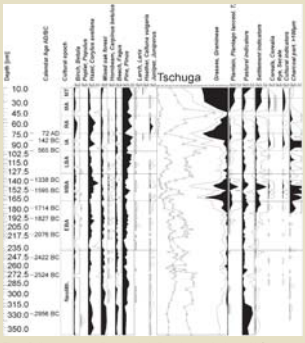


Fig. 7: Pollen percentage diagramm including microscopic charcoal influx (Schmidl et al 2005).

Synthesis

Hints for application of fire are ubiquitous in the soils of the Bartholomäberg. In the subalpine pasture zone charcoal layers within the colluvisols indicate different phases of forest clearances. In the mining zone as well as in the settlment area micromorphological analyses are useful in distinguishing various human activities. Combining these geoarchaeological results with long-term fire and vegetation history and archaeological investigations provide detailed insights into human fire environment interactions. Soils being local archives allow for evaluation of more large scale proxies such as pollen and microscopic charcoal analyses. In most cases the geoarchaeological reconstruction matches the palaeoecological and archaeological record.

- Early and Middle Bronze Age: First human induced fire activity is evidenced in the soils at different elevation. Simulatenously fire, pastoral and settlement activity increased (Schmidl et al. 2005) and a hillfort has been allocated at Friaga(Krause 2007, Würfel et al. 2010).
- Late Bronze Age: No major activity is recognised in the soils nor in the palaeoecological record, but the presence of numerous burnt pits in the settlment area suggested continous settlement activity. According to our micromorphological investigation the Bronze Age people had sufficient knowledge for achieving high temperature fires.
- Iron Age and Roman Period: The data of the disciplines provide ambiguous information. Following the palaeoecological study there was low human influence on the environment during the Early Iron Age. However, from this period a settlement site was found and charcoal layers in the subalpine area support continous land use activity. On the other hand Archaeology yields only few findings for Late Iron Age and Roman Period, while increasing land use activity emerges in the pollen record.
- Middle Ages: During Early *and* High Middle Ages soils were modified by land use again, in contrast to the pollen data which document strong human impact only for the High Middle Ages. First written sources imply mining activity already in the Beginning of High Medieval Times for the area in question.

References

Krause
Mayer (1974)
Schmidl et al. 2005)
Würfel et al. 2010:

Acknowledgements
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