A Neolithic Pile Dwelling in Keutschacher See?

Palafitte research in Keutschacher See
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1. LOCATION OF LAKE AND SHOAL

The Keutschacher See is located as largest of four lakes in a valley furrow, together with several ponds. The valley developed during the retraction of the Würm-glaciation south of the Wörther Lake; the Keutschacher See is drained into the Wörther Lake via the Reifnitz stream with a drop of 66 metres. In the east, a bog stream meets, which emanates from a widespread aggradation zone. The Baßgeigen Lake, which is situated further east and seven metres higher, flows off in an eastward direction; it is separated from the Keutschacher See by a watershed. In the west, the Keutschacher See is fed by the runoff water of two metres higher situated Hafner See (Fig.1), the Weißen Stream, and another stream. The whole bottom of the valley used to be a wide bog area. The originally much bigger water surfaces, which arguably partly merged, diminished continually by illuviation and plant growth.

The pile setting is situated on a shallowness in the middle of the lake, north of the connection line between the peninsula of the bathing beach Keutschach in the northeast and the bay in the southwest, where the runoff of the Hafner See and two further streams meet. The distance to the Northern bank as shortest connection to the shore is about 300 metres.

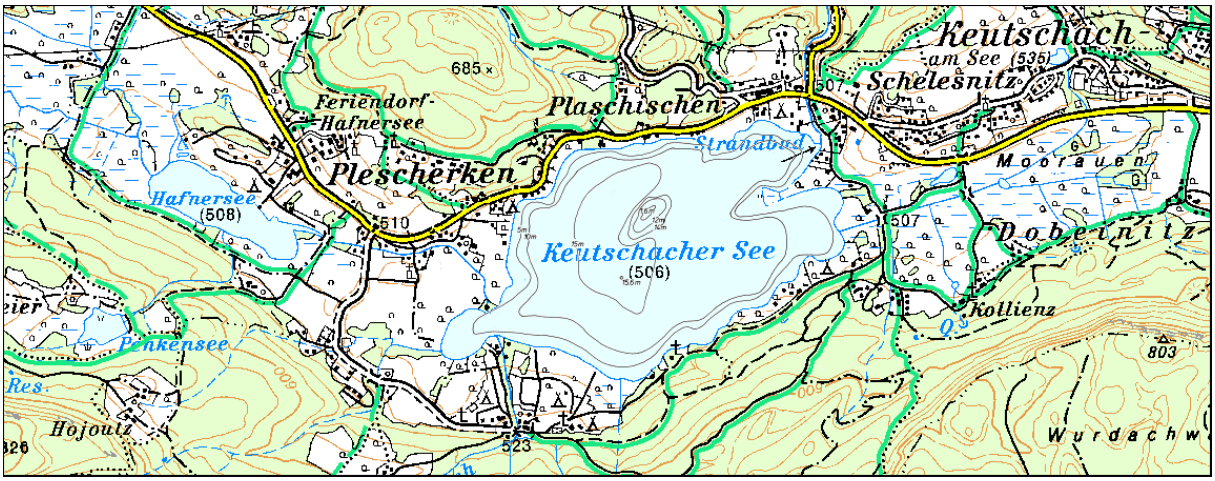


Image 1: Location of Keutschacher See with in- and outlets (Source BEV, ÖK 50, detail 5,6 x 2,2 km, contour lines added following SAMPL 1989).

2. RESEARCH HISTORY

The pile dwelling in the Keutschacher See has been an item of scientific investigations since 1864. Starting from Switzerland, fieldwork and collection expeditions for the natural history collections in various middle European states led to new findings about several places of discovery. So, Austria-Hungary, as well, conducted such ventures in the Keutschacher See, led by J. Ullepitsch (1864), F. v. Hochstätter (1865), U. Gallenstein (1865), G. v. Wurmbrand (1871/72) and K. Hauser (1886). The artefacts which were salvaged there, and also by other persons, were presented and investigated by L. Franz (1928) and R. Pittioni (1935). But only few artefacts reached the imperial collection of the Viennese court's natural history collection (there, mainly finds from later gatherings from the Salzkammergut are to be found); the finds from Keutschach are kept in the State Museum Carinthia, in the municipal office Keutschach,

and in private collections (detailed research history in OFFENBERGER 1982 und B. SAMONIG in this volume).

3. PARTICULARITIES OF WETLAND SETTLEMENTS

As water saturated site, a lake dwelling holds an exceptional position among several possibilities, how remains of the activity of former dwellers of a place can be preserved until our time.

Inherently, such a state of preservation is an absolute exception, as plants and animals, wind, rain and frost soon cover the tracks of human being in the cycle of nature. Houses tumble down, fields are overgrown by forests once again and bones are scattered to the four winds after a short while. If such remains get into the soil soon and stay there untouched, ceramics, stone tools, bone and often even charcoal can be preserved for a very long time. If archaeologists excavate them skilfully, not only the finds are interesting, even if they are not made of gold. The exact find coherences with inconsiderable soil layers can tell a story, how these things once came underneath the soil, what kind of role they played in people's life in those days and how and under what conditions these people lived.

There are better preservation conditions in the find layers under water of a wetland settlement, where pile dwellings belong to, than in dry, undisturbed soil. The anaerobic conditions prevent the life of microbes, so that not only stone, charcoal and bone, but also short-lived plant and animal remains can outlive millennia. The analysis of such find complexes with fruits and seeds can deliver additional insight into the menu, hoe traces on timber objects give indication of workmanship techniques and tools, preserved mountings show how the stone axes were once used, net- and fabric remains are evidence of highly developed skills of these people. Often, pollen grains are preserved in such layers. Their identification allows statements about the plants, which then grew in the vicinity of the finding spot or were cultivated and collected by the dwellers. Or, whole building parts once fell into the water and allow a reconstruction today. Here, an undisturbed storage is even more important than on land. Because, if the top layer is harmed digging hands or a dragging anchor, the water current soon washes away the light particles and they are lost.

The multitude of diverse finds demands specialised knowledge for a comprehensive analysis. Thus, especially on such sites, not only archaeologists with trowel and spade, but also these with microscope and wet sieve are necessary in order to read out an as comprehensive and accurate as possible story from the preserved remains.

As divers search for 'treasures' ever and anon and thus a continuous destruction of this unique archive of an age-old culture was imminent, the palafitte was put under a preservation order in 1953, so that each change to it was outlawed. Later on, an absolute scuba diving ban in the whole lake had to be imposed additionally. During a control dive by the Federal Office for Historical Monuments in 1974, the settlement seemed to have been relatively undisturbed (OFFENBERGER 1982); at a later inventory (OFFENBERGER 1986) it was categorised as 'plundered and destroyed'.

4. RESEARCH PROGRESS IN THE INVESTIGATION OF THE KEUTSCHACHER SEE DWELLING

4.1. Federal Office for Historical Monuments 1952/53

An extensive interdisciplinary survey of an archaeological site by archaeologists and natural scientists took place for the first time in Austria, in the Keutschacher See. This was in the years 1951/52 under the direction of G. Mossler (1954). But the researchers had to confine themselves to a small part of the pile field, whose shallower water allowed the assignment of skin-divers. A polygon was marked and the therein-situated piles were sounded from the water surface and plotted in a plan (Fig. 2). Wood-anatomic and palynologic identification as

well as lake-water analysis was carried out. The spectrum of woods of 22 extracted piles consisted of Alnus sp. (alder), Populus sp. (poplar), Fraxinus excelsior (ash), Fagus sylvatica (red beech), Tilia sp. (basswood), Quercus sp. (oak), and Abies alba (fir); charcoal samples additionally produced Tilia sp. (basswood), and Populus sp. (poplar). Drilling cores in the settlement area showed a sediment stratification of 12 cm peat, under it 1,5 cm fine sand and 6 cm humouse lake marl with roots from later times running through it, which gradually passes into pure lake marl. Additionally, an alluvial wood layer in a depth of 130 –140 cm (based on today's lake level) was found in the south-eastern bank area, which can be categorised as isochronic with the settlement due to the differences of the pollen spectra, encountered above and underneath it. The layer was thus taken as indication for a lowering of the lake level in the respective period. That the lake might be subject to considerable lake level variations emanates on the one hand from Ullepitsch's report, saying that the shallowness with the piles stood dry since 1838, on the other hand from native tradition that the Keutschacher See temporarily formed one water surface with the Hafner See, which is situated 2 m higher (B. Samonig, oral report).

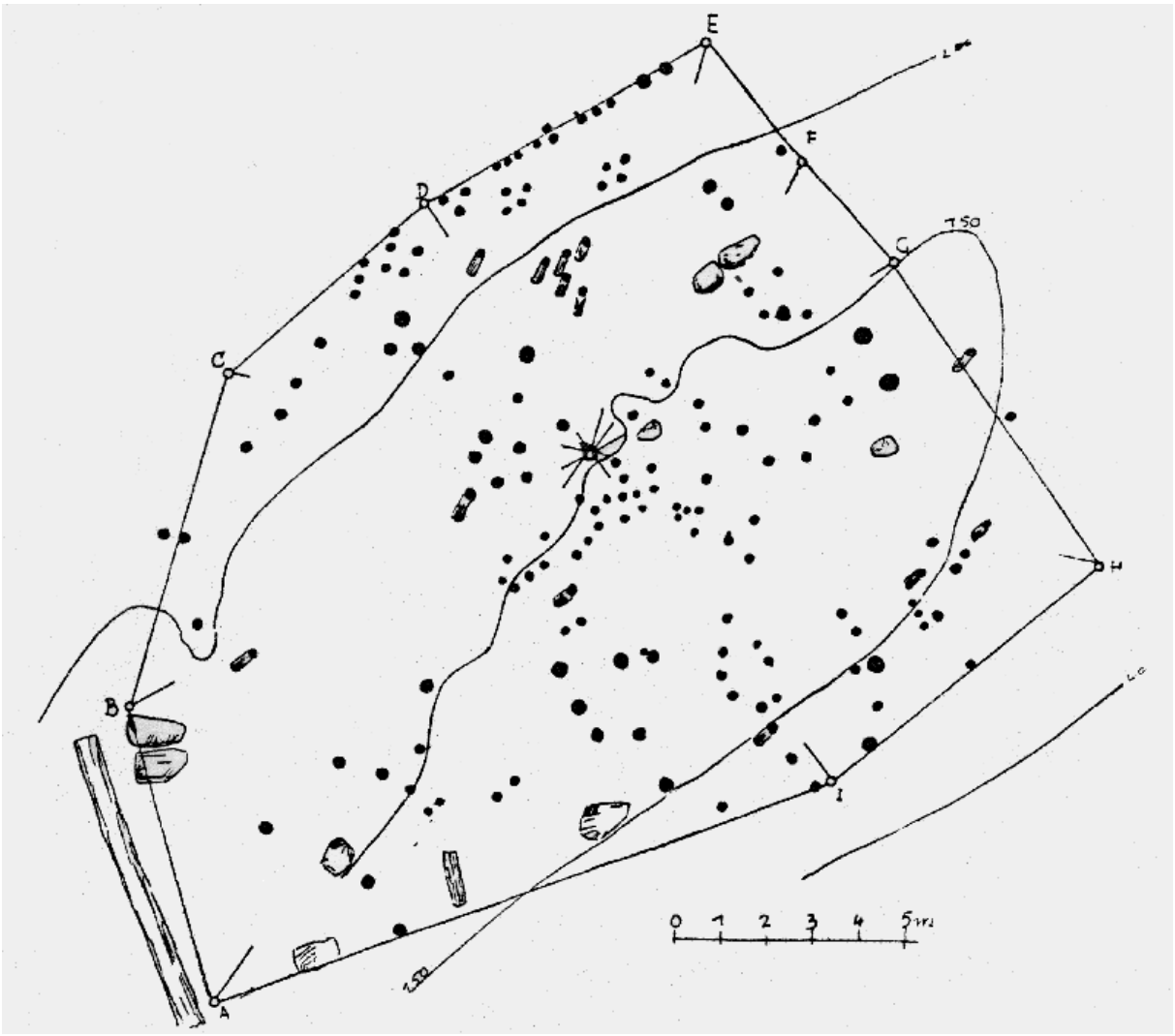


Image 2: Map depicting piles from the interdisciplinary survey 1952/53 (MOSSLER 1954)

4.2. Prehistoric Dept. Natural History Museum 1993/94 and 1999/2000

In 1993, fieldwork in the Keutschacher See was reassumed in the course of the palafitte project under the direction of Ms. Dr. E. Ruttkay, financed by the Fund for the promotion of

scientific research, FWF, with assistance of the Federal Office for Historical Monuments (CICHOCKI 1994a, b). This task was continued in 1994 and, with an interruption, in 1999/2000 with a project of the Austrian National Bank. The promotion of the work by the municipality of Keutschach, and the active assistance of the Water Ambulance facilitated the creation of a pile-plan and the measurement and recovery of surface finds and wood samples for the formulation of a dating-basis.

That the research-work took place in the Keutschacher See was on grounds of several oak piles, which were found in 1951/52 during the wood identification. So, the hope for an exact dating was justified, as oak-wood remains have never been found before in other lakes in Austria, not even in the Salzkammergut. Besides, a rapid investigation and documentation seemed reasonable due to the progressive destruction.

In 1993/94, divers levelled 1684 piles and big, lying timbers; a first pile-plan was drawn. Unfortunately, it was not possible to reliably fit the measured area into the new ground plan. The reason was that the then fixed points were not traceable anymore and, apparently, strong changes had taken place at the piles on the shallow hilltop.

In 1999/2000, the plan was revised and amended in two three-week campaigns, as new timber parts were unveiled (Fig. 3). Additionally, a 3D-representation of the shallowness could be generated with a reflection sounding (CICHOCKI 2000).

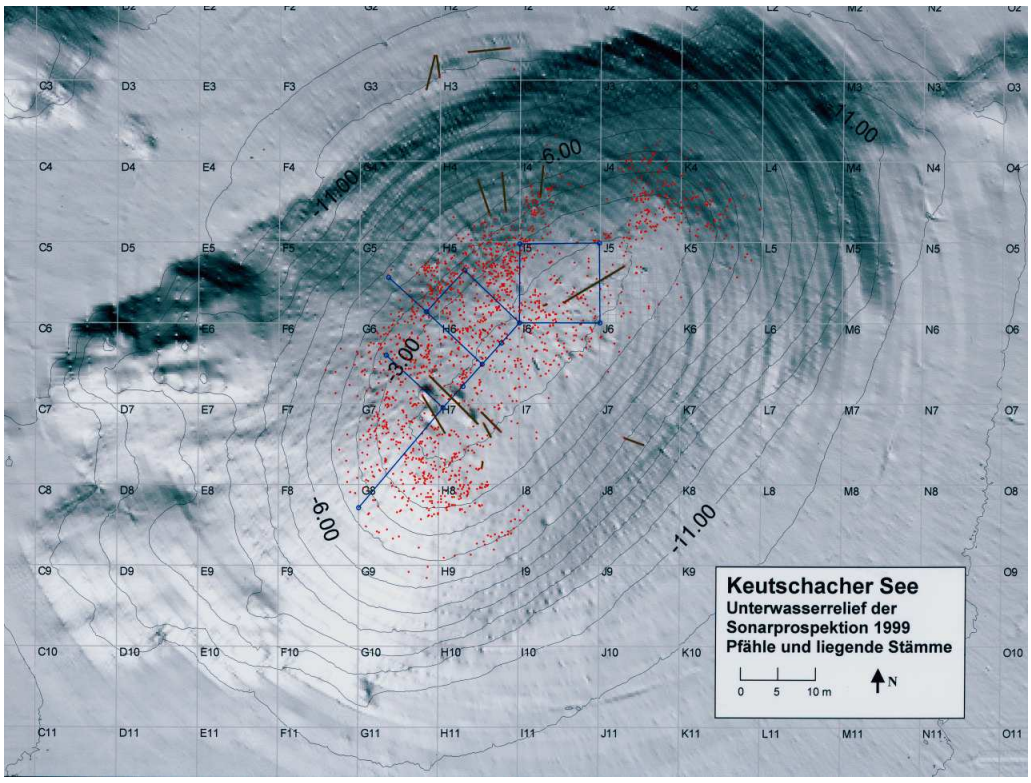


Image 3: Map depicting piles and a contour relief of the shallowness

Suitable wood samples could be used successfully for the dating of the pile setting by means of C14 analysis and dendrochronology. Soil investigations provided evidence of cultural layer remains and much older soil stratifications. Some wooden parts with tool marks were salvaged and conserved, these were found during a survey of the deeper surrounding of the underwater elevation.

Two wooden constructions, which were unveiled for, at that time, unknown reasons presented an additional requirement on the schedule and the available budget. In 1999, there were a few parallel lying round woods with a diameter of 8 cm on a surface of about 4 square meters in the shallow area, which could possibly represent the remains of a floor or a

wall. In 2000, several thumb-thick round woods and the remains of a wooden frame construction with rectangular mortises appeared on an area of 3x3 m, likewise on the upper field (Fig. 3). In both cases, the uncovered surfaces with all wooden parts, ceramics, and stones were drawn to scale and all superficial wooden remains were recovered. In order to prevent further erosion for the short term, the sites were covered with a fibreglass mat.

4.3. Vienna Institute for Archaeological Science VIAS 2001/02

The frame construction with mortised round woods, which was discovered in the year before, possibly represents the remains of a box-shaped weir basket; a C14 date resulted in a manufacture during the Hallstatt era around 900 B.C. In a rescue action in the years 2001/02, the construction was completely excavated, documented, and recovered in course of the activity of the research institute VIAS in cooperation with the research association TRITON. Therewith, not only another piece of the jigsaw for the use of the location in the wide period of so far dated finds between the Neolithic and medieval times was discovered, but it was also verified that archaeological relevant organic remains do exist on the site.

Image 4: Hallstatt period wooden construction in situ

5. METHODS AND RESULTS

5.1. Underwater Archaeology

At archaeological investigations under water, a series of problems arouse which add to the usual archaeological work. On the one hand, an adequate diving equipment (neoprene suit, tank, regulator...) is expensive and service-intensive; on the other hand, a good training is a precondition to move securely and according to the conditions on site. Accurate taring enables the diver to hover above the findspot, on whose fragile contents it is impossible to rest on. Additionally, a thoughtless bottom contact immediately results in a silt cloud, which inhibits a continuation of work for hours. In order to prevent tiring during a constant employment, platforms were developed, where the diver can do his work (uncovering probes and finds, measuring and levelling, drawing, recovering) while lying. Usually, the area to be investigated is sectioned and then levelled from fixed points. After the drawing and photography, the single finds are plotted, packed in numbered bags and brought to land. Even objects, which rise above the soil, are covered by a thin silt and algae layer, which has to be blown away gently prior to any further treatment. The general visibility conditions depend on the season as well as the weather conditions of the foregoing days.

In the Keutschacher See, the great distance between the findspot and the lakeside creates additional transport problems. In order to conduct as few as possible rides, a floating platform was anchored close to the palafitte and serves as base.

Image 5: Warming up on the platform

5.2. Survey, drawing up of the plan

The pile field runs as 65 m long and 27 m wide elliptic area from northeast to southwest via a shallowness, whose highest point was 1,5 m underneath the water surface at the time of the survey. The deepest pile was found in a depth of 6,3 m; otherwise, the pile border runs at about -5 m, only in the southeast they reach up to -2 m.

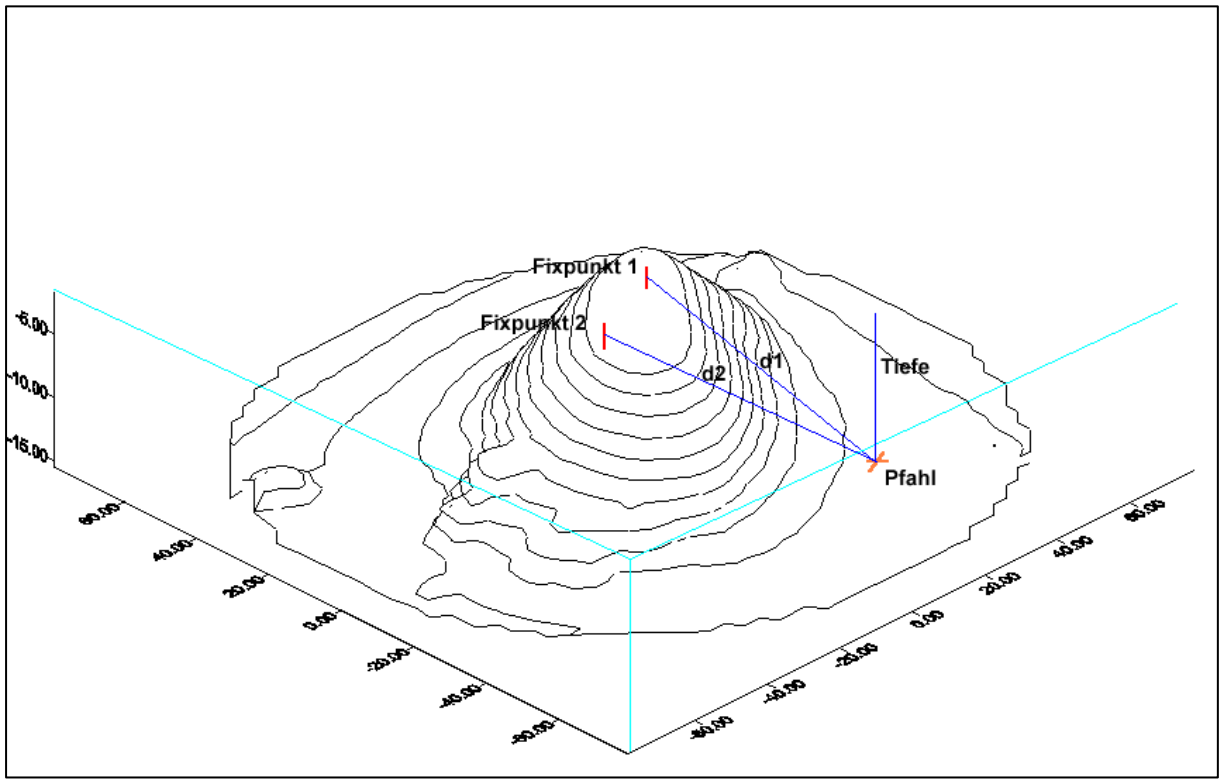
For the drawing up of the plan, a survey system with six fixed points, marked with 2 m long metal tubes, was set up in the pile field. This approach was necessitated by the underwater elevation, whose relief disallowed a sounding from a large levelled and horizontally aligned survey frame. A survey frame graded according to the slope would have gone beyond the financial scope of the project. The distance d1 and d2 to a pile was measured from two fixed points at a time, and the pile's depth was established (Fig. 6 top). Consequently, each pile in space was defined. An especially developed PC programme projected the points subsequently onto the elevation of the planning level. The underwater fixed points were levelled exactly with a theodolite and inserted into the State graticule. The data were then transmitted to the Federal Office for Historical Monuments Klagenfurt as mapping basis of the findspot.

In 1999/2000 a new survey method was developed and successfully tested. It facilitates more accurate and error-free results at a reduced expenditure of time and less personnel expenses. A self-constructed measuring device allows the direct transmission of the horizontal angle and the distance d1 to a measuring buoy into a laptop; the distance was established using a laser distance-measuring facility. The diver holds the line of the measuring buoy (=tape measure) to the pile that has to be levelled, and notes the

established depth (Fig.6 bottom). Therewith, the horizontal tape measures with their tendency to get caught in the piles, and the complex correction of the reading is eliminated.

In 2001, the measurement of a reflective perpendicular buoy, positioned above a pile, was also employed successfully by means of a theodolite from land.

Survey using measurement tapes and depth



Survey using a theodolite and laser distance measurements

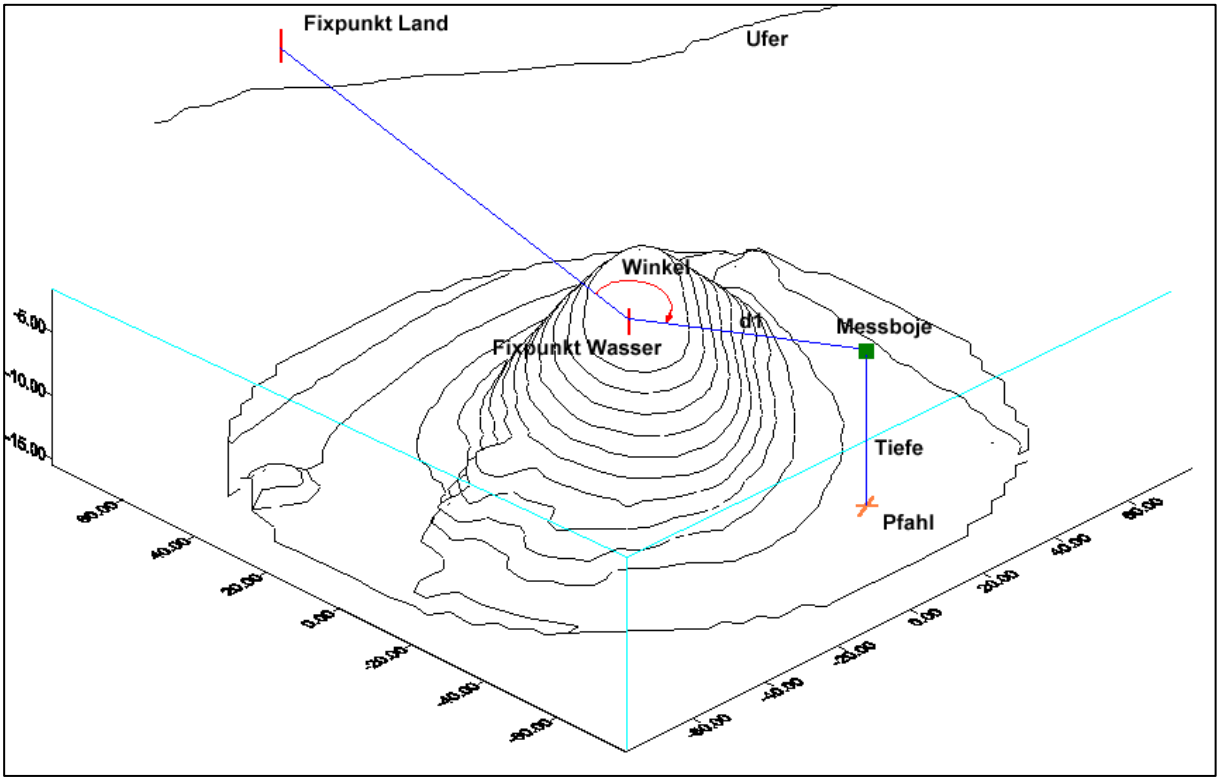


Image 6a, b: Different measuring systems used for mapping

5.3. 3D-reconstruction of the underwater elevation

In May 1999, a sonar survey of the shallowness could be carried out in cooperation with the Donaukraft AG and the Simrad/Hamburg Company. A single-beam sonar with 200 kHz and 38 kHz oscillators was employed.

For an easier navigation on a course that should grate the entire area in 1 m intervals, a routing rope was recoiled on a drum with a circumference of 1 m in the centre of the area to be measured. A spiral course with 1 m track distance resulted from the continuous circumscribing of the drum with stretched routing rope. Along this course, in the area of the pile settings, an echo-sounding was carried out every 5 cm and, further outside, every 20 cm; their position was taken via GPS, and the measuring result was recorded. Altogether, a circular area of 150 m diameter was investigated.

The evaluation of this survey generated an accurate depths relief map (in Fig. 3 combined with the pile positions) and a deviation image, which provides information about silt thickness and the existence of anomalies (eventual larger objects). Dives to individual anomalies verified very diverse reasons for these signals: partly, it was logs/bigger timber remains and partly, it was silt-free gravel. These possibly represent those submarine springs, to which the occasionally appearing holes in the hibernal ice crust are attributed. A detailed interpretation of these data is still outstanding.

5.4 Dating

5.4.1. C14 analysis

This method uses the content of radioactive carbon C14 which is contained in the remains of a creature. In its lifetime, a certain amount of C14 was built up in the body, which slowly breaks down after death. With the measured remaining quantity of C14 it is possible to estimate the age, and to specify a space of time wherein the creature might have lived. With wood, it is the creation period of the just measured annual rings which are naturally much older in the inside of a thick tree than underneath the bark.

For the new C14 examinations which took place at the Institute for Radium Research and Nuclear Physics at the University Vienna (laboratory number VRI and VERA), only samples from the innermost parts of the woods were taken; this was due to the sometimes identifiable, but not securely removable traces of younger, secondary rooting. In order to obtain the felling date or the age of the outermost preserved rings, the according ring-number has to be subtracted from the measuring result.

Labor-Nummer:	Alter BP (Jahre vor 1950).:	Pfahl-, Fundnr:	Zahl der Ringe	kalibriertes Alter zwischen.:
Mittelalter:				
VRI 1558	420 +- 50	503	---	n. Chr. 1440 - 1490
VRI 1556	520 +- 50	46	---	n. Chr. 1400 - 1440
Hv 5033	525+/-40	Pfahl (1972)	---	n. Chr. 1390 - 1440
VRI 1555	590 +- 50	7	---	n. Chr. 1310 - 1410
Hv 8113	630+/-60	Pfahl (1976)	---	n. Chr. 1300 - 1450
Hallstattzeit				
VERA 2208	2705 +- 40	Holzkonstruktion	12 (Ast)	v. Chr. 930 - 800
Neolithikum:				
VRI 1559	5070 +- 60	1005	45	v. Chr. 3960 - 3790
VRI 1552	5140 +- 60	605	Ca. 200	v. Chr. 4080 - 3780
VERA 0046	5140 +- 60	Hirschgeweih		v. Chr. 4080 - 3780

VRI 1561	5190 +- 60	x 1 Treibholz	---	v. Chr. 4040 - 3960
VRI 1562	5230 +- 60	x 2 Treibholz	---	v. Chr. 4210 - 3970
VRI 1550	5230 +- 60	254	137	v. Chr. 4210 - 3970
VRI 1560	5260 +- 60	F 78 Holzkohle	---	v. Chr. 4220 - 3990
VRI 1549	5290 +- 60	72	271	v. Chr. 4230 - 4000
VRI 1557	5290 +- 60	328	88	v. Chr. 4230 - 4000
VRI 1553	5300 +- 60	626	162	v. Chr. 4230 - 4000
VRI 1551	5420 +- 60	604	160	v. Chr. 4340 - 4230
Spät-/Postglazial				
VERA 2210	12790 +- 35	Profil Oberante (Bodenprobe)	---	v. Chr. 13900 - 12400
VERA 2211	13365 +- 40	Profil Unterkante (Bodenprobe)	---	v. Chr. 14700 - 13300

5.4.2. Dendrochronology

This dating method is based on the fact that trees in a region with similar weather influences develop similar sequences of wide and narrow annual rings, whereas this pattern is typical and recognisable for the according space of time from a length of approximately 80 years. A computer then compares the pattern of the measured ring-width sequence of a sample with the pattern of a standard-curve. The correct chronological position should be characterised by a significant statistic similarity. If several positions are similar, statistic tests and the pointer year (years with distinct climatic changes) analysis help. There, only the years of the standard-curve, where more than 75% of all the included trees have the same growth trend in the same year, are considered. This evolves through especially drastic climatic influences.

The dendrochronolical analysis of the samples taken so far, which was carried out in cooperation with Dr. A. Billamboz, State Office for Historical Monuments of Baden-Württemberg, initially produced one mean curve. The curve is composed of three samples (number 72, 254, 2004), it is 271 years long, and the samples 1005 and 626 could be added later on. Due to the lack of samples, there is no possibility to establish an oak standard-curve which regionally applies to Carinthia, and goes from today back to the Neolithic. Left was the attempt to consult the existing standard-curves of more distant regions as a basis of comparison for the initially floating, thus not absolutely dated, mean curve. In the comparison with the Main oak-curve, a position with unexpectedly high parallelism was found; its correctness was confirmed by the C14-data which were calculated later on.

The absolutely dated mean-curve, now comprising 294 annual rings, will be used as dating basis for the other oak piles in the settlement. If this curve is overlaid very well, we will also try to use it for the dating of other kinds of wood, like ash and beech.

So far, two felling dates for oak piles with forest edge could be established: 3947 B.C. and 3871 B.C.

With the expression ‘forest edge’ the wood layer directly beneath the bark is denoted, which contains the last annual ring that was formed by the tree. Thus, the established age is the felling date of the tree. In our case, it is even possible to verify the felling season with the microscope; the two trees were exactly felled in winter 3947/46 B.C. and winter 3871/70 B.C.

In the medieval period from about 1310 to 1490, a building could have existed too, or the timber remains derive from ‘fishing sticks’ (OFFENBERGER 1982).

In the year 2000, we began with the dendrochronological dating and the wood identification of the piles of one section, in cooperation with Dr. Jitka Dvorská (†), Brünn, CZ. This task was carried out in order to find out, if it is possible to merge matching pile-settings into house ground plans (from the tangle of piles). The survey was very difficult due to the sometimes pretty bad state of preservation and the prevailing timber species, alder, poplar, and willow – most of the samples had to be frozen before preparation. Some samples could be

synchronised with the floating chronology; many build floating complexes and need further examination.

5.5. Find recovery

The recovery and storage, especially of the wet timber remains, is very complex. As timber finds are preserved well only externally, and the cell walls are still partly broken down, such a piece of wood would shrink and crack heavily when air-dried. In order to prevent this, timbers have to be stored wet and cool, before they are examined and possibly conserved.

Soil samples are cut out of the sediment with plexiglas tubes and are also stored in humid conditions.

6. PRESERVED REMAINS

6.1. Piles

The piles often stand together in groups of two or three. Many are leant in a north-easterly to a north-westerly direction. Mossler (1954) interprets this leaning as a result of the wash of the waves, as most of the piles only stick in the lake marl very shallow. An erosion of the top soil layers would explain not only the, for the weight of a building, statically insufficient bracing, but also the then complete absence of a ‘cultural layer’. But the leant piles are situated not only on the knoll, but also in a greater depth and among upright standing timbers. An attempt to interpret this leaning as a result of the simultaneous influence of ice drift and storm onto a certain range of piles, which just carried a building, yielded no result. The mapping of piles with the same leaning generated no floor plans.

Nearly all piles are round woods. Sometimes, the bark is still preserved on the part that sticks in the lake marl. Split woods are missing; only underneath the lying timbers the fragment of a square trimmed pile and two pieces of oaken split planks were found. Tool marks, as well, are rare. Four, big, lying timbers show recesses (for the attachment of a crosswise round wood?) sidewards, near to the end; one piece of timber is mortised at the end.

Image 7a: Lumber with traces of workmanship - large peripheral deepening

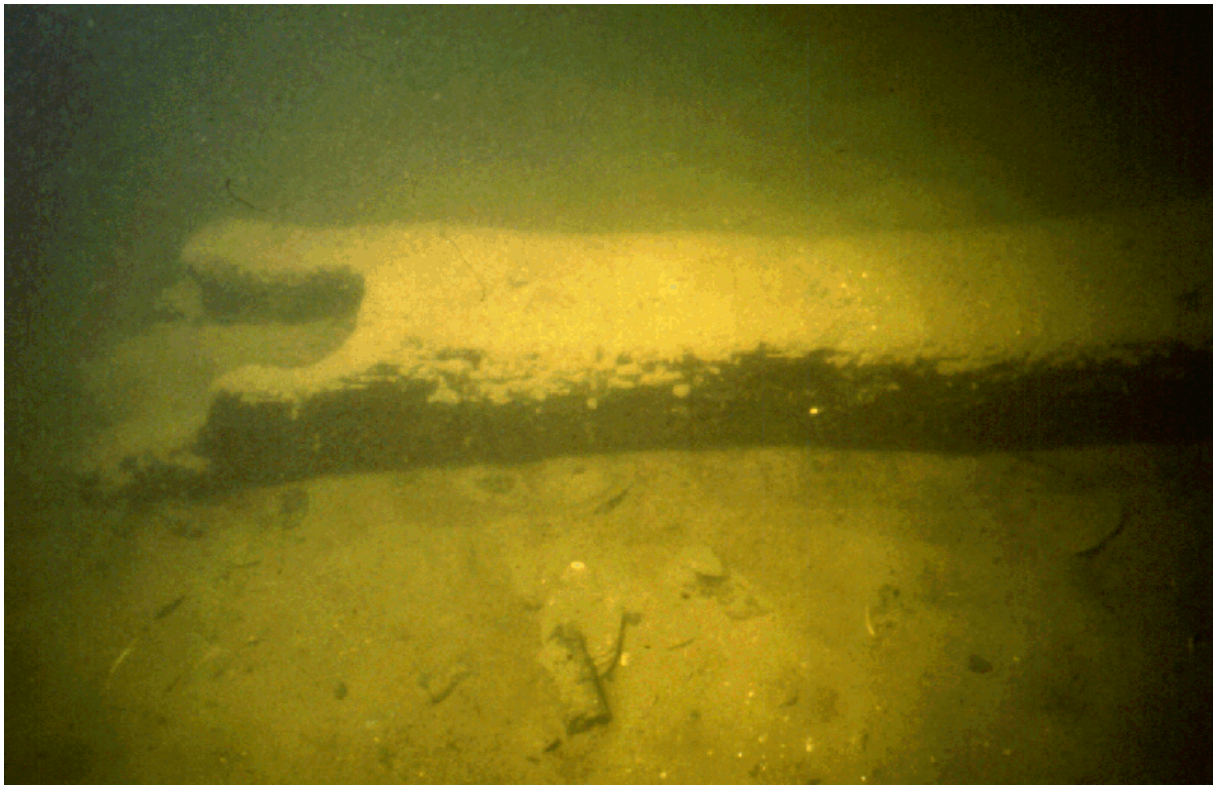


Image 7b: Lumber with traces of workmanship - mortise joint

One pile is peaked in a furcating way, another one shows a boring. The preservation condition of the timbers outside the lake marl depends on the timber species and the age of the pile. Their heads are decayed tapered to blunt-tapered. Though, none of the timbers show shrinkage cracks, meaning that they could never have dried out completely since their usage. Five big, limbless oak logs (diameter up to 60 cm), whose biggest one is weighted by a slab which lies in a crevice near to the root onset, are lying in the pile field.

6.2. Other timber objects

The timber construction from the Hallstatt period proved as a very elaborately constructed element. On its ends, the board was embedded into square joined planks with small tenons. The carved ends of long rods were mortised into the board in two rows of square holes; the rods' ends were secured with wedges. With same intervals, they had a diameter of about 4 cm in one row, and about 2,5 cm in the other row. These rods had a preserved length of about 1,5 m (Fig. 8a-c).

Image 8a: Hallstatt period wooden construction - overhead view

Image 8b: Hallstatt period wooden construction - Detail: Mortised rods

Image 8c: Hallstatt period wooden construction - Corner joint of frame planks

As the construction is only preserved very incompletely, its purpose cannot be concluded from the excavation findings. As interpretation possibility, a weir basket is suggested. According to this, the board would be part of a rectangular frame; the thicker rods functioned as weir case, and the thinner ones inside were bound to a funnel. At present, similar comparative pieces are missing.

6.3. Other botanical remains

At the surface, large quantities of hazelnut shells and charcoal particles accumulate as organic remains. The hazelnuts were probably desired as fatty and well storable food. The charcoal derives from extinguished fires in the hearth, but, certainly, also from at least one hut fire, as bigger, externally charred pieces were found as well.

6.4. Ceramics

Articles about the typology and chronology of the Kanzianimountain-Lasinja-group were published by E. Ruttkay in 1990, 1996, and 1997. In 2001, B. Samonig submitted the still unpublished ceramics material as thesis (see B. SAMONIG in this volume).

6.5. Bone

In the whole pile field, but especially on the northern slope of the shallowness, large amounts of bones were found; it was predominantly long bones, but also scapulars and pieces of antler. These are sometimes coloured dark brown and are mostly very well preserved. As, in these areas, no soil samples have yet been elutriated, the current species spectrum of meat providers, which is dominated by the red deer with two thirds of the bones, followed by the domestic cattle (a tenth), sheep or goat, roe, and wild-boar, can still shift to the smaller species. For the same reason, no fish remains exist at present, although these certainly have been on the menu, as they were quasi waiting on the doorstep in large amounts.

Some of the antler remains are provided with borings, which probably have held a mounting.

6.6. Daub

In many places of the pile field, badly burnt, oblong loam pieces with an even and two concave long sides are lying. They once were the flooring or daub, and closed the gap between two wooden poles. If a building burnt down, the flooring and daub was more or less fired and remained preserved in its shape, like it once moulded the lumbers. If the hut sank down, without burning, the loam disintegrated over the years into fine particles and formed a thin layer in the soil, like we came across it in places.

A mapping of these fired daub remains might reveal the location of a burnt down hut.

6.7. Stone slabs

Noticeable is the accumulation of bigger stone slabs in some places. As these are lying on the soft lake marl in the middle of the lake, the builders must have transported them there with an effort.

Underneath one of these slabs, a pile sticks out almost horizontally. G. Mossler (1954) interpreted these slabs as intentionally deposited, with the aim to enhance the stableness of the shallow planted piles. But they also might have served as stabilisation for the swampy underground, in case the top knoll of the shallowness was dried up.

The mapping of the stone slabs was impossible in the course of the accomplished echo-sounding due to the gauge of 1 m. The implementation of a photogrammetric survey so far failed due to extremely bad visibility conditions caused by the weather, and the enormous costs. But meanwhile, it has come within affordable reach with the digital photo and film technology. With an underwater camera, a digital photo-mosaic of the settlement surface is compiled from numerous, overlapping pictures after photogrammetric equalisation (possibly also in 3D). With the aid of this mosaic, the distribution of the slabs is then mapped. As the visibility improves in winter according to experience, and algae growth abates, this kind of work should be carried out in that period. But it demands a great deal of the diver and his equipment.

6.8. Snails and shells

If they were deposited simultaneously with the settlement, the species spectrum with an accumulation of snail-shells on the knoll of the shallowness, which showed a pure water community of the Middle Holocene (C. FRANK, unpubl.), argues against the assumption of a knoll emerged from the lake.

6.9. Traces of animal life

Crabs are living underneath many of the slabs; they throw the material that accumulates on clearing up their living duct ‘in front of the door’. Likewise, bigger fishes create a ground motion on steeper lake marl spots when making their living ducts.

Especially zanders free a patch from silt on their resting places as well as on their spawning grounds, and so create flat swales (Fig.9).

Image 9: Zander in a resting hollow

7. LAYERS IN THE LAKE SOIL

In nature, a constant change of deposition (sedimentation) and reduction (erosion) is taking place. In lakes, washed in, and gradually sinking suspended particles, through temperature and chemical processes precipitated lime, and calcareous remains from algae, higher aquatic plants, or plankton, lead to the deposition of new soil layers (Fig.10); currents, mechanical interferences, and reverse chemical processes result in their erosion. Over the millennia, the sedimentation mostly prevailed, through which surfaces of the water decrease and silt up with time.

Image 10: Sedimentation live – Suspended matter, algae, hydrophytes and a small pike

The glacier of the Würm-Ice Age caused the last massive erosion process in the Keutschacher See valley. The ice pushed all earlier sediments, except the grown rock, out of its way and deposited them intermixed on the edge or at the glacier tongue as moraine.

After the retraction of the ice between 16.000 and 14.000 B.C., the sedimentation began once again. In times of intensive precipitation rather clayey layers developed, during warmer phases the lake marl formation predominated; plant remains created darker coloured intermediate layers.

As the humans erected their buildings, an additional sediment contributor came along. During the building activities bits of wood, bark pieces, and needles were scattered on the hilltop. While the settlement was in use, people threw their leftovers and fire remains into the water. But rotting buildings and collapsing roofs, as well, produce organic particles, which altogether make up the ‘cultural layer’. One can find it in every undisturbed pile dwelling. Only in Keutschach the cultural layer was considered a victim of erosion, until, in 2001, it was managed to detect small areas with the dark coloured single-ply layer in 50 cm long drilling cores, taken with plexiglass tubes. These were dated Neolithic by means of C14 analysis. Their organic content will possibly allow new conclusions about nutrition and building material. These cultural layer remains show an only thinly coverage with younger sediments.

On the other hand, a deeper lying, 160 cm thick, lake marl packet with slight lamination and some clearly humous layers in the upper 50 cm was opened up through several 100 cm long, overlapping cores (Fig.11). The absolute thickness of the packet is not known at present. C14 dating of the top and the bottom of the humous layers verified their formation in the late Würm and the early Postglacial (VERA-2210/11).

Image 11: Stratum with organic layers dating into the young postglacial

Longer drilling cores are only possible to extract as a whole with a gravity corer (underwater core drilling device). As the destruction of soil layers has to be prevented, this heavy drilling device is only applicable from an ice cap that is able to take the load, or from a special platform. Additionally, the machine requires qualified operators.

8. PRESENT RESULTS AND INTERPRETATION

8.1. Cultivation

At present, we do not know what has driven the people to settle on such a place. Possibly, more than one fishing base was located there, like the find of a casting spoon and several other ceramic remains, the various wild- and domestic-animal bones, and also the size of the site are suggesting. On the other hand, remains of cereals are missing up to now. They are to be found in all other wetland settlements and, especially in winter, they loomed large in the diet.

But, if we imagine that families (with children!?) lived out there in any weather with all the transport problems and then, after the humid November days, the icy winter came and the piles had to be pecked out of the ice daily in order to prevent them bending over; that was an inconceivable hard life – or it was still different...

On the other hand, the situation is much better on the lake than on land – enemies needed a boat or had to swim, one sees them afar and can prepare oneself. In other shore-side settlements, in Switzerland and South Germany, there are indications, that nationwide dryness in the course of severe short-timed climatic fluctuations was a motif to move directly to the water. This would also match the consideration that, with the pile thickness and –length, the statics of such buildings would be exceedingly critical on today's water level. But if the ridge of the shallowness was sticking out, these problems are solved; and also the preserved layers of parallel rods would then be interpretable as ground-floorings. Even the stone slabs would then make more sense. But here, a lot of research work has to be carried out in order to resolve these open questions.

8.2. Type and duration of the housing

The Neolithic wooden buildings existed in the period from about 4000 – 3700 B.C. according to the present C14 data. The duration of use lay at least between 3947 B.C. and 3871 B.C., like the dendro-dated piles show. An intensive dendrochronological examination of more piles can answer this question more precisely and resolve the question of building ground plans and –sequences.

9. FUTURE PROSPECTS

In the face of the three-phased C14 data of the settlement remains (Neolithic, Hallstatt era, Middle Ages) and the long neolithic period (as the ceramics examination stands now (SAMONIG 2001), a longer neolithic use with a possible shorter interruption is to be expected), the capture of ground plans of the neolithic buildings and the scientific proof of the utilisation time is of great interest. Also the lake level at the time of the respective settlement is of importance for the interpretation of the building remains as, apart from some lying timbers which are not classifiable at present, indications of heights and overground construction details and thus clues for the ground level are missing throughout. The survey of the numerous stone slabs, scattered in the settlement area, could help explaining their function. Further evaluation of the survey results of the surroundings of the shallowness lets expect additional timber finds and, possibly, also other objects.

Flat drilling cores from the shallowness could give information about the distribution of the cultural layer remains. Deep drilling cores help reconstructing the original cause of the shallowness and climatologic/ecological developments (lake level variations, temperature, precipitation) up to the Würm-glacial, maybe even further back.

Between the campaigns in the years 1993/94 and 1999/2002, distinct erosion processes took place in the pile field. Several, already measured piles, were missing or were found as driftwood. New timber- and ceramic objects were unveiled, so that an accelerated disappearance of the upper, feature-bearing soil layers can be expected. As the observed erosion effects display an increasing threat to the existing findings, an as quick and broad as possible documentation of the findings, as well as information about the erosion-causing forces is of importance for the protection of historical monuments, the protection of this special ground monument. This can only work with the coaction of all residents and lake-users. If these know about the violability of the site and its importance as archive of prehistoric times, the divers will respect the significance of inconspicuous small things in find-coherences, fishermen will no longer drop anchor and leashes in the pile-field, and swimmers will no longer have a rest there.

On the one hand, the area of distribution of the Balaton-Lasinja culture extends to Hungary, on the other hand, the lake dwelling Keutschach is situated in the wetland-settlement triangle Slovenia (Ljubljana moor), Upper Italy (Fiave), and the Austrian Salzkammergut. Settlement-technical, cultural, and economic comparisons are only possible with still more precise knowledge of the circumstances and conditions under which the settlers on the Keutschacher See lived. To acquire this knowledge, and to make further organic finds

concerning the various labour- and economic techniques is of special interest for us, as we want to support the plan of the municipality of Keutschach to make this treasure more accessible for the residents and visitors by means of a museum and a pile dwelling reconstruction.

Image 12: Breaking the surface after work

10. Literature

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