

Archaeology and Anthropology of Salt: A Diachronic Approach

Proceedings of the International Colloquium,
1-5 October 2008
Al. I. Cuza University (Iași, Romania)

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BAR International Series 2198
2011

Published by

Archaeopress
Publishers of British Archaeological Reports
Gordon House
276 Banbury Road
Oxford OX2 7ED
England
bar@archaeopress.com
www.archaeopress.com

BAR S2198

Archaeology and Anthropology of Salt: A Diachronic Approach. Proceedings of the International Colloquium, 1-5 October 2008 Al. I. Cuza University (Iași, Romania)

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ISBN 978 1 4073 0754 1

Cover illustration: Salt spring of Zlatina in Vrâncioaia (Vrancea, Romania). Photograph Olivier Weller

Printed in England by 4edge, Hockley

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Provadia-Solnitsata (NE Bulgaria): A Salt-Producing Center of the 6th and 5th Millennia BC

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Abstract

Tell Provadia-Solnitsata as well as the Chalcolithic production complex nearby both lie upon the only deposit of rock salt in the eastern Balkan peninsula. Salt production in the late Neolithic (5400-5000 BC) was carried out by means of boiling brine from the salt water springs in thin-walled ceramic bowls, which were laid inside massive dome ovens. The ovens are to be found in buildings within the borders of the site. Brine evaporation in ceramic bowls is the earliest recorded case of salt production in Europe using this technology. In the middle Chalcolithic (4600-4500 BC), a big solid salt production center emerged. It went on working until the late Chalcolithic (4500-4200 BC). The dome ovens were replaced by huge open-air features: wide pits, where very deep and voluminous thick-walled bowls were arranged. Brine was evaporated by means of open fire, lit at the bottom of the pit, in the space between the bowls, whose rims were fixed next to each other.

The defense system of the middle Chalcolithic settlement consists of an enclosing ditch and a wall with two oppositely positioned gates. The wall is made up of two linked parts, constructed by using different techniques: wood and clay palisade, and stone bastions. The gates were flanked by two stone bastions each, which collapsed as a result of a strong earthquake in about 4550 BC. New L-shaped stone bastions were constructed behind the previous ones, which also collapsed at the time of a subsequent strong earthquake in about 4500 BC.

Keywords

salt production, brine evaporation, late Neolithic (Karanovo III-IV), middle Chalcolithic (Hamangia IV), defense system, northeast Bulgaria

The excavation at the complex archaeological site of Provadia-Solnitsata started in 2005. It is located in the valley of the Provadiyska River, near Lake Varna, about 45km from the Black Sea coast. Until recently, we used the term 'salt-producing center' to designate solely the prehistoric tell, upon which, and partially by means of whose cultural layer, a Thracian tumulus was piled up much later. The excavation of the prehistoric layers of the tell (late Neolithic and Chalcolithic) has been carried out for four seasons now, providing results of exceptional interest, some of which bear relation to the 'salt issue' discussed here (Николов 2008). The tell exploration up to now covers an area of about 700m²; however, the main results have been secured by a sector of approximately 600m² in its southeast periphery, beyond the borders of the tumulus. Two phases have been identified so far in the prehistoric

layer: late Neolithic (Karanovo III-IV period) and middle Chalcolithic (Hamangia IV period), having an average thickness of 1.20m each. The late Chalcolithic layer (Varna period), which existed in this part of the settlement, was used as a source of building material for erecting the Thracian tumulus and thus destroyed.

During the last 2008 season, an exceptionally large Chalcolithic salt-producing complex was also recorded in the immediate vicinity of the tell, extending the archaeological site both territorially and structurally, and corroborating my suggestions as to the role of the Provadia-Solnitsata prehistoric salt-producing center in the Neolithic and Chalcolithic.

The tell, which used to have a cultural layer about 6m thick (preserved in some areas beneath the tumulus) before being partially destroyed for the erection of the Thracian (burial?) tumulus, and featuring a diameter of 105m, as well as the Chalcolithic production center next to it both lie upon the huge truncated cone of the sole East Balkan rock salt deposit. Brine springs with an almost maximum salt concentration (310g/l) used to gush out from the 9 to 20m deep 'salt mirror'.

Field observations and the technology of salt production

At the time of the late Neolithic Karanovo III-IV culture, which spread all over Thrace in the period 5400-5200 BC, a group of its bearers crossed the Balkan Mountains and settled close to the brine springs near today's town of Provadia, where they started extracting salt.

The late Neolithic salt production technology at Provadia-Solnitsata involved boiling the spring brine in specially designed thin-walled ceramic bowls, which were put into specially constructed massive dome ovens. The ovens, whose productivity amounted to about 10 tons of solid rock salt per year, were located within the settlement. It turns out that boiling brine in ceramic bowls at Provadia-Solnitsata is the earliest recorded use of this salt production technology in Europe.

The remains of a late Neolithic two-storey building with a floorage of about 55-60m² were revealed in 2005-2007. A big dome-shaped clay installation designed for boiling brine was found on the ground floor (see Николов 2008a). It has four bulging sidewalls with rounded corners (Figure 1). Its dimensions are 1.70 x 1.50m along the two axes. The installation comprises a massive dome and a thick inside bottom, but lacks the variably thick base, elevated above the room floor and typical of the

domestic ovens. The accumulating function in this case was transferred exclusively on the massive dome, suggesting a purpose, different from that of the ordinary ovens.

The dome is a massive clay structure. Its walls near the base are about 25cm thick and get thinner with height, reaching 13-14cm thickness at 40cm; this thickness is likely to have been the same for the entire upper section. Judging by the dome walls, preserved to our day in their original condition, its maximum inside and outside height was respectively 50 and 65cm.



Figure 1. Provardia-Solnitsata prehistoric salt producing center. Southeast area. Remains of a late Neolithic dome oven for brine evaporation.

The installation used to have two insertion openings. They were shaped in the eastern and southern sides of the dome. The eastern one is 26cm wide and its preserved height is 25cm. A low platform is shaped in front of it. The second opening was positioned in the southern wall and was considerably larger, most probably about 60cm wide, but it is in poor condition. It also had a platform in front.

The presence of two openings in the dome of a late Neolithic oven is quite unusual. The most likely reason for the existence of the small side opening is the technological requirement for a particular temperature regime during the brine evaporation process and the salt crystallization, as well as securing draught to lead away the steam. All this was achievable only by means of regulated air access into the installation. The big opening served as an inlet for the ceramic bowls, which were also taken out through it at the end of the cycle, with the solidified salt inside.

The installation floor, taking up the entire area below the dome, was made of tamped clay. Its surface is about 1.35 m².

The above mentioned ceramic bowls, designed for producing pure salt by boiling of salt solution (brine) represent a specific ware type, which has been discovered for the first time in the late prehistory of Europe. The vessels in question are thin-walled, deep

ceramic bowls with special function (Figure 2) (see Стоянова 2008).

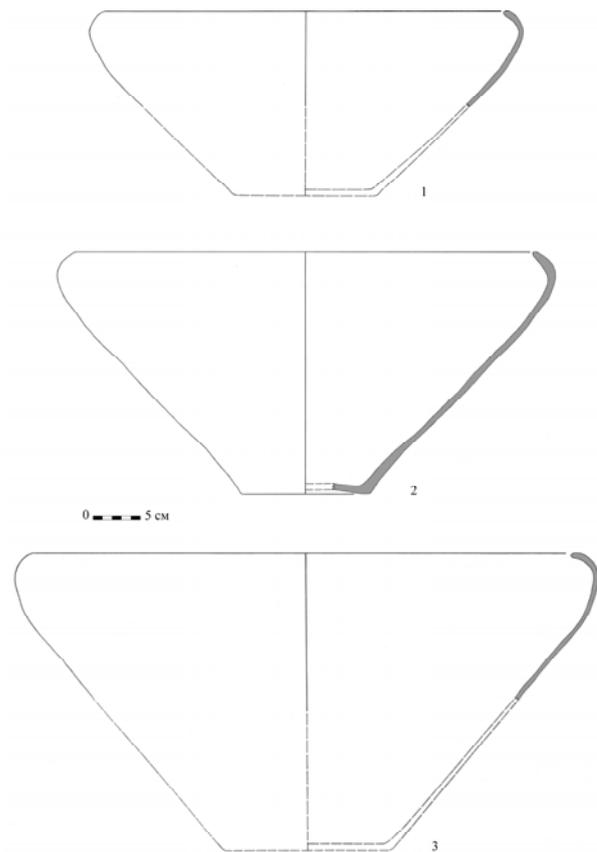


Figure 2. Provardia-Solnitsata prehistoric salt producing center. Southeast area. Late Neolithic ceramic bowls for brine evaporation in an oven (after П. Стоянова).

The surface of the production bowls is roughly smoothed, and their usage has contributed for the accumulation of a thick whitish build-up. Only sherds of them can be found due to their thin walls. The thickness of the walls varies between three or four to five or six mm, reaching 10mm at the mouth. The thin walls and the high porosity of these specially made bowls both facilitated brine evaporation.

The production bowls are wide open shapes with deep carinated bodies, with the carination located at two-thirds of their height. The bottom diameter is 11 to 18cm, and that of the mouth is 32 to 56cm. The mouth rim is rounded and slightly thickened on the inside.

The inverted rim prevented brine spilling at the time of inserting the bowl into the oven, as well as unwanted seething during the evaporation. The maximum temperature during this boiling process had to be lower than the boiling point of brine with a concentration of sodium chloride around 310g/l (the natural brine concentration of Provardia springs), which is 105°C. Bearing in mind the surface area under the dome of the oven, as well as the volume of the bowls (from 5 to 36l when filled up to their maximum diameter), one may presume that, at an optimal arrangement of bowls with

various diameters, an average of 90l brine could have been evaporated at one load of the installation. Therefore, given the respective sodium chloride concentration of the brine and at one production cycle per day (however, two and possibly three are theoretically plausible), the process will result in 26-28kg of purified solid salt, i.e. up to 10 tons annual production in a single oven. And should the probability be accepted for a preliminary brine concentration by way of sun exposure (during the warmer months), the quantity produced could have been much more.

Boiling in brines was a normal practice through the late Neolithic, i.e. until 5th millennium BC, but there is no evidence of early Chalcolithic production as yet (such a layer has not been revealed in the excavated area of Tell Provadia-Solnitsata).

Life at the tell continued in the middle Chalcolithic as well, i.e. between 4600 and 4500 BC. It was precisely in the middle Chalcolithic that a big production center for solid salt extraction originated near the settlement. Probably, it continued its work through the late Chalcolithic, i.e. as late as the third quarter of the 5th millennium BC. It owed its existence to the obvious necessity to increase salt production, which was carried out by technological modification.

At the time of the middle Chalcolithic or even earlier the dome ovens at Provadia-Solnitsata were replaced by large open-air features: wide pits, where ceramic bowls of a new ware type - very deep thick-walled bowls whose capacity was much bigger than that of the late Neolithic ones - were tightly arranged, with their rims touching each other. Brine evaporation was carried out then upon an open fire, lit at the bottom of the pit in the space between the bowls.

The Chalcolithic production center was revealed at the end of the 2008 season. So far, its area seems to come up to at least fifty ares, but it may turn out to be larger in reality. It is located immediately north-northeast of the tell.

A small amount of data was collected from a narrow trench in one of the middle Chalcolithic production pits, whose diameter has not yet been precisely identified, but is certain to exceed 3m. Its depth is about 1.60m and there is another cylindrical pit in the middle (?) of the bottom, at least 30-40cm deep and 1.50m in diameter. The bottom of the pit at 1.60m is thick, probably tamped, and red in color, with clear indications of being exposed to fire. The walls of the pit were not revealed by the trench; however, judging by the found fragments of fired clay 'wall' with holes from burnt vertical sticks within, the pit walls were probably plastered.

The pit was densely packed with predominantly large sherds of very deep and wide thick-walled ceramic bowls, and a great quantity of wood ash (Figure 3). The mouth diameter of the bowls normally exceeds 50cm, and that of the bottom is ca. 18-20cm, and the likely

height is 60-70cm. The walls are ca. 1.5-2.5cm thick. The outer surface is rusticated, with vertical pairs of big conic buttons below the mouth. The inner surface of the bowls is smoothed. The sherds testify to a secondary firing. Only a few thin-walled sherds have been found in the pit, allowing for dating the feature to the end of the middle Chalcolithic or the beginning of the late Chalcolithic in this region.



Figure 3. Provadia-Solnitsata prehistoric salt producing center. Wall of a trench made in a middle Chalcolithic negative feature for brine evaporation.

The shift in the brine evaporation technology is obvious: the ovens were replaced by much more efficient negative features. I suggest that the deep ceramic bowls were laid on the bottom of the pit in such a way that their rims were tightly pressed onto each other, while the bowls in the periphery touched the pit wall. Bearing in mind their height and their inverted cone shape with the mouth diameter considerably exceeding that of the bottom one, it is obvious that fairly large spaces, widest at the bottom, were left between the lower parts of the bowls. It was evidently a purposeful solution. These spaces were probably filled in with firewood. Throughout the evaporation process, mostly the upper layer of the brine was laterally heated by the fire; its level fell with the advance of evaporation, and so did the flames' height outside. Temperature went down simultaneously with the subsiding fire, creating thus conditions for crystallization of the salt. Hard, cone-shaped salt ingots remained in the vessels, which made their transportation convenient even over long distances.

The Chalcolithic salt producers near today's Provadia invented a faultless technique for a lot more high-speed extraction of considerable for that time amounts of salt

that can rightly be labeled 'industrial'. The details of this novel technology will be clarified by the future field work and laboratory tests. This also applies to the role of the negative middle part of the bottom of the production pit.

The recorded shift in the salt extraction technology, which led to a serious increase of the production capacity of the 'factory' near today's Provadia in the middle and late Chalcolithic, lends strong support to the presumed connection between the salt production and respectively salt trade there on the one hand, and the amazing abundance of prestige items at the late Chalcolithic 'gold' Varna cemetery in the same region (Николов 2005) on the other hand. The long-sought-for clue to the existence of such a unique concentration of prestige items at a cemetery from the second half of the 5th millennium BC seems to be finally solved.

Defense system. Most probably, the late Neolithic salt producers satisfied their own needs for salt by using the spring brine itself, whereas solid salt was exported south of the Balkan Mountains. Salt production obviously amounted to quantities that might be called 'industrial' with regard to that time. Solid salt, which played the role of money at the time, is likely to have turned into an equivalent in a large-scale trade with neighboring regions. The riches, amassed by the salt producers, had to be defended; this is why the tell settlement was fortified by means of a strong fortification system dating back to the middle Chalcolithic.

The defense system comprises an enclosing ditch and a wall close behind, with two diametrically opposed gates. According to the archaeological evidence and geophysical surveys, the ditch has the shape of an irregular circle. The main source of information is the Southeast area of the tell, where the ditch has been uncovered over the entire range of the excavated area, while its south and southwest parts have been recorded by means of several trenches. Remains of the fortification wall and the southeast gate have been uncovered only in the Southeast area.

The presumed diameters of the inner side of the ditch are as follows: about 102m in the north-south direction and about 98m from east to west. It was dug out in the virgin yellow soil, at the beginning of the late Chalcolithic Hamangia IV period, when a late Neolithic cultural layer, at least 1m thick, had already existed along the periphery of the natural elevation. Since in the excavated area, this layer was partially destroyed during the erection of the Thracian tumulus, the width of the ditch in its upper part can only be subject to surmise. The width of the enclosing ditch on the level of the virgin soil varies from 1.15 to 1.95m, but its prevailing width is ca. 1.40m. At these measurements, the actual width of the ditch in its upper part must have been 2m at the least, extending to 3m at certain places. The depth of that part of the ditch that was dug into the virgin soil varies from 1.20 to 2.70m, measured from the higher inner side, but is 1.60-1,80m

at most places. Bearing in mind also the thickness of the late Neolithic layer, I presume that the real depth of the feature was between 2.20 and 3.30m. The ditch features a markedly asymmetric and tapering down trapezoidal profile.

The defense wall, excavated in the Southeast area, consists of two joined parts, constructed by use of different techniques: a palisade of wood and clay, and stone bastions (Figure 4). Almost only their substructure has been preserved. The palisade was located at the distance of 3-4m from the ditch, while the lower level of its preserved superstructure used to stand higher than the upper part of the higher inner wall of the ditch.

The palisade consists of a massive upright wooden structure and a thick clay plastering. The wooden posts were at least 20cm in diameter. In some of the sectors, where the Neolithic cultural layer was thinner, they were rammed straight into the virgin soil to a depth of 70cm. At other locations with burnt ruins, the depth of ramming into the natural terrain is smaller, but the clay substructure compensated for it, functioning to a great extent as a virgin soil. The distance between the wall posts is 30 to 50cm. The width of the palisade was about 80cm. The wall was constructed of well-tramped yellow clay. So far as its height is concerned, the matter is quite complicated; however, I would assume a minimum of about 3m.



Figure 4. Provadia-Solnitsata prehistoric salt producing center. Southeast area. A panoramic view of the middle Chalcolithic defense system.

The palisade type defense wall probably also fenced in the entire southern part of the settlement. Northeast of the excavated palisade section, within the Southeast area, the defense structure continues in the form of a stone wall. Its length to the gate is 8.60m. Only the substructure has been preserved *in situ*, comprising eight big adjacent limestone rocks with irregular shape and a maximum size between 1.05 and 1.40m.

The back (interior) side of the stone wall base is located about 3m from the former inner edge of the ditch. A few more large and medium-sized rocks of the

same kind lie in front of the northeast half of the stone wall. They come from the base of a massive stone bastion, filling the space to the former inner edge of the ditch at this particular location. They outline an impressive solid rock structure with dimensions about 4.50 x 3.00 to 3.30m.

This structure, also including the main wall, must have been tall enough for a defense facility. One should bear in mind the important fact that at least 22 big and medium-sized rocks have been found during the excavation of the ditch (the big ones among them are 11); hundreds of smaller ones should also be added. Besides, part of the stones in this area were taken out and used for the then newly-constructed Thracian stone feature at the base of the tumulus.

The stone bastion and the adjoining short stone wall fell down as a result of a strong earthquake (Figure 5), the shock having a north-northeast to south-southeast direction, which is evidenced by the position of some stones in the ditch. They were thrown diagonally towards southeast. According to the seismologist, B. Rangelov, the earthquake had a magnitude of 7.5-8 and was related to Shabla-Kavarna seismic focus. Having in mind that this happened in the Hamangia period and that life in the settlement went on in the same period, I suppose the earthquake took place approximately around 4550 BC.



Figure 5. Provadia-Solnitsata prehistoric salt producing center. Southeast area. Remains of the southeast bastion (the large rocks) and the southeast L-shaped structure (in the rear). Middle Chalcolithic Hamangia IV period.

A second bastion, probably built in a similar way (Figure 6), existed north-northeast of the one discussed above. Only a few big stones have been preserved from it. One can think of several reasons for this poor condition, but I will not discuss them here.

The two stone bastions flank the gate of the fortification. The gate is about 2.40m wide; as wide as the street, starting from there. It leads northwest, heading precisely for the settlement's center. It is clear that the street extends to the opposite side of the fortification, where a piling of big and medium-sized

rocks was recorded through trench excavation. These can be the remains of the second stone gate.

The two bastions, flanking the southeast gate, were at least 3m high, but most probably slightly more than that. Their upper leveled surface served for deploying fortress defenders, where they had the advantage of a better strategic position against invaders. The special attention paid to the most vulnerable spots in the fortification (the gates) along with enhancing their defense by flanking bastions, is perhaps the earliest known case of such fortification works. One should also add here the ditch, particularly deep and wide at this place, as well as the purposeful expressive drop in elevation between the lower level of the gate and the bastions, respectively the inner edge of the ditch, on the one hand, and the then outside edge of the ditch, on the other hand – ca. 2.50m! If we take for granted that the bastions were more than 3m high, it means that the defenders had an elevation advantage of about 6m, which rendered the gate practically impregnable. There must have been an at least partially movable wooden draw-bridge across the ditch, but as yet there is no conclusive evidence to confirm its existence.



Figure 6. Provadia-Solnitsata prehistoric salt producing center. Southeast area. Remains of the northeast bastion (the large rocks) and the northeast L-shaped structure (in the rear). Middle Chalcolithic Hamangia IV period.

I will summarize the above information. The defense system of the first middle Chalcolithic settlement at Tell Provadia-Solnitsata consisted of a wood and clay palisade, crossed at two places by a stone wall with bastions, flanking both gates of the fortification; the gates in the defense wall are opposite each other, with the settlement's main street connecting them. The defense wall is probably an almost regular circle with a diameter of 92-95m, while the inner diameter of the ditch is 98-102m. The average height of the defense wall may have been ca. 3m; the thickness of the palisade was ca. 80cm, the thickness of the stone wall exceeded one meter; the bastions protruded over 2m before the wall line; the gates' width was ca. 2.40m. This source data means that the overall length of the defense wall was approximately 295m, about 40 of which were taken by the two stone walls with the gates,

and about 255m, by the two arcs of the palisade. The enclosed area amounted to some 70 ares.

The defense system of Tell Provadia-Solnitsata was badly damaged by the earthquake, which occurred around 4550 BC. This is certainly true for the two stone bastions, almost entirely demolished by it. Obviously, it was not possible to lift the enormous rocks back into place or bring new ones in because of the already existing settlement and the enclosing ditch. The fastest and most plausible option to close the disrupted fortification wall was to erect two L-shaped walls from smaller stones immediately behind the demolished bastions. Most probably, the palisade's resilient structure was not damaged beyond repair. However, a new connection with the newly built stone walls had to be made. The ditch in its part around the southeast gate was filled in by the huge bastion stones and hundreds of smaller ones as well. So it turned out to be easier to dig a new by-pass ditch immediately in front of the clogged one, which had to connect the still functional neighboring parts of the enclosure ditch. The length of the bypass is 24m.

The newly-built L-shaped stone structure behind the demolished southwest bastion (Figure 5) was so positioned that its short wall (about 4m) was constructed as an extension of the northeast side of the base of the bastion in front of it. The long wall of the new structure (about 9m) was almost parallel to the base of the bastion's northwest side. The walls of the new stone structure were about 1.20m thick. The southwest end of the long wall was connected with the then existing or rebuilt palisade. The preserved height of the walls, established at the excavations, reaches 45-50cm, but the interior space of the facility is filled in with a much higher layer of crushed stones, used as a building material.

The newly-built L-shaped stone structure behind the demolished northeast bastion (Figure 6) was so positioned that its short wall (about 4m) was erected upon the main street, thus narrowing it from 2.40 to about 1.30m. The short walls of the two symmetrical facilities were parallel to each other, forming a gate, about 1.30m wide. The long wall of the northeast L-shaped structure was about 15m. The walls of the second stone structure were also about 1.20m thick and their preserved height at the excavations is more than 1m. It has not yet been clarified whether the long stone wall of the structure goes northwest in the form of a stone wall or palisade; excavation will continue in this direction.

The new defense facilities were built by crushed stones without any mortar to hold them together. They were no less than 3m tall.

The period, during which both new 'bastions' were in use is not likely to have lasted long, either. They were demolished by a subsequent strong earthquake, probably at the end of the middle Chalcolithic Hamangia IV period (ca. 4500 BC). The seismic wave, however, came then from either east or southeast; the walls collapsed inside, towards the fortification. Due to the presence of red clay among the remains of the northeast L-shaped structure, the stones have a specific color shade; this allowed for measuring their total volume and establishing the above cited height of the structure. It stands to reason that the neighboring symmetrical structure was equally tall, i.e. at least 3m. The total length of the two structures with the street between was about 25m. Together with the southeast palisade, the length of the uncovered sector of the fortification is about 40m.

Several fortified tells have been explored in northeast Bulgaria. In this context, the fortification system of the middle Chalcolithic settlement at Tell Provadia-Solnitsata has a few peculiarities. The space, encompassed by a defense wall, is considerably larger compared with that of the excavated early and middle Chalcolithic settlements in the region. The combination of defense wall and ditch has been recorded at one more site, but at Tell Provadia a section of the defense wall, which is near the gates at that, was built by stone, and the gates themselves were flanked by stone bastions, to be replaced by L-shaped stone structures at a later stage. This is the first case of this type on the Balkans.

The research at the Provadia-Solnitsata prehistoric salt producing center is going on.

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