

THE EARLIEST GOLD MINING OF THE ANCIENT WORLD? RESEARCH ON AN EARLY BRONZE AGE GOLD MINE IN GEORGIA

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Introduction

The exploitation of gold always has raised many questions in prehistoric archaeology and still does: tracking back the sources of ancient gold is difficult as the strong geochemical devices such as the isotopic composition have been applied to artefacts only seldom in recent time. Older results from spectrometric analyses did not sufficiently match with gold deposits and therefore just brought some insights to sorts of ancient gold (Hartmann 1970; Morteani & Northover 1995). So it remains elusive until to today where the gold has come from for the particularly rich gold complexes of the Chalcolithic and Early Bronze Age periods - a long time before we have positive evidence for also Egyptian Gold Mining respectively. One should either not forget that evidencing wash gold as the source most probable also has its own problems: there is the enrichment of heavy metals such as tin and silver in placer deposits. Whilst such sources are often exploited completely it is difficult to compare them with rock gold deposits. There is however a slight chance by the help of isotopic ratios in such cases when regional geological strata are not too complicated and mixed by different formation ages. Beside the geochemical methods there is the other way of using archaeological sources: But gold mines are difficult to find especially at the beginning of the metal ages but in fact easier to find than alluvial placer deposits. There is no doubt that the combination of analytical and field archaeological devices can bring success and

this was the way of the Bochum Caucasus project. Actually the mining area of Sakdrissi and Bolnissi area was known before as rich in polymetallic ores including gold as well as ancient mining has been reported by several researches from the 19th century on (Tschochonolidze, unpublished). But it was the first systematic field work on mining sites that has revealed the secure result that Sakdrissi can be dated to a period around 3000 thus being one of the most ancient mining areas in the Caucasus. The mine itself was reported as an Iron Mine of the medieval first, later has been identified by T. Mudschiri (1987) as a prehistoric one on the basis of hammer-stones found there¹. In the beginning the Bochum Caucasus project has started as a program mainly focused on educating junior scientists in Mining archaeology and Archaeometallurgy (2004-2006). After the discovery of the Sakdrissi Gold mine the program now has shifted to a scientific project whose goals still are the education of Georgian trainees but also a detailed investigation of gold mining and gold processing in the Caucasus (2007-2010)².

The area of Sakdrissi-Kazreti is located in a favourable traffic position in the Maschawera valley that directly links the Tblissi/Kura river valley with the Caucasus and the Armenian mountains in the southeast. Thinking of the rich polymetallic resources of this region it may not wonder that early agricultural societies such as those of the Schulaweri-Schomuntepe-culture (end 5th and 1st half of the second mill.) did produce the earliest evidences of metallurgy in the Caucasian region (Chramis Didi Gora, Aruchlo, Sioni, Imiris Gora u.a.: Kawtaradze 2001: 136 ff. Abb.1). The southern Caucasus region is therefore suspicious to be one of the areas where metallurgy was introduced by transfer of technological ideas from Oriental cultures. And therefore it is quite logical to ask if metals of the Southern Caucasus, especially from Qemo Kartli (SE-Georgia) did play a role in international trading networks especially during the Kura Araxes period when Sakdrissi gold mine had been exploited.

¹ The area of Sakdrissi has been denominated after the medieval village nearby as Abulmulg.

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The Mine of Sakdrissi - Results of Research in 2004-2007

The Sakdrissi gold mine prospect, as it is named today by the Mining Company of Madneuli, actually was planned to be mined and extracted within a time-span in near future. It already had been explored during Soviet times in the 1980ies, so it was just a matter of time until a final extraction by an open-cast mine would have been destroyed all ancient mining traces. The old exploration mine did leave some underground tunnels and also surface-structures such as loading roads; the hillock itself was heavily overgrown with bush-vegetation and smaller trees. Despite that we found a quite favourable situation whilst a part of the mine was accessible also underground and seemingly most of the surface mining structures had survived above ground in the bush-vegetation; as for Mudschiri (1987) it was clear that the mine could be dated at least to the 2nd millennium on behalf of thousands of hammer-stones lying around on dumps and also near underground find spots. After clearing the vegetation in 2004 and 2005 we got a perfect insight into a comparatively small mine that had left mining depressions and tailings above ground. These depressions turned out to be mainly collapsed mining galleries that followed smaller and bigger loads of a geometrically complex ore-deposit, a "stock-werk" deposit. It was extremely lucky that also underground find spots became accessible by the Soviet period's exploration galleries. Ancient underground galleries have been cut by modern tunnels at two sites (mine 1 and 2). These "Old man" galleries provide a perfect imagination of underground parts and their connection with above-ground mines. But even better was the fact that those galleries were filled with debris from Bronze Age mining so it was comparatively easy to extract datable charcoal from undisturbed strata during a first campaign (see below). During a first campaign in 2004 a general survey and documentation of the mine was achieved, in 2005 and 2007 further detailed excavations stood in the centre of the Georgian-German field campaigns. The goal of these excavations was a detailed excavation of at least one mine in order to be able to calculate effort and extraction rate as well as the gold-outcome of such a prehistoric enterprise. To understand the detailed working methods and to put it in an operational chain has been the main goal right from the beginning. It was unavoidable to get sufficient insight into production and depositing processes by investigation of mining debris and tools that we found in large numbers above and below ground.

Below ground: The 2005 and 2007 excavation not only did record all working tools by description and coordination we also started a test trench in front of mine A (a part that is connected with mine 1 underground). The excavation first had to remove heaps of spoil flown into the depressions again; according to

younger ceramic finds this influx can be dated into late antique and medieval periods; it is consisting mainly of Bronze Age spoil mixed with ceramics and working tools; despite of hammer-stones it is worth mentioning that grinding and anvil-stones were found in large numbers. These finds can be seen in tight connection with bowl-shaped impressions that have been found at the edges of the mining depressions. thus a first step of a dry ore beneficiation by mean of crushing and grinding at the ancient spoil heaps can be assumed in the direct surrounding of the mine. Further steps of a finer grinding and milling have not been discovered – although they are principally expectable if a further wet beneficiation and separation gold is taken into consideration (see below).

The surface excavation however brought a lot of information and is still not finished; within the big mining depression (called mine A) many more smaller galleries and surface exploitations have been found: this shows the reality of a complex – “stock-werk” deposit where many small gold-bearing quartz veins were well visible and have been exploited nearly completely. In front of mine A some kind of platform was detected - obviously part of an earlier dump that was stabilized later by a dry wall in order not to collapse into the open galleries in the back; this platform however may have been a multifunctional area: many functions are imaginable but none of them is evidenced so far by archaeological finds. The excavation had been extended in 2007 when also the neighbouring mine B and the flat area in between get been reopened – under massive layers of spoil we have discovered again refilled pits and a ditch that leads towards the entrance of mine B - obviously an entrance gully that allowed a smoothly declining access to this mine.

Due to the massive spoil-covering it was difficult to find untouched Bronze Age layers: only in small areas it was possible to find them but the sectors are still too small to give a conclusive picture.

This is completely different underground: There it was possible to find untouched deposits right from the beginning when we started excavation in mine 1: this site had been opened by exploration tunnels in the 1980ies; by work of explosives parts of this mine had been damaged but finally three small working pockets could be discovered; two of them (1/1 and 1/3) are ending at the level of the modern gallery while the largest one is extending further to the north: all of them were completely filled with different layers of mining debris thus indicating, that the mines itself were refilled again carefully - for what reason ever. It was doubtlessly the most important result right from the beginning to have found considerable quantities of Kura-Araxes-ceramic: This again could be a strong argument for an intentional refilling: But also the stratigraphies allow more information on

behalf of this assumption: While many of the layers certainly belong to mining debris that directly could be linked with the extraction process (these are coarse and burned rocky layers or even finer crushed gravel-layers) there are others that contained almost no gold and were of a very fine crushed consistency. Can we identify these backfill-layers as crushed debris from outside the mine? Further research and examination of such debris must help to make us understanding not only the extraction but also the way and reasons for backfilling of prehistoric mines: it is an observation which was made quite often but had quiet serious consequences if we think on dating and our interpretative approach of functional correlations.

The mine itself has brought to light other spectacular features: During our excavations we frequently observed depositions of hammer-tools of which most cannot really interpreted otherwise than as accidental depositions; but two of them have been deposited certainly deliberately at an working end, a niche in mine 2 and a working hole in mine 1/3 – even more striking is their combination of nearly unused and unusually large hammer stones: it is certainly not misleading when we think on ritual deposits especially as these hammers are of exquisite shape and quality!³

The mine however can now be followed under surface about more than 24 m; the working spaces are very narrow and partly it is impossible to pass through with head or shoulder. Even more astonishing is the fact that most of the galleries have been advanced by hammering work by help of fire-setting; there arises either the problem of circulating the air in a depth of more than 6 to 9 meters but even more if one drives the fire-setting-process for weakening the hard rock. The deposit itself is consisting mainly of a gold- and iron bearing quartz-vein while the host rock is composed of softer rhyolitic and other volcanic rocks but is silicified in the contact zone and therefore quiet as hard as the quartz-vein itself. The high technical level of hammering work can easily be understood when one looks on the quantity but also the different types of hammer-stones. There are five distinctive types of hammers that not only allow crushing work at the mine-walls but also show specialized forms for extracting even very small veins - obviously very specialized work that allowed the extraction of gold enriched quartz-pockets and vein lets.

³ Best analogy for depositions in mines has been found at Rudna Glava: Jovanovic 1976; Jovanovic 1982. – At A ritual after-usage is likely in the mines of Aibunar according to depositions and graves found on top of the mining debris: Chernykh 1978: 203-217; Chernykh 1982: 5-15.

Dating

According to the stratigraphic sequence and the preservation of untouched stratified features we got only unquestionable results from the underground excavation at first; in 2007 finally also undisturbed layers were discovered at the excavation above ground: according to Kura-Araxes ware found in untouched areas there is no doubt to date most of the mine to the Kura-Araxes period: Neither by technological observations nor by stratified material we have to doubt this connexion – younger mining activities can however not be excluded but they are not very likely any longer. The ceramic found so far cannot be dated easily more exactly as there are only small fragments. According to general chronological models for the Kura-Araxes-culture a dating to period IV have to be excluded, but more detailed results are not possible now. So we only can get some ideas by ¹⁴C-AMS-dating results that we gained from charcoal out of the underground deposits of mine 1; the results are interesting on the one hand as they support a mining before of 3000 BC. This could mean that the mine began in the earlier steps of Kura Araxes-culture. But there are also two dates that fall into a calibration time-span after the beginning of the 3rd millennium or the first half of the 3rd millennium. This in general does prove mining during a considerable time of at least some centuries.

Bronze Age Settlement-structure in the Surrounding of the Sakdrissi Gold Mine

The Kura-Araxes mine in Sakdrissi immediately raised the question where we should look for contemporary settlements: As we have discovered a larger quantity of ceramic it seems logical to think on a settlement nearby. Such a settlement also should allow some answers on behalf of the further steps of gold-processing which we have not found at Sakdrissi; this includes also gold washing. Thus it was clear right from the beginning that this settlement should not be situated far from the river Maschawera. Although older archaeological observations did not report of Bronze Age settlements before the 1970ies, it was obvious that the area of modern villages of Kazreti and Balitschi provides favourable settlement ground. The medieval villages of Abulmulg and Orsakdrebi also have been famous for their large populations and also their iron smithies and metal production: they were situated once in the surrounding of the Sakdrissi-hillock area. Bronze Age features have not been found earlier than 1973 and 1980 when M. Sinauridze carried out some rescue excavations in the village of Kazreti: near the main train station she reported some settlement pits from Kura Araxes but also a late Bronze

Age graveyard. During our surveys in 2007 we could confirm also a late Bronze Age settlement as we found parts of a burned house at northern slope nearby the Kazreti train station. All these find spots are situated at the side valley of the Maschawera main valley: The Kazretula valley guides to the ore-deposits of Madneuli also nowadays. Iron bars that we found nearby the burned house of 2007 may confirm some relation with later prehistoric mining found in the oxidic parts of the Madneuli ore deposit. Late Bronze/Iron Age settlements are predominant however in the surroundings of Kazreti. Sinauridze has also reported about a large graveyard south of the Kazretula valley at the area Telebisweli (Sinauridze 1985: 13 ff.).

A survey in the surrounding of Kazreti and Sakdissi finally brought also results in concern of the Early Bronze Age settlements; our surveys have produced a large settlement area nearly 1 km southeast as the crow flows from the Sakdissi mine. The area is called Balitschi-Dzedzwebi⁴. It is in fact a large settlement plateau that stretches on a length of nearly 1 km alongside the Maschawera-valley. It has an approximate size of about 60 ha and is therefore one of the largest settlement plateaus known in the Caucasus. The plateau is bordered in the west by the river banks of the Maschawera and in the east by the Dampludka-valley. Therefore the large area is well protected from most sides: first surveys allow an idea of the extension and also periodicity of prehistoric occupation: there is a large find scatter of late Bronze-Age ceramic but also of Kura-Araxes ceramic: a closer look immediately brought evidences for settlements and also for graves. The large settlement area is consisting of several smaller scaled units (area I-IV) with plateaus, dry-stone walls and even fortifications at the southern end of the area, where the Dampludka and the Maschawera-valleys draw close to each other. Test soundings that we started subsequently gained further important results in area II and III where we discovered remnants of an Early Bronze Age house (site 2) and a completely preserved collective burial from the same period (site 3). The grave was undisturbed and found near the surface by its stone rows that built up a chamber of about 0.8 and 1.8 m in rectangle. The burial contained not less than five individuals⁵ and nearly 17 vessels: Most of the bones and of the vessels have been packed at the western end of the chamber only three smaller Kura-Araxes jars/bowls and the remnants of one individual of younger age were found right in the centre. It seemed that parts of the previous burials have been

⁴ Many thanks go to Dr. G. Mindiaschwili and Dr. G. Gogochuri who provided us with their excellent field expertise during surveying and test excavations

⁵ Anthropological investigations will be carried out by the anthropologist Dr. Thea Taschaschwili from Dmanisi research base (current: University of Zurich).

cleared aside subsequently when a new burial was laid down. Unfortunately no metals were found inside the grave despite some small calcareous beads.

The Kura-Araxes house of site 2 was the other enlightening feature of the Balitschi-Dzedzwebi investigations in 2007. It was found accidentally on the surface of a field road that had cut parts of the central hearth; stone rows and working stones immediately did indicate a settlement feature. Although the feature was disturbed and destroyed in parts it was possible to uncover a typical Kura-Araxes house with rounded edges and the typical hearth in the centre⁶. Different layers of clay floors let us expect some internal stratigraphy but this has not fully investigated yet (the excavation could not be concluded in 2007). Ceramic and other small tools (clay figurines, arrow head of obsidian, flint-blades or a small copper awl) provide sufficient insight into the chronology of the site. We have to date the inventory as well as the house construction most likely to the older periods of Kura-Araxes-culture and this could mean a dating right before 3000 BC⁷; this chronological classification coincides presumably with the dating of the burial vessels of grave 1 in site 3.

In consideration of that dating it is interesting to assume that the settlement was contemporaneous to the gold mine in Sakdrissi; there is another fact that supports our assumption of a close connection between these two site: we note a high amount of grinding and milling stones at house 1 as well as in stray find scatter of the whole settlement: they are characteristically furnished with central grooves and have fine grinded surfaces: their typical working-traces speak for a combination of crushing and fine grinding; the sediments in the surrounding of house 1 were tested on gold contents and in fact did deliver some traces⁸. So it is highly probable that time consuming grinding and milling once have been performed in the settlement. Further field research is planed in near future so more

⁶ Hearth constructed by clay are very typical for Kura-Araxes-settlements (e.g. Miron/Orthmann 1995: 64 Fig. 21-22 [Kwazchelebi]; 167 Abb. 170-171 [Zichiagora]); they are consisting often with in bending "clay-tongues" such as those we found in Dzedzwebi; they normally are situated right in the centre of the houses. Our house seems to be round-shaped in its layout. Following the stratigraphy of Kwazchelebi (layer C and D) Kuschnarewa 1997: 56 Fig. 30) this could be an argument for a dating it an older stage within the Kura-Araxes cultural development.

⁷ This insight has been gained by an overview about Kura-Araxes stratigraphies especially from Georgia in the southern Caucasus (generally: Kuschnarewa 1997: 48 ff. Fig.30) and on basis of A. Sagona's radiocarbon and 14C-chronology (Sagona 1984).

⁸ Many thanks to Susanne Körde from Dortmund, Museum of Naturkunde, for sieving, washing and separating the gold from our excavation sediments.

detailed aspects can be expected in concern of settlement and working patterns of the gold mining population of the Maschawera-valley.

Some Thoughts on Gold in the Caucasus Region and Beyond during the Earlier Metal Ages

After three field campaigns it is still an open question to what areas the gold of Sakdrissi has been transported and used; the Kura-Araxes-culture it self has produced only a small quantity of golden objects according to their graves and settlements. It is by certain that this is reasoned in special burial customs and ritual pattern why we have to state such an evidence gap. There is one major exception that is commonly known: it is the Arslantepe “princely” tomb that also can be linked with the Caucasian cultures: Frangipane *et al.* 2002; Frangipane 2004. The grave contained several pieces of precious metal which generally states the far distant connexions of Arslantepe in these days (Hauptmann *et al.* 2003). It is fairly clear that the early urban society of Arslantepe stood in tight connection also with migrating people of the Kura-Araxes-culture (e.g. Kura-Araxes vessels in the grave goods of this tomb). If we follow the conclusion that has been drawn by A. Sagona (1984) by considering the expansive pattern of Kura-Araxes especially after the earlier phases in the Caucasus, we may think that these contacts have happened in the upper Euphrates region after a first phase of migration. Would it be surprising if capable miners from Caucasian origin stood in tight economic exchange with towns like Arslantepe? Was there also a technological exchange with Kura-Araxes? Knowledge and skills in metallurgy are of great value in the grave equipment of the princely tomb, so it may worth thinking on some technological margin of this urban society.

However, neither the gold of Arslantepe got investigated so far nor others from the 2nd half of the 4th and the beginning of the 3rd millennium BC. It is an open and puzzling question to investigate more on this question. If we look at the northern Caucasus especially to the famous Maikop burial with its gold and silver vessel, we also may think on connections to the upper Euphrates on the basis of metallurgical knowledge: Especially the silver vessels indicate the knowledge of the cupellation technique which is evidenced for that time only in Iran, the upper Euphrates and northern Syria-region (Kohlmeyer 1994; Stöllner 2005: 460 f. Fig. 11): Has it come due to procurement of the Kura-Araxes-culture? New radiocarbon –dates, however, does indicate a dating in the 4th, perhaps in the 2nd half of the 4th millennium BC. (recently e.g. Trifonov 1994; 1996; Chataignier 1995; Kohl 2007: 72 ff.).

Interesting as it is larger quantities of gold objects does not appear in the southern Caucasus before the Martkopi-Bedeni stage and the early Kurgan graves (Parvani, Irgantschai, Satschkhere). It will be the task of near future to check these relations by detailed comparisons of isotopic compositions in order to learn about the relevance of Southern Caucasus gold deposits for the first steps of a ritually visible social differentiation. It is – globally spoken – the time when Caucasian metals for the first time got into an international focus: Metals rich in Arsenic and Antimony have been widely used in the Eurasian and the Circumponctic as well as the Anatolian sphere (e.g. Chernykh 1992: 147 f. Fig. 50-51; generally now Kohl 2007).

Investigations of 2004 to 2007 have proven one of the oldest gold-mines in Eurasia. It is particularly surprising to find a very advanced mining technology that has reached depths of more than 25 m below ground. This is a clear evidence for advanced techniques which has used fire-setting and skilled advancing-the-tunnel techniques by hammering and picking work. Our mine seems even older than examples from the Eastern desert in Egypt⁹.

The importance of the Sakdrissi-gold mine (others in surrounding can be expected) is easily recognizable when looking at the large settlement of Balitschi-Dzedzwebi. Our field-work could prove both the temporal and functional connection between mine and settlement. This gives a sound basis to argue for a central gold producing area that certainly did not only deliver gold to the neighbouring communities but also to regions further ahead. To understand both the economic circumstances of this outstanding region and the “international” importance will be the research task within the next period of research.

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⁹ In consideration of the still insufficient state of research, especially when counting the numerous undated gold mines, it may be just a question of time when also contemporaneous mines will be found. Gold did also get important in Egypt during the beginning of the first half of the 3rd mill. BC. Other dating attempts cannot be linked with secure complexes and excavations and seem intuitive: Klemm/Klemm 1994; 1997.

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Figure 1: The hillock of Kachagiani (Sakdrissi) with its mining depressions of the Early Bronze Age mine and modern exploitation track-ways; Foto: Irina Gambaschidze, Tblissi.

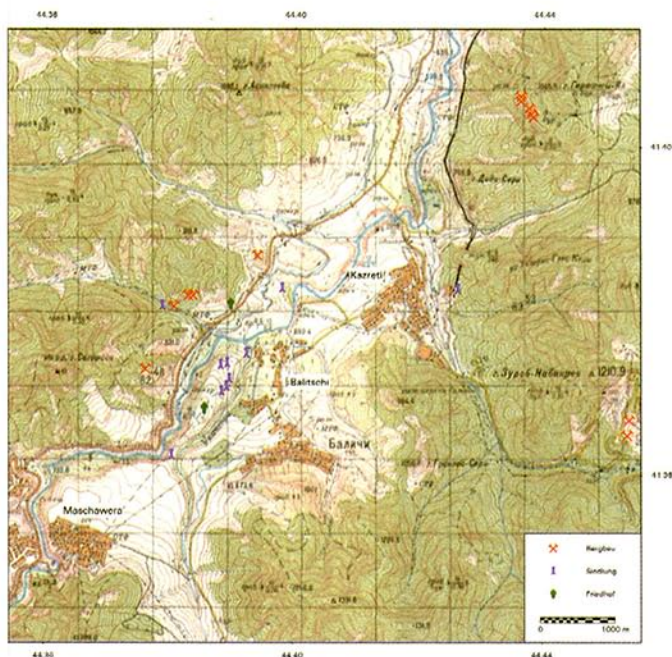


Figure 2: The Maschawera-Valley around Kazreti and Maschawera and their different archaeological sites from Bronze Age according to the survey 2007 (prehistoric mining; old mining from other time periods; settlements and grave-yards of Bronze-Age and early Iron Age); DBM, A. Hornschuch.

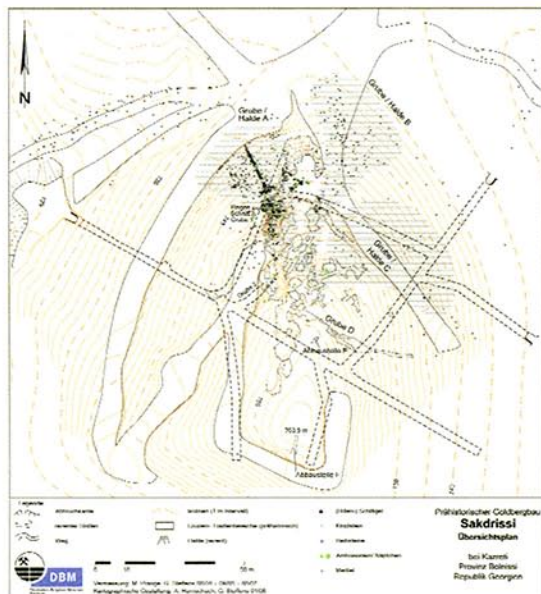


Figure 3: Overview map of the mining features of the gold mine of Sakdrissi; mapping: DBM, G. Steffens/A. Hornschuch.

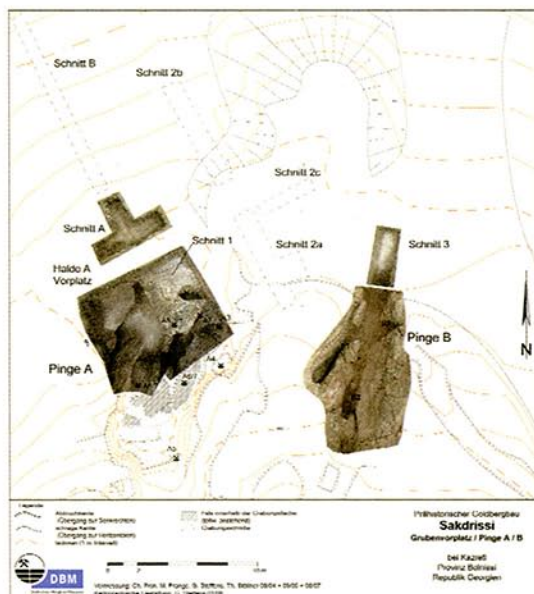


Figure 4: Vertical fotogrammetry of the entrance area of mine A and B of Sakdrissi gold mine after removing the spoil heaps on top; realization: DBM, A. Hornschuch/G. Steffens.

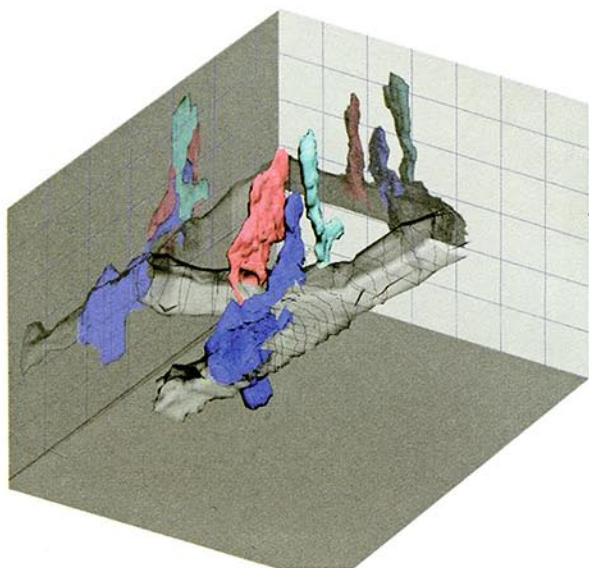


Figure 5: Sakdrissi, Kachagiani-hillock, exploration mining underground; mine 1, 3D-visualisation of the prehistoric feature; realization: DBM, G. Steffens.

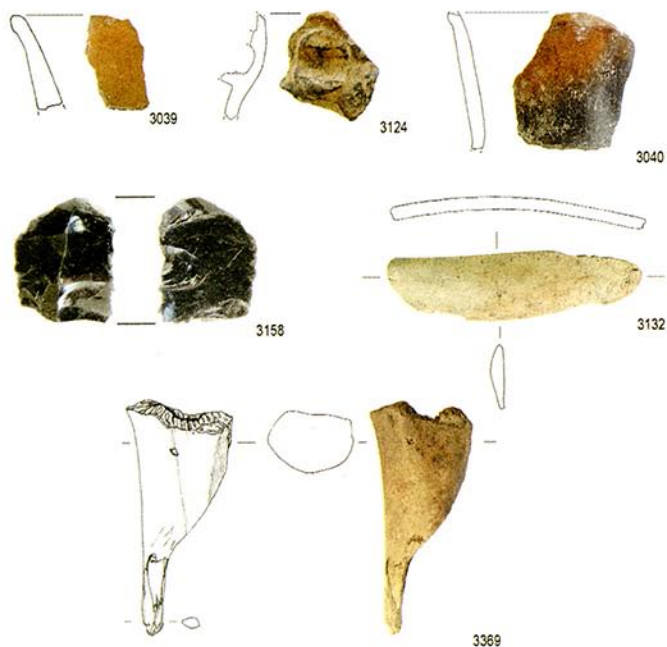


Figure 6: Sakdrissi, Kachagiani-hillock, exploration mining underground; mine 1, mining pockets 1/1-3, findings; realization/drawings: DBM, Th. Rabsilber/P. Thomas.



Figure 7: Sakdrissi, Kachagiani-hillock, exploration mining underground; mine 1/1-3, view into the mining; Foto: DBM/RUB, Th. Stöllner.

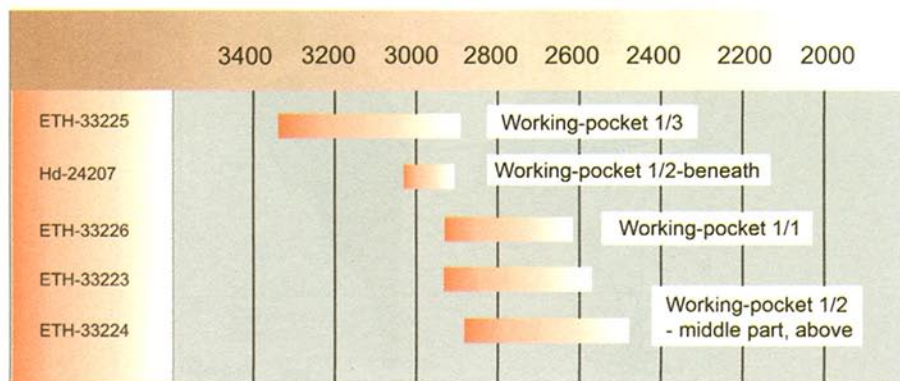


Figure 8: AMS-¹⁴C-Sakdrissi-datings, calibrated by INTCAL04 und CALIB5 (Reimer et al., *Radiocarbon* 46(3):1029–1058, 2004).



Figure 9: Balitschi-Dzedzwebi, area III, site 3, grave 1, chamber-grave with collective burial of at least five individuals; Foto: DBM, A. Hornsusch/Th. Rabsilber.

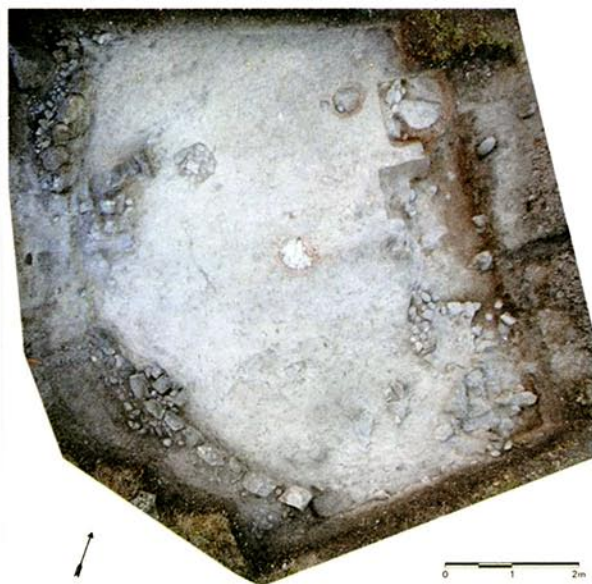


Figure 10: Balitschi-Dzedzwebi, area II, Kura-Araxes house of site 2, right in the centre the hearth; Foto: DBM, A. Hornsusch/Th. Rabsilber.

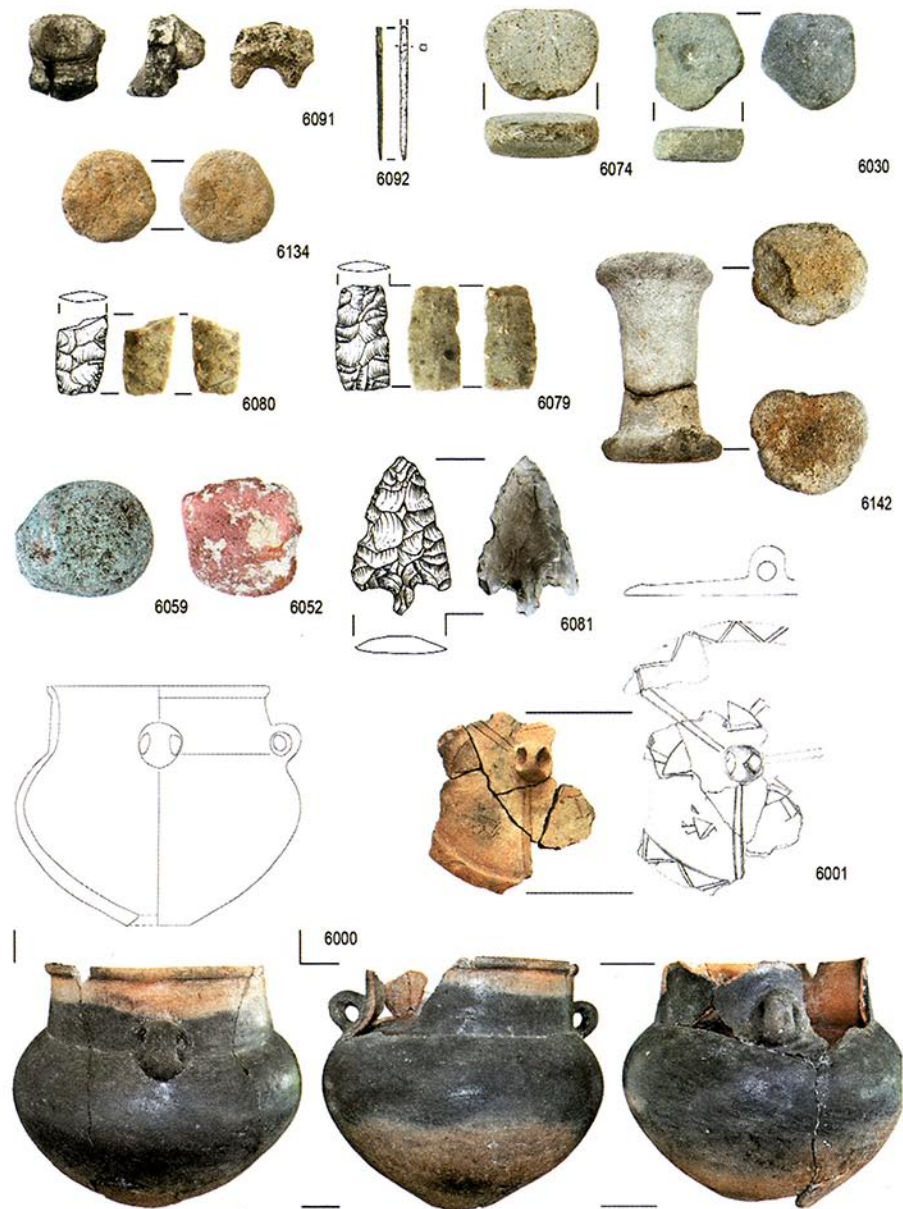


Figure 11: Balitschi-Dzedzwebi, area II, Kura-Araxes-findings of sites 1 and 2; DBM, Fotos/drawings: Th. Rabsilber/Th. Stöllner.