

## **THE SALT MEN OF IRAN: THE SALT MINE OF DOUZLĀKH, CHEHRĀBĀD**

Over a decade ago, a chance discovery was made in Chehrābād salt mine in Zanjan (north-west Iran), which is unprecedented in Iranian archaeology. In January 1994, during salt extraction, miners came across the remains of a human body with long hair and beard. Fortunately, the miners noticed its antique date and informed the officials of the Iranian Cultural Heritage, Handicrafts, and Tourism Organization (ICHHTO/ Miras Farhangi) of Zanjan province about the find. The first archaeological field studies were carried out in the same year, including preliminary research on the discovered objects. The <sup>14</sup>C results proved the body to be around 1700 years old. The body of Salt Man 1 was transported to the National Museum of Iran after the studies, where it has been kept since then. Later on, in November 2004, again the miners discovered human remains of a man whose hair, beard and soft tissues were well-preserved. Beside the human remains of Salt Man 2 they found pottery fragments, pieces of textile rope, parts of a basket, and a metal pick. Both body and objects were transported to ICHHTO of Zanjan province. A rescue excavation was conducted in 2004. Questions and ambiguities which were left unanswered made a subsequent excavation season in 2005 necessary. During the first and second excavation seasons, along with the discovery of the exploited parts of the antique mine, two other well-preserved natural mummies were found. The results of these excavations were so important that since then several attempts had been undertaken to establish a long-term project dealing with the site.

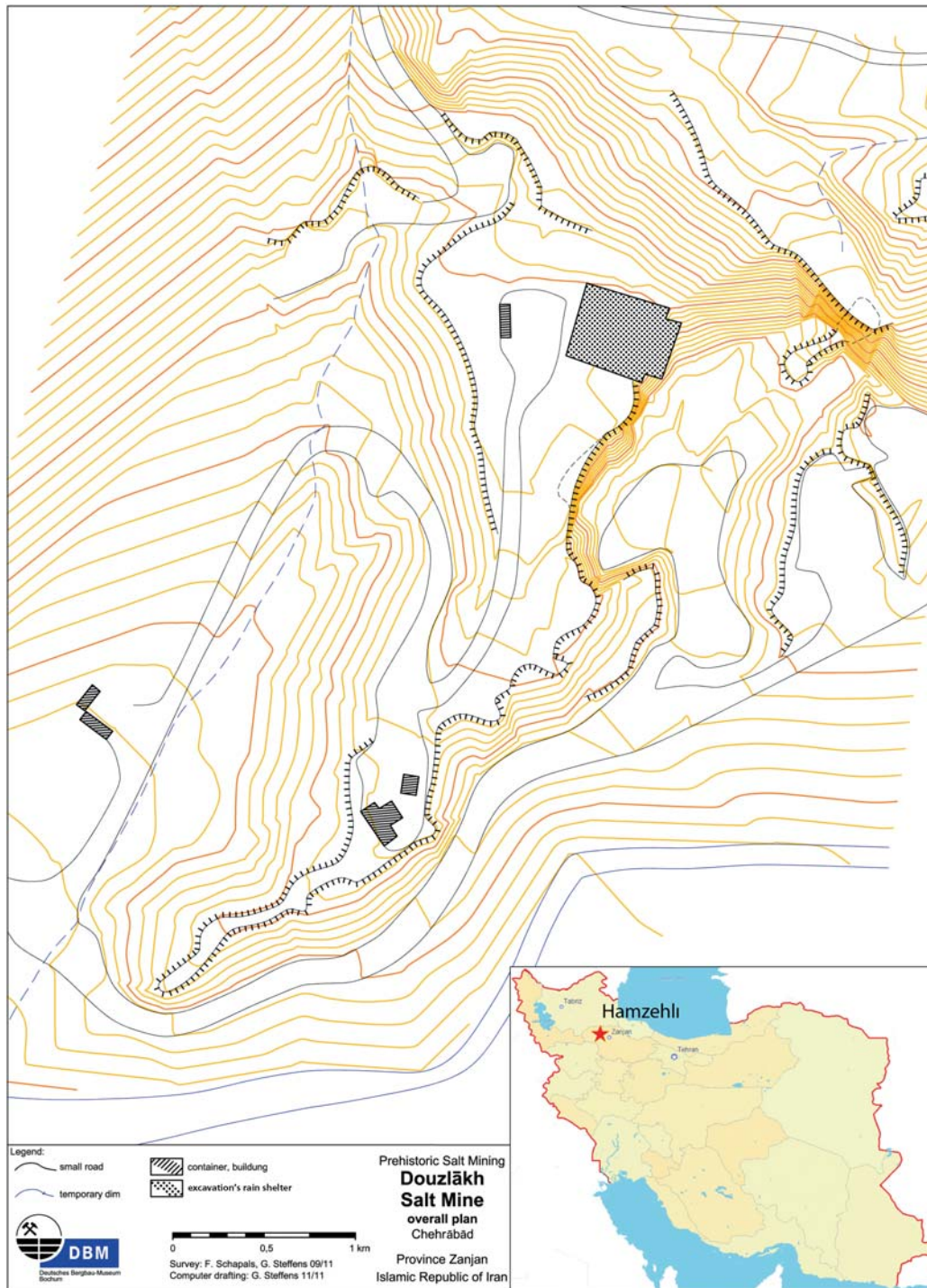
First contacts with the Deutsches Bergbau-Museum Bochum (DBM) were made in 2005, shortly after the second rescue excavation. In 2006 preparation for the project started; in 2007 experts from the University of Oxford and from the University of Zurich joined the program. A workshop held in Zanjan discussed the necessities and scientific problems of such a research. Since winter 2009 the Deutsche Forschungsgemeinschaft (DFG) has been supporting the project, later accompanied by British funding especially focused on isotopic analyses as well as osteometric research of the human remains (Ramaroli et al. 2010) and on the investigations of textiles. Finally, in 2010, field work has been resumed in a first field season. This paper is a report on the discoveries made at the site, including overviews on related studies. An extensive interim report of the recent research will be published in autumn/winter 2012<sup>1</sup>.

### **CHEHRĀBĀD SALT MINE – LOCATION AND HISTORY OF RESEARCH**

#### **Geographical location and geology**

Chehrābād salt mine, lying 1350 m above sea level, is located 75 km north-west of the city of Zanjan, and 1 km south of Hamzelou village in the north-west of Iran. The coordinate of the mine is N 36°54'52" and E 47°51'25" (fig. 1).

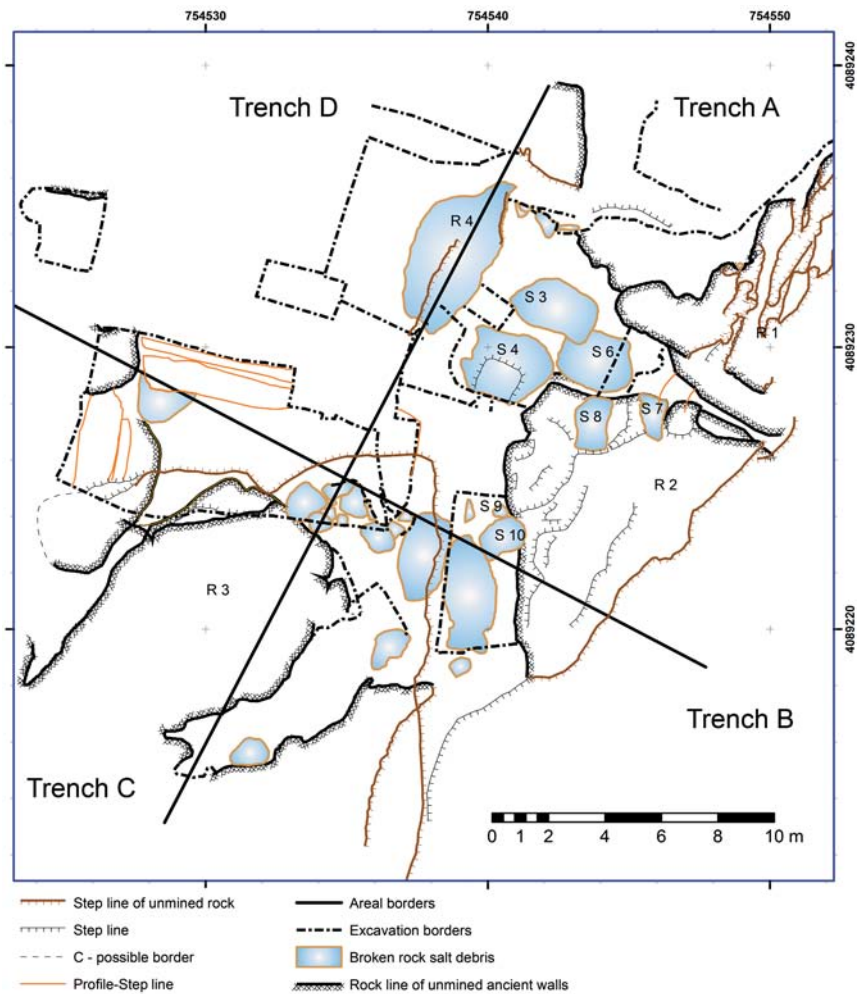
Geographically, the area is located in the Ghezel Ozan basin, and includes a range-like series of mounds and hills which run from north-west to south-east, and are situated between two narrow valleys. The mountain is surrounded by three seasonal streams, Mehrābād, Chehrābād, and Ajichai lying to the north, west and south. Mehrābād and Chehrābād join together on the western side of the mine, near Hamzelou village. The climate is continental, with cold winters and hot and dry summers. The residents are mainly farmers and herdsmen.



**Fig. 1** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Topographical map, showing the vicinity of the site. – (Map G. Steffens, DBM / Miras Farhangi).

The mountain has an extent of about 23 ha, but only rock salt facing Ajichai and Chehrābād streams are exploitable. Therefore, the traditional extraction of salt and the present extraction have both been limited to this area. Long-lasting manual extraction and nowadays modern mechanized extraction, the construction of warehouses, etc., have heavily disturbed different archaeologically interesting sectors, but also given way to a number of antique, hand-made galleries.

Geologically, the sediments developed from Miocene evaporate (Upper Red Formation). The site of Douzlākh is a classical salt-diapir that mainly bears clay deposits rich in salt, gypsum and rock salt (halites); the



**Fig. 2** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Map of the site, showing Trenches A, B, C and D after the excavation 2011. – (Map Th. Stöllner / A. Abar).

minable rock salt layer nowadays is exposed by the modern opencast and is therefore nicely visible at a north-east to south-west trending working edge of nearly 20m height. Consequently, the direction and embedding of the pure rock salt layer can be easily studied. Most of the mining traces, especially the extraction chambers are located in this layer (fig. 2).

The salt-dome is a result of comparable young geological tectonics during the Upper Tertiary; hence, most of the salt-dome is exposed near to the surface and is tectonically unstable. The huge rock salt-embeddings are therefore fractioned especially nearby the surface, causing certain instability within the layers.

### Extractions in recent decades and the origin of the name

According to the residents of Hamzelou and Chehrābād, seven miners were buried alive due to a mining disaster about 100 years ago. Later discoveries of visibly manually dug galleries, antique bodies and tools along with them, prove a long tradition of salt extraction and also several periods of collapse. From about a century ago until 1994 salt extraction was conducted by traditional methods, using manpower and simple tools. Since 1994 a private company had been exploiting the mine, utilizing modern machines<sup>2</sup>. The extracted salt was used as road salt during the winter. Mining activities were brought to an end in 2008 by an order of court.

Chehrābād is the name of a village 5 km south of the salt mine. The name is also applied to the seasonal stream flowing on the western slope of the mountain. The mining area is called Chehrābād by the local

people, as the mine had belonged to the inhabitants of Chehrābād village for a long time, in spite of the fact that Hamzelou village is closer to the mine. The mine itself is called »Douzlākh« which in Azeri means salty ground.

## **EXCAVATIONS AND STUDIES MADE IN THE MINE**

### **The first discoveries in 1994 (Salt Man 1)**

During the first mechanized extractions of the mine in 1994, the miners discovered Salt Man 1. The body was found in the southern part of the mine in one of the collapsed galleries which was dug from south-west to north-east and was about 45 m long (Sobouti 1997, 64).

Archaeological surveys began in the same winter, after the ICHHTO of Zanjan province was informed. First director was Hushang Sobouti followed by Ali Asqar Mir Fattah. The excavation led to the discovery of various interesting objects: three hafted knives, one with leather sheath, a silver toilet-spoon, chisels, trousers with decorated borders, three pieces of patterned cloth, fragments of leather and woollen rope, and walnut shells. Potsherds and bones were also amongst the discovered items of 1994 excavations. But the most important object was a severed left leg in a boot which presumably belongs to Salt Man 1. The boot was made of leather and measured 48 cm in height (Sobouti 1997, 66). According to his hair style and clothes and with respect to the discovered potsherds Sobouti suggested that the body could be dated to the 8<sup>th</sup> century BC. He compared the Salt Man's clothes with those of Scythians' in the 1<sup>st</sup> millennium BC and believed that these together with earrings and other objects associated with the body indicated that the dead person had not been a miner during his lifetime. Sobouti thinks that the individual must have been of high social status (Sobouti 1997, 68-71).

After the excavations had been ended, the body was taken along with the other finds to the research laboratory of the Research Center for Conservation of Cultural Relics, where scientific analyses on date, as well as blood and aDNA were conducted. Results were published in »The Salt Man« handbook<sup>3</sup>.

The <sup>14</sup>C dating results proved the Salt Man 1 to be around 1700 years old, i. e. dating to the Early Sassanian period (details see further down; **figs 10-11**). The analyses carried out so far state that the discovered corpse belonged to a middle-aged man who had suffered a heavy blow on his head and face before death. His hair colour originally had been brown but turned into white due to oxidation and chlorine. According to further analyses his blood type was B. The aDNA tests proved that the leather boot with the leg belongs to Salt Man 1 (Vatandoust 1998, 15-20; Vatandoust / Hadian Dehkordi 2005)<sup>4</sup>. Based on his appearance the experts of the Research Center for Conservation of Cultural Relics, suggested that Salt Man 1 had not been an ordinary miner. Considering his beard, long hair, earrings, and fine boots they assumed that he must have been a prince or noble hunter (Vatandoust 1998, 4).

### **The discoveries in 2004 (Salt Man 2)**

Mechanical salt extraction in Chehrābād was resumed despite the unexpected discovery of Salt Man 1, and associated items in 1994. Hence, during the past decade, a great part of the archaeological site of the salt mine, including the galleries and finds, had been heavily disturbed or destroyed. In 2004, the miners came across the remains of a human skeleton which was seriously damaged by bulldozing activities. The miners searched the area and found fragments of the disintegrated body and some objects which were all delivered to the ICHHTO of Zanjan province. Preliminary research and protective measures were initiated by



experts of the ICHHTO and the Research Center for Conservation of Cultural Relics. First studies on Salt Man 2 indicated that the body belonged to a middle-aged man who had been about 180 cm tall. He died during the collapse of the galleries. Because of the bulldozing activities and the resulting disturbance, a great deal of the soft tissue and bones was ripped apart. The soft tissue was preserved on bones formerly parts of the arms, the right leg, and the thighs only. Along with these pieces the miners found some objects including fragments of a basket, 14 wooden pegs or sticks, 5 pieces of fibre rope, fragments of woollen cloth, and an iron pick.

### **Archaeological excavation in Chehrābād salt mine**

The chance find of Salt Man 2 and the associated objects made a rescue excavation in Chehrābād salt mine necessary. Therefore, in January 2004, the excavation began despite the hostile winter and bad conditions, in order to avoid more damage and to obtain the corpse and items *in situ*. The main purpose of the first excavation season was to perform a rescue operation, but during the work we considered collecting necessary data from the disturbed historical parts of the mine as well.

The first excavation was carried out in January and February 2004, with the aforementioned goals. Due to the important results of the first season, we decided to continue the excavation in the next season, following from remaining questions and ambiguities. The second excavation, which began in November 2005, concentrated on clarifying four issues:

1. The method of salt extraction: investigation of methods used to dig the galleries, techniques and tools used for salt extraction, and the reasons for the collapse.
2. The amount of extraction and interconnected works conducted at the site: one of the main goals was to determine the processes carried out. We intended to find out if Chehrābād salt mine had been used just for salt extraction or if salt refinement and residential areas existed as well.
3. Chronological setting: considering that the first excavation season remained unfinished, the proper dating of the mine was necessary.
4. Interrelations between Chehrābād mine and sites in the vicinity: clarification of this issue required an archaeological survey on the region which was partly conducted before the excavations began.

The excavations in 2004 and 2005

Bulldozing activities in the section where Salt Man 2 was discovered in 2004 caused a great deal of disturbance in the southern parts of the mine. Hence, previous to excavation the area was scanned for objects and human remains belonging to Salt Man 2<sup>5</sup>. Therefore, all heaps of colliery wastes moved by the bulldozer were carefully searched through.

After finishing preliminary investigations, archaeological excavations began in the area where Salt Man 2 had been discovered. The first excavation season took place in three open air trenches and two galleries. The open air part which included Trenches A, B and C, is actually the upper part of solid salt rock in which some galleries had been dug (fig. 2). The salt was covered with a layer of soil and clay, about 30 m thick, which the recent miners removed by using a bulldozer. During the second season, besides resuming the excavations in Trenches A-C, a new trench had been opened, called D (fig. 2). All of these trenches are in the southern part of the mine, and measured 10×10 m. Many salt and clay blocks were unearthed, as the excavation in these trenches started. We kept the salt blocks and removed the clay and soil, in order to reconstruct the galleries and to find out how they had collapsed (fig. 3). Using letters and numbers each salt block and ancient wall was recorded, solid rocks with the letter »R«, collapsed salt blocks with the letter »S«.



**Fig. 3** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Impression of the working section in Trench C with clearly visible working traces of picks. – (Photo Th. Stöllner).

– Trench A: The bodies of Salt Men 3, 4 and 5 were unearthed in this trench. It is located west of the section where Salt Man 1 was discovered. Archaeological excavations in this trench began in an area of about 5×5 m, and were later extended to a size of 10×10 m. Trench A is next to the eastern slope of the mountain. In the eastern area, it leads to recently exploited parts which created a scarp. During the first season, along with the discovery of human remains and a lot of objects and tools, several salt blocks of various sizes were also found. Some showed clear traces of hacks, picks and drills. These salt blocks were once part of the ceiling or wall of a gallery from which salt was extracted. Nine large collapsed salt blocks were found in Trench A, most of them weight several tons. Considering the obtained evidence, Trench A was most probably part of a large gallery complex to which some subordinate galleries were connected. These galleries were not on a particular, even level. Due to recent mechanical extractions the original size could not be determined. During the first season no chambers were discovered in this trench. Hence, in the second season, three soundings were dug in Trench A.

– Trench B: Trench B is located south of Trench A. Although the outdoor section of the excavation site was divided into squares of 10×10 m, Trench B, delimited by the scarp from south, covered less than 100 m<sup>2</sup>. On the first season of excavation, after removing about 1 m of the surface soil and debris, a huge block appeared in the middle of which there was a rather narrow crevice. The crevice was full of soil, stone, salt and artefacts which were glued together and hardened by salt water which had penetrated from upper layers. Excavation in the crevice was very challenging and could only be conducted using tools as chisels and crowbars.

During the first season one part of the subordinate gallery was unearthed. In the course of the second season its junction with Trench A (location of Salt Man 5) was excavated. In the contrary, recent research proved that this impression was not right at all as we realised that the crevice was a result of a very large salt block which had fallen into the open mine chamber with 1 m distance side by side of the south-eastern mine wall (see below), and perhaps was a part of the collapsed ceiling. Because of the great deal of disturbances caused by bulldozing activities there is no information about the ceiling of the gallery and its upper parts. It appears that after the collapse of the gallery the water coming from upper regions of the mountain had been flowing into the gallery. Traces of in seeping water are clearly visible on some parts of the subordinate gallery.

– Trench C: In order to find out how the ancient miners worked, Trench C was excavated in an area of 10×10 m, west of Trench B, in an elevated part of the site which mostly covered the huge salt block. Work was restricted to the northern part of the trench, being very difficult to unearth. The excavations



**Fig. 4** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Impression of the site in 2007: in the central area the broken parts of the ancient mine are clearly visible. – (Photo Th. Stöllner).

led to the discovery of the concave, extracted wall of a mining chamber. Signs of working traces of hacks and picks (**fig. 4**) were visible all over the wall (**fig. 2**, R3). This wall was probably part of an extended mining chamber whose ceiling had collapsed. Unfortunately, we did not reach the bottom part of the gallery. Intensified excavation led to the discovery of its connection with Gallery 2. During the first excavation season in this trench, after removing 120 cm of soil, a rather thick layer of chaff and animal excrements was found, resulting in the conclusion that this place had been used as an embark point, or as a stable, perhaps after an older and partial collapse of this mine part (after the collapse).

- Trench D: A very large salt block west of Trench A (**fig. 2**, R4) covers almost all the area west to Trench A. This block was first thought to be a solid part of the gallery. In order to determine how salt extraction was conducted on the northern part of the block R4, and also to find out how R4 and R3 were connected, Trench D was opened in the second season. In order to speed up excavation and to increase precision, only an area of 5×5 m of the 10×10 m square was opened. During the season in 2005 we unearthed 2.4 m of this trench. Among the most interesting features in this trench we have to mention two layers with chaff and animal waste which is probably the continuation of a similar layer in Trench C.
- Gallery 1: This gallery was discovered during debris removal from upper layers in Trench A. After its access was unearthed, excavations continued inside the gallery. Work inside the gallery was stopped after entering 3 m for safety reasons. Gallery 1 with an average width of 1.5 m and a height of 2 m was the only part of the excavation area from which pottery dating to the Arsacid period was discovered. This gallery may have been one of the old parts being reused during a younger period. Work might have been similar to modern pre-industrial extraction techniques. It seems that this gallery was dug into older compressed and salt-rich mining debris. This is also reported by locals.
- Gallery 2: This gallery was dug into the solid salt rock, east of Trench B. The entrance was discovered while excavating in the eastern part of Trench B, next to the huge salt block mentioned before. The entrance



was filled with large amounts of collapsed material. The interior was filled with soil, debris, and clay lumps. In the previous season 6 m of the gallery had been excavated and cleared. In most parts Gallery 2 is 4 m in height and 2.5 m wide. Signs of salt extraction in the form of cut marks of hacks and picks on the walls have been observed almost everywhere. Generally speaking, we made fewer discoveries in Gallery 2, than we did in other areas, possibly due to decay caused by the high humidity in this part of the mine.

#### The excavations in 2010

The main prospect of the current project is to carry out a comprehensive study on the salt exploitation and the related economy at the outstanding site of Chehrābād, Douzlākh. According to the experiences that were gained by the long-lasting multidisciplinary projects in the Austrian Alps (e.g. Hallstatt and Hallein-Dürrenberg: Kern et al. 2008; Stöllner et al. 2003) it also seems rewarding to compare an Iranian example by following similar research questions and by applying comparable methods. Besides the technological, chronological and economical evaluation of the mining process, the project comprises palaeoenvironmental, social and health aspects of the miners as well. Furthermore, even more general cultural aspects could be deduced from the well-preserved organic material in the salt mine. The diversity and state of preservation are outstanding for Iran, meaning that our studies help to enhance many new perspectives for Iranian archaeology.

The project started with a first field season in Chehrābād following more limited and smaller scaled research goals:

1. A sondage excavation to clarify details of taphonomy and classification of layers.
2. Reconsideration of stratigraphy of the different debris layers at the Trenches A-C including a general survey of mining structures.
3. Establishing of an excavation GIS including a database for features, artefacts, and ecofacts.
4. Development of a sampling strategy by sieving and analyzing of selected sediments and layer samples.

In spring 2010 a joint reconnaissance excavation was carried out in Chehrābād salt mine. By re-examining the areas unearthed by the ICHHTO in 2004 and 2005, it was possible right from the beginning to comprehend the layout of the south-western part of the mine more properly. In Trench A the sounding near the main western profile was restudied and deepened (Trench A2). In the course of our work it got obvious that former excavations did not reach much below the oldest collapse layers and by that only peripherally into older mining debris. Large salt blocks at the surface parts of this mining debris have indicated this presumption. According to the location of Salt Men 4 and 5 who have been found in these layer contexts a dating to the Achaemenid period seems likely.

Mining debris dating to the Achaemenid period has been studied in sounding B1, in the southern parts of the excavation also: the sounding was carried out at the entrance of Gallery 2, an area that has been partly unearthed during the 2004 and 2005 campaign. Artefacts found in this section confirm the principal dating of the mining complex to the Achaemenid phase also.

Again the excavation raised the question, if some of the huge salt blocks found in the centre of Trench A had collapsed during one event or if such collapses had constantly happened over a certain time period: blocks S4-6 (fig. 2) were partly covered with mining debris, possibly indicating mining activities very shortly after the first catastrophe in the Achaemenid period. The situation is complex in a way as the upper layers strongly suggest a refilling of still open areas inside a collapsed mining hall by broken waste debris and huge block debris. Presumably, it is a later intentional filling perhaps during the Sassanian mining period. The main goal was to detect an Achaemenid occupation layer belonging to the collapse event which is clearly indicated by the radiocarbon dates of Salt Men 3-5 (Pollard et al. 2008). Still, huge salt blocks prevented a



further excavation of the old trenches as a whole; only two soundings in Trench A led to further results. In the eastern part a shaft or a connection gallery to a lower gallery could be investigated in parts; the situation is similar to the mining hall, it is filled with large salt blocks presumably deriving from the aforementioned collapse. The basically vertical gallery was driven alongside a tectonic disruption inside the rock salt deposit. It was interesting to find also a mice nest of a younger dating to the Arsacid Age. This indicates that open spaces remained after the collapses and gave access to smaller rodents, bats, and birds.

A second sounding followed the traces of an older sounding from 2005: it opened view to different debris layers of the Achaemenid mining debris. As we have not reached the bottom layers yet – presumably consisting of rock salt – it can be presumed that even older layers might be detected on the basis of the stratigraphy.

Important information was gained by excavating and cleaning the northern profile of Trenches A and D: we were able to distinguish a large sequence of layers from the Sassanian to the Achaemenid mining period. The Achaemenid mining debris layers had been covered by a massive filling, which has been detected in almost all trenches: the layer consists of massive block and salt-clay blocks as well as heterogeneous debris. This massive filling covered many parts of the whole mining hall: it is a remnant of a massive block fall event (and further event?) that were perhaps refilled into parts to older mining areas no longer in use. On top of it lies eroded mining debris, filling up the still existing parts. Following, these layers can be described either by occupation levels or by fillings of Sassanian mining debris. In the meanwhile it became apparent that these layers belong to an upper part of a large mining hall that obviously was exploited during this period a second time. Therefore, the northern profile covers a stratigraphy of nearly 10 m, a circumstance of ample importance for the whole stratigraphy in this part of the Chehrābād mine.

Finally, some words should be added to a sounding being opened sideward of Trench D where fragments of teeth had been discovered before. During the excavation of the remaining parts of Salt Man 6 the pathologist and mummy specialist Frank Rühli was at the site, carrying out additional sampling and testing: only parts of a body, a cranium, and pieces of a pelvic bone have been found, obviously relocated from its original *in situ* position within the Sassanian mining debris. Its position and the dating are in concordance within the layer in which the human remains were embedded; it made clear that the time span between the casualty event and the re-dumping and the reusing of the mining hall must have been quite short (around 1500/1520 ± 35 BP). This makes the hypothesis more favourable that »catastrophic« rock falls and collapses did occur quite frequently. Stray and dung layers found beneath the level of Salt Man 6 are even slightly younger in age; it is clear that the containing layer above was re-dumped later.

We may conclude the results of the radiocarbon dating and of our recent observations of the stratigraphy: Achaemenid mining certainly took place in the 5<sup>th</sup> century BC and perhaps also before. A catastrophe is likely according to the detailed dating of Salt Men 3-5 around 400 BC (see below **fig. 11**; Pollard et al. 2008). During that period already opened parts of the mining hall had been exploited to a large extent. A lower second level might have been interconnected by a vertical tectonic fracture presumably used as a shaft. Although it has not been dated yet, an Achaemenid age seems likely.

Even though soil erosion and debris did fill nearly all parts of the mine after this collapse, some spaces remained open allowing smaller animals access to the cavities. A new activity phase started during the Sassanian period when massive layers of coarser rubble and debris were dumped into the open areas of the partly collapsed mining hall, perhaps to secure the working section while ceiling mining took place in the upper parts of the mining area. The reopening happened in the 5<sup>th</sup> century AD during Sassanian period. The death of miners (here Salt Man 2; **fig. 5**) indicates that this mining provoked further collapses; the recently discovered parts of Salt Man 6 further supports this hypothesis. A problem still remains with the Late Arsacid dating of Salt Man 1 found in 1994. It cannot be connected with an extensive mining phase at the moment.



**Fig. 5** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Head of Salt Man 1. – (After Vatandoust 1998, 1).

### The finds

Salt extracting tools play an important role in reconstructing the antique mining process. Besides the iron pick discovered along with Salt Man 1 (**fig. 6**) and the hammer found along with Salt Man 3, two iron adzes were unearthed during the first two excavation seasons which both have wooden handles.

A wooden, semi-circular basket handle may have belonged to a haulage vessel. To this category may also belong the large number of ropes. The longest piece measures so far 140 cm. The ropes vary considerably in thickness, ranging from 3 to 19 mm. Most of them are two-ply. Only six pieces are three-ply, one exemplar consists of a five-ply. The rope colour mainly ranges from light brown to dark brown. Some of the ropes are knotted at one or both ends. These exemplars were discovered in different parts of the excavation area and come from different depths. Leather belts and bags may belong to haulage activities also. Among the finds in Trench A is a big light brown leather bag. The amount of patches and traces of repeated sewing indicate that it had been in use for a while and repaired several times. When discovered, it was filled with crushed salt. The bag resembles examples from the Iron Age mine of Hallstatt (Kern et al. 2008, 102).



**Fig. 6** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Upper part of the second Salt Man's torso. – (Photo P. Thomas, DBM).

Devices such as oil lamps and perhaps also lighting splinters had been in use for subterranean illumination. In this respect a wooden object deserves special attention: a fire board of about 26.5 cm of length. It is a piece of wood, cut into two halves. One side shows clear traces of fire starting, consisting of three circular black holes.

Many leather and textile fragments may once have belonged to personal equipments and clothing, but most of them found their secondary usage in the mining process. During the excavations small pieces of pelt and leather have been discovered. Fur and wool have been preserved very well. A cloak consisting of fur was found on a salt block in Trench A. It is made of two big pieces of pelt with a strap attached to it. The remaining hair is red and brown in colour. Fur colours are mainly white, red, brown, black and beige. All in all, 37 pieces of leather were found, each of which was part of leather objects such as belts, shoes, leather bags, etc. In some cases leather straps have been preserved.

Personal equipment of miners is displayed by artefacts such as a lathed knife handle and by wooden objects as a needle and a comb with both broad and slim teeth.

Textiles make up one of the most interesting categories at the site. As in the Austrian salt mines they belong to the most outstanding artefact group. During the excavations many different pieces of clothes were discovered. Cream and light brown coloured woollen textiles are the most common. Some of the objects are made of cotton or animal hair. Textiles found in Gallery 2 had disintegrated as a result of high humidity. Some showed bite marks of animals, probably caused by rats. An almost complete exemplar of cloth consisting of several smaller pieces and of light brown colour was discovered in Trench C. It probably belonged to a pair of skilfully sewn woollen trousers. Most of the textiles discovered show a variety of patterns and colours.



Twine and textile ropes found during the excavations display a remarkable variety in sizes, fabrics and colours. In some cases several small pieces had been tied together to make up longer pieces. Most twine is light brown. Others are white, dark brown or cream. The most common style is two-ply. Other ropes are braided in three-ply (in some cases each strand itself is two-ply). There are also ropes made of four, six, or eight-ply.

Other large groups of finds are wood remains and other ecofacts such as faeces and animal bones. Many pieces of wood in various sizes, including small and medium sized branches, shrubs and bushes have come to light. In some cases one or both sides of the objects had been burned. In many other cases the pieces are barked or the point worked out to a tip. A number of sticks had been barked; most probably, they had been used as handles for picks and hacks. Among the wooden finds are many small pieces with sharp tips. These exemplars were probably used as wedges to fix the wooden handles onto the metal part of the tools. A large amount of wheat and barley seeds, as well as chaff had been discovered during the excavation, Trench C providing the largest amount. We also have to mention peach and plum pits, walnut shells, pumpkin and melon seeds, chestnut husks, pomegranate skin, and dried medlar fruits. An interesting point is that some of the fruits such as chestnuts and medlars are not native to the region. Except some northern areas of the province which are near Gilan province, these plants do not grow in Zanzan province. A more detailed picture will be drawn by Nicole Boenke in future.

The animal remains include bones, bird feathers, animal excrements, and mummified animal remains. Animal bones are usually strongly fragmented, and can be found in different parts of galleries and trenches. Except for some of the bones which belong to small animals, mostly rodents, they probably belonged to animals which were used for the food supply of the miners.

During the excavation we discovered several naturally mummified bats. Such finds point to the existence of large, deep galleries at the time when the mine collapsed. Further results according to these discoveries and their interpretation must await the investigations of Marjan Mashkour and Gholamreza Mowlawi.

## **SALT MEN AND HUMAN REMAINS**

During the first two larger excavation seasons we found a number of human remains, e.g. bones, soft tissue, hair, and human faeces in Trenches A, B and C. In Trench A, pieces of human bone and soft tissue were discovered, probably belonging to Salt Men 2 and 3. In Trench C, we found some black hair, which might be of human origin, along with a rib, parts of an upper arm and other broken skeletal fragments. Considering the distance of these discoveries from where Salt Men 2, 3, 4 and 5 were found, they certainly do not belong to one of them.

### **Salt Man 3**

In 2004 the miners unearthed by chance Salt Man 3 in an old area of the mine. The mummy was discovered at the mine during the first days of our stay, before the excavation started in Trench A. The corpse lay under a big salt block. The surface of the salt block lying on the Salt Man showed pick marks and probably traces of metal chisels. Salt Man 3 was mostly skeletonized and only a few remains of soft tissue and clothing were found. Like the other miners, he was killed during a mining catastrophe; a big block of several tons crushed most of his body. When discovered, parts of his clothes and soft tissue were sticking to the block. Analyses on the remaining bones, especially parts of the skull, the mandible and pelvic bone suggest the deceased was of male sex.

Some of his hair and skin had been preserved on a small fragment of his skull. The hair is brown and about 0.5 cm long. Remains of his skin and beard were found on one of the mandible fragments. The beard is dark brown and the longest strand is 2 cm long. Most teeth are preserved on the mandible.

The modern salt extraction caused severe damage to the body, disintegrating it to a large degree; bones, soft tissues and clothes were ruptured. Some parts of the clothing had already started to rot and other parts might probably have been destroyed by animals. Remaining clothes are very densely woven. Most pieces are light brown or of creamy colour. There are also some dark brown fragments. Blood soaked into the fibres and probably caused a change of colour in some parts. Considering the remains we can suggest that the Salt Man's clothes were composed of several pieces sewn together very skilfully.

The clothes bore two types of decoration, a red band of 2.5 cm width, patched and embroidered with decorative motifs. One interesting exemplar of the clothing was a woollen belt found with the body. The belt is 60 cm long, but torn into three pieces. It is made of brown, red, blue, light green and yellow strings. To enhance stiffness the sewer had put together two woven bands and stoaded those with their edges, using a red yarn. Next to the woollen belt, there was also a leather strap 50 cm long and 2 cm wide on average. It is of yellowish colour and 2 mm thick; in some parts it is covered with brown pieces of leather. Considering the fact that the woollen belt is too short on its own, it is probable that this strap was used as a part of the belt as well. The shoes of Salt Man 3 are made of several thick leather pieces, sewn together using a leather cord. Because of their fragility and deformed shape, it is not possible to determine how it once looked like. A big hole in the sole of one shoe and its abrasion prove that it had already been worn out at the time they were in use. They are made of two parts, the upper part and the sole. The sole consists of two layers of leather, sewn together with a leather string. The upper part is also made of leather and still bears some pieces of leather straps. The sole and the upper part are sewn together using a leather cord. We also discovered several thick pieces of leather which probably had been part of these shoes.

Some other objects were found along with Salt Man 3, including several pieces of ropes, fragments of ceramic lamps, and an iron hammer. The hammer consists of a wooden handle and a two-sided metal head combining a pick, and a flat head. Preliminary analyses prove that the hammer is made of high quality iron. The wooden handle is broken; 21 cm remained from the head downwards. The grip between haft and head was improved by a piece of leather.

#### **Salt Man 4**

Salt Man 4 (**fig. 7**) is the less decayed mummy discovered at Douzlākh. The mummy was found in the eastern part of Trench A, between salt rocks S3 and S4 (**fig. 2**), after excavating 4 m in depth.

Besides the deadly wounds resulting from the mine disaster (skull and legs had been broken and the face was smashed), most parts have remained intact including mummified soft tissues. It is obvious that the dry and salt-rich environment has prevented decay to a large degree, and led to an astonishingly good preservation of the body. Furthermore, no large blocks collapsing from the ceiling had fallen on the corpse. When discovered, the body was in procumbent position with the face on the ground. His arms were bent at the elbow, the left arm was on the ground and the right hand was clenched. His right leg was almost straight, the other leg being bent under the body. Despite several fractures of his skull, discovered on CT scans, J. J. Shokouhi believes that Salt Man 4 actually died as a consequence of pressure on his chest and the rupture of his heart (Shokouhi 2005, 7). Analyses indicate that this mummy was a young man, about 16 years old when he died (Shokouhi 2005, 2-3). On the contrary to Salt Men 2 and 3, he had no beard. He is 170-175 cm tall, wearing a metal earring. His hair is brown, and short cut. Some interesting objects were



**Fig. 7** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Salt Man 4 with leather bag in his hands, shown upside down. – (Photo K. Stange, DBM / Miras Farhangi).

discovered along with the mummified body, e. g. a metal knife with bone handle, which stuck in a leather sheath attached to his belt. The sheath consisted of thick leather bound to the belt with a band made out of leather. We should also mention two small pitchers which were found beside his belly, sticking to the clothing. He had probably been carrying them in his hands before he died. The miner was wearing a cloak made of red and brown coloured pelt around his shoulders showing traces of darning in some areas. Other objects associated with the body include 14 pieces of textile ropes with a total length of 485 cm, all made in two-ply, 4 small pieces of brown cloth, 13 small pelts, 9 pieces of leather, one of them shows holes on one of its edge, 3 woollen strings, 1 small marble with blue glaze and vertical lines under the glaze, broken into two halves, 1 sooty lamp, 11 potsherds, a lot of wood chips and 2 pieces of barked wood right under the right leg of the corpse.

An important feature is his well-preserved clothing. It consists of a long garment made of light brown wool and a pair of trousers. The garment which covers the body down to the knees has rather short sleeves and a round collar. A belt is fixing the garment to his waist. A textile rope is fastened to the belt. The garment is decorated with embroidered motifs and a red ornamentation, which is made of twisted red strings, hiding the seam. The trousers consist of light brown wool. The upper parts of the trousers are not closed, so the bare tissue of the thigh is easily visible. Just like the garment, the trousers are decorated with red ornamentations. The lower parts of the trousers are stuffed into the boots. The boots are made of four pieces of leather.

### **Salt Man 5**

The fifth Salt Man (**fig. 8**) was discovered during the second excavation season in the western part of Trench A. While unearthing north of salt blocks S9, S10 and S11 (**fig. 2**), a skull with some remains of skin and hair was partly excavated. The head of the corpse was above the soil, the rest of the body was covered with debris. A large block with traces of picks on the surface (S11), perhaps part of the ancient ceiling, was lying on the corpse. It was necessary to cautiously remove the big block to recover the body. The way the



corpse was laying indicates that this Salt Man was killed during a massive mine accident also. After falling over block S10, Salt Man 5 was buried under the debris coming down from the ceiling. Except for the head which was at the edge of salt block S10, all other parts of the body were crushed. The corpse was bent over a massive salt block facing downwards. The multiply fractured left arm is turned backwards. The right arm, bent at the elbow, is next to the head and block S9. Both legs were lying completely smashed on the right side of the body. The fall of the block on the back of the corpse and the pressure caused by debris, multiply crushed his spinal column. As a result the upper and lower part of the body had been severed. The tip of his tongue projects between his teeth. The remaining hair on his skull is brown. Unlike Salt Man 4, most of the soft tissues decayed. It only remained in small areas on the arms, legs, face, chest, and pelvis. The body was largely spoiled due to the conditions of its environment, most likely caused by penetration of water from upper sections of the mine. His clothes had rotted away almost completely. The only remaining pieces of clothing are brown fragments of a textile on his pelvis and chest. The Salt Man's clothing probably had been bitten to pieces by animals, perhaps small rodents, indicated by textile fragments and rodents' faeces in the vicinity of the body. Until now, no anthropological studies have been carried out on the corpse; the form of the pelvis could indicate that the dead person was of male sex. Right beside the corpse we found a naturally mummified bat, suggesting that when the mine was exploited, there had been a closed gallery system. The bat could also indicate accessibility to some areas after the collapse. Along with Salt Man 5 we discovered a lamp, two pieces of wood, a big horn, and fragments of fabric ropes.

### Salt Man 6

The head of Salt Man 6 (fig. 9) was discovered during the first excavation season of the current project in 2010. Its stratigraphical position suggests that it was deposited during the Sassanian period from an original position somewhere in the younger mining area (see above); from this body only spoiled remnants could be found, basically a cranium without a mandible and a larger fragment of a pelvic bone. According to the stratigraphic and taphonomic observations we cannot be sure that both parts had originally belonged to one body. After the first investigations by F. Rühli the skull and the pelvic bone may derive from a young male person. The cranium clearly shows multiple fractures. The investigations of aDNA preservation have already been started; minor tissue remnants such as a trigeminal nerve and a temporal muscle could be harvested during the excavation.



**Fig. 8** Douzlākh, Chehrābād salt mine (prov. Zanzan/IR). Salt Man 5. – (Photo K. Stange, DBM / Miras Farhangi).



**Fig. 9** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Skull of Salt Man 6. – (Photo A. Abar / Miras Farhangi).

## CONCLUSIONS

### The dating of the Salt Men

Altogether, 25 AMS  $^{14}\text{C}$  datings have been performed in the laboratories of Oxford and Zurich. The results show dates of Late Achaemenid, and Late Arsacid period up to the Late Sassanian period (figs 10-11).

Recent datings of properly stratified samples provided more detailed information, and basically confirmed the dating of two mining phases to which the collapses and also the casualties belong to; as we have not investigated a large portion of the Achaemenid mine yet especially the beginning of the mining activities remains an open question.

The series of datings that had been made after the first excavation season in 2010 also included datable materials of Salt Men 2, 3, 5 and 6; as the dating

was carried out by a single laboratory, so no biases according to the dating methods need to be considered: the dating of mining phases and of the Salt Men fits well together and is consistent with results gained in Oxford laboratories (Pollard et al. 2008). The Achaemenid period up to the large-scale catastrophe can be narrowed down by Bayesian modelling to a calibrated time span between 429/397 and 396/359 BC ( $2\sigma$ ).

Some items dating back to recent centuries were found in the upper layers of Trench D and Gallery 1. These galleries are on a higher level than our excavation trenches and may belong to a sporadically reopening of the old mine galleries. Gallery 1 was partly unearthed in 2004 and makes clear that parts of the older compressed mining waste had been extracted in a later period. The items may either advocate for a reuse during the Early Arsacid period and/or for a recent reopening, probably 40 years ago<sup>6</sup>. Another indication came from Gallery 3 east of Trench A. No excavations have been carried out inside so far; but some parts of it, cut by bulldozers, contain cultural materials of recent periods. Some parts of the mine had probably been used as stables or loading area for animals. A mice nest found in the vertical shaft area at the eastern fringe of Trench A proves on the other hand that parts of the mine were still open during the Arsacid period, when Salt Man 1 came to death. Other evidence could be put in a similar context: a fragment of glazed pottery which belongs to 11<sup>th</sup> or 12<sup>th</sup> century AD was found during the first season of excavation in Trench B. Considering the evidences that prove penetration of water from upper layers into Trench B it is also possible that this potsherd has been washed in from higher layers. Hence, there are residential sites of Early and Mid-Islamic period around the mine; it seems that the people of the region knew about the mine at that time. Salt extraction was probably in action in Mid-Islamic period in other parts of the mine.

Only a few pottery sherds dating to Late Arsacid and Sassanian period were discovered. Though, some of the dated items belong to Sassanian period. Probably, they have been damaged and destroyed by bulldozing activities. According to  $^{14}\text{C}$  dating results, Salt Men 2 and 6 and further related objects belong to the Late Sassanian period. Recent excavations, however, prove that the upper parts of the Achaemenid mining hall were certainly exploited during this time span. But there are still questions, e.g. a fabric found

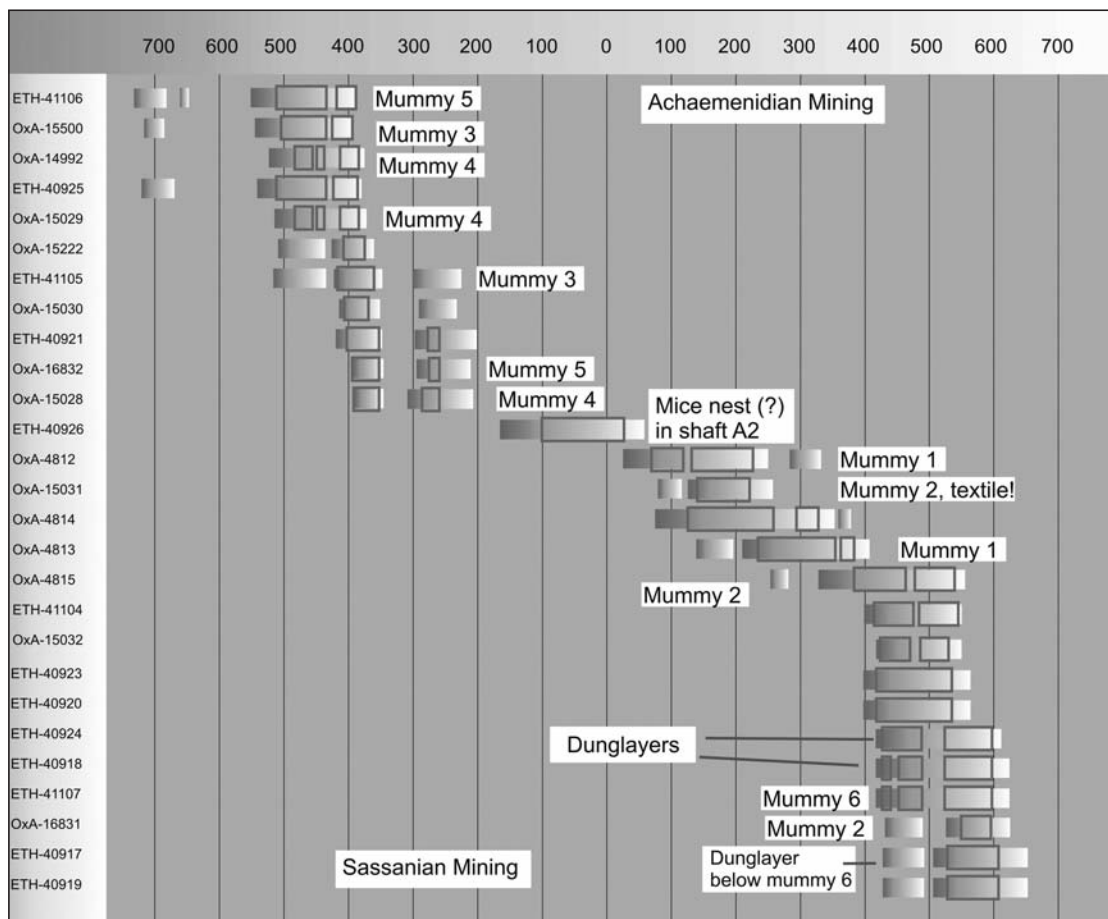


Fig. 10 <sup>14</sup>C data from Douziākh, Chehrābād salt mine (prov. Zanjan/IR). – (Illustration A. Abar).

alongside with Salt Man 2, which was dated between Late Arsacid and Early Sassanian period. If it really must be counted one complex can be question marked. This date might be related to the date when Salt Man 1 died. Unfortunately, the relocation by bulldozers makes it impossible to determine the *in situ* location of Salt Man 2. Hence, it is not known where and how this Salt Man was killed. <sup>14</sup>C analyses indicate an Achaemenid date for Salt Men 3, 4 and 5.

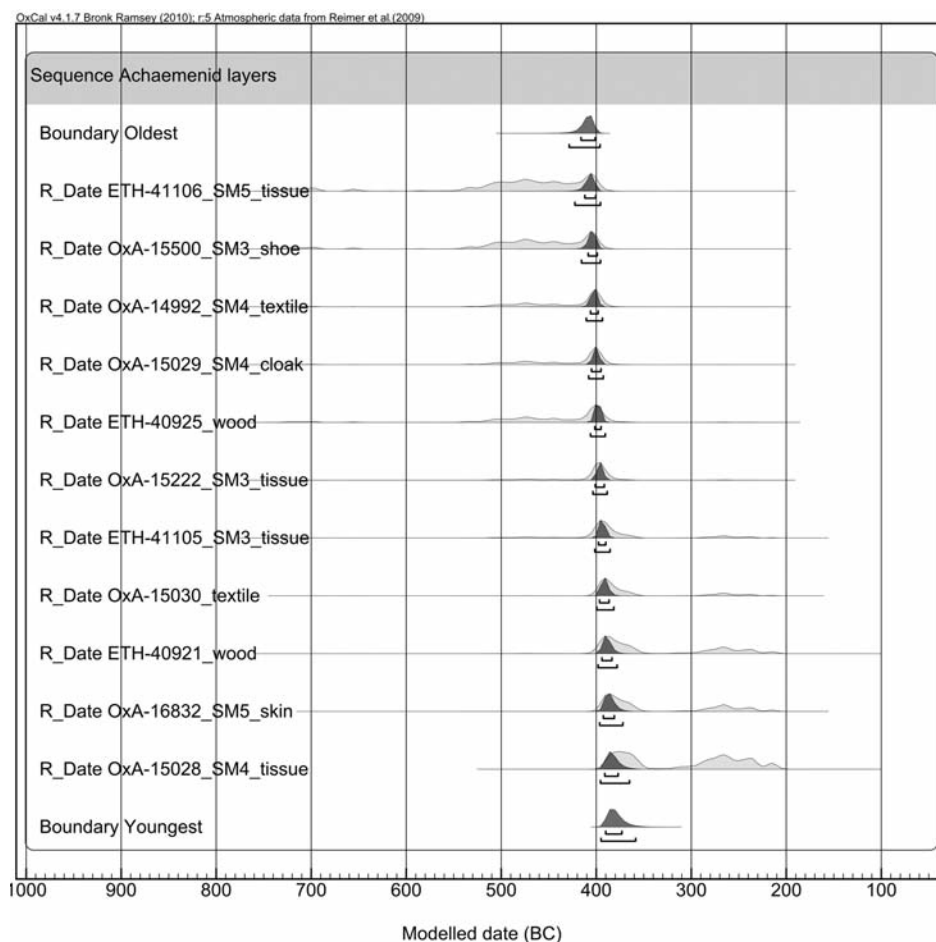
The number of the people who had been killed in the mine, along with Salt Man 2, is not known. During the excavations we found some human bones, scattered over the site, which did not belong to the bodies known so far. Surely, other individuals must have got killed in the mine at the same time, whose bodies have probably been crushed and destroyed by bulldozing or redumping processes during younger mining phases.

### Observations about the mining technique and the collapses in the mine

Generally, we can suggest that the excavated parts of the mine, considering the pottery, have been discovered and exploited from around mid-first millennium BC. This area, which was covered with soil and large clay boulders of 30-40 m height before debris removal, contains very rich salt deposits.

What can be said at the moment in concern of the technique of rock salt extraction is basically related to the Achaemenid mining. The miners' method to approach salt layers had been digging horizontal, and probably also vertical galleries into the mountain. After reaching salt deposits they extracted the salt by





**Fig. 11** Douzlākh, Chehrābād salt mine (prov. Zanjan/IR). Bayesian modelling of  $^{14}\text{C}$  dates from Achaemenid layers in Trenches A and B. – (Illustration Th. Stöllner).

using tools such as picks, adzes and chisels, as is indicated by the numerous marks and impressions on walls and collapsed blocks. Adzes may also have been used for wood working.

At the moment, the general layout of the so far excavated parts of the mine indicates a chamber-pillar mining. Hitherto, it is unclear, if salt was extracted as small salt pieces or as bigger rock salt lumps; if larger blocks have been exported directly or if they were grinded to salt grain nearby the mine is unknown. An Achaemenid leather bag used for transportation, found during the previous excavations, may back up the first suggestion: the bag was filled with small crystals of high quality salt, thus indicating that smaller rock salt pieces were also produced and taken out of the galleries in leather bags. Despite the leather bag further haulage devices such as ropes can be seen as evidence for vertical transport systems, perhaps together with winches. The question remains, if the whole transport rested on manpower; some indications might be hinting into another direction. Donkeys may have played a role for transportation especially during the Sassanid period; spoils of this period contain dung indicating areas which once might have been used as stables. Other parts of the galleries might have been utilized as temporary accommodations for the miners. Unknown aspects are the operations of salt processing (such as grinding and sorting) outside the mine. During their underground work miners used lamps of which a representative amount of examples has been found. Ropes were probably utilized not only to pull out the salt bags but also to avoid getting lost<sup>7</sup>. Despite such preliminary comments observations can be added according the remaining parts of the mine and its rock faces. While the southern wall in the main chamber clearly shows traces of iron picks the south-western oriented Gallery 2 allows the observation of a distinctly visible drift face. Therefore, it can be

explained as an opening gallery that was driven forward parallel to the already existing mining hall in the north. We could not find a bottom, and consequently presume that the salt rock was first mined by bottom-stage mining that was later extended laterally.

Furthermore, there are no traces of wooden timbering in the excavated areas so far. The extensions of the mining hall might have been a reason for collapses: the chamber-pillar mining certainly ended up in a general weakening of the ceiling. This was especially dangerous in the tectonically fractured and stressed rock salt layers in Chehrābād. It seems likely that miners overestimated the carrying capacity of the large ceilings. Have there been also initial impacts by earthquakes which frequently happen in this region (the Teheran-Qazwin fault zone)? The first time was about 2300 years ago when a great portion of the galleries collapsed and Salt Men 3, 4 and 5 died in the mine. Several centuries after their death, other disasters occurred in the salt mine and Salt Men 1, 2 and 6 died. More excavations have to be conducted to determine how and where salt extraction activities took place during the different periods and whether similar disasters had happened. Local inhabitants have witnessed two other incidents during the past 100 years. The first incident which led to the death of seven people from Chehrābād happened about 100 years ago, a second occurred in 1960s and caused the collapse of many galleries in Chehrābād salt mine.

### Future perspectives

Despite the research carried out in 1994-1995, following the discovery of Salt Man 1 at Chehrābād, Douzlākh salt mine, the information on this important site and its finds had not been studied to a satisfactory degree. Dating remained doubtful until closer analyses at the Research Center for Conservation of Cultural Relics, as well as <sup>14</sup>C dating indicated an age of 1700 years for the first Salt Man. Work concentrated on the human remains, while the mine itself was not scientifically studied, resulting in obviously misleading interpretations about the salt mine and the Salt Men.

The four archaeological excavations recently carried out led to valuable discoveries, providing the international team with a large amount of information. The work conducted thus far has just touched upon the surface of the archaeological remains. We intend to continue the excavation of the large collapsed mining hall within the frame of the joint Iranian-European project, involving partners from Germany, Britain, Austria and France. The work will include a detailed examination of artefact groups in the frame of specialized investigations, e. g. tools, leather and skins objects, fabrics/textiles; restoring selected materials also. The continuation of the palaeobotanical studies on nourishment, and the logistics as well as the supply of the miners are of ample importance for an understanding of the related economies in a larger context.

### Notes

- 1) Apart from the authors of this article the following scientists take part in the current project: N. Boenke, M.A. (Bochum), Prof. em. Dr. D. Brothwell (York), Dr. I. Good (Oxford), Prof. Dr. R. Herd (Cottbus), Dr. M. Mashkour (Paris), Ass.-Prof. Dr. G. Mowlawi (Teheran), M. Nezamabadi (Teheran, Besançon), Prof. Dr. M. Pollard (Oxford), S. Saeedi (Zanjan), Dipl.-Ing. G. Steffens (Bochum), Ass.-Prof. Dr. H. Vahdati Nasab (Teheran, Oxford). – For their support we would like to thank Miras Farhangi Iran (Indian Council of Agricultural Research [ICAR] and Zanjan branch, Dr. M. Mireskanderi and Mr. Y. Naghizadeh) as well as the DFG Bonn, especially Dr. H.-D. Bienert, for their financial and organizational support. In Teheran the Deutsches Archäologisches Institut (DAI) helped as in many ways, especially we thank Mrs. M. Hakimpour.
- 2) Report of the Industry and Mine Organization of Zanjan province, 1995: 1 and 2.
- 3) For more information see »Salt Man«, scientific studies on mummy remains and discovered objects from Zanjan: Vatan-doust 1998, 1-24.
- 4) Recently, the results of the aDNA study had been questioned, either as the extraction of DNA did produce a quite complete DNA string that normally would not be expected from aDNA results. Most likely, it is a result of DNA contamination, causing the accordance. Recent AMS dating also indicated a slightly different age of the leg and the head (Pollard et al. 2008).

5) We used spades and sometimes sieves. The search led to the discovery of many objects from the surface soil of the site including 66 pieces of fiber rope, 15 small pieces of pelt and 2 fragments of leather, 16 differently woven ropes, some animals' excrements and several feathers. And the discovered human remains include a piece of humerus, two fragments of the lower arm bone, some part of scapula, and half of a lower jaw with the teeth on it. Some of the bones probably belong to

Salt Man 2, which have been scattered around during the bulldozing activities. But some of the bones, e. g. a mandible, cannot belong to Salt Man 2.

6) According to old miners records a collapse filled and blocked many galleries in 1963.

7) There is a piece of fiber rope, fastened to the belt of Salt Man 4.

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## Zusammenfassung / Abstract / Résumé

### Die Salzmänner aus Iran: das Salzbergwerk von Douzlākh, Chehrābād

Die vorläufigen Ergebnisse der Grabungen aus den Jahren 2004, 2005 und 2010 deuten darauf hin, dass das Salzbergwerk von Douzlākh während der späten Eisenzeit/achämenidischen Zeit eine intensive Nutzung erfuhr. Ob während der arsakidischen Zeit ein Abbau stattfand, ist bislang nicht hinreichend geklärt. Wie <sup>14</sup>C-Analysen zeigen, wurde das Bergwerk in sassanidischer Zeit wieder aufgeföhren und eventuell bis in die frühislamische Zeit hinein genutzt. Der Abbau scheint den Befunden nach als Pfeiler-Kammer-Bau stattgefunden zu haben, der ohne jeglichen Holzbausbau unternommen wurde, obwohl die mumifizierten Leichen von Bergleuten und der sie umgebende Kontext beredtes Zeugnis von der Instabilität der Grube ablegen. Die ersten beiden Kampagnen wurden von der iranischen Kulturerbebehörde/Miras Farhangi unter der Leitung von Abolfazl Aali durchgeführt. Im Jahr 2010 wurde das Projekt auf eine internationale Basis gestellt, in dem nun Forschungseinrichtungen aus dem Iran, aus Deutschland, Frankreich, Großbritannien und aus der Schweiz gemeinsam an der wissenschaftlichen Untersuchung des Bergwerks arbeiten.

### The Salt Men of Iran: the salt mine of Douzlākh, Chehrābād

During 2004, 2005, and 2010 scientific excavations took place at the salt mine of Chehrābād. According to the work conducted and further scientific investigations, the beginning of salt exploitation dates to the mid-first millennium BC. Some indications possibly hint to mining activities during the Late Arsaacid period. Salt extraction certainly was taken up again during the Sassanian period and might have continued up to the Early Islamic period. The extraction was carried out as a chamber-pillar mining; no wooden props have been found so far, although the mummified bodies of mine workers and the context bear ample witness of instabilities and mining catastrophes. The first two campaigns were conducted by the Iranian Cultural Heritage Organization/Miras Farhangi under the auspices of Abolfazl Aali. The excavation in 2010 laid the basis for the establishment of a multinational group of scientists, comprising research facilities in Iran, Germany, Great Britain, France, and Switzerland.



### **Les Hommes du Sel en Iran: la mine de sel de Douzlākh, Chehrābād**

Les premiers résultats des fouilles entreprises en 2004, 2005 et 2010 sur le gisement de sel de Douzlākh semblent indiquer que la mine de sel a fait l'objet d'une exploitation intense à la fin de l'âge du Fer/période achéménide. Les périodes postérieures, séleucides et arsacides sont en revanche plus difficiles à établir. Des analyses <sup>14</sup>C montrent que l'exploitation du sel a repris durant la période sassanide, probablement jusqu'au début de la période musulmane. L'extraction se faisait par un système des piliers et des chambres, sans renforcement des parois en bois, alors que les corps momifiés d'ouvriers de la mine mis au jour lors des fouilles attestent bien de l'instabilité de l'extraction. Les deux premières campagnes se sont déroulées sous la direction de Abolfazl Aali du service de la culture iranienne/Miras Farhangi. En 2010 le projet a été reformulé sur des bases internationales, associant des chercheurs iraniens, allemands, françaises, britanniques et suisses à l'étude de ces mines. L. B.

#### *Schlüsselwörter / Keywords / Mots clés*

Iran / Eisenzeit / Salzbergwerk / Mumie / Leiche

Iran / Iron Age / salt mine / mummy / corpse

Iran / âge du Fer / mine de sel / momie / corps

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Bei Verwendung von Euro-Standardüberweisungen mit IBAN- und BIC-Nummer entfallen unsere Bankgebühren (IBAN: DE 08 5519 0000 0020 9860 14; BIC: MVBM DE 55), ebenso wenn Sie von Ihrem Postgirokonto überweisen oder durch internationale Postanweisung zahlen.

Das Römisch-Germanische Zentralmuseum ist nicht umsatzsteuerpflichtig und berechnet daher keine Mehrwertsteuer.

If you use the European standard money transfer with IBAN- and BIC-numbers there are no bank charges from our part (IBAN: DE 08 5519 0000 0020 9860 14; BIC: MVBM DE 55). This is also the case if you transfer the money from a post office current account or with an international post office money order.

The Römisch-Germanische Zentralmuseum does not pay sales tax and therefore does not charge VAT (value added tax).

L'utilisation de virement SWIFT avec le numéro IBAN et SWIFT supprime nos frais bancaires (IBAN:

DE 08 5519 0000 0020 9860 14; SWIFT: MVBM DE 55); ils peuvent aussi être déduits en cas de règlement postal sur notre CCP (compte courant postal) ou par mandat postal international.

Le Römisch-Germanische Zentralmuseum n'est pas imposable à la taxe sur le chiffre d'affaires et ne facture aucune TVA (taxe à la valeur ajoutée).

Senden Sie diese Abo-Bestellung bitte per Fax an: 0049 (0) 61 31 / 91 24-199

oder per Post an:

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Archäologisches Korrespondenzblatt, Ernst-Ludwig-Platz 2, 55116 Mainz, Deutschland