FROM SALAMANDER TO THE ROBE OF THE FIRE RAT. AN OUTLINE HISTORY OF THE ASBESTOS FROM PREHISTORY TO THE MIDDLE AGES

Bartłomiej Szymon SZMONIEWSKI[*]

Cuvinte-cheie: *azbest, ceramică cu azbest, textile cu azbest, istoria azbestului.*
Keywords: *asbestos, asbestos pottery, asbestos textile, history of asbestos.*

Rezumat: *Azbestul a fost folosit la fabricarea ceramicii într-o zonă mare a Eurasiei, din Scandinavia, Corsica până în Peninsula Coreeană și Arhipelagul Japonez. Cele mai timpurii urme ale utilizării azbestului ca degresant pentru ceramică datează din perioada neolitică și în unele zone această tradiție a supraviețuit până în Evul Mediu. Vechii greci și romani foloseau azbest în pânzele, giulgiurile și fitilele de lumânare. Cu toate acestea, cele mai multe descoperiri arheologice de azbest provin din context funerar, sub formă de haine de incinerare, saci sau cearșafuri. Situație similară în care textilele cu azbest sunt plasate în înmormântări antice se observă în Asia de Sud-Est. În China Antică, cârpa de azbest huo huan pu (pânză curățată în foc) era asociată cu producția de textile Da Qin (Imperiul Roman). Originea fibrelor de azbest, în tradiția occidentală din Evul Mediu timpuriu, a fost identificată cu salamandra sau lâna pământului lui Avraam. Astfel, în Est, originea lor a fost mai complexă. Au fost precizate trei propuneri de proveniență diferite: a) - din florile arborilor inflamabili, b) - din scoarța arborilor menționați și c) din părul lung al anumitor rozătoare albe care au intrat în foc fără să se ardă. Părul putea fi smuls și țesut. Evident, azbestul a avut un succes uriaș în vest și est din perioada neolitică până în trecutul recent, în primul rând, datorită proprietăților magice, în al doilea rând, datorită efectului ignifug.*

Abstract: *Asbestos was used in making pottery in a large area of Eurasia, from Scandinavia, Corsica to the Korean Peninsula and the Japanese Archipelago as well. The earliest traces of using asbestos as pottery temper is dated back to the Neolithic period and in some areas this tradition survived up to the Middle Ages. The ancient Greeks and Romans used asbestos in their cloth, shrouds, candlewicks. However, most archaeological asbestos finds come from funeral context as a cremation robes, sacks or sheets. Analogous situation putting the asbestos textiles in ancient burials is observed in Southeast Asia. In*

[*] Bartłomiej Szymon SZMONIEWSKI: Centre for Archaeology of Hills and Uplands of Institute of Archaeology, Polish Academy of Sciences, Cracow. bartheque@yahoo.fr

the Ancient China asbestos cloth huo huan pu (cloth cleaned in fire) were associated with the Da Qin (Roman Empire) textile production. The origin of the asbestos fibers, in Western tradition from Early Medieval times identified with salamander or wool of Abraham land. Thus, in East their origin was more complex. Three different provenances proposals have been specified: a) - from the flowers of inflammable trees, b) - from the bark of the said trees and c) from the long hair of certain white rodents which went into the fire without burning. The hair could be plucked and woven. Evidently, the asbestos had a huge success in West and East since Neolithic period until recent past, firstly, due to magic proprieties, secondly, due to fire-retardant effect.

1. Introduction

The (chemical) term asbestos refers to certain mineral fibres, or minerals of fibrous structure, first and foremost to silicates which include mainly serpentine asbestos (chrysotile) and amphibole asbestos (amosite, riebeckite asbestos/crocidolite, anthophyllite asbestos, tremolite asbestos, actinolite asbestos).[1] This group of minerals also includes other types of silicates or non-silicates, including which, however, to this discussion, would exceed the frames of this article because they have hardly been used by humans. As a thinning ingredient in pottery mass, especially in Finland, anthophyllite, actinolite and chrysotile[2] were used, the choice of the above minerals according to a geographical and geological region. The range of mineral raw materials, shredded, flaked, or otherwise prepared for further processing, show a wide variety regarding the length of fibres as well as their colors. Long fibres and light brown color are characteristic for anthophyllite asbestos. Actinolite asbestos, on the other hand, is featured with long powder-like fibres of a green color. Chrysotile asbestos reminds with its structure of the cotton texture and was used for spinning.[3]

2. The beginning of asbestos usage and asbestos containing pottery.

Asbestos as a thinning ingredient in pottery was used in four regions which are quite remote from one another: North Europe (Fennoscandia), Corsica, Korean Peninsula with Japan, and East Africa.

The earliest signs of using asbestos as a temper was characteristic for Comb Ceramic culture, also called Pit-Comb Ware culture. The oldest traces of using mineral fibres as a temper in wheel-thrown vessel types come from today's East Finland and are dated in about 4500 calBC – second half of Early Neolithic Period. The asbestos implementation in pottery production is regarded as a proof of a local innovation in exploring local deposits of anthophyllite in the area of the lake Saimaa. It is also there that the most products of this kind are being found. This phenomenon is called *the early asbestos ceramics* which in its early phase includes two types (from about 4500 calBC - type Sperring 2 and 4300 calBC -type Kaunissari). Principally, apart from the same ingredient applied, these two types

[1] LEVANTO & HORNYTZKYJ 1995, p. 72; ROGGLI & COIN 2004, p. 1-16.
[2] LEVANTO & HORNYTZKYJ 1995, p. 73; DAMM 2012, p. 56.
[3] CAMERON 2000, p. 47; BROWNE 2003, Fig.1

differ in form.[4] During the Early Middle Neolithic, the habit of using asbestos in ceramics decreases, in its course, however, the local tradition of adding asbestos continues, and in some regions this inclusion becomes the dominant tempering element after 3600 calBC (Kierikki Ware in Finland and Voynavolok in Karelia)[5]. As next, Pöljä and Jysmä wares (3100-1900 BC)[6] become another characteristic examples of asbestos implementation.

In the transition period from the Stone Age to the Early Chalcolithic Period (i.e. about 3000 calBC), this habit spreads north and east: Finish Lapland, adjacent areas of Norway and Russia, Karelia, Lapland, Norwegian Finnmark, Kola Peninsula[7]. On these areas, three kinds of asbestos were implanted: anthophyllite, actinolite and chrysotile, yet anthophyllite was used in most cases.[8] In Finland, asbestos as a thinning substance was in use as late as third and fourth centuries AD. The fibres were also used in construction for chinking spaces and gaps between wooden planks in house building, as it proved to be an excellent insulating material.[9] In Norway, asbestos pottery from the Early Bronze Age to the pre-Roman Iron Age (ca. 1700-400 BC) is divided into Arctic and Nordic groups.[10] In the Roman Iron Age and during the Great Migration, ceramics where asbestos had been implemented was wheel-thrown as small fine vessels with rich and diversified surface decoration, called bucket-shaped vessels. Most of the vessels known from Norway have asbestos as the dominant temper; to a lesser degree, also soapstone, talcum, or steatite were implemented.[11] In Sweden, asbestos was also used in the same times, not so often as in Norway perhaps, but sites where vessels with asbestos were found concentrate in the region of Norrland, in the north of Sweden.[12] A possible relation between the earlier tradition of implementing asbestos in ceramic production in the region of Fennoscandia, with the younger bucket-shaped vessel production 'are not thoroughly investigated'.

A second region of asbestos implementation for tempering of the ceramic was the Far East. The addition of this mineral has been traced in vessels of the Chulmun type (ceramics decorated with geometrical patterns or comb-patterned design) from the so-called Korean Neolithic lasting from[13] 6000 to 2000/1500 BC. The spread of asbestos ceramics is limited to the so-called Western Group of Chulmun ceramics characterized, next to its implementation of asbestos, also by using mica and steatite as tempering substances.[14] Asbestos implementation as a ceramic temper has been also documented on one of isles of the Japanese

[4] NORDQVIST & MÖKKÖNEN 2017, p. 81.

[5] NORDQVIST & MÖKKÖNEN 2017, p. 81, 83, Fig. 3h, g, Map. 1b; MÖKKÖNEN & NORDQVIST 2017.

[6] PESONEM & LESKINEM 2009, p. 311.

[7] DAMM 2012, Fig. 1; KULKOVA *et alii* 2012, p. 1049–1063; GERASIMOV *et alii* 2019.

[8] DAMM 2012, p. 55.

[9] BOZSAKY 2010, p. 51.

[10] HOP 2016.

[11] ENGEVIK 2008; ERIKSSON & LINDHAL 2018, p. 53.

[12] ERIKSSON & LINDAHL 2018, p. 53.

[13] IM 1996, p. 6-7.

[14] KIM 1962, p. 43.

Archipelago – Kyushu, in the pottery of Sobata type, which is considered to be some evidence of contacts between the Korean Peninsula and Japan in the Early Jomon Period (about 3000 BC). Similarities as regards to the forms as well as to asbestos and talcum inclusion to pottery clay mass points out directly and unambiguously to some Korean prototypes. In later periods, there was a slight influence of the Korean pottery on the Jomon culture which was otherwise developing quite independently.[15]

When it comes to the similarities in asbestos implementation in the Comb Ceramic culture, also termed *Pit-Comb Ware culture*, it is assumed that for the spread of this particular type, a technology factor was responsible, and that it was only 'a technological designation without cultural meaning'.[16] Asbestos was used to throw vessels with the function of cooking meals in them and undoubtedly had its advantage of being resistant against a possible thermal shock as the addition of as small amount as 5% already increased a vessel's resistance against its cracking caused by fire.[17]

It is worth at this place to return to the first of the presented regions where asbestos pottery has been documented, namely to Northern Europe, and especially its southern periphery within north-western Russia. It is just there where such ceramics were found in the utmost south-western region from the times of Late neolithic. In this territory, there are no deposits of asbestos, so it must have been imported as raw material from more distant locations, such as Finland. Because of this, ceramics containing asbestos had a non-pragmatic significance. Due to the scarcity of this resource, the pottery must have been highly valued, perhaps it presented an object of prestige. The tradition of producing such vessels was to be transmitted generation to generation as a heritage of the ancestors.[18]

The third region where asbestos-containing pottery was found is Corsica. Azbest in pulverized or fibrous form was added to local types of clay. To this purpose, presumably, deposits localized in the northeastern part of the island were explored. The first distinguished period of the exploration is dated in middle Iron age (second age du fer) (ca. 450 BC – to the turn of the eras) and High Roman Empire (alto-imperiale [31 BC-284 AD]).[19] In this time, the occurrence of vessels with asbestos as a compound is not limited to the northern Corsica – such containers are discovered on the Elba Island and in Etruria, and they are imports from this island. According to Kewin Peche-Quilichini, it is hardly justifiable in this case to speak about the export of asbestos as a resource, but rather it we should define it as trade with ready products made of clay with asbestos as admixture.[20] The second period began, following an extremely long time gap, in the 14th century as a new phenomenon which persisted in an almost unchanged form until the year 1930 when last potters on the island died out. The feature that

[15] OKAZAKI 1993, p. 270.
[16] ZWELEBIL 1981, p. 57.
[17] KELLY 1975, p. 476.
[18] KHOLKINA *et alii* 2020a & KHOLKINA *et alii* 2020b.
[19] PECHE-QUILICHINI 2018, p. 21.
[20] PECHE-QUILICHINI 2018, p. 27, Fig. 15 & 16.

distinguishes this kind of pottery from the kind imported from Tuscany and Liguria at the end of the Middle Ages is the type of potters' clay, as well as the repetition of the forms of vessels. On the other hand, simultaneously with the renewed discovery of asbestos, there appeared a new form of a vessel, the so called *la marmite à anse de panier*, or the caldron with basket handle, and it was used mainly for cooking dishes. Such a cauldron was set directly on a flame. Therefore, applying asbestos meant facilitation of vessel production; forms were produced which were large and light at the same time, with thin walls. They were not only fire-proof but also water-proof. According to Daniel Istra, it was a household production type organized within the family circle, seasonal work, *ne requiert qu'un faible investissement*.[21] Specialistic research of the 19th century's fragments supported the thesis of using chrysolite (white asbestos) and crocidolite (blue asbestos) which indicates 'that a selection of the best quality available has been made by the potter to optimize the mechanical behavior of the cooking wares. '[22]

The fourth area where asbestos was used as a thinning ingredient in ceramic production (documented as late as twentieth century) were regions of East Africa inhabited by Plains Nilotic tribes. Regarding the origins of these Nilotic tribes, they seem to have been a mixture of various populations inhabiting a section of the Nile valley which belongs to Sudan, those settled around Turkana Lake, and in the Horn of Africa. They migrated to Uganda, Kenya, Tanzania in the time between 1000 BC and 1400 AD and built up there a significant political power in the second millennium AD.[23] The inclusions of asbestos fibres (amphibolitic asbestos) in cooking pots have been documented for Karismojong, Turkana, and Pokot tribes. A similar practice has been observed among the tribe of Didinga, also belonging to Plain Nilots inhabiting Southern Sudan, which is quite extraordinary because this region is considered to be the starting point in their migration south; it might well be that the tradition of using asbestos as well as talcum has originated just there. Most interesting seems to be the reason for which people of Karimonjong use this mineral in ceramics, according to Wilson, is *that they have traditionally incorporated asbestos in their cooking pots as it lengthens the life of the article, seemingly reduced the incidence of cracking on repeated domestic use*.[24]

3. Asbestos viewed in Western World and beyond. From Antiquity to the Middle Ages.

In ancient Greece, the very first and indisputable mention of asbestos and its features is to be found in the work of the geographer Strabo (64 BC–21 AD) in *The Geography*, Book 10, written in the first century BC:

In Carystus is produced also the stone which is combed and woven, so that the woven material is made into towels, and, when these are soiled, they are thrown into fire and cleansed, just as linens are cleansed by washing.[25]

[21] ISTRIA 2007, p. 42- 44.
[22] COLOMBAN & KREMENOVIĆ 2020, p. 9.
[23] OLIVER & ATMORE 2001, p. 135; *Encyclopedia* 2009, p. 500.
[24] WILSON 1970, p. 81-82; WILSON 1973, p. 300-302.
[25] STRABO ed. 1928, p. 11.

The Karystos stone (*lithos Karystos*) is one of the first name given to asbestos, it was mined from the quarries located in the neighborhood of Strabo's Karystos (Karistos), in the southern part of the island Euboea (Evvia).[26] It is worth mentioning that Solinus and Plutrach also inform us about fiber coming from that location.[27] We do not know, however, how vast these asbestos deposits were, and when they had been used up completely yet it is assumed that this is just the location where, most probably, chrysotile 'known to the ancients as 'Karystian stone', may have been quarried within ophiolite terrane' during the Antiquity.[28] In a later time, basically until the Early Byzantine Period *Karystia lithos* or *Cipollino* of *Karystos*, were the terms used for a special type of marble, the so-called onion marble, which was mined around Karystos as well as Styra.[29] Thus, it can be assumed indirectly that these asbestos deposits were used up completely already in the Antiquity.

When discussing some oldest mentions referring to asbestos, one cannot possibly omit Theophrastus (c. 371 BC – c. 287 BC) and his work *On Stones*, where he wrote:

[...] one was once found which was like rotten wood in appearance. Whenever oil was poured on it, it burnt, but when the oil had been used up, the stone stopped burning, as if it were itself unaflected.[30]

Some researchers interpret this information as the first description of asbestos. In the light of some more recent findings, the stone described there is interpreted as a mineral resembling asbestos and called *palygorskite* or *mountain leather*.[31] The most informative writer on this subject, however, turned to be Pliny the Elder (23/24 – 79 AD) in his *Naturalis Historia*, where asbestos is mentioned under the term *amiantus* or 'live' *linen*.[32] I would like to focus on a fragment from the book 19, chapter 4, containing information which could be verified archeologically. This information refers to textiles woven of asbestos fibres which are fire-resistant; moreover, they become completely white and clean in fire about implementing the material for regal shrouds; about its originating from India, and about the etymology of its Greek term:

Also a linen has now been invented that is incombustible. It is called 'live' *linen, and I have seen napkins made of it glowing on the hearth at banquets and burnt more brilliantly clean by the fire than they could be by being washed in water. This linen is used for making shrouds for royalty which keep the ashes of the corpse separate from the rest of the pyre. The plant grows in the deserts and sun-scorched regions of India where no rain falls, the haunts of deadly snakes, and it is habituated to living in burning heat; it is rarely found, and is difficult to weave into cloth because of its shortness; its colour is normally red but turns white by the action of fire. When any of it is found, it rivals the prices of exceptionally fine pearls. The Greek name for it is asbestinon, derived from its peculiar property. Anaxilaus states that if this linen is wrapped round a tree it can be*

[26] EVANS 1906, p. 143-148.
[27] BOWLES 1955, p. 9.
[28] ROSS & NOLAN 2003, p. 449.
[29] SUTHERLAND & SUTHERLAND 2002, p. 251-259.
[30] THEOPHRASTUS ed. 1956, p. 88.
[31] MAINES 2005, p. 25.
[32] MAINES 2005, p. 26-27.

felled without the blows being heard. Consequently this kind of linen holds the highest rank in the whole of the world.[33]

A mention of asbestos which is most fruitful for an archeologist seems to be this about using asbestos-woven shrouds in funeral rites. There are some archeological findings which point to the existence of a blanket between the corpse to be cremated and the funeral pyre prepared for the cremation. The evidence pointing to it may be the urns containing cleanly burnt bones deposited directly in the vessel as ossilegium, without any trace of contact with the rests of the pyre. Clean bones differ from remnants of the corpse burnt directly in the pyre as the latter ones which are mixed with gray ashes and some mites of carbonized wood. Such differences could be observed at burials of Etruscans, neighbors of Romans.[34] Yet the direct material evidence constitute some findings of textiles (asbestos clothes) found in Apennine Peninsula, dated on the Roman Period and documented since seventeenth century. Such artifacts were found in Pozzuolli in the Napoli province and in Vasto in the province of Chieti. In the town museum of Aquilea, there is a network made in asbestos. However, most numerous finds come from Rome, for example from Porta Maggiore; yet the most interesting findings are those with the funeral context like those excavated along Via Appia or Via Triumphalis.[35] It should be stressed here that at Via Triumphalis' site, three or four textiles woven of asbestos were found, among which, one most certainly found in a grave.[36]

Without getting into specific discussions on each mention in the Antique literature and concerning asbestos, we are focusing on two of them which are most informative. The first one by Pedanius Dioscorides (c. 40– 90 AD), a Greek medic, botanist, and pharmacologist who in his work, *De materia medica*, in the section *On metallic stones*, V, 156, writes:

Amiantus stone is found in Cyprus. It is like alumenscissile which the workmen make webs of cloth from for a show, because put into the fire they take flame, but come out more bright, not burnt by the fire.[37] *He mentions asbestos for the second time, however, in the context of Calx Viva (Qick lime) the unquenchable stone, in the chapter titled Metallic Stones*.[38]

These antique sources of information on the skills of asbestos mining and this know-how of the craft on Cyprus has been proven by analyses of the 12th century's wall -paintings in Enkleistra of St. Neophytos, a Byzantine monastery, where chrysotile fibres were evidently applied for plaster finish.[39]

The next author worth mentioning is Pausanias (c. 110-180 AD) in his *Description of Greece*, in the first volume concerning *Attica* where he depicts the temple of Athena in Acropolis; in the chapter 26 he mentions a lamp – the work of

[33] PLINY 1950, p. 432-433.
[34] BAKER 2009, p. 235-236.
[35] BIANCHI & BIANCHI 2015, p. 84, fig.1; DI GENNARO *et alii* 2008, p. 64-66, Fig.1.
[36] LIVERANI *et alii* 2010, p. 187.
[37] DIOSCORIDES 2000, p. 822.
[38] DIOSCORIDES 2000, p. 812-813.
[39] KAKOULLI *et alii* 2014.

Callimachus (c. 310/305-c.240 BC) the sculptor; the lamp wick was made of Karpasium linen:

Having filled the lamp with oil, they wait until the same day next year, and the oil is sufficient for the lamp during the interval, although it is alight both day and night. The wick in it is of Carpasian flax, the only kind of flax which is fire-proof, and a bronze palm above the lamp reaches to the roof and draws off the smoke. The Callimachus who made the lamp, although not of the first rank of artists, was yet of unparalleled cleverness, so that he was the first to drill holes through stones, and gave himself the title of Refiner of Art, or perhaps others gave the title and he adopted it as his.[40]

It seems that there was a custom of using asbestos fibres as lamp wicks which may be supported by a description found in Lateran Baptistery in Rome, built in the fourth century AD, in *Liber Pontificalis* which records Constantine's dedication:

In the center of the baptismal font there is a porphyry column topped by a golden basin where a candle is placed. It is of pure gold weighing 52 lb. And at Easter 299 lb. of incense is burned by a stick of compressed asbestos. On the edge of the font there is a gold lamb from which water flows and which weighs 30 lb. And on the right side of the lamb the Savior in purest silver, 5 ft. high weighing 170 lb., on the left of the lamb is Saint John the Baptist in silver, 5 ft. high, holding a scroll with the message, "Behold the Lamb of God-beholden-that which lifts off the sins of the world." It weighs 125 lb. There are seven silver stags from which water flows, each weighing 80 lb. And an incense burner of purest gold with 48 green gems weighing 15lb.[41]

Concluding this presentation of antique mentions referring to asbestos in the context of using the fibres as textiles or, generally, as fire-proof materials (for example lamp wicks), one more example should be noticed, i.e., using asbestos for the curtain in the Temple in Jerusalem. This information appears at the occasion of the description of Maria of Nazareth's youth found in the *Proto-Gospel (Protoevangelium) of James* (written in the late second century), more exactly in chapter 10 titled *Mary Spins of the Curtain in the Temple*:

Then the priests held a council and said, 'We should make a curtain for the Lord's temple.' And the priest said, 'Call to me the undefiled virgins from the tribe of David. ' The servants went out looking for them and found seven virgins. The priest then remembered that the child Mary was from the tribe of David, and that she was undefiled before God. The servants went out and led her back. And they brought her into the Lord's temple. And the priest said, 'Cast lots before me to see who will spin the gold, the asbestos, the fine linen, the silk, the sapphire blue, the scarlet, and the true purple. ' Mary drew the lot for the true purple and the scarlet, and taking them she returned home. At that time Zacharias became silent. Samuel took his place, until Zacharias spoke again. And Mary took the scarlet and began to spin it.[42]

By the end of the Antiquity, two tendencies in describing the origins of asbestos are to be noticed, trends continuing into the Middle Ages. First of them, referring to some earlier findings or opinions, defines asbestos as a mineral- an excellent example could be here a mention in *Civitate Dei* Augustine of Hippo

[40] PAUSANIAS 1918, p. 137.
[41] *Liber Pontificalis* 172–75. Quoted after ROSS HOLLOWAY 2004, p. 76.
[42] EHRMAN & PLEŠE 2014, p. 29.

(354-430 AD). This early medieval philosopher and theologian mentions asbestos several times in the volume XXI: part 5 and 6, in the context of a mineral mined in Arcadia:

There is a stone in Arcadia, and called asbestos because one lit it cannot be put on.[43]

It is out of this material that a rather extraordinary lamp placed in a Venus temple was made: *[…] in which a candelabrum set in open air holds a lamp, which burns so strongly that no storm or rain extinguishes it, and which is therefore called, like the stone mentioned above, the asbestos or inextinguishable lamp*.[44]

In the early medieval period, Rabanus Maurus (c. 780- 856 AD) includes asbestos into the category of stones in the 17th chapter titled the dust and soil of the earth in his thesaurus On the Universe. This category, next to asbestos, includes also *salt, flint, sand, lime, jet and the Persian moonstone, of whose brightness he claims that it waxes and wanes with the moon*.[45]

The second, stronger tendency, is based on associating asbestos with a salamander[46] (**Fig. 2**). Numerous translations of an Old-Greek early Christian text Physiologus (written either in the second c. or in the second half of the fourth c. AD) to modern languages had an undisputedly great influence on spreading this theory. In this book, especially chapter XLVII is of importance, titled *On the Lizard, that is, the Salamander*:

[…] Physiologus said of the lizard which is called the salamander that, if it is put into a fiery furnace or an oven for the baths, the fire will be quenched. Such is the salamander's nature. How much better are those 'who through justice quenched the power of fire, and who stopped the mouths of lions' [Heb.11:33].[47]

Especially, further in the text, the author's comparing a true Christian believer who, thanks to his faith, will pass through hell-fire and the flame will not touch him[48] , salamander became the symbol of spiritual integrity and chastity and thus, righteousness, therefore ideal faith and easily be associated more generally with the symbolic of Christ[49]. This impact and influence of the symbol of the fire-proof salamander is indicated by the fact of using it in comparisons in medieval love poems, in Provençal as well as Italian literature. As an example, let us take one canzone from Italian quattrocento by Francesco Petrarca (1304-1374 AD), where the author wrote: *he lives in the flames (of love) like a marvelous salamander*.[50]

Remaining in the Early Medieval period, one should not forget about the famous tablecloth of Charlemagne (748-814 AD). The emperor had a habit of throwing the linen after a finished meal into fire to his guests' astonishment; no wonder the ruler as called the wizard by them.[51] This gave rise to a suggestion

[43] *The city*, 1948, p. 421.
[44] *The city*, 1948, p. 423, 425.
[45] Quoted after DE WOLF GIBBS ADDISON 1908, p. 278.
[46] BROWNE 2003.
[47] PHYSIOLOGUS, 2009, p. 61.
[48] PHYSIOLOGUS, 2009, p. 61.
[49] BIANCHI & BIANCHI 2015, p. 83-90.
[50] BIANCHI & BIANCHI 2015, p. 85-86.
[51] COOK 1984, p. 166.

that one of Charlemagne's death could be *mesotelioma*, an illness caused by inhalating fibres of asbestos. However, it is still a vague hypothesis.[52]

Outside European territories during the early Middle Ages, there is a mention to be found about extraordinary fire-proof qualities of asbestos where it is called *tamatghost*, more precisely tām(a)tgh(u)st[53] by an Arabian historian from Andalusia, Al-Bakri (1040–1094), who left the following record in his work Geography of Northern Africa:

Near the river Derā is found a substance similar to it. This is a sort of stone, called, in the language of the Berber, tamatghost. When rubbed between the hands, it softens to such a degree that it assumes the consistency of linen. It serves for the making of cordage and halters, which are absolutely incombustible. A costume was made from this substance for one of the Zenatian princes who ruled at Sidjilmessa. A man of proved veracity told me that a trader had sent for a napkin made from this mineral for Ferdilend, King of Galicia, in Spain (Ferdinand I of Leon). He offered it to the prince, explaining that it had belonged to one of the disciples of Jesus, and that fire could produce no impression upon it. He furnished the proof under the eyes of the King, who, struck by such a marvel, expended all his wealth to purchase this relic. He sent it to the sovereign of Constantinople, that it might be deposited in the principal church, and in return received a royal crown with the authorization to wear it. Several persons tell of having seen in the house of Abul Fadl of Bagdad the fringe of a napkin made of this substance, which, when put into fire, became whiter than previously. In order to clean such a napkin, which had the appearance of linen, it was sufficient to place it on a fire[54].

This information is repeated by Al-Dimashqi, a medieval Arab geographer born in Damascus (1256–1327), who additionally states that asbestos softens when placed in a warm place. Then the fibers come out, from which clothes and towels can be weaved, and after getting dirty, it is enough to put them into fire for cleaning.[55]

Al-Bakri also mentions that inhabitants of the city of El-Lames, in western Sudan, made a fabric of white wool extracted from a fruit of the tree called *turzi* that does not burn even under great heat.[56]

Repercussions of these unusual qualities of asbestos textiles which also gives evidence of faith is to be found in Friar Odoric of Pordenone (1286-1331 AD) work *The Eastern Parts of the World*. In the 6th chapter of History of the martyrdom of the four Friars in the city of Tana[57], where a description can be read of an event that had taken place on the fourth of April in the year 1321 i.e. the martyr's death of four Italian Franciscan friars (Friar Thomas of Tolentino, Friar James of Padua, Friar Peter of Sienna) and one from Georgia (Friar Demetrius), members of the Indian mission conducted by a Dominican Jordan of Catalonia (Jordanus

[52] SCHLEIFRING *et alii* 2019, p. 12; PRITCHARD 2000, p. 170.
[53] LEWICKI 1967, p. 86.
[54] cited in LAUFER 1915, p. 328.
[55] LEWICKI 1967, p. 86.
[56] LEWICKI 1967, p. 86.
[57] Tana (Thana), a city located in Salsette Island, north of Mumbai. During the action of mentioned invent under the rule of Delhi Sultanate (1206-1526), cf. MAŁYSZ 2014, p. 120-121.

Catalanus) di Sévérac. They were executioned by cadi[58] punished for their speeches against Mohammed. One of John's brothers thrown into fire was saved from being burned by wearing a special garment, a robe made of *lana terrae Abrahae* (wool of Abraham land):

[…] And when the fire was quite spent, there was Friar James standing on the embers, joyous and exultant, with his hands raised to heaven making the sign of the cross, and with sound mind and pure heart praising the Lord without ceasing. And though the fire had been so great the slightest hurt or burn could not be found upon him. And when the people saw this they began to call out with one consent, 'They are saints! They are saints! 'Tis sin to do them hurt. And we see that in truth their religion is good and holy.' And when they had said thus, Friar James was called forth from the fire, and came out sound and unhurt. And when the Cadi saw this, he too began to cry out saying: 'He is no saint! He is no saint! But the reason why he is not burnt is that he hath on his back a garment from the land of Abraham. Wherefore let him be strip naked and so cast into the fire'[59].

The cadi's knowledge about this special textile is connected with the story of Abraham who was to be catapulted into fire by the king Nimrod but he was eventually saved, unburnt and unhurt. This narrative is described in *Quran*[60], and its strong influence in the Islamic world can be indicated by a variety of existing versions. Some good iconographic example can be one of the illustrations in the sixteenth- century manuscripts of the sixteenth century, the Zubdat-al Tawarikh, where Abraham in flames is depicted, sitting cross-legged in a quite Turkish pose.[61]

Marco Polo (1254-1324 AD), an Italian merchant and traveler, was one of very few who doubted in associating asbestos with salamander as a living creature[62], on the other hand – he pointed to the mineral provenience of asbestos. His observations regarding this material were contained in the first of his volumes in the chapter XXXIX on the occasion of the description of City of Chinchitalas, located most probably in East Turkestan:

A substance is likewise found of the nature of the salamander, for when woven into cloth, and thrown into the fire, it remains incombustible. The following mode of preparing it I learned from one of my travelling companions, named Curficar[63]*, a very intelligent Turkoman, who had the direction of the mining operations of the province for three years. The fossil substance procured from the mountain consists of fibres not unlike those of wool. This, after being exposed to the sun to dry, is pounded in a brass mortar, and is then washed until all the earthy particles are separated. The fibres thus cleansed and detached*

[58] Cadi or Qadi – a judge responsible for the application of Islamic law.

[59] *The Eastern Parts* 1866, p. 64.

[60] *They said 'Burn him and help your deities, if you are resolved to do something.' But We said, 'Fire! Be cool and a means of safety for Abraham.' They had sought to do him harm, but We frustrated them. And We saved him and Lot [and brought them] to a land which We had blessed for all people […]. The Quran* 2016, 21, p. 68-71.

[61] Cf. VICCHIO 2008, p. 30-32.

[62] It gives the different meaning of the beginning of chapter XXXIX in Yule's translations *For the real truth is that the Salamander is no beast, as they allege in our part of the world, but is a substance found in the earth […]. Everybody must be aware that can be no animal's nature to live in fire* (The book 1903, 213).

[63] According to Xiaolin Ma, Marco Polo met Turkic baron Çulficar in the years 1271-129. Thus, during almost all the period of his stay in China (MA 2016, p. 130).

from each other, they then spin into thread and weave into cloth. In order to render the texture white, they put it into the fire, and suffer it to remain there about an hour, when they draw it out uninjured by the flame, and become white as snow. By the same process they afterwards cleanse it, when it happens to contract spots, no other abstergent lotion than an igneous one being ever applied to it.

Of the salamander under the form of a serpent, supposed to exist in fire, I could never discover any traces in the eastern regions. It is said that they preserve at Rome a napkin woven from this material, in which was wrapped the sudarium of our Lord, sent as a gift from one of the Tartar princes to the Roman Pontiff. [64]

Or

' […] sent as a gift from the Great Khan to the Pope to make a wrapper for the Holy Sudarium of Jesus Christ. ' [65]

When we concentrate on asbestos imports coming from the western direction, we must acknowledge the technological know-how of such production documented for the ancient Persia, more exactly for Mosul, where asbestos was applied to make protective clothes for soldiers spraying naphthalene.[66] Mosul as the trade hub for asbestos textiles is mentioned in Chu-fan-chi [Zhu Fan Zhi][67] by Chau Ju-Kua [Zhao Rukuo] (1170-1231 AD) around 1200 AD: *Asbestos cloth and coral are native products*.[68]

4. Asbestos in the East Asia.

Information about procuring asbestos fibres published by Marco Polo found the support of a somewhat later work because compiled in the years 1369/70 and edited in print in 1370 and titled Yüan shih [Yuan shi].[69] Under the year 1267 there is an entry with the information about issuing an edict by the court Yuan and regarding mining asbestos in the mountains Pieh ch'ieh ch'ih shan [Bieqiechi shan], which are located in East Xinjiang east from Urumchi, thus in a possible localization of the place indicated by the Italian traveler. A second valuable source of information suggesting the existence of the custom of waving asbestos textiles is a stela presenting a biography of Gao Xin (1291-1288), who was the vice-director in I yang chü [Yiyang Ju] (Extraordinary Patterns Bureau) throughout most of his life.[70] The purpose of this institution was supervising the production of imperial textiles for the Yuan court. Yet the most important information, documented by an inscription, is manufacturing of 'fire-washing dragon-bearded fairy clothes'[71], which are interpreted as textiles made of asbestos fibres. According to Xiaolin Ma, who refers to the inscription on the stela, the

[64] *The Travels* ed. 1930, p. 79-80.

[65] *The Travels* ed. 1926, p. 80.

[66] CAMERON 2000, p. 49.

[67] Due to the fact that the notation of Chinese authors and titles cited in the text are transliterated in the Wade-Giles system, pinyin transliterations were used in square brackets.

[68] CHAU JU-KUA 1911, p. 140.

[69] *History of Yuan*

[70] MA 2016, p. 129; MA & QIU 2017, p. 279-292.

[71] Huo huan lung hsü pu hsien ch'ang [huo huan long xu bu xian chang].

textiles were produced in the years 1261-1288. It is therefore probable that the textile mentioned by Marco Polo was later used for the above-mentioned 'wrapper for the Holy Sudarium of Jesus Christ', that it was manufactured in such a workshop and was brought to Rome in the years 1265-66 by the brothers Nicolau and Maffeo Polo[72].

The information regarding China in the Yuan Period (1279-1368) is extremely valuable because it shows a significant change in the perception of the nature of asbestos. It turns out that contrary to the ancient Romans who had the knowledge about the mineral origin of asbestos and defined it as a substance extracted from rock[73], in China, more fantastic views of its provenance had been spread as late as into the times of the Yuan dynasty: it was regarded to be of the vegetal origin (tree bark) or of animal nature (animal hair, hackles of salamander-rat or even as hair of phoenix).[74] A first attempt of some more proper identification of the asbestos origin was undertaken by Ko Hung [Ge Hong] (283-343 or 364 AD) about 300 AD in this way:

There are three kinds of fireproof cloth. It is said that in the ocean there is a (volcanic) mountain, Hsiao Chhiu, with fire that burns of itself. This fire rises in the spring and is extinguished in autumn. On the island grows a tree the wood of which is non-inflammable, but only scorches slightly, assuming a yellow color. The inhabitants use it for fuel, but this fuel is not transformed to ashes. When their food has been cooked they put out the fire by water, and use it again and again – an inexhaustible supply. The barbarians also gather flowers from these trees and weave cloth from them (This is the first kind of fireproof cloth). Further, they also peel the bark, boil it with lime, and so weave cloth, coarse and not so good as former. (This is the second kind.). Moreover, there are white rodents (pai shu), covered with hairs each three inches long, which live in hollow trees; these can enter fire without being burnt, and their hair may be collected and woven into cloth. This is the third kind.[75]

Asbestos had been, however, mentioned in China earlier than in the fragment cited above; yet it had been done only within the context of textiles and regarding the location from where it had been brought – Da Qin.[76] Information regarding clothes made of garments which are termed there *cloth cleaned in fire*[77]. Other names were also in use, like: *shih mien* – stone wool, or *shih jung* - stone velvet [78] or in the Yuan period *fire-washing dragon-bearded fairy clothes*[79]. A good example which became later the ground for further replications made by Taoists about fireproof cloth is Lieh Tzu [Liezi], a Taoist text ascribed to the Chinese philosopher Lieh Yü-k'ou [Lie Yukou] who lived at the turn of sixth/seventh century BC and compiled in the times of Han dynasty in the fourth century:

[72] MA 2016, p. 129.
[73] SCHAFER 1963, p. 199.
[74] LAUFER 1915, p. 342-346; SCHAFER 1963, p. 199.
[75] NEEDHAM & LING 1959, p. 658.
[76] NEEDHAM & LING 1954, Table 7
[77] huo huan bu [huo huan pu].
[78] CAMERON 2000, p. 49.
[79] ŻUCHOWSKA (2015) 2016, p. 226; MA 2016, p. 129.

When King Mu [Jing] of the Chou dynasty made a great expedition against the Western Jung people (Hsi-jung) they presented (to propitiate him) a Khun-Wus sword and some fire- proof cloth (huo wan pu). The sword was one foot eight inches long, a red blade of fire- transformed (or refined) steel (lien kang) which would cut jade like clay. The fireproof cloth was cleaned by being thrown into a fire, when the cloth became the color of the fire, and the dirt assumed the color of the cloth. When taken out of the fire and shaken, it became as white as snow. A certain prince did not believe it, and thought that those who brought news of it must be mistaken, but Hsiao Shu I said, 'Must the prince insist on maintaining a preconceived idea, and deny the (demonstrable) truth?'[80].

Special importance ascribed to asbestos textiles is suggested in a story about the famous general Liang Chi [Liang Ji] (d. 159), told by Fu Hsüan [Fu Xuan] (217–278 AD) and titled Fu Tzu [Fu Zi] (third century AD), where we read: he had a costume made from asbestos- cloth, which he used to wear on the occasion of great banquets. He would insist on declining the wine-cup till it was spilled on his suit; and then with feigned anger he would take it off, ordering it to be thrown into the fire. It blazed up as if it were reduced to ashes; but the stains being removed, and the fire extinguished, the cloth appeared bright and clean, as if it had been purified with lees.[81]

Another story titled Sou Shen Chi [Sou shen Ji] and written by Kan Pao [Gan Bao] (about. 290 AD) contains two very important pieces of information about the location of mines or deposits where the raw material for the production of fire-proof textiles and about ceasing of the import of such products after the fall of Han dynasty:

In the time of the Han dynasty, at a remote period, there were offerings of this cloth from the western regions, but during the long interval which elapsed between that and the beginning of the Wei dynasty, people came to doubt of its existence. The emperor Wen Ti [Wendi] (reign from 220 to 226), considering that the fierce nature of fire was incompatible with the preservation of life, wrote a book entitled Tien Lun (Discourses on Literature) in which he showed the absurdity of the whole thing and warned intelligent people against giving any credence to it. When the emperor Ming Ti [Mingdi](reign from 227 to 239) ascended the throne, he issued an edict to the three dukes, saying 'The maxims in the essay by my imperial predecessor are imperishable.' He caused it to be carved in stone outside the door of the ancestral temple, and also among the stone-carved classical texts in the Great College, to be a perpetual testimony to coming generations.

Not long afterwards an envoy from the western regions arrived with an offering of fireproof cloth, whereupon the emperor ordered that the inscription should be obliterated. It thus became a subject of general ridicule.[82]

Another source points also to the Western Regions, which also could probably be the place where asbestos was mined and locally processed (?) or, due to their localization on the Silk Road, could be a kind of hub for exotic ware from the widely conceived Western World as it was the case with other kinds of textiles, among other products:

[80] NEEDAM & LIANG 1959, p. 656.
[81] LAUFER 1915, p. 311.
[82] NEEDAM & LIANG 1959, p. 659.

*Toward the close of the reign of Kao Tsun , better known as Wen C'en [Wencheng] (452-465 AD) of the Hou Wei[Northern Wei] dynasty (386-532), the king of Su-le (Kashgar) sent an emissary to present a garment (*kāṣāya*)[83] of Çakyamuni Buddha, over twenty feet in length. On examination, Kao Tsun satisfied himself that it was a Buddha robe. It proved a miracle, for, in order to get at the real facts, the Emperor had the cloth put to a test and exposed to a violent fire for a full day, but it was not consumed by the flames.*[84]

During the Tang period, asbestos imports were reaching China from two directions: from the west and south. The western direction should not only mean z Da Qin and Fu-lin locations but also Persia from where, about 750 AD, the Tang emperor received a Persian gift in the form of a dance mat, 'a rug made of Salamander wool'.[85] It is therefore possible that during this time, due to the increased production of asbestos textiles, they may have been available also to a number of rich aristocrats, which seems to be supported by a couplet by a poet Li Ch'i [Li Qi] (690-751 AD) describing an asbestos-woven garment of an aristocrat:

A fire-washed single garment, with embroidered square collar;
A 'dogwood brocade' girdle, with jeweled plates and wallet.[86]

The other direction from the south points to regions in Southeast Asia, especially Fu-nan, which will be more closely discussed in the following part.

An echo of the view originating asbestos from the hair of a fire-rat, the interpretation which was widespread in the Chinese literature[87] could also be traced in Japan, in the tenth century's legend Monogatari (The bamboo-Cutter Tale). Leaving details of the story aside, its general plot should be presented in a few words. There were many candidates willing to wed a gorgeous girl found in a bamboo stalk by an old man Taketori no Okina gathering bamboo. She was given the name Nayotake no Kaguya-hime. The most persistent princely candidates were given a requirement necessary to win her hand: which of them would bring her objects which she desired from far-off lands. One of such wished-for gifts, assigned to be brought by the third of the princes, the right minister Abe no Mimuraji, was a robe of Chinese fur obtained from a fire-rat. The candidate employed a Chinese merchant Wang Ching, who replied: *Robes made from the skins of fire-rats do not exist in my country. I have indeed heard of such things, but have yet to see one. If one really does exist in the world it is curious that it has not already been brought to China. […]. However, I shall make inquiries among the rich men of India to ask if by any chance one has turned up there.* After long enquiry, Wang Ching received information, *that long ago a great Indian priest had brought it to this country and that it was now to be found in a mountain temple in the west* and he bought it for a very large amount of gold. Prince Abe no Mimuraji packed the dark-blue robe in a valuable box; the garment emanated golden shine from tips of its hair and was finally brought and offered it to the princess. Yet the robe did not

[83] Kāṣāya, a set of robes for the devotees of Gautama Buddha.
[84] LAUFER 1919, p. 498.
[85] SCHAFER 1963, p. 199.
[86] SCHAFER 1963, p. 200.
[87] NEEDAM & LIANG 1959, p. 658.

stand the fire trial: *They put it in the flames, where it burned brightly. 'Just as I thought,' said Kaguya-hime, 'it was not the right fur'*.[88]

5. Asbestos in the Southern and Southeast Asia

The other direction of the asbestos textile imports, coming via marine from the south to China, was especially strongly highlighted in the literature, mainly because of the special interest focusing on goods from the western world as being more exotic. This situation has changed, due to some new findings of textile remnants in South Asia and South-East Asia.

A lively trade with asbestos textiles from Da Qin (Ancient Rome) can be suggested by a remark in a work entitled I wen chü [Yiwen Leiji] (Literary Material by Category) ascribed to Ou-yang Hsun [Ouyang Xun] (557-641) and edited in the year 624; it is there, under the date 282, that we find such entry:

In this year, (an embassy from) Da Qin came to offer tribute and it passed through the Guangxi Circuit. Of the many treasures they offered the strangest was 'fire-washed cloth' (asbestos).[89]

It was probably an official diplomatic mission yet we must also assume a trade activity of a team from Alexandria.[90]

Another location where asbestos could be obtained was India, as pointed to by Pliny, the author mentioned earlier in this text. He wrote of India as of - the deserts and sun-scorched regions. Some of researchers represent the opinion, however, that it was Romans who brought those products from India with them: payments were made in some raw materials from the West (red coral and asbestos) but principally in Roman coins.[91] This *Indian connection* of merchandise is indicated also by another Chinese source Chin shu [Jinshu][92] covering historical events during the rule of Chin [Jin] dynasty (265-420). On the occasion of describing the rule of Fu Chien [Fu Jian] emperor (337-384), under the year 383 A.D. we read about sixty-two foreign rulers who sent him their tribute including among other things fire-retardant cloth (asbestos) from India, blood-sweating horses from Central Asia and arrows from the far Northeast.[93]

The presence of asbestos is evidenced by discovering layers of unprocessed asbestos, found during archeological excavations at the site of a storeroom in Kamrej[94]. It is located in the north-western part of the site and identified with a haven in Kammoni, mentioned in some Roman sources (Periplus Maris Erythrae).[95] On the grounds of special analyses, the earlier hypotheses connecting these fibres with cotton have been excluded.[96]

---

[88] KEENE 1956, p. 329-355.

[89] MCLAUGHLIN 2010, p. 139.

[90] MCLAUGHLIN 2010, p. 139; more about the Roman marchands and Roman finds from Southeastern Asia cf.: BORELL *et alii* 2014, p. 110-112.

[91] LOEWE 1971, p. 176.

[92] Book of the Jin.

[93] LAUFER 1919, p. 349; HOLCOMBE 2019, p. 123.

[94] CEMERON *et alii* 2015, p. 167, fig. 9.

[95] TOMBER 2008, p. 126, fig. 21: 21.

[96] CAMERON *et alii* 2015, p. 168.

Taking into account that the Indo-Roman trade contacts were unusually lively, the suggestion that one of the traded goods must have been asbestos cannot be excluded; the fibres could w then be distributed among Indian merchants who transported them even further.

Chinese sources referring to the first half of the first millennium list some south-eastern havens in the context of the trade with asbestos textiles. Most informative, however, are somewhat younger reports where the most frequently mentioned location appears to be Funan – a state organism existing in the Mekong river delta.[97] Judith Cameron, the author mentioned earlier in the chapter on China, recalls a remark from Ko Hung [Ge Hong] (around 300 AD) about three kinds of asbestos and associated them with the raw material traded on the markets of Funan.[98] An extremely interesting description in the context of Funan is also the one from Liang (Liang Shu), The History of Liang dynasty (502-557) completed in 635 AD, depicting the landscape around Funan alongside isles with volcanos on them, from which asbestos was said to have originated:

It is reported that Fu-nan is bounded on the east by the ocean known as Ta-chang ('Great Expanse'). In this ocean is a great island on which the kingdom of Chu-po (Java) is situated. East from this kingdom is the island of Ma-wu. Going again over a thousand 1i in an easterly direction across the Ta-chang Ocean one reaches Volcano Island. On this island there are trees which grow in the fire. The people in the vicinity of the island peel off the bark, and spin and weave it into cloth hardly a few feet in length. This they work into kerchiefs, which do not differ in appearance from textiles made of palm and hemp fibres, and are of a slightly bluish-black color. When these are in the least soiled, they are thrown into fire and thoroughly purified. This substance is made also into lamp-wicks which never become exhausted.[99]

It is hardly possible to unambiguously state whether the bark-cloth which was mentioned by this occasion could be related to asbestos textiles, or rather should be identified as tapa, a kind of plait, produced traditionally in Indonesia, and woven of different kinds of tree-bark.[100]

Similar localization to those islands east of Java, where the mineral fibres were produced, is recalled by Tang court chronicle Chiu t'ang shu [Jiu Tang shu], in which, on the islands of Kunlun people *il y a un volcan où on se procure les fibres dont on fait la toile d'amiante*.[101]

The islands as suggested here are identified with Timor or Maluku (the islands of Indonesian Archipelago).[102] In the case of the last localization, mining for asbestos has been still continued until now, however, it is hard to state if the deposits were exploited in the past, and when the mining had been established.[103]

All those mentions found in written sources can, and indeed are, supported by archeological excavations and their results, similarly to the case of research on

[97] CAMERON 2000, p. 49; CAMERON *et alii* 2015, p. 169.
[98] CAMERON 2000, p. 50.
[99] LAUFER 1919, p. 346-348.
[100] LAUFER 1919, p. 348.
[101] PELLIOT 1904, p. 220.
[102] CAMERON *et alii* 2015, p. 169.
[103] CAMERON *et alii* 2015, p. 12.

the Roman Empire or the ancient civilizations on the Indian subcontinent. Probably the oldest finds of asbestos fibres are from Thailand from the site in Khok Phanom Di (2000 -1500 BC). In Central Thailand, they were popular in elite burials. The function of the textile remnants were determined as shrouds and described as *white fabric, made from beaten bark or sheets of naturally-occurring asbestos*.[104]

The asbestos application cannot be doubted in the north-eastern Tailand where its occurence is supported by the finds in Khorat Plateau in Ban Chinag (1500-1000 BC), as well as in Ban Pasrat (ca. 800 BC); moreover, they were documented in layers showing mending activities in the furnaces in Noen U-Loke, on the site dated between 100 BC and 300 AD. Most of the asbestos material found there was spun and woven.[105]

The greatest sensation, however, has turned to be excavations in Batujaya in West Java. Significant numbers of asbestos textile remnants have been excavated in three burials belonging to the same group of 23 graves in sector A of Sagaran II mound. The burials are dated on the phase of mid-Buni which is placed chronologically in the period between the 1st AD and the 2nd century AD. The rests of the textiles show the white coloration and had not been died; their microscopic analysis established its chrysotile origin.[106]

6. Conclusion

Asbestos was considered to be 'magic mineral' since the days of Antiquity. Regards its attractivity which is based not only on its functionality as it is the case of its addition in ceramics but, first and foremost, its magical meaning caused by its fire reterdant effect. It is also interesting that in the Western world, asbestos textiles overwhelmingly appear in the context of sacrum which constitutes this religious meaning (i.e. curtains, knot, tablecloth, Holy Shroud) and in the funeral context, i.e. as a shroud. In the Far East, however, it is perceived somewhat differently as a special, exotic kind of garment displaying a high social and financial status of their owners, to a lesser degree also connected with the sphere of sacrum, and as such, it appears termed as the Buddha cloth. It is probable that such use of asbestos is reflected in the remnants of garments left in the burials in Tailand (Khok Phanom Di) and in Java (Butujaya). Asbestos textiles were also produced in the times of Yuan dynasty as dragon-bearded fairy clothes.

Another interesting issue is that archeological findings in ancient Rome, India and South-East Asia (Funan and beyond) are supporting literary sources which does not have place in regard to China. The reason for this status quo lies perhaps in the poor understanding of the material and its provenance; this can be illustrated by some excavations in India when such asbestos pieces of garments were wrongly identified as cotton rests.

Attitudes and knowledge referring to asbestos as a material were very differentiated, as I have been trying to show in this article. It certainly evaluated,

[104] HIGHAM & THOSARAT 1998, p. 47-48; Discussion on different results of specialist analysis of fibres in CAMERON 2000, p. 47-48.

[105] CAMERON *et alii* 2015, p. 170.

[106] CAMERON *et alii* 2015, p. 165.

and ranged from the western, most scientific approach where it was ascribed the mineral provenance, to the mythological view associating it with a salamander, a tree bark or finally with hair of some rat or other rodent animal.

Written sources, mentions and remarks on asbestos, in the Mediterranean Antiquity as well as in ancient China texts, are most valuable and fascinating evidence of the extension to which off-shore trade was conducted between the East and the West in the ancient times; literature on the subject can be supplemented, supported and elucidated by archeological research and its findings.

BIBLIOGRAPHY

BAKER 2009 - M. J. Baker. *Cremation and communication at Etruscan Tarquinia in the 5th -4th century BC: insights into cultural transformations from tomb 6322*, in: M. Gleba, H. Becker (eds), *Votives, Places, and Rituals in Etruscan Religion: Studies in Honor of Jean McIntosh Turfa*, Leiden-Boston, 2009, p. 230-248.

BIANCHI & BIANCHI 2015 - C. Bianchi, T. Bianchi. *Asbestos between science and myth. A 6.000-year story*, La Medicina del Lavoro 106 (2015), p. 83-90.

BORELL *et alii* 2014 - B. Borell, B. Bellina, B. Chaisuwan, *Contacts between the Upper Thai-Malay Peninsula and the Mediterranean World*, in: N. Revire, S. A. Murphy (eds), *Before Siam was Born: New Insights on the Art and Archaeology of Pre-Modern Thailand and its Neighbouring Regions*, Bangkok, 2014, p. 98-117.

BOWLES 1955 - O. Bowles, *The Asbestos Industry*. Bulletin (United States. Bureau of Mines) 522 (1955), Washington.

BOZSAKY 2010 - D. Bozsaky, *The historical development of thermal insulation materials*, Periodica Polytechnica 41(2) 2010, p. 49–56.

BROWNE 2003 - C. Browne, *Salamander's Wool: The Historical Evidence for Textiles Woven with Asbestos Fibre*, Textile History (34/1) 2003, p. 64-73.

CAMERON 2000 - J. Cameron, *Asbestos cloth and elites in Southeast Asia*, Indo-Pacific Prehistory Association Bulletin 19 (2000), p. 147-51

CAMERON *et alii* 2015 - J. Cemeron, A. Indrajaya and P-Y. Manguin, *Asbestos textiles from Batujaya (West Java, Indonesia): Further evidence for early long-distance interaction between the Roman Orient, Southern Asia and island Southeast Asia*, Bulletin de l'École Française d'Extrême-Orient 101 (2015), p. 159-176.

CHAU JU-KUA 1911 - Chau Ju-Kua. *His Work on the Chinese and Arab trade in the twelfth and thirteenth centuries, entitled Chu-fan-chi*, translated from the Chinese and annotated by F. Hirth and W. W. Rockhill, St. Petersburg 1911.

COLOMBAN & KREMENOVIĆ 2020 – P. Colomban, A. Kremenović, *Asbestos-Based Pottery from Corsica: The First Fiber-Reinforced Ceramic Matrix Composite*, Materials, 2020 13 (16):3597, doi: 10.3390/ma13163597.

COOK 1984 - J. G. Cook. *Handbook of Textile Fibres: Natural Fibres*, Cambridge, 1984.

DAMM 2012 - Ch. Damm, *From Entities to Interaction: Replacing pots and people with networks of transmission*, in: R. Grünthal, P. Kallio (eds), *A Linguistic Map of Northern Europe*, Mémoires de la Société Finno-Ugrienne 266 (2012), Helsinki, p. 41-62.

DE WOLF GIBBS ADDISON 1908 - J. De Wolf Gibbs Addison, *Arts and Crafts in the Middle Ages: A Description of Mediaeval Workmanship in Several of the Departments of Applied Art, Together with Some Account of Special Artisans in the Early Renaissance*, Boston, 1908.

DI GENNARO *et alii* 2008 - F. di Gennaro, D. Ferro, A. Marconi, L. Masato, I. A. Rapinesi, *Trattamento e restauro dei materiali d'amianto di natura archeologica*, Kermes 72 (2008), p. 64-66.

DIOSCORIDES ed. 2000 – Dioscorides, *De materia medica: being an herbal with many other medicinal materials written in Greek in the first century of the common era*, A new indexed version in modern English by T.A. Osbaldeston and R.P.A. Wood, Johannesburg, 2000.

EHRMAN & PLEŠE 2014 - Bart D. Ehrman, Z. Pleše, edited and translated, *The Other Gospels. Accounts of Jesus from Outside the New Testament*, Oxford, 2014.

Encyclopedia 2009 - *Encyclopedia of the Peoples of Africa and the Middle East*, J. Stokes (ed.), A. Gorman, A. Newman (Historical consultants), New York, 2009.

ENGEVIK 2008 - A. Engevik, Jr. *Bucket-Shaped Pots: Style, Chronology and Regional Diversity in Norway in the Late Roman and Migration Periods*, Oxford, 2008.

ERIKSSON & LINDHAL 2018 - T. Eriksson, A. Lindhal, *The Handicrafts of Iron Age Pottery in Scandinavia Regionalities and Traditions*, Lund Archaeological Review 18 (2018), p. 45-60.

EVANS 1906 - J.-W. Evans, *The Identity of the Amiantos or Karystian Stone of the Ancients with Chrysotile*, Mineralogical Magazine 14 (1906), p. 143-148.

GERASIMOV *et alii* 2019 - D. Gerasimov, T. Gusentsova, M. Kholkina, *Tracing the bonduary: Southern Periphery of the Neolithic Asbestos Ware*, Estonian Journal of Archaeology 23 (2019), p. 146-172.

HIGHAM & THOSARAT 1998 - C. Higham, R. Thosarat, *Prehistoric Thailand from Early Settlement to Sukothai*, Bangkok, 1998, p. 47-48.

HOLCOMBE 2019 - C. Holcombe, *The Sixteen Kingdoms. The Cambridge History of China 2. The Six Dynasties 220-589*, Cambridge, 2019, p. 119-144.

HOP 2016 – H. M. B. Hop, *Asbestos Ceramics along the West Norwegian Coast – Influences, Age and Morphology in the Bronze Age/ Early Pre-Roman Iron Age (ca. 1700–400 BC),* in: P. E. Petterson (ed.), *Prehistoric Pottery Across the Baltic: Regions, Influences and Methods*. BAR International Series 2785, 2016, p. 3-12.

IM 1996 - H. Y. Im, *The Korean Neolithic Age and its Cultural Relationship to Northeast China*, Korea Journal 36 (4)(1996), p. 5-16.

ISTRIA 2007 - D. Istria, *L'utilisation de l'amiante en Corse du XIV^e^ au XIX^e^ siècle*, Médiévales 53 (2007), p. 39-50.

KAKOULLI *et alii* 2014 – I. Kakoulli, S. V. Prokhodko, A .King, C. Fisher, *Earliest evidence for asbestos composites linked to Byzantine wall paintings production*, Journal of Archaeological Science 44 (2014), p. 148-153.

KEENE 1956 - D. Keene, *The Tale of the Bamboo Cutter*, Monumenta Nipponica 11(4) (1956), p. 329-355.

KELLY 1975 - A. Kelly, *Prospects and Problems of Fibre Reinforced Concrete*, in: A. Neville (ed.), *Fibre Reinforced Cement and Concrete - Rilem Symposium 1975*, Addison, 1975, 463-479.

KHOLKINA *et alii* 2020a – M. A. Kholkina, T. M. Gusentsova, D. V. Gerasimov, *Pero feniksa: ob osobom znachenii primesi asbesta v keramike Severo-Zapada,* Arkheologiya Podmoskov'ya. Materialy nauchnogo seminara 16 (2020), p. 49-60.

KHOLKINA *et alii* 2020b - M. A. Kholkina, R. I. Murav'yev, A. M. Zhul'nikov, *Tekhnologiya izgotovleniya asbestovoy keramiki: postanovka problemy i programma eksperimenta,* Izvestiya Samarskogo nauchnogo tsentra Rossiyskoy akademii nauk. Istoricheskiye nauki. 2(3)2020, p. 103-108.

KIM 1962 - W.-Y. Kim, *Some Aspects of the Comb-Pattern Pottery of Prehistoric Korea*, Arctic Anthropology 1(1)(1962), p. 42-50.

KULKOVA *et alii* 2012 - M. Kulkova, T. Gusentzova, E. Nesterov, P. Sorokin, T. Sapelko, *Chronology of Neolithic-Early Metal Age sites at the Okhta river mouth (Saint Petersburg, Russia)*, Radiocarbon 54 (3–4)(2012), p. 1049–1063.

LAUFER 1915 - B. Laufer, *Asbestos and Salamander, an Essay in Chinese and Hellenistic Folk-lore*, T'oung Pao 16 (1915), p. 299–373.

LAUFER 1919 - B. Laufer, Sino-Iranica, *Chinese contributions to the history of civilization in ancient Iran, with special reference to the history of cultivated plants and products*, Chicago, 1919.

LEWICKI 1967 – T. Lewicki, *Średniowieczni pisarze arabscy o bogactwach mineralnych Afryki i ich eksploatacji*, Studia z Dziejów Górnictwa i Hutnictwa 11 (1967), p. 7-112.

LEVANTO & HORNYTZKYJ 1995 - M. Levanto, S. Hornytzkyj, *On Asbestos used as temper in Finnish Subneolithic, neolithic and Early Metal Period Pottery*, Fennoscandia archaeologica 12 (1995), p. 71-75.

LIVERANI *et alii* 2010 - P. Liverani, G. Spinola, P. Zander, *Le Necropoli Vaticane. La città dei morti di Roma,* Rome, 2010.

LOEWE 1971 - M. Loewe, *Spices and Silk: Aspects of World Trade in the First Seven Centuries of the Christian Era,* The Journal of the Royal Asiatic Society of Great Britain and Ireland 2 (1971), p. 166-179.

MA 2016 - Ma Xiaolin, *Xīn chū yuán dài shíkè guānyú mǎ kě·bō luó suǒ jì huǒ huàn bù de yìnzhèng (A Contemporary Inscriptional Evidence on Marco Polo's Salamander Cloth under the Mongol-Yuan Dynasty)* in: Xu Zhongwen and Rong Xinjiang (eds), *Mǎkěbōluó·yángzhōu·sīchóu zhī lù (Marco Polo, Yangzhou, and the Silk Road)*, Beijing, 2016, p. 122-130.

MA & QIU 2017 - Ma Xiaolin & Qiu Zhirong, *Yuán dài yìyàng jú, yùyòng zhīwù yǔ zhōngwài jiāoliú - yǐ xīn chū shíkè "gāo xìn shéndàobēi" wéi zhōngxīn zhōngxīn [Yiyang Ju (the Extraordinary Patterns Bureau), Royal Textiles and Eurasian Exchanges in the Yuan Dynasty: Based on a Newly-Discovered Stone Inscription]*, Xīyù wénshǐ (Literature & History of the Western Regions) 11(2017), p. 279-292.

MAIER 1618 - M. Maier. *Atalanta Fugiens: hoc est, Emblemata nova de secretis naturae chymica, accommodata partim oculis et intellectui, figuris cupro incisis, adjectisque sententiis, epigrammatis et notis, partim auribus et recreationi animi plus minus 50 fugis musicalibus trium vocum, quarum duae ad unam simplicem melodiam distichis canendis peraptam, correspondeant, non absque ; singulari jucunditate videnda, legenda, meditanda, intelligenda, dijudicanda, canenda et audienda*, Oppenheim, 1618.

MAINES 2005 - R. Maines. *Asbestos and Fire Technological Trade-offs and the Body at Risk*, New Brunswick, New Jersey and London, 2005, p. 25.

MAŁYSZ 2014 - B. Małysz, *Odoryk z Pordenone i jego relacja z podróży na Daleki Wschód*, in: D. Quirini-Popławska and Ł. Burkiewicz (eds), *Itinera clericorum: kulturotwórcze i religijne aspekty podróży duchownych*, Kraków, 2014, p. 96-136.

McLAUGHLIN 2010 - R. McLaughlin, *Rome and the Distant East: Trade Routes to the ancient lands of Arabia, India and China*, London, 2010.

MÖKKÖNEN & NORDQVIST 2017 - T. Mökkönen, K. Nordqvist, *Kierikki Ware and the Contemporary Neolithic Asbestos- and Organic-tempered Potteries in North-east Europe*, Fennoscandia Archaeologica 34 (2017), p. 83–116

NEEDHAM & LING 1954 - J. Needham, W. Ling, *Science and Civilisation in China, Vol. 1. Introductory Orientations*, Cambridge, 1954.

NEEDHAM & LING - J. Needham, W. Ling, *Science and Civilisation in China 3. Mathematics and the Sciences of the Heavens and Earth*, Cambridge, 1959.

NORDQVIST & MÖKKÖNEN 2017 - K. Nordqvist, T. Mökkönen, *Periodisation of the Neolithic and radiocarbon chronology of the Early Neolithic and the beginning of the Middle Neolithic in Finland*, Documenta Praehistorica 44 (2017), p. 78-86.

OKAZAKI 1993 - T. Okazaki, *Japan and the Continent*, in: Cambridge History of Japan 1. Cambridge, 1993, p. 268-316.

OLIVER & ATMORE 2001 - R. Oliver, A. Atmore, *Medieval Africa, 1250-1800*, Cambridge, 2001.

PAUSANIAS ed. 1918 - *Pausanias. Description of Greece* with an English translation by W. H. S. Jones, Litt. D. and H. A. Ormerod, M. A., in 4 Volumes, Cambridge, Mass, London, 1918.

PECHE-QUILICHINI 2018 (2017) - K. Peche-Quilichini, *De la signature technique à la signature ethnique. Les productions céramiques locales des IIe-Ier siècles avant notre ère à I Palazzi*, Archéopages 45 (2017) 2018, p. 20-31.

PELLIOT 1904 – P. Pelliot, *Deux itinéraires de Chine en Inde à la fin du VIIIe siècle*, Bulletin de l'École française d'Extrême-Orient 4 1904, p. 131-413.

PESONEM & LESKINEM 2009 - P. Pesonem, S. Leskinem, *Pottery of the Stone Age Hunter – Gathers in Finland,* in P. Jordan, M. Zvelebil (eds*), Ceramics before farming. The Dispersal of Pottery Among Prehistoric Eurasian Hunter-Gatherers*, Walnut Creek, 299-318.

PHYSIOLOGUS ed. 2009 Physiologus. *A medieval Book of Nature Lore*. Translated by Michael J. Curley, Chicago, 2009.

PLINY ed. 1950 - *Pliny. Natural History. Volume V: Books 17-19*, Translated by H. Rackham, Loeb Classical Library 371, Cambridge Mass, 1950.

PRITCHARD 2000 - D. Pritchard. *Was Charlemagne killed by his tablecloth?*, Biologist 47 (2000), p. 170.

ROGGLI & COIN 2004 - V. L. Roggli, P. Coin, *Mineralogy of Asbestos,* in V. L. Roggli, T. D. Oury, T.A. Sporn (eds.), *Pathology of Asbestos-Associated Diseases*, New York, 2004, p. 1-16.

ROSS HOLLOWAY 2004 - R. Ross Holloway, *Constantine and Rome,* New Haven and London, 2004.

ROSS & NOLAN 2003 - M. Ross, R. P. Nolan, *History of asbestos discovery and use and asbestos-related disease in context with the occurrence of asbestos within ophiolite complexes*, Geological Society of America Special Paper 373 (2003), p. 447–470.

SCHAFER 1963 - E. H. Schafer, *The Golden Peaches of Samrakand. A study of T'ang Exotics*, Berkley, Los Angeles, London, 1963.

SCHLEIFRING 2019 - J. H. Schleifring, F. M. Galassi, M. E. Habicht, F. J. Rühli, *Autopsing history: The mummy of Charlemagne (c.747 – 814 AD), father of Europe*, Economic and Human Biology 32(2019), p. 1-56.

STRABO ed. 1928. *Geography*, Volume V. Books 10-12, translated by H. L. Jones. Loeb Classical Library 211, Cambridge, 1928.

SUTHERLAND & SUTHERLAND 2002 - A. Sutherland, J. Sutherland. *Roman marble quarrying near Karystos Southern Euboea*, Journal of Cultural Heritage 3(2002), p. 251–259.

The book 1903 - *The book of Ser Marco Polo, the Venetian: concerning the kingdoms and marvels of the East.* Translated and edited, with notes, by Colonel Sir Henry Yule, R.E., C.B., K.C.S.I., Corr. Inst. France. Third edition, revised throughout in the light of recent discoveries by Henri Cordier (of Paris), London, 1903.

The city 1948 - *The City of God by Saint Augustine*, translated and edited by Marcus Dodd, DD, Vol. II, New York, 1948.

The eastern parts 1866 - *The Eastern Parts of the World Described, by Friar Odoric the Bohemian, of Friuli, in the Province of Saint Anthony*, in Cathay and the Way Thither Being a Collection of Medieval Notices of China, v. 1. (digitally printed version from 1866), Ed. by H. Yule, Cambridge: Cambridge University, 1866.

The Quran 2016 - *The Quran*, Translation and Commentary by Maluna Wahiduddin Khan. Pararel Arabic Text. Ed., Noida, 2016.

The Travels ed. 1926 - *The Travels of Marco Polo. [The Venetian]*. Revised from Marsden's Translation and Edited with Introduction by Manuel Komroff, New York, 1926.

The Travels ed. 1930 - *The Travels of Marco Polo. The Venetian*. With an introduction J. Masefield. Garden City, N.Y, 1930.

THEOPHRASTUS ed. 1956 - *Theophrastus. On Stones*. Introduction, Greek text, English translation and commentary. E. R. Caley, J. F. C. Richards, Columbus, The Ohio State University, 1956.

TOMBER 2008 - R. Tomber, *Indo-Roman Trade: From Pots to Pepper*, London, 2008.

VICCHIO 2008 - S. J. Vicchio, *Biblical Figures in the Islamic Faith*, Eugene, 2008, p. 30-32.

WILSON, 1970 - J. G. Wilson, *Notes on the Use of Naturally Occurring Minerals in Karamoja*, Uganda Journal 34 (1970), p. 81-82.

WILSON 1973 - J. G. Wilson, *The Addition of Talc and Asbestos to Pot Clay by Past and Present Inhabitant's of Karamoja District in Uganda and Adjoining Districts of Kenya*, Man 8(2) (1973), p. 300-302.

ZWELEBIL 1981 - M. Zwelebil, *From Forager to Farmer in the Boreal Zone*, British Archaeological Reports. International Series 115i, Oxford, 1981.

ŻUCHOWSKA (2015)2016 - M. Żuchowska, *"Roman Textiles" in the Hou Han Shu. A 5th Century Chinese Vision versus Roman Reality*, Anabasis. Studia Classica et Orientalia 6(2015) 2016, p. 216-242.

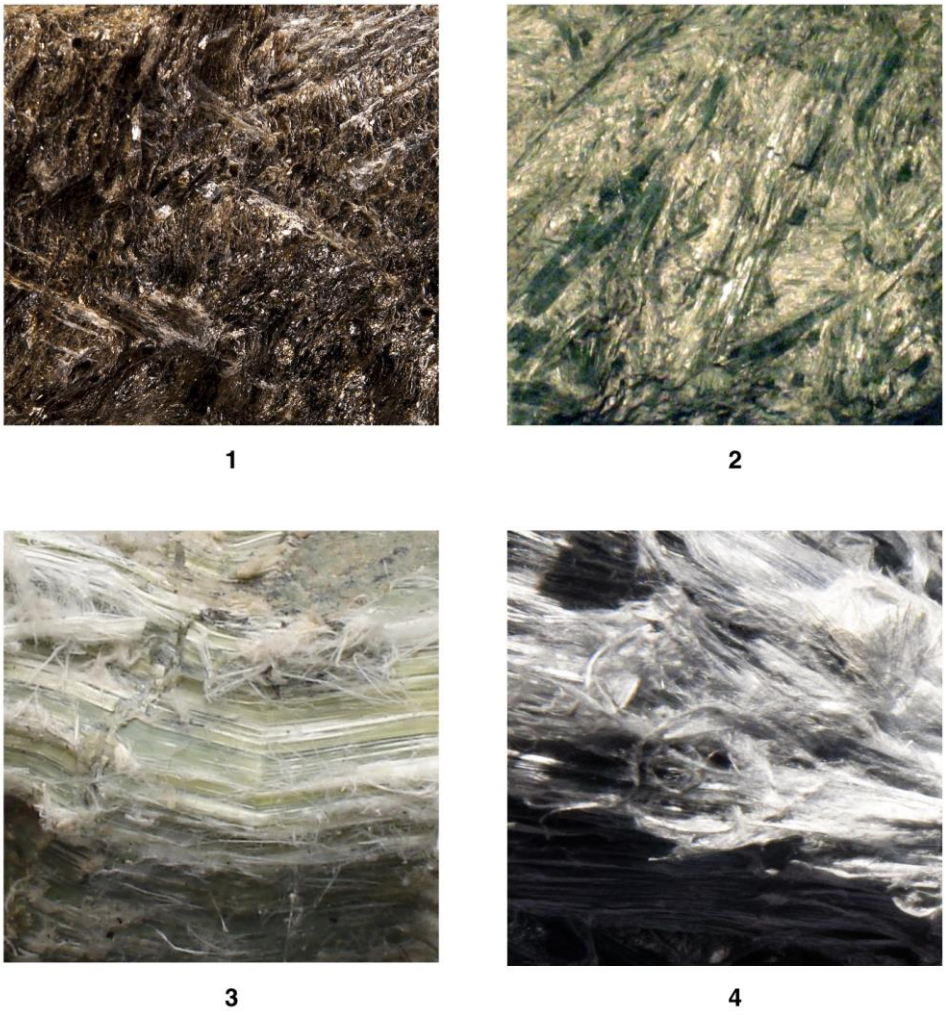

Fig. 1. Main types of Asbestos mentioned in text: 1 – Anthophyllite, 2 – Actinolite; 3 – Chrysotile; 4 - Riebeckite (crocidolite). 1 – Didier Descouens (own work); 2 – Ingo Wölbern (own work); 3 –Eurico Zimbres (own work); 4 - Marie-Lan Taÿ Pamart (own work), modified, [**CC-BY-SA-3.0** and 4.0], via Wikimedia Commons).

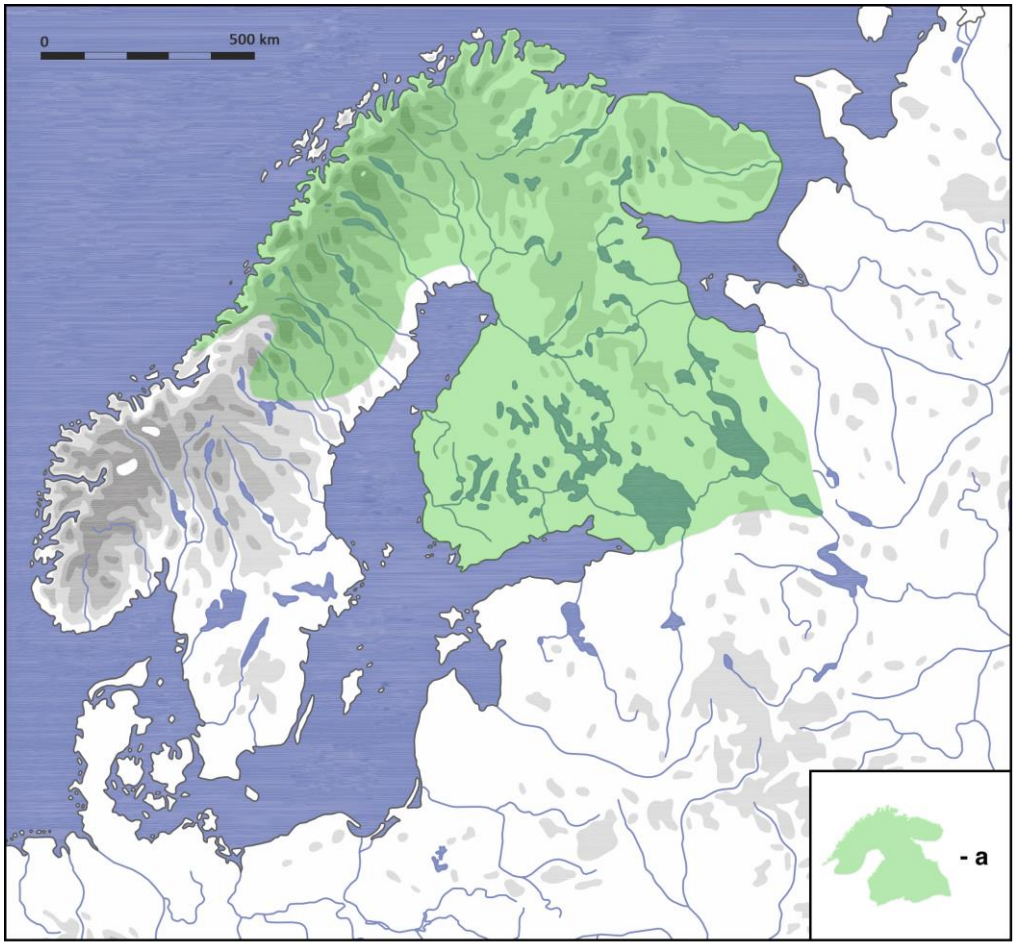

Fig. 2. Asbestos pottery in Fennoscandia and in adjacent territories in Neolithic (a) (after GERASIMOV *et alii* 2019 and MÖKKÖNEN & NORDQVIST 2017), drawing by author.

Fig. 3. An example of the Roman time asbestos textile found in necropolis of the Via Triumphalis in Rome (after Bianchi & Bianchi 2015).

Fig. 4. Ut Salamandra vivit igne sic lapis (Like the Salamander the stone lives in the fire). Emblem 29 from the book with an alchemical theme Atalanta Fugiens (Atalanta Fleeing) written by Michael Maier and illustrated by Matthias Merian 1618 (https://digital.sciencehistory.org/works/rv042t84c), public domain.