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ON ASBESTOS USED AS TEMPER IN FINNISH SUBNEOLITHIC, NEOLITHIC AND EARLY METAL PERIOD POTTERY

Abstract

Asbestos in fragments of pottery from 16 asbestos-tempered ceramic vessels dating from the period 3500 B.C.– 400 A.D., and found in the Ancient Lake Saimaa area in eastern Finland, has been analyzed using scanning electron microscopy and X-ray microanalysis with a view to identifying the types of asbestos used as temper. The results show that the asbestos is antophyllite which probably came from the metamorphosed ultramafic rocks of East Finland.

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Introduction

While the general use of asbestos in international commerce dates back to the late 19th century, its utilization in human culture goes back to at least 3500 B.C. This earliest use of asbestos is connected with the Subneolithic Asbestos Tempered Ware, which was already being made in the Ancient Lake Saimaa area during the Early Neolithic period (Carpelan 1979; Edgren 1966). The inhabitants of this area had a knowledge of strengthening their vessels and cooking utensils with asbestos.

Although the detailed chronology of the Subneolithic Asbestos-Tempered Ware remains unclear until now, some traits connect it with the period before Typical Comb Ceramics. The most recent ^{14}C-datings (1993) from the Rääkkylä Pörrinmökki 5270±100 bp (Hel-3222) and 5090±100 bp (Hel-3223) will connect the beginning of this tradition to the period just before the breach of the Vuoksi outlet (Saarnisto 1970).

The general chronology for asbestos ceramics in eastern Finland is based on Christian Carpelan's studies (1979) and his later, unpublished research. The Subneolithic Asbestos-Tempered Ware can be considered as the beginning of the long-lived tradition of Asbestos Tempered ware. The term tradition in this connection should not be understood as a continuous and uniform cultural phenomenon; asbestos has been used as temper in different cultures and culture groups. In its early phase this sort of tempering seems to be a phenomenon characteristic of the Ancient Lake Saimaa area.

The second phase in the sequence is the Typical Comb Ware styles 1 and 2. It is essential to note that only part of these ceramics are tempered with asbestos. In the Middle Neolithic Period the use of asbestos continues with the Ceramics of Kierikki, Pöljä and Jysmä types.

The Early Metal Period is characterized in eastern Finland by the introduction of two new types of ceramics: the Ceramics of Sarsa and Tomitsa types. A profound change appears in the vessel form and decoration. This wave of influence spreads into Finland from the east and south. Together with these types of ceramics the production and casting of metal objects began in eastern Finland. This horizon was soon followed by a new one: the Säräisniemi 2 pottery, the origin of which is more local than that of Sarsa and Tomitsa types.

The Säräisniemi 2 pottery is in fact a common but at the same time out-of-date name for a hetero-

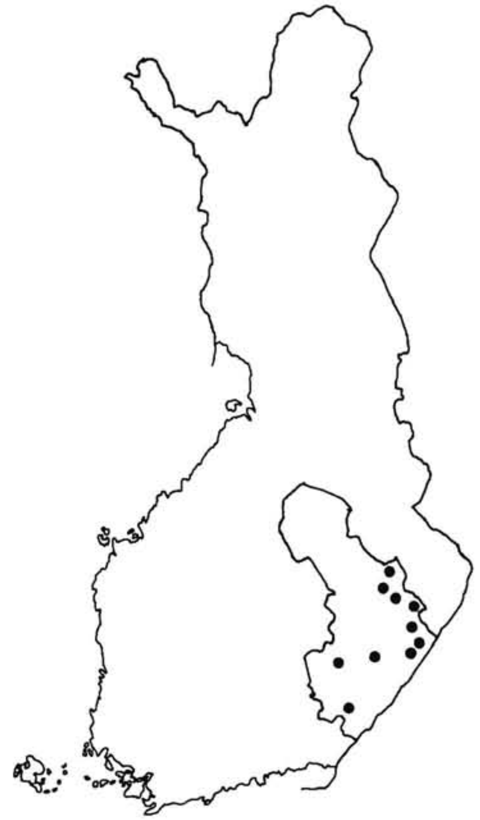

Fig. 1. Location of the sample sites in the Ancient Lake Saimaa area.

geneous entity, which includes actually four different types (Carpelan 1965). Three of them are represented in the Ancient Saimaa area. Otherwise these groups have spread generally into northern Fennoscandia.

In the ceramics of Sarsa and Tomitsa types asbestos has not been used, unlike in the Säräisniemi 2 pottery to which it belongs as an essential part. Pottery-making ceases in eastern Finland during the third or fourth century A.D. As we see, the use of asbestos in ceramics covers a period of nearly 4000 years.

Previous papers on the subject have focused mainly on typological and chronological questions (Ailio 1909; Carpelan 1965; 1979; Edgren 1964; Jørgensen & Olsen 1987; Kehusmaa 1972; Meinander 1954; 1969; Siiriäinen 1967; 1984; Äyräpää 1951). Consequently it is not generally known what type(s) of asbestos was utilised during its nearly 4000-year period of use. In the 1950's one attempt was made to analyze asbestos fibres by optical microscopy and X-ray diffraction (Carlson & Meinander 1968). Seven analyzed samples showed that all asbestos used for tempering was antophyllite, which "can be from the asbestos fields in Savolaks in Middle Finland" (Carlson & Meinander 1968:56). Some ceramic samples from Suomussalmi, in Kainuu have been studied by optical microscopy, also. Also these results showed that the tempering asbestos was antophyllite — the local chrysotile occurrences seemed not to be exploited (Lavento 1989).

What is asbestos?

Asbestos is a commercial and generally used name for fibrous varieties of naturally occurring silicate minerals of the amphibole or serpentine group. Over the millennia many fibrous minerals have been called asbestos, including the six minerals presently accepted, as well as other silicates and nonsilicates. The six minerals are the serpentine mineral chrysotile and the amphibole minerals grunerite asbestos (also referred to as amosite), riebeckite asbestos (also referred to as crocidolite), antophyllite asbestos, tremolite asbestos and actinolite asbestos (Ross et al. 1984).

Materials and methods

The material for this preliminary study consists of fragments of pottery from 16 asbestos-tempered ceramic vessels. A list of the samples and their geographical distribution is presented in Figure 1. The first aim was to study the geographical distribution of types of asbestos in ceramics within the Ancient Lake Saimaa area. The second aim was to analyze samples from different periods in order to compare samples from different ceramic groups.

A small amount of material (less than ten micrograms) was scraped from various parts of each pottery fragment, mixed with distilled water and kept in an ultrasonic bath for five minutes and filtered through a polycarbonate filter. The filter was then dried and coated with carbon to facilitate examination and analyses in the scanning electron microscope. Identification of the asbestos was carried out with a Jeol JSM 840A scanning electron microscope (SEM) fitted with a PGT IMIX energy dispersive spectrometer (Fig. 2).

Electron microscope beam electrons have sufficient energy to exite characteristic X-rays in the specimen. The X-rays are called "characteristic" because their energies (or wavelengths) are unique to the elements from which they are emitted. Energies of the emitted X-rays identify the elements present in the specimen, and the intensities of the different X-rays emitted relate to the abun-

Table 1. List of the sample sites, NM-numbers, ceramic groups and analyze results. Ka = Typical Comb Ceramics; Vasb = Subneolithic Asbestos Tempered Ware.

Site	Number (NM)	Ceramic group	Analyse
Juva Risulahti Otamo	21488	Kierikki	Antophyllite
Kesälahti Purujärvi Naukkarila	20007:4	Kierikki	Antophyllite
Kitee Muljula Sarvisuo	21095:4	Kierikki	Antophyllite
Kitee Niinikumpu Hiekanpää IV	21011:2	Vasb	Antophyllite
Liperi Taipale Juvonen	21090:1	Luukonsaari	Antophyllite
Outokumpu Sysmä Majoonlampi	20015:1	Jysmä	Antophyllite
Polvijärvi Sola Suovaara	15124:131	Ka II	Antophyllite
Polvijärvi Sola Suovaara	15124:167	Ka II	Antophyllite
Polvijärvi Sola Suovaara	15124:276	Kierikki	Antophyllite
Punkaharju Vaara Pahatso	12170	Ka II	Antophyllite
Pyhäselkä Porolahti Nivansalo	27565:2	Säräisniemi 2	Antophyllite
Rääkkylä Jaama Huotinniemi	27578:1	Säräisniemi 2	Antophyllite
Rääkkylä Jaama Mehonlahti	23167:2	Vasb	Antophyllite
Rääkkylä Jaama Mikinsuo	25920	Vasb	Antophyllite
Rääkkylä Täitimänniemi Rantala	27576:2	Jysmä	Antophyllite
Savonlinna Niittylahti Niittyranta	24900:4	Kierikki	Antophyllite

dances of the respective elements. Determination of the distribution of characteristic X-ray energies and intensities thus provides a kind of "fingerprint" to identify the specimen. There are several different kinds of X-rays detectors available, of which the energy-dispersive detector, which distinguishes between X-ray according to their energies, is most widely used in conjunction with electron microscopes. The complete energy-dispersive X-ray analyzer or energy-dispersive spectrometer (EDS) systems comprises the detector and an associated electronics package which provides the facility to sort and count the detected X-rays and display the EDS-spectrum (i.e. the distribution of energies and intensities). The EDS-system is usually completely computer-based, so a wide variety of reference material, data manipulation, and display options may be utilized to facilitate the analysis and optimize the information presentation.

Figure 3 shows an EDS-spectrum obtained from one of the six types of asbestos (antophyllite). This is the usual EDS-spectrum presentation; positions of the peaks along the horizontal axis identify the elements, and the peak heights (intensities) relate to the amounts of each element present in the specimen. The peaks are labelled to identify the elements they represent. Ratios of peak intensities of the elements sodium (Na), magnesium (Mg), silicon (Si), calcium (Ca), and iron (Fe) (oxygen, which is present in abundance in all the asbestos types, is not detected here) differ from one asbestos type to another, so that each mineral may be identified uniquely from the relative peak heights of the X-rays.

Results and discussion

Results of the SEM-EDS analyses show that the asbestos used as temper in all the samples is antophyllite. The chemical composition of the antophyllite in the samples was also analyzed quantitatively using a standardless ZAF program (PGT IMIX) and the results compared with those obtained from test antophyllite samples from Paakkila and Maljasalmi deposits prepared in the same way as the antophyllite in analyzed ceramic samples. The results are very similar which might indicate that the antophyllite used as temper came from the same areas in eastern Finland where it was commercially exploited in recent times. However, further studies are required to test this hypothesis critically.

Based on the results of the above-mentioned analyses the following tentative conclusions can be drawn:

1) All the asbestos temper material in the samples is antophyllite; there is no positive evidence of the use of chrysotile for ceramics.

2) It seems probable that antophyllite was ob-

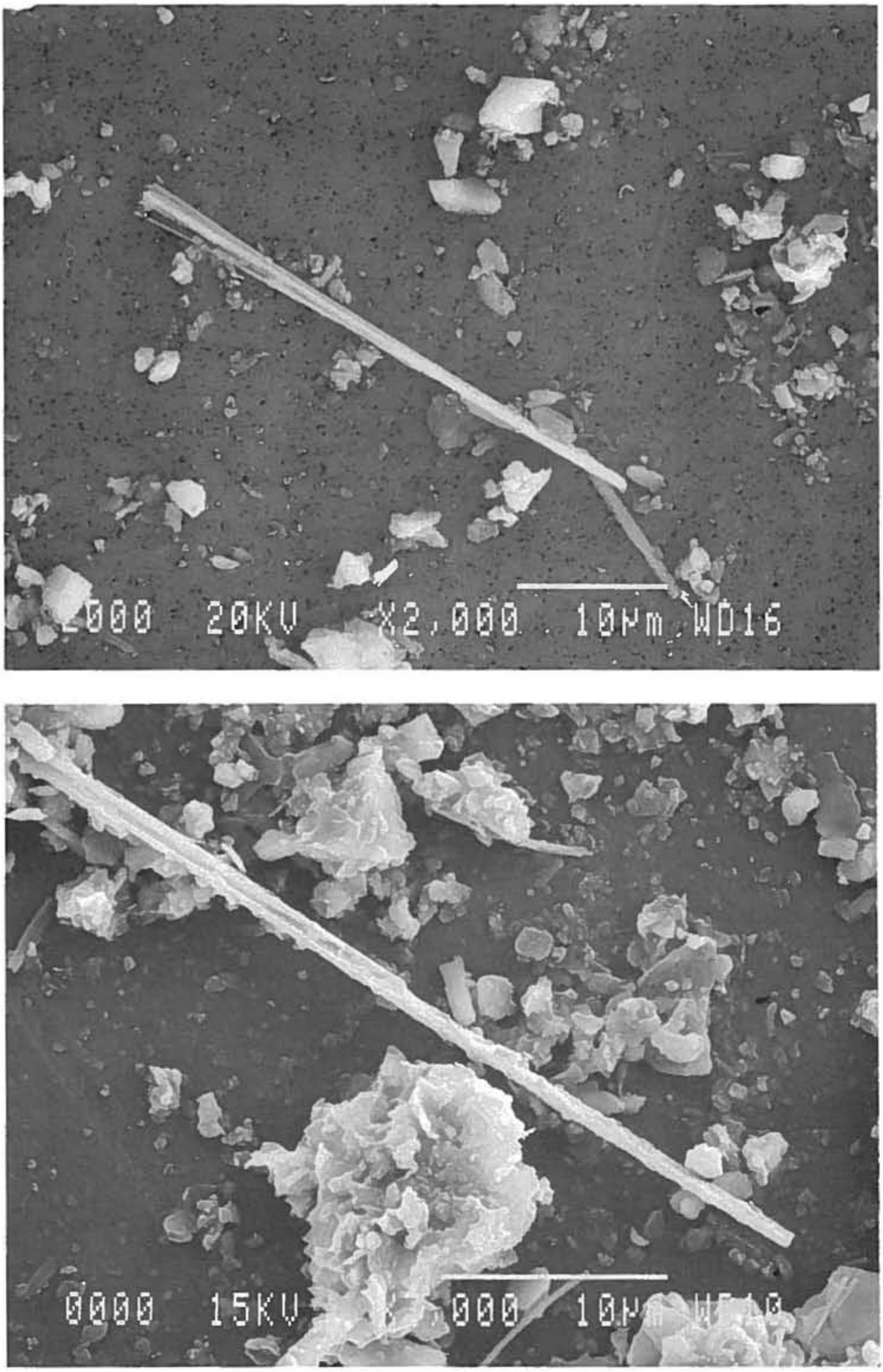

Fig. 2. Two examples of asbestos fibres in the Finnish asbestos-tempered ceramics analysed by SEM-EDS. Above: magnification 2 000 scale bar x µm; below: magnification 7 000 scale bar y µm.

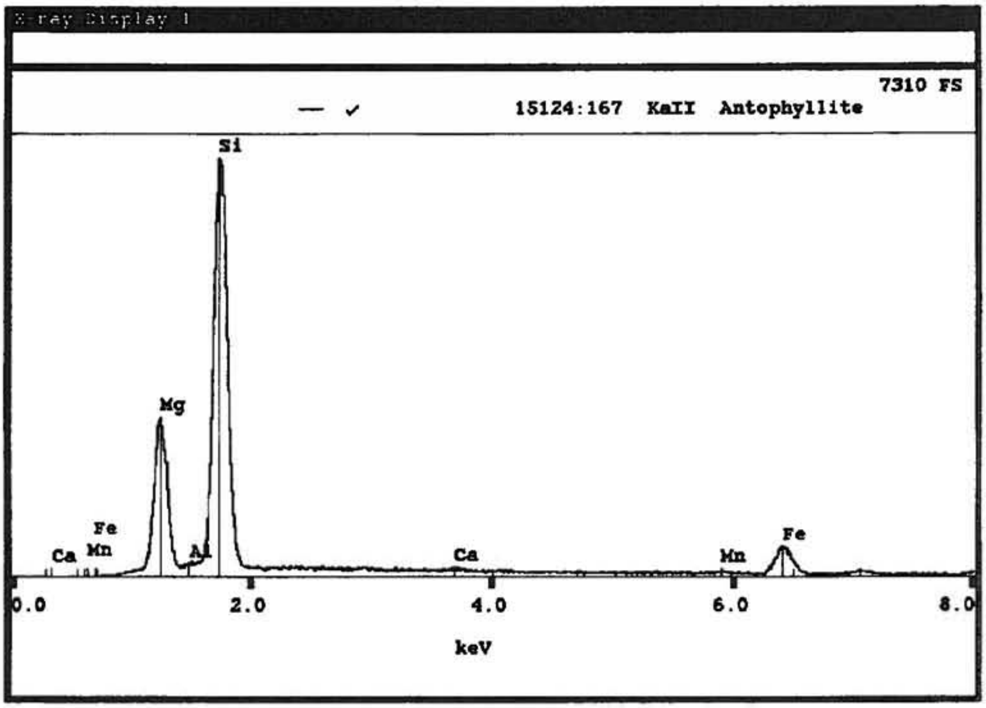

Fig. 3. EDS-spectrum of an antophyllite asbestos fibre in the Finnish asbestos-tempered ceramics. The position of the peaks along the horizontal axis identify the elements — their heights relate to the amount of each element.

tained from the deposits in the metamorphosed ultramafic rocks of East Finland.

3) It seems probable that the same raw material sources were exploited during the whole prehistoric period. There cannot be found any spatial or chronological differences in the choice of asbestos for tempering.

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