PETROARCHAEOLOGICAL AND MICROPALEONTOLOGIC CLASSIFICATION OF FINNISH FLINTY MATERIALS: A CRITICAL REVIEW

J.-P. TAAVITSAINEN

National Board of Antiquities, Box 913,
SF-00101 Helsinki

Abstract

The applicability of various geomicroscopic methods on Finnish flinty materials has been tested. Especially microfossil composition, petrographic properties and surface textures provided diagnostic observations. The results show that the prehistoric flinty artefacts of Finland are mainly composed of Carboniferous chert and Cretaceous and Tertiary flint and of jasperoid of unknown geological age.

When Stone Age trade is discussed, the student of archaeology learns early in his basic courses that the artefacts and flakes abundantly met with in Stone Age sites are either eastern (Carboniferous) or western (Cretaceous) flint, since there are no such sediments in Finland where flinty rocks could be found. So far the archaeologists have determined the origin of flinty samples primarily on the basis of the form of the artefacts, and especially on the basis of the colour of the sample. Before this work, scientific determinations of the origin have not, been carried out in Finland. International studies on the subject exist, but it has to be emphasized that, when dealing with the petrographic properties and fossil relicts of flinty rocks, they are mostly based on different material from that found on archaeological sites in Finland. It is considerably easier to determine the age of sedimentation of a whole series of a sedimentary pile than to try to determine the age of sedimentation on the basis of a few small flakes of flinty rocks.

Thus the first aim of the study has been to try to develop paleontologic and petrographic methods suitable for Finnish archaeological material in order to discover a few diagnostic features, on the basis of which archaeologists would be able to ascertain the origin of a flinty sample, if possible without destroying archaeological, often unique finds.

The second purpose of the study was to devise such methods based on surface textures which would make it possible to distinguish historical flinty material from prehistoric research material.

The following archaeological summary is based on the monograph by Kinnunen et al. (1985) to which the interested reader is referred. In it our primary observations are presented and the research methods are explained in detail.

The archaeological samples from twelve prehistoric sites have not been selected on the basis of the needs of archaeological research but in order to develop and test

DIAGNOSTIC FEATURES	ARCHAEOLOGICAL MATERIAL IN FINLAND	BALLAST FLINTS	SENONIAN - DANIAN FLINTS	CARBONIFEROUS CHERTS
FOSSILS				
CALCAREOUS ALGAES		○ ●		
CHAROPHYTES		●		
COCCOLITHS			–	
DINOFLAGELLATES		×	×	
FORAMINIFERS	× ○ ●	× ○	○ ●	●
SPONGE SPICULES	●	●	○ ●	
CORALS		●		
BRYOZOANS	●	○ ●	○ ●	●
BRACHIOPODS		●	●	●
GASTROPODS				●
SERPULIDS		●	●	●
CRUSTACEANS		●	×	
OSTRACODS				●
CRINOIDS	●			●
ECHINOIDS		●	●	
CONODONTS				●
ROCK TYPES				
FLINT	○ ●	○ ●	○ ●	
CHERT	○ ●			○ ●
JASPEROID	○ ●			
QUARTZITE	○ ●			
SURFACE TEXTURES				
GLACIAL STRIATIONS	+ ● 2)			
MECHANICAL V-PITS	+ ● 2)			
DISSOLUTIONAL FEATURES	+ ●	+ ●	1)	1)
PERCUSSION SCARS	+ ●	+ ●		
CORTEX		●		
USE-WEAR	+ ●			

EXPLANATION OF THE SYMBOLS: ● STEREOMICROSCOPY FROM NATURAL SPECIMEN SURFACES (MAGNIFICATION 10 - 100 X), ○ THIN SECTIONS (MAGNIFICATION 100 - 1000 X), – SCANNING ELECTRON MICROSCOPY, × MACERATION RESIDUE STUDIES, + INCIDENT LIGHT MICROSCOPY; 1) SAMPLES MAINLY FRAGMENTS WITHOUT NATURAL SURFACES, 2) ONLY ON JASPEROID SPECIMENS.

Table 1. Summary of the fossil groups found with the aid of palynological methods and the microtopographical features of flint, chert and jasperoid materials in the study (according to Kinnunen et al. 1985).

suitable scientific methods for dating of flinty material. Archaeological samples were compared with material originating in Denmark, USSR and old Finnish anchoring places. A great difficulty in the study was that reference samples from flint and chert mines were lacking. Consequently, the identification of types of material conserns only the possible, extensive areas of origin and the internal classification of archaeological material. A more exact localization of quarries and occurrences has to wait for reference material from Stone Age mines.

The traditional archaeological method based on colour is not reliable. In spite of their petrologic similarity chert and flint belong to a rock type occurring in such a polymorfism that in an effort to determine the origin of a sample old methods are not sufficient. The scientific methods used in the study, and the results obtained by them, are mentioned in table 1. Here the most useful methods for archaeologist will be briefly mentioned.

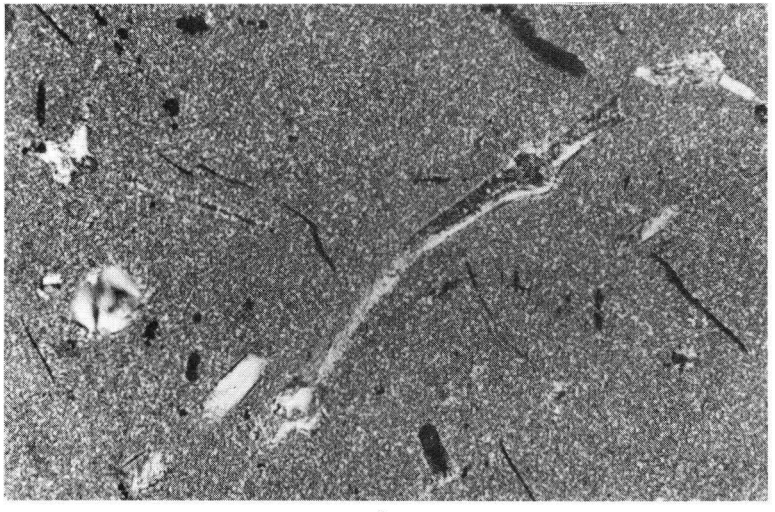
Of the paleontologic procedures, the determination of microfossils is a reliable dating method. The fossil diversity of the research material is comparatively restricted, and the use of fossils without damaging the archaeological sample is possible with the aid of the stereomicroscopy, in some cases a good magnifying glass is sufficient for solving the problem of Carboniferous v. Cretaceous. The main restriction is, however, the sporadic absence of fossils or their rare occurrence. Of the total research material approximately 50 per cent contained fossils, and rich occurrences were even rarer.

Of the different petrographic methods the grain size of the silica matrix is the best means for dating the material. The determination of the grain size offers a considerable certainty as to the date of a sample. The grain size divides the samples into four groups: Cretaceous and Tertiary flint, Carboniferous chert, jasperoid of unknown age, and quartzite. These groups are further characterized by other petrographical features, e.g. primary sedimentary and relict metasomatic features, matrix textures, silica mineral composition, accessory minerals and the mode of mineralization of microfossils. These features show more variability between the samples than the average grain size. A factor restricting archaeological use of the grain size analysis, however, is the fact that a chip has to be taken or a thin section has to be prepared out of a sample. As a matter of fact macroscopic petrographic observations were also made use of: in many cases native jasperoids can be identified with the help of characteristic unorganic structures on the surface a sample.

The purpose of examining the surface textures was to separate natural marks and man-made use-wear traces in order to distinguish historical flinty material from prehistoric material. Through an analysis of surface textures the samples were divided into gun- and tinderflints, prehistoric artefacts, ballast flints and natural pebbles and cobbles. Moreover, the observations regarding surface texture are likely to tell facts about the »industrial» history of flint and chert.

The advantage of an analysis of the surface texture is its usefulness and cheapness: it does not destroy the sample and only a magnifying glass is usually needed.

Paleontologic and petrographic procedures have not, however, solved all the archaeological problems. Unfortunately the material available for comparison has not offered possibilities of examining more closely where in the region of chert or flint the samples originate. For the same reason, there is no answer to the question whether eastern or western flints are possibly distinguishable. In addition, it has to be pointed out that it is hardly possible to differentiate historical ballast flint from prehistoric flints which have also been imported as nodules. Paleontologic and petrographic



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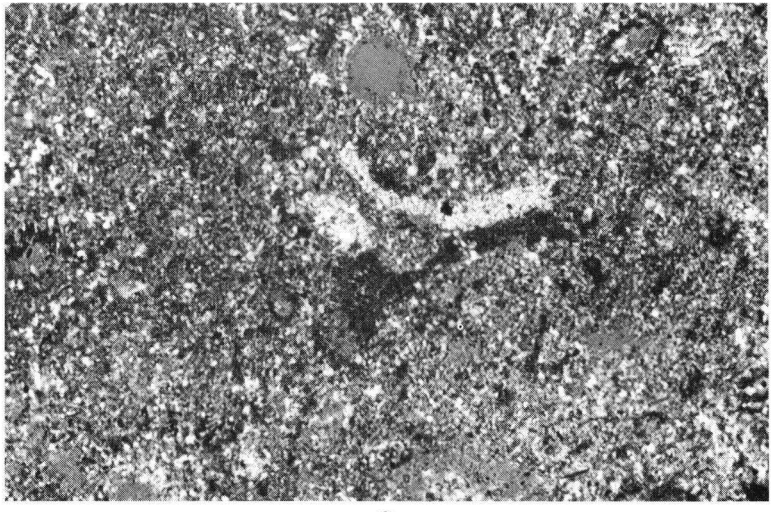

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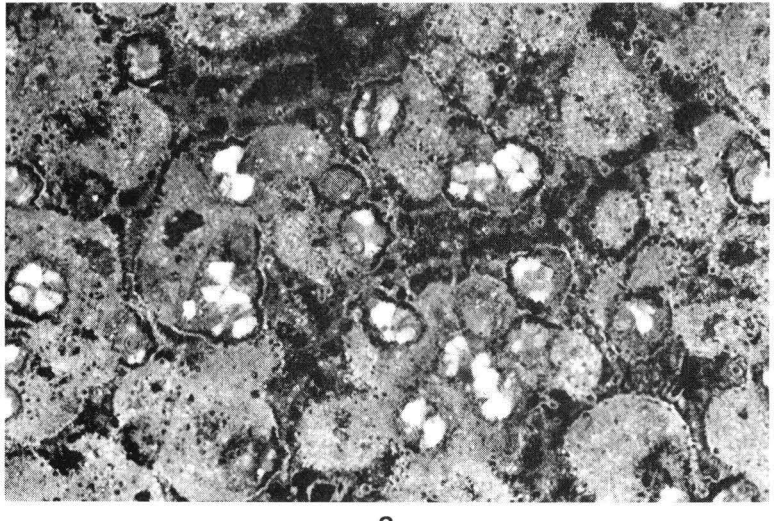

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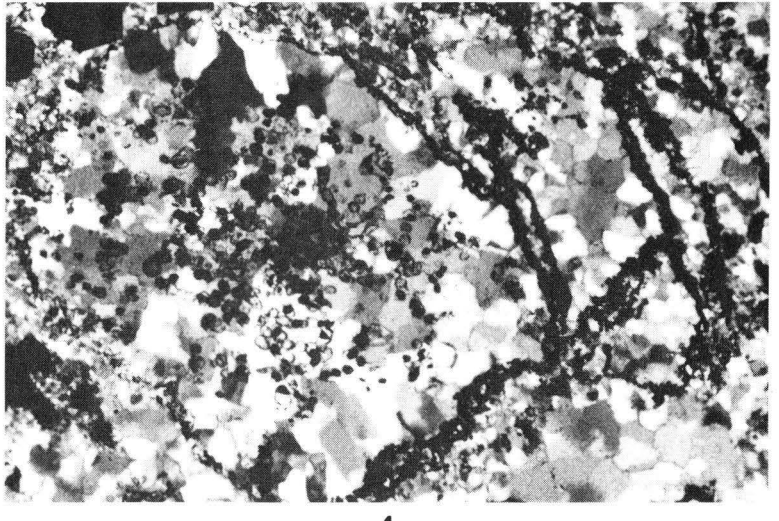

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methods have, however, diminished the sources of error in determining the origin of flinty material. Thus the age determination of flint and chert is on more secure grounds.

REFERENCES

Kinnunen K. A., Tynni R., Hokkanen K. and Taavitsainen J.-P., 1985. Flint raw materials of prehistoric Finland: rock types, surface textures and microfossils. Geological Survey of Finland, Bulletin 334.

Photo 1. Typical flint. Møns Klint, Denmark. Characterized by very fine-grained matrix material composed of chalchedony and quartz. Mean grain size 8—17 μm. Microfossils replaced by chalchedony. Photographed from a thin section. Partly crossed polarizators with gypsum plate inserted. Scale 1:150. Photo by Kari Kinnunen.

Photo 2. Typical chert. Valdai, USSR. Characterized by coarser-grained matrix material composed of quartz, chalchedony and carbonates, mean grain size 22—44 μm. Microfossils mainly composed of carbonate minerals. Photographed from a thin section. Partly crossed polarizators with gypsum plate inserted. Scale 1:150. Photo by Kari Kinnunen.

Photo 3. Typical jasperoid. Vuotso, Finland. Large chalchedony sferulites in relatively coarse-grained matrix material composed of chalchedony and quartz, mean grain size 3—10 μm. No microfossils found. Photographed from a thin section. Partly crossed polarizators with gypsum plate inserted. Scale 1:150. Photo by Kari Kinnunen.

Photo 4. Typical quartzite. Kittilä, Finland. Relatively coarse-grained metamorphic chert composed of quartz as the only silica mineral. Mean grain size 32—270 μm. No microfossils found. Photographed from a thin section. Partly grossed polarizators with gypsum plate inserted. Scale 1:150. Photo by Kari Kinnunen.