

PETROFABRICS AND CLASSICAL ARCHEOLOGY

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ABSTRACT. Petrofabrics is applied to two problems of classical archeology: determining provenance of building and statuary marble, and assembling inscriptions. Parian lychnites marble is found to have a weakly oriented fabric, Naxian and Delian marble a very strongly oriented fabric with one great maximum. Pentelic and Hymettian marble also have distinctive fabric patterns. Fabric work on inscription fragments indicates that differing patterns are from different inscriptions, but similar patterns may indicate only a contemporaneous origin for separate inscriptions.

INTRODUCTION

This paper is not a contribution to the basic data of petrofabrics, but rather a diverting application of petrofabric methods to two typical problems of classical archeology. The prime problem concerns itself with the origin of different statuary and building marble. The second problem has to do with assembling inscription fragments.

Archeologists have long known that marble was quarried in ancient Greece at certain sites and at definite times. They know that most of the early marble came from the island of Naxos; later a beautiful translucent variety was discovered and mined on the island of Paros, and called lychnites, from *λύχνος*, lamp, because lamps were used in the underground workings. Finally, during the golden age of Athens, marble was discovered on Mount Pentelikon, in Attica, which supplanted island marbles as a building stone. Since all varieties were selectively quarried with the same standard in mind, that is, purity of color, they are difficult to tell apart. In fact, no simple petrographic method has yielded definitive criteria for any one marble. Petrofabrics was tried in the hope that each marble might prove to have a distinctive fabric.

An interesting digression from this main problem was furnished by an epigrapher, W. K. Pritchett, who was trying to assemble fragments of different inscriptions. His first problem was deciding which fragments belonged together, before he could start assembling the separate inscriptions. His quandary is similar to the family's at Christmas, doing jig-saw puzzles after Junior has mixed several sets together. Petrofabrics was used to see if the different inscriptions had distinctive, or differently oriented fabrics; if so, then important pieces could be assigned on the basis of their own particular fabric.

The opportunity for this study was provided by the Fulbright Act, during 1951-1952, when the author was a Research Scholar in Geology in Greece.

The author is expressly indebted to Professor Ernst Cloos for first suggesting to him that classical archeo-geology might prove to be an interesting research, and for his unflinching interest in the author's own progress in the field. Assistance and encouragement should also be acknowledged from Professors H. W. Fairbairn, A. N. Georgiades, Bruno Sander, H. A. Thompson, and Francis J. Turner. Professor Fairbairn also kindly read and criticized the manuscript. The author's wife, Rhoda Herz, drafted figure 2.

PROCEDURE

Oriented specimens were collected from ancient quarries on the islands of Naxos, Paros, and Delos in the Cyclades, and from Mounts Pentelikon and Hymettus in Attica for the primary study (fig. 1). To assist the epigrapher, pieces were cut from the back side of inscription fragments, then wafers for thin sectioning were sawed from these pieces perpendicular to the inscription face and parallel to the inscribed lines. On the finished inscription thin sections a barbed arrow pointed to the left margin, and the barb to the top. Oriented thin sections were also prepared from the quarry samples.

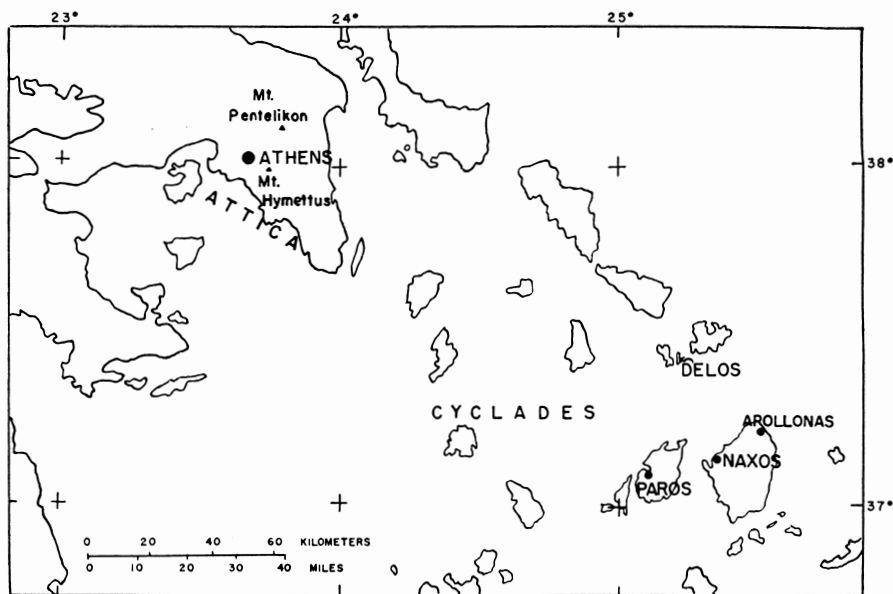


FIGURE 1. INDEX MAP.

The fabric diagrams were prepared at the Mineralogische-Petrographische Institut in Innsbruck and at the mineralogy laboratories of the University and the Greek Geological Service in Athens. Poles to (0112) composition planes were plotted for each thin section; the total number of plotted poles varied from 150 for an inscription to 400 for the Parian marble.

ATTIC MARBLES¹

Pentelic marble.—The type locality for the classical Pentelic marble is the ancient quarry of Spilia Daveli on the southern slope of Mount Pentelikon. Five gradational types of marble are found:

- (1) marble breccias, best developed near the base of the mountain,
- (2) schistose marbles, found especially about the schist-marble contacts,
- (3) white, medium-coarse-grained marbles, aesthetically "Pentelic," and the Pentelic marble of this study,

¹ These next two sections are abridged from Herz, 1951, p. 16-28.

(4) banded blue and white, or medium- and coarse-grained marble, aesthetically "Hymettian," and

(5) dolomitic marble, finer grained than any of the others.

Type (3), white marble, was selectively quarried in antiquity, and is also the "Pentelic marble" of most archeological descriptions. It is typically well foliated, the plane of foliation indicated by muscovite or chlorite. Grain size may also vary in bands parallel to the folia, coarse grains measuring 0.6 by 0.8 mm alternating with fine to medium grains. Quartz, graphite, and magnetite or pyrite may occur in minor amounts.

Hymettian marble.—The type locality for the classical Hymettian marble is about the lower reaches of the Kakorhevma on the western slope of Mount Hymettus, in an area of old Roman quarries. The same general marble types are found here as on Mount Pentelikon, though the banded marbles (4), "Hymettian marble" of most archeologists, dominate in the quarries. These rocks tend to be finer grained than the Pentelic and are not very translucent. The best Pentelic is translucent through a 15 mm diameter, Hymettian through only 5 mm (Lepsius, 1890, p. 47). The color banding is apparently due to abundant included carbonaceous material in certain bands. For more on the Hymettus-Pentelikon relations, see Herz and Pritchett, 1953, p. 73-76.

ISLAND MARBLES

Introduction.—Most marbles from the Cyclades Islands are coarse to very coarse to granular and lack a well-defined foliation plane. These two criteria are the best for differentiating island from Attic marbles, although they are not infallible. Thus, Parian lychnites marble may be about equigranular to Pentelic, but is much more translucent. Accessory minerals, abundant in Attic marbles, are generally not as common in the island varieties.

Parian marble.—Most of the marble quarried on the island of Paros was obtained in the valley of the present-day Aghias Minas, about 5 kilometers east of the town of Paros. The lychnites marble was mined in a bed that is only 3 meters thick and dips to the east 35°, an extremely steep slope for primitive mining operations. The rock is a remarkably pure crystalline calcite marble. Accessory minerals are not seen, and the calcite grains themselves have rather uniform dimensions. Most of the grains are about 1 to 2 mm in diameter, though many range down to about ½ mm, about the dimensions of Pentelic marble; the Parian marble lacks a well-defined foliation, however. The lychnites marble is translucent through a thickness of about 35 mm (Lepsius, 1890, p. 47) and was the most popular statuary marble of Greek antiquity because of its high translucency and purity, and the fact that it could be worked comparatively easily. There was little danger of a nearly finished work splitting on a well-developed foliation plane, nor of a cluster of splotchy black magnetite crystals coming to light in a prominent area.

Other Parian marble was quarried on the west side of the same valley of Aghias Minas and in another valley, a little over 3 kilometers east of the town of Paros. These types are similar in hand specimen to Naxian marble.

Naxian marble.—Most of the ancient workings of Naxos were on the northeast coast of the island, to the west of and about the town of Apollonas.

This marble lacks a well-defined foliation plane, is coarse to granular, and commonly shows dark gray bands of included carbonaceous matter in the otherwise white marble. The volume of accessory minerals is highly variable; muscovite, quartz, and graphite are normally present, and biotite, hornblende, magnetite, and lime silicates including grossularite occur where the marble is interbanded with gneiss. The Naxian marble is not nearly as translucent as the lychnites.

Delian marble.—Marble was quarried in small pits on the island of Delos and may have been used locally. It is generally indistinguishable from the Naxian marble in hand specimen.

FABRIC OF THE QUARRY MARBLES

Preliminary fabric work shows promising results. The diagrams presented here are not offered as final, but rather as suggestive of the lines that future work should follow.

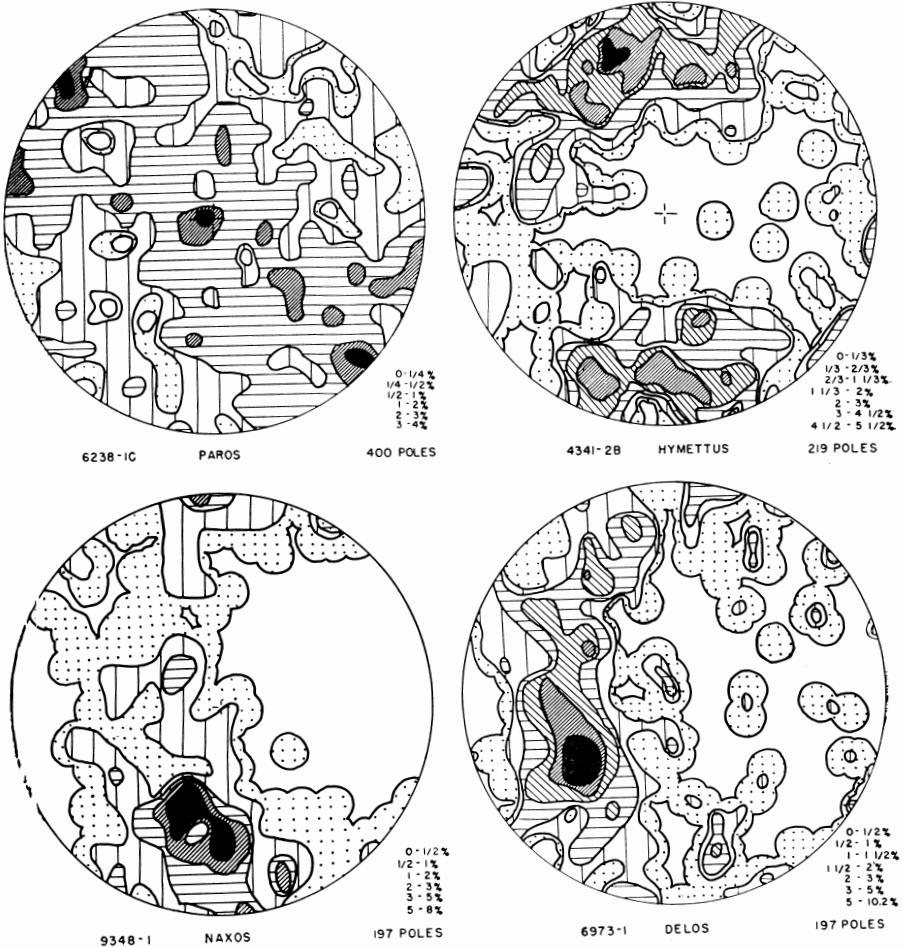


Fig. 2

Parian lychnites marble (fig. 2, 6238-1C) has a fabric that is weakly oriented, in a broad girdle pattern with only two maxima. The thin sections show an excellent foliation formed by rectangular calcite grains, in bands, with a definite though slight elongation to them. The larger grains, averaging 1.6 by 1.3 mm, tend to a rectangular shape; the smaller, averaging 0.40 by 0.35 mm, are more sutured. Very fine disseminated carbonaceous matter is seen throughout the slides.

Naxos Apollanas marble (fig. 2, 9348-1) yields a very strongly oriented fabric in a narrower girdle, and with only one very great maximum. In thin section it shows no apparent foliation, and grains vary from very coarse, 3.0 by 2.0 mm to fine, 0.6 by 0.3 mm. Abundant opaques, such as limonite and pyrite, comprise the accessories.

The Delian marble, (fig. 2, 6973-1) has a fabric that is similar to the Maxian marble. It is also similar in thin section.

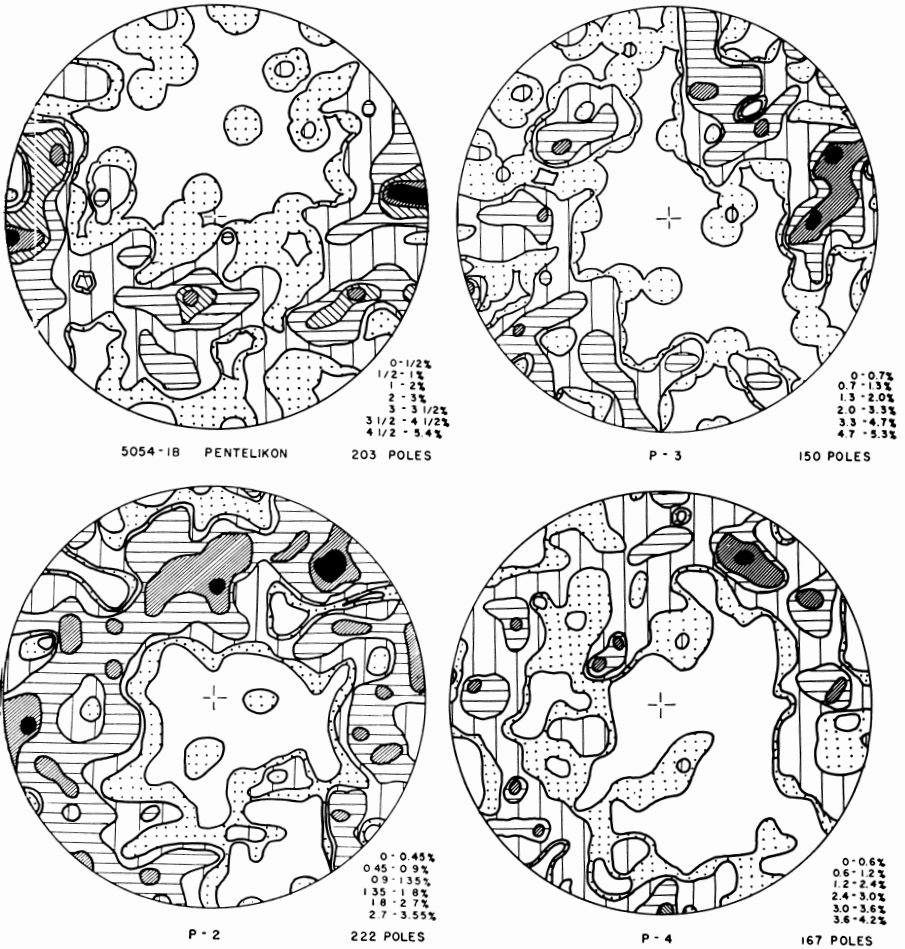


Fig. 2 (cont.)

Pentelic Spilia marble (fig. 2, 5054-1B) yields a fabric with a very strong incomplete girdle, and with several maxima, very different from any of the island marbles. The thin section shows grains varying from about 0.70 by 0.60 mm to 0.35 by 0.25 mm. Carbonaceous matter is abundant; muscovite and quartz are also present.

Hymettian Kakorhevma marble (fig. 2, 4341-2B) shows a strongly oriented fabric in a weak girdle and with one or two maxima. In thin section it is fine to medium grained and layered, with fine-grained graphite-rich bands or alternating fine- and medium-grained bands.

FABRIC OF THE INSCRIPTIONS

As a test of the method, three thin sections were studied, two belonging to one inscription and a third to another. It was known that both inscriptions were made about the same time, so it was possible that both slabs were quarried about the same time.

The resulting fabric from all three thin sections is remarkably similar, and also similar to the Pentelic Spilia fabric, 5054-1B. In figure 2, P2 and P3 are fragments from the same inscription; P4 is from a second inscription. A logical conclusion is that both slabs were cut in the Spilia quarry about the same time, and probably from the same block. Then they were shipped to the inscriber who preserved the quarry's orientation. The fact that both inscriptions have identically oriented fabrics almost suggests a "mass production" of slabs in the ancient quarry, with top and bottom clearly indicated to the purchaser.

CONCLUSIONS

Any device that can differentiate the different marbles used in classical antiquity will be a powerful tool for archeology. Since the different sources of marble are well dated, if the device can unequivocally assign a source to any given building or statuary marble, then limiting dates for its construction can be assigned. Because of gradations of grain size, color, accessory minerals, and structures in each quarry, simple petrographic methods, though suggestive, do not provide unequivocal answers (Herz and Pritchett, 1953, p. 83).

Fabric studies, as far as they now go, indicate different patterns for the lychnites statuary marble of Paros, for the marble of Naxos and Delos, for Pentelic marble, and for Hymettian marble. If further studies bear out these indications, then many perplexing archeological problems, such as the date of construction of the Treasury of the Athenians at Delphi, might easily be solved by determining the source of the building stone used.

Fabric must be used with utmost discretion as an aid to epigraphy. Under ordinary circumstances, two fragments with dissimilar fabrics could not belong to the same inscription, but fragments with similar fabrics may merely be products of the same period.

Editor's note:

After the completion of this manuscript, the author learned of the paper by Weiss (1954) which explores in detail the use of petrofabrics in assembling inscriptions here only touched upon. By oversight Weiss and the author were each unaware that the other was pursuing the problem further. Both used specimens collected by Herz, but, unfortunately, Weiss did not have Herz' orientation data.

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