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ANCIENT MONUMENTS LABORATORY

REPORT

3115

SERIES/No	CONTRACTOR
AUTHOR	Dr D F Williams June 1980
TITLE	The petrology of certain Byzantine Amphorae; some suggestions as to origins

THE PETROLOGY OF CERTAIN BYZANTINE AMPHORAE: SOME SUGGESTIONS AS TO ORIGINS

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INTRODUCTION

It is well-known that a study of amphorae can often provide invaluable evidence of economic activity not easily available from other classes of vessel. These large two-handled container jars were used primarily for transporting a variety of merchandise over long distances, and information on the classical ecomony and the trade routes employed can be obtained from an appreciation of the goods carried and their point of origin. Of lesser importance generally is the ability of many amphorae types to provide close dating evidence when found in stratified contexts, for common forms such as the Spanish globular type (Dressel 20) or the Greco-Roman type (Dressel 2-4) had a long life with little typological variation. Even a broad date-range, however, can be useful when other evidence is lacking, and one thinks of the Italian Dressel 1 amphorae which is only found in Britain in late Iron Age contexts (Peacock,1971a).

The origins and contents of many amphorae are as yet unknown, and in this paper the writer is concerned with three such distinctive types of Byzantine amphorae which occur on many Mediterranean sites, including Carthage, as well as an increasing number of sites in Western Britain (Fig.1). The date-range of these amphorae covers roughly the period from the late fourth century A.D. to the mid seventh century (see Fulford and Peacock, forthcoming). Due in part to their unknown origins and wide distribution, several forms of classification are in common use. The nomenclature adopted here is that of Radford (1956) and Thomas (1959), who sub-divided the post-Roman amphorae from the monastic site of Tintagel, Cornwall, into four main types, reflecting a range of different fabrics and typological traits. The term Bi refers to an amphorae of globular form with close-set grooving on the upper part of the body (Carthage Late Amphorae 2; Kuzmanov Type 19); Bii is an ovoid type with widely-spaced ribbing (Carthage Late Amphorae 1; Kuzmanov Type 13; Ballana Type 6); and Biv is in a highly micaceous fabric with characteristic strap-handles (Carthage Late Amphorae 3; Kuzmanov Type 7; Ballana Type 13a). At Tintagel Biii is a typologically ill-defined group which now seems to include a variety of fabrics and will not be considered here.

Large numbers of each of the three amphorae types are to be found in particular in the area of the Eastern Mediterranean and Black Sea. However, although there is general agreement amongst researchers that the amphorae are likely to have originated in this region, no kilns producing these late forms have been located, and there has been considerable speculation as to the precise production areas involved. In recent years the Bi form has been ascribed to an origin in the Greek Islands (Thomas,1959,92), in the vicinity of the brick kiln at Oltina, Roumania (Alcock,1971,204), the Bodrum region of Turkey (Radulescu,1973,205) and the Eastern Aegean (Hayes,1976,116); while the Bii has been attributed to the Greek Islands (Thomas,1959,93), Egypt (Hayes,1976,116) and Cyprus (Lang,1976,58); and the Biv to Egypt (Grace,1961,fig.67), Byzantium (Thomas,1976,246-247) and Western Asia Minor (Hayes,1976,117).

In view of the wide discrepency of the suggested source areas for these amphorae, it seemed worthwhile to the writer to embark on a programme of petrological analysis. The object of the examination being firstly to more closely characterize the fabrics involved, and secondly to see if it is possible to indicate likely production centres. In the recent past the application of petrology to help solve problems of source areas for certain amphorae, mainly carried out by David Peacock (1971a; 1977a; 1978), has often yielded positive results, and the method has obvious advantages over the more traditional strictly typological approach to amphorae studies (see Callender, 1965).

MATERIALS AND METHODS

The sherds selected for petrological examination were chosen from material from Carthage and Berenice in North Africa and Tintagel and Trethurgy in South-West England.

The only published analytical work on the late amphorae forms under review has been petrological thin sectioning by David Peacock (1971b) of Bi and Bii types from Glastonbury Tor, Somerset, England. The results showed that both fabric types were clearly distinct and came from different geological locations. Bi is characterized by limestone and mica, indicating a source area of sedimentary rocks; while Bii contains pyroxene and limestone, indicating a source area of basic igneous and sedimentary rocks. As these non-plastic inclusions are fairly common in the Eastern Mediterranean and Black Sea region, it was not possible for Peacock to be specific about likely sources for either of the amphorae types.

In view of these results, heavy mineral separation was considered by the writer as a valuable alternative means of analysis in the hope of further geologically restricting the production areas involved. This valuable petrological method relies on the fact that heavy minerals occur in varying amounts in sediments, sands in particular, and so are usually to be found in sand tempered pottery. Distinctive combinations of heavy minerals, or certain individual species, can often help to characterize pottery, and sometimes indicate the geological system to which the sand is related.

The process of separating out the heavy minerals from a sample of pottery is a fairly long and laborious task. The sherd needs to be gently crushed with a pestle and mortar until all the grains can be passed through a sieve of an appropriate size. A 500µ mesh is suitable for very sandy wares, while a mesh size in the range 200-60µ is recommended for finer-textured pottery. The powdered sample is then introduced to a heavy liquid such as bromoform or tetrobromethane (specific gravity 2.89). After separation from the clay and light minerals, the heavy minerals can be mounted on a glass slide and studied under the petrological microscope.

The most rewarding results achieved by this method have usually been carried out on very sandy wares, which normally yield a large assemblage of heavy minerals, e.g. Romano-British black-burnished ware (Williams,1977) and certain Spanish amphorae types (Peacock, 1971a). However, some of the late amphorae dealt with in this paper are fairly fine-grained in texture, and it was found that with these fabrics the normal 'settling' method of separating out the heavy minerals described above, produced too few grains for a meaningful assemblage. Instead, the majority of samples were centrifuged to help separate the heavy minerals from the clay and lighter minerals (Williams,1979), and this was found to greatly increase the numbers of grains recovered.

TYPOLOGY, FABRIC AND ORIGINS

Bi Amphorae (Fig.1 : Carthage Late Amphorae 2; Kuzmanov Type 19)

This form has a globular body with a small basal knob, a short stocky neck and a straight-everted rim. A scheme of deep horizontal grooves set close together appear on the upper part of the vessel, these are commonly straight but a wavy variety also occurs (Hayes,1973,116). Hard, buff to creamy-pink fabric, inclusions of white limestone are commonly visible. The time-span for this type appears to have been a fairly long one, from the late fourth century to the mid seventh (Fulford and Peacock,forthcoming).

Heavy mineral separation on this type of vessel has given disappointing results, even with centrifuging, as the heavy mineral residue achieved has been too small to allow any conclusions to be drawn. In view of this, a number of Bi sherds from Carthage, Tintagel and Trethurgy were thin sectioned instead. While the majority agreed with the petrological description given by Peacock (1971b) for the Glastonbury Tor samples, i.e. mainly limestone and mica, a few sherds differed from this and contained fragments of volcanic glass, together with a small amount of felspar, chert and siltstone. It is possible that inclusions of limestone may also have originally been present in this pottery but have since disappeared due to unfavourable soil conditions. In the hand-specimen it is virtually impossible to distinguish between sherds from the two petrological groups, and so it seems more likely that the Bi fabric was made in an area which includes both sedimentary and volcanic formations, rather than contemplate two separate areas of origin.

A source for the Bi amphorae fairly close to the coast might be expected, as the distribution pattern suggests a seaborne trade in these vessels (Thomas,1959,92; Hayes,1973,116). The volcanic areas of the Aegean situated in coastal regions include many of the Greek Islands, Northern Greece, and in Asia Minor the North-West area and the Bodrum region. Volcanic rocks can also be found on the Bulgarian coastline of the Black Sea, though Alcock'(1971,204) suggestion of a Bi source further north on the coast of Roumania in the vicinity of the Oltina brick kiln can be ruled out, as this is a non-volcanic area.

<u>Bii Amphorae</u> (Fig.1 : Carthage Late Amphorae 1; Kuzmanov 13; Ballana Type 6)

This is an ovoid type with a rounded base, broad neck and thickened rim, with thick stumpy handles. Widely-spaced ribbing appears at the mid-point of the body, gradually narrowing at the shoulder and base of the vessel. Hard, reddish-buff to yellowish-cream, fairly sandy fabric. There seems to be some slight variation in the percentages of inclusions present, but no real difference was noted under the microscope. The period of activity of this type runs from the late fourth century to the mid seventh (Fulford and Peacock, forthcoming).

The heavy mineral suites from the Carthage, Berenice, Tintagel and Trethurgy samples analyzed are dominated by pyroxene, mostly diopside and enstatite, to the virtual exclusion of other minerals (Table 1). An examination of the thin sections of these four samples, and others from the four sites, show that in addition to pyroxene and limestone found by Peacock (1971b) in the Bii amphorae from Glastonbury Tor, the sections also contain grains of serpentine, which points to a source area of ultra-basic rocks (serpentine has also been noted by Peacock in the better preserved Carthage Bii amphorae. Pers. Comm.). This agrees with the heavy mineral assemblage. The presence together of diopside and enstatite, and the comparative lack of other minerals, especially zircon, suggests derivation from peridotite, an ultra-basic rock.

Ultra-basic rocks have a fairly restricted distribution in the Eastern Mediterranean and hardly appear at all around the Black Sea area. There are small outcrops on Cyprus, Lesbos and Euboea, while larger tracts are to be found along the South-West coast of Asia

Minor and Northern Syria. Some ultra-basic rocks occur in Egypt, but not in the north of the country where one might expect the production of such a frequently found amphorae to be sited.

If olive-oil was carried in the Bii amphorae, as has been suggested (Thomas,1959,92), a source in North Africa, the traditional suppliers of this commodity to the West, seems unlikely given the petrology of the Bii type. Instead, it is tempting to see the Bii amphorae originating from the Antioch region of Northern Syria, which is suspected of being the centre of a large olive-oil export trade during the fifth and sixth centuries A.D., and which may well have lasted into the seventh century (Liebeschuetz,1972,79-81). It is possible that the diopside/enstatite sand present in the Bii forms may have derived from the large ultra-basic formations to the north of Antioch. The presence of oil-amphorae from the Eastern Mediterranean at Carthage, itself a noteable exporter of olive-oil, might possibly be explained in differences of quality. However, such a view is speculative until Eastern comparanda has also been analyzed. In this context it should be pointed out that Cyprus, another of the likely geological areas, has also been suggested as an origin for the Bii on the basis of painted inscriptions on Bii sherds at Athens that bear the Cypriot modius (Lang,1976,58).

Biv Amphorae (Fig. 1 : Carthage Late Amphorae 3; Kuzmanov Type 7; Ballana Type 13a)

This form has a long slender neck with two short strap-handles, high rounded shoulders and a tapering foot. A broad shallow ribbing covers most of the vessel. Deep red or reddish-brown, highly micaceous fabric, fairly thin-walled. A similar form of micaceous amphorae, but with only one handle, occurs in pre-fifth century contexts (Lang,1955; Robinson,1959,M255; Peacock,1977b), and small body-sherds belonging to this type may be confused with those from the later, possibly related, fully developed Biv form. The two-handled version first appears in the late fourth century and seems to last until the mid seventh century (Fulford and Peacock, forthcoming).

Thin sectioning of samples of Biv fabric from Carthage, Tintagel and Trethurgy, shows little else but numerous inclusions of mica and quartz grains. Four samples were selected for heavy mineral separation, three from Tintagel and one from Carthage (Table 1). The results show that the Tintagel sherds are all very similar, each having a practically monomineralic suite of dahllite grains, indicating that they were made in the same area (this fairly rare heavy mineral proved difficult to determine by petrological tests alone, and was identified by X-ray diffraction). The large amount of dahllite, a variety of apatite, is unusual, as dahllite/apatite rarely dominates an assemblage to the virtual exclusion of other heavy minerals. Dahllite normally occurs as a secondary mineral in phosphorite (Kerr,1959,232), though in this case the large size of the grains and the good euhedral form suggests an igneous source rather than a sedimentary one. The sample from Carthage displays a quite different composition to this, containing fairly large amounts of garnet and kyanite, indicating a metamorphic area of origin.

On this basis, an origin for the Biv amphorae in Western Asia Minor (Hayes,1976,117) with its great variety of igneous, volcanic and metamorphic formations appears much more attractive than either Byzantium (Thomas,1976,246) or Egypt (Grace,1961,fig.67). The area around Byzantium is composed mainly of Devonian rocks, while the north of Egypt is made up predominantly of sedimentary rocks (again assuming a source fairly close to the coast). However, phosphatic deposits are recorded in Egypt (Said,1962), so the latter area cannot entirely be ruled out as a source for the dahllite present in the Tintagel samples. Similarily, another igneous/metamorphic source besides Asia Minor is equally possible. Eastern comparanda or geological samples from suspected areas are necessary if the production centre(s) are to be tied down with any confidence.

CONCLUSIONS

The petrological examination of Bi, Bii and Biv Byzantine amphorae has now gone some way in characterizing in detail the fabrics for each of these types, and in considerably narrowing down the likely geological production areas involved. In particular, this present study has shown that heavy mineral separation on Bii and Biv forms has allowed the fabrics to be more closely characterized than is possible through thin sectioning alone. Enough petrological information is now available to identify Bi and Bii types when these are present as only small undistinguished body-sherds. This latter point, for instance, may well be of crucial importance when assigning a British site to a post-Roman date on the evidence of the amphorae alone. It is possible that this may also apply to body-sherds of the Biv type, though in this context heavy mineral separation urgently needs to be carried out on the earlier micaceous one-handled amphorae to see if it can be distinguished from the later two-handled form (Peacock,1977b).

It is, however, still a matter for conjecture as to exactly where these three distinctive types of late amphorae were made, although it is to be hoped that the results presented here will allow the search for origins to be concentrated in reasonably well-defined areas. Clearly the next step is to obtain suitable comparanda from suspected production areas to see if this material can be matched to the petrology of the Bi, Bii and Biv fabrics, so that the source in each case can be satisfactorily tied down.

ACKNOWLEDGEMENTS

Samples of pottery for analysis were generously provided by Dr. David Peacock of the British Excavation Team at Carthage, Dr. John Riley, Mr. H.L. Douch, Curator of the Truro Museum, Mrs. Henrietta Miles, and DOE Plymouth. Thanks are also due to Nick Bradford, Department of Archaeology, University of Southampton, for taking the photomicrographs. I have been able to benefit from much useful discussion with Drs. David Peacock and John Riley, who both kindly read and criticized a draft of this paper, though the writer must alone retain responsibility for the views expressed.

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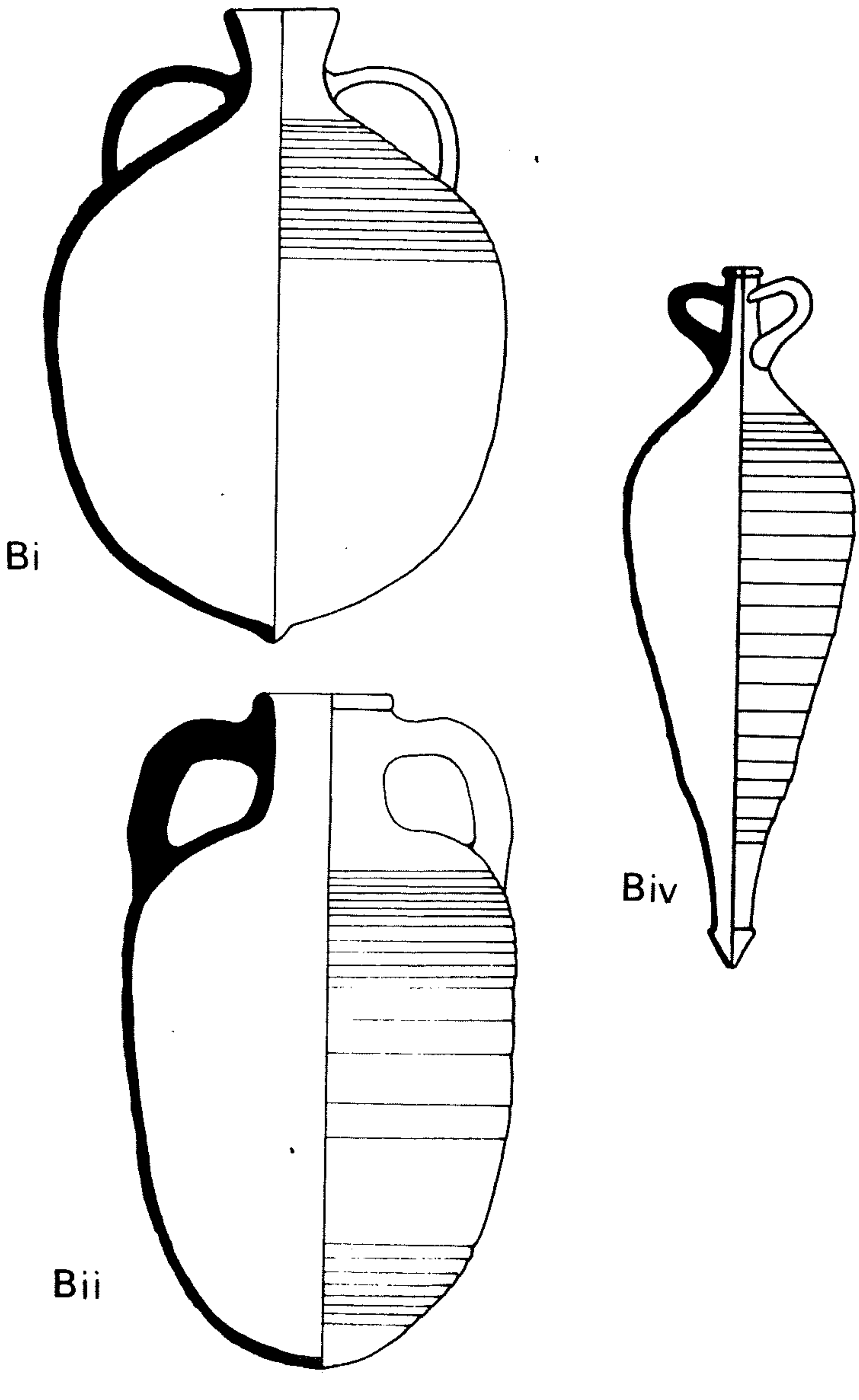


Fig. 1. Bi, Bii and Biv types of amphorae ([illegible]).

TABLE : Heavy Mineral Results

No.	Type of Vessel	Site	Total Count of Non-Opaque Minerals											
			Zircon	Tourmaline	Garnet	Rutile	Andalusite	Kyanite	Apatite	Mica	Pyroxene	Dahllite	Unidentified	No. grains counted
1	Bii amphora	Carthage	-	-	-	-	-	-	-	-	539	-	28	567
2	Bii amphora	Berenice	-	-	-	-	-	-	-	-	681	-	42	723
3	Bii amphora	Tintagel	-	-	-	-	-	-	-	-	566	-	31	617
4	Bii amphora	Trethurgy	-	-	-	-	-	-	-	-	420	-	26	446
5	Biv amphora	Tintagel	-	-	-	-	-	-	-	-	-	331	32	363
6	Biv amphora	Tintagel	-	-	-	-	-	-	-	-	-	924	78	1002
7	Biv amphora	Tintagel	-	-	-	-	-	-	-	-	-	764	26	790
8	Biv amphora	Carthage	28	2	133	23	-	74	4	9	-	-	-	288

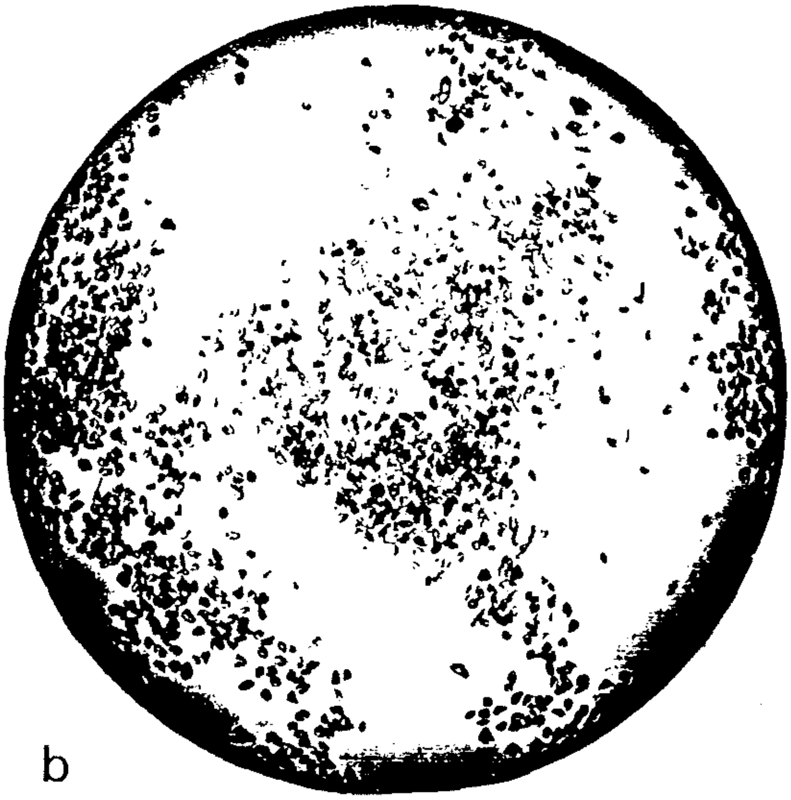
PLATES: heavy mineral photomicrographs of Bii and Biv amphorae

a) Bii amphora, Tintagel. Numerous large grains of pyroxene (diopside and enstatite - some masked by staining). Plane polarized light (x 65).

b) Biv amphora, Tintagel. Abundant small grains of dahllite. Plane polarized light (x 45).

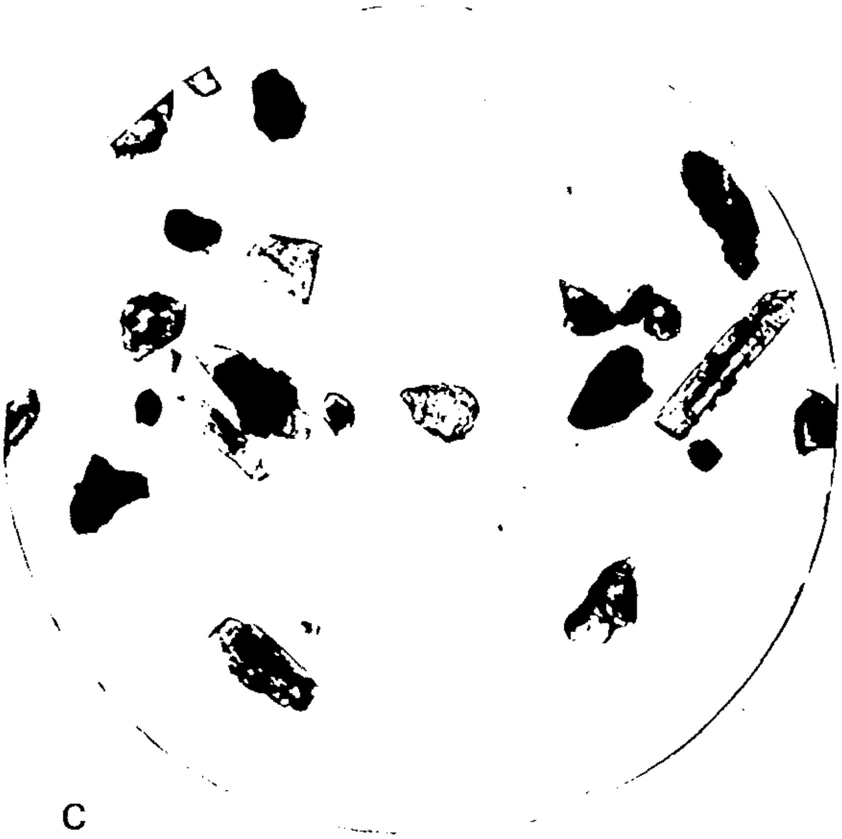
c) Biv amphora, Carthage. Large grains of garnet (irregular-shaped) and medium-sized kyanite (bladed). Plane polarized light (x 65).

a



b

Plates: heavy mineral photomicrographs of Bii (a= x65) and Biv (b= x45) amphorae (N. Bradford)



C

Plate: heavy mineral photomicrograph (x65)
of Biv amphora (N. Bradford)