replaces chalcopyrite. Therefore, in the ores studied, the number of inclusions of chalcopyrite has apparently not been influenced to a noticeable degree by the host mineral.

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HEAVY MINERALS OF THE COASTAL PLAIN OF MARYLAND

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The Coastal Plain of Maryland and contiguous states has been almost neglected by workers in sedimentary petrology. The one notable exception to this statement is furnished by Goldman's work on the Upper Cretaceous.[1] Wentworth and Campbell have considered, in a general way, the mode of formation of the Pleistocene terraces, omitting, however, any account of the heavy minerals contained therein.[2]

Lately, there have appeared two papers, one of which has for its purpose the description of minerals of the coastal terraces of Virginia (based on Wentworth's collections),[3] and another which makes passing reference to the mineralogy of the Eocene greensands of Virginia.[4] The present author wishes to animadvert on certain conclusions and methods found in these two papers, and to show the bearing on the problem of results attained in studying Maryland deposits of the same age. It is hoped that these results may be published in much greater detail later.

Eocene: Gunnell and Wilgus describe a modern beach glauconitic sand, confusingly said to have been collected from a shore bluff in the Aquia formation.[5] Their percentages show not a single typical heavy mineral, other than "ores," present. Glauconite, which may sometimes fall into the category of heavy minerals, composes 40 per cent of the sample.

The writer has examined ten samples of the Eocene from parts of southern Maryland adjacent to Virginia. The heavy mineral content of these samples is remarkably consistent in its general character, and may be averaged, for this purpose, as follows:

(Opaques—very large percentage,—not considered)

Zircon	35%
Staurolite	30%
Garnet	8%
Rutile	8%
Epidote	7%
Tourmaline	6%
Kyanite	3%
Chloritoid	2%
Sillimanite	1%

In addition, there are found occasional grains of andalusite, corundum, topaz, brookite, dumortierite, monazite, glaucophane, anatase, zoisite, titanite, muscovite, chlorite, hypersthene (?), and clinozoisite (?).

Gildersleeve states that, "The minerals commonly associated with glauconite in order of their importance are: quartz, feldspar, hornblende, magnetite, augite, zircon, epidote, tourmaline, garnet, and other minerals in smaller amounts."[6] This statement, as it stands, has little meaning. To be sure, these minerals, as common heavy minerals, probably are associated with glauconite, but their relative importance in the glauconite-bearing sediments of the world must be based on more than a statement, since local conditions will doubtless alter such proportions to a great degree. It should be noted, also, that staurolite is absent from the list cited, whereas in the Eocene greensands of Maryland this mineral is next in frequency after quartz, opaques (ilmenite and hematite) and zircon.

Considering the two papers cited, the following summation may be made with respect to Eocene heavy minerals:

(1) If the sample (No. 1738) of Gunnell and Wilgus came from the Aquia formation (Eocene), or, if the modern beach glauconitic sand is supposed to give some clue to the beds from which it is said to be derived, then, in either case, the composition of the Virginia greensands is essentially different from that found for the same beds a few miles away in Maryland.

(2) That Gildersleeve's statement as to minerals associated with glauconite has no evident basis in fact.

Miocene: To the writer's knowledge no one has enumerated or described heavy minerals from the Miocene of Maryland or nearby states. It is almost a reprehensible act to submit a list of minerals without giving the stratigraphy which has been worked out. Only

to complete the sequence from Upper Cretaceous to Pleistocene (to be spoken of in the following section) is the subjacent table submitted. The percentages are averages, used to give a general picture, only:

CALVERT FORMATION; 70 samples:

Zircon	50%
Staurolite	15%
Garnet	10%
Epidote	10%
Tourmaline	5%
Sillimanite	5%
Rutile	2%
Kyanite	2%
Chloritoid	1%

CHAPTANK FORMATION: 5 samples showing essentially the same composition.

ST. MARY'S FORMATION: one sample, only, showing about 15% hornblende, and otherwise essentially the same minerals.

Pleistocene: The writer has examined but two samples from Pleistocene terraces in Maryland. Gunnell and Wilgus present the analyses of 16 samples from these formations in Virginia. Comment on their results may be best taken up as a study of the methods they have employed. Methods: (1) The 16 samples mentioned above were studied from grade sizes obtained in mechanical analysis. The distribution in fractions is as follows:

No. of samples	Grade size(s)
2	−1/16 mm.
6	+1/16 mm.
5	+1/8 mm.
1	−1/16, +1/8 mm.
1	+1/16, +1/8 mm.
1	+1/16, +1/8, +1/4 mm.

It is obvious from this table that, granted the possibility of variation of proportions with grade size (an actual occurrence in some known cases),[7] then the samples of different grade sizes cannot be compared with one another.

(2) One sample, only, was concentrated with heavy liquids. All are said to be "natural concentrates" and, hence, are not representative of the formation in which they are found.

(3) Failure to eliminate quartz by heavy liquids leaves that mineral present in such large quantities as to obscure rarer species of heavy minerals. This fact may explain the paucity of species in

many samples. In addition, such results cannot be compared with those of other workers, who uniformly separate off the "light" constituents.

(4) The method of estimating percentages is of doubtful value in correlation.[8]

The writer has attempted two tasks: (1) to prevent mistaken judgement of the heavy mineral content of certain formations; (2) to call attention to certain methods which render worthless results attained by tedious labour.

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