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THE PLIOCENE-PLEISTOCENE BOUNDARY IN THE GULF COAST REGION

C. WYLIE POAG

CHEVRON OIL COMPANY, NEW ORLEANS

INTRODUCTION

Beard and Lamb (1968) focused renewed attention on the Gulf Coast Plio-Pleistocene boundary by describing the stratigraphic sequence of planktonic foraminifera in a piston-core recovered from one of the Sigsbee Knolls in the Gulf of Mexico. Upon this single core they base the late Neogene biostratigraphy for the entire Gulf of Mexico region. This is ill advised especially since the authors fail to reconcile their data with information available in published reports. The following comments are offered with the hope that a clearer perspective can be gained.

1) *Previous Gulf Coast data are ignored.*

To ignore prior published ranges of Neogene planktonic foraminifera from the Gulf Coast area is not in the best interest of objectively deciphering the geologic history of

this region. Among others, Poag and Akers (1967) presented data gathered from hundreds of well samples (both rotary cuttings and cores) from numerous locations widely scattered along the Louisiana continental shelf. Some of the foraminiferal ranges listed by Poag and Akers (1967) are compared below with those of Beard and Lamb (1968).

2) *Contradictory interpretations of paleotemperature changes across proposed Pliocene-Pleistocene boundaries have not been satisfactorily resolved.*

Beard and Lamb (1968) express little doubt that the transition from a warm late Pliocene to a cool early Pleistocene is represented by the extinction level of *Globobulimina altispira* which . . . corresponds closely with the disappearance of other warm-water species such as *G. venezuelana*, *Globorotalia menardii*, and *Globigerinoides*

obliquus extremus, and with the first appearance of the cold-water immigrant species *Globorotalia inflata*. Since, however, such precision is unwarranted by the species range data that Beard and Lamb (1968) present, the choice of *G. altispira* as the marker of the Pliocene-Pleistocene boundary seems rather arbitrary [see figure 5 (Jamaica), and figure 6 (Sigsbee Knoll core) of Beard and Lamb (1968)]. Moreover, Poag and Akers (1967) show that the dextral *G. menardii* group does not disappear at the *G. altispira* horizon, but persists along with *G. obliquus extremus* above *G. altispira* to the extinction of *G. miocenica*, and *G. inflata* occurs below the extinction of *G. altispira*.

A more convincing reflection of cooling surface waters based on planktonic foraminifera occurs at the extinction of the warm-water species *G. miocenica* and *G. obliquus extremus* (Poag and Akers, 1967), which is associated with a distinct increase in the frequency of the cool tolerant species *G. truncatulinoides* and *G. inflata*, the change in coiling direction of the *G. menardii* group upward from dextral to sinistral, and the major reduction in frequency of species and individuals of *Discoaster*. The fact that McIntyre *et al.* (1967) interpret the changes in the coccolithophorid population across the Ericson boundary (which corresponds to the boundary of Poag and Akers, 1967) as a shift upward from cool to warm water contradicts Ericson's and the present writer's interpretation of the planktonic foraminiferal data. In the present state of knowledge, however, the Coccolithophoridae are no more reliable as paleotemperature indicators than planktonic foraminifera. The foraminiferal data should not be simply ignored as Beard and Lamb (1968) have done. It is significant that there is not complete agreement among the Lamont scientists regarding the paleotemperature changes across the Ericson boundary as Beard and Lamb (1968) have implied. Ericson and Wollin (1968) recently reaffirmed their belief, based on planktonic foraminifera, that the first occurrence of abundant *G. truncatulinoides* and the major extinction of *Discoaster* reflect cooling of surface waters during the Nebraskan glacial period.

3) *The charted Pliocene-Pleistocene boundary of Poag and Akers (1967) is similar to that of Beard and Lamb (1968).*

Although Beard and Lamb (1968) state without elaboration that the Miocene-Pliocene boundary of Poag and Akers (1967) is a close approximation of the Pliocene-Pleistocene boundary of Beard and Lamb (1968), it is clear upon careful comparison of the respective range charts that this is a serious misinterpretation. The extinction of *G. altispira*, which is used by Beard and Lamb (1968) to mark the Pliocene-Pleistocene boundary, the extinction or disappearance of *G. venezuelana*, *G. obliquus extremus*, *G. multicamerata*, and the uppermost shift in coiling direction of the *G. menardii* group, all occur at or near the Pliocene-Pleistocene boundary in both charts. Above all, the persistent presence of abundant *G. nepenthes* well above Poag and Akers's (1967) Miocene-Pliocene boundary refutes a Pleistocene age for this section.

Two observations may clarify the cause of Beard and Lamb's (1968) misinterpretation. First, a comparison of the vertical scales of the respective range charts can be confusing. The vertical thickness represented in the chart of Beard and Lamb (1968) is only 250 cm, while the vertical thickness in that of Poag and Akers (1967) is several thousand feet. The charted distance between the extinction of *G. altispira* and *G. miocenica* in Beard and Lamb's (1968) chart is one inch, which represents a true thickness of 44 cm. The same two horizons on Poag and Akers's (1967) chart are less than a centimeter apart, but the true thickness represented is several hundred feet. Secondly, Poag and Akers's (1967) comparison of their Miocene-Pliocene boundary with that of Bandy (1964) may have been misleading. It should be noted that Poag and Akers (1967) only tentatively accepted Bandy's boundary, and there is growing doubt that the two are isochronous.

In order to demonstrate more clearly the similarity of sequences in the two respective range charts, it is pertinent to establish the presence of *G. margaritae* and *P. primalis* in the offshore Louisiana section. Several authors have shown that these species become extinct in or near the middle Pliocene (Banner and Blow, 1967; Parker, 1967; Beard and Lamb, 1968). The extinction levels of these species occur above the Miocene-Pliocene boundary of Poag and

Akers (1967) at relative points similar to those given by Beard and Lamb (1968).

If one should accept at face value, then, the species ranges given by Beard and Lamb (1968), the Pliocene-Pleistocene boundary of Poag and Akers (1967) is near to, but slightly younger than the Pliocene-Pleistocene boundary of Beard and Lamb (1968). The precise ranges charted by Beard and Lamb (1968) must be used with caution, however, for the reasons listed below.

- 4) *Discrepancies in the charted foraminiferal ranges may be due to sampling interval and non-standard species identification.*

Beard and Lamb (1968) studied samples representing a total thickness of 90 cm of their core, while 232 cm of core between sample intervals were not examined; the amount of core not examined exceeds 2.5 times the amount examined. Furthermore, 150 cm above and 150 cm below the sampled interval were not studied in detail. This, in light of the discontinuous occurrence of many of the species charted by Beard and Lamb (1968), is reason to suspect that the charted ranges may not represent the true ranges of such species as *G. altispira*, *G. truncatulinoides*, *G. inflata*, and others. As a case in point, Beard and Lamb (1968) report that "*G. miocenica*, usually present in the late Pliocene is not recorded until the Pleistocene." The disappearance of species in the upper samples is especially subject to question since the foraminifera from the youngest 150 cm were not recorded. One wonders if the charted disappearance of *G. miocenica*, for example, should be considered any more reliable than that of the living species *P. obliquiloculata* which Beard and Lamb (1968) show disappears earlier than *G. miocenica*.

The improbability that true ranges of foraminiferal species (especially those with low frequency of individuals and/or discontinuous stratigraphic occurrence) will be represented in any single deep-sea core, well, or outcrop is amply demonstrated by the published record (e.g., Parker, 1964, 1967; Ericson, Ewing, and Wollin, 1963; Bolli and Bermudez, 1965; Bolli, 1966; Berggren *et al.*, 1967; Bolli *et al.*, 1968; Ericson and Wollin, 1968). This and the ever-present problem of standard species identification must be given serious consideration before

basing precise Neogene correlations in the Gulf of Mexico region on core 64-A-9-5E.

- 5) *McIntyre et al. (1967) moved the Pliocene-Pleistocene boundary below the boundary of Ericson, Ewing, and Wollin (1963), not above it.*

Beard and Lamb (1968) erroneously state that McIntyre, Bé, and Preikstas (1967) revised the Pliocene-Pleistocene boundary upward to the base of the next cool period above the boundary of Ericson *et al.* (1963). They further note that ". . . shifting the boundary upward half a climatic cycle puts it a full cycle above the base of the Nebraskan of Gulf Coast usage, or near the base of the Kansan." In reality, however, McIntyre *et al.* moved the Pliocene-Pleistocene boundary *below, not above* the Ericson boundary. They implicitly state (p. 23) that the ". . . best placement of the [Ericson] boundary is that of Akers (1965), *i.e.* between the Nebraskan Glacial and Aftonian Interglacial stages of the early Pleistocene."

It is clear that misrepresentation of this sort is not consistent with Beard and Lamb's (1968) intention ". . . to determine the most suitable horizons for placement of the Miocene-Pliocene and Pliocene-Pleistocene boundaries with respect to the planktonic succession. . . ."

- 6) *The extinction of G. altispira under the Louisiana continental shelf occurs in the Aftonian of Akers and Holck (1957).*

Transcending the discussion above, Beard and Lamb's (1968) use of *G. altispira* as the Pliocene-Pleistocene boundary marker in the Gulf Coast presents an insurmountable paradox. In the offshore Louisiana area this species becomes extinct in the lower part of the shale unit which Akers and Holck (1957) and Akers and Dorman (1964) have referred to the Aftonian interglacial [Beard and Lamb (1968) conclude that this shale unit is even younger]. Obviously, its extinction can not then be coincident also with the base of the Nebraskan Glacial that Beard and Lamb (1968) place well below the Aftonian of Akers and Holck (1957). The writer must conclude that Beard and Lamb's (1968) reported disappearance of *G. altispira* is lower than its extinction as seen in offshore Louisiana.

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CONCLUSION

As Cati *et al.* (1968) point out, the scattered Mediterranean Plio-Pleistocene sections still afford a variety of correlation and zonation schemes based on planktonic foraminifera. They imply caution in the use of *G. crassaformis* s.l. in zonation, declining use of its possible subspecies *G. crassula*, *G. aemiliana*, *G. crotonensis*, and *G. crassacrotonensis* because this lineage ". . . with its many taxonomic problems . . ." is still being studied. This group of twenty-one authors agreed unanimously on a single zonation for the Mediterranean Miocene, but could agree on no fewer than three alternate zonations for the Pliocene. Pending further knowledge regarding species ranges in both regions, it is the writer's belief that in the Gulf Coast, the ranges of these and other species must be more firmly established before correlation with Italy can be reliably assumed.

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