Pliocene stratigraphy and the Miocene/Pliocene boundary in Corfou (Greece)

by

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The present investigation is part of a broader regional research devoted to evaluate the nature, age and significance of the Pliocene transgression in the Mediterranean : was it a progressive shoreline transgression of a prograding sea on a shallow basin, or a sudden flood of a previously desiccated basin, as postulated by the so-called deep-basin desiccation model for the origin of the Mediterranean Evaporite [see HSÜ, CITA & RYAN, 1972]? Testing these alternative models represents one of the scientific objectives of the Italian program on the geodynamic significance of the late Miocene " salinity crisis ", funded by Consiglio Nazionale delle Ricerche (C.N.R.).

The field work in Corfou was undertaken in the summer of 1973. Four stratigraphic sections have been examined : that of Giannades in the central part of the island, extending from the late Miocene to the early Pliocene, previously known after the studies of BIZON [1967]; the Kavaddades section of Messinian age, in the NW part of the island; the Sidari section, at its northernmost edge and the Pliocene section Palaiokarion-Lefkimi to the south, close to that of Sparteron [see BIZON, 1967]. The samples collected in Corfou were examined in their fossil content, including planktonic and benthic foraminifera (MBC and AVS) and calcareous nannofossils (HS).

The field observations and the subsequent micropaleontological studies lead to the following conclusions :

The late Miocene, pre-evaporitic succession investigated at Giannades is largerly clastic, thus unsuitable for detailed biostratigraphic studies : the occurrence of *Globigerinoïdes obliquus* indicates a generalized late Miocene age (Zone N15 or younger), nannofossil Zone NN10 *(Discoaster calcaris)* or younger.

The late Miocene evaporitic sequence has been investigated at Giannades and at Kavaddades : it includes thick banks of selenitic gypsum, with large twinned crystals randomly oriented. By comparison with similar evaporitic facies recently investigated in their sedimentary petrography and isotopic composition [see SCHREIBER, 1974; PIERRE, 1974] from Sicily, they are interpreted as being deposited in a subacqueous hypersaline environment. At Kavaddades the highest bank of selenitic gypsum is conformably overlain by finely laminated (varved) gypsum which in turn is overlain by varved clays and silts yielding a characteristic assemblage of *Cyprideis " pannonica "* and *Ammonia beccarii tepida*, practically identical with the assemblage yielded by the highest strata of the Messinian neostratotype at Pasquasia [see CITA, STRADNER & CIARANFI, 1973], by the marls of the " Formazione a Colombacci " in Romagna, and as recorded in the Strabo Trench of the Levantine Basin at DSDP Site 129 [RYAN, HSÜ *et al*, 1972]. The nannofossils from this levels yield an assemblage tentatively referred to the *Discoaster quinqueramus* nannofossil Zone NN 11, which zone has also been identified in the neostratotype Messinian [STRADNER in CITA, STRADNER & CIARANFI, 1973; SCHMIDT, 1973]. The *Cyprideis-Ammonia beccarii tepida* assemblage has also been identified in the Giannades section, in between the topmost gypsum bed and the basal

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" Trubi " marls of the Pliocene. Though the field relationships are not so clear, and dramatic, as observed in Sicily [CITA, 1972 *a*] and in the subbottom of the Tyrrhenian Sea [RYAN-HSÜ *et al*, 1972], the Miocene/Pliocene boundary displays the same characters. In other words, also in Corfou we found evidence of a direct superposition, without any perceptible time-gap, of open marine pelagic sediments on top of brackish, shallow water sediments.

The " Trubi " transgression is materialized in the Giannades section by some 10 meters of whitish marls yielding rich foraminiferal assemblages characteristic of the *Sphaeroidinellopsis* Acme-zone (sensu CITA, 1972 b) and nannofossils of the *Ceratolithus tricorniculatus* Zone NN12. The carbonate curve of these basal Pliocene beds is strikingly similar to that obtained from isochronous sections investigated in Sicily and in the subbottom of the Tyrrhenian Sea [CITA, 1974]. The benthic fauna however is more abundant and diversified than those yielded by the basal Pliocene layers in the localities mentioned. According to the present day distribution of the benthic foraminiferal assemblage, which includes taxa as *Planulina ariminensis*, *Anomalina ammonoides*, *Pleurostomella alternans*, *Bulimina costata*, *Uvigerina peregrina*, *Siphonina reticulata*, *Gyroidinoides neosoldanii*, the depth of deposition of the " Trubi " at Corfou is estimated to 500-600 m.

The overlying Lower Pliocene succession at Giannades is characterized by sediments rich in terrigenous components, with high sedimentation rates; they are referable to the *Globorotalia margaritae margaritae* foraminiferal Zone and to the *Ceratolithus tricorniculatus* (NN12) nannofossil Zone in their lower part; to the *Globorotalia margaritae evoluta*, *Ceratolithus rugosus* (NN13) and *Discoaster asymetricus* (NN14) zones in their upper part. The first occurrence of *D. asymmetricus* is recorded within the concurrent range of *Globorotalia margaritae* and of *G.puncticulata*, as in deep-sea Mediterranean sediments [CITA, 1972].

The thick Palaiokarion/Lefkimi section is also essentially terrigenous; calcareous planktons, though locally well represented, are not particularly abundant, which results in a broad and occasionally uncertain zonation. The section is Upper Pliocene in age and includes the *Sphaeroidinellopsis subdehiscens* Zone, possibly extending into the *Globigerinoides obliquus extremus* Zone; the *Reticulofenestra pseudoumbilica* nannofossil Zone NN15 and the *Discoaster surculus* Zone NN16. As a criterion for distinguishing the Lower and Upper Pliocene, we used the extinction horizon of *Globorotalia margaritae*, which was shown to coincide with the boundary between the Gilbert and Gauss paleomagnetic epochs at about 3.4 m.y. [CITA and RYAN, 1972].

Also terrigenous is the Sidari section, where an angular unconformity is clearly detectable in the field. Evidence of important reworking from early Neogene and Paleogene sediments is noticed both in the foraminiferal and in the nannofossil assemblages. The more age-diagnostic levels are referable to the *Globigerinoides obliquus extremus* foraminiferal Zone and to the lower part of the *Discoaster surculus* nannofossil Zone of the Upper Pliocene.

Summarizing, the stratigraphic successions investigated in Corfou demonstrate that after the transgression of the basal Pliocene, which fits the deep-sea transgression model, the area underwent a rapid geodynamic evolution, leading to outer shelf and inner shelf conditions in a time span which can be conservatively evaluated at less than 3 m.y. (from 5.2 to 2.5 m.y.).

References

BIZON (C.), 1967. — Contribution à la connaissance des Foraminifères planctoniques de l'Epire et des Iles Ioniennes (Grèce occidentale). *Publ. Inst. Franç. Pétrole, Ed. Techn.*, Paris.

CITA (M.B.), 1972*a*. — The Miocene/Pliocene boundary. History and definition. XXIV *Intern. Geol. Congress*, Symposium on Late Neogene Epoch Boundaries, New York.

CITA (M.B.), 1972*b*. — The Pliocene record in deep-sea Mediterranean sediments. 1. Biostratigraphy and chronostratigraphy, *in :* Ryan, Hsü et al *(op. cit)*.

CITA (M.B.), 1974. — Early Pliocene paleoenvironment after the Messinian salinity crisis. *Proc. VI Congrès Micropal. Africaine*, Tunis *(sous presse)*.

CITA (M.B.) & RYAN (W.B.F.), 1972. — The Pliocene record of deep-sea Mediterranean sediments. 5. Time-scale and general synthetis, *in :* Ryan, Hsü et al *(op. cit.)*.

CITA (M.B.), STRADNER (M.) & CIARANFI (N.). 1973. — Biostratigraphy of the Messinian stratotype and of the overlying " Trubi " marls. *Riv. Ital. Paleont.*, **79**, 1, 3, Milano.

HSÜ (K.J.), CITA (M.B.) & RYAN (W.B.F.), 1972. — *Origin of the Mediterranean Evaporites. In :* Ryan, Hsü et al *(op. cit.)*.

PIERRE (C.), 1974. — Stable isotopes of the Messinian evaporites. *Thèse, Université de Paris.*

RYAN (W.B.F.), HSÜ (K.J.) & al., 1973. — Initial Reports of the Deep Sea Drilling Project. V.XIII, pt. 1-2, Washington.

SCHREIBER (B.C.), 1974. — *Upper Miocene (Messinian) evaporite deposits of the Mediterranean basin and their depositional environment.* Thesis, Rensselaear Polytechnic Institute, Troy, New York.

SCHMIDT (R.), 1973. — A calcareous nannoplankton zonation for Upper Miocene. Upper Pliocene deposits from the Southern Aegean Area, with a comparison to Mediterranean stratotype localities. *Kon. Neder. Akad. Weten., Proc.*, **76**, 4, pp. 287-310.

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Discussion

***Finetti* I. :** To this paper made a question M. LETOUZEY saying that at the base of evaporites exist an evident unconformity.

I remark that this unconformity is evident only on the margins and particularly on the ligurian-french margin; while on the bathyal plains there are no evidences of unconformity both at the base of evaporite and between Miocene and Pliocene.

***Letouzey* J. :** Pensez-vous que les bassins évaporitiques de Sicile ou de Grèce soient comparables à ceux des plaines abyssales? En particulier comment expliquez-vous la contradiction qui existe entre la « discordance » mio-pliocène que vous faites figurer sur tous vos schémas et que vous décrivez dans votre dernière publication sur le stratotype du Zandien (Pliocène inférieur du Capo Rosello), et le fait que cette discordance n'est visible sur aucun profil sismique en mer. La seule discordance visible sur les profils sismiques se trouve à la base des évaporites suprasalifères et uniquement sur certaines bordures de bassins.

The unconformity at the base of the Pliocene, as I described it from the deep-sea record as well as from sections on land (Capo Rossello, Eraclea Minoa, Pasquasia in Sicily; Giannades in Corfou) is *not* an angular unconformity. Bedding planes are consistently parallel above and below the unconformity. This unconformity differs from the Messinian erosional surface to which you make reference and which can be traced across the continental margins in that no significant time-gaps are present in between the oldest Pliocene strata and the youngest Miocene strata. The unconformity exists, however. In fact we find directly superposed sediments — and fossils — indicating completely different environments. Not only the make-up of the sediments is essentially different above and below the unconformity, but the structures, textures, carbonate content, clay mineral content, oxygen isotopic composition strongly differ. Not to speak of the fossils yielded by the sediments above and below the unconformity, which indicate different bathymetries and salinities.

WALTHER's law states that we find superposed in the fossil record facies which are found juxtaposed in nature. The Miocene/Pliocene boundary, as recorded in basinal settings in the Mediterranean, or in other words where no significant time-gaps are involved, does not follow Walther's law. This is why I speak of an unconformity.

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