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PALEOENVIRONMENTAL CONTROL ON THE MORPHOLOGY OF *NUMMULITES FABIANII* (PREVER) IN THE LATE PRIABONIAN PARASEQUENCES OF THE MORTISA SANDSTONE (VENETIAN ALPS, NORTHERN ITALY)

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Riassunto. Viene descritta la distribuzione di *Nummulites fabianii fabianii* e *Nummulites fabianii retiatus* nelle arenarie di Mortisa, un'unità prevalentemente silicoclastica del Priaboniano superiore affiorante a sud dell'Altipiano di Asiago (Prealpi Venete). L'analisi di facies ha permesso di riconoscere una organizzazione ciclica in parasequenze *thickening-coarsening upward* prodotte dalla progradazione di sistemi costieri. Nelle facies di base e di tetto di ogni ciclo sono presenti abbondanti macroforaminiferi, fra i quali numerosi esemplari della specie *Nummulites fabianii*. La distribuzione dei due morfotipi corrispondenti alle "sottospecie" *N. fabianii fabianii* (Prever) e *N. fabianii retiatus* Roveda è risultata strettamente legata alle condizioni paleoambientali. *N. fabianii retiatus*, forma relativamente appiattita, si trova nella facies marnosa di *offshore* a base ciclo, caratterizzata da bassa energia idrodinamica e bassa intensità luminosa. *N. fabianii fabianii*, forma più bombata, è invece tipica della facies biocalcarenitica di tetto ciclo, caratteristica di un ambiente meno profondo con energia idrodinamica ed intensità luminosa relativamente elevate.

Dalle osservazioni riportate non si evidenzia alcun legame diretto tra la morfologia e la posizione stratigrafica. L'utilità stratigrafica comunemente riconosciuta alle due "sottospecie" (utilizzate per distinguere Priaboniano inferiore e superiore) deve pertanto essere attentamente verificata.

Abstract. The distribution of *Nummulites fabianii fabianii* and *Nummulites fabianii retiatus* in the Mortisa sandstone is discussed. The Mortisa sandstone is a terrigenous unit of late Priabonian age occurring south of the Asiago Plateau (Venetian Alps, northern Italy). The facies analysis allowed to recognize thickening-coarsening upward cycles interpreted as shallowing upward parasequences corresponding to depositional regressions. In each cycle five different facies were recognized. The first and the last facies of every cycle contain larger foraminiferal assemblages with numerous specimens of *Nummulites fabianii*. Two different morphotypes of this species were attributed to the "subspecies" *N. fabianii fabianii* (Prever) and *N. fabianii retiatus* Roveda. Their distribution was influenced by the paleoenvironmental conditions. The flat "subspecies" *N. fabianii retiatus* occurs in the base-cycle marly facies, deposited under low-energy, low-light conditions. The more inflated *N. fabianii fabianii* characterises the shallower top-cycle limestone, deposited under high-energy, high-light conditions.

Our observations suggest there is no obvious link between the morphology and the stratigraphic position, so the biostratigraphic significance of the two "subspecies" (currently used to divide the Priabonian in a lower and an upper part) remains uncertain.

Introduction.

This note deals with the problem of the biostratigraphic significance of the so-called subspecies *N. fabianii fabianii* and *N. fabianii retiatus*. They have been used since now to divide the Priabonian in a lower (with *N. fabianii fabianii*) and an upper (with *N. fabianii retiatus*) part, but some authors (Herb & Hekel, 1973; Barbin, 1988) pointed out the possible paleoenvironmental control on their distribution. In the frame of the IGCP 393 ("Neritic events at the Middle-Upper Eocene boundary") the problem of the biostratigraphic usefulness of these "subspecies" has to be carefully considered.

In this paper we cannot discuss the problem exhaustively: the data presented here are only the first step. Additional studies on more morphological features could help to better understand if *N. fabianii fabianii* and *N. fabianii retiatus* are real subspecies or simply morphogroups ecologically controlled.

Our study was made on *N. fabianii fabianii* and *N. fabianii retiatus fabianii* populations from the Mortisa sandstone unit. This is a terrigenous unit of late Priabonian age deposited on the eastern margin of the Lessini Shelf. It crops out south of the Asiago Plateau, along the piedmont zone between the Astico river and the Brenta river (Fig. 1). Its thickness decreases from West to East: about 60 m near Calvene and about 10 m in the Bassano del Grappa area.

The Mortisa sandstone unit has been studied since the past century and dated as Lower Oligocene (Oppenheim, 1900, 1901). More recently the age was corrected

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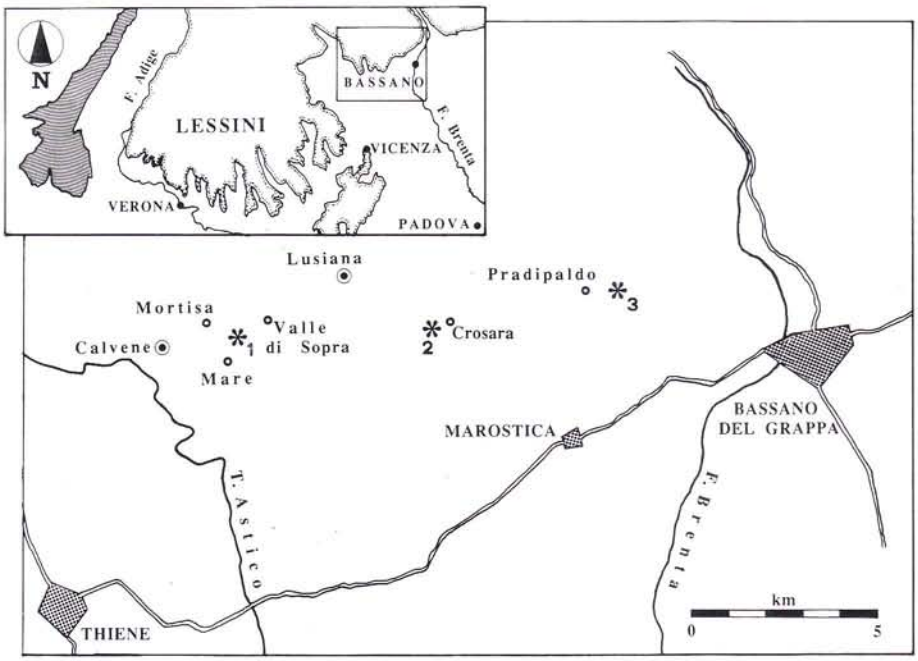

Fig. 1 - Location map of the study area and sites of the examined stratigraphic sections. 1) Mare section; 2) Crosara section; 3) Pradipaldo section (from Trevisani, 1993)

as Upper Eocene-Lower Oligocene (Frascari Ritondale Spano, 1967). The regressive features of the unit and its variable thickness were pointed out by Frascari Ritondale Spano (1969). Frascari Ritondale Spano & Bassani (1973) considered the Mortisa sandstone as sublittoral or deltaic deposits forming the basal member of the Calvene Formation. Trevisani (1993) remarked the cyclic organization of the Mortisa sandstone and interpreted the cycles as shallowing upward parasequences.

Facies analysis.

The Mortisa sandstone consists of thickening-coarsening upward cycles (T-C-U), where five different facies have been recognized (Fig. 2). The A facies is represented by bioturbated marls, less frequently marly limestones, with nummulites; the B facies by bioturbated coarse siltstones to fine sandstones; the C facies by sands and sandstones with storm layers; the D facies by conglomeratic sandstones to sandy conglomerates with storm layers; the D facies by biocalcarenites with nummulites. The thickness of each cycle increases westward, from about 10 m in the Bassano area to over 40 m near Calvene. On the basis of facies analysis these T-C-U cycles are interpreted as shallowing upward parasequences which are the result of depositional regressions produced by the progradation of shallow water siliciclastic systems. These progradational phases were interrupted by abrupt relative sea level rise, resulting in a backshift of the various facies belts toward more internal positions. These parasequences appear to be part of a depositional sequence bounded in their lower part by an erosional limit underlying the Pradelgiglio Formation. Therefore, in terms of sequence stratigraphy, the Mortisa sandstone represents the lowstand phase of this depositional sequence. For further details see Trevisani (1993).

Paleontologic analysis.

Although the Mortisa sandstone is prevailing siliciclastic, in some parts we found assemblages of larger foraminifera. In particular, they are abundant in the A facies at the base of the cycles, which corresponds to an offshore environment below wave base level, and in the E facies at the top of the cycles, corresponding to bioclastic sandy shoals. Also in the uppermost part of the D facies the larger foraminifera are often abundant.

Among the larger foraminifera the specimens of *Nummulites fabianii* (Prever) were recognized to show different morphotypes in different facies: in the A facies the tests are distinctly flatter than in the E facies. These morphotypes correspond to the so-called subspecies *N. fabianii fabianii* (the more inflated ones) and *N. fabianii retiatus* (the flatter ones). The distinction between the two "subspecies" relies mainly on external features such as the ornamentation and the more or less inflated profile. Roveda (1959, 1970) reported that *N. fabianii retiatus* has an ornamentation with larger mesh than *N. intermedius* (=*N. fichteli*) and a transverse lamina weaker than that of *N. fabianii*. Moreover, *N. fabianii retiatus* is flatter than *N. fabianii fabianii*. The profile is well approximated by the diameter/thickness (d/t) ratio. From the data reported by Roveda (1970) this ratio results about 2.0 for *N. fabianii fabianii* and about 2.7 for *N. fabianii retiatus*.

In the Upper Eocene section of Possagno, some fifteen km north-east of Bassano del Grappa, Herb &

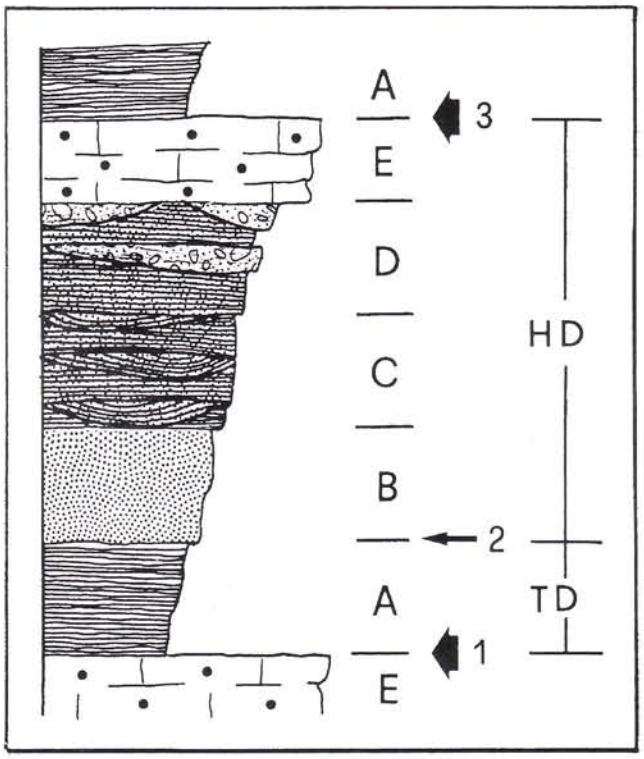

Fig. 2 - Modal cycle (thickness variable from 10 to 40 m) of the Mortisa sandstone. A-E) different facies recognized; TD) transgressive deposits; HD) highstand deposits; 1 and 3) marine-flooding surface (parasequence boundary); 2) surface of maximum flooding (modified from Trevisani, 1993).

Hekel (1973) found a lithologically controlled distribution of the two "subspecies": the limestones contain *N. fabianii fabianii* and the silty-argillaceous sediments *N. fabianii retiatus*. Barbin (1988) made a comparison between the test flattening of *N. fabianii fabianii* from Buso della Rana, near Priabona, and the *N. fabianii retiatus* described by Roveda (1959), concluding that *N. fabianii retiatus* is an ecologically controlled morphotype of *N. fabianii fabianii*.

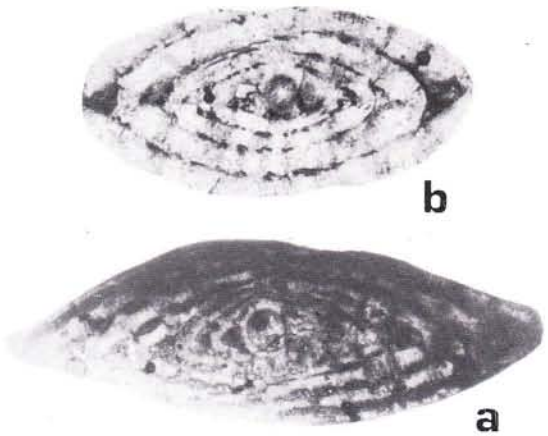

Fig. 3 - Axial sections of *Nummulites fabianii* (x 25). a) *N. fabianii retiatus*; sample MV 9, Mare section, lower part of the A facies; b) *N. fabianii fabianii*; sample MV 21, Mare section, E facies.

Our samples from the Mortisa sandstone were examined to test the possible environmental control on the morphology. The d/t ratio of the specimens of *N. fabianii* from different facies was measured. In the E facies, represented only by hard limestones, diameter and thickness were measured on thin sections only where the proloculus was visible and the central pillar well recognizable. Nevertheless, a correction was made for the possible obliquity of the section, reducing all the measured values by about 10%. The correctness of this assumption was tested on two samples where both free specimens and thin sections were available.

The mean d/t ratio of the *N. fabianii* from the A facies amounts to about 2.8, whereas it is about 2.1 for the samples collected in the E facies. In particular, the sample MV 9 (Fig. 3a), from the base of the A facies in the Mare section, shows a d/t ratio of 2.89 (twenty-four isolated specimens measured); the sample MV 21 (Fig. 3b), from the E facies of the same section, about 45 m above MV 9 has a d/t ratio of 2.05 (six axial sections measured on two thin sections; thickness values corrected). Therefore, the E facies is characterized by *N. fabianii fabianii*, whereas *N. fabianii retiatus* occurs in the A facies.

Discussion and conclusions.

In living larger foraminifera the test shape depends mainly on light intensity (influencing algal symbiosis) and water energy (Reiss & Hottinger, 1984; Hallock & Glenn, 1986; Hallock et al., 1986, 1991). The Recent nummulitid *Operculina ammonoides* shows flatter tests on soft substrates than on hard ones at the same depth (Pecheux, 1995). In the Mortisa sandstone the A facies contains flat species of nummulitids: together with *N. fabianii retiatus* there are *N. chavannesi* de la Harpe and *Operculina* spp. This agrees well with the sedimentological evidences of a low-energy, low-light, relatively deep paleoenvironment with soft substrate. On the other hand, in the E facies *N. fabianii fabianii* is associated with the inflated species *N. incrassatus* de la Harpe and *N. variolarius* (Lamarck). Here a high-energy, high-light, shallower paleoenvironment (probably with hard substrate) is inferred.

In conclusion, the late Priabonian *N. fabianii* shows two different morphotypes, probably controlled by the paleoenvironmental conditions (light intensity, water energy, substrate). *Nummulites fabianii fabianii* prevails on hard substrates, with high light intensity and high water energy, whereas *Nummulites fabianii retiatus* occurs in opposite environmental conditions.

The data here reported are not conclusive to ascertain if we are facing two morphogroups of the same taxon, produced by different paleoenvironmental conditions (like Recent *Operculina ammonoides*) or really two distinct subspecies with stratigraphic significance. Nevertheless, we underline that the sample MV 9 (with *N. fabianii retiatus*) is well below MV 21 (with *N. fabianii fabianii*). Therefore, the two "subspecies" do not appear one after the other but are present at the same time, at least in the upper part of the Priabonian.

Thus, our observations suggest that the "subspecies" of *N. fabianii* could be ecological morphotypes, but a more comprehensive study is needed to solve the problem of their biostratigraphic value.

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REFERENCES

Barbin V. (1988) - Réflexions sur *Nummulites fabianii* et *Nummulites fabianii retiatus*, leur signification stratigraphique et leur origine phylétique. *Rev. Paléobiol.*, v. spéc. 2, n. 2, pp. 609-614, Genève.

Frascari Ritondale Spano F. (1967) - Osservazioni stratigrafiche e tettoniche sui dintorni di Calvene nel Vicentino. *Giorn. Geol.*, v. 34 (1966), pp. 307-340, Bologna.

Frascari Ritondale Spano F. (1969) - Serie paleogeniche nell'area pedemontana a sud dell'Altipiano di Asiago (Vicenza). *Mém. B.R.G.M.*, v. 69, pp. 173-182, Paris.

Frascari Ritondale Spano F. & Bassani P. (1973) - Ricerche geologiche nei dintorni di Bassano del Grappa (Vicenza). *Mus. Trident. Sc. Nat.*, v. 19, pp. 65-106, Trento.

Hallock P., Forward L.B. & Hansen H.J. (1986) - Influence of environment on the test shape of *Amphistegina*. *Journ. Foram. Res.*, v. 16, n. 3, pp. 224-231, Washington.

Hallock P. & Glenn E.C. (1986) - Larger Foraminifera: A Tool for Paleoenvironmental Analysis of Cenozoic Carbonate Depositional Facies. *Palaios*, v. 1, n. 1, pp. 55-64, Tulsa.

Hallock P., Röttger R. & Wetmore K. (1991) - Hypotheses on form and function in foraminifera. In Lee J.J. & Anderson O.R. (Eds.) - Biology of Foraminifera. *Academic Press*, pp. 41-72, London.

Herb R. & Hekel H. (1973) - Biostratigraphy, variability and facies relations of some upper Eocene Nummulites from Northern Italy. *Ecl. Geol. Helv.*, v. 66, n. 2, pp. 419-445, Basel.

Oppenheim P. (1900) - Ueber eine riesige *Perna* (*Pachyperna* n. sbg. *laverdana* n. sp.) aus dem Alttertiär Venetiens und die übrigen Perniden des Gebietes. *Zeitschr. Deutsch Geol. Ges.*, v. 52, pp. 237-243, Stuttgart.

Oppenheim P. (1901) - Die Priabonaschichten und ihre Fauna. *Palaeontographica*, v. 47, pp. 1-348, Stuttgart.

Pecheux M.J.-F. (1995) - Ecomorphology of a recent large foraminifer, *Operculina ammonoides*. *Géobios*, v. 28, n. 5, pp. 529-566, Lyon.

Reiss Z. & Hottinger L. (1984) - The Gulf of Aqaba. Ecological Micropaleontology. V. of 354 pp., Springer-Verlag, Berlin.

Roveda V. (1959) - *Nummulites retiatus*, nouvelle espèce de nummulite réticulée des Abruzzes (Italie). *Rev. Micropaléontol.*, v. 1, n. 4, pp. 201-207, Paris.

Roveda V. (1970) - Revision of the Nummulites (Foraminiferida) of the *N. fabianii-fichteli* group. *Riv. It. Paleont. Strat.*, v. 76, n. 2, pp. 235-324, Milano.

Trevisani E. (1993) - Analisi di facies e ciclicità delle Arenarie di Mortisa (Priaboniano superiore, Prealpi Venete). *Mem. Sc. Geol.*, v. 45, pp. 57-65, Padova.

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