

Miogypsina globulina (Michelotti) from Samatzai section (Lower Miocene - Southern Sardinia)

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KEY WORDS - *Miogypsina*, *Biometry*, *Miocene*, *Burdigalian*, *Sardinia*.

ABSTRACT - *Biometric data measured on a Miogypsina s.s. population are presented. Twenty-four megalospheric specimens have been obtained by means of a random picking on washing residues of a marl layer sampled in the Samatzai Miocene succession (Southern Sardinia), cropping out along the eastern side of the Plio-Pleistocene Campidano Graben. This succession has been mainly deposited into a neritic marine carbonate environment during the Early Miocene rift phase.*

M. globulina (Michelotti) has been detected in Sam-1 sample, at a central evolutionary stage of the species. It indicates a reference to a early-middle Burdigalian age, that is confirmed by the overlying planktonic foraminiferal assemblage.

RIASSUNTO - [*Miogypsina globulina* (Michelotti) nella successione di Samatzai (Miocene inferiore - Sardegna meridionale)] - È stato eseguito uno studio biometrico su una popolazione di *Miogypsina* (24 esemplari), estratta da un campione proveniente da una successione miocenica affiorante nell'area di Samatzai (parte orientale del Graben plio-pleistocenico del Campidano). Questa successione si è deposita inizialmente in ambiente neritico durante la fase miocenica del rifting sardo. Gli esemplari studiati sono stati ricavati dal residuo di lavaggio di un campione marnoso (Sam-1). I risultati delle misure e dei conteggi effettuati sugli apparati embrionali e nepionici, indicano che la popolazione del campione Sam-1 rientra nei limiti di *Miogypsina globulina* (Michelotti), con un grado evolutivo medio rispetto ad altre popolazioni della stessa specie conosciute in letteratura. Sulla base di questi risultati, il campione Sam-1 risulterebbe riferibile alla parte medio-bassa del Burdigaliano. Questa datazione risulta coerente con l'indicazione fornita dallo studio dai foraminiferi planctonici in ricerche precedenti.

INTRODUCTION

A biostratigraphic study, based on the integrated analysis of both miogypsinid and planktonic foraminiferal assemblages, has been carried out on the Samatzai succession (Southern Sardinia), cropping out along the eastern side of the Plio-Pleistocene Campidano Graben. This succession has been mainly deposited into a neritic marine carbonate environment during the early Miocene rift phase. Larger foraminifera, such as Miogypsinidae, which are particularly abundant in the neritic facies, have a high biostratigraphic potential. A biometric study has been performed in well-oriented thin sections along the equatorial plane of 24 megalospheric specimens belonging to *Miogypsina* s.s., that have been obtained by a random picking on washing residues of a marl layer sampled in the Samatzai Miocene succession. The aim of the present paper is therefore to improve the knowledge about the phyletic line of *Miogypsina* s.s. in Sardinia and to use it for dating tectonic events in this area.

THE PERDA FITTA SECTION (SAMATZAI)

The section is located in Perda Fitta area (coordinates: 1503000E 4371000N UTM Roma 40 W), 100 meters South of Samatzai village (Fig. 1), along the provincial road n. 33 (Nuraminis - Pimentel). Probably, Perda Fitta deposits represent an accumulation on a small "morphological high", overlying Bruncu

Murdegu conglomerate sandstones formed in continental/transitional environment, containing Paleozoic clasts and subordinate andesitic fragments, belonging to the Oligo-Miocenic calc-alkaline cycle (Cherchi et al., 2000).

The succession is made up mainly by limestones. From bottom to top it contains:

a) limestone (thickness about 3.50 m) with ostreids, pectinids, barnacles, red algae, branching coral fragments (*Porites*), miogypsinids, and small benthonic foraminifera;

b) limestone (4.50 m thick) with many limy-marls intercalations containing elongated fragments of branching corals and miogypsinids (sample Sam-1, at the bottom of the first marl level);

c) limestone (thickness 4.10 m) with elongated fragments of branching corals, locally encrusted by coralline algae and rare ostreids;

d) silty marl (0.70 m thick) with abundant planktonic foraminifera (sample Sam-2).

METHODS

Counts and measurements (Fig. 2) have been made on embryonic-nepionic chambers (equatorial sections).

X = number of the chambers of the principal spiral, excluding protoconch (I) and deutoconch (II).

Where the second principal chamber (PAC) with its spiral was present, the number of chambers of the longest spiral around the protoconch have been

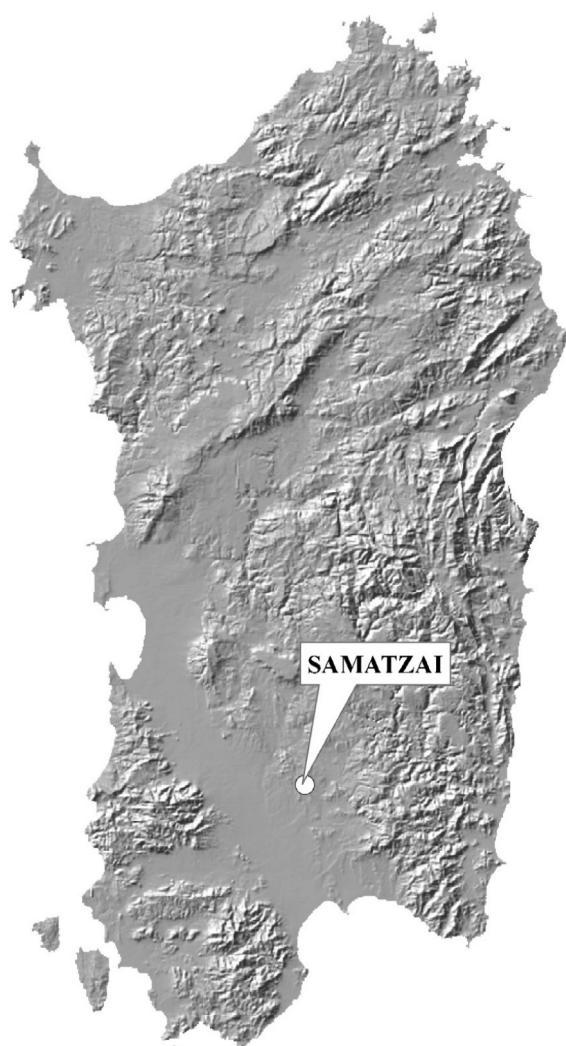


Fig. 1 - Geographical setting of the outcrop of Samatzai.

counted. In this case, the “symmetrical (or closing) chamber”, placed at the meeting point of the two nepionic spirals from opposite directions, have been considered as 1/2 (XI) (De Mulder, 1975) or as whole chamber (XII) (Drooger, 1952, 1963; Raju, 1974; Schüttenhelm, 1976).

γ° = The angle between the apical-frontal line of the test (AF) and the medio-embryonic line (ME) (Drooger, 1952).

The apical-frontal line passes through the centre of the protoconch between the apex and the middle of the frontal edge. It divides the test into two approximately equal parts. The medio-embryonic line passes through the centres of the protoconch and the deutoconch. The value of the angle γ° depends on the length of the nepionic spiral; it may be either positive or negative (Amato & Drooger, 1969; Raju, 1974; De Mulder, 1975):

- γ° is negative when the length of the principal spiral exceeds one whorl; in the case of shorter spiral or of two spirals round the protoconch, γ° is negative if the third chamber or the larger of the two PAC is turned towards the apex of the test.

- $\gamma^\circ = 0$ when the apical-frontal line and the medio-embryonic line coincide.
- γ° is positive when the length of the principal spiral is less than one whorl and the third chamber, or the larger of the two PAC, is turned towards the frontal edge of the test.

V = the degree of symmetry of the spirals round the protoconch in specimens with two PAC. V is calculated by the formula $V = \alpha/\beta \cdot 200$. In this equation the angle β represents the length of the arc relating to both the spirals round the protoconch, delimited by the half-lines with origin in the centre of the protoconch and passing through the points of contact between the walls of the two embryonic chambers, while the angle α represents the length of the arc relating to the shortest spiral.

D_I and D_{II} = the diameters of the protoconch and of the deutoconch, measured at right angles to the line joining the centers of the first two chambers (ME line). In these measurements, half of the thickness of the walls is included.

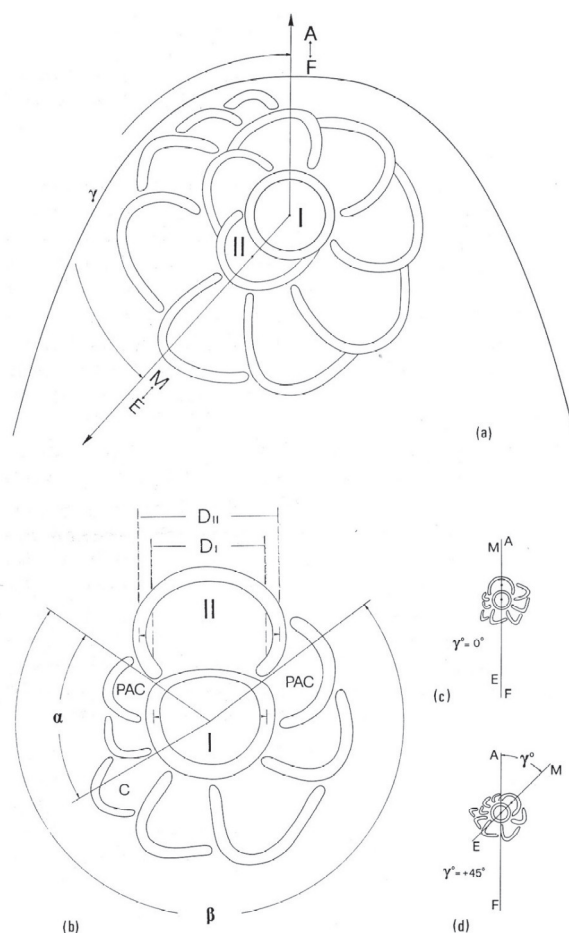


Fig. 2 - Schematic drawing showing the methods of counting and measuring the internal features in horizontally sectioned embryonic-nepionic stage of primitive (a) and more developed (b) *Miogypsina*. Meaning of the symbols: I=protoconch; II=deutoconch; PAC= primary auxiliary chambers; c= closing chambers; AF= apical-frontal line; ME= medio-embryonic line; γ° = angle between ME and AF line; α = angle made by the shortest spiral around the protoconch; β = angle made by both spirals around the protoconch; D_I = diameter of the protoconch; D_{II} = diameter of the deutoconch (after Schiavinotto, 1985).

Parameter	N	Range	M	S. d.	S. e.
X	24	4,5-6,5	5,42	0,50	0,10
γ°	24	0-52	24,79	12,54	2,56
V	24	0-55	35,33	13,98	2,85
DI	24	114-234	167,38	30,22	6,17

Tab. 1 - Results of count and measurements on internal characteristics of *Miogypsina globulina* (Michelotti) population from sample Sam-1.

DESCRIPTION

External characteristics

The test outline is often sub-triangular or rounded (Pl. 1, figs. 1-4). A highly variable swelling can be observed at the apex. Pillars are evidenced on the tests surface.

Internal characteristics

The embryonic chambers are always in a peripheral-apical position.

A second principal auxiliary chamber (Pl. 1, figs. 5-6) is present in 23 specimens (95.8% of the possible observations). At the meeting point of the two nepionic spirals a symmetrical or closing chamber is visible.

Specimens without lateral chambers (typical for *Miogypsinoides*) are absent. An intraseptal canal-system (typical for *Miogypsinoides*) has not been observed.

The results of counts and measurements are summarized in Tab. 1.

Diagnosis

The Sam-1 population from Samatzai falls within the limits of *Miogypsina* (*Miogypsina*) *globulina* (Michelotti). For this species, values of $\bar{x}$ less than 7, values of $\bar{v}$ between 0 and 45, and a positive γ° are defined. More than 50% of the specimens must have a second principal auxiliary chamber (Drooger, 1952).

Drooger introduced these limits for the species *Miogypsina irregularis* established by Michelotti (1841); later on, the name *Miogypsina irregularis* was substituted with *Miogypsina globulina* by Drooger & Socin (1959).

The histograms in Fig. 3 show the homogeneity of the population. Overall unimodal distributions are evidenced, close to the normal trend for all the parameters/factors.

The mean values of V in Tab. 2 highlight that our sample Sam-1 is very similar to some populations from the Piedmont sedimentary basin (Drooger, 1954; Schüttenhelm, 1975), to many populations from Greece (De Mulder, 1975), to some populations from Aquitaine (Drooger et al., 1955) and to the population from Mt. La Serra, Central Apennines (Schiavinotto, 1979).

Evolutionary stage

To determine the evolutionary stage of Samatzai miogypsinids in comparison with material from other localities, X, V-D₁ mean values derived from Sam-1 were plotted (Fig. 4) on the diagram of De Mulder (1975), which shows measurements from European

as well as African populations. The mean values from sample Sam-1 fall within the range of *Miogypsina globulina* assemblages as reconstructed on the basis of French, Greek and Italian material.

The scatter-diagrams in Fig. 5 highlight that the Sam-1 population has a good fitting in the evolutionary trend that has been observed in *Miogypsina* populations, assigned to *M. globulina* species in the previous literature.

It is possible to refer the Sam-1 population to an evolutionary degree that is representative for a central to higher level in the evolutionary development of the *globulina* stage in the Mediterranean *Miogypsina* lineage.

BIOSTRATIGRAPHY

Sam-1 *M. globulina* population, when compared with *Miogypsina intermedia* already recorded in Sardinia (Smit, 1974; Schiavinotto, 1985), confirms that the miogypsinids in Lower Miocene neritic deposits of Sardinia improve the detailed biostratigraphy based on the *Miogypsina* lineage.

This preliminary result is supported by the data that can be obtained from the overlying planktonic foraminifera (Mancin et al., 2003a): the planktonic assemblages are characterized by rare specimens of *Globigerinoides trilobus* and very rare *Globigerina ciperoensis* and *Globigerinoides primordius*. *Catapsydrax dissimilis* is always absent and the *Globigerinoides* group is usually less diversified. The

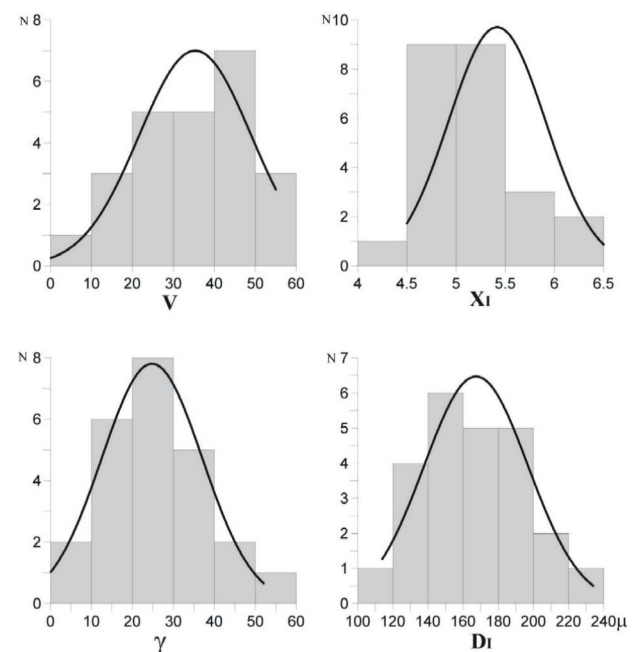


Fig. 3 - Histogram showing the distribution of counts and measurements on internal characteristics of the *Miogypsina globulina* (Michelotti) population from sample Sam-1.

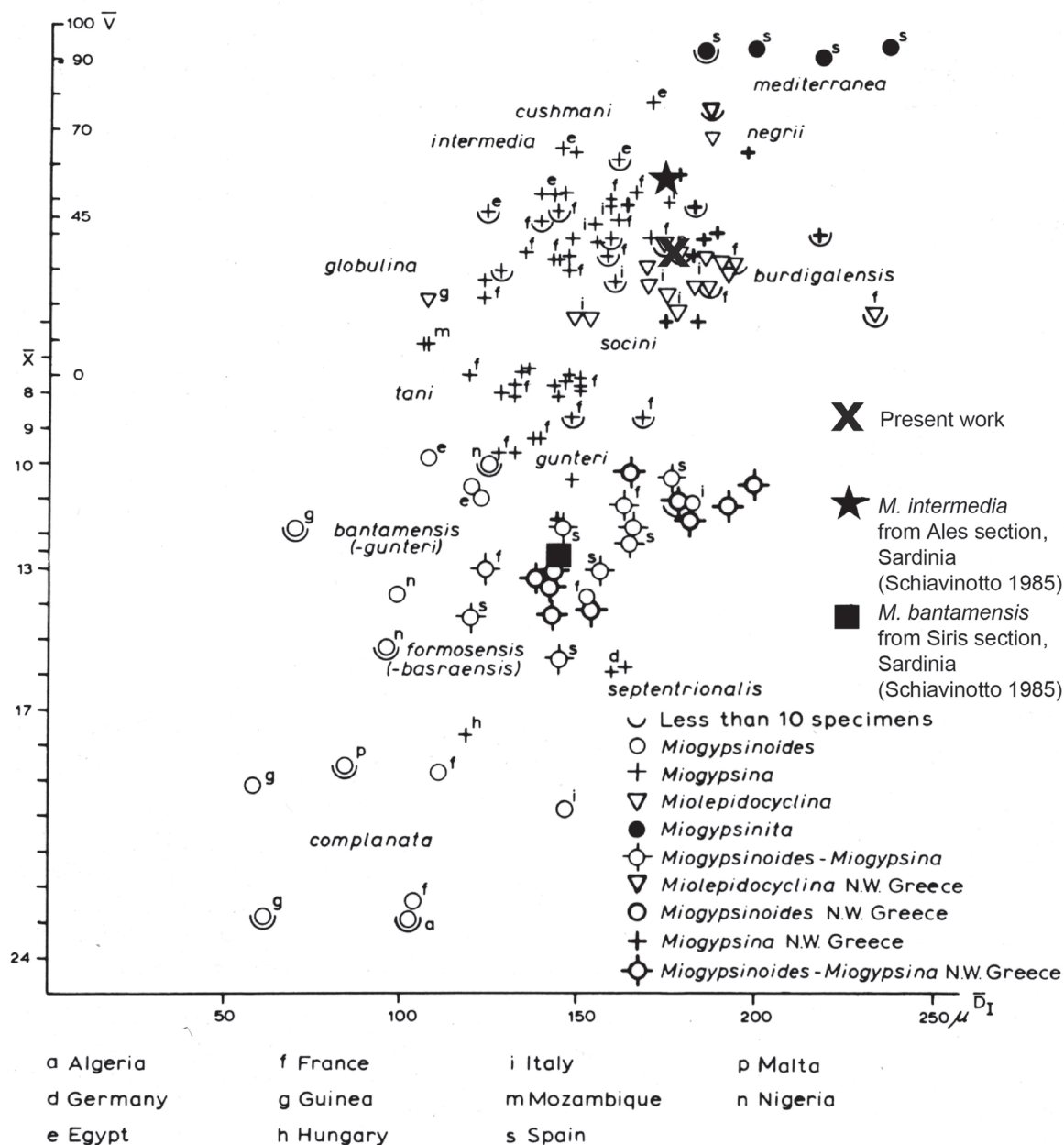


Fig. 4 - Scatter diagram showing the relationship between the mean diameter of protoconch $\overline{D}_1$ and the $\overline{X}-\overline{V}$ scale values in Miogypsinid assemblages from Europe and Africa (after De Mulder, 1975) with the position of assemblages from Sardinia.

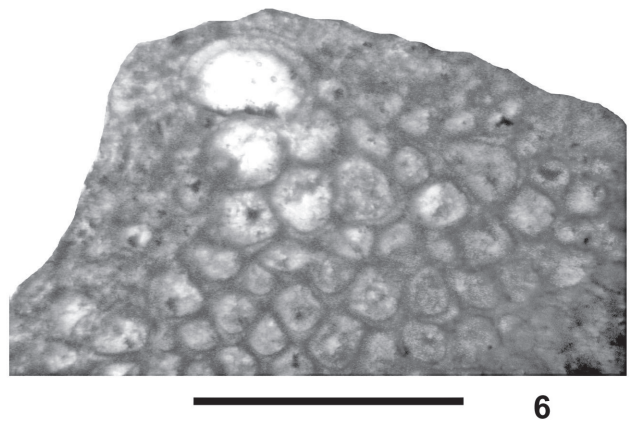
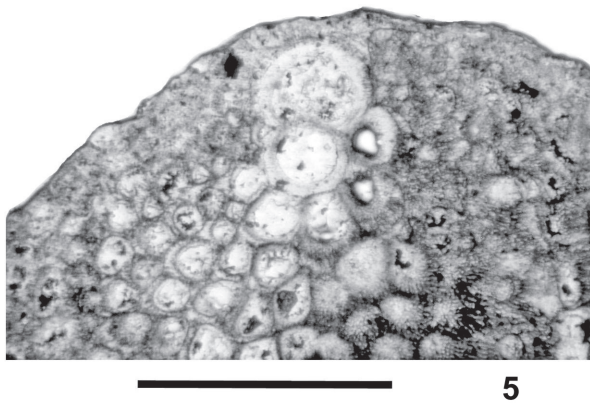
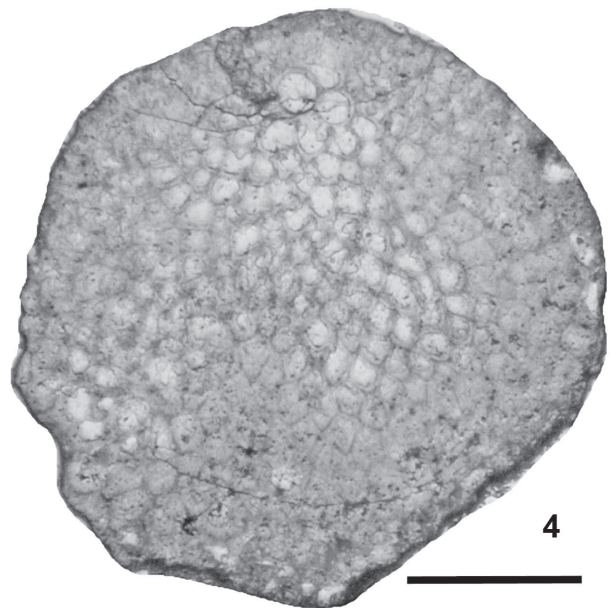
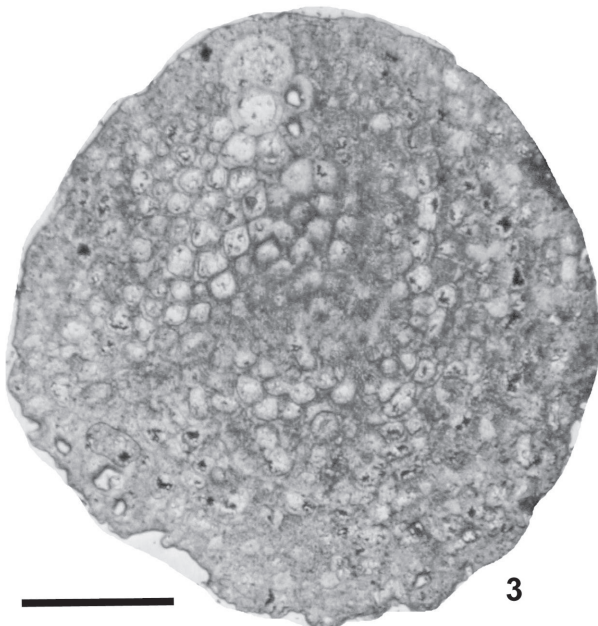
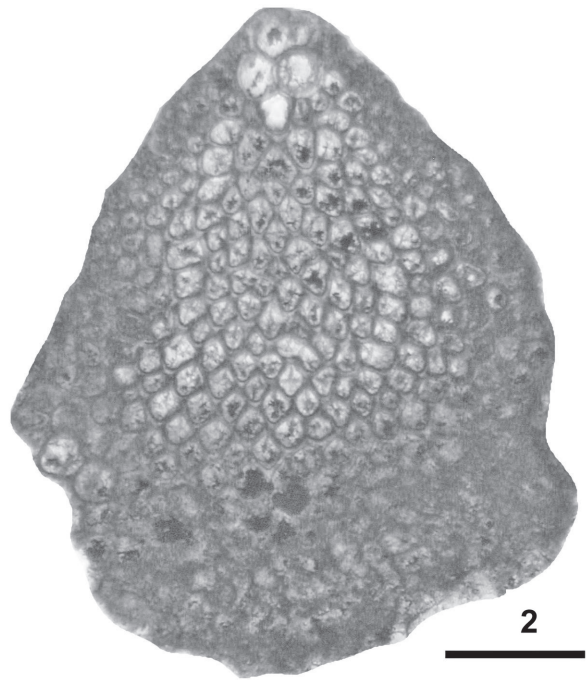
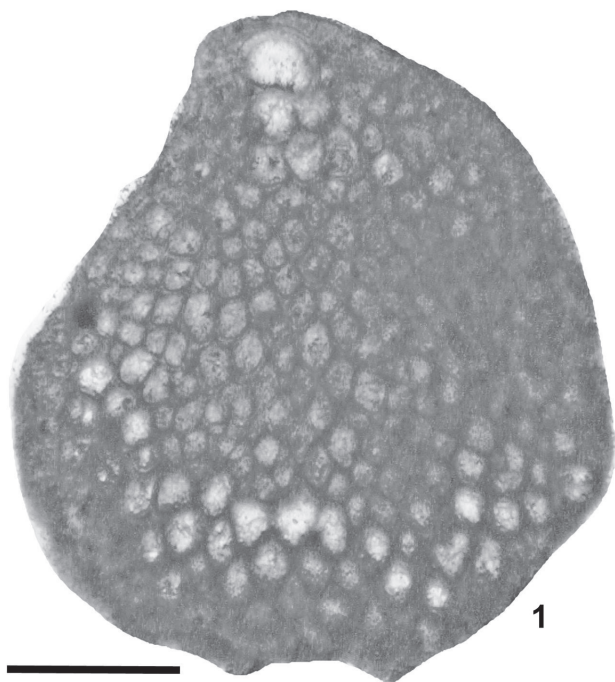
EXPLANATION OF PLATE 1

Figs. 1-6 - Equatorial sections of *Miogypsina globulina* (Michelotti), A-forms from sample Sam-1 (Samatzai, Sardinia).

- 1 - Specimen with triangular outline of the test, embryonic chambers in a peripheral position, γ° angle with a clearly positive value. Specimen 9 Sam-1;
- 2 - Specimen with sub-triangular outline of the test, embryonic chambers in a peripheral position, γ° angle with a clearly positive value. Specimen 4 Sam-1;
- 3 - Specimen with circular outline of the test, embryonic chambers in a peripheral position, γ° angle with a clearly positive value. Specimen 16 Sam-1;
- 4 - Specimen with circular outline of the test, embryonic chambers in a peripheral position, γ° angle with a clearly positive value. Specimen 26 Sam-1;
- 5 - Embryonic and nepionic chambers with morphometric characters close to the mean values of the Sam-1 population. Specimen 16 Sam-1;
- 6 - Detail of the embryonic and nepionic chambers in specimen 4 Sam-1.

Scale bars = 500 μ m

All specimens are stored in the ENEA-Casaccia palaeontological collection.



References	Samples	XI	γ°	V	DI	Species
DROOGER (1952)	19	6			109	irregularis
DROOGER (1954)	C. Bert 6	6,6	35	38	171	irregularis
DROOGER (1954)	C. Bert 5	6,5	24	38	149	irregularis
DROOGER (1954)	F. Franc 10	6,7	13	37	185	irregularis
DROOGER et al. (1955)	24	6,1	24	37	156	irregularis
DROOGER et al. (1955)	35	5,9	20	28	148	irregularis
DROOGER et al. (1955)	43	6,2	21	21	124	irregularis
DROOGER et al. (1955)	1	6,3	27	33	148	irregularis
DROOGER & SOCIN (1959)	CM 9			49		globulina
DROOGER & SOCIN (1959)	CM 8			38		globulina
DROOGER & SOCIN (1959)	CM 7			40		globulina
DROOGER & SOCIN (1959)	CM 10			40		globulina
DROOGER & SOCIN (1959)	CM 10			32		globulina
DROOGER & SOCIN (1959)	CM 13a			33		globulina
RAJU (1974)	KR 36(B)	6	18,3	18,7	103	globulina
RAJU (1974)	G 1401 (B)	6,23	3,8	15,42	89	globulina
DE MULDER (1975)	DM 117	5,7	14	38,4	190	globulina
DE MULDER (1975)	DM 116	6,1	16	39	188	globulina
DE MULDER (1975)	DM 114	6,5	4	34,3	183	globulina
SCHUTTENHELM (1976)	SM 28	5,8	36,7	39,8		globulina
SCHUTTENHELM (1976)	CM 10			40		globulina
SCHUTTENHELM (1976)	SM 87	6,2	23,8	31,7		globulina
SCHUTTENHELM (1976)	CM 13a			33		globulina
SCHUTTENHELM (1976)	SM 81	6,7	23,2	40		globulina
SCHUTTENHELM (1976)	SM 268	6,4	29,1	34,6		globulina
SCHUTTENHELM (1976)	SM 157A	6,6	20,9	30,9		globulina
SCHUTTENHELM (1976)	SM 110	6,6	36,3	36,7		globulina
SCHUTTENHELM (1976)	SM 131	5,8	37,3	35		globulina
SCHUTTENHELM (1976)	SM 135	6	39,6	37,4		globulina
SCHUTTENHELM (1976)	SM 166	6,2	29,2	37,1		globulina
SCHUTTENHELM (1976)	SM 251	6,4	33,2	40		globulina
SCHUTTENHELM (1976)	SM 248	6,2	35,4	42		globulina
SCHUTTENHELM (1976)	SM 469	6,5	28,7	34,9		globulina
SCHUTTENHELM (1976)	SM 140	6,3	34,1	30,6		globulina
SCHIAVINOTTO (1979)	TLS 76	5,98	25,85	38,36	185	globulina
DELICATI & SCHIAVINOTTO (1985)	PMT 6/80	5,93	25,26	41,54	169,19	globulina
SCHIAVINOTTO & MANZOTTI (1990)	CC43	5,58		41,72	163,94	globulina
SCHIAVINOTTO & PIZZI (1990)	CC41	6,17		31,18	175,4	globulina
SCHIAVINOTTO & EVANGELISTI (1992)	CC42	5,85		39,81	161,14	globulina
WILDENBORG (1985)	JT 5063	4,59		45		globulina-intermedia
WILDENBORG (1985)	JT 5124	4,88		44		globulina-intermedia
present work	SM	5,4	24,8	37,3	167,4	globulina

Tab. 2 - Comparison between internal characteristics of *Miogypsina globulina* (Michelotti) population from sample Sam-1 and mean values in co-specific populations from literature.

co-occurrence of *G. trilobus* and very rare *G. primordius*, in absence of *C. dissimilis* are used in the scheme by Mancin et al. (2003b), to identify the lowermost part of the *G. trilobus* Zone (MNF7 Zone) of the early Burdigalian (Mancin et al., 2003a).

CONCLUSIONS

The Mediterranean *Miogypsina* lineage is represented in Sardinia also by the *Miogypsina globulina* evolutionary stage. This result has been pointed out by

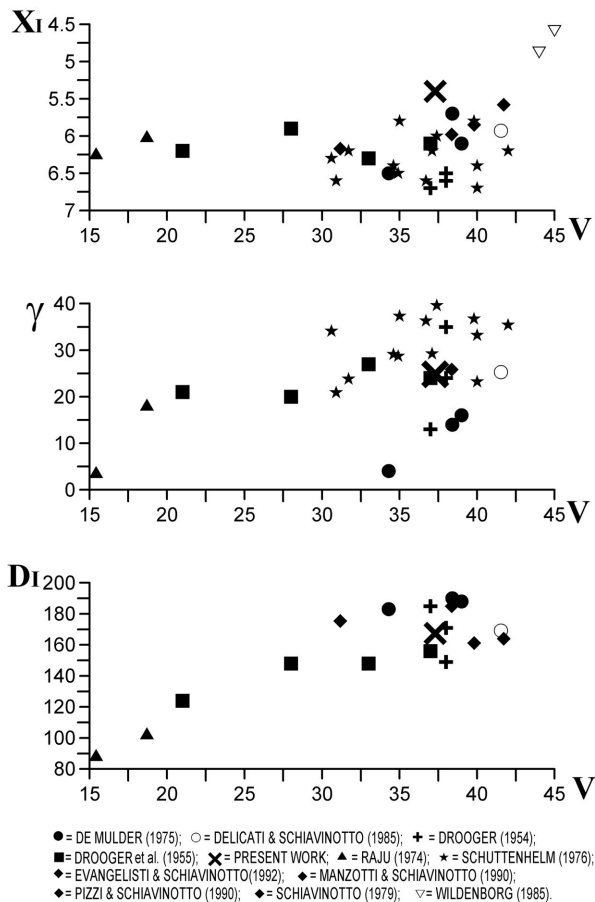


Fig. 5 - Scatter diagrams showing the relation between mean values of V and DI, and XI in *Miogypsina globulina* (Michelotti) from sample Sam-1 and in co-specific populations from literature.

biometric data obtained on the population of Sam-1 sample. In detail, *M. globulina* in Sam-1 sample indicates a central evolutionary stage of the species, as compared with other populations in literature; thus it indicates an early-middle Burdigalian age.

The overlying planktonic foraminiferal assemblage of Sam-2 sample, confirms the attribution of sample Sam-1 to the lower part of the Burdigalian.

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