ANN. INST. GEOL. PUBL. HUNG. | vol. LXX. | Budapestini, 1987

Proceedings of the VIIIth RCMNS Congress

STRATIGRAPHICAL AND BIOGEOGRAPHICAL SIGNIFICANCE OF BRYOZOAN FAUNAS FROM MIOCENE TO RECENT IN TETHYS AND PARATETHYS

by

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Introduction. For twenty years, the studies about the bryozoan faunas of the tethyan realm have been sufficiently numerous to give a good idea of stratigraphical scale and palaeoecological significance. Several palaeontological studies have been done on the Burdigalian of the Rhone basin, the Badenian of the Vienna basin, the Messinian of Morocco, Algeria and Spain, Italy and Tunisia (Fig. 1).

We collected data about Neogene or recent deposits or sites (Fig. 2). Finally, a list of 452 taxa of the Cheilostome bryozoans has been available for our study.

Among these data sets, we have chosen three examples:

– six recent sites in the western and eastern Mediterranean;

– four Burdigalian deposits from the south Rhone basin, four Badenian localities from the Vienna basin and one in the Serravallian from the north Rhone basin;

– three localities from the western mediterranean Messinian and three from the Pliocene of Spain, Tunisia and Portugal.

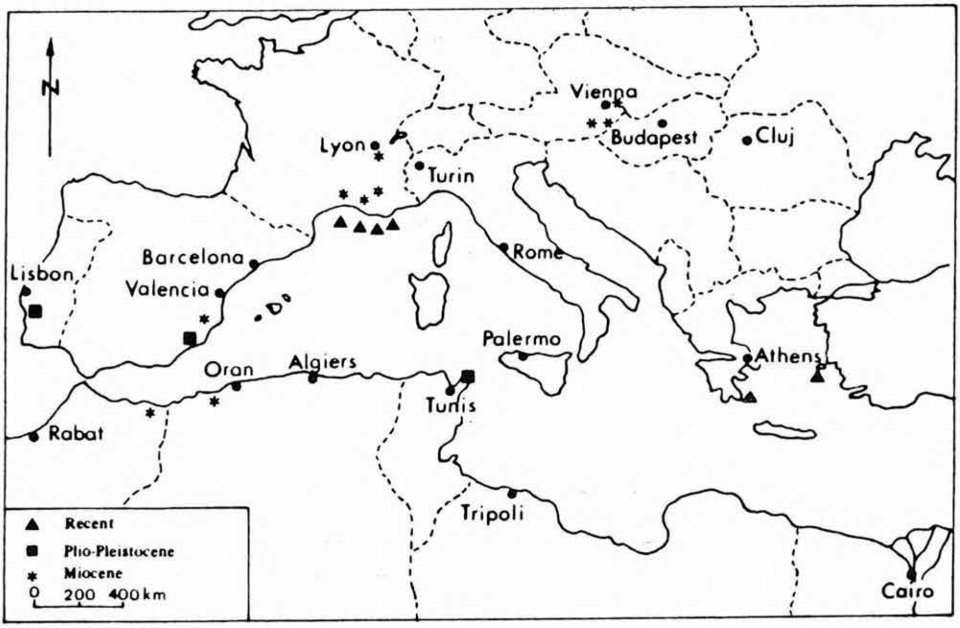

Fig. 1. Geographical distribution of main Neogene and Recent bryozoan deposits from the Mesogean realm

These three examples are enough to show the interest of comparison tests between the bryozoan faunas of Tethys and Paratethys.

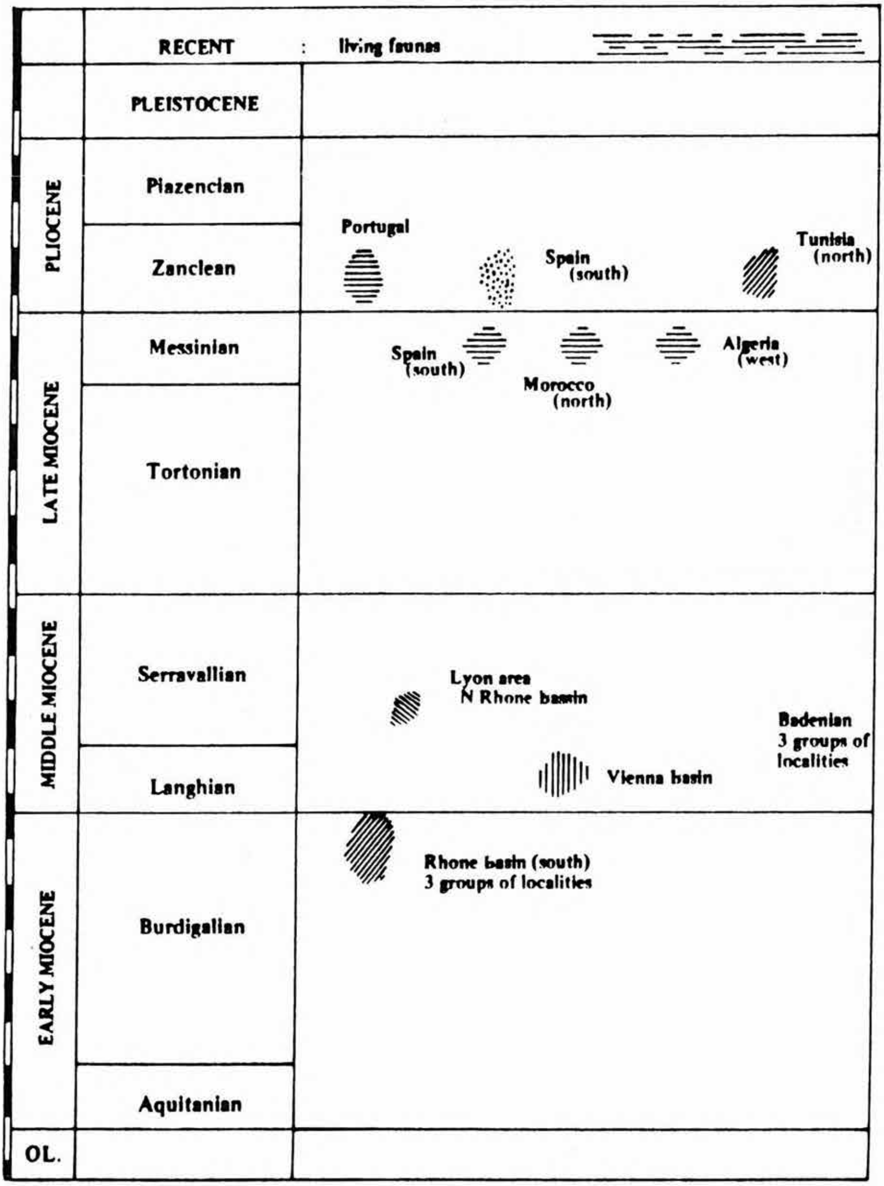

Fig. 2. Stratigraphical distribution of main bryozoan localities

Methods

For each recent site or fossil locality, we established a list of species: we confine ourselves to the study solely of the cheilostome species. A complete study of the bryozoan faunas will have to include ultimately also the Cyclostomata.

We kept all the specific taxa, included doubtful species (cf, aff, ?). We excluded generic taxa and, for the living species, the ones which cannot be fossilized. Subspecific species are considered only as one taxa.

We used a similarity test to compare our lists the Kojumdgieva coefficient (1976), it allows a better comparison between localities in which the number of species is very unequal:

$$K = \frac{Ca\% + Cb\%}{2}$$

$$Ca\% = \frac{C}{A} \times 100 \qquad Cb\% = \frac{C}{B} \times 100$$

A = number of species from *a* locality
B = number of species from *b* locality
C = number of species both in *a* and *b* localities

Then, we used cluster analysis to calculate a coefficient of distance between the percentages of similarity coefficients and to produce dendrograms. The program was written by DR. GILLES CARBONNEL of the Claude-Bernard University (Lyon); we thank him for his assistance.

Results

FIRST EXAMPLE: comparison between recent sites of the Mediterranean (Figs. 3, 4 and Table 1).

We chose four sites from the Tyrrhenian Sea studied by HARMELIN (1976) and two sites from the Aegean Sea: Chios Island (HAYWARD, 1974) and the Charcot cruise (HARMELIN, 1969).

The 4 sites of the Tyrrhenian Sea correspond to four different biocoenoses: rocky ground (97 species), Posidonia beds (70 species), detritic sea bottom (87 species) and minute substrate (70 species). The coefficient of similarity K and the dendrograms (Fig. 3 and Table 1) show a very strong correlation between the two hard substrata then a good correlation with the Posidonia beds and finally a slight one with the sandy substratum (= detritic sea bottom).

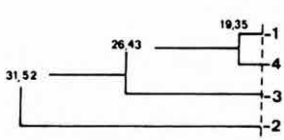

Fig. 3. Dendogram showing the distance coefficient between four sites of living faunas in the Tyrrhenian Sea (see Table 1)

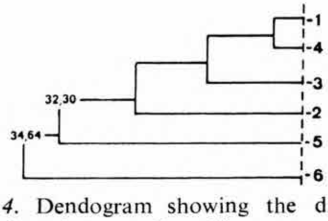

Fig. 4. Dendogram showing the distance coefficient between four biocenoses of the Tyrrhenian Sea and two sites of the Aegean Sea (see Table 1)

Table 1

		rocky ground 1	posi-donies 2	detritic sea bottom 3	minute substrate 4	Chios Island 5	Charcot cruise 6
W Mediterranean Tyrrhenian Sea	1	100	63,95	68,68	73,17	49,56	53,33
	2	63.95	100	48.99	64.76	51.04	38.85
	3	68.68	48.99	100	61.07	38.64	51.98
	4	73.17	64.76	61.07	100	51.46	53.62
E Mediterranean Aegean Sea	5	49.56	51.04	38.64	51.46	100	38.60
	6	53.33	38.85	51.98	53.62	38.60	100

The sites of the Aegean Sea are weakly correlated with the ones of the Tyrrhenian Sea. The biocoenoses are similar but the biogeographic distance is great. The geographic distance is the main factor which marks the differences between the sites.

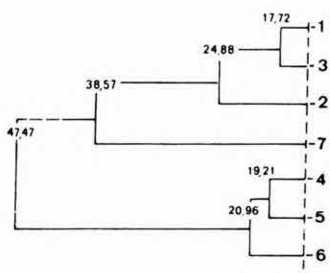

Fig. 5. Dendogram showing the distance coefficient between the seven localities of Table 2

SECOND EXAMPLE: comparison between several localities from Tethys and Paratethys in Rhone basin and Vienna basin (Fig. 5 and Table 2).

In the south part of the Rhone basin, we studied numerous outcrops from three areas:

– four outcrops from the Mus area (Gard, Languedoc) (DAVID, MONGEREAU & POUYET, 1972; POUYET, 1973). The bryozoan faunas are very similar and we compiled a single list of 83 species for the whole region;

– three outcrops from the Valreas area (Drome) (DAVID, MONGEREAU & POUYET, 1970) for which we established a list of 59 significant species;

– thirteen outcrops from the Faucon-Mollans-Malaucene area (Vaucluse) (POUYET & DAVID, 1984). We obtained a list of 76 species.

Table 2

		Rhone basin			Vienna basin			Rh. b.
		Mus	Valréas	Faucon	North	South	West	Lyon
		1	2	3	4	5	6	7
	1	100	56.55	68.06	22.55	28.99	30.91	29.10
Burdigalian	2	56.55	100	54.20	23.16	24.09	23.65	34.78
	3	68.06	54.20	100	30.75	33.53	34.84	36.18
	4	22.55	23.16	30.75	100	64.43	60.75	17.18
Badenian	5	28.99	24.09	33.53	64.43	100	62.47	16.44
	6	30.91	23.65	34.84	60.75	62.47	100	25.39
Serravallian	7	29.10	34.78	36.18	17.18	16.44	25.39	100

These three groups of localities have the same age: Upper Burdigalian. Their comparison shows a very strong similarity (K = 54 to 68) and very short distance (17 and 24).

In the paratethyan Vienna basin, a great deal of deposits were studied in three areas (David & Pouyet, 1974; Vavra, 1977):

— nine localities from the northern part of the intraalpin basin at the north of Vienna. A single list of 62 species was established;

— twelve localities from the southern part of the intraalpin basin at the south of Vienna. The complete list includes 76 species;

— ten localities from the eastern Pannonian basin with a list of 92 species.

These three groups of deposits have the same age: Badenian i.e. Langhian—Serravallian. This age is slightly younger than the one of the south Rhone basin. The comparison of these three groups shows also a very strong similarity (K = 60 to 64) and a very short distance (19 and 20).

In conclusion, the similarity is very strong when the deposits have an identical age and when they are in the same palaeogeographical area.

Then, we compared a Serravallian deposit from the north of Rhone basin (Lyon area) (David, 1965) with the south Rhone basin and the Vienna basin. The age of this locality is nearer of that of the Vienna basin, however the similarity is greater with the south of the Rhone basin. The palaeogeographical unity is more significant than the stratigraphical position.

THIRD EXAMPLE: comparison between fossil deposits from Upper Miocene and Lower Pliocene of the western Mediterranean sea (Fig. 6 and Table 3).

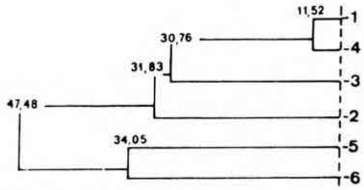

Fig. 6. Dendogram showing the distance coefficient between the six localities of Table 3

At first, we compared three groups of Messinian deposits from western Algeria, south Spain (MOISSETTE & POUYET in press) and north Morocco (EL HAJJAJI, 1982). The similarity co-efficient is 46 to 64: the deposits belong to the same palaeogeographical area: the Alboran basin.

Then, we compared three groups of Lower Pliocene localities from south Spain (POUYET, 1976), Tunisia (BUGE, 1956) and Portugal (GALOPIM DE CARVALHO, 1971). The similarity co-efficient is weak: from 30 to 41. This result confirms that the palaeogeographical unit is the most important fact: indeed the localities belong to three different palaeogeographic basins: Atlantic, Alboran and central Tethys.

At last, the comparison between Messinian deposits from south Spain and Pliocene deposits from south Spain leads to a value of 89 for the similarity co-efficient and a value of 11 for the distance. We can suppose a very high palaeogeographical endemism in a part of the Alboran basin only.

Table 3

		ALGERIA W 1	SPAIN S 2	MOROCCO N 3	SPAIN S 4	TUNISIA 5	PORTUGAL 6
Messinian	1	100	64.90	59.32	89.54	33.08	31.86
	2	64.90	100	46.85	43.85	21.07	18.40
	3	59.32	46.85	100	49.22	33.52	30.42
Pliocene	4	89.54	43.85	49.22	100	38.71	30.90
	5	33 08	21.07	33.52	38.71	100	41.36
	6	31.86	18.40	30.42	30.90	41.36	100

Conclusion

Comparing the results of both recent and fossil faunas as illustrated in the three examples, the following conclusion may be drawn: the fossil asscciations are dependent of three main factors, time, ecology and palaeogeography.

TIME is the fundamental factor which is always present. The standard systems of comparison of faunas (percentage of living faunas) are found upon the stratigraphical distribution i.e. time only.

ECOLOGY is a very important factor. The comparison between living faunas (1st example) shows the influence of ecology very well. This factor is less important in the fossil assemblages which are less dependent of the environment because there are several various biotopes, not only one. The similarity co-efficient is enough to estimate the effect of environment.

PALAEOGEOGRAPHY: in appearance, it is the main factor because it takes evolution (migrations, endemism), environment and geodynamic into account. Palaeogeography has a synthetic significance and the best mean to appreciate it, is cluster analysis.

This study represents the initial step in the comparative analysis of Neogene and Recent mediterranean bryozoan faunas. Further works will be necessary to confirm our results.

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