Aberrant features of the Messinian coral reefs, Spain*

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RESUMEN

Se describen someramente los principales arrecifes del Messiniano en España, haciendo hincapié en el conjunto de "anomalías" que presentan los arrecifes del Neógeno inferior en comparación con las asociaciones arrecifales actuales. Se discute la importancia y significado de Porites sp. como coral claramente dominante, y a menudo exclusivo, en la construcción de edificios arrecifales.

During the Messinian event, coral reefs existed scattered along the Mediterranean coast. We should be able to obtain accurate information on Messinian environments by studying its reefs. Although some of these reefs are recognized in the literature, we are not aware of detailed studies on them; one exception in Spain is the work of DABRIO (1974, 1975) in the area of Purchena. The purpose of this paper is to present a preliminary report of our work on the Messinian reefs in Spain, pointing out a constant set of "anomalies" in the community composition of these reefs in relation to earlier Neogene and to modern reef communities. Although the precise age of most of these outcrops is not well known, we believe that they are roughly contemporaneous, mainly because (1) these anomalies in the communities are a response to very specific and exceptional environmental conditions, clearly related to the Messinian crisis, (2) it appears that analogous aberrant communities existed in other Mediterranean localities in analogous stratigraphic position. We do not have as yet a completely satisfactory explanation for all of these aberrant features; but a tentative interpretation is here outlined as a working hypothesis.

GENERAL DESCRIPTION

Spanish Messinian reefs vary considerably in size, morphology, substrate and diageneric processes. Fig. 1

Reef substrata are silicilastic fan deposits in Pur-
chena and Lucainena, volcanics in Carboneras (pro-
bably with atol-like morphologies), and older Miocene
sediments in Mallorca. Preservation of wide reef-wall
buttresses is particularly good in Santa Pola and Ni-
jar, and to a lesser degree in Carboneras. Evidence of
extensive submarine cementation is found in Mallorca
and decreases toward the west. In Purchena there is
practically no cementation. The inferred water turbu-
lence was very high in the area of Mallorca, and in ge-
genral also seems to be diminishing toward the west.
Gravitational displacement of reef blocks and sediment
is quite common during the Messinian and Lower Plio-
cene. A characteristic vertical fracture system parallel
to the reef-front seems to have contributed to slope
instability.

All these variations are suggestive of a complex pa-
leogeography; in general, the open sea should be to-
ward the east and, apparently, there is not much evi-
dence of good communication with the Atlantic.

REEF COMMUNITIES

In view of the variability in the Spanish Messinian
reefs, the rather constant coral composition is here
considered to be quite significant. The reef builder in
the Spanish Messinian is Porites sp. This coral is
clearly dominant, and often exclusive, in the reef-wall
framework. The typical Porites morphology is long,
vertical, bifurcating or trifurcating sticks, 2-10 cm
thick and up to 4 m high, in bush-like and organlike
configurations. In more exposed areas Porites appears
in successive flat colonies connected by vertical co-
lumns. In more protected areas hemispherical star cor-
ral heads of Sidereastra sp and Montastrea sp may
occur. Although these coral heads may be up to 50 cm
in diameter they are not conspicuous as reef builders.
In some places star corals adapt a columnar colonial
morphology similar to Porites. Brain corals are less
coman except at some points Purchena, the area with
the highest coral diversity in the Spanish Messinian.
That high diversity occurs in the less expected locality,
with the thinner reefs, poor cementation, and probably
less wave action away from the inferred open seas to
the east. Significantly, in this locality Porites is sma-
ller than farther east, but still is very abundant and
has the same morphology.

In the area of Santa Pola, and probably in Carbonera-
s and Mallorca, Porites is intergrown or closely as-
sociated with blue-green (?) algal stromatolite bio-
herms, one to tens of meters high, in the reef-front.
This stromatolite-Porites association is also well deve-
oped in oolitebar sequences in more shelfward posi-
tions. The apparent absence of tidalite sequences, fe-
restrial fabrics or indications of emergence, together
with the stromatolite morphology (units up to 15 m
thick of perfect hemispherial heads up to 10 m in
diameter), may suggest a rather deep submarine envi-
ronment.

Production of Halimeda sp is usually very high. This
codiacean alga occurs in thick (2-5 m) packstone beds
in the fore-reef slope. Red algal nodules and branches,
vermetid gastropods, bryozoa and serpulid worms
are present in some locations, but do not play a signif-
ificant role as binders in the reef-wall framework. Orga-
nic boring (spunge, mollusc, worm, alga, fungi) of the
reef is abundant in some places, specially in Mallorca.

ABERRANT FEATURES

In the community composition of the Spanish Messin-
ian reefs that we have briefly summarized, we find a
significant set of anomalous or aberrant features: (1) A
drastic reduction of diversity of reef-building species,
in comparison with earlier Miocene, or older, reefs in
the area (CHEVALIER, 1961, PERMANYER and ES-
TEBAN 1973); (2) The exclusivity to the Messinian of
the large size and shape of Porites. This group appea-
red in the Middle Cretaceous and is well represented
in reefs since the beginning of the Cenozoic, showing col-
onal morphologies similar to the ones of modern spe-
cies. Only during the Messinian do they develop except-
ionally large columns and flat-and-column structures,
or appear in exclusive Porites-reef; (3) The presence
and abundance of stromatolites in a reef front or in
areas associated with corals, Halimeda and bryo-
zoans, all these supposedly sensitive indicators of nor-
mal marine conditions.

INTERPRETATION

These anomalous or aberrant features produce a
special archaic aspect in the Messinian reefs in rela-
tion to other reef communities in the area. These fea-
tures reflect conditions of growth that differ consider-
ably from “normal” marine. Porites and Sidereastra are
known in modern seas as the corals more resistant to
salinity and temperature variations or to waters high
in suspended sediment. However, in these physically
stressed modern environments they occur as small and
isolated colonies, in contrast with the ones in optimal
marine conditions. This suggests that another kind of
ecological control had to favor the huge Messinian Po-
rites colonies, perhaps growth in absence of ecologic
competition.

WORKING HYPOTHESIS

Our hypothetical interpretation in skies two stages.
First, a Messinian crisis (salinity -) would eliminate
most of the normal marine biota, only preserving some
of the more resistant species (particularly, Porites and
Sidereastra) and favoring the development of stroma-
tolites. Second, a rapid re-establishment of normal or
near-normal marine conditions would provide these
communities with the opportunity for growth in a non-
competitive situation. The problematic part of this hy-
hypothesis is to explain the absence of coral and stromatolite competitors and, at the same time, the presence of Halimeda, bryozoans, etc. What kept browsers, grazers and scrapers on algal mats and corals from re-establishing themselves in the reef environment?

Several considerations may help explain this problem. During the Tortonian, coral reefs disappear on the Atlantic side of France and yet they were flourishing on the Mediterranean side (CHEVALIER 1961), suggesting that the Mediterranean was a "refuge" during the Late Miocene. In the periods of re-establishment of marine conditions during the Messinian, there were no corals or coral competitors on the Atlantic side that could emigrate to the Mediterranean. To explain other absences we can also consider that during the Messinian, periods of normal marine conditions were so short or so rapidly established that there was no time for invasion of diversified Atlantic communities. Other possible considerations may involve the nature of the communication with the Atlantic or the amount of organic matter or suspended sediment in the water.

Much more information and field data are needed in order to delineate a basic paleogeography and paleoecology of the Messinian reefs. The ideas here expressed only attempt to stimulate further work on this exciting and poorly understood subject.

REFERENCES


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