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OCURRENCE OF ALGAL BALLS-LIKE STRUCTURES IN THE PRE-ORDOVICIAN LIMESTONES OF PORTEL, ALENTEJO

by

A. A. SOARES DE ANDRADE

ABSTRACT: Core samples of Portel epimetamorphic limestones, so far azoic, contain spheroidal to ellipsoidal structures which markedly resemble those described in the literature as algal balls or algal pellets. A brief description of these structures is given, and their stratigraphic and palaeogeographic implications discussed.

RÉSUMÉ: Existence de structures du type *Algal-Balls* dans les calcaires ante-ordoviciens de Portel, Alentejo. Quelques échantillons de calcaires épimétamorphiques provenant de carottes de sondages (région de Portel) exhibent des structures plus ou moins ellipsoïdales qui ressemblent aux *algal-balls* des auteurs anglo-saxons. Ces structures sont brièvement décrites et leurs incidences stratigraphiques et paléogéographiques envisagées.

RESUMO: Ocorrência de estruturas do tipo *Algal-Balls* nos calcários ante-ordovícicos de Portel, Alentejo. Descrevem-se algumas estruturas esféricas a elipsoidais semelhantes às conhecidas *algal-balls* dos autores anglo-saxónicos e discutem-se sumariamente as suas implicações estratigráficas e paleogeográficas. Aquelas estruturas encontram-se em calcários dolomíticos epimetamórficos, até agora supostos azoicos, provenientes de sondagens efectuadas na região de Portel.

Though pre-Ordovician rocks are widespread in Portugal, lack of fossils have so far precluded the elaboration of fine stratigraphical divisions; this can be illustrated by the fact that the classical three-fold scheme of J. Delgado (1905) (1) is still widely

(1) Cambrian, Algonkian and Archaean (lithostratigraphical units, in spite of the committal designations used).

used by Portuguese geologists (Neiva, 1966; Teixeira, 1966) with but minor changes. Fossils are apparently restricted to the Vila Boim area, in south-eastern-central Portugal (Delgado, 1904); they suggest an Upper Georgian age (Teixeira, 1953). Very recently, C. Teixeira and F. Gonçalves (1967) have reported a *Lingulella* specimen from the Serra do Marão greywackes (alleged pre-Ordovician); and structures of a «probable algal origin» have been referred by C. Romariz (1966) in the Serra de Ficalho Cambrian (?) limestones.

The organic structures described in this note were first observed by the author in June 1965 in cores from boreholes drilled by the Serviço de Fomento Mineiro (Government Mining Staff) in the Algarés de Portel mineralized area. New observations were later made (February 1966) in the company of V. Oliveira, geologist of the Serviço de Fomento Mineiro.

GEOLOGICAL SETTING

The Portel anticlinorium (Carvalhosa, 1966) belongs to the so-called Evora Massive or Evora Belt (Delgado, 1905; Teixeira, 1954), which builds up the Portuguese section of the Arcena-Evora Complex (Fabriès, 1963). This Complex is part of the Ossa-Morena Zone of the Iberides (Lotze, 1945); it is composed by metamorphosed, highly folded volcanics and sediments, which have been invaded by crystalline rocks (chiefly tonalites and gabbro-diorites).

Three main lithostratigraphic units have been distinguished in the Portel area (Andrade, 1966), from youngest to older:

- *Degebe Group*: phyllites and micaschists with minor porphyritic rocks.
- *Algarés Complex*: epimetamorphic pyroclastic rocks and sediments (limestones, dolomites, cherts) interbedded with lava flows of the ophiolitic sequence.
- *Zangalho Group*: Dark slates and greywackes, black quartzites and minor basic volcanics (?).

In spite of the up-to-present lack of fossils, a probable Cambrian (and Infra-cambrian?) age was recently assigned to these

formations by A. Carvalhosa (1965, 1966): this is largely based upon lithological and structural similarities with fossiliferous rocks within the Ossa-Morena Zone (Fabries, 1963; Bard, 1964).

THE FOSSILS

Several types of crystalline, more or less dolomitic and/or silicious limestones are known in the Portel area (Silva, 1956). Attention has recently been given to these limestones, as they apparently control the emplacement of a sulphide deposit (Gomes, 1964, 1965; Carvalhosa, 1965, 1966; Andrade, 1966; Gaspar, 1967).

Fossil remains were first observed in dolomitic limestones from borehole n.º 2; they are apparently restricted to a zone lying between —174,5 and —181,0 meters (in a 80° dipping borehole). In hand specimen, limestones are grey, dense, finely crystalline; cavities after structures of organisms are locally present, in which calcite recrystallized. A conspicuous feature of these limestones is given by a few horizons of intraformational breccias in association with the organic structures referred in this note. Obviously, the number of such horizons is very difficult to estimate because of intensity of folding.

The fossil structures typically have an average diameter ranging from 0,5 to 1 cm. Macroscopically, they appear spheroidal to ellipsoidal in shape, as pointed out by a thin film of dark cryptocrystalline calcite (sometimes associated with finely crystalline pyrite) developed around a carbonate nucleus. This nucleus often consists in gray, dolomitic limestone, similar (but generally coarser) to the bulk rock (fig. 1 a, b, c); but locally the inner material is lighter (fig. 1 e) or darker (fig. 1 f) than the outer one. Secondary pyrite (fig. 1g) is conspicuously less frequent.

These features seem to agree with those ascribed to the so-called algal balls or algal pellets (Johnson, 1952, 1961, 1966; Carozzi, 1960). Similar structures have also been described by many authors, in particular by L. Dangeard (1935), who called them «pisolithes a Girvanelles», and by I. Zamarreno and M. Julivert (1967), in Cambrian limestones from northwestern Spain, as oncolites. The fact may be noted that some of the Portel pellets (fig. 1c) exhibit a pronounced bean shape; according to H. Johnson (1966), such feature seems characteristic of the genus *Girvanella* (blue-green algae). However, in absence of further, micros-

copie studies, any attempt to class these algal balls would be too hazardous.

Attention may be called to the fact that rounded nodules are not the unique structures of assumed algal origin; such an origin could be responsible for some thin, layered structures that we can observe in hand specimen (fig. 1 h).

CONCLUSIONS

Evidence is given in this note that suggests a biological, algal origin for part (at least) of Portel limestones. This apparently confirms the results of a recent study by C. Romariz (1966), who described a «calcarenite which seems to contain recrystallized organic structures» in the Preguiça-Ficalho area, in the southeastern part of the Evora Massive. The existence of reef structures in the Evora Massive appear more and more likely; they could be associated with intrageosynclinal ridges during the initial, subsident phase of the geosyncline development (Andrade, 1966),

Obviously, a detailed study of the Portel fossiliferous limestones is necessary in order to obtain valuable palaeontological, stratigraphic and palaeogeographical data.

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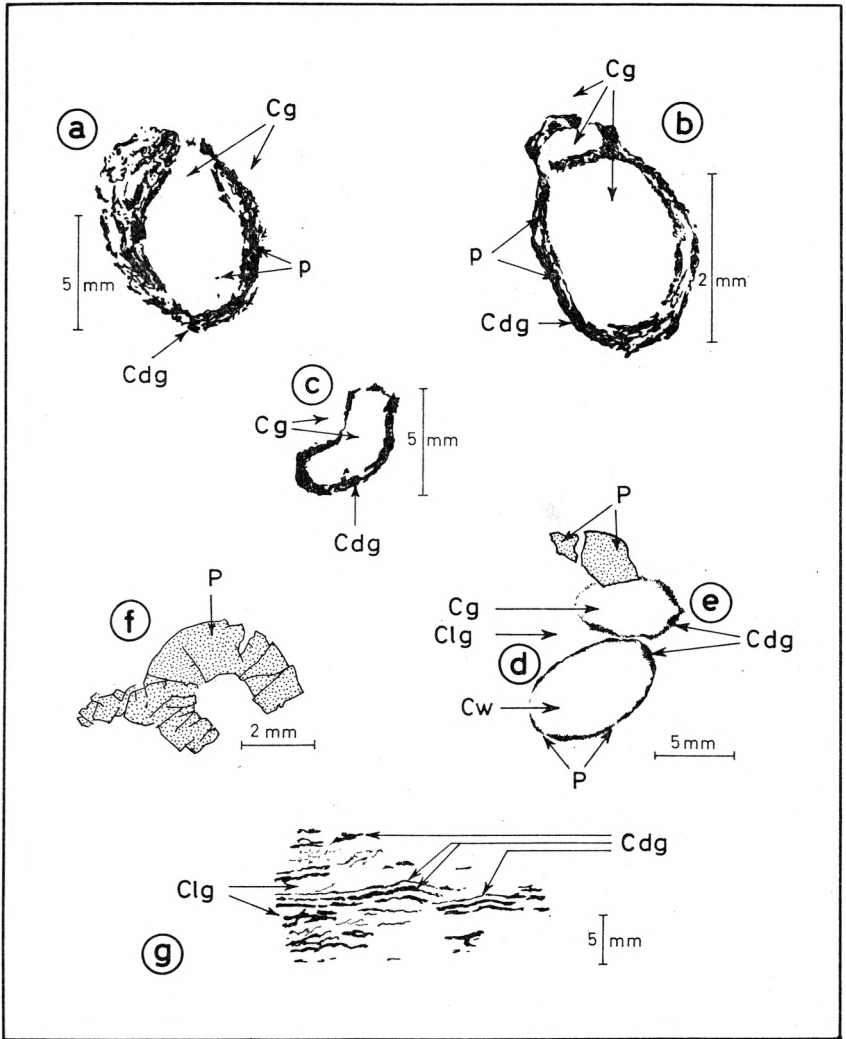


Fig. 1 — Macroscopic features of the Portel fossiliferous limestones.

C_w — white carbonate. C_g — Grey carbonate. Cl_g — Light grey carbonate.
 C_{dg} — Dark grey carbonate. P — Coarse pyrite. p. — fine pyrite.

a b c f Sample n.º S_2 — 176,0

d e Sample n.º S_3 — 63,8

g Sample n.º S_4 — 85,6