

THE PALAEOZOIC STRATA NEAR MOECHE IN GALICIA, NW SPAIN

BY

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ABSTRACT

Coral fragments, crinoidal debris and foraminifers found in limestone beds near Moeche (Galicia) are evidence of a Devonian-Silurian age for the strata in the greenschist facies belt around Cabo Ortegal, hitherto considered on the Spanish 1:200,000 map-La Coruña Hoja 1 (IGME), to be Precambrian in age. Their deposition by turbidity currents into troughs on an ancient ocean floor is being suggested.

INTRODUCTION

The northwestern extremity of Spain, near El Ferrol, Cabo Ortegal and Ortigueira is an area of igneous and metamorphic rocks which forms part of the Galician-Castilian zone (Lotze, 1945) in western Spain. Towards the East the exposed strata become progressively younger in age and in the Cantabrian Mountains the Palaeozoic succession is finally buried under a thick cover of Mesozoic sediments.

Since 1957 petrological fieldwork has been carried out around Cabo Ortegal by students and staff of the petrologic department of the Geological Institute in Leiden. This work resulted e. g. in theses by Vogel (1967), Maaskant (1970), Engels (1972) and in a geological map by Vogel, Engels and Ho Len Fat. Also the Mapa Geologico de España, 1:200,000, sheet 1, by the Instituto Geologico y Minero de España (IGME) is most important with regard to the present paper.

GENERAL GEOLOGICAL SETTING

The area around Cabo Ortegal can be divided into a NE-SW trending complex of eclogites, granulites, amphibolites and paragneisses with abundant catazonal mafic inclusions considered to be of Precambrian age. These are intruded by ultramafic rocks and metagabbros. Faults separate this complex from intensively folded metasediments and greenschists to the Southeast, the South and the Southwest. Within this belt of greenschist facies rocks are isolated outcrops of serpentinite. Near Moeche (Pereiro) and Insua, half a kilometer SE of Peña Grande, fossiliferous limestone beds can be found associated within serpentinite (Fig. 1, Photo 1). Eastward of the greenschist facies belt lies an area of very slightly

metamorphosed sediments considered to be of Ordovician to Silurian age on the Mapa Geologico de España mentioned above.

STRATIGRAPHY

The stratigraphic succession in the area under consideration is very difficult to be established in the field due to the lack of palaeontological data and marker beds, complicated folding of the strata and the metamorphism of the sediments. The most pertinent palaeontological and stratigraphical data bearing on an area close to our region have been published by Matte (1968). His work contains an excellent synopsis of the stratigraphy of the Palaeozoic succession in northwestern Spain. From his data, correlations can be established between Silurian and older strata in the Cantabrian Mountains and their equivalents near El Picon, on the northern flank of the Barquero anticline (Fig. 2). This is important since the strata in the greenschist facies belt around Moeche are almost on strike with the Palaeozoic succession near El Picon.

The stratigraphic succession described by Matte from the northern flank of the Barquero anticline is presented in Figure 3. The most important aspects of this succession are in stratigraphical order:

1. the Ollo de Sapo volcano-detrital formation, considered by Matte to be of Precambrian age (although elsewhere it might be Cambrian in age);

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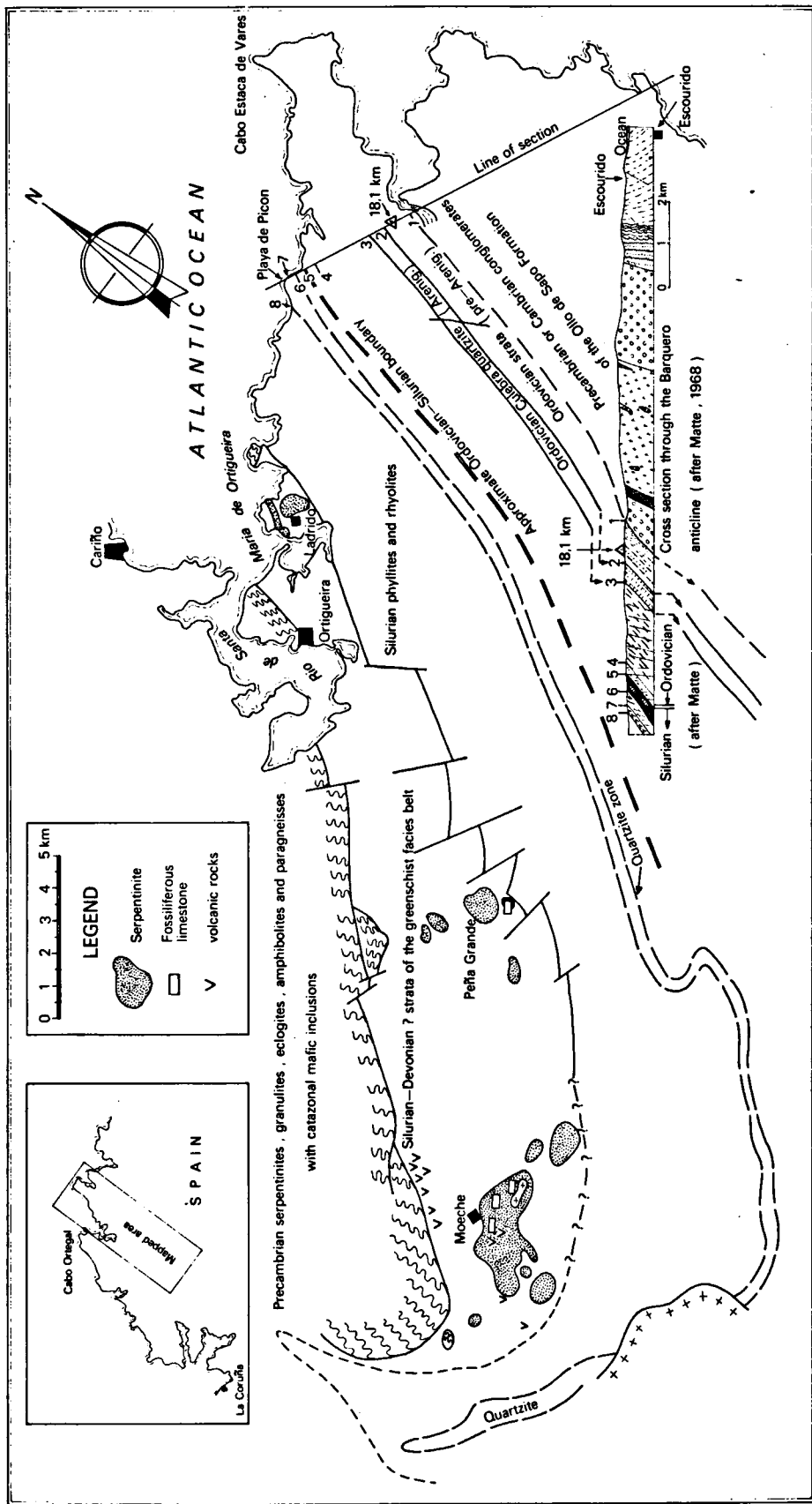


Fig. 1. Geological sketch map of the Palaeozoic strata to the East of the Cabo Ortegal Complex.

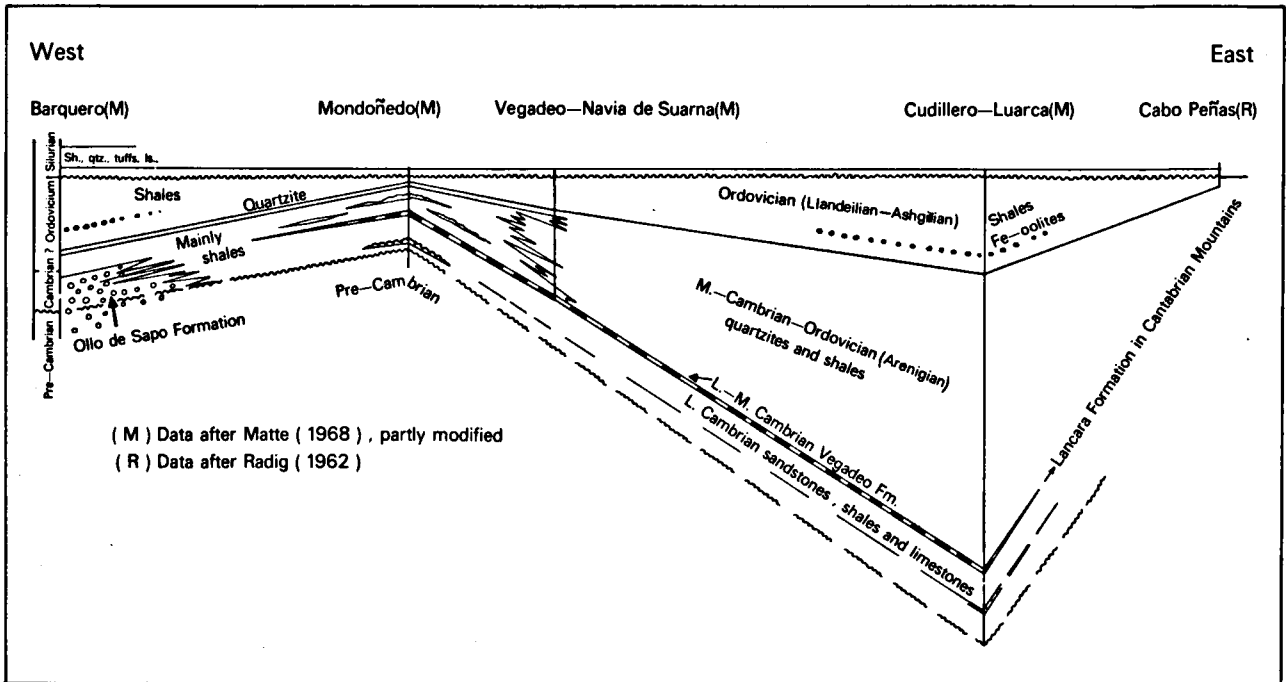


Fig. 2. Stratigraphic cross-section of the Lower Palaeozoic strata between Cabo de Peñas and the anticline of Barquero close to the Cabo Ortegual Complex. Data after Radig (1962) and Matte 1968 (modified).

2. a thick sequence of Ordovician strata of predominantly shales with a pronounced interval of quartzites believed to be equivalent to the Culebra quartzites (Arenig.);
3. a sequence of shales, intercalated with limestone lenses, greenish quartzites, rhyolitic tuffs and, near the top, limestones containing crinoids and siliceous shales with *Monograptus halli* Barr. and *Rastrites linnaei* Barr.

From Matte's cross-section through the Barquero anticline, the Spanish geological map of El Coruña, and mapping done by Hoogervorst (internal report, 1973) it can be deduced that the Silurian rhyolitic tuffs are probably analogous with a distinct quartzite zone that can be followed many kilometers inland (Fig. 1). It changes its original SSW strike just about SE of Moeche. After that this quartzite zone continues in a northwestern direction around the Cabo Ortegual complex. It finally strikes northwards to Punta Corbeira at the Atlantic Coast (see IGME-map).

The strata lying to the West and to the North of this quartzite zone up to the greenschist facies belt could be Silurian in age according to Matte's data. They are marked as phyllites on the geological map by Vogel et al. (1967).

The greenschists are probably separated from the phyllites by faults. Faults also border this facies belt towards the northeast forming its contact with the amphibolites and the gneisses.

The greenschists are mainly chlorite-schists and metavolcanites. According to Hoogervorst (1973) they are

light green to grey coloured, finely laminated schists with abundant quartzveins and lenses. They occur in the greenschist facies belt as well as on top of the serpentinite body near Moeche. Several of the metavolcanites show a relict variolitic texture (Photos 2 and 3). The cavities have been generally filled with quartz and feldspar.

#### THE STRATA NEAR MOECHE

Serpentinite bodies occur around Moeche, Peña Grande and near Ladrado. They consist of greyish-green rock composed of a mass of serpentine which no longer contains any remnants of olivine or pyroxene. Only near Ladrado did Ho Len Fat (internal report, 1968) find a quarry in which the serpentinite still contained some remnants of pyroxenite.

In quarries near Moeche (Photo 1) and Peña Grande limestone beds occur interlayered with serpentinites. Repetition of this sequence is probably due to recumbent folding.

These limestones of which several samples were collected in the Moeche quarry and Peña Grande are lightgreen, slightly fossiliferous, well stratified carbonate rocks.

In thin section they turned out to consist of a mass of microsparite with about 5–10% calcite 'porphyroblasts' which in many cases show the outlines of crinoid columnals (Photo 4). Many of these crinoid fragments show up as ghost-structures inside the porphyroblasts. We have to do here with crinoid fragments which often became surrounded by a rim of syntaxial calcite cement and in that fashion withstood the severe conditions, including

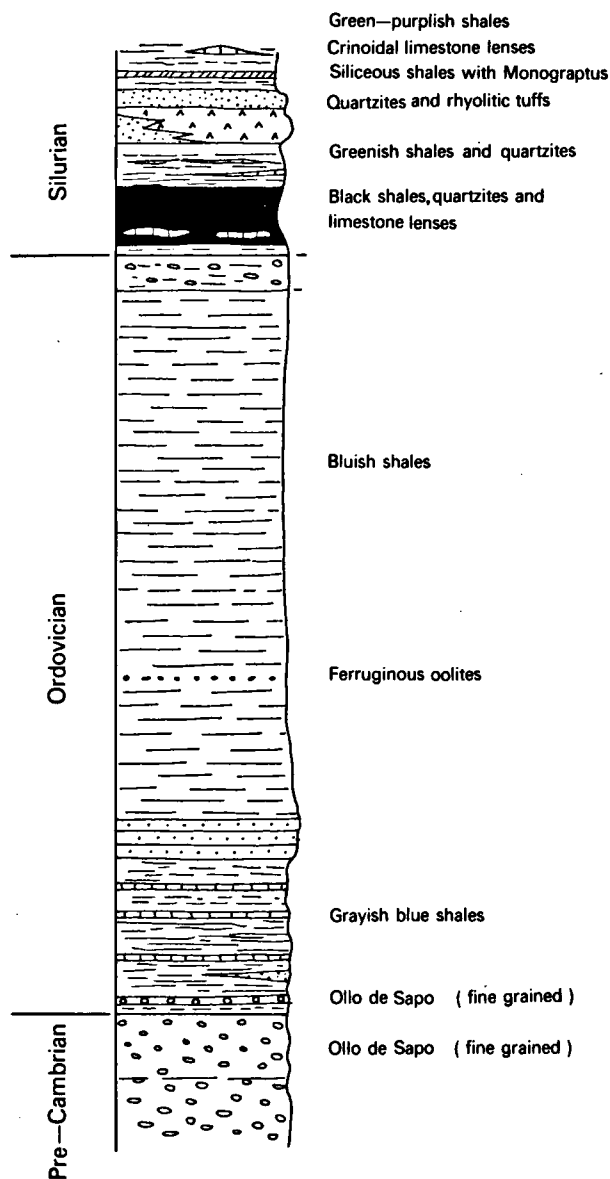


Fig. 3. Stratigraphic succession of Lower Palaeozoic strata near the Barquero anticline, after Matte (1968).

metamorphism, to which they were submitted afterwards.

Apart from crinoid fragments some foraminifers (*Glomospira?*) (Photo 5) were observed in the thin sections as well as fragments of tabulate corals (Photos 6 and 7). The latter were found in a limestone breccia collected in the Peña Grande quarry.

These findings of fossils in the limestones near Moeche and in Peña Grande rule out the previously suggested Precambrian age of the strata in the greenschist facies belt (see IGME-map).

Since neither echinoderms nor corals have ever been found in Precambrian rocks we have to do with Phanerozoic strata. Considering the presence of branching

and laminar *Tabulata* these beds cannot even be older than Middle Ordovician. However, since we know from the work by Matte (1968) and Nissen (1959) that the Silurian strata near El Picon contain crinoidal limestones, an identical age for the Moeche and Peña Grande limestone beds seems to be the most likely possibility.

There is, of course, also a possibility that the limestones might even be younger in age; perhaps they might date from Devonian times. However the nearest Devonian strata known to-day are at a considerable distance from Moeche. Yet it cannot be ruled out that Devonian strata might once have been deposited far more to the West than they are presently found, and in another facies than they are present in the Cantabrian Mountains. Corals are abundantly present in the Devonian strata in the Cantabrian Mountains but do not occur in the underlying pre-Devonian, marine deposits.

The emplacement of the fossiliferous limestones is another problem. The average percentage of crinoid fragments in these limestones is in no way comparable to the amounts found in shallow water carbonates known from so many other places. Neither did we get the impression that the corals or the foraminifers were originally present in great numbers. It must be however admitted that shearing and recrystallization could have caused the destruction of the skeletal structure of many bioclasts, particularly those of corals or Bryozoa. Turbidity currents, sweeping material from a nearby platform, could have caused the transportation of bioclastic material into deeper parts of a sea. There such detritus could have become deposited in calcareous muds overlying lavaflores of a basic, and mantle slices of an ultrabasic composition.

## CONCLUSIONS

The preceding observations and deductions lead to the conclusion that the greenschist facies belt is of Silurian–Devonian age and that their strata might have been deposited in deep troughs.

A Caledonian folding for the Galician-Castilian zone has been suggested by Wagner et al. (1974). His idea is based on a pre-Upper Wenlockian unconformity reported by Martínez-García (1972) from NW-Zamora. However, in the vicinity of Cabo Ortegal we do not find any concrete evidence of a Caledonian orogeny. The unconformable contact, in northern Spain, between Ordovician and Silurian strata can be explained by uplifts of a foreland and block faulting.

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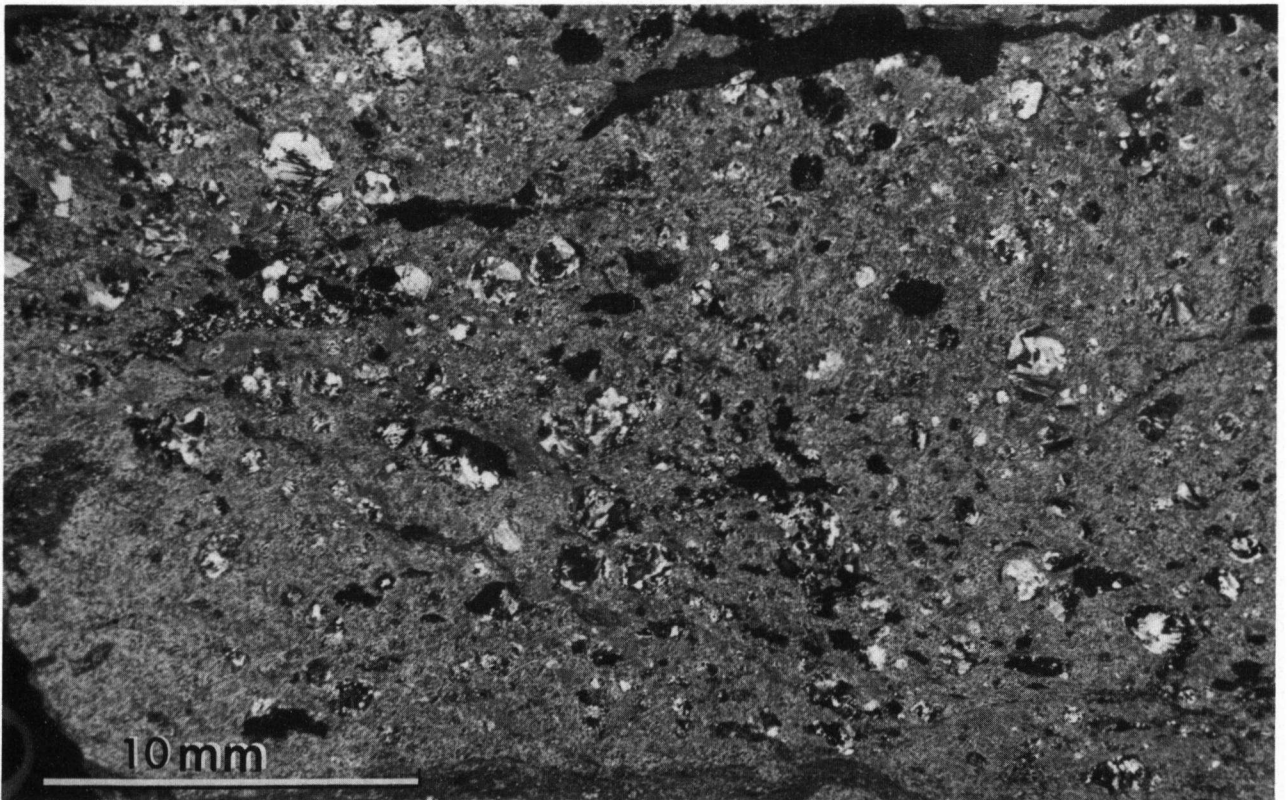
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PHOTOGRAPHS →

**Photo 1. Light coloured fossiliferous limestone beds interlayered with darker coloured serpentinites in a disused quarry near Moeche.**

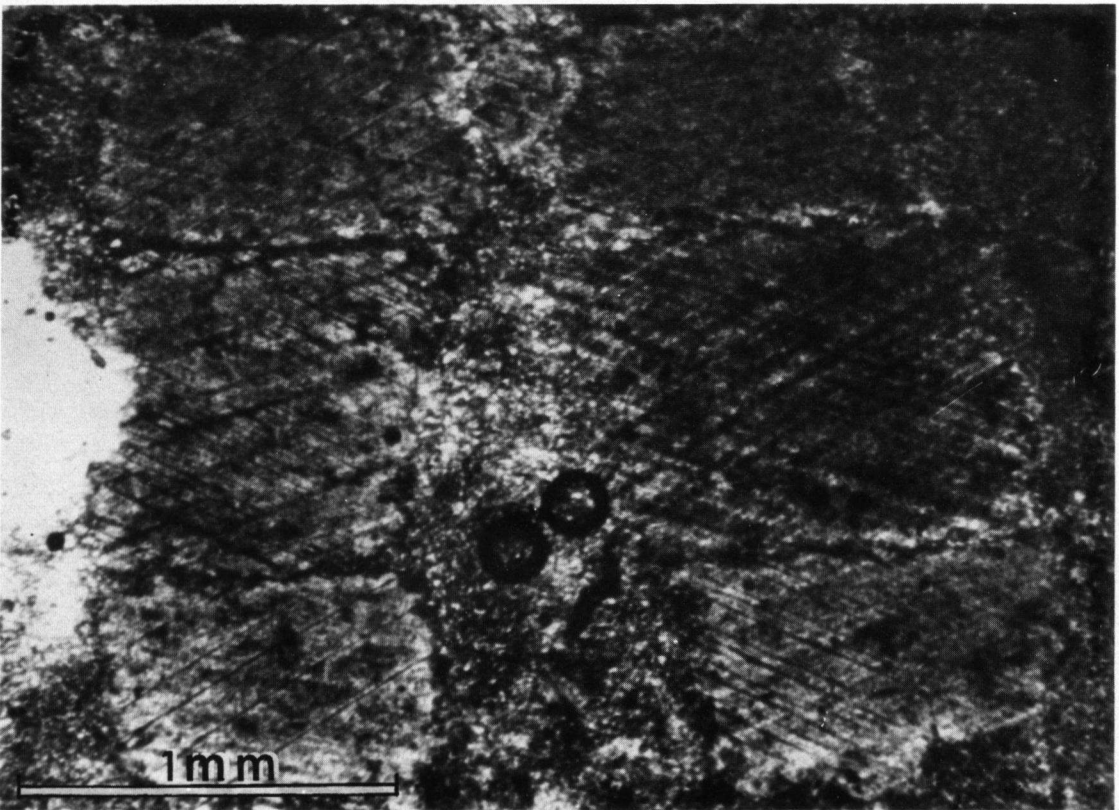
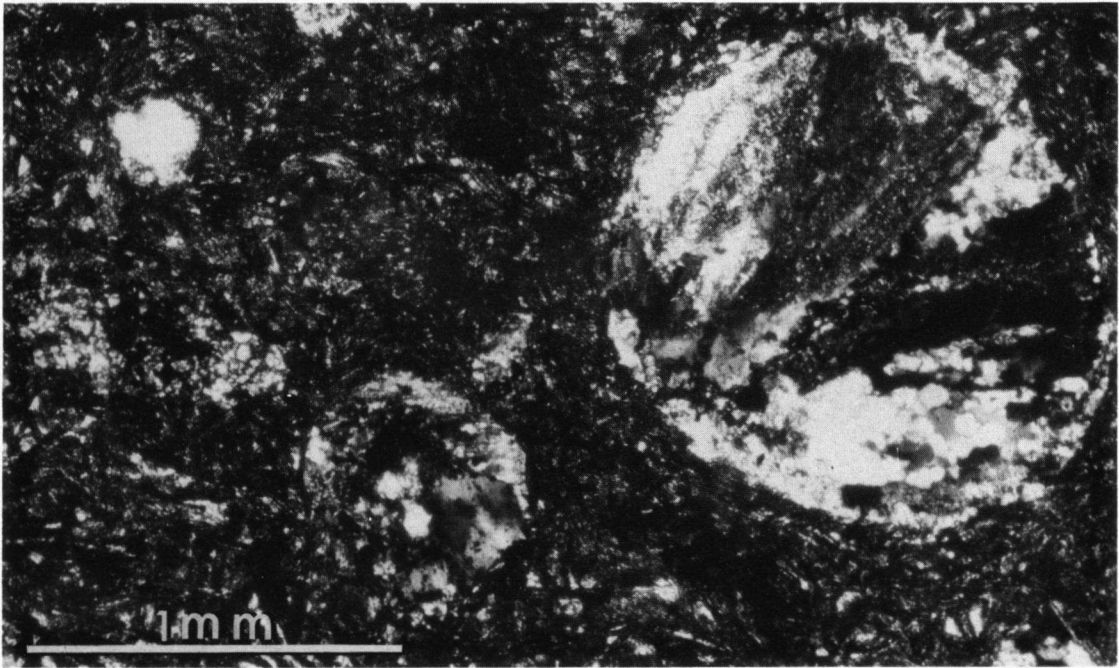
**Photo 2. Metavolcanite from the serpentinite body near Moeche showing relict variolitic texture.  $\times 5$ , crossed nicols. Thin section 7-c4-107. Printed with permission of G. H. T. C. Hoogervorst.**



**Photo 3.** Same thin section as on Photo 2 showing quartz and feldspar crystals (albite) filling variolites.  $\times 50$ , ordinary light. Printed with permission of G. H. T. C. Hoogervorst.

**Photo 4.** Axial cut through three crinoid columnals. Peña Grande quarry.  $\times 50$ . Photo is a negative of thin section.





**Photo 5.** *Glomospira*-like foraminifer from a fossiliferous limestone bed near Moeche. ×350.

**Photo 6.** Fragment of a tabulate coral fragment in a limestone breccia (?) in the Peña Grande quarry. ×50. Photo is a negative of thin section.

**Photo 7.** Fragment of a tabulate coral or Bryozoa (?) in a limestone breccia (?) in the Peña Grande quarry. ×50.

