

VESTIGES OF LATE PRECAMBRIAN (OR YOUNGER) MICROFOSSILS IN CHERT OF THE LA TINTA FORMATION, NORTHEAST ARGENTINA

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INTRODUCTION

Systematic examination of thin sections of silicified sediments in the paleontology collections of the Institute of Geosciences, University of São Paulo (IG/USP) has revealed the presence of poorly preserved vestiges of probable microfossils in a light-gray chert from the La Tinta Formation of the Sierras Bayas, near Olavarría, NE Argentina. The microfossils include filaments, averaging about 40 μm , in diameter, and spheroidal and ellipsoidal microstructures of similar and larger sizes but of somewhat less certain biological origin. These are apparently the first microfossils reported from the La Tinta Formation. Although not comprising unequivocal evidence for age determinations, their presence is at least consistent with the late Precambrian age proposed for the formation by AMOS et al. (1971) and by MARCHESE and DI PAOLA (1975). Furthermore, the supposed La Tinta microfossils are sufficiently larger than silicified microfossils recently discovered in the Paraopeba Formation of the Bambuí Group of Brazil (FAIRCHILD and DARDENNE, this volume) to allow the hypothesis that the La Tinta Formation may be younger than the Paraopeba Formation. The discussion of these apparently biogenic microstructures from the La Tinta Formation hopefully will stimulate further micropaleontological studies of the Argentine Precambrian that one day may help establish a Precambrian biostratigraphic scheme for South America.

GEOLOGIC SETTING AND AGE

For many years the definition, extent, and age of the La Tinta Formation have been the source of much debate. Recently, MARCHESE and DI PAOLA (1975) proposed that the entire pre-Tertiary sedimentary sequence exposed in the more than 300 km-long, NW-trending series of low mountains known as the Sierras Septentrionales, several hundred kilometers south of Buenos Aires, represents a single lithostratigraphic unit, the La Tinta Formation, of distinctly miogeosynclinal character. At the northwestern end of this range, in the Sierras Bayas-Olavarría region where the microfossiliferous chert was collected by U. G. Cordani (IG/USP), the La Tinta Formation rests nonconformably upon the altered granitic-migmatitic Buenos Aires Com-

plex and comprises a nearly flat-lying sequence consisting of, in ascending order, 6-15m of light-colored, cross-bedded quartzites; 4 to more than 30m of dark-gray to yellowish, thick-bedded, primary dolostones with locally abundant stromatolites; 15-30m of quartzites like those at the base; 5-30m of variegated, laminated, illitic argillites; and, at the top, 15 to more than 50m of black to grayish-red limestones, portions of which are silicified. The stratigraphic position of the microfossiliferous chert was not noted at the time of its collection, but it apparently comes from the dolostones or from higher in the section (Cordani, pers. comm., 1978).

Stromatolites in the dolomitic member in the Sierras Bayas-Olavarría region were briefly described by AMOS et al. (1971) and more thoroughly documented by MARCHESE

and DI PAOLA (1975). They are apparently most abundant near the top of the member, where they occur in lenticular beds up to 100m long and exhibit a rich variety of morphologies, including *Collenia* and *Cryptozoon* (BONORINO, 1954, CUERDA, 1972, both apud MARCHESE and DI PAOLA, 1975), as well as unnamed, branched, columnar forms (MARCHESE and DI PAOLA, 1975). Up to five stromatolitic layers are evident locally, and individual stromatolites may reach 50cm in transverse diameter. Columnar stromatolites also occur in the lower part of the dolomitic member. Careful study of the biostratigraphically significant columnar stromatolites may help resolve the problem of the age of the La Tinta Formation.

Prior to the suggestion by AMOS et al. (1971) that the La Tinta stromatolites might indicate a Precambrian age, the La Tinta Formation was long considered to be Paleozoic in age, an assumption reinforced by BORRELLO'S discovery (1966, apud AMOS et al., 1971) of supposedly Ordovician ichnofossils in the southeastern part of the Sierras Septentrionales. The possibility of a Precambrian age for the formation has been further investigated by MARCHESE and DI PAOLA (1975) who argue that many of the "ichnofossils" are of doubtful biologic origin, that the La Tinta Formation is not correlatable with the generally fossiliferous, lower Paleozoic sequences of Argentina, and that the variety and abundance of stromatolites probably signify a Precambrian age for the formation. They suggest a very late Precambrian age of about 675 to 570 Ma, apparently partly in the belief that the formation slightly post-dates late Precambrian Brasiliano metamorphism (see ALMEIDA et al., 1973, 1976). However, the cartonic block upon which the La Tinta Formation rests apparently was very little affected by the Brasiliano event (ALMEIDA et al., 1973; Cordani, pers. comm., 1978), so that this event can not be considered

as good geochronologic evidence for the formation's maximum possible age. Nevertheless, on the basis of the correlation of the La Tinta Formation with "Eocambrian" sequences in Brazil and Paraguay, ALMEIDA et al. (1973) arrived at an age very similar to that suggested by MARCHESE and DI PAOLA (1975). The formation is probably no younger than Ordovician, as it is intruded by a 450-500 Ma-old (K-Ar ages) diabasic sill about 150 km SW of the Sierras Bayas-Olavarría area (RAPELLA et al., 1974).

METHOD OF STUDY

The microfossils in the La Tinta Formation were studied in two petrographic thin sections (GP/L-3T-42 and -43) from a single hand sample (GP/3T-558) in the Paleontology Collection, IG/USP. The microfossils are too poorly preserved to be recoverable by acid maceration of the chert matrix.

PRESERVATION OF THE MICROFOSSILS

The microfossils are structurally preserved, but rather poorly so, with apparently little remaining of their organic matter (Figs. 1-5). They occur within a thin, beige lamina in crypto- to microcrystalline, light-gray chert with a waxy luster and well-developed conchoidal fracture. The microfossils are delimited by concentrated, submicron-sized grains of undetermined composition that define the 3-6 μm -wide walls of the microfossils. Similar grains are also widely dispersed throughout the chert and appear to be mostly mineral grains deposited or formed prior to siliceous replacement of what was probably an originally carbonate sediment.

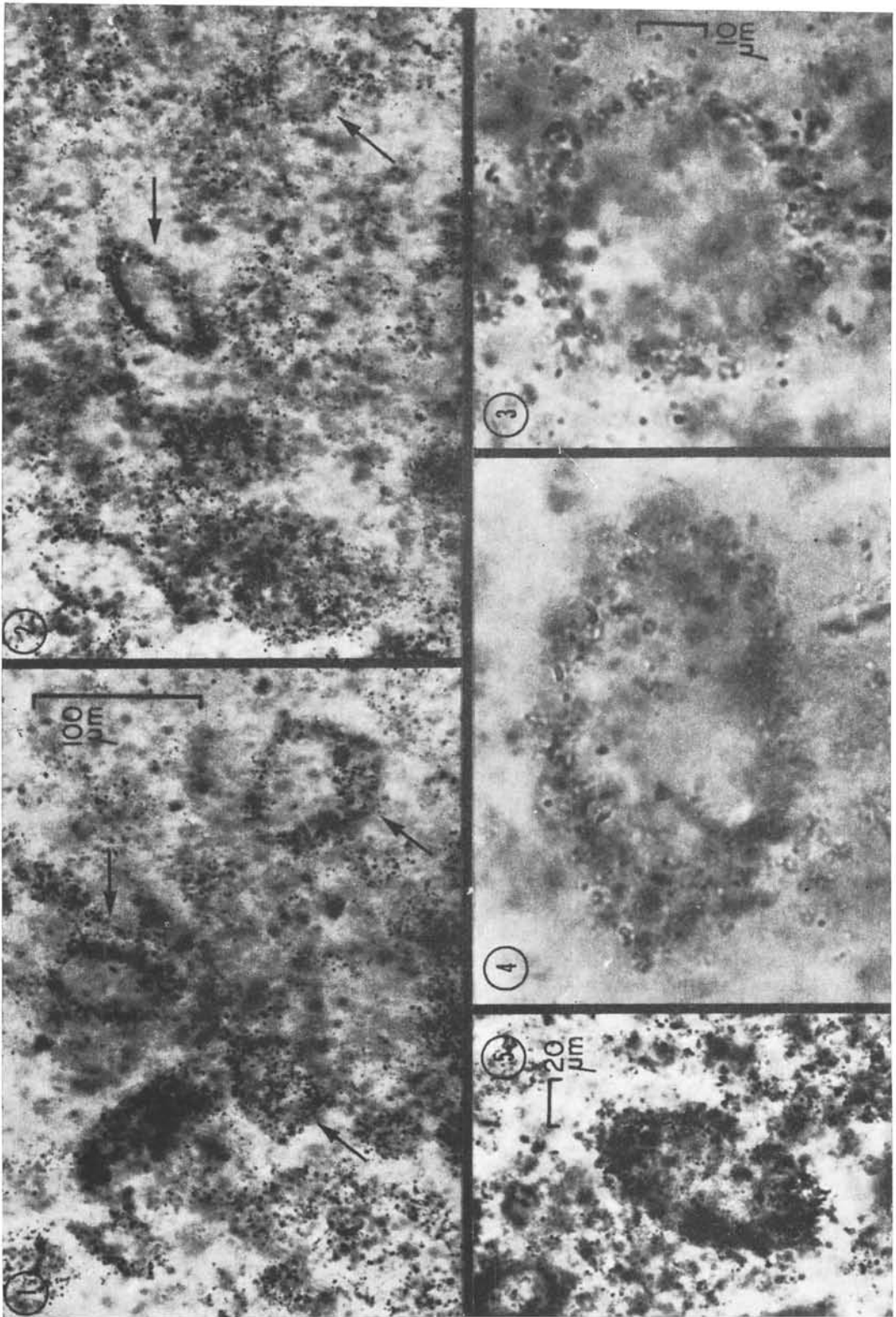
Photomicrographs of probable microfossils in a petrographic thin section of chert from the La Tinta Formation, Sierras Bayas, NE Argentina (Thin section no. GP/L-3T-43, Paleontology Collection, IG/USP). Scale in Fig. 1 also serves Fig. 2; that in Fig. 3 also serves Fig. 4.

Figs. 1,2, Overviews of areas with suspected microfossils, several of which are indicated by arrows.

Fig. 3, Close-up of spheroidal form shown in corner of Fig. 2.

Fig. 4, Elliptical outline of oblique cross-section through a poorly preserved filament.

Fig. 5, Closed, ellipsoidal body, possibly a microfossil.



The filamentous microstructures (Fig. 4) exhibit a size range and morphology that suggest a biologic rather than a sedimentary origin. The ellipsoidal and spheroidal forms, on the other hand, are more difficult to interpret partly because of their less distinctive morphology. But many of these probably also represent microfossils, especially as they lack the dirty internal aspect of apparent clasts, have relatively smooth, regular outlines and margins (Figs. 1-3), and are preserved like the filamentous microfossils. These bodies lack vestigial crystalline textures or fabrics that might relate them to oolites or to siliceous spherulites. Their poor preservation, however, does not allow us to rule out completely a possible detrital origin for some of the closed bodies (?perhaps fig 5).

THE MICROFOSSILS AND THEIR INTERPRETATION

The microfossils are relatively abundant (Figs. 1,2) and are associated with some very fine sand-sized and silt-sized debris within a thin (1-2.5 mm thick), nonstromatolitic sedimentary lamina. Elliptical outlines (Fig. 4) commonly represent oblique sections of filamentous microfossils. These range in minimum outside diameter from 28 to 56 μm ($n = 20$) and average 39.6 μm . Few filaments have been observed in longitudinal section, possibly because their poor preservation makes them difficult to distinguish in this orientation. Nevertheless, one or two elongate microstructures interpreted as representing filaments appear to be possibly segmented, with the segments resembling some of the ellipsoidal microfossils. Straight cross-walls, branching, and intracellular organic matter have not been observed.

Spheroidal (Fig. 2,3) and ellipsoidal (Fig. 1,?5) microfossils similar in size to, or larger than, the filament diameters are also relatively common. Some closed bodies are possibly elongated bacillar microfossils, which would fit well with the possibly segmented (cellular?) character of some of the longitudinal filament sections. Superficial ornamentation and intracellular organic remains are not preserved.

On the basis of their simple morphology, small size, mode of preservation, similarity to other poorly preserved silicified microfossils (Fairchild, unpubl.), and lack of hard parts, the La Tinta microfossils probably represent algal remains rather than metazoan remains. Although their poor preservation prohibits close comparison with other fossil algae, the filamentous and unicellular forms are sufficiently larger than the majority of modern procaryotic (cyanophytic) algal species (see SCHOPF, 1977) to suggest possible affinities with the evolutionarily more advanced eucaryotic (nucleated, mitotic) algae. When compared with the sizes reported for simple microfossils in silicified stromatolitic microfloras (SCHOPF, 1977), the relatively large size of *both* the filaments and the closed bodies in the La Tinta chert seems indicative of a very late Precambrian or younger age, probably less than 700 Ma. However, even though the microfossils occur within a stromatolite-bearing formation, they do not comprise a stromatolitic microflora, so that Schopf's scheme may not be fully applicable in this case. Nevertheless, the suggested age is consistent with that inferred by AMOS et al. (1971), ALMEIDA et al. (1973), and MARCHESI and DI PAOLA (1975).

The relatively large size of these microfossils also differentiates them from the much smaller microfossils in the recently discovered silicified microfloras of the Paraopeba Formation of the >620 Ma-old Bambuí Group in Brazil (FAIRCHILD and DARDENNE, this volume). This difference suggests, as a working hypothesis, that the La Tinta Formation quite possibly is younger than the Paraopeba Formation and therefore not correlatable with much of the Bambuí Group. Comparative studies of stromatolites in these units should provide a good test of this hypothesis.

SUMMARY AND CONCLUSIONS

Filamentous and unicellular microfossils probably representing the poorly preserved remains of ancient algae occur in chert of the La Tinta Formation in NE Argentina. The relatively large size of these microfossils

suggests a very late Precambrian (or younger) age for the La Tinta Formation, which is consistent with the ages inferred by certain previous workers. The microfossils are different from those in cherts of the Bambuí Group (FAIRCHILD and DARDENNE, this volume), so that the correlations between the La Tinta Formation and this group (AMOS et al., 1971) may not be entirely valid. Because the studied material is both poorly preserved and of uncertain stratigraphic position within the formation, the observations and inferences made in this paper, rather than comprising firm conclusions, provide the bases for reasonable hypotheses whose confirmation will depend upon future study of carefully collected, better preserved

material. Our Argentine colleagues are encouraged, therefore, to take up the very interesting challenge presented by this difficult-to-study material.

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