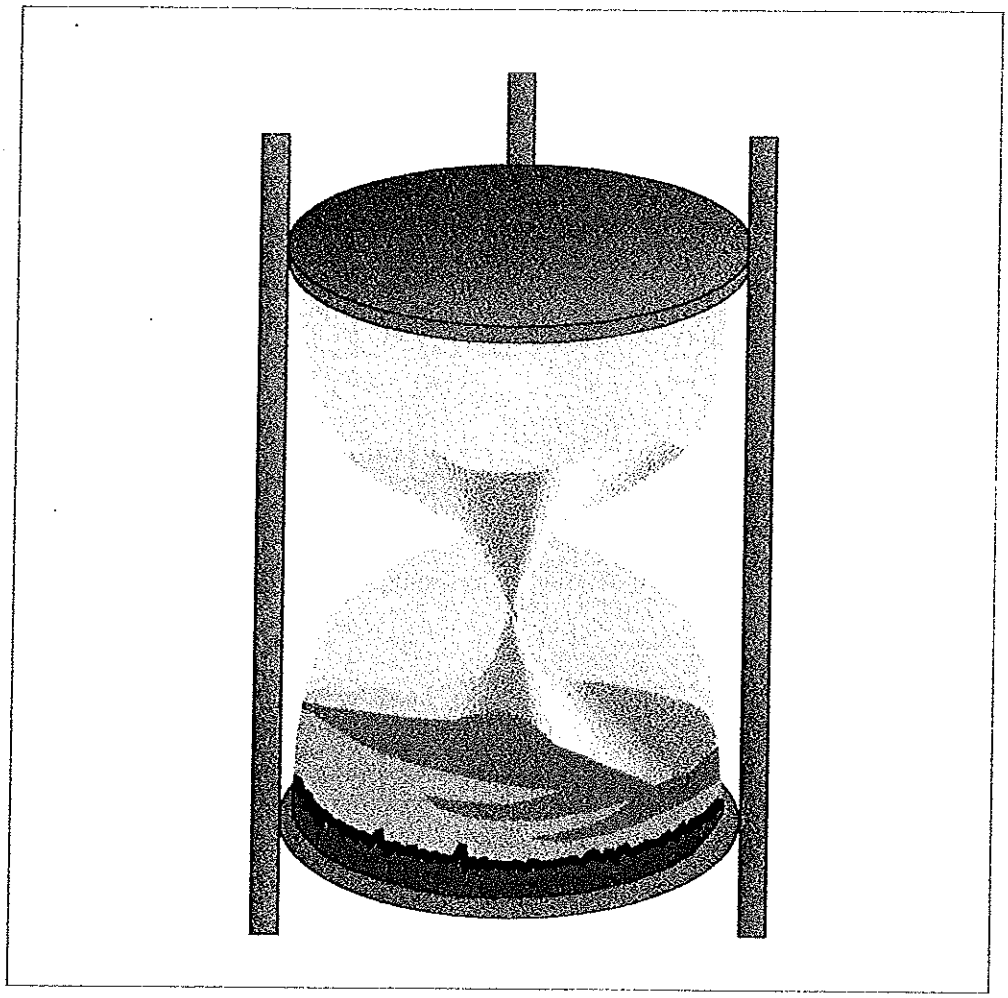
# CRONOESTRATIGRAFIA DA BACIA DO PARANÁ

## 2° SIMPÓSIO SOBRE



27 a 29 de Setembro de 1995
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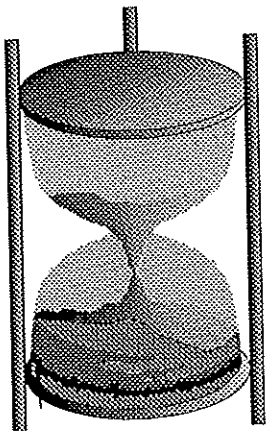
# BOLETIM DE RESUMOS EXPANDIDOS



# 2º SIMPÓSIO SOBRE CRONOESTRATIGRAFIA DA BACIA DO PARANÁ

**27 a 29 de setembro de 1995.**

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## PROMOÇÃO

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SOCIEDADE BRASILEIRA DE GEOLOGIA (SBG-RS)

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# BIOCHRONOSTRATIGRAPHIC INVESTIGATIONS OF THE PRAGIAN AND EMSIAN STAGES ON THE SOUTHEASTERN BORDER OF THE PARANÁ BASIN[1]

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## INTRODUCTION

Newly obtained palynological data allowed the first record of Pragian rocks in the Paraná Basin (Dino & Rodrigues 1995, Loboziak *et al.* in press). These new data modified to a great extent the biostratigraphic schemes proposed by earlier authors for the Lower Devonian of that region.

Pragian datings are available for two distinct lithostratigraphic intervals, *viz.*: (i) the uppermost Furnas Formation, both in outcrops (Jaguariaíva area of Paraná State - cf. Dino & Rodrigues 1995) and in the subsurface of the southern part of the basin (core 23 of PETROBRAS well 2-CN-1-SC, after Loboziak *et al.* in press); and (ii) the basal section of the overlying Ponta Grossa Formation in PETROBRAS wells 2-CN-1-SC (cores 21-22), 1-PH-1-PR (core 7) and 2-AG-1-MT (core 18), drilled in the southeastern and northern portions of the basin (Loboziak *et al.* in press). (Fig. 1).

The chief purpose of this contribution is to discuss the biochronostratigraphic significance of these new palynological datings in the light of Sequence Stratigraphy concepts, in particular as concerns the Lower Devonian outcrops of the southeastern border of the Paraná Basin.

## PALYNOSTRATIGRAPHICAL CONSIDERATIONS

### a) Outcrop data

Dino & Rodrigues (1995) reported a quite abundant, miospore-dominated palynomorph assemblage from shaly/silty lenses within coarse-grained, cross-stratified sandstones of upper Furnas Formation, in outcrops of the PISA locality (Jaguariaíva area, Paraná State). Associated to the same lenses are numerous land plant remains belonging to such genera as *Horneophyton*, *Zosterophyllum* and *Cooksonia*, among others (Mussa *et al.* in press). Similar plant assemblages with essentially identical stratigraphical settings have been also reported in the literature from other upper Furnas outcrops in the Paraná, Mato Grosso and Goiás States. The possibility that most of those fossil plant localities, though far removed from one another, could represent a single chronocorrelative interval throughout the Paraná Basin makes their precise dating of utmost importance.

The microflora of the PISA locality is particularly rich is smooth, small-sized miospores and other forms of simple morphology, typified by *Ambitisporites* spp., *Amicosporites* (*A. miserabilis*), *Calamospora* (*C.* cf. *microrugosa*), *Retusotriletes* (*R. maculatus*) and *Synorisporites* (*S. tripapillatus*, *S. verrucatus*). Also present, although far less abundant, are patinate forms (*Chelinospora pseudoreticulada*) and small indeterminate, non-ornamented zonates/camerates, as well as foveolate and reticulate genera like *Brochotriletes* (*B. foveolatus*, *B.* cf. sp. A RICHARDSON & IOANNIDES) and *Dictyotriletes* (*D. emsiensis*, *D. subgranifer*, *D.* cf. *gorgoneus*), respectively. In contrast, the microplankton is only represented by a few acritarch genera, of which *Schizocystia* is the

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commonest (*S. saharica, S. pilosa*). Also present are *Tetraletes* (*T. granulatus, T. variabilis*) and *Veryhachium* sp., all devoid of biostratigraphic significance. The extremely low diversity of the acritarch assemblage, as compared to the overwhelming dominance and higher diversity of land-plant miospores, is consistent with the very nearshore to nonmarine (largely transitional) environmental settings suggested by the plant megafossils.

Dino & Rodrigues (1995) did not assign their upper Furnas palynomorphs to any definite biozone. However, they pointed out that miospore assemblages of similar composition elsewhere in the world (*e.g.*, North Africa, North America and Western Europe) are usually restricted to the upper Lochkovian - lowest Emsian interval. The presence of zonates/camerates and *Dictyotriletes emsiensis* would exclude any age assignments older than late Lochkovian, whereas the younger age limit relies on the absence of *Emphanisporites annulatus* (a cosmopolitan miospore species which first appears in the basal Emsian).

**b) Subsurface data**

Palynological data afforded by miospores from the subsurface of the Paraná Basin favor pre-Emsian age assignments to the uppermost Furnas Formation and the basal part of the overlying Ponta Grossa Formation. The known stratigraphic ranges of selected miospore species occurring in those units are shown in Fig. 2.

According to Loboziak *et al.* (in press), core 23 of well 2-CN-1-SC from the uppermost Furnas Formation has yielded an abundant, low-diversity miospore assemblage. It consists only of small-sized forms like *Dictyotriletes emsiensis, D.* cf. *granulatus, Dibolisporites* cf. *eifeliensis, Tholisporites chulus, Synorisporites* cf. *verrucatus, Amicosporites* sp., *Chelinospora* cf. *cassicula* and *C.* cf. *retorrida*. Of all recorded species, *D. emsiensis* has the highest appearance in terms of the Western European miospore zonation, where it defines the base of Interval Zone E within the upper *breconensis-zavallatus* (BZ) Oppel Zone in the upper Lochkovian of the Ardenne-Rhenish regions. Furthermore, miospores with biform sculpture such as *Dibolisporites* are first recorded about the Lochkovian/Pragian boundary. Also of biostratigraphic significance are the small size of specimens and the absence of *Emphanisporites annulatus* and *Brochotriletes bellatulus*, for the joint occurrence of both species characterizes the *annulatus-bellatulus* (AB) Oppel Zone, whose base lies close to the Emsian/Pragian boundary. All these facts combined allow to restrict the age of the uppermost Furnas Formation to the early Pragian, much in the same way as the outcrop datings by Dino & Rodrigues (1995) in the Jaguariaíva area.

Other Early Devonian miospore assemblages have been recorded in the basal Ponta Grossa Formation in wells 2-CN-1-SC (cores 21-22), 1-PH-1-PR (core 7) and 2-AG-1-MT (core 18). In comparison to the upper Furnas assemblages these are still less diverse and age-diagnostic ones, containing only some of the forementioned species in addition to *Emphanisporites rotatus, Synorisporites tripapillatus, Dibolisporites* sp., *Cymbosporites* sp., *Dictyotriletes* sp. cf. *D. richardsonii* and *Cirratriradites* sp. cf. *D. diaphanus*. They all range into the Emsian, with the doubtful exception of the latter two taxons. However, as in the case of the Furnas Formation a pre-Emsian age is favored by the absence of Emsian index species (such as *E. annulatus*), of large-sized spiny zonates/pseudosaccates and of other more advanced miospores, all well known in the Emsian part of the lower Ponta Grossa Formation.

## PRAGIAN - EMSIAN FACIES AND STRATIGRAPHY ON THE SOUTHEASTERN BORDER OF THE PARANÁ BASIN

In the following discussion reference is made to three localities in the Devonian outcrop belt of the eastern Paraná State, herein coded as PISA, PR-092 (Jaguariaíva area) and Tibaji (Fig. 1).

The facies setting verified in these sites is quite similar, *i.e.*, deltaic facies, coastal (foreshore to upper shoreface) facies and shallow marine (lower shoreface to offshore) facies arranged in a retrogradational stacking pattern (Figs. 3). On the northern flank of the Ponta Grossa Arch, essentially sandy, deltaic to coastal deposits of the uppermost Furnas Formation (Bergamaschi 1992) include shaly lenses containing fossil plants and miospore assemblages of Pragian age (Dino & Rodrigues 1995). As seen in localities PR-092 and Tibaji, these top-Furnas deposits are abruptly overlain by shallow marine deposits (lower shoreface tempestites and offshore pelites) of Pragian?-Emsian age, which belong to the lowest part of the Ponta Grossa Formation. The sharp lithological contact between both units is clearly seen in these localities of the southeastern outcrop belt. Stratigraphical data suggest that facies stacking took place during a relative sea-level rise in the Pragian and early Emsian.

In site PR-092 (Fig. 3), the coastal deposits of the upper Furnas Formation are abruptly succeeded by shallow marine (lower shoreface to offshore) deposits of the lower Ponta Grossa Formation. In the Jaguariaíva region (*e.g.*, the PR-092 roadcut profile), basal Ponta Grossa deposits are initiated by a section, up to 15 m thick, of tabular strata consisting of hummocky cross-stratified, fine-grained sandstone (tempestites), which grade upward to offshore shales.

In the Tibaji locality (Fig. 3), deltaic facies of the uppermost Furnas Formation are abruptly overlain by a layer of fine-grained sandstone, about 3 m thick, displaying plane parallel lamination as well as low-angle and wave cross-lamination. The latter section is interpreted as littoral to coastal (foreshore to upper shoreface) deposits belonging to the basal part of the Ponta Grossa Formation. These, on their turn, are succeeded in a likewise abrupt fashion by offshore pelites of the lower Ponta Grossa Formation. (Bergamaschi, 1994)

The basal, sandier interval of the Ponta Grossa Formation (including tempestites) varies from 2 m up to 15 m in thickness. It is interpreted as the result of reworking (chiefly by storm waves in upper to lower shoreface settings) of coastal sediments following a sudden rise of the relative sea-level.

The onset of the transgressive dynamics, resulting from the increased flooding rate from the Pragian onwards, may have caused some loss of preexisting sedimentary section. The magnitude of the unrecorded geologic time involved is still debatable. It may have varied in space as a function of varied sedimentary input and basin physiography, but the available palynological data do not allow the recognition of a significant hiatus. From the viewpoint of Sequence Stratigraphy the Furnas/Ponta Grossa contact represents a major marine-flooding surface, and thus, is here envisaged as a parasequence set boundary, at least along the Devonian outcrop belt of the southeastern Paraná Basin.

As concerns the characterization of depositional sequences and system tracts (*sensu* Van Wagoner *et al.* 1990), Pragian and Emsian sediments of the Paraná Basin can be grouped into a single, possibly second order depositional sequence. Together, they probably constitute a transgressive system tract.

## PROPOSED EARLY DEVONIAN PALEOGEOGRAPHIC EVOLUTION OF THE SOUTHEASTERN BORDER OF THE PARANÁ BASIN

Based on the distribution of depositional systems supposedly developed during the sedimentation of Furnas strata on the southeastern basin flank, a NE-SW depositional slope gently tilted to SW can be envisaged for that part of the basin (Bergamaschi 1992). Besides, the existence of a southern paleotopographic high in Santa Catarina State, as implied in Lange's (1967, fig. 2a) N-S transect, can no longer be accepted, following Loboziak *et al.* 's (in press) reinterpretation of Lange's

palynological data for cores 21-23 of well 2-CN-1-SC (Pragian, not Givetian).

During the Pragian, such physiographic scenario was probably dominated by a widespread, braid delta-like system (*sensu* McPherson *et al.* 1987), detected in the present-day sedimentary record as delta plain (fluvial?) facies, delta front (mouth bar) facies and littoral/coastal (foreshore to upper shoreface) facies. Due to the absence of a well developed land plant cover in pre-Emsian times - which would have contributed to a greater shoreline stability - the dynamics of physiographic settings was extremely high. This, together with the similarity of physical processes operating in different compartments of the scenario, have posed serious problems to the establishment of a more refined facies model for the Lower Devonian of that region. However, it is suggested that the most proximal facies of the deltaic system have been preserved on the southeastern flank of the basin, with more distal facies becoming progressively dominant towards the south.

In view of the above, the Pragian sandy interval of the uppermost Furnas in the region of well 2-CN-1-SC (Loboziak *et al.* in press) is probably represented by coastal to shallow marine facies, corresponding to more distal physiographic settings than those of the Paraná State outcrop belt to the north. These distal facies are certainly related to the same system tract identified in the outcrops.

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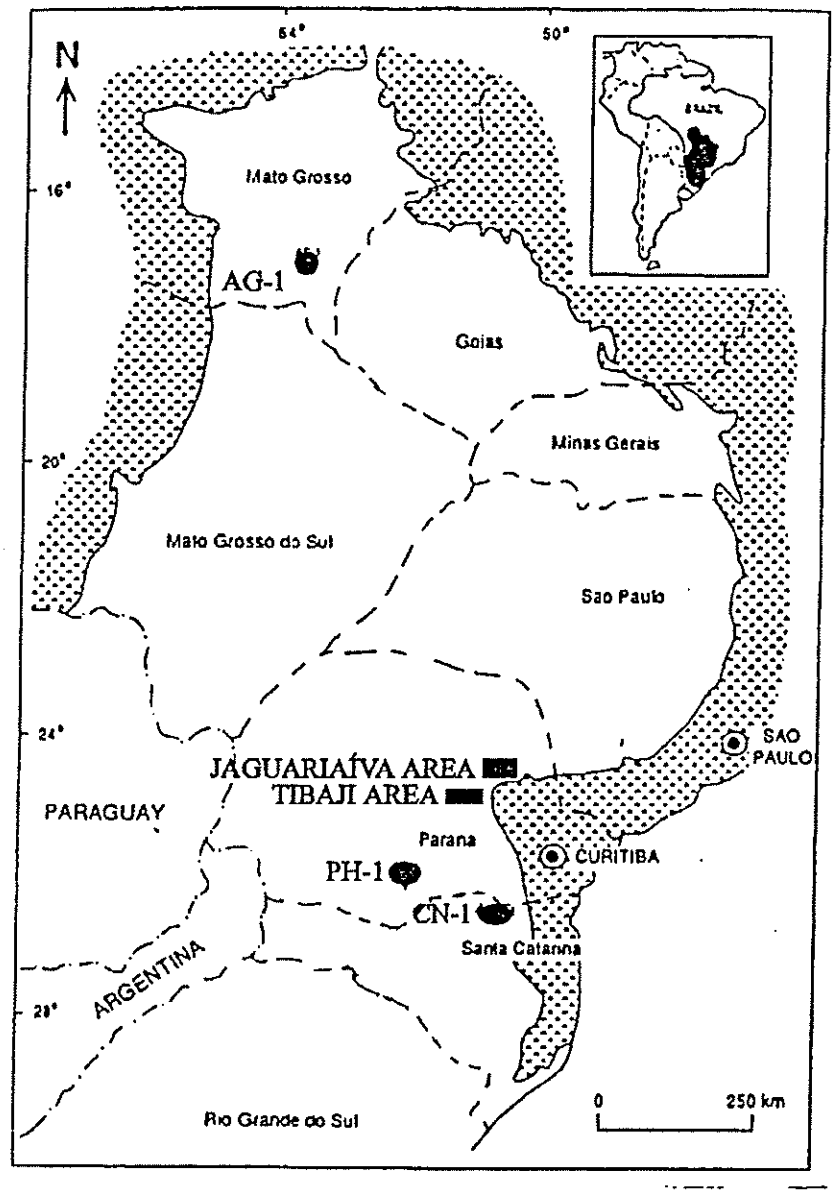



FIG.1- LOCATION MAP SHOWING THE OUTCROPS AREAS AND WELLS STUDIED

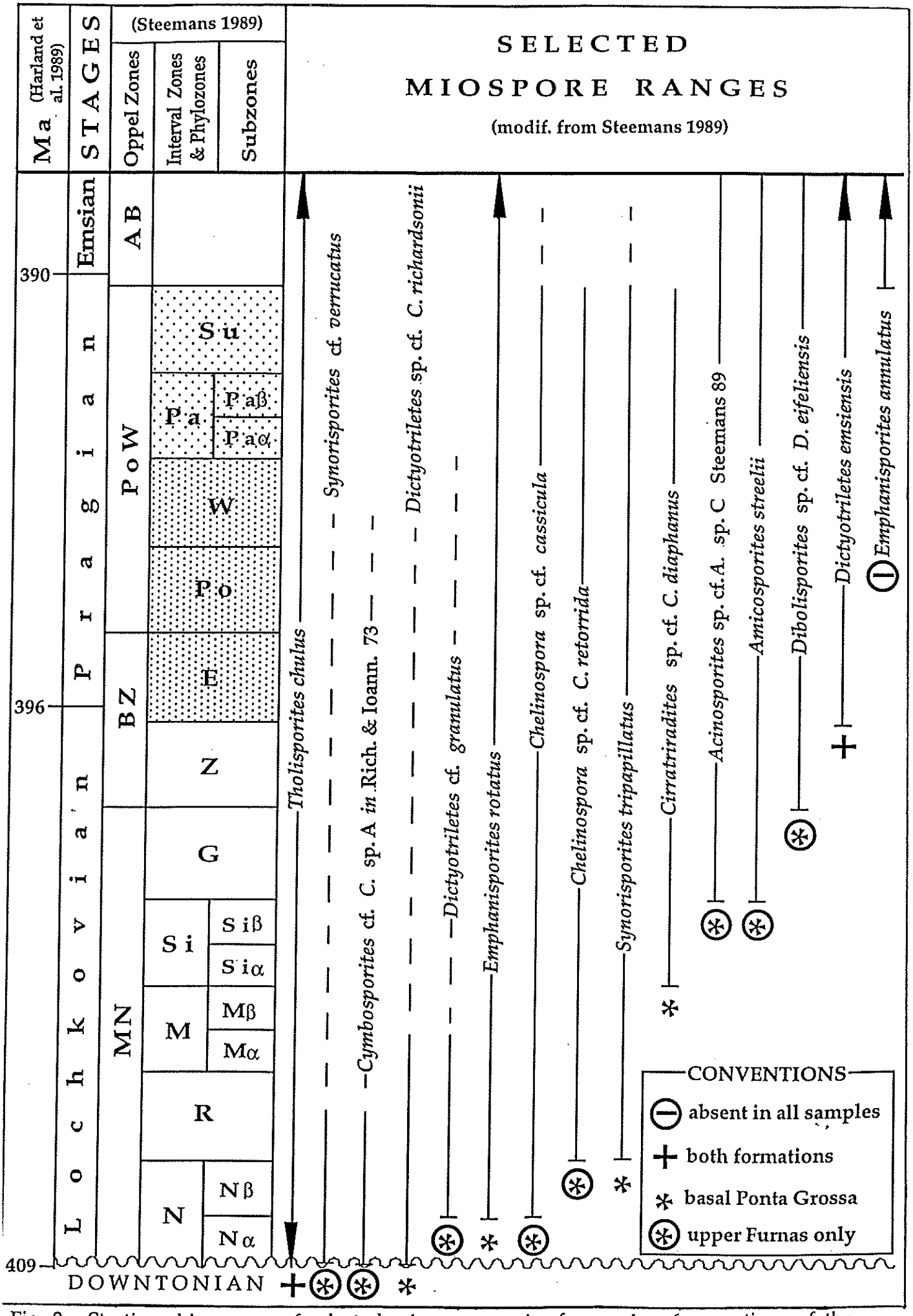
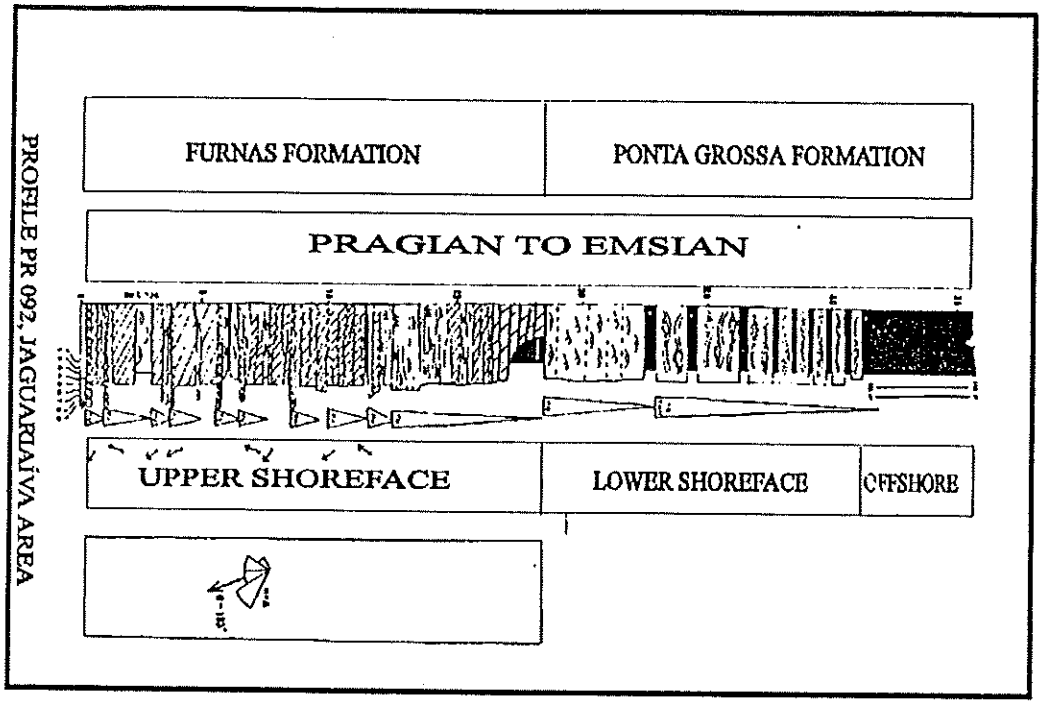
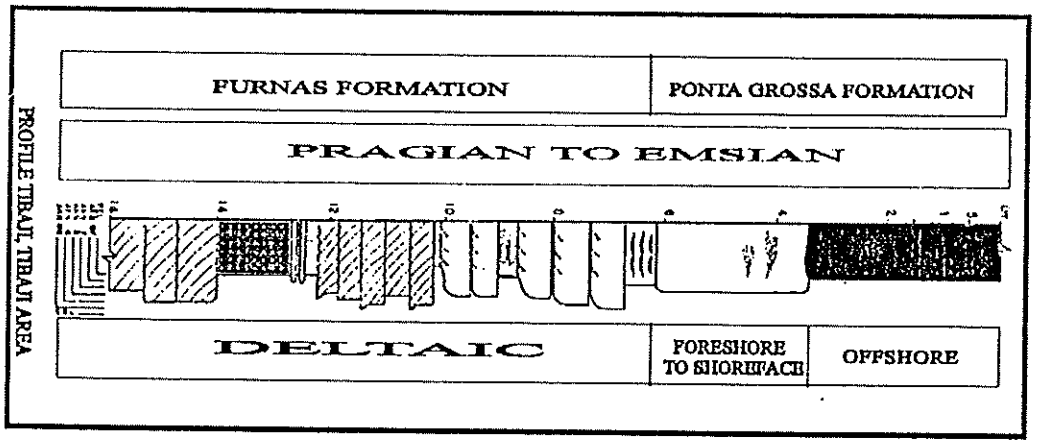



Fig. 2 - Stratigraphic ranges of selected miospore species from subsurface sections of the Furnas and Ponta Grossa Formations.



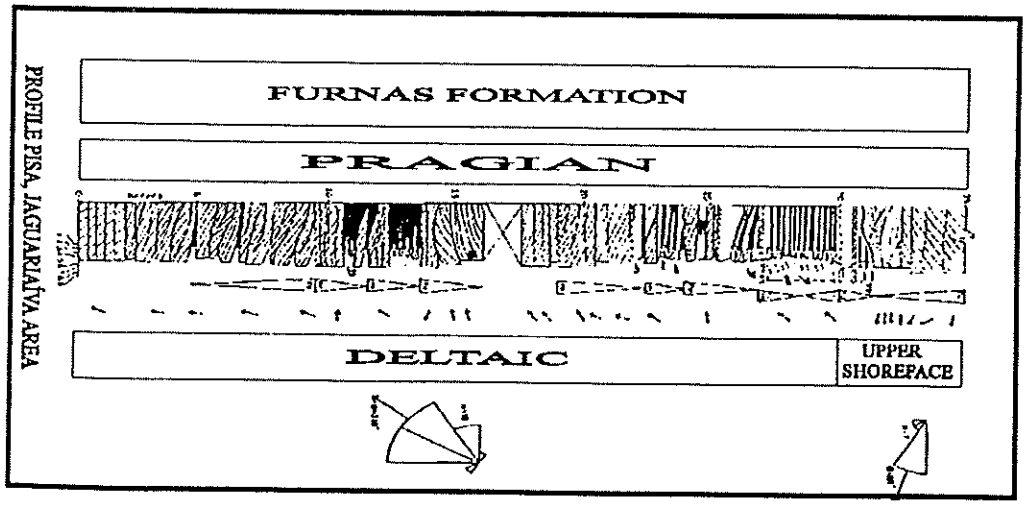




FIG.3 - PROFILES SHOWING THE FACIES ARRANGE