PALAEOECOLOGY OF THE BADENIAN FORAMINIFERA BETWEEN THE PRAHOVA VALLEY AND TELEAJEN VALLEY (SUBCARPATHIANS OF MUNTENIA)

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Abstract: An image on the paleoecological evolution of the studied area during the Middle Miocene was obtained by the qualitative study, and where possible the quantitative study of the planktonic and benthonic foraminifera from the marly deposits of the Campinita Formation (Lower-Middle Badenian), the evaporitic deposits and breccias of the Cosmina Breccia (Middle Badenian), and silty-marly and silty-clayey deposits of the Telega Formation (Upper Badenian).

Key words: foraminifera, paleoecology, Badenian, Subcarpathians of Muntenia

Geological setting

The studied area is situated in the southernmost part of the Romanian Subcarpathians, the Sucarpathians of Muntenia.

The Miocen deposits represent the filling of some small piggy-back basins on the back of the Tarcau Nappe.

Within the marine Middle Miocene deposits three lithostratigraphic units were separated (Crihan, 1999): the Campinita Formation, the Cosmina Breccia and the Telega Formation.

The Campinita Formation (Lower-Middle Badenian) is made up mainly of light grey marls, very rich in planktonic microfossils, both foraminifera and calcareous nannoplankton. The studied sections are the Prahova Valley sections, the Campinita Valley section and the Piatra Verde Quarry (Fig. 1). This last section is characterized by the presence of thick tuffaceous intercalations.

The Cosmina Breccia (Middle Badenian) is represented by an evaporitic facies at the lower part, and by a breccia with rare marly-clayey intercalations at the upper part. Usually, the in situ foraminiferal assemblages are very rare within this unit, only one outcrop yielding a well preserved in situ foraminiferal association.

The Telega Formation (Upper Badenian) is represented in its lower part by a silty-clayey dark brown laminitic sequence, very rich in siliceous microfossils and organic matter, known as the "Radiolarian Shales", which passes laterally and upwards into a sandy sequence with rare marly-clayey intercalations. Towards the upper part of the formation the marls become predominant.They contain a rich association of species of the pteropod genus *Limacina*, as well as rich assemblages of foraminifera. The studied samples were collected from the Cosmina Valley, Telega Valley, and Martin Hill sections as well as from some isolated outcrops (Fig. 2).

Methods and material

The studied samples were washed over a 0.063 sieve, and then the residue from at least one picking tray was determined and counted for planktonic and benthonic foraminifera. Due to the bad state of preservation or due to the obvious transport and/or reworking no sample from the Campinita Formation was quantitatively studied. Only 7 samples from the Telega Formation were suitable for quantittive determinations. The determined parameters were the total number of foraminifera, the planktonic/benthonic ratios, the percent of porcellanous, agglutinated and hyaline benthonic foraminifera, as well as the percent of deep infaunal and opportunistic benthic foraminifera (Table 1). For the rest of the samples the palaeoecological study was based only on the qualitative composition of the foraminiferal assemblages.

For the quantitative statistical study were used the ternary diagram of Murray (1973, 1991), based on the wall structure of the benthic foraminifera, in order to determine the different environmental fields (Fig. 3), and diversity statistics for quantifying taxonomical diversity in samples (Table 2). Foraminiferal abundence, diversity and dominance patterns enable discrimination of a range of environments (Murray, 1973, 1991; Jones, 1996). The PAST program was used for both plotting the countings in the ternary diagram and for calculating the diversity indices (Hammer et al., 2001).

Results and conclusions

The qualitative and quantitative study of the foraminifera evidenced the changes in the surface conditions, bottom waters characteristics and paleobathymetric evolution of the basin.

The warm tropical surface waters during the Early Badenian and the early part of the Middle Badenian, assumption supported by the planktonic foraminifera assemblage, dominated by species of the genera *Globigerinoides*, *Globoquadrina*, *Orbulina* and *Praeorbulina*, were replaced by colder surface waters during the Late Middle Badenian and during the Late Badenian. Within the upper part of the Campinita Formation and in the Cosmina Breccia dominate cold water species of the genera *Globigerina*, *Globigerinita* together with *Globorotalia transsylvanica*, and only small specimens of the genus *Globigerina* and *Globigerinita* are present in the marly deposits of the Telega Formation.

The bottom conditions evolved from well ventilated waters during the Early Badenian, to periods of stressed hypoxic or even anoxic environments during the Middle and Late Badenian, as shown by the dominance of the deep infaunal and opportunistic benthic foraminifera or from the complete absence of the benthic organisms.

The paleobathymetrical evolution of the basin is based on the proportion of the planktonic foraminifera in the total assemblages. The reconstruction fails when bottom water oxygenation decreases. An alternative method is based on the benthic faunall compositions.

References

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Table 1 Results of the foraminiferal countings on the samples from the Telega Formation

Table 2 The diversity indices for the samples in table 1.

Fig. 1 Lithological columns of the studied sections from the Campinita Formation.

Fig. 2 Lithological columns of the studied sections from the Telega Formation.

Fig. 3 The cross-plot of the foraminiferal morphogroups in the ternary diagram of Murray (1973, 1991).

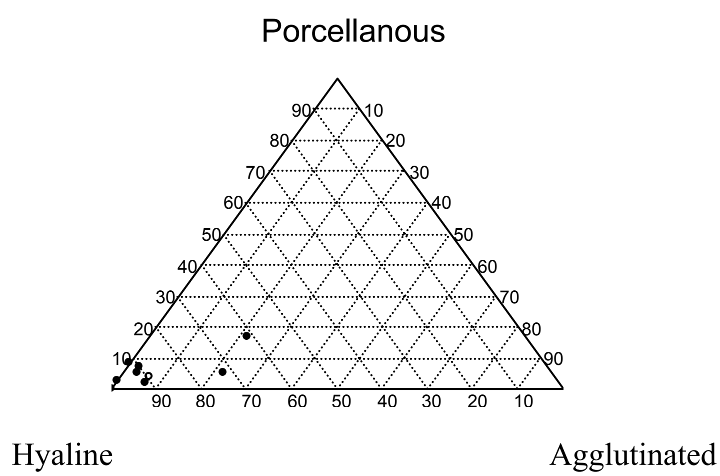
Table 1

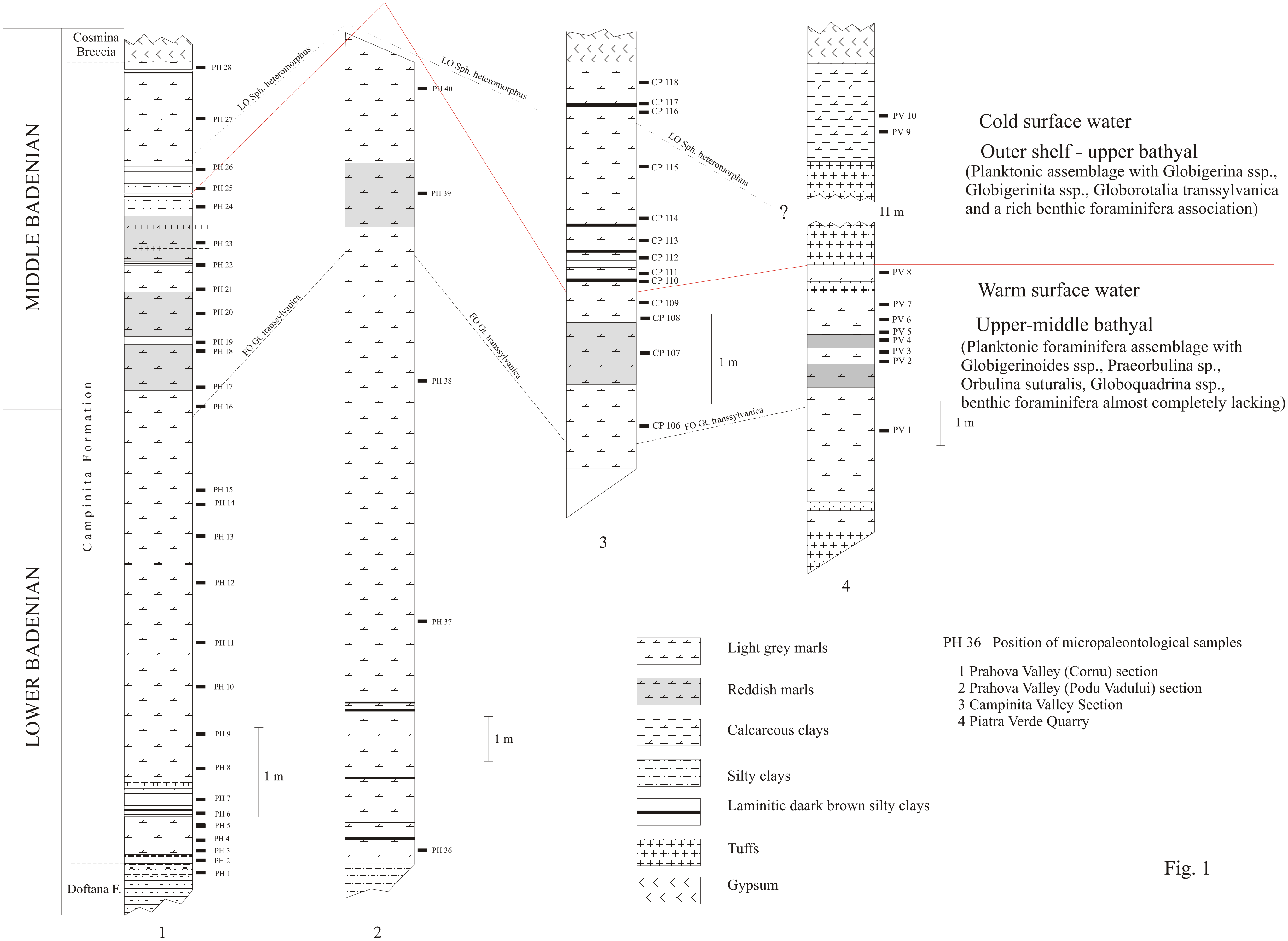
	Total	%Agglutinated	%Porcellanous	%Hyaline	%Planktonic	%Benthic	Deep infaunal	% Deep infaunal	Opportunists	% Opportunists
M4	1530	6,32	4,25	89,43	43,14	56,86	505	33	56	3,66
M5	498	6,83	1,95	91,22	58,84	41,16	136	27,3	17	3,41
M6	965	0,13	0,13	99,74	18,96	81,04	591	61,2	120	12,4
M10	2195	22,23	5,27	72,49	55,95	44,05	47	2,14	524	23,9
C3	215	0,00	8,61	91,39	2,79	97,21	145	67,4	12	5,58
C4	448	0,00	3,13	96,87	21,65	78,35	258	57,6	47	10,5
C5	530	2,80	7,14	90,06	60,75	39,25	34	6,42	31	5,85
C17	420	3,57	5,24	91,19	22,38	76,67	207	49,3	12	2,86
C17bis	477	22,12	16,83	61,06	10,90	88,05	297	62,3	42	8,81

Table 2

	M 4	M 5	M 6	M 10	C3	C4	C5	C17	C17bis
Taxa	50	31	21	33	26	19	32	23	27
Individuals	868	205	782	967	203	348	208	322	418
Dominance	0,1157	0,1273	0,4527	0,2973	0,1468	0,2046	0,06315	0,1134	0,09034
Shannon index	2,897	2,654	1,427	2,006	2,472	2,035	3,062	2,464	2,718
Equitability	0,7405	0,7727	0,4687	0,5739	0,7586	0,691	0,8836	0,786	0,8247
Fisher alfa	11,54	10,15	3,971	6,61	7,923	4,316	10,56	5,669	6,449

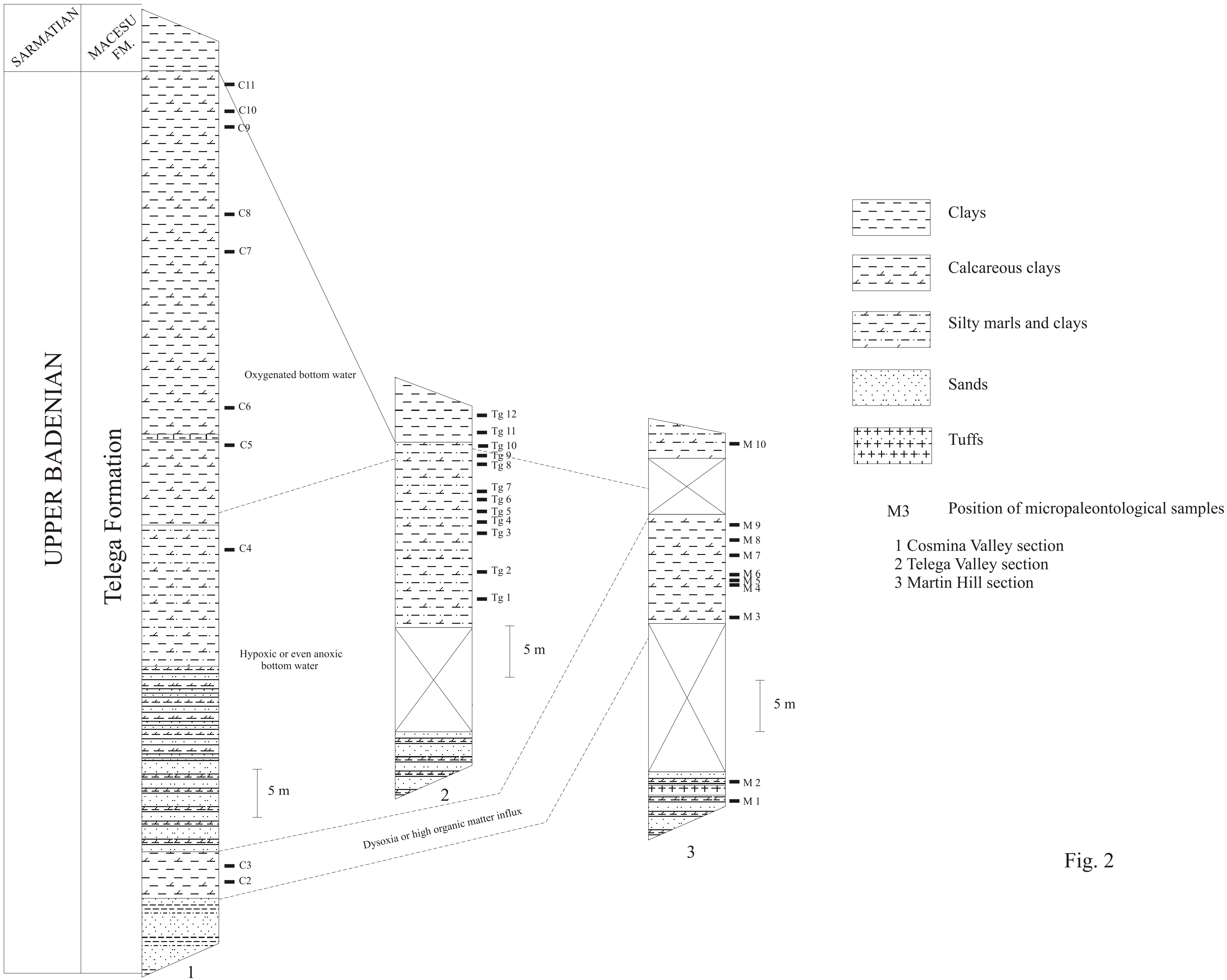
Fig. 3





MIDDLE BADENIAN
LOWER BADENIAN
Cosmina Breccia
Campinita Formation
Doftana F.
LO Sph. heteromorphus
FO Gt. transsylvanica
PH 28
PH 27
PH 26
PH 25
PH 24
PH 23
PH 22
PH 21
PH 20
PH 19
PH 18
PH 17
PH 16
PH 15
PH 14
PH 13
PH 12
PH 11
PH 10
PH 9
PH 8
PH 7
PH 6
PH 5
PH 4
PH 3
PH 2
PH 1
PH 40
PH 39
PH 38
PH 37
PH 36
CP 118
CP 117
CP 116
CP 115
CP 114
CP 113
CP 112
CP 111
CP 110
CP 109
CP 108
CP 107
CP 106
PV 10
PV 9
PV 8
PV 7
PV 6
PV 5
PV 4
PV 3
PV 2
PV 1
1 m
11 m
?
1
2
3
4
Cold surface water
Outer shelf - upper bathyal
(Planktonic assemblage with Globigerina ssp., Globigerinita ssp., Globorotalia transsylvanica and a rich benthic foraminifera association)
Warm surface water
Upper-middle bathyal
(Planktonic foraminifera assemblage with Globigerinoides ssp., Praeorbulina sp., Orbulina suturalis, Globoquadrina ssp., benthic foraminifera almost completely lacking)
Light grey marls
Reddish marls
Calcareous clays
Silty clays
Laminitic daark brown silty clays
Tuffs
Gypsum
PH 36 Position of micropaleontological samples
1 Prahova Valley (Cornu) section
2 Prahova Valley (Podu Vadului) section
3 Campinita Valley Section
4 Piatra Verde Quarry

Fig. 1



SARMATIAN
MACESU FM.
UPPER BADENIAN
Telega Formation
C11
C10
C9
C8
C7
C6
C5
C4
C3
C2
Oxygenated bottom water
Hypoxic or even anoxic bottom water
Dysoxia or high organic matter influx
5 m
1
Tg 12
Tg 11
Tg 10
Tg 9
Tg 8
Tg 7
Tg 6
Tg 5
Tg 4
Tg 3
Tg 2
Tg 1
5 m
2
M 10
M 9
M 8
M 7
M 6
M 5
M 4
M 3
M 2
M 1
5 m
3
Clays
Calcareous clays
Silty marls and clays
Sands
Tuffs
M3 Position of micropaleontological samples
1 Cosmina Valley section
2 Telega Valley section
3 Martin Hill section

Fig. 2