

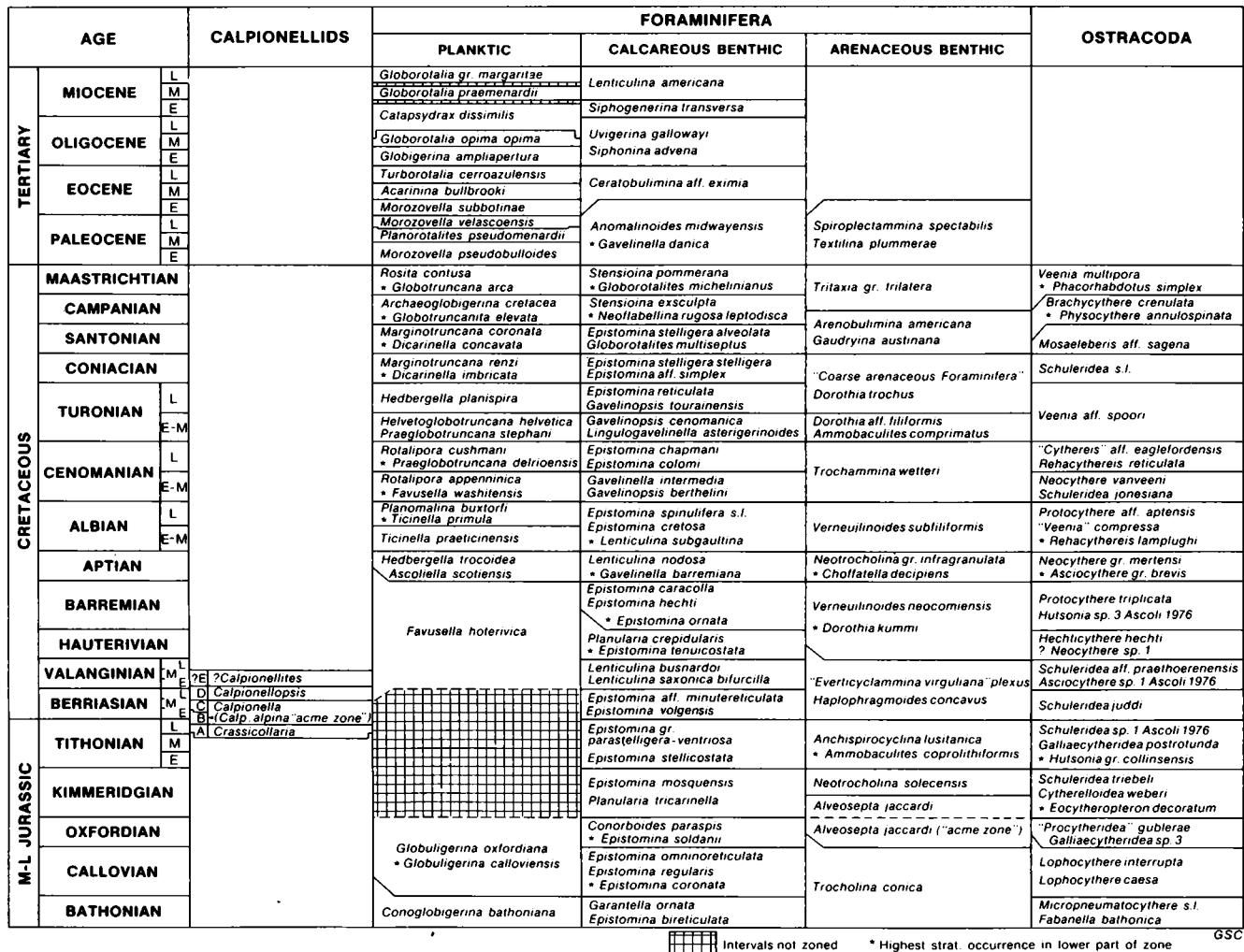
The use of highest or latest stratigraphic occurrences, instead of lowest or earliest occurrences for zonal indices and correlation is necessary because most samples analyzed are well cuttings, which are commonly contaminated by fossil material caved from the overlying sediments in the wells. Of the few sidewall core samples examined, several are also contaminated with younger material.

The calpionellid zones were originally defined on the lowest stratigraphic occurrences of index genera (Alleman *et al.*, 1971). To allow utilization in subsurface biostratigraphy, the calpionellid zones have been redescribed on the basis of the highest stratigraphic occurrences of their index taxa (Ascoli, *et al.*, 1984); they have also allowed calibration of the ages of both foraminiferal and ostracode zones across the Jurassic-Cretaceous boundary.

The correlation chart (Fig. 2) shows the ages and relationships of all the zones presented in this zonation. All 87 zones have been described in detail by Ascoli (1988), whose biozonation scheme is here updated as follows.

PLANKTIC FORAMINIFERA ZONES. "*Globuligerina gr. oxfordiana* Zone". Recent comparison of our specimens of *G. gr. oxfordiana* with topotypic material of *G. oxfordiana* from the U.S.S.R. has shown that the Canadian specimens having highest stratigraphic occurrence at the top of this zone — approximately equivalent to the top of the Oxfordian — can be positively identified as *Globuligerina oxfordiana* (Grigelis). By contrast, the specimens having highest stratigraphic occurrence in the lower part of the zone — approximately corresponding to the Callovian — should be referred to *Globuligerina calloviensis* Kuznetsova, a species which in the U.S.S.R. ranges from the Early to Middle Callovian. Accordingly, *G. calloviensis* is now included as a second zone marker species, characterizing the lower part of this zone. The "*Globuligerina gr. oxfordiana* Zone" of Ascoli (1988) is here renamed the "**Globuligerina calloviensis — Globuligerina oxfordiana* Zone".

"*Favusella aff. washitensis — Hedbergella trocoidea* Zone". According to Banner and Desai (1988), *Favusella aff.*



Intervals not zoned * Highest strat. occurrence in lower part of zone GSC

Fig. 2. Mesozoic-Cenozoic calpionellid, foraminifer and ostracode informal assemblage zones, Georges Bank-Scotian Basins and N.E. Grand Banks (Jeanne d'Arc, Carson and Flemish Pass basins). Vertical scale not calibrated to geological time.

WELLS AGE	GEORGES BANK BASIN		SW SCOTIAN BASIN												
	COST G-1	COST G-2	MOHAWK B-93	MOHICAN I-100	NASKAPI N-30	MOHEIDA P-15	ACADIA K-62	ONEIDA O-25	DEMASCOTA G-32	CREE E-35					
CRETACEOUS	MAASTRICHT.	NE	NE	NE	NE	NE	NE	NE	NE	NE	753(2470)		696(2280)		
											853(2800)	P		P	
	CAMPANIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	864(2835)	P	975(3200)	
												896(2940)	P		
												911(2990)	P		1000(3280)
	SANTONIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1058(3470)	P	P	
												1132(3714)	C		1219(4000)
	CONIACIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1220(4000)	P	1225(4020)	
												1311(4300)			1314(4310)
	TURONIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1360(4460)	P	1323(4340)	
												1372(4500)			1329(4360)
	CENOMANIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1417(4650)	P	1390(4560)	
												1427(4680)	P		1393(4570)
												1692(5550)	P		1494(4900)
	ALBIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	1722(5650)	P	1500(4920)	
1894(6214)												P		1615(5300)	
1906(6252)												P		1615(5300)	
HAUTERIVIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2027(6650)	P	2195(7203)		
											2039(6690)	P		2222(7290)	
APTIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2057(6750)	P	2453(8048)		
											2111(6925)			2484(8150)	
BARREMIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2396(7860)	C	2585(8480)		
											2447(8028)			2606(8550)	
VALANGINIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2609(8560)	C	2890(9480)		
											2611(8566)			2911(8550)	
BERRIASIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2640(8660)	C	3042(9980)		
											2661(8730)			3052(10012)	
TITHONIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2722(8930)	C	2731(8960)		
											2731(8960)			2879(9445)	
KIMMERIDGIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	2879(9445)	C	3438(11280)		
											2902(9520)			3459(11350)	
OXFORDIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	3115(10220)	C	3591(11780)		
											3145(10320)			3615(11860)	
CALLOVIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	3298(10820)	C	3328(10920)		
											3481(11420)			3532(11588)	
BATHONIAN	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	3694(12120)	C	4538(14890)		
											3726(12220)			4560(14960)	
M-L JURASSIC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	4110(13484)	C	4660(15290)		
											4336				
M-L JURASSIC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	4360	P+O			
											4633				
M-L JURASSIC	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	5287	BA			

NE BA = PART OF SECTION NOT EXAMINED (NE) BARREN OR NOT DATABLE (BA)

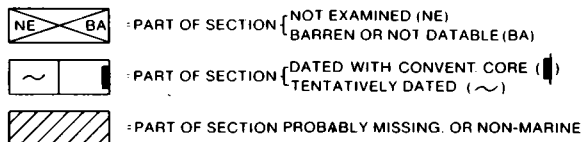
 ~ = PART OF SECTION DATED WITH CONV. CORE () TENTATIVELY DATED (~)

 = PART OF SECTION PROBABLY MISSING, OR NON-MARINE

 ~~~~~ UNCONFORMITIES
   
 - - - UNCERTAIN BOUNDARIES
   
**ZONES**
  
 P=PLANKTIC FORAMINIFERA
   
 C=CALCAREOUS BENTHIC FORAMINIFERA
   
 A=ARENACEOUS BENTHIC FORAMINIFERA
   
 O=OSTRACOD
   
 CP=CALPIONELLID
 GSC

Fig. 3. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the Georges Bank and southwest Scotian basins. Refer to Figure 2 to determine zonal names.

| WELLS      |                  | SW SCOTIAN BASIN  |                                 |                                   |                                   |                                 | NE SCOTIAN BASIN                |                   |                                 |                               |                               |                                 |                               |                                 |
|------------|------------------|-------------------|---------------------------------|-----------------------------------|-----------------------------------|---------------------------------|---------------------------------|-------------------|---------------------------------|-------------------------------|-------------------------------|---------------------------------|-------------------------------|---------------------------------|
|            |                  | ONONDAGA<br>E-84  | GLENELG<br>J-48                 | MIGRANT<br>N-20                   | THEBAUD<br>I-94                   | PENOBSCOT<br>L-30               | SABLE IS.<br>C-67               | ABENAKI<br>J-56   | VENTURE<br>B-43                 | VENTURE<br>B-13               | MIC MAC<br>H-86               | WYANDOT<br>E-53                 |                               |                                 |
| CRETACEOUS | MAASTRICHT.      | 1195(3920)<br>P   | 1650<br>P                       | 646(2120)<br>P<br>710(2330)       | 826(2710)<br>P<br>890(2920)       | NE                              | 1227(4025)<br>P<br>1287(4221)   | NE                | 1320<br>P<br>1360               | 1350<br>P<br>1380             | 677(2220)<br>P<br>695(2280)   | 331(1085)<br>P<br>335(1100)     |                               |                                 |
|            | CAMPANIAN        | 1298(4259)<br>P   | 1690<br>P                       | 728(2390)<br>P<br>957(3140)       | 908(2980)<br>P<br>1244(4080)      |                                 | 1315(4314)<br>P<br>1356(4450)   |                   | 1364(4474)<br>P<br>1396(4580)   | 1402(4600)<br>P<br>1450       | 1420<br>P<br>1440             | 1470<br>P<br>1490               | 704(2311)<br>P+C<br>796(2610) | 381(1249)<br>C<br>434(1425)     |
|            | SANTONIAN        | 1366(4480)<br>P   | 1710<br>P                       | 975(3200)<br>P<br>1067(3500)      | 1258(4126)<br>P<br>1271(4170)     |                                 | 1493(4900)<br>P<br>1501(4926)   |                   | 1554(5100)<br>P<br>1562(5126)   | 1570<br>P<br>1590             | 1450<br>P<br>1470             | 1550<br>P<br>1580               | 817(2680)<br>P<br>832(2731)   | 463(1520)<br>P<br>468(1535)     |
|            | CONIACIAN        | 1426(4680)<br>P   | 1740<br>P                       | 1085(3560)<br>P<br>1176(3860)     | 1289(4230)<br>P<br>1381(4530)     |                                 | 1638(5375)<br>P<br>1651(5417)   |                   | 1691(5548)<br>P<br>1691(5548)   | 1950<br>P<br>1950             | 1470<br>P<br>1490             | 1500<br>P<br>1580               | 837(2746)<br>P<br>832(2731)   | 468(1535)<br>P<br>468(1535)     |
|            | TURONIAN         | 1463(4800)<br>P   | 1800<br>P                       | 1194(3920)<br>P+C<br>1286(4220)   | 1399(4590)<br>C+A<br>1463(4800)   |                                 | 1554(5100)<br>P<br>1562(5126)   |                   | 1638(5375)<br>P<br>1651(5417)   | 1950<br>P<br>1950             | 1530<br>P+O<br>1550           | 1560<br>P+A<br>1580             | 908(2980)<br>P<br>914(3000)   | 533(1750)<br>C<br>536(1760)     |
|            | CENOMANIAN       | 1551(5090)<br>P+O | 1890<br>A+O                     | 1314(4280)<br>P+C<br>1625(5330)   | 1481(4860)<br>O+P<br>1481(4860)   |                                 | 1638(5375)<br>P<br>1651(5417)   |                   | 1691(5548)<br>P<br>1691(5548)   | 1950<br>P<br>1950             | 1590<br>C<br>1590             | 1590<br>C<br>1590               | 1250(4100)<br>A<br>1250(4100) | 683(2240)<br>A<br>719(2360)     |
|            | ALBIAN           | 2265(7430)<br>P+C | 1980<br>O                       | 1643(5390)<br>O<br>1820(5970)     | 1682(5520)<br>O<br>1682(5520)     |                                 | 1929(6330)<br>P<br>1929(6330)   |                   | 1929(6330)<br>P<br>1929(6330)   | 2320<br>O<br>2320             | 2340<br>O<br>2340             | 2460<br>O<br>2460               | 1280(4200)<br>O<br>1280(4200) | 1469(4820)<br>BA<br>1469(4820)  |
|            | APTIAN           | 2405(7890)<br>P+C | 2440<br>C                       | 2039(6690)<br>BA<br>2329(7640)    | 2131(6990)<br>P<br>2149(7050)     |                                 | 2399(7910)<br>C<br>2399(7910)   |                   | 2715(8908)<br>C<br>2715(8908)   | 2790<br>O<br>2790             | 2770<br>O<br>2770             | 2980<br>O+C<br>2980             | 2195(7200)<br>C<br>2225(7300) | 1558(5110)<br>C<br>1558(5110)   |
|            | BARREMIAN        | 2512(8240)<br>C   | 2850<br>C                       | 2624(8610)<br>BA<br>2804(9200)    | 2734(8970)<br>C<br>2734(8970)     |                                 | 2829(9280)<br>C<br>2829(9280)   |                   | 2829(9280)<br>C<br>2829(9280)   | 3000<br>O<br>3000             | 2980<br>O<br>2980             | 3080<br>C<br>3080               | 2225(7300)<br>C<br>2225(7300) | 1558(5110)<br>C+O<br>1558(5110) |
|            | HAUTERIVIAN      | 2688(8820)<br>C   | 3450<br>C                       | 2804(9200)<br>C+O<br>2822(9260)   | 2734(8970)<br>O<br>3036(9960)     |                                 | 2715(8908)<br>C<br>2715(8908)   |                   | 2715(8908)<br>C<br>2715(8908)   | 3110<br>O<br>3110             | 3110<br>O<br>3110             | 3110<br>C<br>3110               | 3000<br>C<br>3000             | 1692(5550)<br>C+O<br>1780(5840) |
|            | VALANGINIAN      | 3196(10486)<br>C  | 3660<br>C                       | 3197(10490)<br>C+O<br>3222(10570) | 3338(10950)<br>A+O<br>3357(11010) |                                 | 3216(10550)<br>O<br>3216(10550) |                   | 3216(10550)<br>O<br>3216(10550) | 3280<br>O<br>3280             | 3360<br>C<br>3360             | 3280<br>C+A<br>3280             | 3360<br>C<br>3360             | 1780(5840)<br>A<br>1780(5840)   |
|            | BERRIASIAN       | 3408(11180)<br>C  | 3680<br>C                       | 3197(10490)<br>A<br>3222(10570)   | 3338(10950)<br>A<br>3357(11010)   |                                 | 3758(12330)<br>C<br>3758(12330) |                   | 3762(12342)<br>C<br>3762(12342) | 4290<br>O<br>4290             | 4310<br>A<br>4310             | 4320<br>A+O<br>4320             | 4310<br>A<br>4310             | 4360<br>A<br>4360               |
|            | TITHONIAN        | 3438(11280)<br>C  | 4070<br>C                       | 3222(10570)<br>A<br>3222(10570)   | 3357(11010)<br>A<br>3357(11010)   |                                 | 3762(12342)<br>C<br>3762(12342) |                   | 3762(12342)<br>C<br>3762(12342) | 4310<br>C<br>4310             | 4360<br>A<br>4360             | 4360<br>A+O<br>4360             | 4310<br>A<br>4310             | 4360<br>A<br>4360               |
|            | KIMMERIDGIAN     | 3478(11410)<br>C  | 4730<br>BA                      | 3600(11810)<br>A+C<br>3618(11870) | 3319(10890)<br>A+C<br>3341(10960) |                                 | 3319(10890)<br>C<br>3341(10960) |                   | 3319(10890)<br>C<br>3341(10960) | 4675<br>C<br>4675             | 4560<br>C<br>4560             | 2929(9610)<br>C+O<br>2953(9690) | 2067(6780)<br>O<br>2097(6880) | 2067(6780)<br>O<br>2097(6880)   |
| OXFORDIAN  | 3499(11480)<br>C | 4750<br>BA        | 3600(11810)<br>C<br>3874(12710) | 3319(10890)<br>C<br>3341(10960)   | 3319(10890)<br>C<br>3341(10960)   | 3319(10890)<br>C<br>3341(10960) | 4695<br>C<br>4695               | 4600<br>C<br>4600 | 2953(9690)<br>C+O<br>2953(9690) | 2097(6880)<br>O<br>2097(6880) | 2097(6880)<br>O<br>2097(6880) |                                 |                               |                                 |
| CALLOVIAN  | 3856(12560)<br>C | 5250<br>BA        | 3600(11810)<br>C<br>3874(12710) | 3319(10890)<br>C<br>3341(10960)   | 3319(10890)<br>C<br>3341(10960)   | 3319(10890)<br>C<br>3341(10960) | 4695<br>C<br>4695               | 4600<br>C<br>4600 | 2953(9690)<br>C+O<br>2953(9690) | 2097(6880)<br>O<br>2097(6880) | 2097(6880)<br>O<br>2097(6880) |                                 |                               |                                 |
| BATHONIAN  | 3956(12988)<br>C | 5250<br>BA        | 3600(11810)<br>C<br>3874(12710) | 3319(10890)<br>C<br>3341(10960)   | 3319(10890)<br>C<br>3341(10960)   | 3319(10890)<br>C<br>3341(10960) | 4695<br>C<br>4695               | 4600<br>C<br>4600 | 2953(9690)<br>C+O<br>2953(9690) | 2097(6880)<br>O<br>2097(6880) | 2097(6880)<br>O<br>2097(6880) |                                 |                               |                                 |



**ZONES**  
 P-PLANKTIC FORAMINIFERA  
 C-CALCAREOUS BENTHIC FORAMINIFERA  
 A-ARENACEOUS BENTHIC FORAMINIFERA  
 O-OSTRACOD  
 CP-CALPIONELLID

Fig. 4. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the southwest and northeast Scotian Basin. Refer to Figure 2 to determine zonal names.

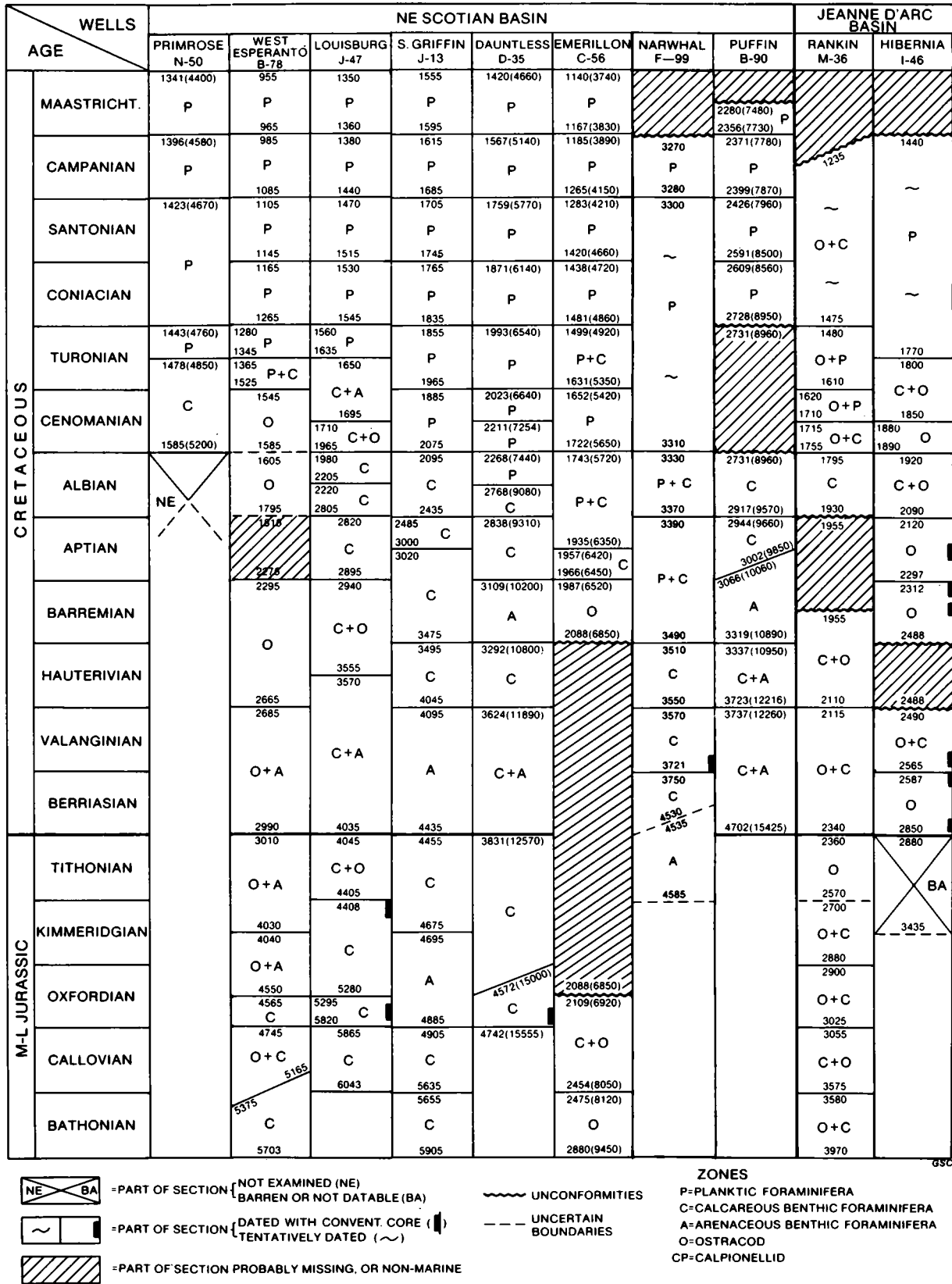
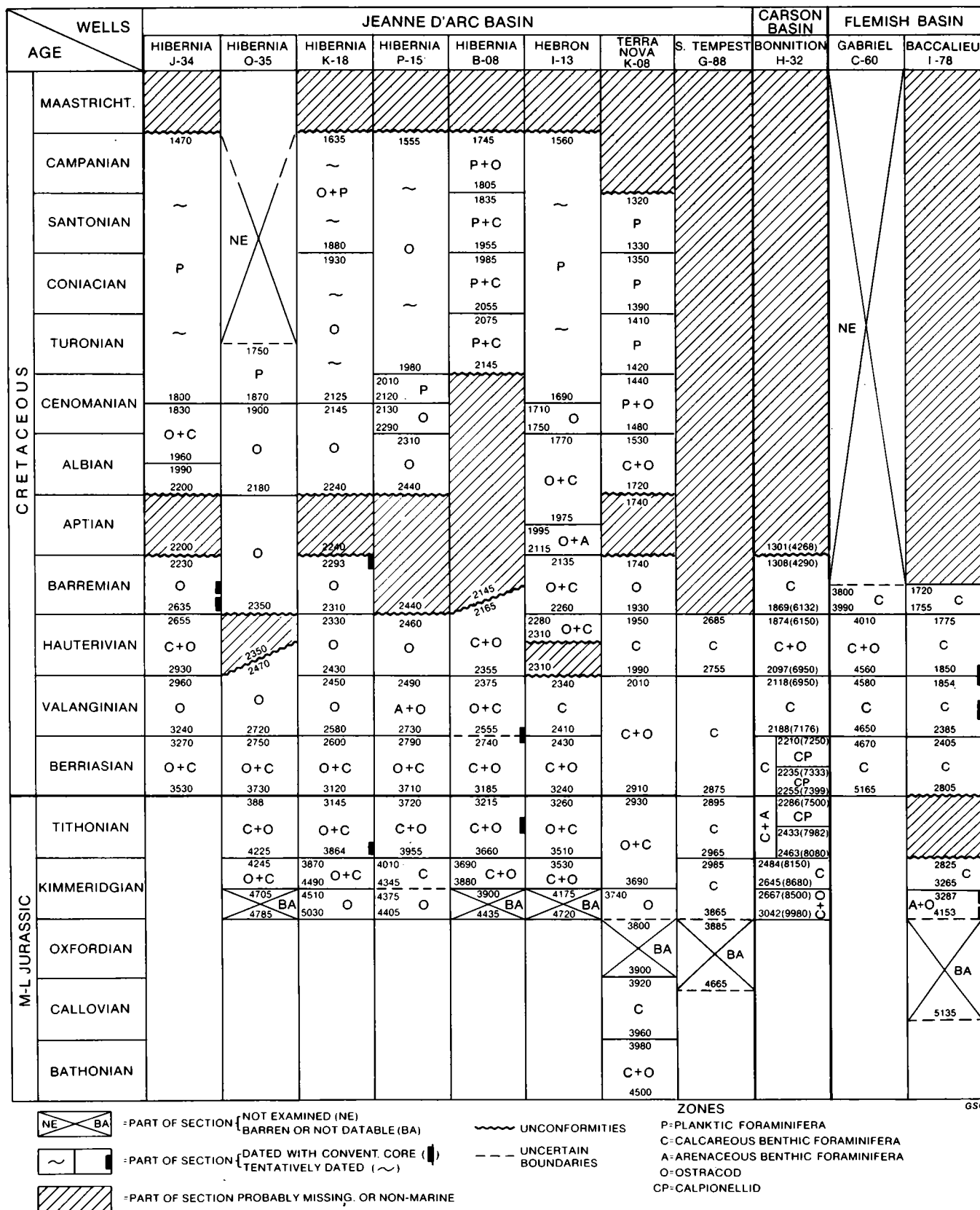


Fig. 5. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the northeast Scotian Basin and Jeanne d'Arc Basin. Refer to Figure 2 to determine zonal names.



GSC

Fig. 6. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the Jeanne d'Arc, Carson and Flemish Pass basins. Refer to Figure 2 to determine zonal names.

*washitensis* (Carsey), as illustrated by Ascoli (1976), is assignable to their new genus and species *Ascoliella scotiensis*. Therefore, this zone is now the "*Ascoliella scotiensis* — *Hedbergella trocoidea* Zone".

**CALCAREOUS BENTHIC FORAMINIFERA ZONES.** "*Epistomina* sp. 2 Ascoli 1984 — *Epistomina* aff. *minutereticulata* Zone". Recent examination of topotypic material of *Epistomina volgensis* Mjatluk from the U.S.S.R. has shown that this species is similar to *Epistomina* sp. 2 Ascoli 1984, and identical to *Epistomina* sp. 3 Ascoli 1984. The stratigraphic ranges of the latter two species are identical on the Canadian Atlantic Shelf, where their highest stratigraphic occurrence has been dated Berriasian by calpionellids (Ascoli, 1984, 1988). Therefore, *Epistomina volgensis* Mjatluk becomes one of the two zone marker species — in place of *Epistomina* sp. 2 Ascoli 1984 — for this renamed "*Epistomina volgensis*-*Epistomina* aff. *minutereticulata* Zone".

**OSTRACODE ZONES.** "*Macrodentina* sp. 1-*Hechticythere hechti* Zone". Since the zonal marker *Macrodentina* sp. 1 appears to be more closely related to the genus *Neocythere*, the taxon is renamed "*Neocythere* sp. 1". Consequently, the zone is renamed "*Neocythere* sp. 1-*Hechticythere hechti* Zone".

### BIOSTRATIGRAPHIC CORRELATION OF 42 WELLS

The composite zonation described here has been used to correlate strata in 42 selected wells. The results are shown in the zonation charts (Figs. 3-7), where the wells are arranged in geographic order from southwest to northeast. The type of zone, whether foraminiferal, ostracode or calpionellid, is indicated and related to the corresponding age, with the lower and upper boundaries given in metres only for recent wells and in metres and feet for earlier wells, the depths of which were originally reported in feet. Different symbols depict the different kinds of zones most relevant for dating the various intervals of each well. Other symbols indicate those sections dated using conventional cores, those tentatively dated, those barren of microfossils and/or not datable, and those not examined. Missing sections, including those due to stratigraphic hiatuses, unconformities and uncertain zonal boundaries are also indicated in Figures 3 to 7.

The tops of the zones or biostratigraphic units and the corresponding ages reported in Figures 3 to 7, which were established almost exclusively on the basis of relatively widely spaced cuttings, should be considered approximate. Examination of more abundant fossil material would probably

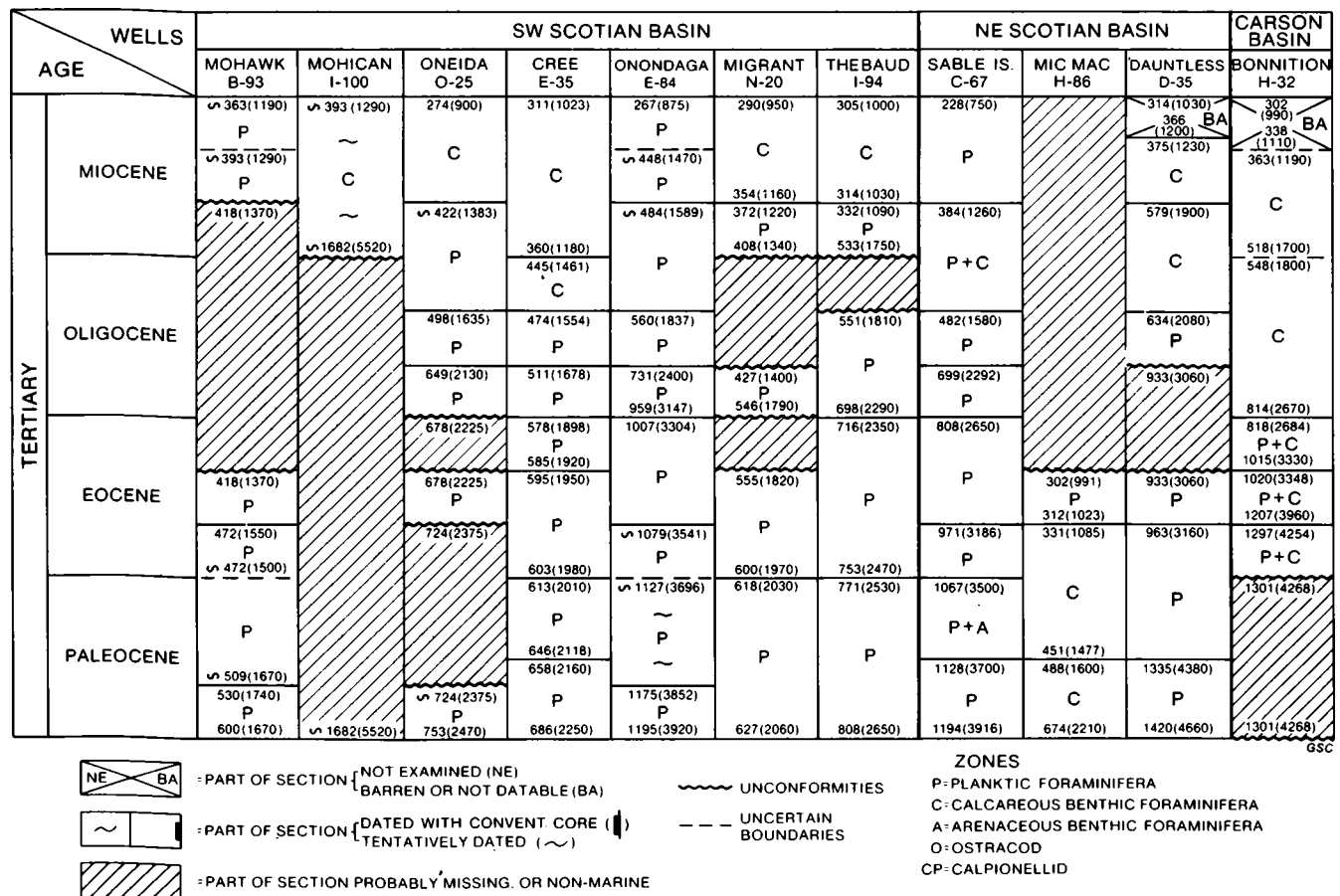


Fig. 7. Biostratigraphic correlation of Tertiary microfossil zones in wells of the Scotian and Carson basins. Refer to Figure 2 to determine zonal names.

lead to the upward adjustment of some tops of biostratigraphic units and corresponding ages.

The correlations presented here are based on a study of only the *examined sections* of the wells. This "examined section" in most wells is only part of the total drilled section; it reflects the order or priority given by the Geological Survey of Canada to the biostratigraphic study of the wells. This is reflected in the emphasis of the study on the Mesozoic and particularly on the Middle and Upper Jurassic and lowest Cretaceous sediments, where most of the Scotian Shelf and Grand Banks hydrocarbon-producing horizons are located.

#### REFERENCES

- Alleman, F., Catalano, R., Fares, F., and Remane, J. 1971. Standard Calpionellid Zonation (Upper Tithonian-Valanginian) of the Western Mediterranean Province. *Proceedings of Second Planktonic Conference, Roma, 1970*, v. 2, p. 1337-1340.
- Ascoli, P. 1976. Foraminiferal and Ostracod Biostratigraphy of the Mesozoic-Cenozoic, Scotian Shelf, Atlantic Canada. *In: First International Symposium on Benthonic Foraminifera of Continental Margins, Part B: Paleocology and Biostratigraphy*, C.T. Schafer and B.R. Pelletier (eds.), Maritime Sediments Special Publication 1, Pt. B, p. 653-671.
- \_\_\_\_\_. 1984. Epistominid biostratigraphy across the Jurassic-Cretaceous boundary on the northwestern Atlantic Shelf. *In: Benthos '83*, H.J. Oertli (ed.), 2nd International Symposium Benthic Foraminifera, p. 27-34.
- \_\_\_\_\_. 1988. Mesozoic-Cenozoic foraminiferal, ostracod and calpionellid zonation of the north Atlantic margin of North America: Georges Bank-Scotian basins and northeastern Grand Banks (Jeanne d'Arc, Carson and Flemish Pass basins). Biostratigraphic correlation of 51 wells. Geological Survey of Canada, Open File 1791, p. 1-41.
- \_\_\_\_\_, Poag, C.W. and Remane, J. 1984. Microfossil zonation across the Jurassic-Cretaceous boundary on the Atlantic margin of North America. *In: Jurassic-Cretaceous Biochronology and Paleogeography of North America*, G.E.G. Westermann, (ed.), Geological Association of Canada, Special Paper 27, p. 31-48.
- Banner, F.T. and Desai, D. 1988. A review and revision of the Jurassic-Early Cretaceous Globigerinina, with especial reference to the Aptian assemblages of Speeton (North Yorkshire, England). *Journal of Micropaleontology*, v. 7, no. 2, p. 143-185.