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Foraminiferal, ostracode and calpionellid zonation and correlation of 42 selected wells from the north Atlantic margin of North America

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BIOZONATION

The foraminiferal-ostracode zonation presented here for the Mesozoic-Cenozoic of offshore eastern North America is based on data from 42 hydrocarbon exploration wells selected fro the 58 so far examined from the Canadian and adjoining U.S. Atlantic Margin (Fig. 1). This zonation, a refinement of that in Ascoli (1976) and Ascoli (1988), includes: 25 planktic foraminiferal zones (Bathonian-Late Miocene), 15 arenaceous benthic Foraminifera zones (Bathonian-Early Eocene) and 18 ostracode zones (Bathonian-Maastrichtian). Furthermore, five calpionellid zones allow calibration of the ages of the foraminiferal and ostracode zones in the proximity of the Jurassic-Cretaceous boundary (Tithonian-Berriasian). This composite zonation has been used in correlating 42 wells located in five basins: Georges Bank Basin (two wells), Scotian Basin (Scotian Shelf and southwestern Grand Banks, 27 wells) and Jeanne d'Arc, Carson, and Flemish Pass basins (northeastern Grand Banks, 13 wells).

All 87 zones are informal assemblage zones, the upper boundaries of which are defined by the highest stratigraphic occurrences of one or two "zone marker species", after which the zones are named. In several zones, one of the two "zone marker species" (rarely a third one) has its highest stratigraphic occurrence in the lower part of the zone, thereby effecting a subdivision of the zone into lower and upper parts. In addition to "zone marker species", "zone diagnostic species" have also been used in identifying zone boundaries. "Zone diagnostic species" also have their highest stratigraphic occurrence at the top or in the lower part of their zone.

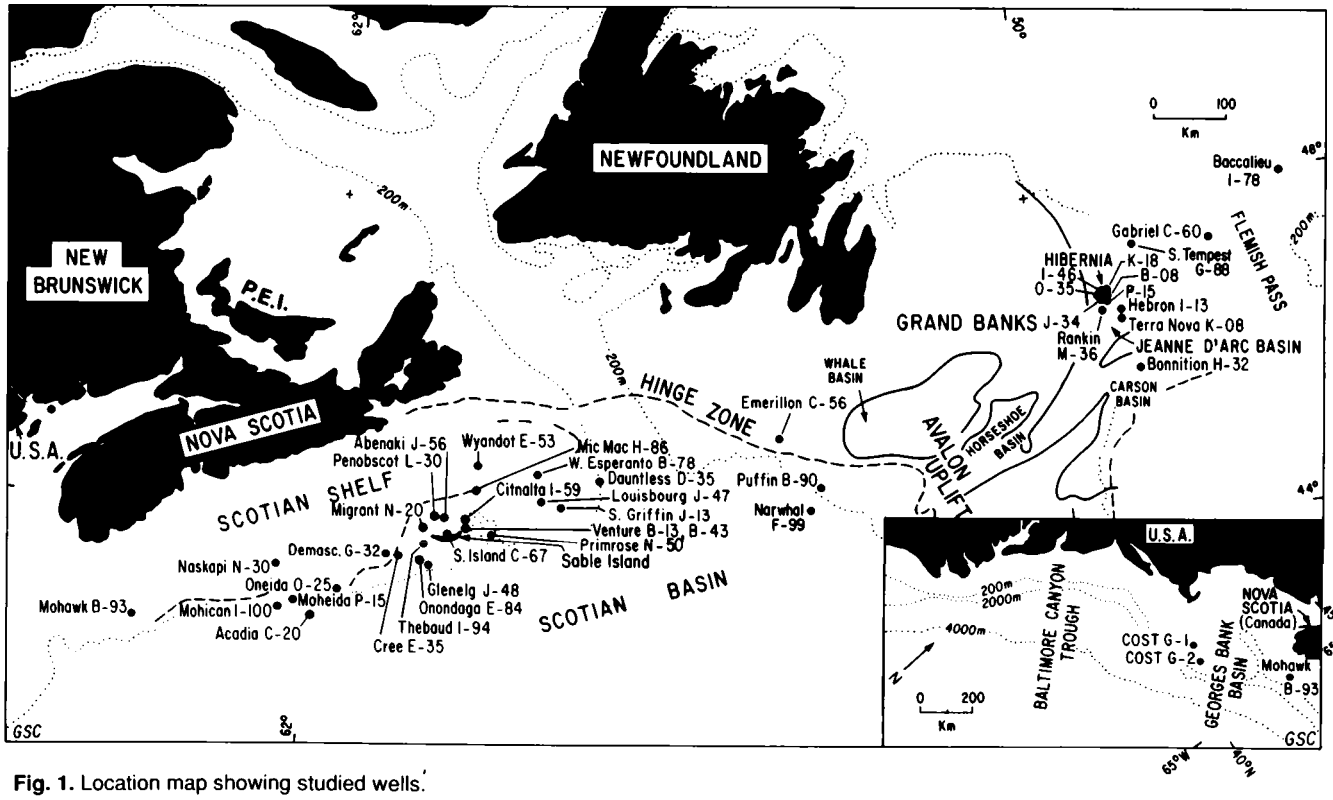

Fig. 1. Location map showing studied wells.

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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 FORMINIFERA ZONES. "*Globuligerina* gr. *oxfordiana* Zone". Recent comparison of our specimens of *G.* gr. *oxfordiana* with topotipic 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.

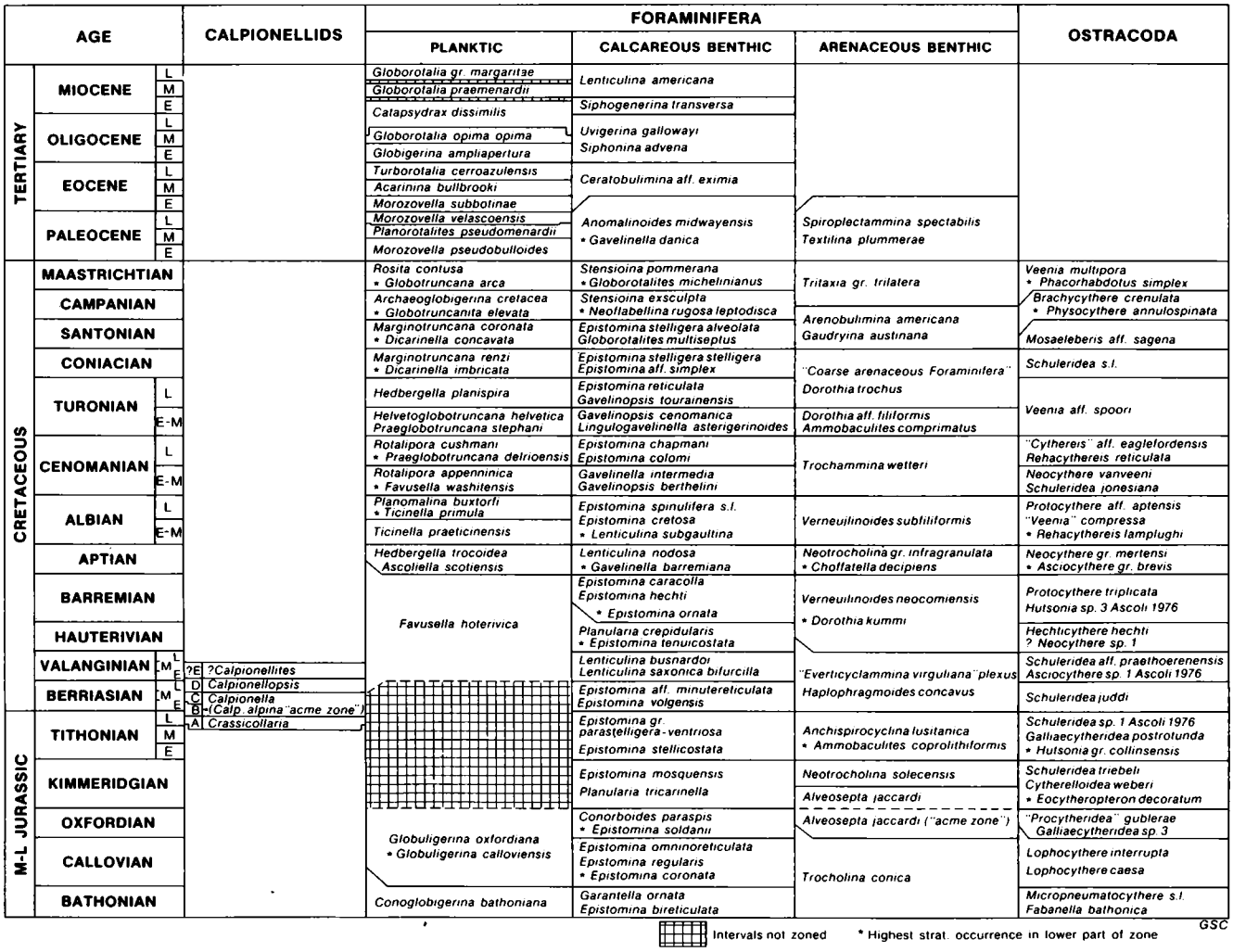

Fig. 2. Mesozoic-Cenozoic calpionellid, foraminifer and ostracode informal assemblage zones, Georges Bank-Scotian Basins and N.E. Grand Banks (Jeanne d'Arc, Carson and Flemish Pass basins). Vertical scale not calibrated to geological time.

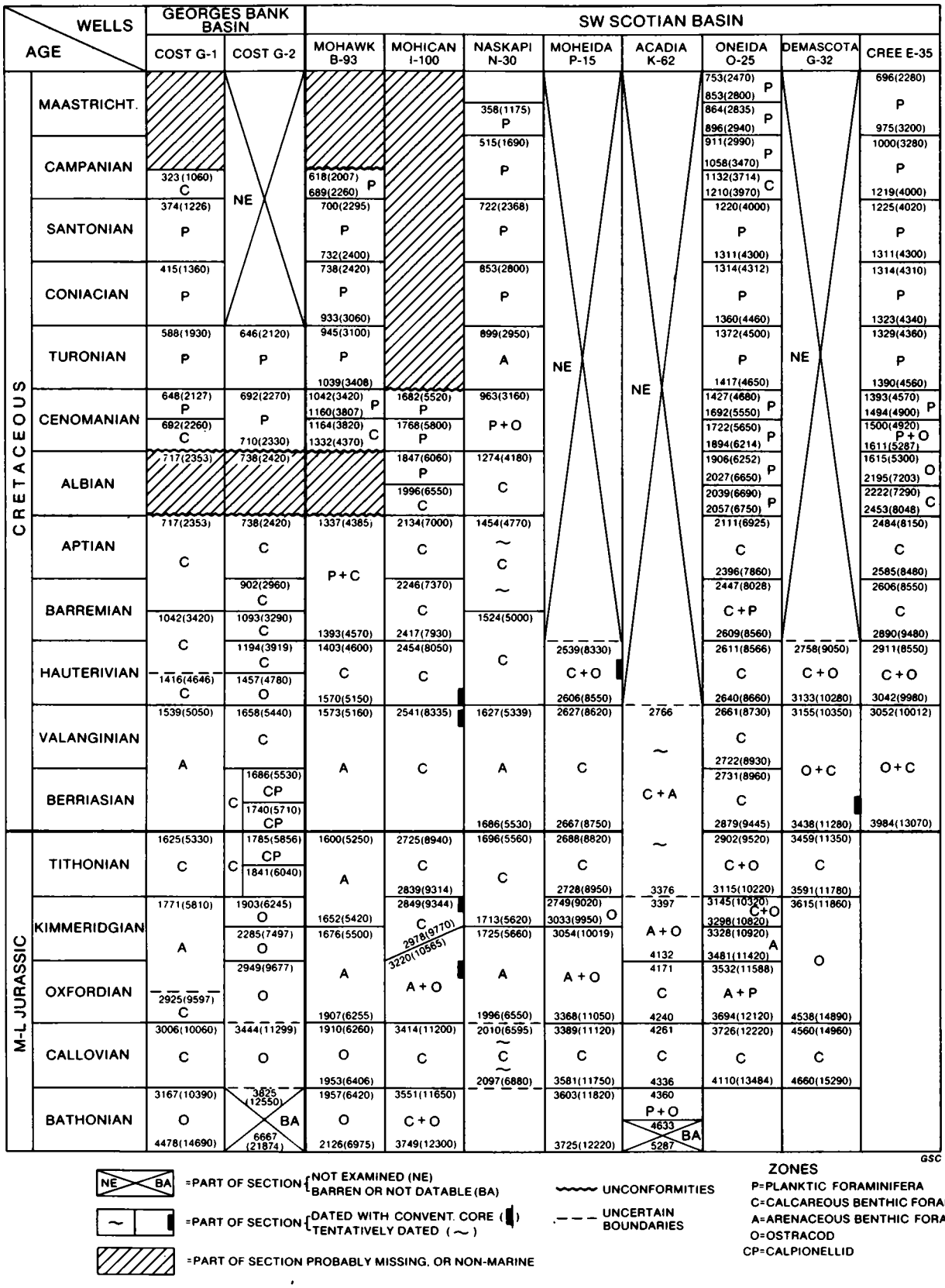

Fig. 3. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the Georges Bank and southwest Scotian basins. Refer to Figure 2 to determine zonal names.

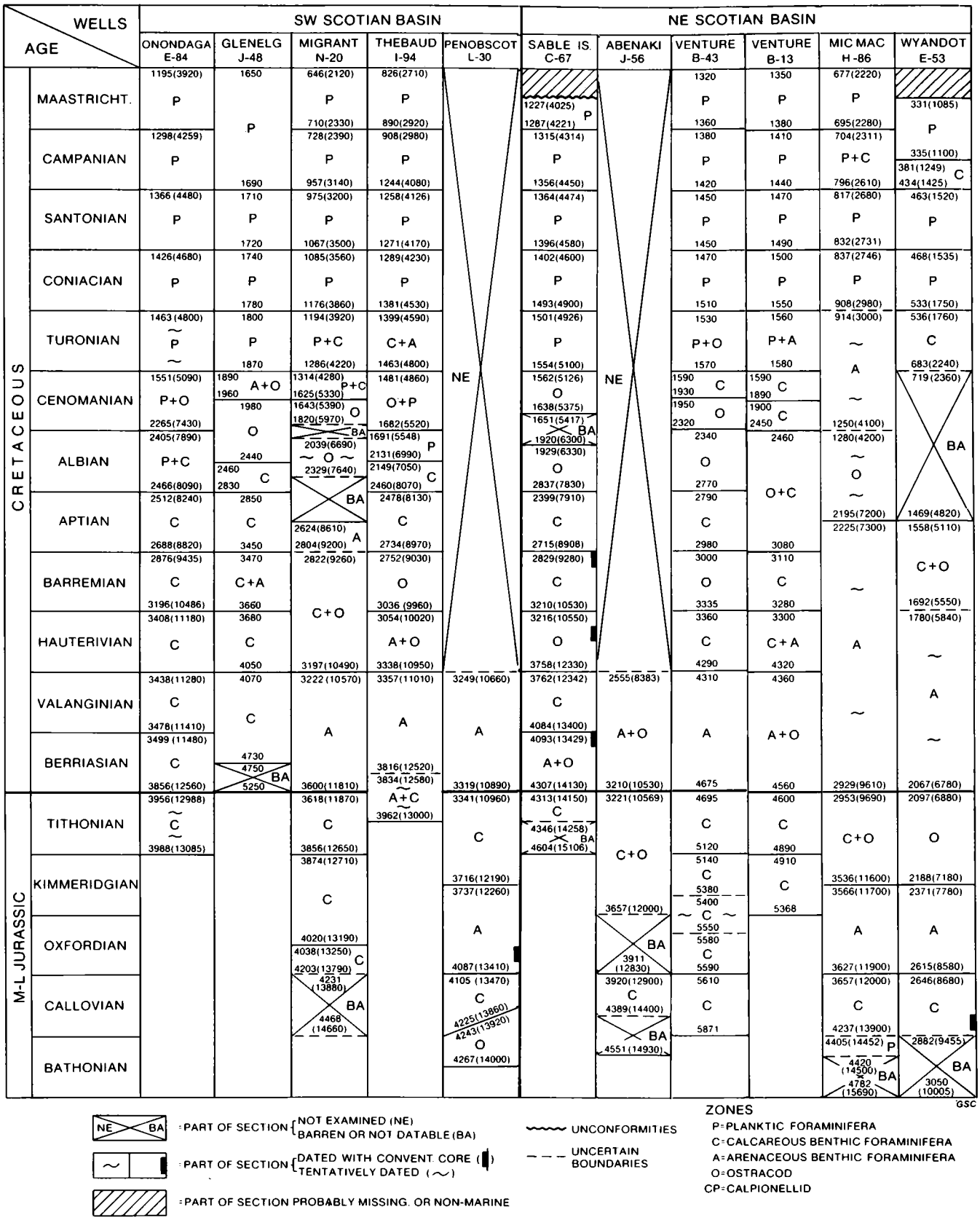

Fig. 4. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the southwest and northeast Scotian Basin. Refer to Figure 2 to determine zonal names.

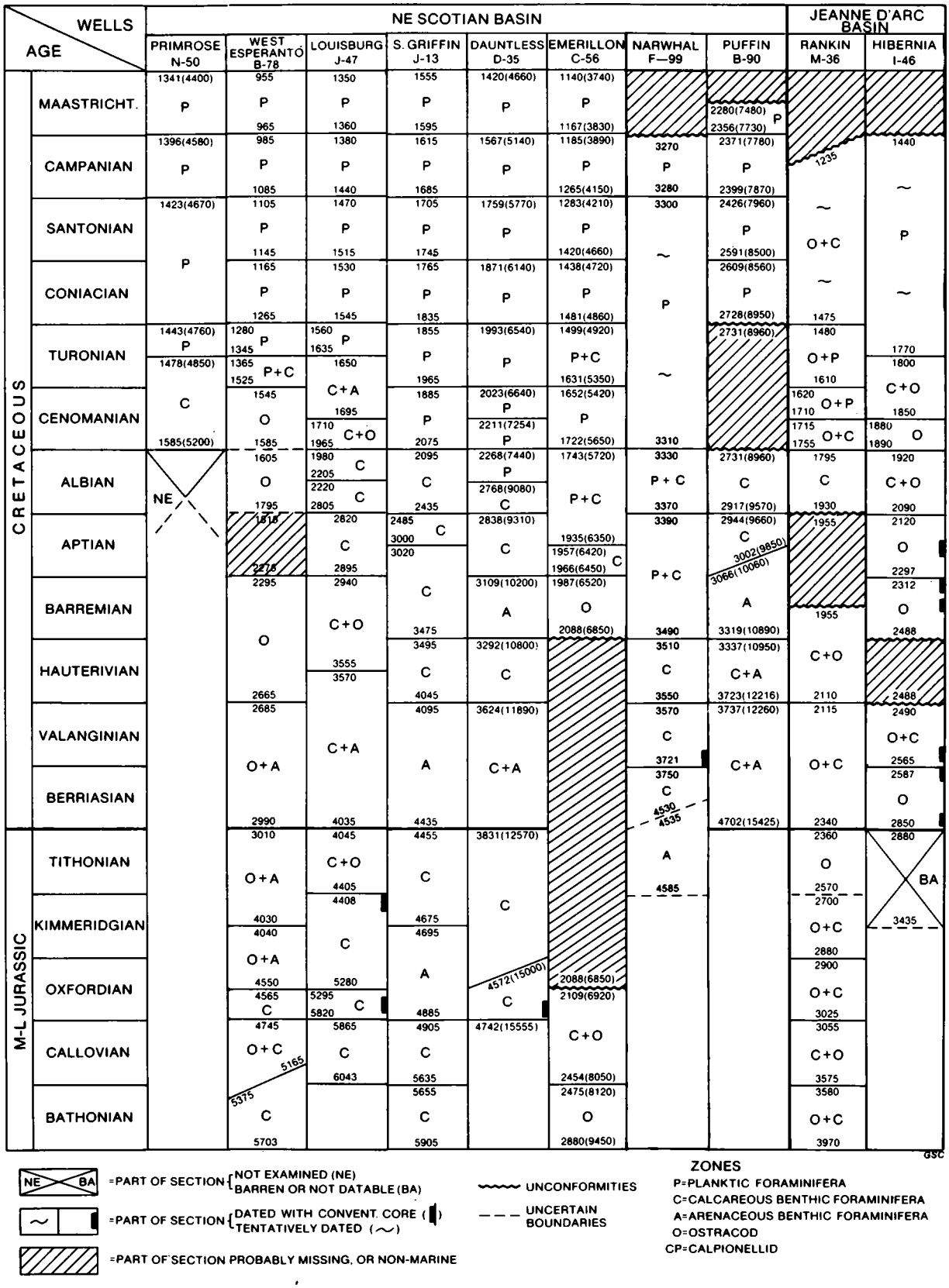

Fig. 5. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the northeast Scotian Basin and Jeanne d'Arc Basin. Refer to Figure 2 to determine zonal names.

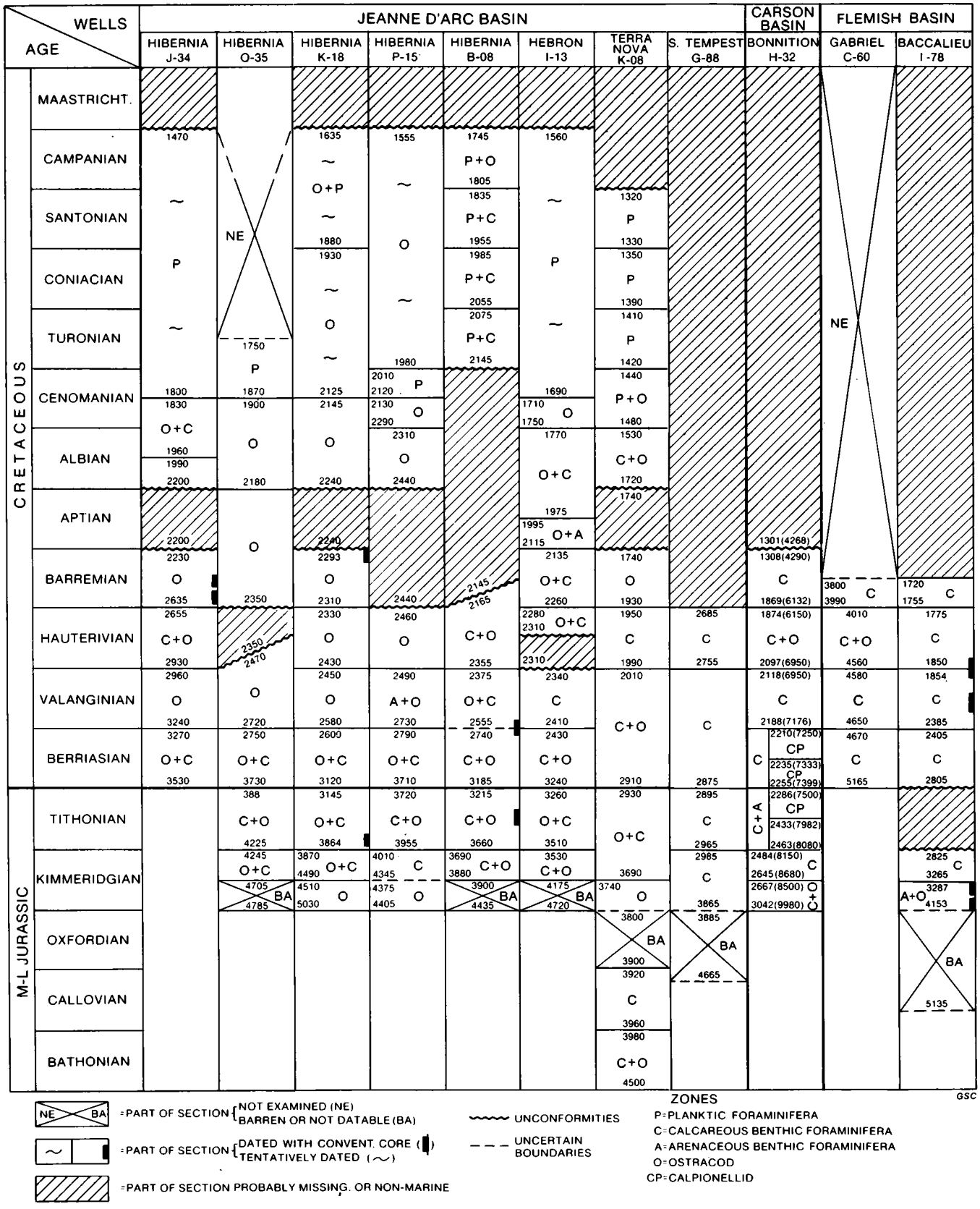

Fig. 6. Biostratigraphic correlation of Mesozoic microfossil zones in wells of the Jeanne d'Arc, Carson and Flemish Pass basins. Refer to Figure 2 to determine zonal names.

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 topotipic material of *Epistomina volgensis* Mjatliuk 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* Mjatliuk 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

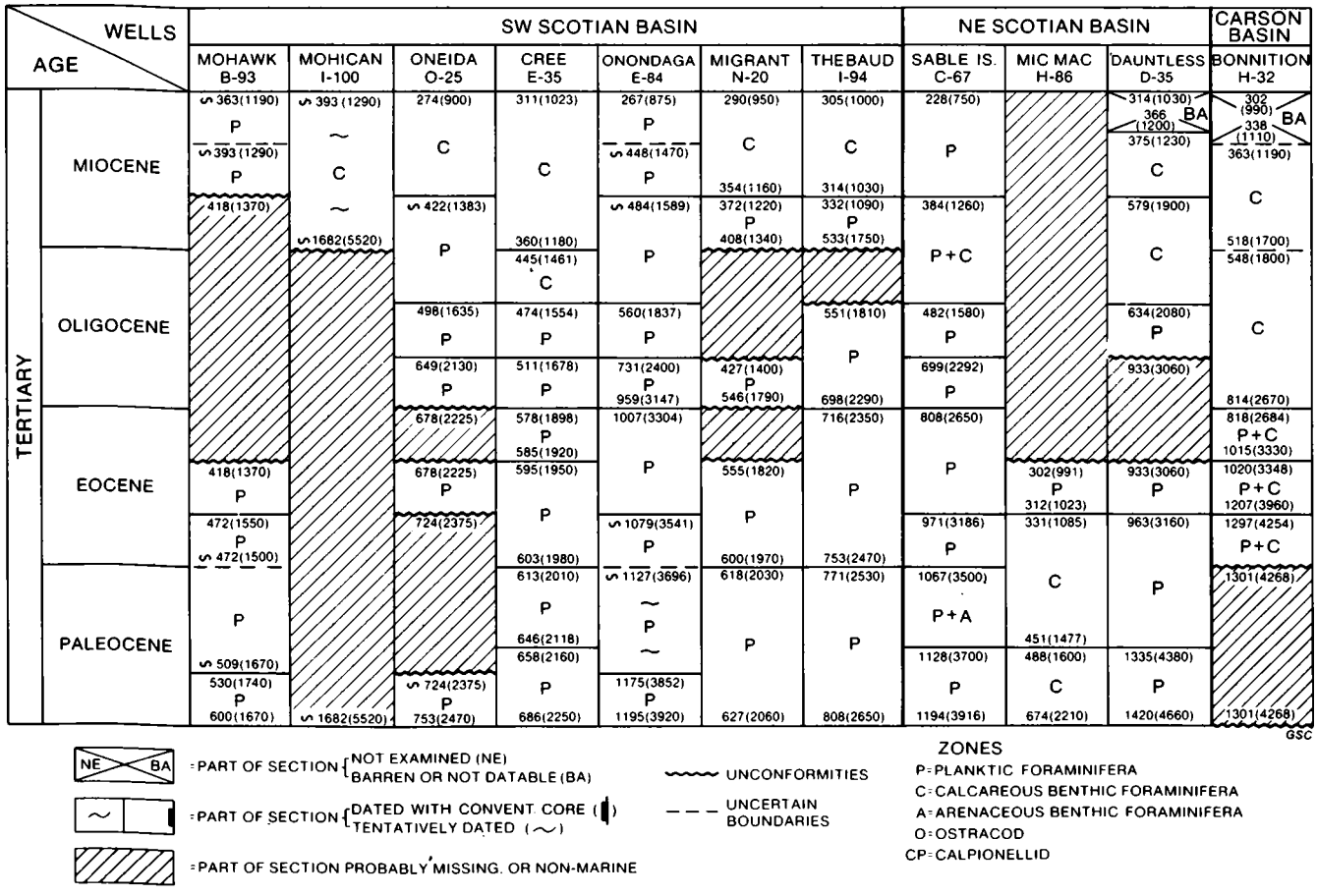

Fig. 7. Biostratigraphic correlation of Tertiary microfossil zones in wells of the Scotian and Carson basins. Refer to Figure 2 to determine zonal names.

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.

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