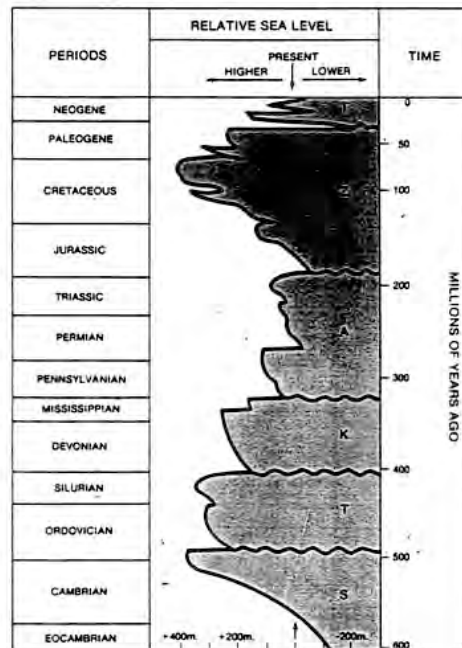


Paleozoic Life in the Seas

- Environmental variables to watch
 - Sea level
 - Positions of land and sea (continents & oceans)
 - Climate
- Patterns of diversity
- Mass extinctions
- Cast of characters



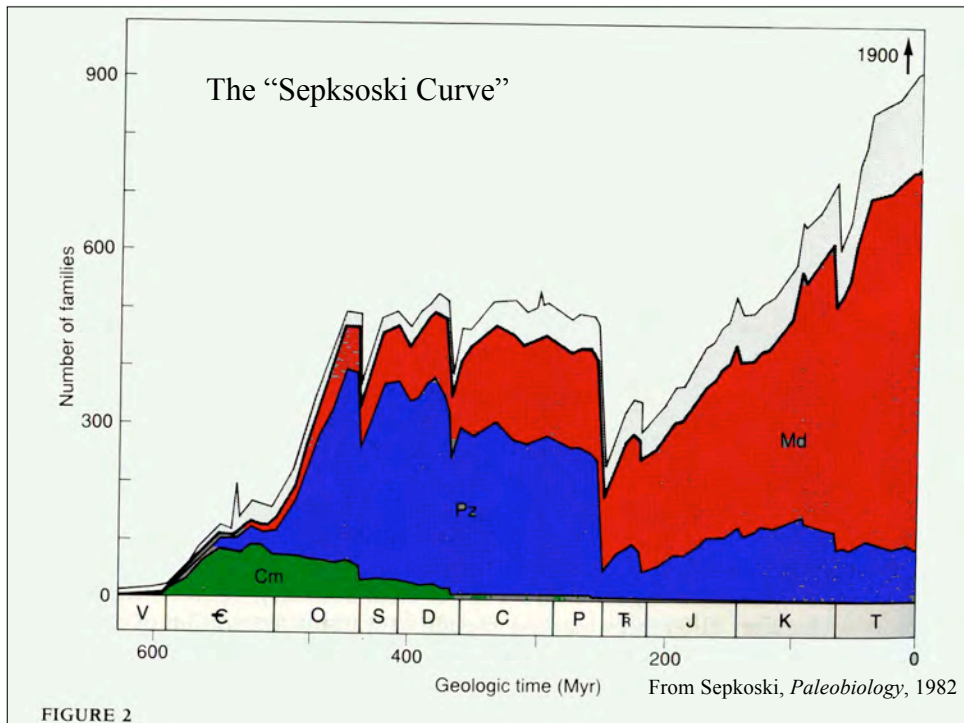
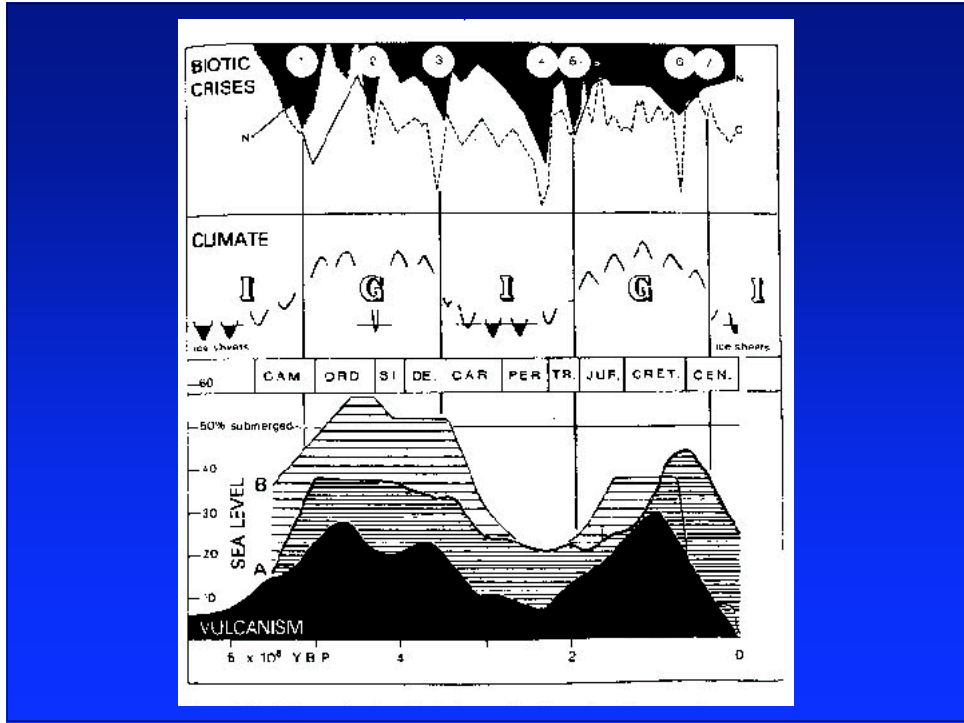
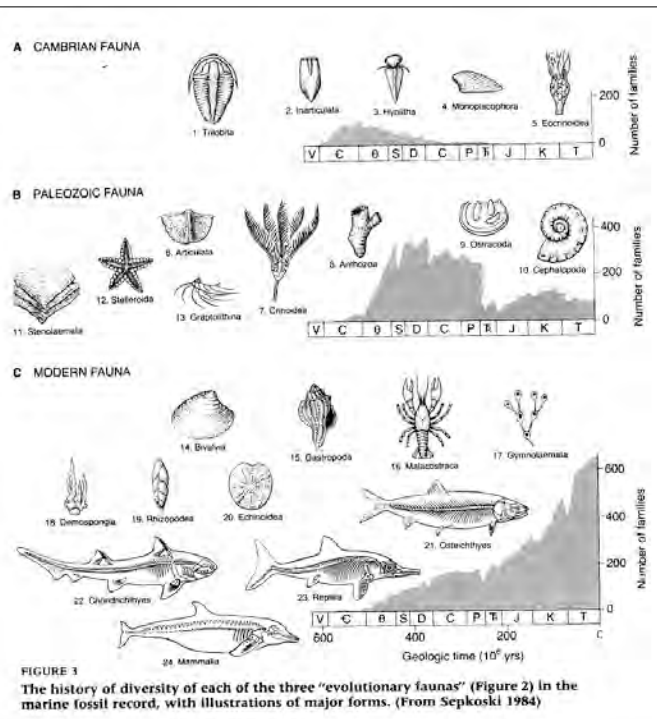
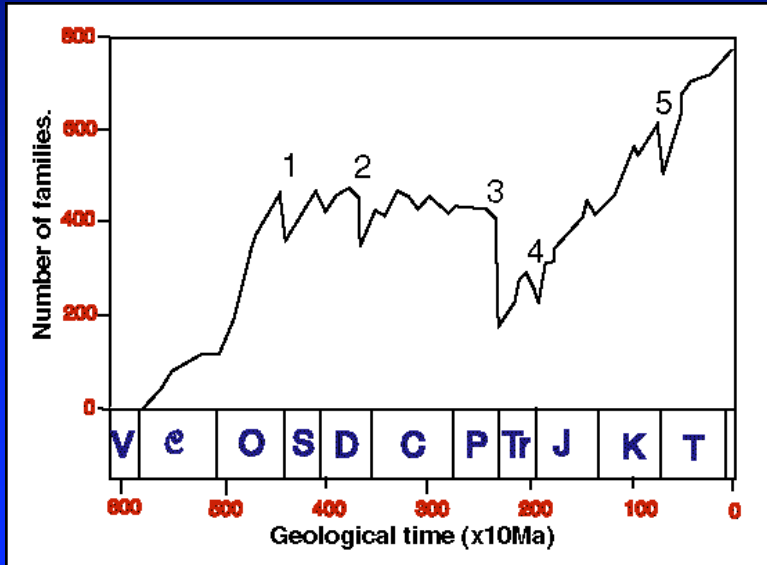


FIGURE 2

The Big 5 Mass Extinctions



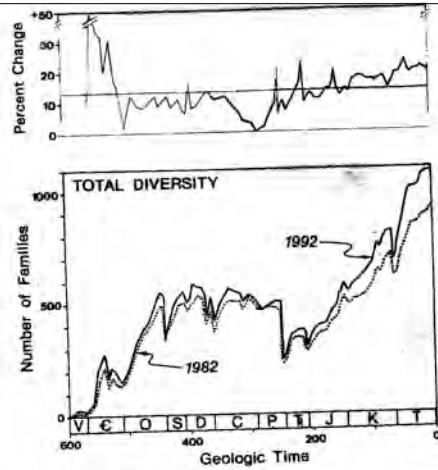


FIGURE 4. Comparison of diversity curves for the total marine fauna computed from the 1982 and 1992 familial compendia. Although the 1992 curve is higher than the older curve, the two are very similar in shape. The graph for the percentage of change shows that the greatest proportional increase in diversity has occurred over the Cambrian and the least over the Permian. (The dashed line in the graph is the median level of change, +13.5%.) The diversity curves were compiled straight from the data, with no interpolations of ranges within orders with discontinuous fossil records (e.g., Octopoda); such interpolation would have increased the apparent change over the Permian.

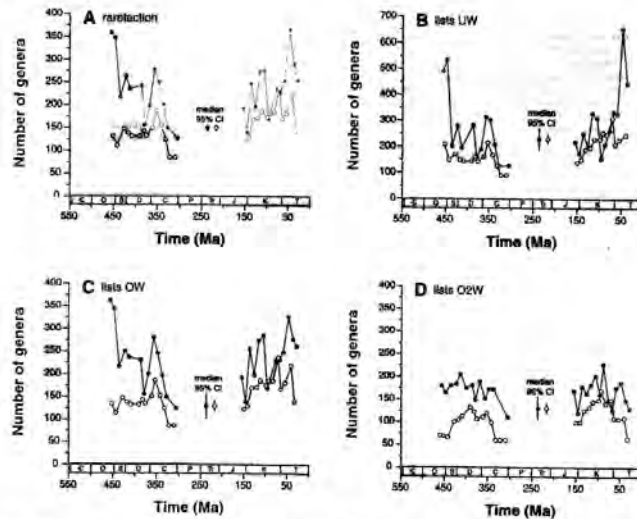
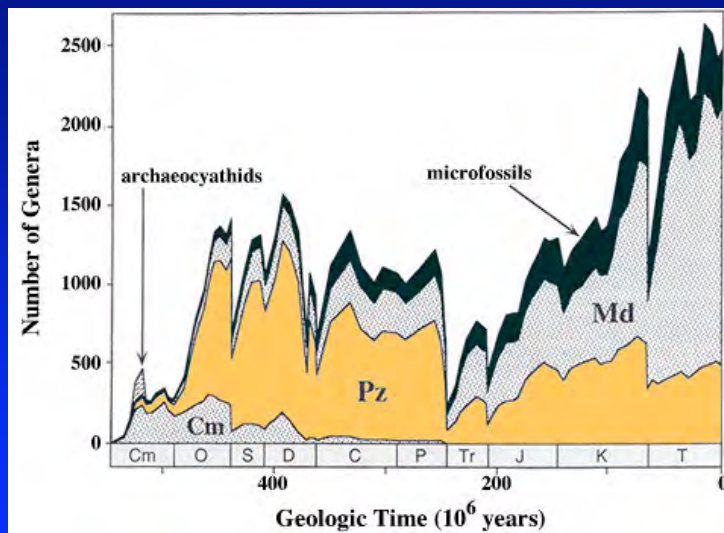
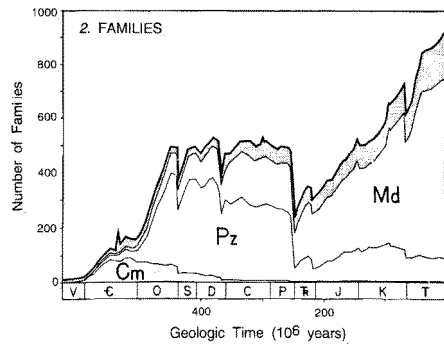
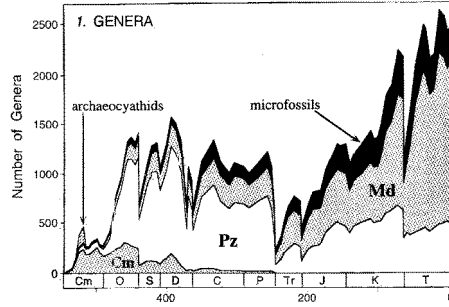


Fig. 5. Diversity curves corrected for variation in sampling intensity by using four different subsampling algorithms (Table 2) and two methods of counting genera. Each data point represents the median value seen across 100 individual subsampling trials. Some data points are excluded when bins fail to meet the appropriate sampling goals. Filled circles show counts of genera actually sampled within a bin; open circles show counts of genera crossing the boundaries between consecutive bins. Legends labeled "95% CI" show the median 95% confidence interval across all intervals in a particular analysis; separate values for sampled-within-bin and boundary-crosser counts are illustrated. Only North American, European, North African, and Middle Eastern collections, and only occurrences of Anthozoa, Brachiopoda, Echinodermata, Mollusca, and Trilobita, are included in the analyses. Period names are given in the legend for Fig. 1. (A) Classical rarefaction of taxonomic occurrences. Individual taxonomic occurrences are randomly and independently drawn until each temporal bin includes 700 occurrences. (B) Subsampling by unweighted lists (LW). The algorithm draws 60 lists per bin. (C) Subsampling of lists weighted by taxonomic occurrences (OW). The number of taxonomic occurrences included in each list is summed, and lists are drawn until each bin includes lists totaling 700 occurrences. (D) Subsampling of lists weighted by taxonomic occurrences squared (O2W). This method counts the sum of the squared richness values for the lists that are drawn. Each bin includes 10,000 occurrences-squared.

From Alroy et al.
PNAS (2001)



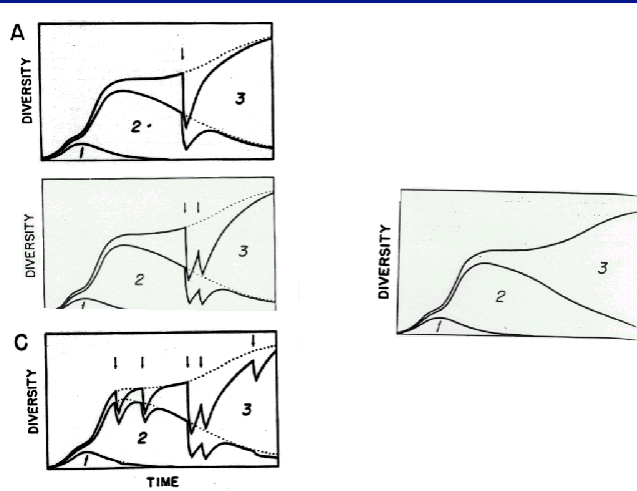
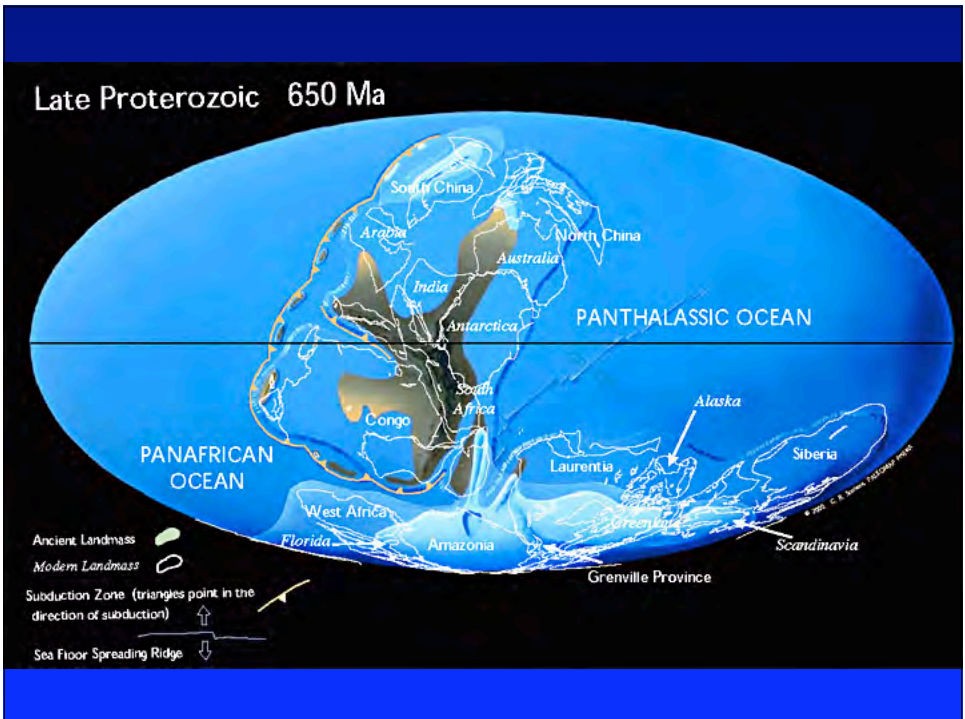
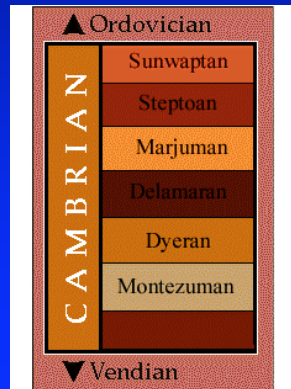


FIGURE 8. Three solutions to the three-phase kinetic model illustrated in Fig. 3 with time-specific perturbations (indicated by arrows) simulating the major mass extinctions of the Phanerozoic marine fossil record. A. A single, intense perturbation tuned to the timing and magnitude of the Late Permian mass extinction. B. The solution in A with an additional perturbation caused by the Norian mass extinction. C. The solution in B with three more perturbations corresponding to the Ashgillian, Frasnian, and Messinichian mass extinctions. The dotted lines in all three solutions represent the trajectory of the unperturbed three-phase system.

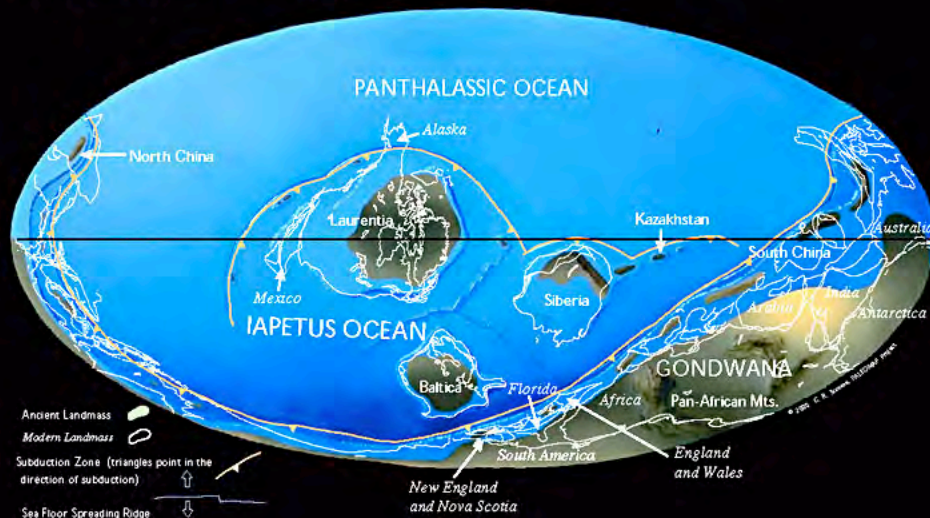


Cambrian Period

543 - 490 million years ago

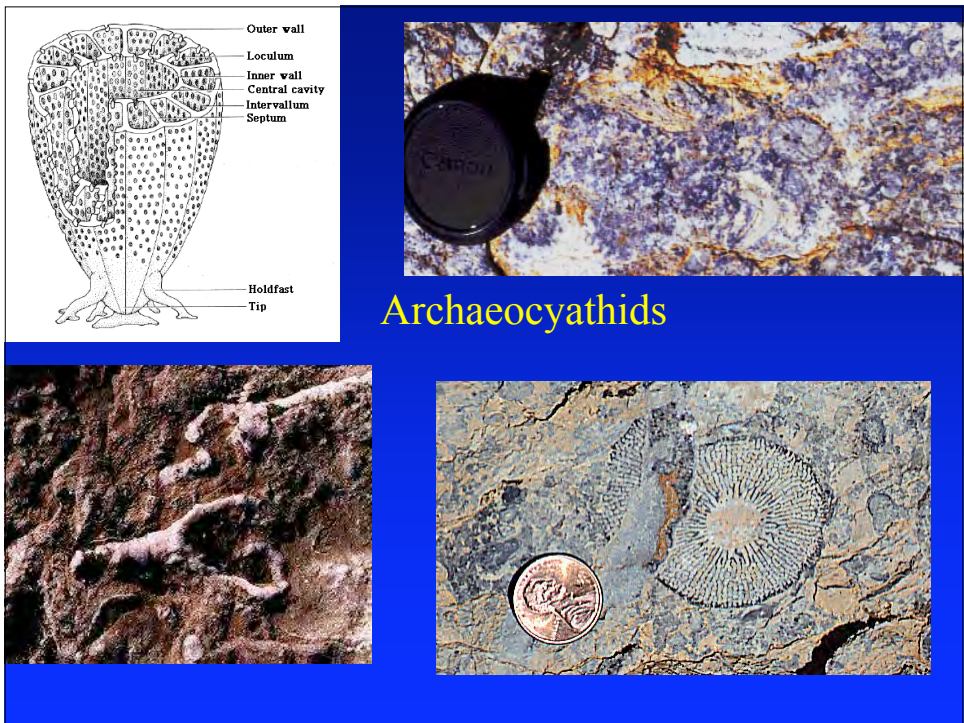


Late Cambrian 514 Ma

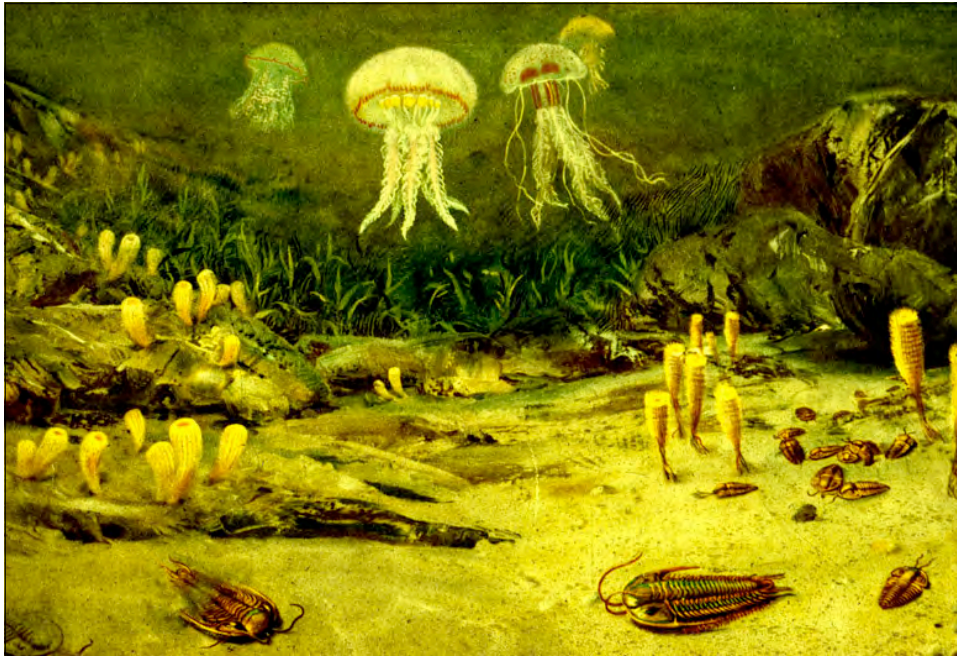




Cambrian Trilobites



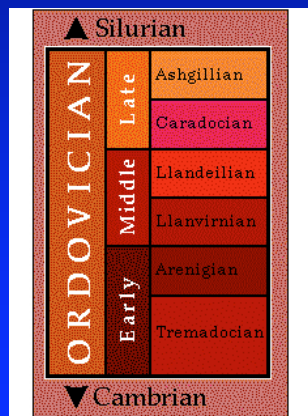
Archaeocyathids



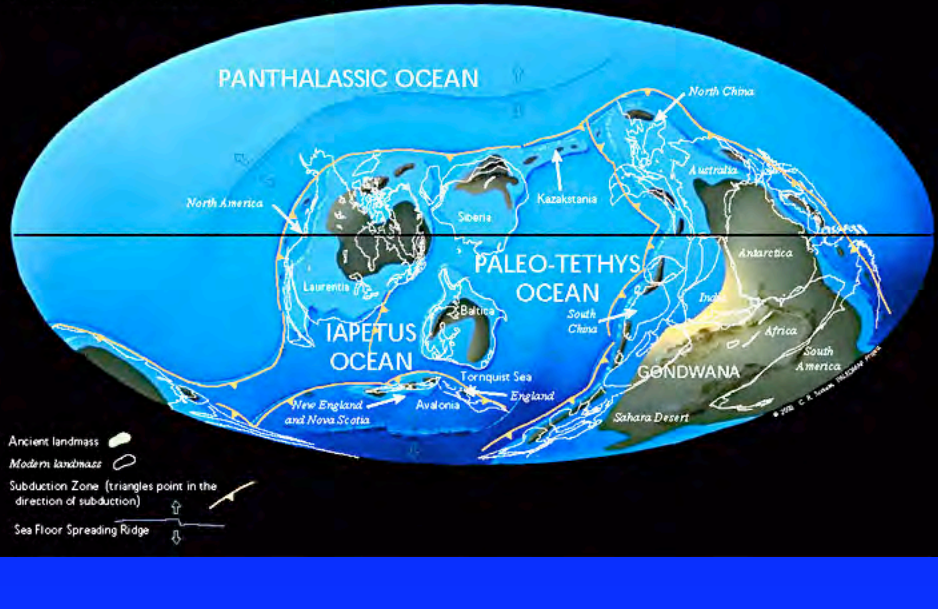
Cambrian seascape, painting by Zdenek Burian, ca. 1960

Ordovician Period

490 to 443 Million Years Ago



Middle Ordovician 458 Ma



Ordovician Brachiopods



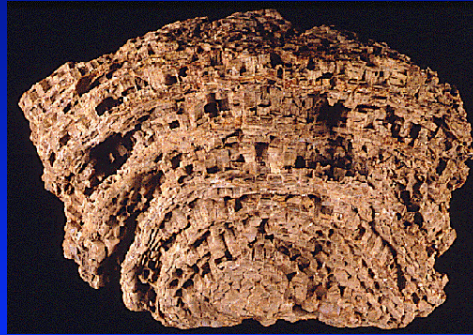
Brachiopods, Ordovician, Ohio

Ordovician Corals

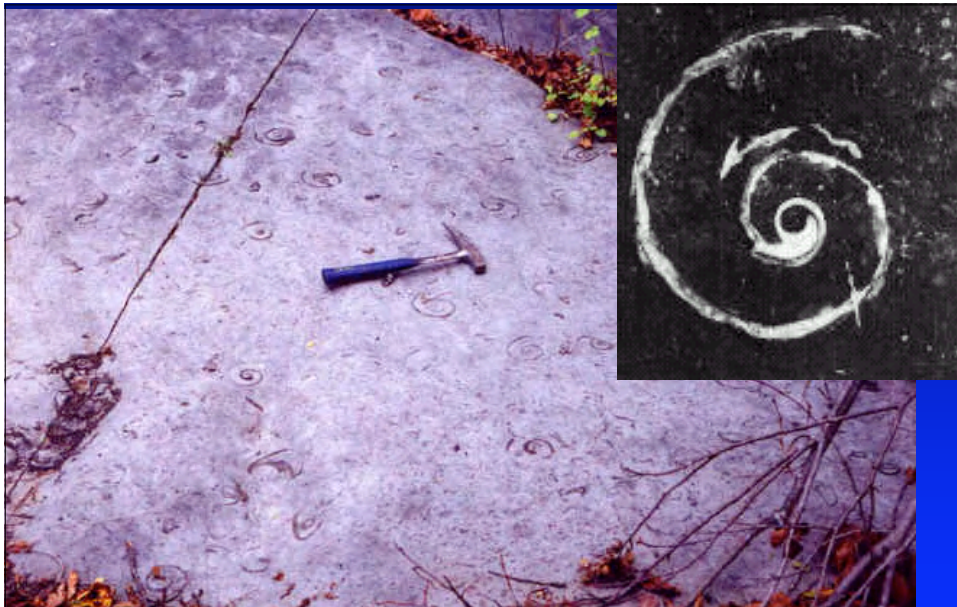
Rugose



Tabulate



www.humboldt.edu/~natmus/Exhibits/Life_time/Ordovician.web/55b.jpg



Maclurites at Crown Point, Lake Champlain, NY



Leviceraurus



Asaphus

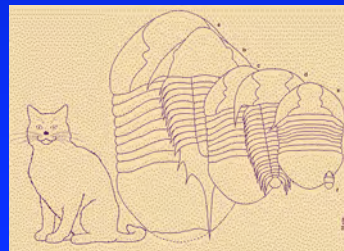


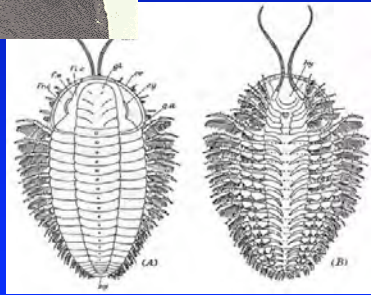
Ordovician Trilobites

Isotelus



The largest known trilobite
Isotelus rex, Late Ordovician,
northern Manitoba





Triarthrus, Ordovician, New York



Kentucky

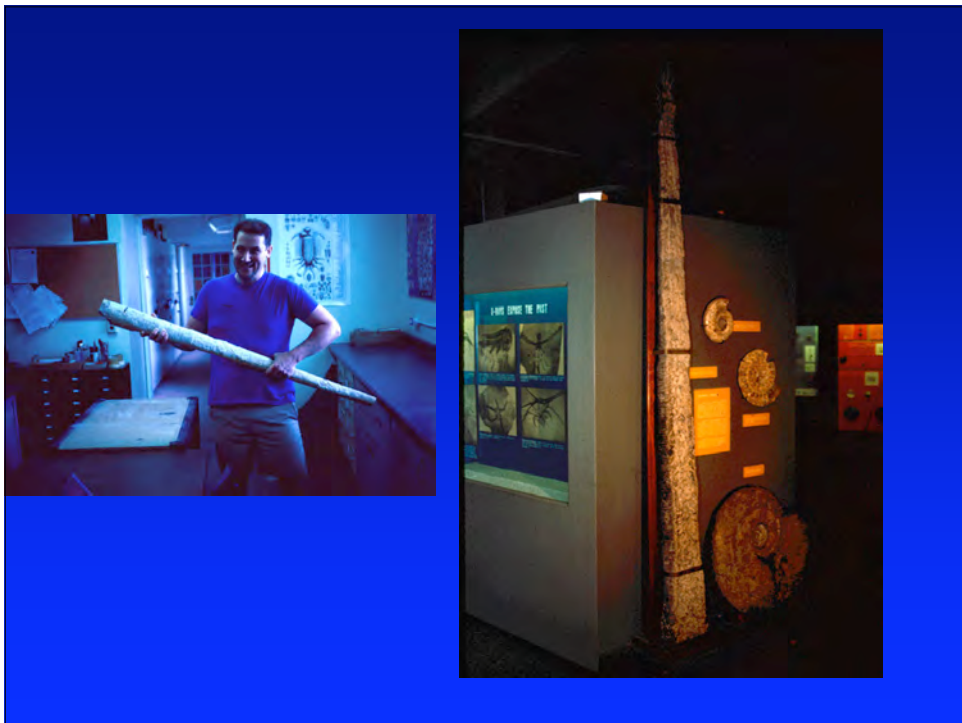
Ordovician Nautiloids



Ohio



Minnesota

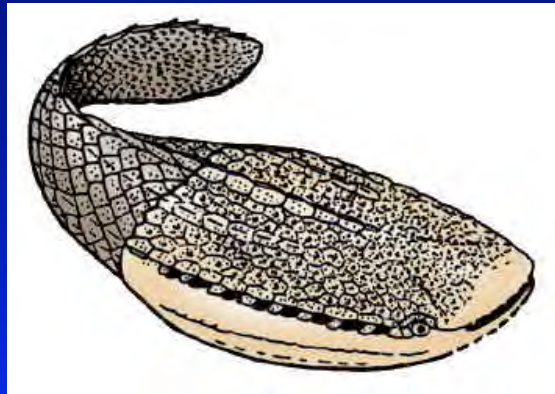


Giant nautiloid
Rayonoceras solidiforme
Mississippian, Fayetteville, ARK



Ordovician crinoids

www.emc.maricopa.edu/faculty/farabee/BIOBK/1ord04b.gif

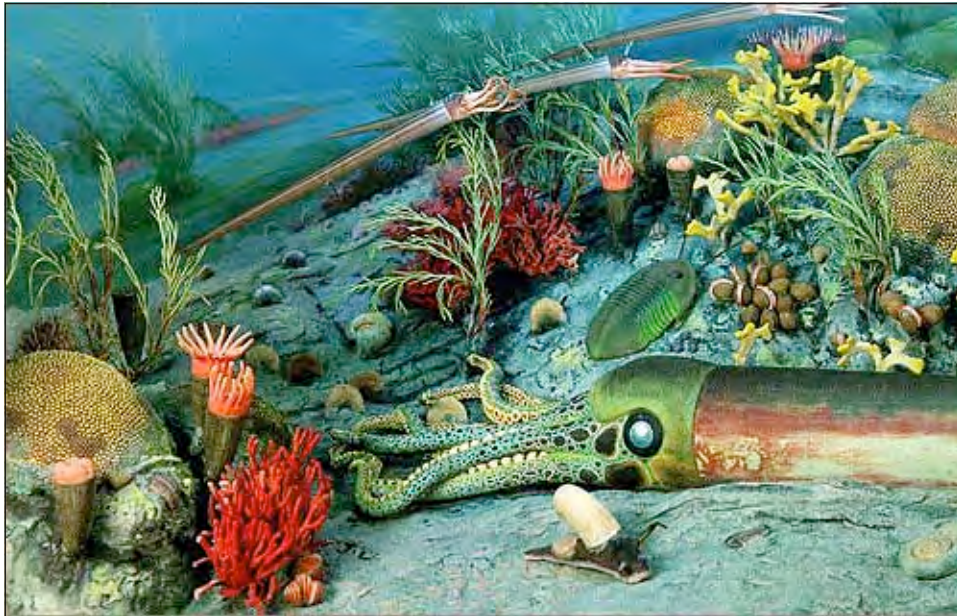


Ordovician vertebrates
Harding Sandstone, Utah



Ordovician
seascape

www.karen.com



Ordovician seascape

www.pbs.org/wgbh/nova/link/images/hist_img_03_ordo.jpg



Ordovician seascape

<http://www.ucmp.berkeley.edu/ordovician/ordovicsea.gif>



Univ. of Michigan Exhibit Museum of Natural History -- Life Through the Ages Diorama

Ordovician seascape

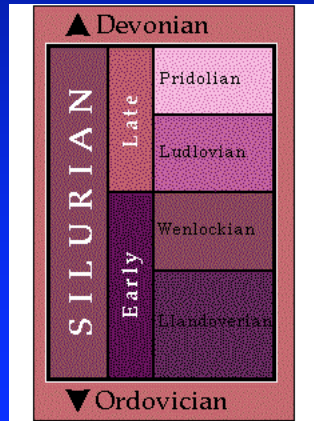
www.emc.maricopa.edu/faculty/farabee/BIOBK/lord04b.gif



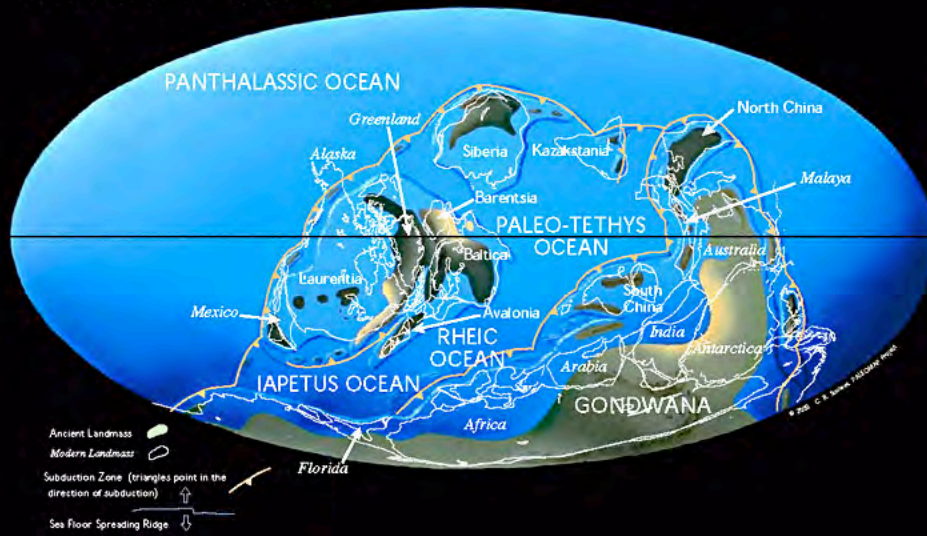
<http://news.bbc.co.uk/2/hi/science/nature/4433963.stm>

Silurian Period

443 to 417 Million Years Ago



Middle Silurian 425 Ma





Arctinurus



Bumastus

Silurian Trilobites



Dalmanites



Eurypterids (sea scorpions)





http://www.karencarr.com/images/Detail/detail_silurian.jpg



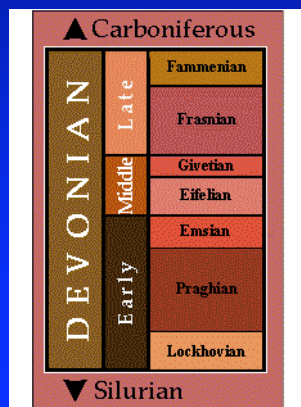


Silurian seascape
Painting by Zdenek Burian

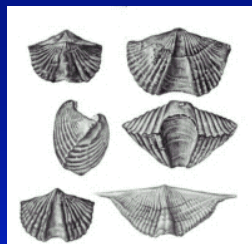
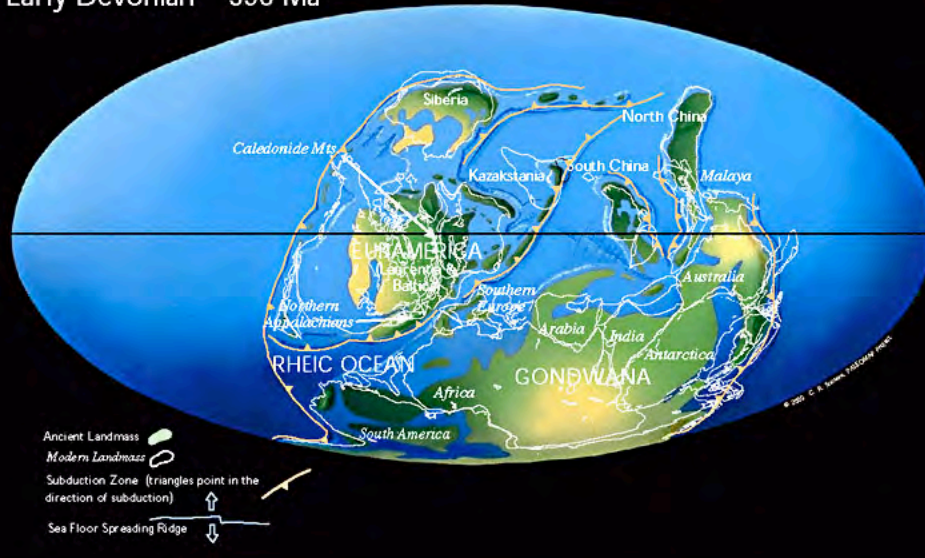


Devonian Period

417 to 354 Million Years Ago



Early Devonian 390 Ma



Devonian Brachiopods





Odontochile formosa



Phacops rana

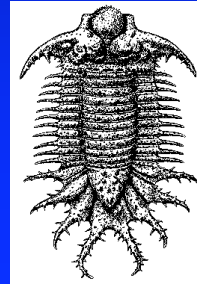


Devonian Trilobites

Dipleura dekayi



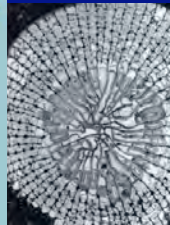
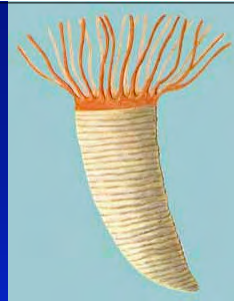
Greenops



Terataspis



Devonian Rugose Corals





Univ. of Michigan Exhibit Museum of Natural History -- Life Through the Ages Diorama



www.falls-of-the-hoio.org/virtualtour/images/FALLS4.JPG

www.palaeos.com/Paleozoic/Devonian/ Images/dev16b.jpg



www.emc.maricopa.edu/faculty/farabee/BIOBK/dev15b.gif

Devonian seascapes

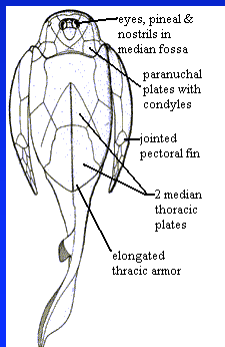


Placoderms

“The Age of Fishes”



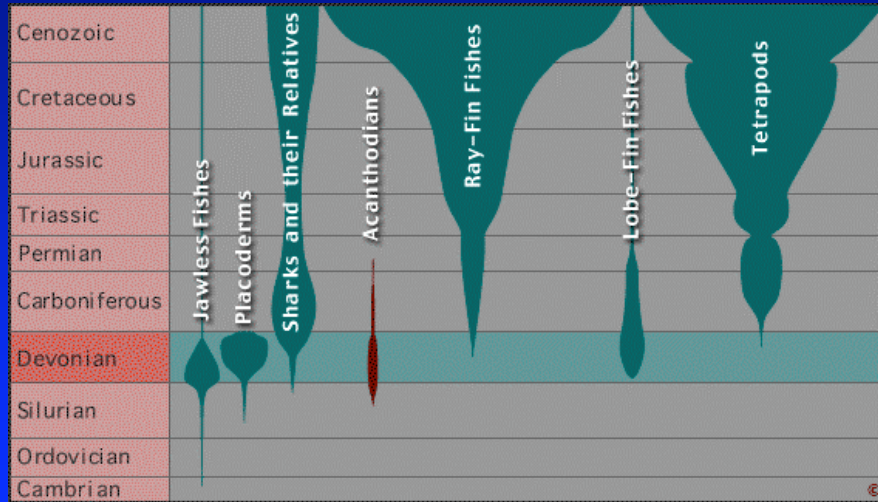
Acanthodians



Sharks



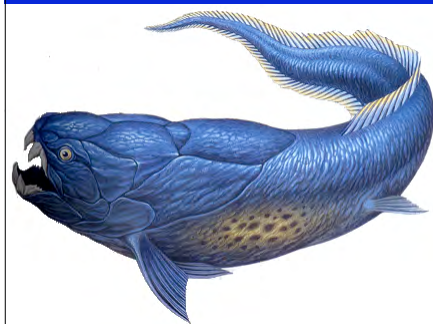
“The Age of Fishes”



Dunkleosteus

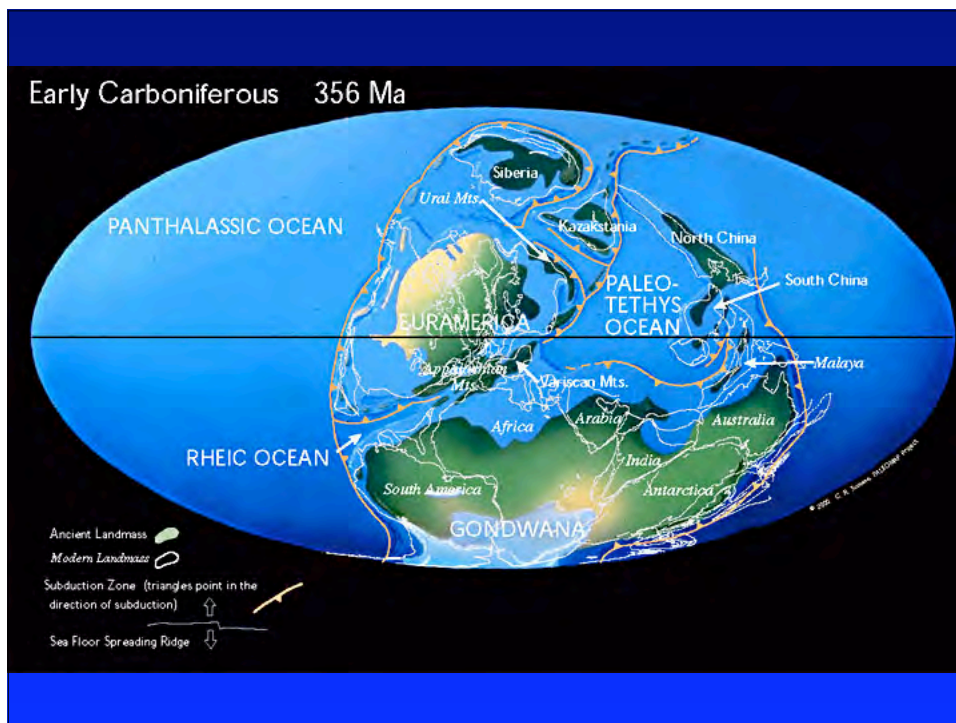
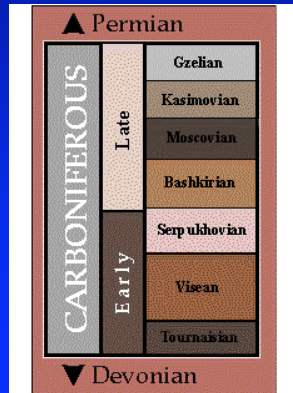


ダンクレストテウス

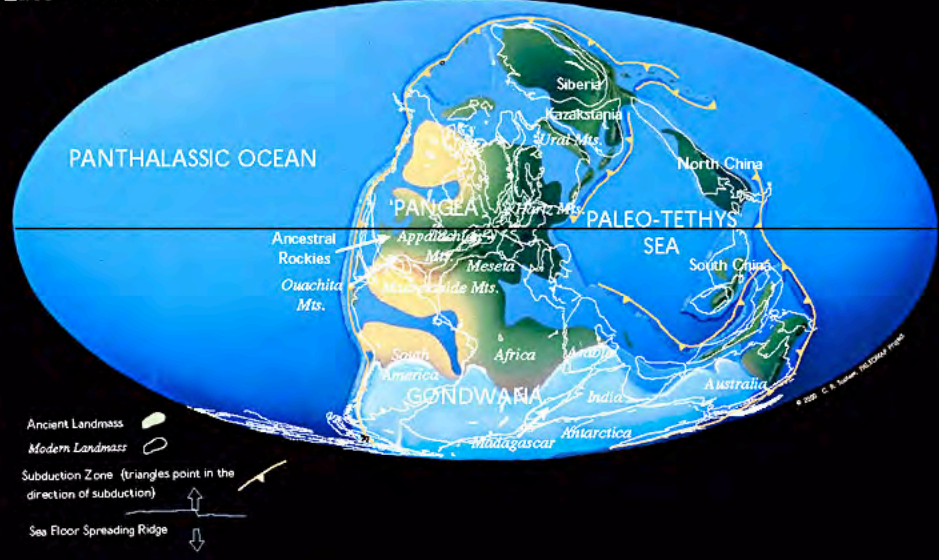


Carboniferous Period

354 to 290 Million Years Ago



Late Carboniferous 306 Ma



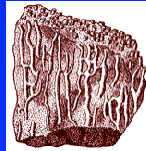
Carboniferous Crinoids



Carboniferous Corals



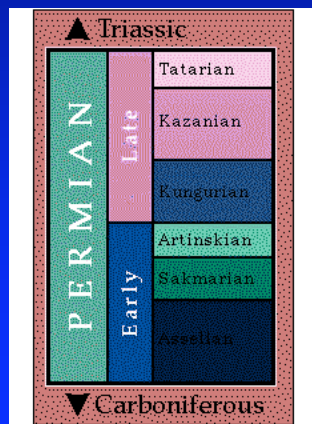
Tabulate



Rugose

Permian Period

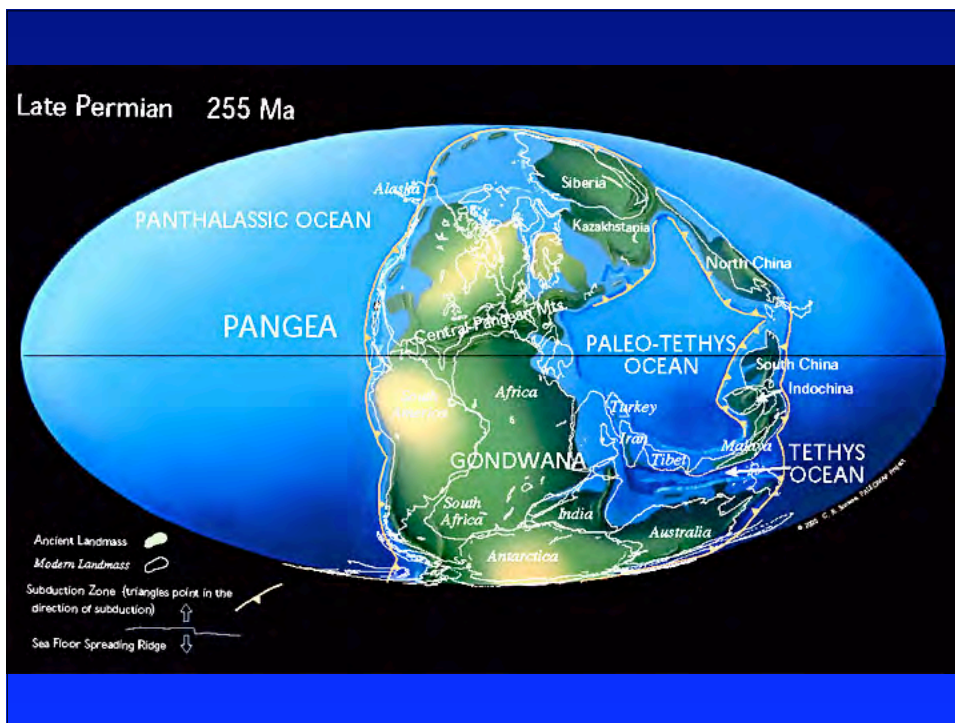
290 to 248 Million Years Ago





University of Michigan Exhibit Museum of Natural History -- Life Through the Ages Bioreama

Permian reef



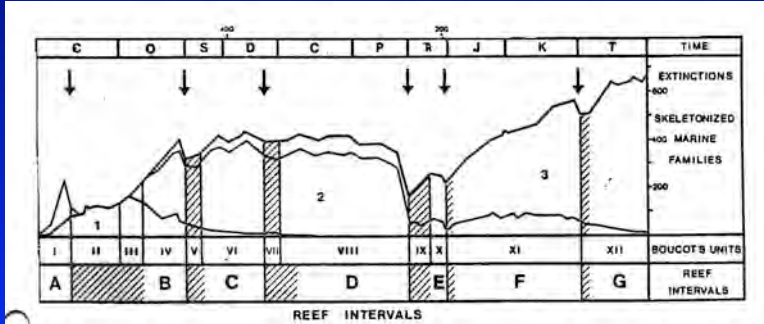


Figure 1. Framework-supported reef intervals during Phanerozoic related to family diversity, community ecology, and extinctions. Reefs with complex framework organisms were present during seven intervals (A-G). Hatched areas denote intervals lacking framework-supported reefs. Arrows mark principal extinction events. Upper solid curve shows diversity of well-skeletalized marine families through Phanerozoic (after Sepkoski, 1981). Three evolutionary faunas of Sepkoski (1981) are numbered 1, 2, 3. Roman numerals I through XII designate intervals of community evolution termed ecologic-evolutionary units by Boucot (1983). Diagonal-rule areas under diversity curves indicate ecologic-evolutionary units when communities were being reorganized (see text).

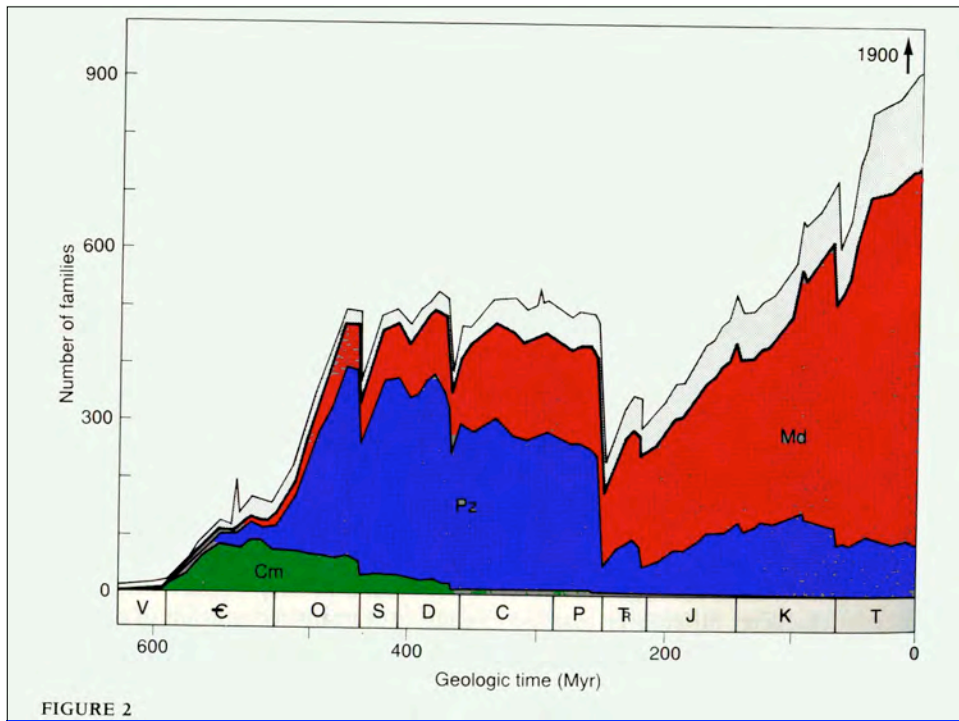


FIGURE 2

