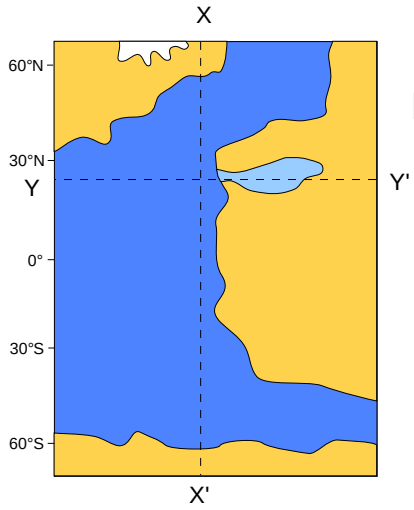
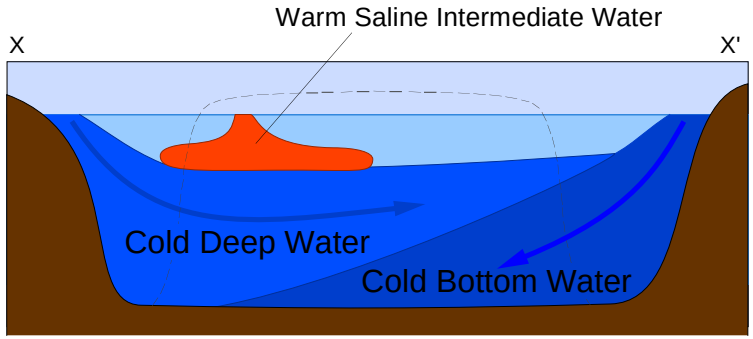
The Warm Saline Deep Water hypothesis

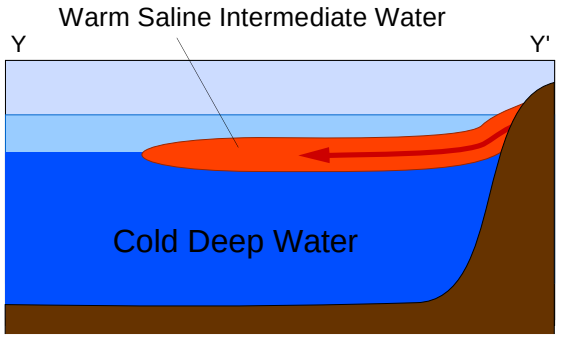
In the modern (Holocene) moderately glaciated world, the oceans' deeper waters are dominated by cold (-2 to +4 °C) waters that sink from surface waters at high latitudes. Those waters are dense, and thus sink, largely because they are cold. However, the oxygen isotope ratios of ancient benthic foraminifera indicate that deep waters were considerably warmer in the Cretaceous and Paleocene to Eocene (see this series' page on "Oxygen isotope records of Cenozoic global cooling and glaciation"). To explain how these Cretaceous deep waters could have been warm, paleoceanographers have developed the hypothesis of Warm Saline Deep Water. In this scheme, evaporation in low-latitude seas produces a large flux of saline water like the outflow from the modern Mediterranean and Red seas and Persian (or Arabian) Gulf. Meanwhile, warming in polar regions allows a sinking flux of only cool, rather than cold, waters sufficiently dense to sink only to intermediate depth, but not dense enough to displace the denser saline water from the Horse Latitudes.

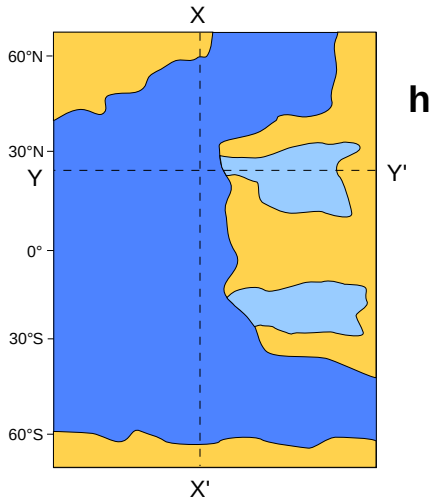


Cold low-sea-level world

In the modern world, cold waters from high latitudes dominate the deep Atlantic, but warm saline water emerges from the Mediterranean. That warm saline water is more dense than the cold deep water, but its volume is sufficiently small that it only mixes with surrounding less saline waters to make an intermediate water mass, Mediterranean Intermediate Water (MIW). MIW is the prototype for the saline intermediate water shown in the schematic cold world here.

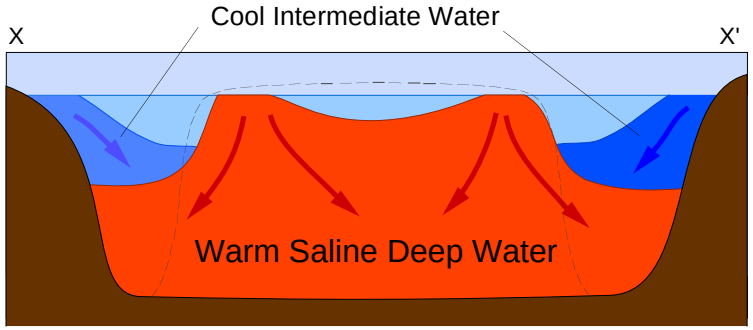


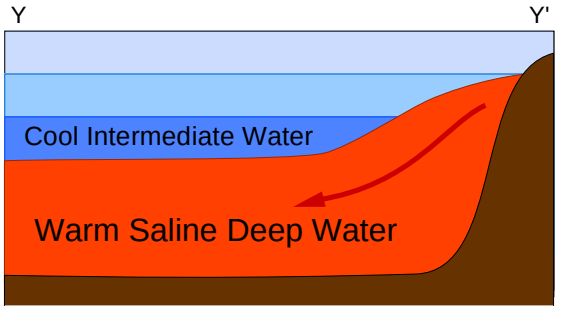




Warm high-sea-level world

In a warmer world with higher sea level, flooding of the continents might give more analogs of the modern Horse-Latitude seas from which saline waters emerge. At the same time, warmer polar regions would produce deep waters not as cold, and thus not as dense, as modern polar waters. Thus warm saline deep water could dominate the deep oceans of this world. The map at left does not, but could, also invoke plate-tectonic rearrangement to give more seas in the Horse Latitudes and high-latitude geographies less favorable to production of cold deep water.





Sources: Brass et al. (1982, *Nature*), Railsback et al. (1990, *Nature*), O'Connell et al. (1996, *GSA Bulletin*)