

Subequatorial fronts in the Pacific, Indian and Atlantic

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Pronounced subequatorial fronts (SEF) in properties are typical at about 15 to 20 degrees latitude from the equator in each ocean, at intermediate and abyssal depths. A clear frontal indicator at mid-depths is a shift in isopycnal potential vorticity patterns from swirled or homogenized within the subtropical gyres to beta-dominated in the tropics. Tropical flow is thus constrained to be much more zonal than in the anticyclonic subtropical gyres. Most communication between the tropical and subtropical regions is at the western boundary. These subequatorial fronts can thus be considered the bounding structures for the tropical region. They appear to be the poleward-shifted expression of the surface division between the subtropical and tropical circulations. In the deep water layer of each ocean, the front might be slightly poleward of the intermediate-depth front, but is at a uniform location vertically within the layer.

In the Pacific, the northern hemisphere front coincides with the limit of the North Pacific Intermediate Water's salinity minimum. Slightly deeper, the front is the northern boundary of the Antarctic Intermediate Water's (AAIW) salinity minimum. In the South Pacific, the front is the northern boundary of the potential vorticity minimum and oxygen maximum associated with AAIW and Subantarctic Mode Water. From intermediate depths to the bottom it divides saline tropical waters from fresher subtropical waters. The southern hemisphere SEF in the Indian ocean coincides with the Indonesian throughflow jet near the surface and is a major boundary in salinity, oxygen and nutrients; it shifts poleward with depth, marking the northern boundary of AAIW. In the Atlantic Ocean, the northern hemisphere SEF is the boundary between the AAIW's salinity minimum and the saline Mediterranean influence, and the southern hemisphere front is the northern boundary of the AAIW's oxygen maximum. In the Atlantic's deep water layer it separates vertical well-mixed waters in the tropics from more variable water masses in the subtropics. Exceptions to these water mass boundaries occur in the western boundary currents. The fronts are sharpest in the east.