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[Volume 2, Issue 3 \(July 1972\)](#)

Journal of Physical Oceanography

Article: pp. 205–211 | [Abstract](#) | [PDF \(560K\)](#)

Negative Oceanic Heat Flux as a Cause of Water-Mass Formation

L.V. Worthington

Woods Hole Oceanographic Institution, Wood Hole, Mass. 02543

(Manuscript received January 14, 1972, in final form March 30, 1972)

DOI: 10.1175/1520-0485(1972)002<0205:NOHFAA>2.0.CO;2

ABSTRACT

Regions of large ($>60 \text{ kcal cm}^{-2} \text{ year}^{-1}$) net annual heat flux from the oceans to the atmosphere are found only on the western sides of Northern Hemisphere oceans and in the Norwegian Sea, according to Budyko. It has been assumed that these negative heat fluxes are the result of the transport of warm water to middle and high latitudes by major ocean currents, specifically the Gulf Stream, the North Atlantic Current and the Kuroshio. In the case of the Norwegian Sea, Worthington suggested a mechanism for maintaining the negative heat flux, whereby warm surface water is advected northward to replace the dense, deep water formed within that sea by the cooling action of the atmosphere. The deep water mass so formed overflows the sills of the Norwegian Sea and moves southward into the depths of the Atlantic. It is postulated 1) that this mechanism maintains the negative heat fluxes found at mid-latitudes on the northwestern sides of the oceans, and 2) that water masses are also formed at these latitudes; they are intermediate rather than deep water masses. The water-mass producing agent in these northwestern regions of the oceans is polar continental air which breaks out over the sea surface at relatively low latitudes during northern winter.

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Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
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