INTERMEDIATE WATER DOWNSTREAM OF THE STRAIT OF SICILY

by

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In July 1970 the ATLANTIS II sailed through the western Mediterranean providing an opportunity to make a quasi-synoptic observation of the Levantine Intermediate Water between the Strait of Gibraltar and the Strait of Sicily. The results of the study have already been presented at the 8th Annual Symposium on Military Oceanography held in Monterey, California [Ref. 2] and an analysis of the observations is now in press [Ref. 3]. Discussed below is a partial summary of these results, with the emphasis on the eastern end of the section, one of the special of this workshop.

An (STD) hydrographic line was made paralleling the North African coast [Fig. 1]. The resulting section [Fig. 2] can be compared to previous sections [Refs. 5, 6, 10]. The finer spatial sampling while sharpening the delineation of higher salinity core water terminating southwest of Sardinia, repeats the result of the previous investigators: that there is no further significant freshening of the core water until approaching the Alboran Sea. As a result of this section, and additional observations made in the area, we were led to conclude that all the intermediate water passing south of Sardinia is probably turned northwards away from the African coast. This is in agreement with Nielsen's [Ref. 7] original contention; a view which seems to have been discarded by more recent investigators in favour of a splitting of the flow with one of two branches heading directly towards Gibraltar [Refs. 5, 6, 8, 10].

A sequence of three T-S diagrams downstream of Sardinia [Fig. 3] describes the change in the water column as the intermediate water turns out of the section. Each data point represents about two metres of water and, in lowering No. 16, the open gap in the curve is the result of such turning. This hypothesis was documented further by bathythermograph traces and tows at core depth [Ref. 3].

The observations made downstream of the Strait of Sicily proved to be inadequate to describe the flows of the intermediate water there. The uneven result of our observations is partially explainable by recourse to the most recent bathymetric chart [Ref. 1] [Fig. 4]. Lowering No. 20, which was located where an earlier chart [Ref. 9] indicates the sill to be, is now found to be off to one side of the deepest channel through the straits. The result is core water which is abnormally dense [Fig. 5]; i.e. $\sigma t > 29.1$. It may suggest a stagnated pool of core water, partially blocked from further advance, and cooled from above.

Four lowerings downstream of the straits are shown in Fig. 6. From amongst them lowering No. 21 also appears to be outside the immediate downstream flow. Though it is only separated from the sill by depths comparable to the previous sill depth, the relatively low salinity core water observed at this location suggests that such depths are sufficient to interfere with the fanning out of the intermediate water. Intermediate water found there apparently travelled around the broken ridge rather than directly from the sill.

In contrast, lowering No. 22, nearly equidistant from the sill as the previous lowering, is clearly in the main downstream flow. Topographically, it is on the axis of the most direct channel to the deep water of the Tyrrhenian Sea and suggests that at least the initial flow path from the sill is predictable from the bathymetric chart.

The remaining lowerings, Nos. 19 and 23, provide a small test of another difference of opinion in the literature. In question is the path taken by the intermediate water between the Straits of Sicily and Sardinia. Some authors indicate that there is a direct flow from one to the other [Refs. 5 and 10]; while others suggest a more circuitious path with some cyclonic circulation into the Tyrrhenian [Refs. 7 and 8]. From a comparison of these two lowerings there is no suggestion that one is a later manifestation than the other of the intermediate water. In this instance the evidence is for the direct path, placing the two lowerings sites on two different paths.

One additional observation was made downstream of the straits. It consisted of towing an STD type package over a 120 km path at three different depths [Ref. 4]. The track coincides with the axis of the deepest channel out of the sill [Fig. 4] and the depths were selected as representing the core water (370 m), a shallower layer of the intermediate water (270 m) and the interfacial region between surface and intermediate water (135 m). These depths are indicated on the T-S diagram of the water columns at either end of the tow track [Fig. 6]. The resulting salinity traces [Fig. 7] indicate that the variance in the salinity at the two deeper depths was of the order of 0.02 ‰ (the variance in temperature was 0.04° C). These values are comparable to the difference noted between the two lowerings. The trend between the two lowerings is also not monotonic. It is apparent that the evolution of the T-S relationship of the intermediate water entering the western Mediterranean is subject to temporal variations of this resolution even over short-time spans.

The trace in the interfacial water shows much more variation and the fresh (and cool) water recorded 15 km from C has the properties of the water observed during lowering No. 22, one day earlier. It suggests that the interfacial water at a fixed site in this area is highly variable and changing rapidly. The properties of the intermediate water below it, however, do not seem significantly affected.

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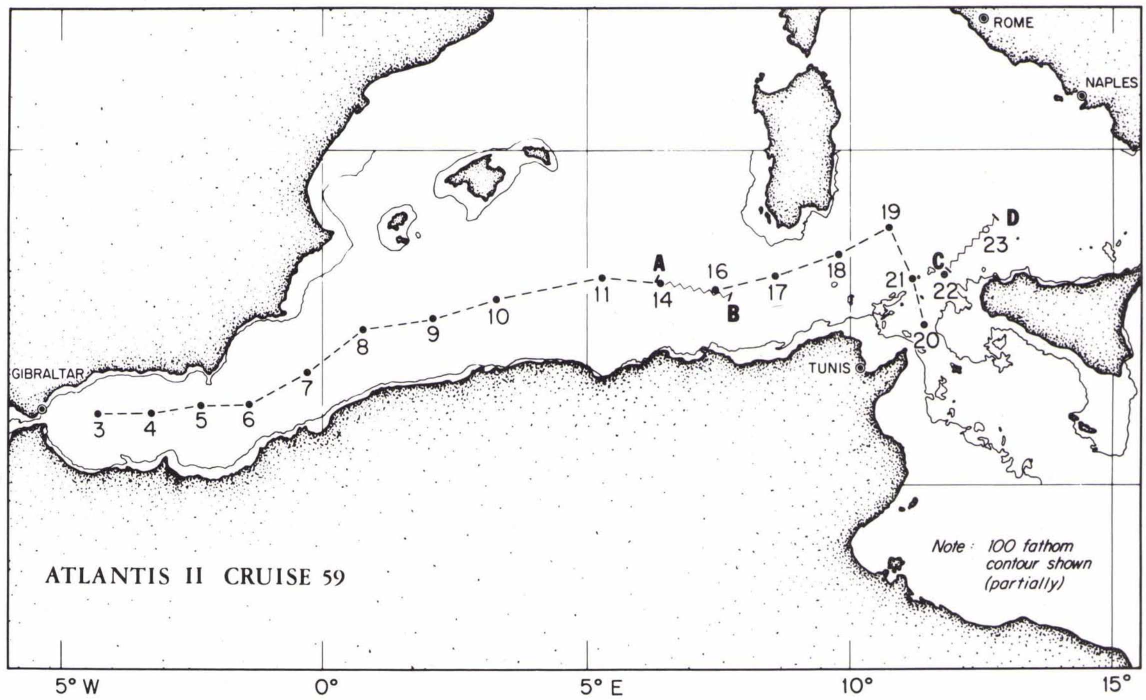


FIG. 1

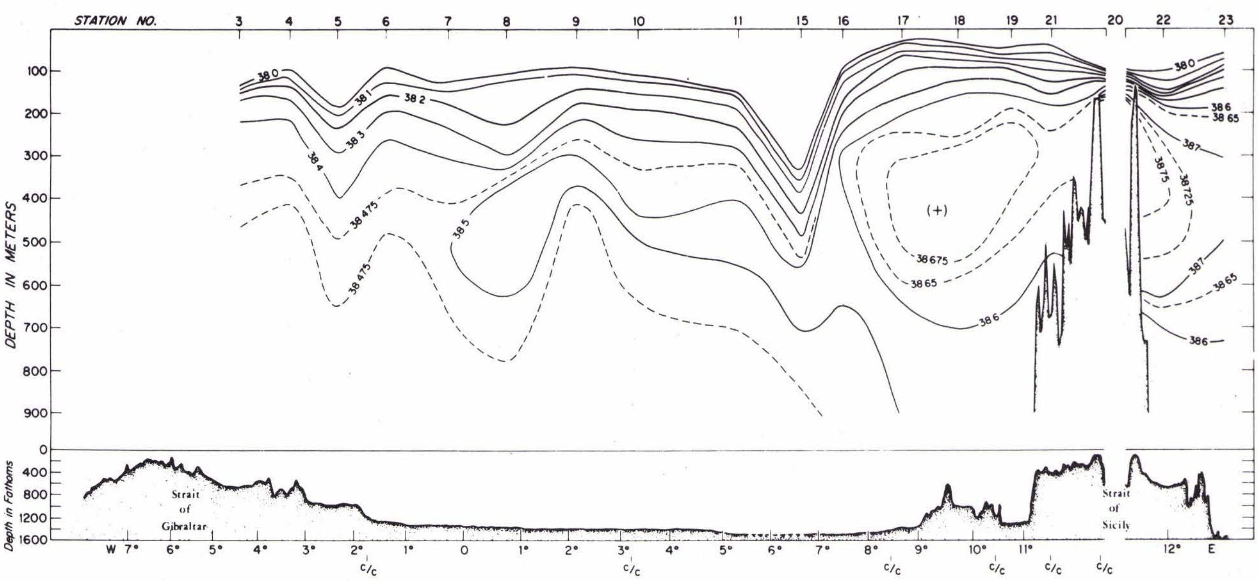
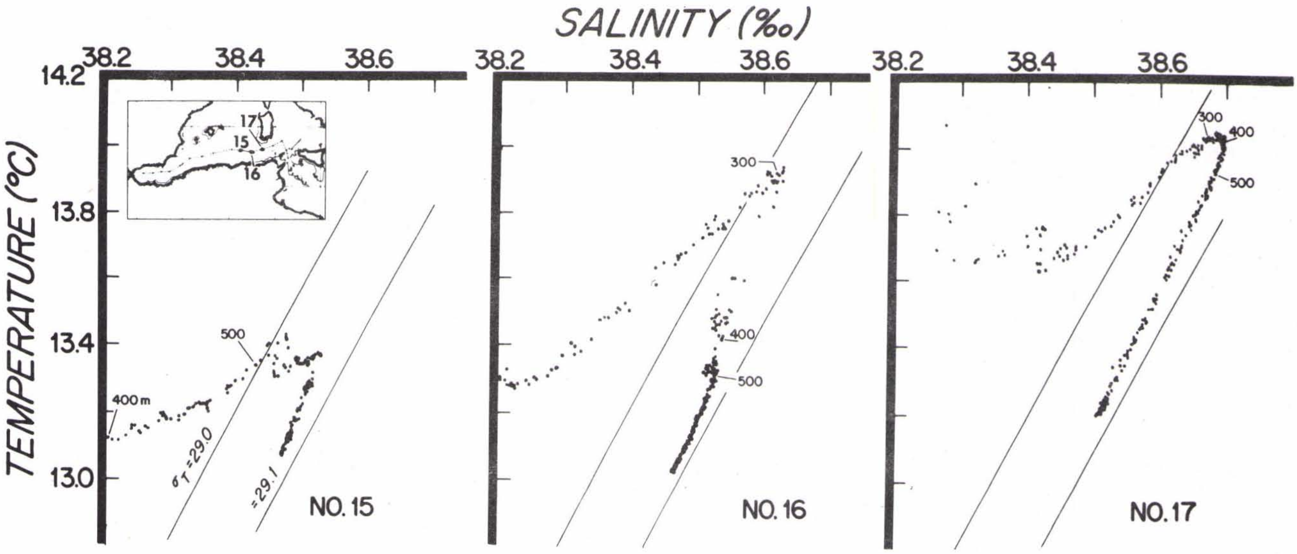


FIG. 2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38.4
38.6
14.2
13.8
13.4
13.0
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15
16
500
400 m
σ_T=29.0
=29.1
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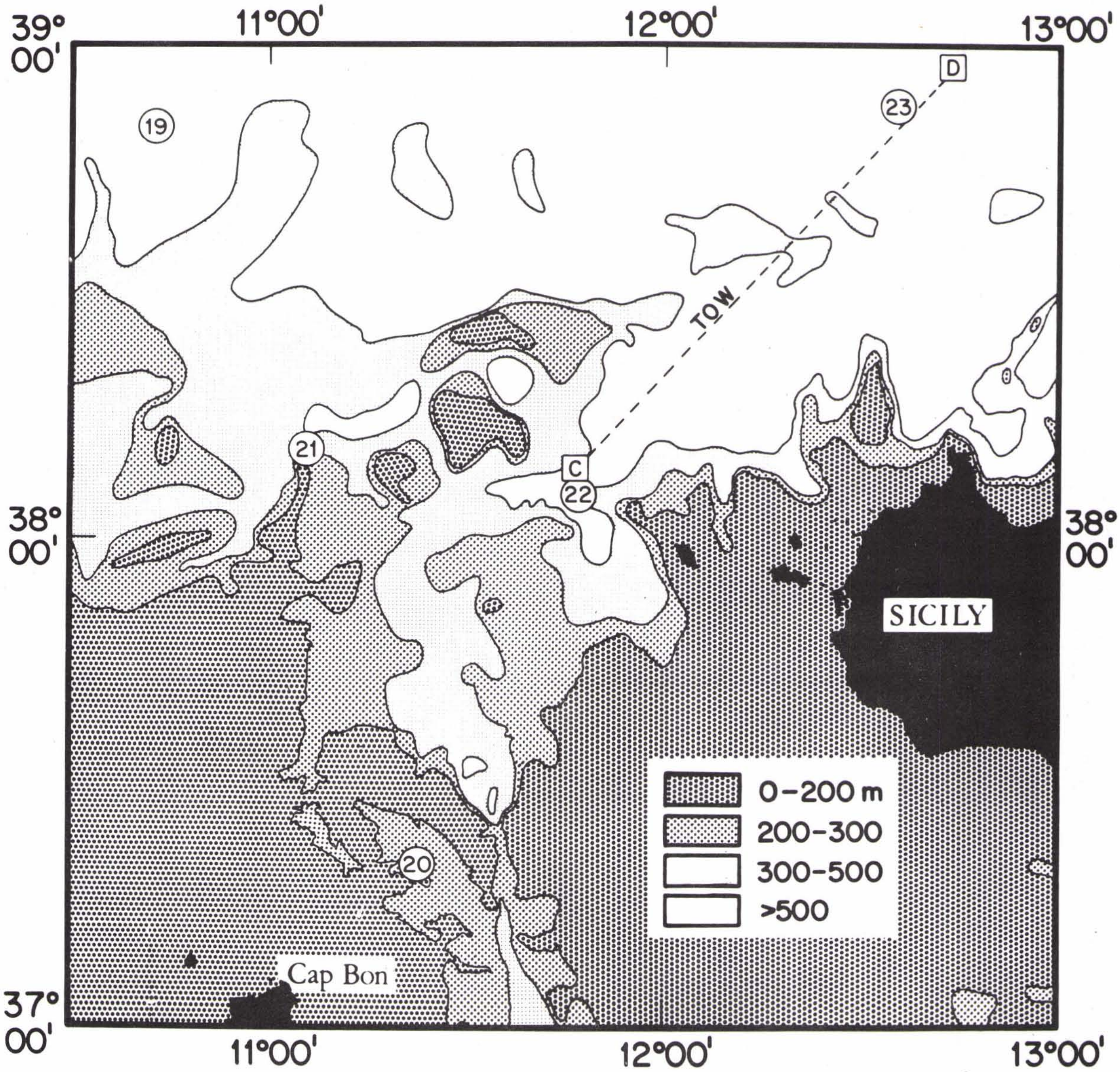
300
400
500
NO. 16
300
400
500
NO. 17

FIG. 3


39°
00'
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23
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200–300
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FIG. 4

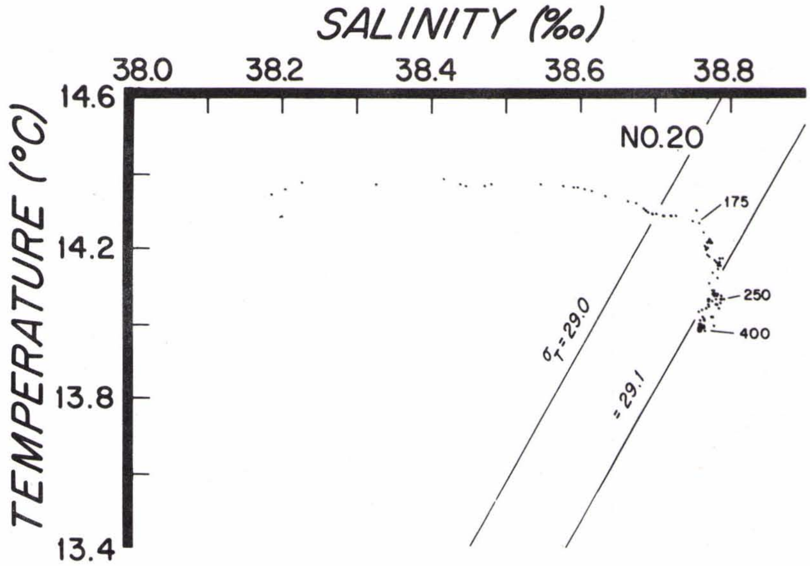

FIG. 5

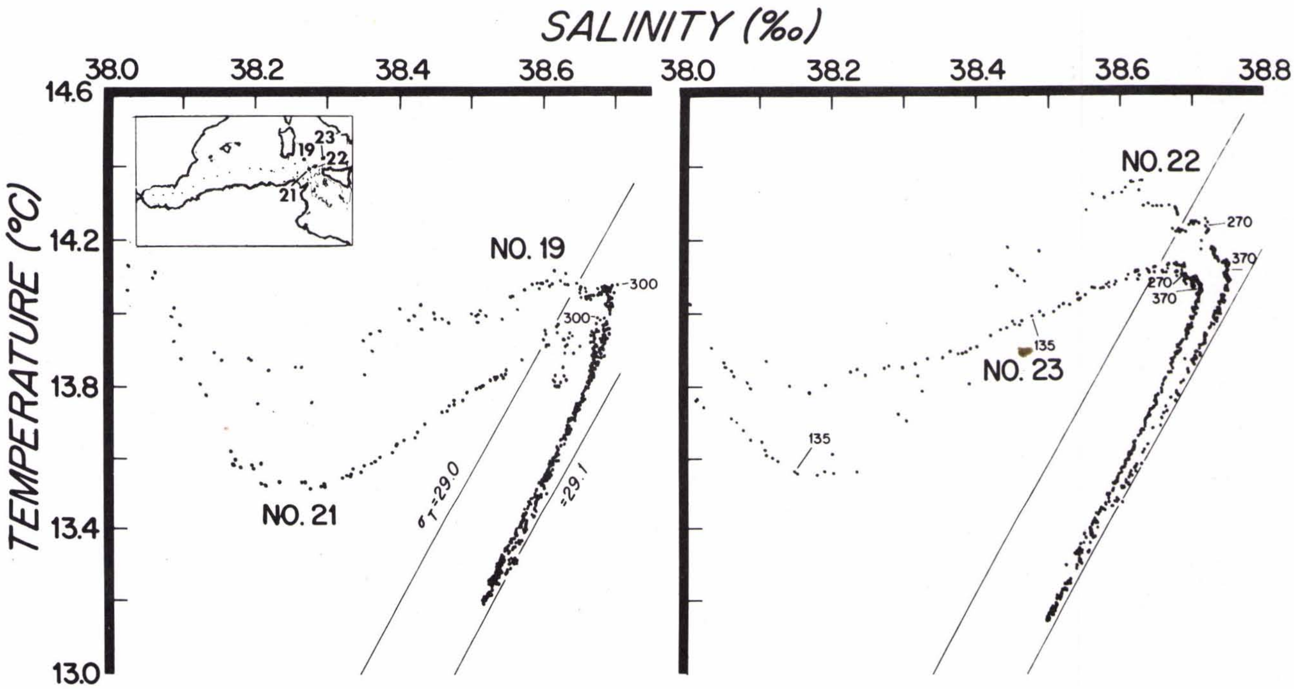

FIG. 6

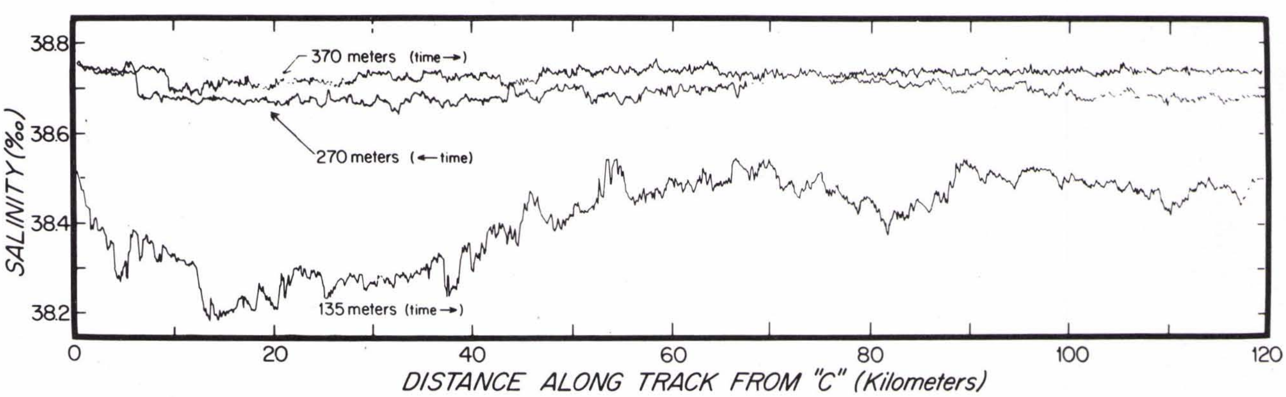

FIG. 7