Figure Captions.

Figure 1. The exponential growth rate of salt fingers as a function of density ratio (R_ρ). The growth rate has been scaled with the buoyancy frequency, N, and multiplied by 2π for expression in "e-foldings per buoyancy period". Most of the main thermocline of the subtropical gyres has $R_\rho \sim 2$, while the regions with strong salt finger staircases have R_ρ closer to one.

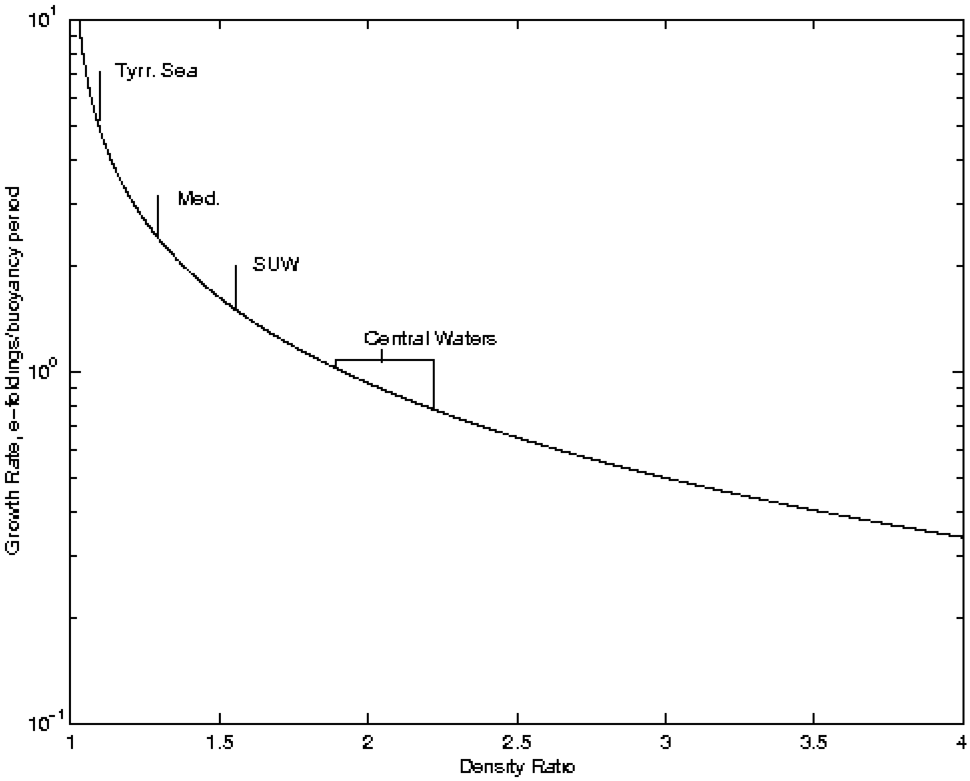
Figure 2. The occurrence of thermohaline staircases as a function of density ratio. The strong staircases of the Tyrrhenian Sea, beneath the Mediterranean water in the eastern Atlantic, and the Subtropical Underwater of the western tropical North Atlantic, have $R_\rho < 1.7$. Irregular steppiness characterizes the Central Waters of the subtropical gyres, where $R_\rho \sim 2$. (From Schmitt, 1981).

Figure 3. Potential temperature - salinity values of the mixed layers observed during C-SALT. The solid circles are from mixed layers more than 10 m thick; the open circles are from layers 5-10 m thick. Temperature-salinity relationships from the northwest and southeast corners of the survey are also shown (----). Layers become warmer, saltier and denser from southeast to northwest, as would be expected from the vertical convergence of salt finger fluxes. The layer properties cross isopycnals (the 26.8, 27.0 and 27.2 potential density surfaces are shown) with an apparent heat/salt density flux convergence ratio of 0.85. (From Schmitt *et al*, 1987; reproduced by permission of Elsevier Press.)

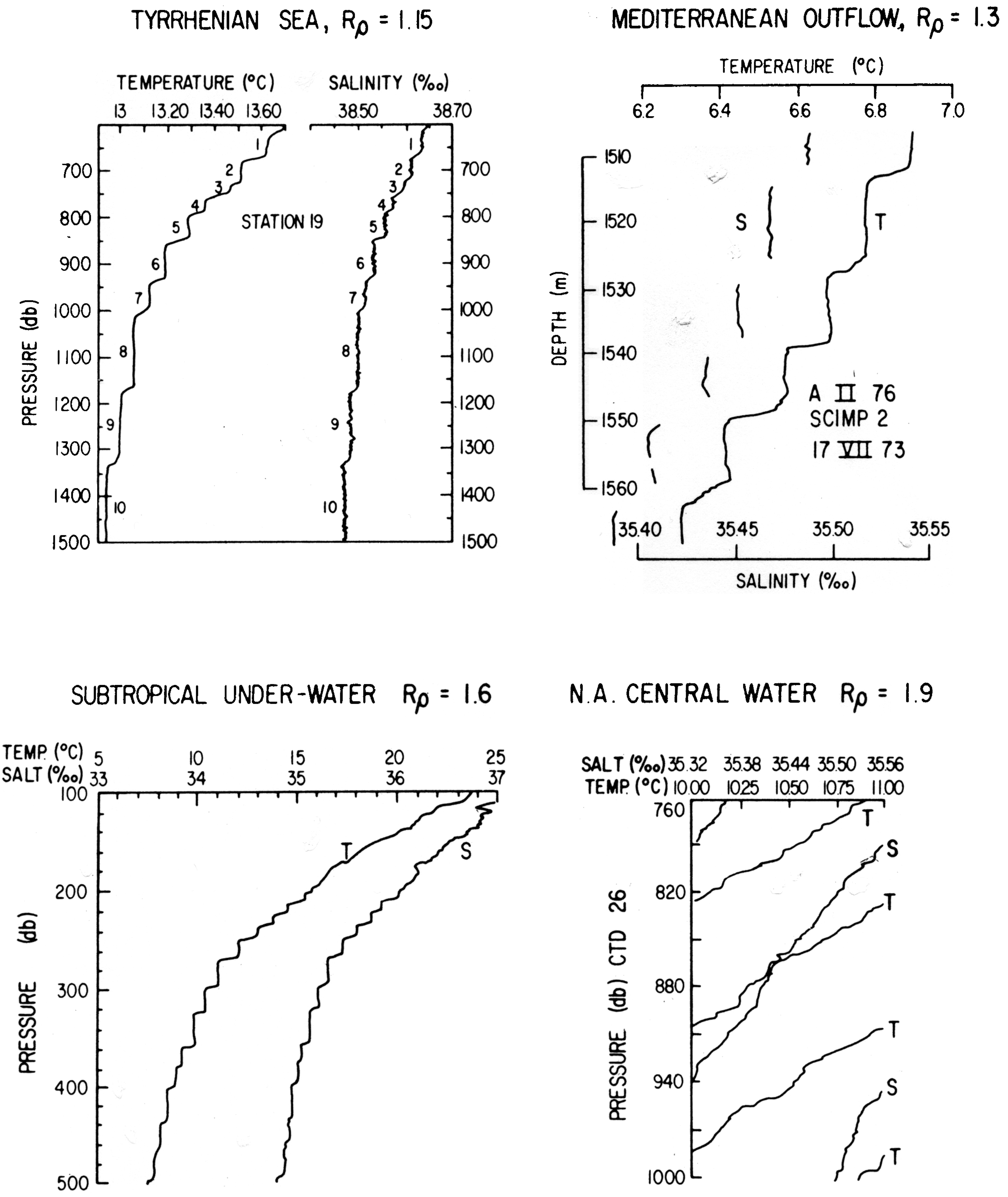
Figure 4. The "scaled dissipation ratio" as a function of Density Ratio and Richardson number. Data from a region of the Pacific that is double-diffusively stable is consistent with turbulence (left panel), whereas data from the North Atlantic thermocline show high thermal dissipation at low density ratio and high Richardson number. This is a clear indication of salt-fingering, in a parameter regime which characterized much of the water column at this site. (Figure adapted from St. Laurent & Schmitt, 1999.)

Figure 5. Conversion of the oceanic dissipation ratio estimates to a salt finger flux ratio (solid line, with gray error bars) shows the data to be consistent with previous laboratory work. (From St. Laurent & Schmitt, 1999).

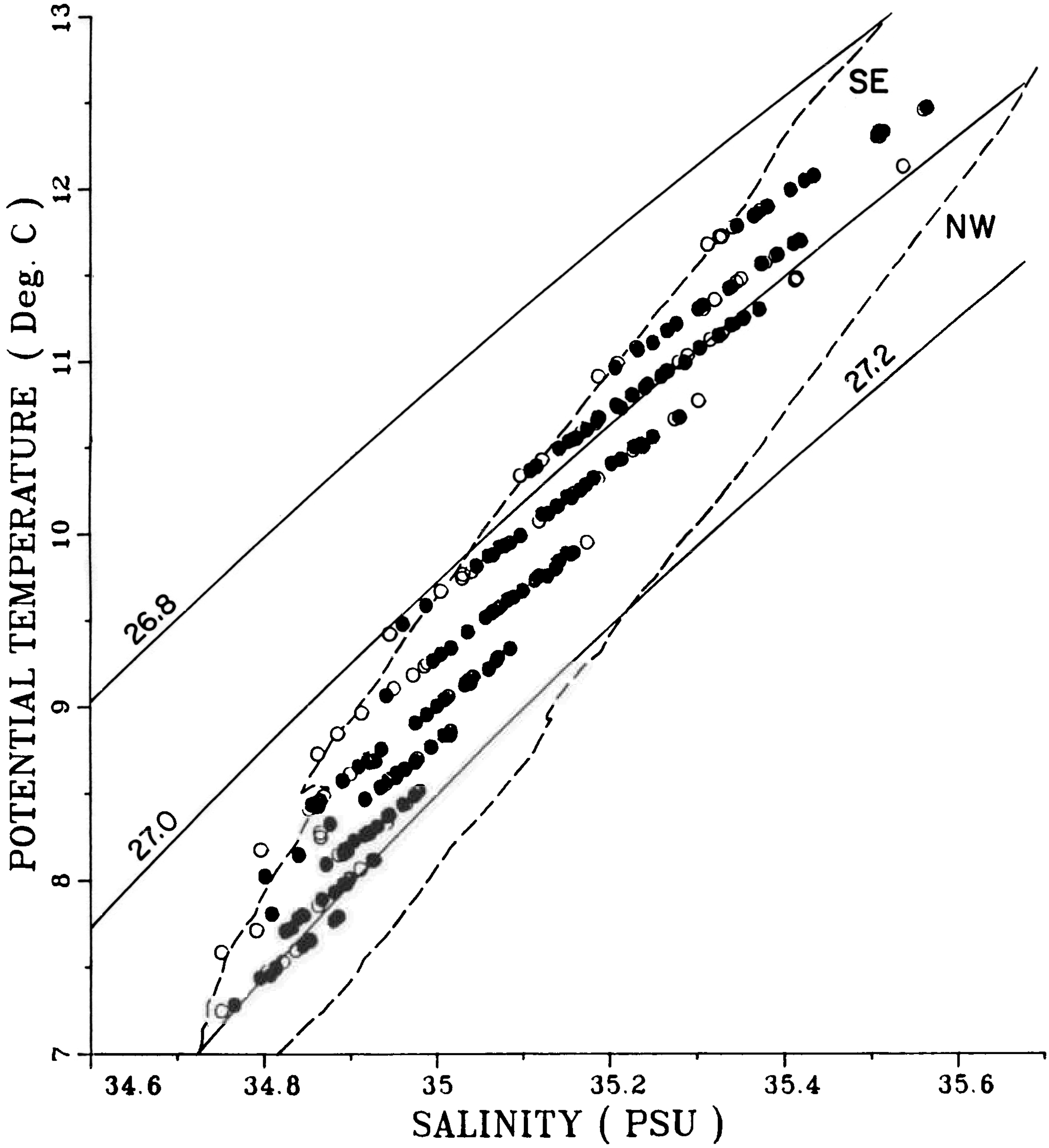
Figure 6. Vertical profiles of the density ratio (left), the vertical diffusivities of heat and salt (center) and buoyancy (right) from the North Atlantic Tracer Release Experiment microstructure measurements of St. Laurent & Schmitt (1999). The vertical eddy diffusivities are different for heat and salt due to salt-fingering. The observed dispersion of the tracer over the six months following the microstructure measurements is shown at 300 m depth. The estimate of the diffusivity for buoyancy is negative at the level just above the tracer, which contributes to an estimate of a downward diapycnal velocity, consistent with the tracer movement. (From St. Laurent & Schmitt, 1999.)



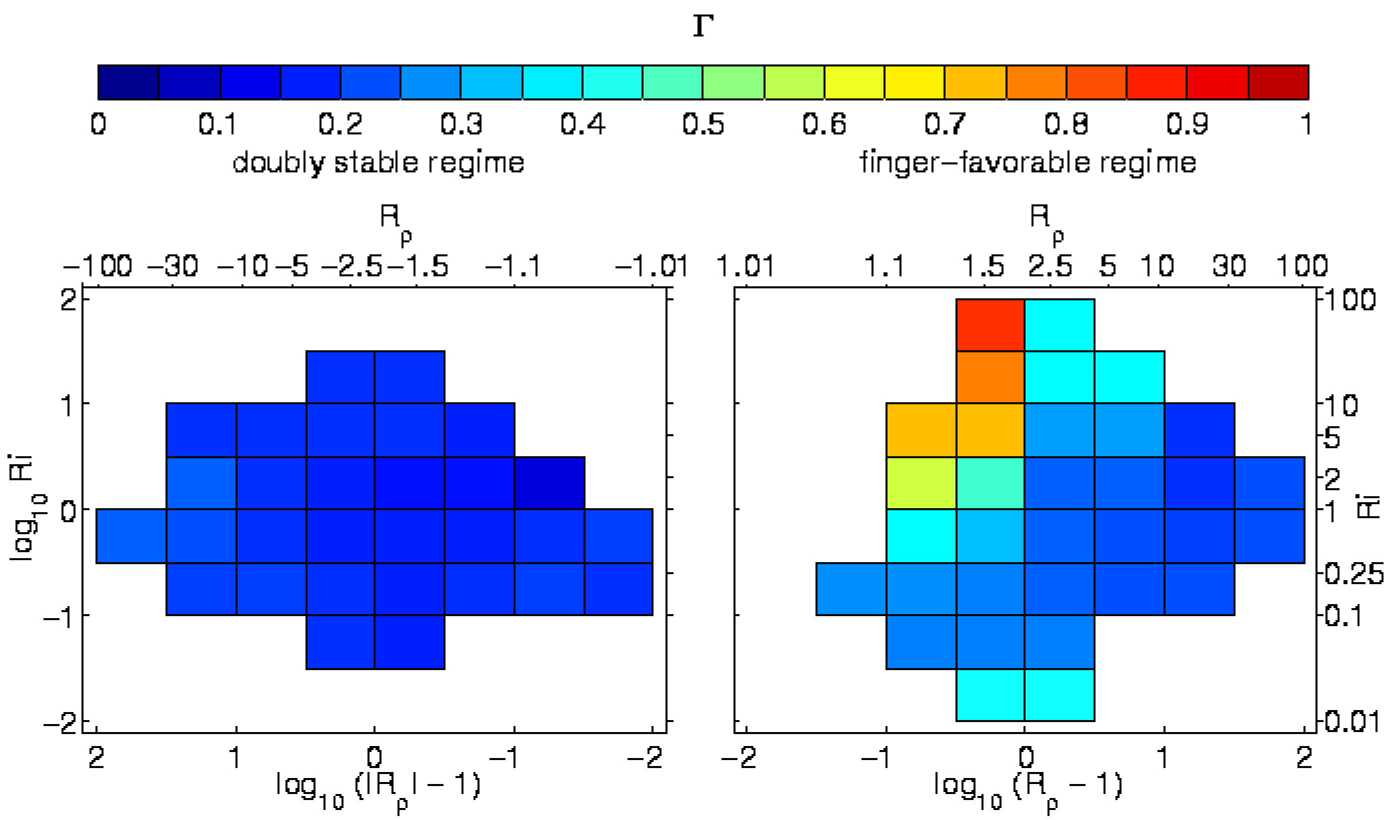
Tyrr. Sea
Med.
SUW
Central Waters
Growth Rate, e−foldings/buoyancy period
Density Ratio
10^{1}
10^{0}
10^{-1}
1
1.5
2
2.5
3
3.5
4

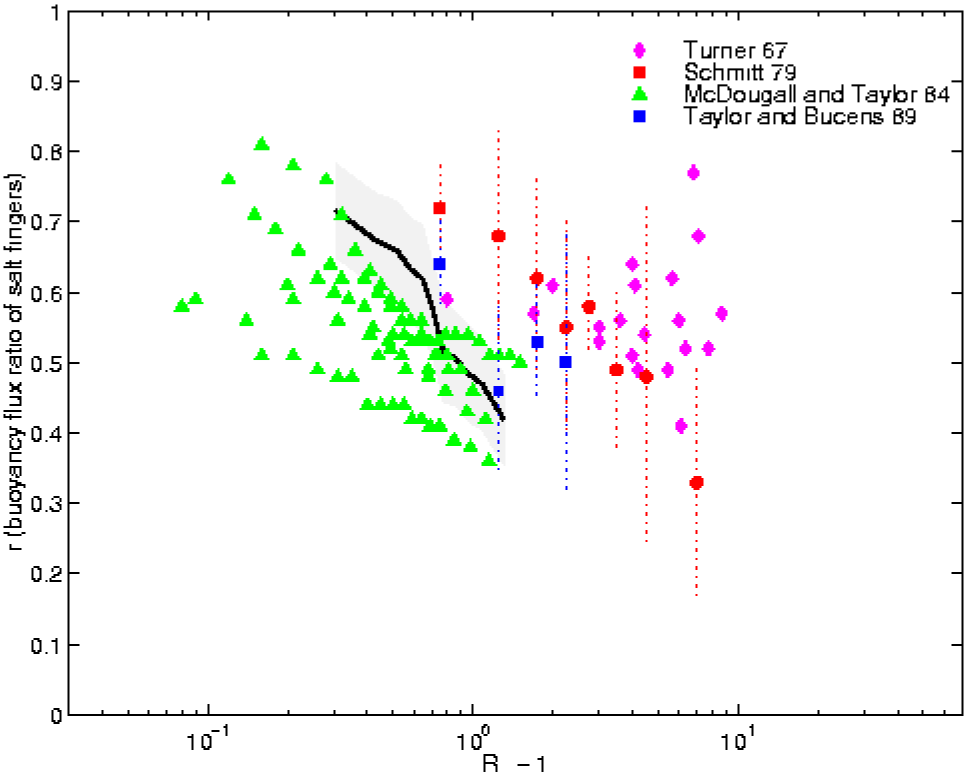


TYRRHENIAN SEA, Rρ = 1.15
TEMPERATURE (°C)
SALINITY (‰)
13
13.20
13.40
13.60
38.50
38.70
PRESSURE (db)
700
800
900
1000
1100
1200
1300
1400
1500
STATION 19
1
2
3
4
5
6
7
8
9
10
MEDITERRANEAN OUTFLOW, Rρ = 1.3
TEMPERATURE (°C)
6.2
6.4
6.6
6.8
7.0
DEPTH (m)
1510
1520
1530
1540
1550
1560
S
T
A II 76
SCIMP 2
17 VII 73
35.40
35.45
35.50
35.55
SALINITY (‰)
SUBTROPICAL UNDER-WATER Rρ = 1.6
TEMP. (°C) 5 10 15 20 25
SALT (‰) 33 34 35 36 37
PRESSURE (db)
100
200
300
400
500
T
S
N.A. CENTRAL WATER Rρ = 1.9
SALT (‰) 35.32 35.38 35.44 35.50 35.56
TEMP. (°C) 10.00 10.25 10.50 10.75 11.00
PRESSURE (db) CTD 26
760
820
880
940
1000
T
S
T
T
S
T

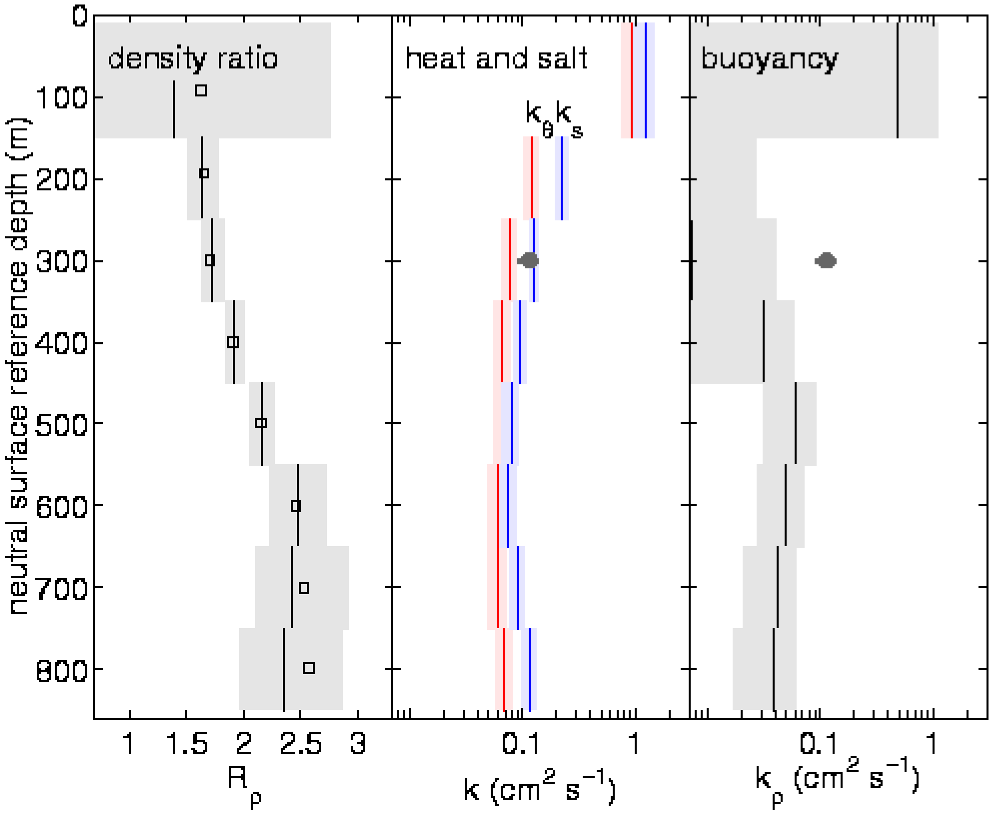


POTENTIAL TEMPERATURE (Deg. C)
SALINITY (PSU)
7
8
9
10
11
12
13
34.6
34.8
35
35.2
35.4
35.6
26.8
27.0
27.2
SE
NW


Γ
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
doubly stable regime
finger−favorable regime
R_ρ
−100 −30 −10 −5 −2.5 −1.5 −1.1 −1.01
$\log_{10}$ Ri
2
1
0
−1
−2
$\log_{10}(|R_\rho| - 1)$
R_ρ
1.01 1.1 1.5 2.5 5 10 30 100
Ri
100
10
5
2
1
0.25
0.1
0.01
$\log_{10}(R_\rho - 1)$



Turner 67
Schmitt 79
McDougall and Taylor 84
Taylor and Bucens 89
r (buoyancy flux ratio of salt fingers)
$R_\rho - 1$



density ratio
heat and salt
buoyancy
k_θ k_s
neutral surface reference depth (m)
0
100
200
300
400
500
600
700
800
1
1.5
2
2.5
3
R_ρ
0.1
1
k ($cm^2 s^{-1}$)
0.1
1
k_ρ ($cm^2 s^{-1}$)