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Sill Overflows: Single Layer

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Sill Overflows: Single Layer

Lecture for ICTP Advanced School on Oceanography
International Centre for Theoretical Physics
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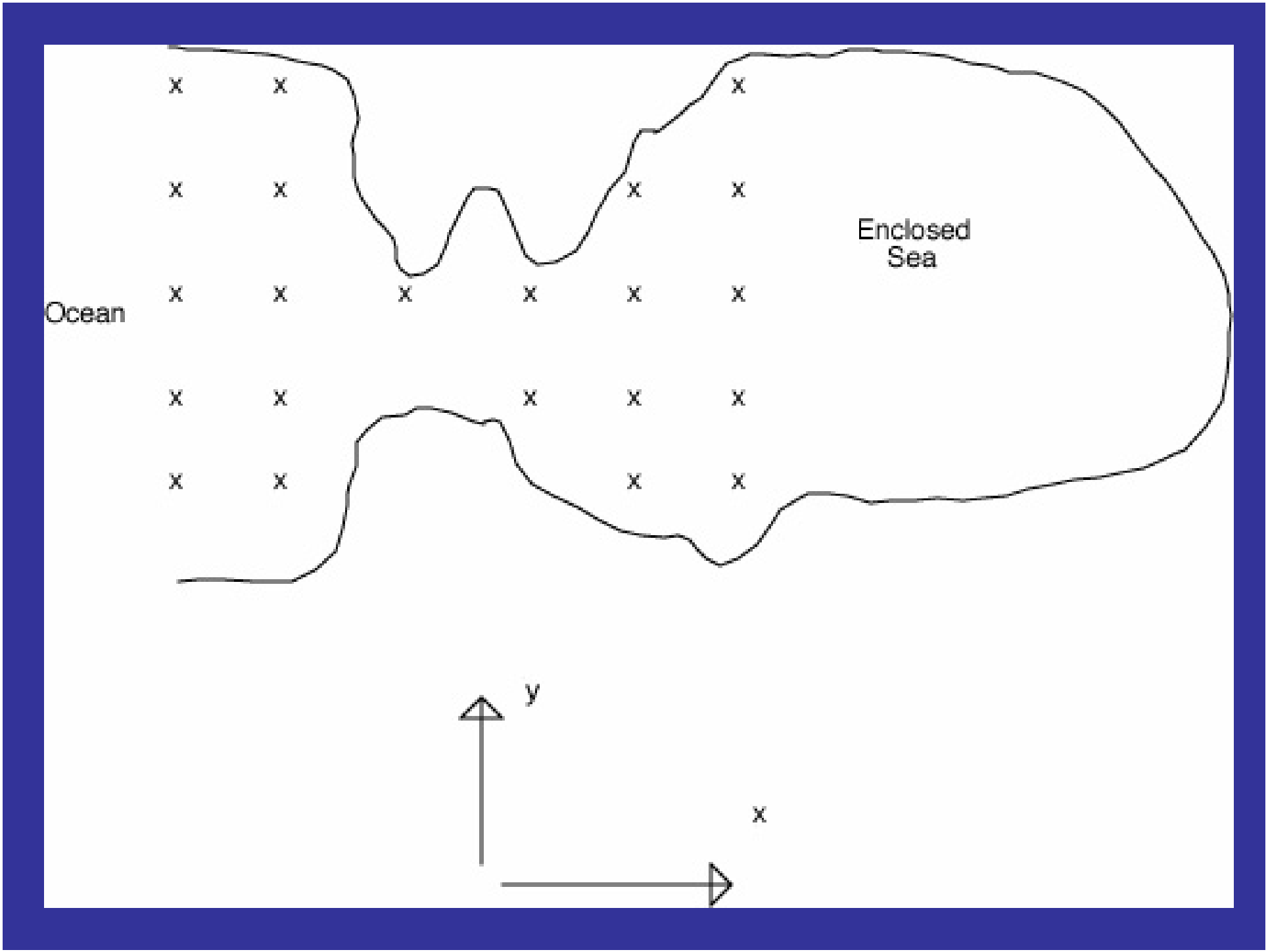
Prof. Harry L. Bryden


Ocean
Enclosed
Sea
y
x

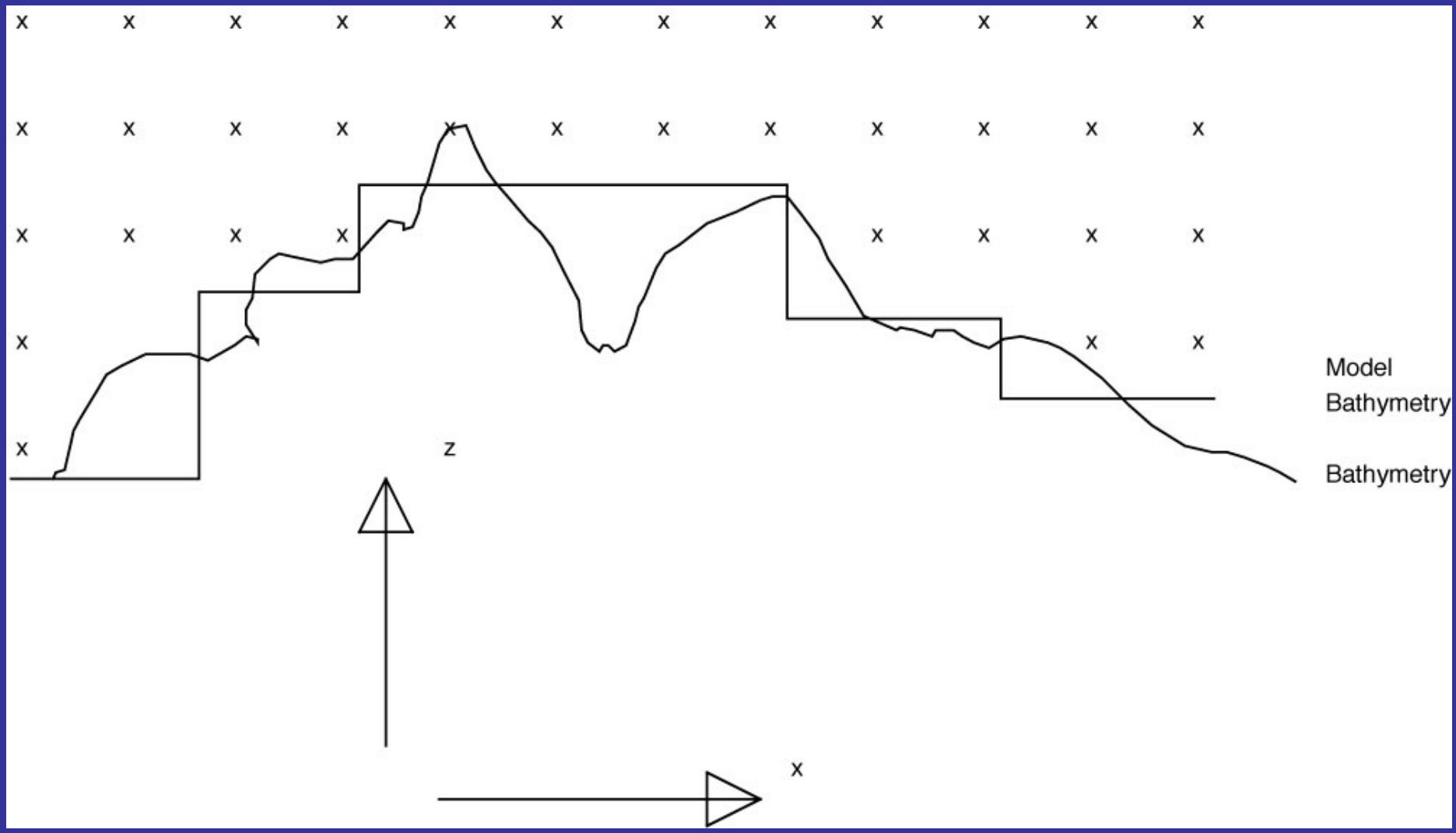
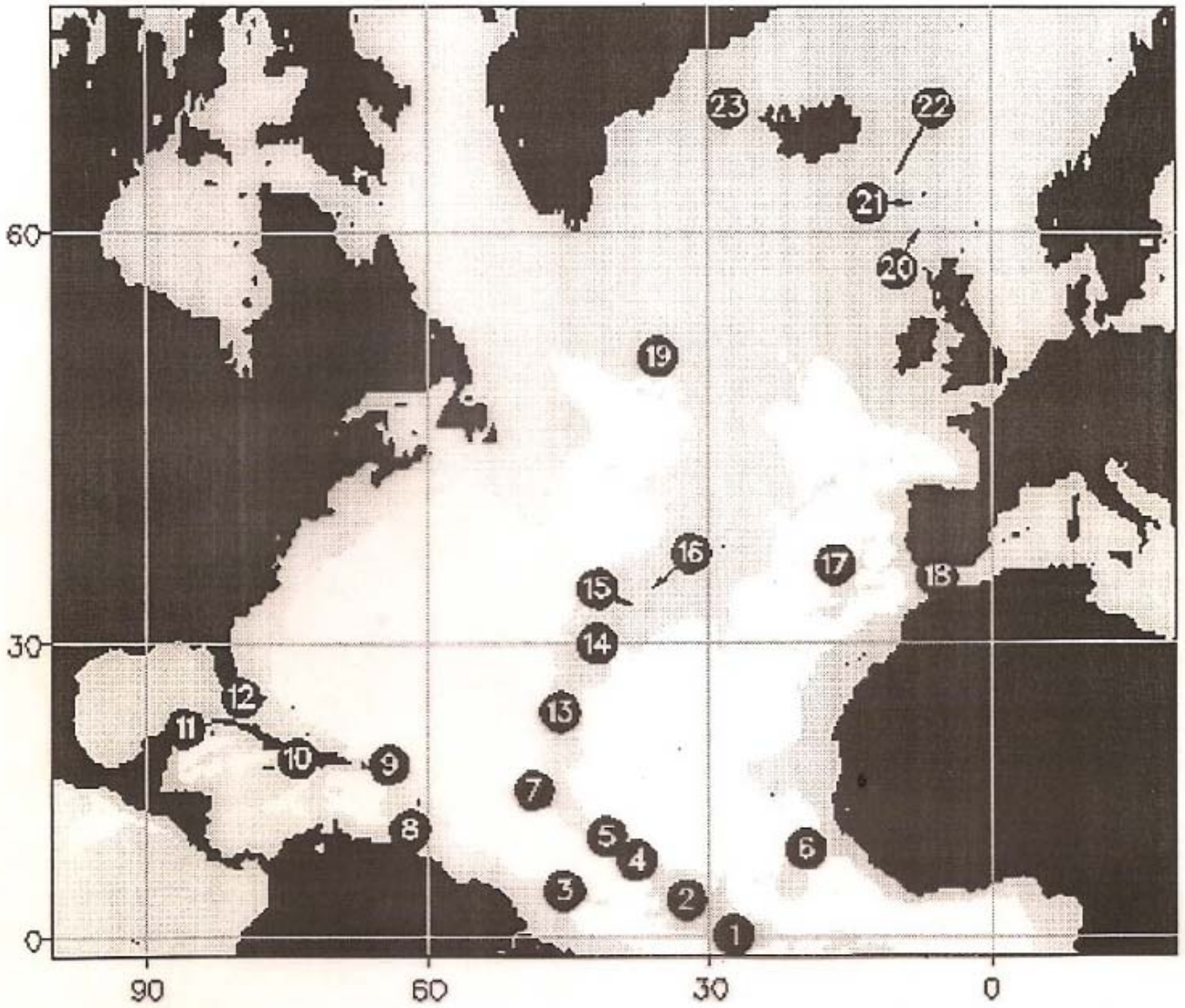
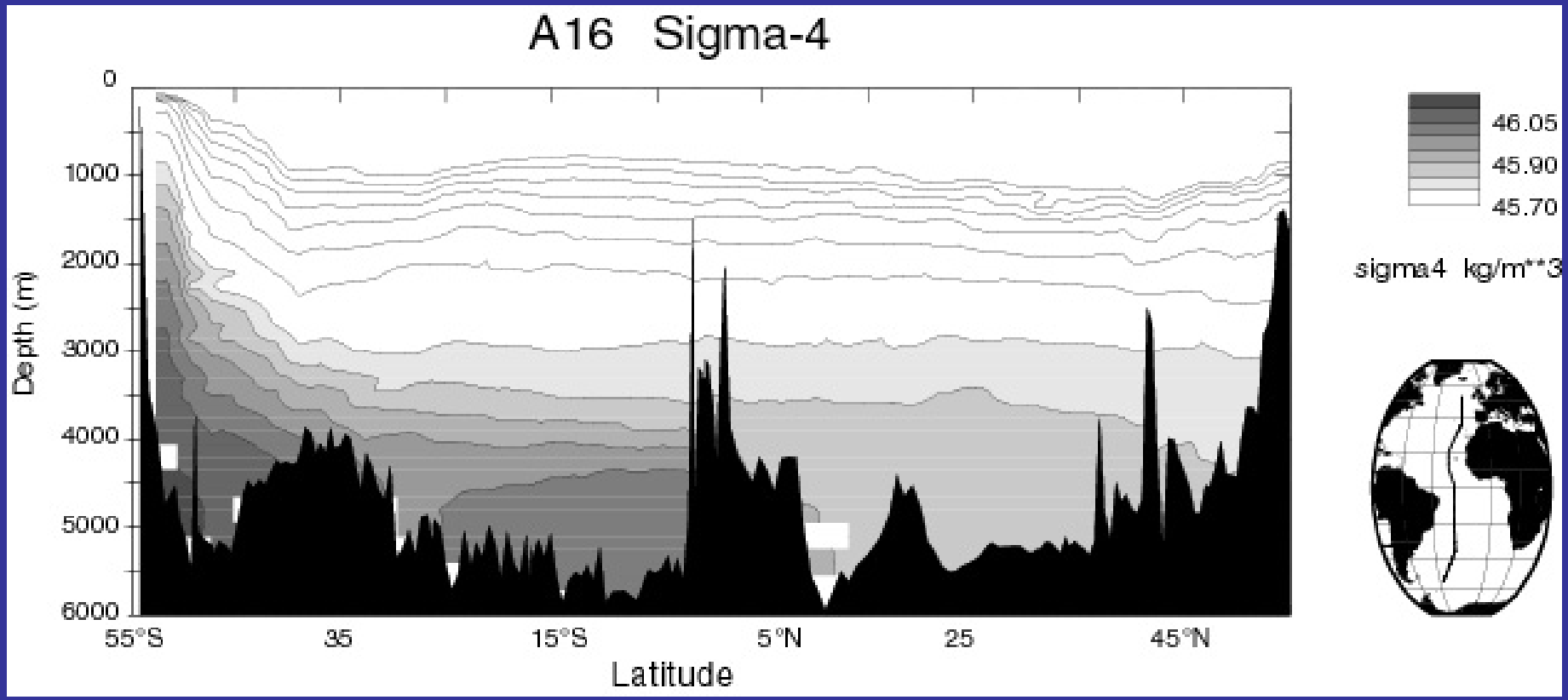

Model
Bathymetry
Bathymetry
z
x

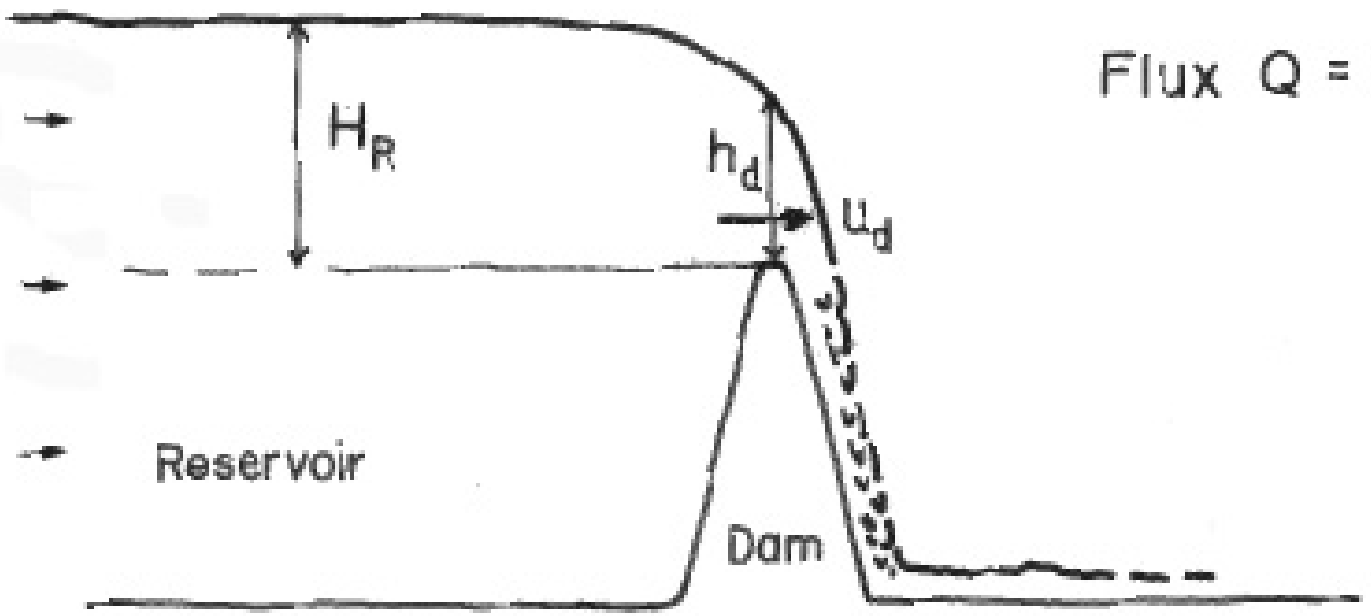
Table 1 The Atlantic

	Name	Depth	Width	Lat	Long	Reference
1	South Sandwich Trench	4600	70	61 15 S	023 45 W	Locarnini 1993
2	Orkney Passage	3200		60 40 S	040 45 W	Locarnini 1993 /DBDB5
3	Powell Basin	2000		60 32 S	048 15 W	Nowlin and Zenk 1988
4	Shackleton F.Z.	3500		60 45 S	056 45 W	Nowlin and Zenk 1988
5	Drake Passage	3500		57 30 S	065 00 W	Reid 1986/Gebco
6	Georgia Passage	3200		56 00 S	031 00 W	Locarnini 1993
7	Shag Rocks Passage	3200		53 00 S	049 00 W	Locarnini 1993
8	Falkland Ridge Gap	5100		49 00 S	035 30 W	DBDB5/Gebco
9	Vema Sill	4200		28 40 S	038 00 W	Cherkis et al 1989/DBDB5
10	Hunter Channel	4300	50	35 00 S	027 00 W	Speer 1992
11	Meteor F.Z	3500		35 30 S	018 00 W	Cherkis et al 1989
12	Walvis Ridge					
	Walvis Passage	4200	50	36 00 S	007 00 W	Warren and Speer 1991
	No name	4000		32 40 S	002 20 W	Needham et al/Warren 1991
	No name	3600	12	30 00 S	001 45 E	DBDB5/Warren and Speer 1991
	Namib Col	3000	50	22 00 S	007 15 E	DBDB5/Warren and Speer 1991
13	Cox F.Z	3600		32 00 S	012 15 W	Cherkis et al 1989
14	Rio Grande F.Z	3900	13	26 00 S	014 45 W	Cherkis et al 1989
15	Rio de Janeiro F.Z.	3900	35	22 30 S	013 15 W	Cherkis et al 1989
16	Bagration F.Z.	3800		16 30 S	013 30 W	Cherkis et al 1989/DBDB5
17	Cardno F.Z.	3500		14 00 S	013 30 W	Cherkis et al 1989/Gebco
18	Ascension F.Z	3800	24	08 00 S	014 00 W	Cherkis et al 1989/Gebco
19	Guinea Rise	4300		2-7 S	3W - 1 E	Warren and Speer 1991
20	Chain F.Z	4050	10	01 00 S	014 11 W	Mercier et al 1994
21	Romanche F.Z	4350	10	00 50 S	013 45 W	Speer et al 1994

www.soc.soton.ac.uk/JRD/OCCAM/sills.html

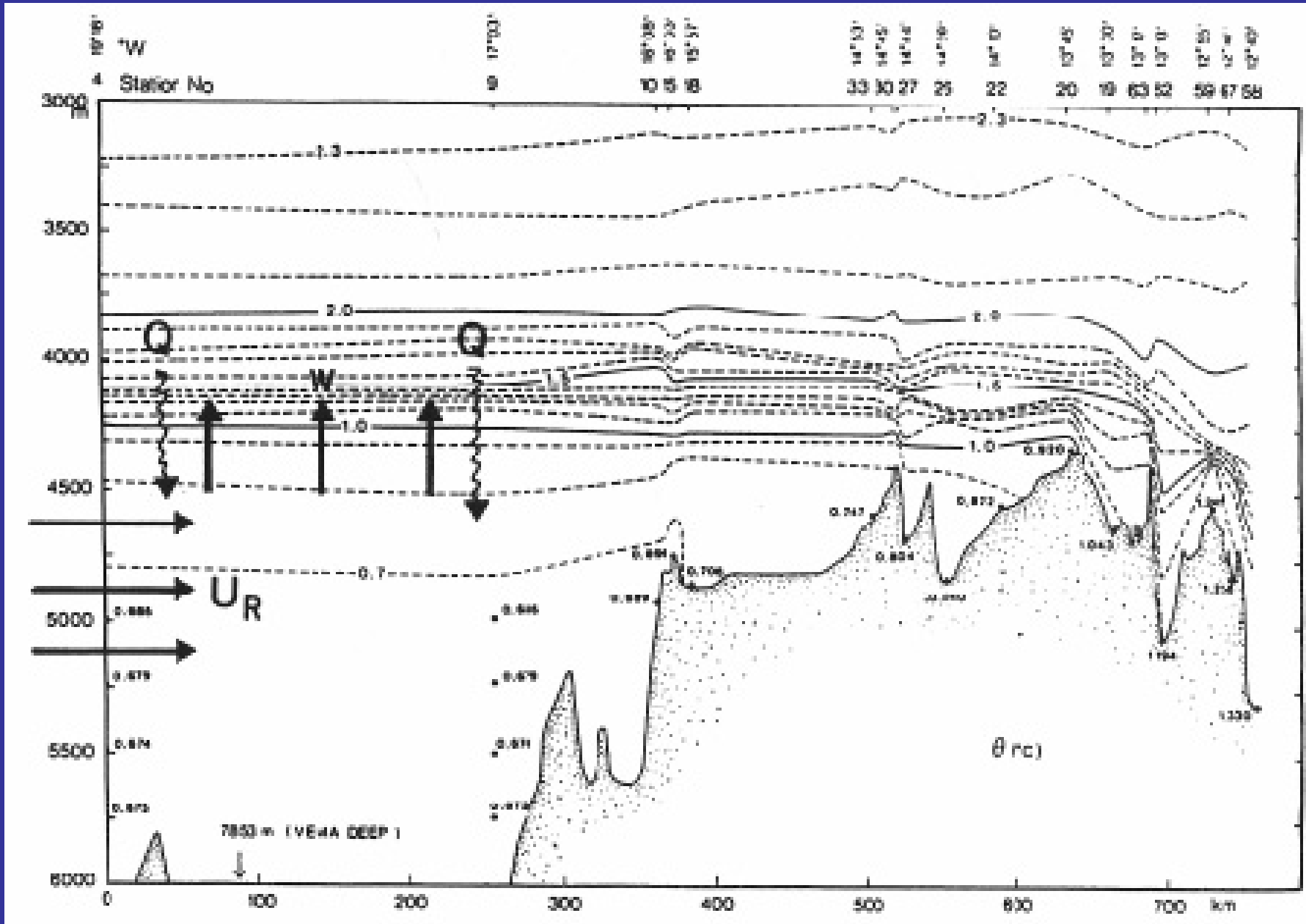


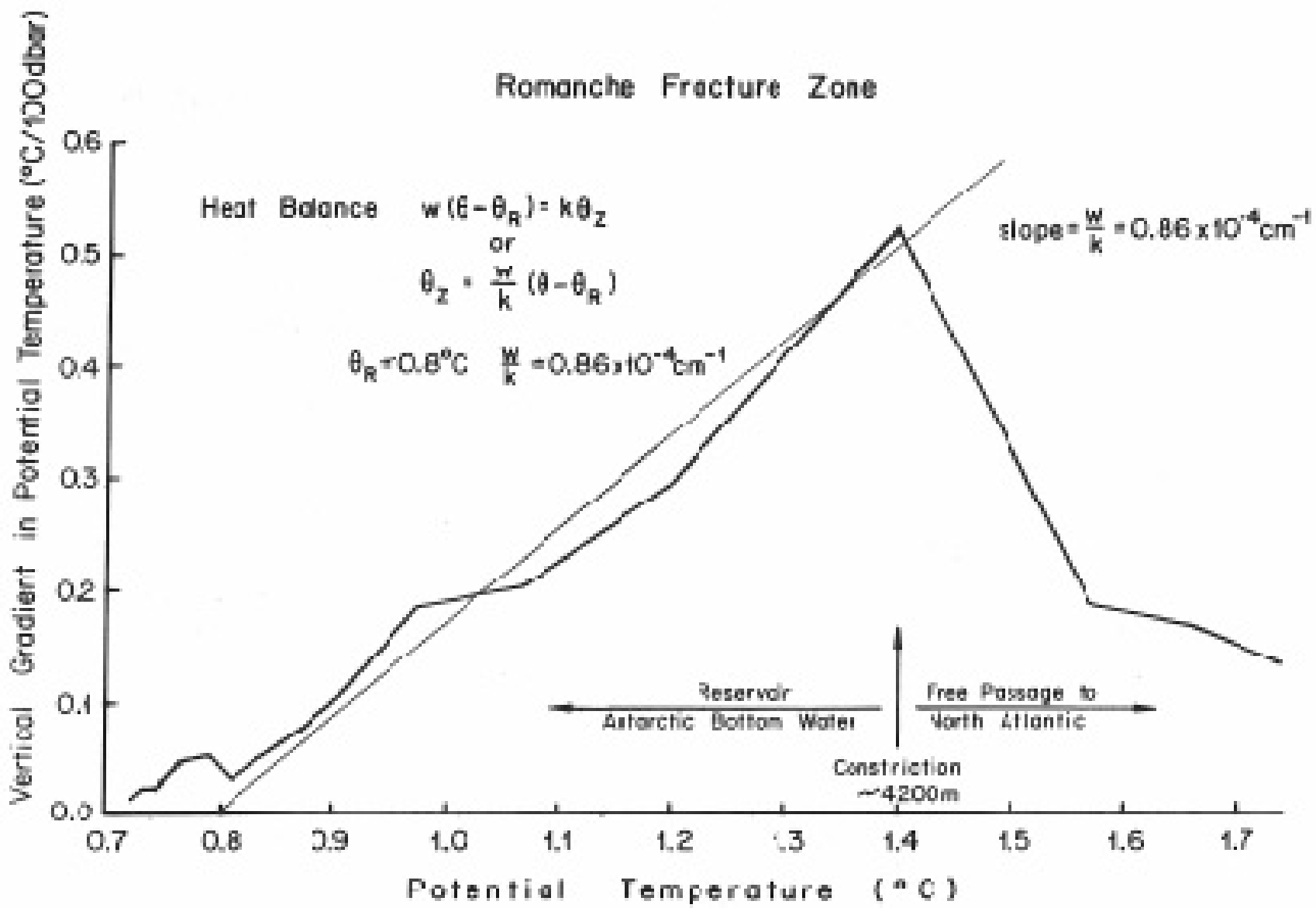

A16 Sigma-4
0
1000
2000
3000
4000
5000
6000
Depth (m)
55°S
35
15°S
5°N
25
45°N
Latitude
46.05
45.90
45.70
sigma4 kg/m**3



Flux $Q = u_d h_d$

$$Q = u_d * h_d = \sqrt{\frac{2}{3} g H_R} * \frac{2}{3} H_R$$


°W
Station No
3000 m
3500
4000
4500
5000
5500
6000
Q
W
Q
U_R
1.3
2.0
1.0
0.7
7850 m (VEMA DEEP)
0
100
200
300
400
500
600
700 km
θ (°C)


Romanche Fracture Zone
Heat Balance $w(\theta-\theta_R)=k\theta_z$
or
$\theta_z=\frac{w}{k}(\theta-\theta_R)$
θ_R=0.8°C $\frac{w}{k}=0.86\times10^{-4}cm^{-1}$
slope = $\frac{w}{k}=0.86\times10^{-4}cm^{-1}$
Reservoir
Antarctic Bottom Water
Free Passage to
North Atlantic
Constriction
~4200m
Vertical Gradient in Potential Temperature (°C/10Odbar)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
Potential Temperature (°C)

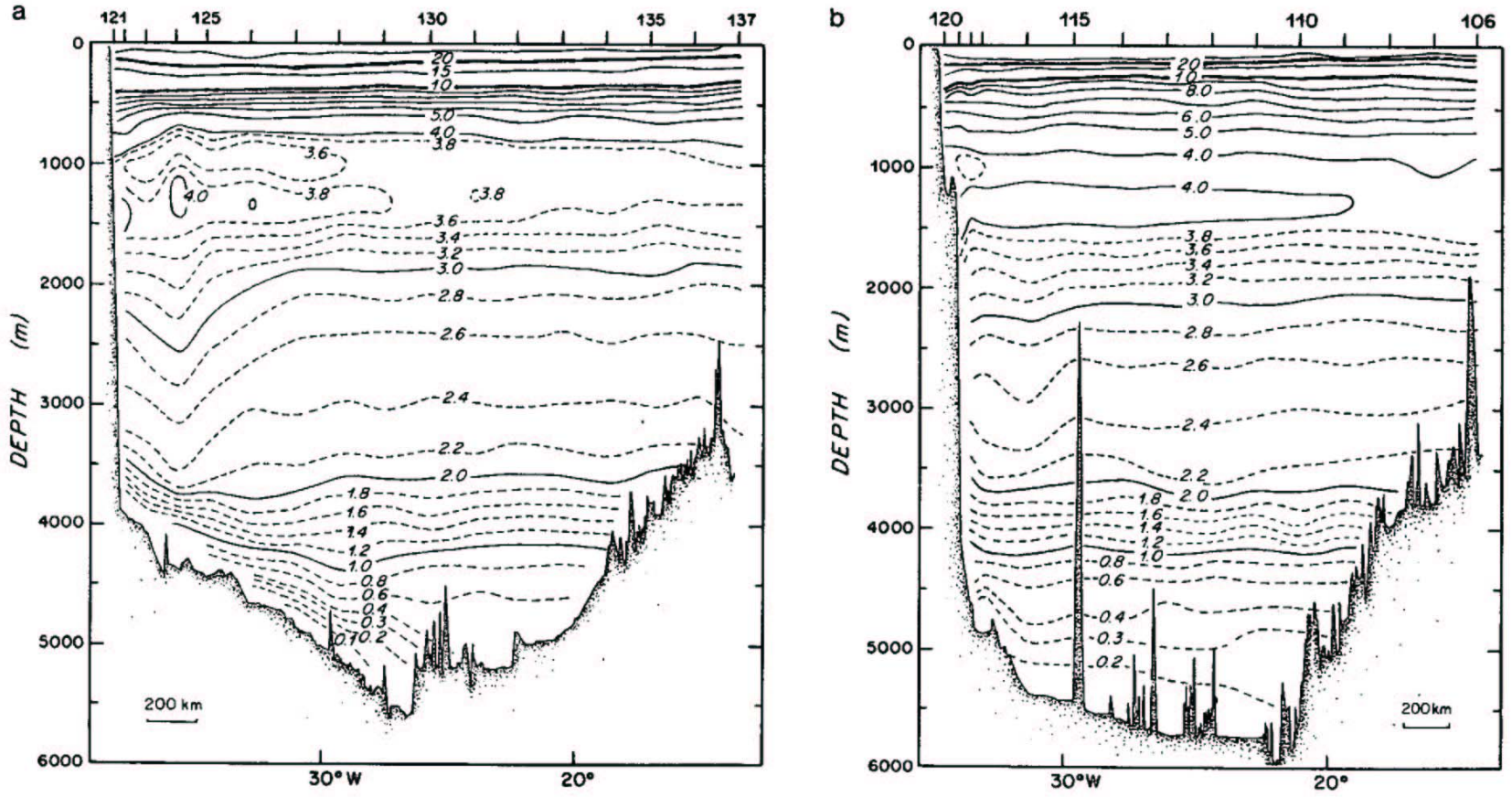
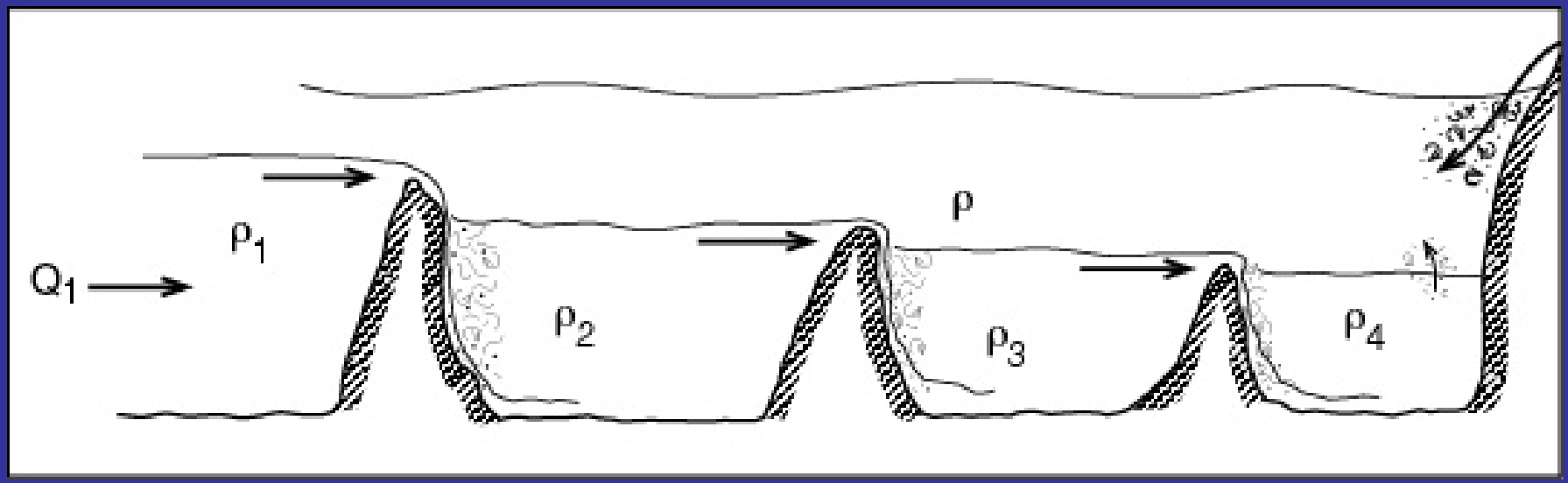


FIG. 11. Potential temperature distributions from zonal sections made from the R/V *Crawford* in March–April 1957 (Fuglister 1960). Station positions are shown on Fig. 1. (a) 16°S; (b) 8°S.


Q1
ρ1
ρ2
ρ
ρ3
ρ4

Strait Mixing versus Interior Mixing in the Abyssal Atlantic Ocean

	Strait Mixing $Q\Delta\rho$	$K\frac{\partial\rho}{\partial z}$
Brazil Basin Area = 3×10^6 km^2		1 - 3
Romanche Fracture Zone Q = 1.2 Sv	15	
Eastern North Atlantic Area = 8×10^6 km^2		1.6 - 4

For interior mixing the vertical diffusivity, K, is taken to be 1×10^{-4} m^2 s^{-1}. $\Delta\rho$ is estimated from the difference in bottom water densities across each sill.