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SEA FLOOR GEOTHERMAL MEASUREMENTS FROM VEMA CRUISE 23

by

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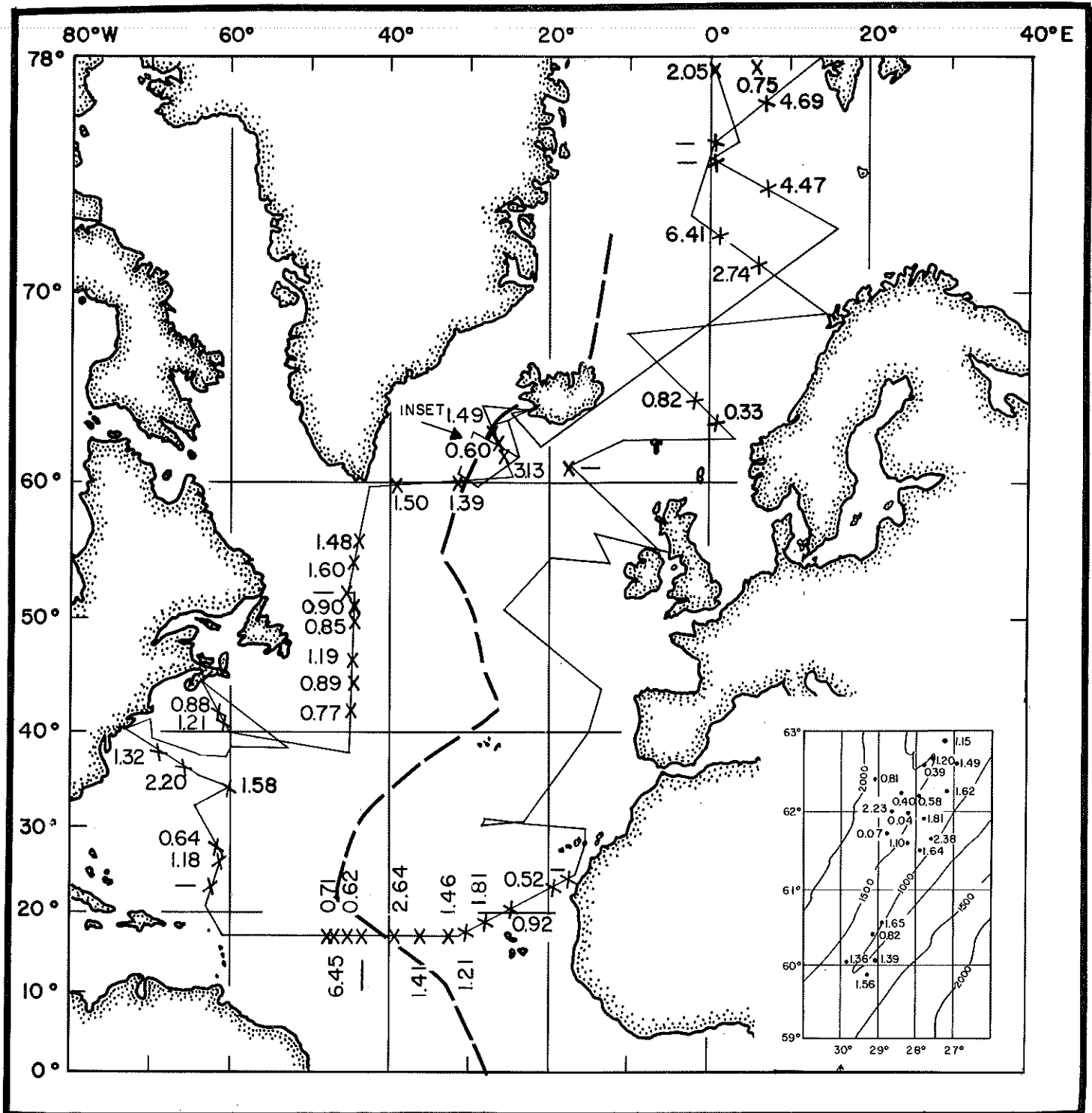
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Track of VEMA 23 showing heat flow values, with inset of intensive survey area. Stations with a dash indicate conductivity measurement only.

Introduction: This report gives results of temperature measurements in the deep-ocean water and sea-floor sediment, and results of conductivity measurements on sediment cores taken with the temperature measurements. These measurements were made on VEMA Cruise 23 that left New York City July 27, 1966, and returned to New York City on December 15, 1966, spending the entire time in the North Atlantic. The principal objective of these measurements is to determine the geothermal heat flux through the sea floor (see for example Bullard, 1954). These measurements are also pertinent to studies of water temperature in the deep ocean, and steady-state and transient thermal processes at the sediment-water interface. We have attempted in this report to present the data in a form that is useful to scientists interested in the thermal regime of the deep ocean.

Instrument Techniques: For a complete description of the instruments and techniques used to measure temperature and conductivity in the deep sea see Gerard et al. (1960) and Langseth (1965). A summary of the measurement technique is given below so that the reader can better assess the data.

The Ewing Thermograd: All of the temperature data reported was measured with the Ewing thermograd. This instrument uses an array of 3 to 5 thermistor probes mounted along a coring tube to measure sediment temperatures, a thermistor probe to measure water temperature, and a pressure gauge to indicate the depth of the instrument in the water. The temperature and pressure are recorded on 70 mm film as analog traces. The recorder is placed inside of a pressure case that is secured inside the

weight at the top of the piston corer.

Water Temperature Measurements: Water temperatures are measured during lowering and hoisting of the thermograd with a bead-type thermistor that is mounted in a watertight stainless steel probe. The diameter of the probe is about 1.25 mm and its length is 2.5 cm. The probe has a time constant of about 0.5 sec in flowing water. This probe is mounted on the pressure vessel. During lowering, the water probe points downward so that relatively undisturbed water is continually flowing past it. (Lowering rates vary from 100 to 200 meters/minute.) Upon hoisting, the probe is in the wake of the core weight. (Hoisting rates are usually 50 to 100 meters/minute.)

The water temperature trace on the 70 mm film record has a displacement of about 2.5 cm/°C. The film record can be read with a precision of about 0.1 mm. The water probe is calibrated prior to use at sea in a constant-temperature bath at 5 or 6 points with an absolute accuracy of $\pm 0.05^\circ \text{C}$. The relative accuracy of calibration between temperature points is about $\pm 0.005^\circ \text{C}$.

Instrument Depth Measurements: The depth of the instrument below the sea surface is measured by a pressure gauge. This gauge consists of a cavity exposed to the ambient sea pressure and surrounded by strain-sensitive wires. The linearity of the gauge is about 0.35%. The pressure detected by the gauge is recorded as a separate trace on the 70 mm film record. The sensitivity of this trace is variable but is usually equivalent to 1500 m/cm in terms of water depth. Thus the resolution of the record is

about 15 m. Depths during lowering are found by a linear interpolation between the surface and bottom readings. The accuracy of depth reading is about ± 25 m.

Sediment Temperatures: Temperatures at up to five points below the sediment-water interface are measured by means of thermistor probes mounted along the core tube. The thermistor is in the end of a stainless steel probe 0.317 cm in diameter. This probe is pressure proof and mounted on a steel fin so that it is held about 5 cm from the core tube. The probe itself is secured in a plastic (PVC) collar that provides thermal insulation from the fin. The tip of the probe projects about one inch beyond this collar.

To measure sediment temperatures the corer is lowered to within about a hundred meters of the bottom and held for a few minutes to allow the probes to equilibrate in the nearly isothermal near bottom water. The corer is then lowered until bottom contact is made. Upon contact, the corer free-falls about 10 ft., penetrating the sediment to depths up to 25 meters. The corer is left undisturbed in the sediment for about 5 minutes. During this time temperatures are recorded as the probes equilibrate with the sediment. The corer is then extracted from the sediment and hoisted back up to the ship.

The sediment probes are calibrated in the same way as the water probe described earlier. Temperature gradients in the sediment, which are of prime interest, are determined by taking the difference between measurements in the water near the bottom and in the sediment after equilibration.

Thus in determining gradients we depend only on the relative calibration accuracy which is $\pm 0.005^\circ \text{ C}$.

Conductivity Measurements: Measurements of thermal conductivity are made on the sediment core samples aboard the research ship about one hour after the core has been extruded from the core tube. A thin probe is imbedded in the sediment and the temperature measured while the probe is heated at a constant rate. We use a probe about 6 cm in length and 0.8 mm in diameter that contains a 50 Ω heater wire and a thermistor. The probe is inserted into the 2 1/2" sediment sample at an angle of about 45° to the long axis of the core. Six volts is applied to the heater and the temperature rise is recorded on a Varian strip-chart recorder for about two minutes.

Reduction of Thermograd and Conductivity Data: The trace displacements on the 70 mm thermograd film record are read by means of a digitizing table. The film is projected with a magnification of about 4X onto the surface of the table. The minimum digitizing increment of this table is 0.01". The digitized trace displacements corresponding to water and mud temperatures and instrument depth are entered on computer punch cards. The digitized film traces are reduced to temperature versus depth information by means of an IBM 1130 computer.

The conductivity measurements are reduced by manually reading displacements from the strip chart records. Displacement versus resistance calibration, made on board ship, and temperature versus resistance calibration of the thermistor are used to reduce the displacements to

temperature. Readings are taken approximately every 10 seconds after the probe heater is turned on. These temperatures are then plotted versus the logarithm of time. The slope of these semi-log plots can be interpreted in terms of conductivity by means of the following relation.

$$K = \frac{Q \cdot \ln(t_2/t_1)}{4\pi (T_2 - T_1)}$$

where:

Q = the heater power in cal/cm sec

t₂ and t₁ are times after heater turn-on usually 10 and 100 seconds

T₂ and T₁ are temperatures at t₁ and t₂.

PRESENTATION OF THE DATA:

Summary Table: The thermal data relevant to the geothermal heat flux is given for each station in Table 1.

The depths are given in corrected meters, determined by taking the depth indicated by the Precision Depth Recorder at the time of the core contact and correcting for the velocity of sound in water using Matthews (1939) tables.

The gradient refers to the vertical gradient in the sediment usually determined from temperature measurements at the two deepest points in the sediment. Units are °C/10 m.

The listed conductivity value is the harmonic mean of all measurements within the interval of gradient measurement. Units are mcal/°C sec cm.

Each conductivity measurement is followed by an "M" or "A" which indicate whether the value is based on measurements (M) or is assumed from nearby stations (A).

Heat flow is the product of the gradient and the conductivity. The units are $\mu\text{cal}/\text{cm}^2\text{sec}$.

The evaluation is a subjective index applied by the authors to indicate the appraisal of the reliability of the temperature and conductivity measurements. The numbers are interpreted in Table 2.

TABLE 1: VEMA 23 GEOTHERMAL DATA

Latitude North	Longitude West	Depth Meters	Gradient	Conduct.	Heat Flow	Eval.	T' Grad Number	Core Number	Year
41° 55'	61° 21'	4193	0.40	2.20(A)	0.88	3	3	7	1966
40° 33'	60° 49'	4981	0.54	2.24(M)	1.21	8	4	8	1966
41° 31'	45° 08'	4845	0.36	2.15(M)	0.77	10	9	13	1966
43° 29'	45° 15'	3200	0.37	2.41(A)	0.89	4	10	14	1966
46° 00'	45° 03'	2803	0.49	2.43(M)	1.19	4	11	16	1966
49° 38'	44° 57'	3372	0.34	2.50(M)	0.85	10	12	19	1966
51° 24'	44° 36'	4120	0.38	2.36(M)	0.90	9	13	20	1966
52° 06'	45° 27'	4230	1.50	2.20(A)	3.30	2	14	21	1966
54° 12'	45° 58'	3667	0.81	1.97(M)	1.60	10	15	22	1966
56° 04'	44° 33'	3259	0.73	2.03(M)	1.48	10	16	23	1966
59° 46'	39° 24'	2776	0.76	1.98(M)	1.50	10	19	27	1966
60° 07'	29° 09'	1141	0.81	1.72(M)	1.39	8	20	30	1966
61° 25'	26° 01'	1426	1.79	1.75(M)	3.13	10	21	32	1966
61° 52'	26° 22'	875	0.24	2.48(M)	0.60	7	22	33	1966
62° 35'	26° 57'	1415	0.61	2.45(M)	1.49	10	23	34	1966
62° 00'	28° 41'	1606	0.87	2.57(M)	2.23	10	24	35	1966
62° 13'	28° 23'	1634	0.18	2.20(A)	0.40	10	25	36	1966
62° 31'	27° 58'	1540		2.24(M)			26	37	1966
62° 40'	27° 34'	1428	0.52	2.30(M)	1.20	10	27	38	1966
62° 35'	27° 46'	1465	0.19	2.05(M)	0.39	10	28	39	1966
61° 43'	28° 45'	1609	0.03	2.20(M)	0.07	10	29	40	1966
61° 60'	28° 14'	1648	0.02	2.17(M)	0.04	10	30	41	1966
62° 11'	27° 56'	1511	0.25	2.32(M)	0.58	10	31	42	1966
61° 23'	28° 03'	1362		2.65(M)			32	43	1966
61° 29'	27° 53'	708	0.69	2.37(M)	1.64	10	33	44	1966

TABLE 1: VEMA 23 GEOTHERMAL DATA

Latitude North	Longitude West	Depth Meters	Gradient	Conduct.	Heat Flow	Eval.	T'Grad Number	Core Number	Year
17° 42'	29° 52'	4645	0.45	2.69(M)	1.21	8	63	103	1966
17° 13'	32° 21'	4955	0.56	2.61(M)	1.46	9	64	104	1966
17° 12'	35° 50'	5011	0.56	2.51(M)	1.41	7	65	105	1966
17° 25'	39° 01'	5104	1.12	2.36(M)	2.64	8	66	106	1966
17° 24'	43° 14'	4369	-	2.65(M)	-	0	67	108	1966
17° 22'	45° 04'	4327	0.24	2.57(M)	0.62	8	68	109	1966
17° 16'	46° 45'	2847	2.48	2.60(M)	6.45	9	69	112	1966
17° 16'	47° 21'	4142	0.24	2.96(M)	0.71	9	70	113	1966
22° 48'	61° 40'	5740	-	2.52(M)	-	-	72	133	1966
25° 58'	60° 19'	5874	0.50	2.35(M)	1.18	6	73	135	1966
27° 26'	61° 18'	5770	0.29	2.21(M)	0.64	8	74	136	1966
34° 25'	60° 40'	4766	0.63	2.50(A)	1.58	7	75	141	1966
36° 14'	65° 43'	4925	0.83	2.65(M)	2.20	7	76	142	1966
37° 05'	69° 36'	4314	0.52	2.54(M)	1.32	8	77	143	1966

TABLE 2: DEFINITION OF EVALUATION INDEX

Index	Estimated Error Range	Reliability	Remarks
9-10	5-10%	High	Three or more sediment temps.
7-8	10-15%	Good	Only two probes in sediment. Conductivity may be assumed.
5-6	15-50%	Fair	Corer may have moved in sediment. Apparent shunting of thermistors.
4	>30%	Poor	Only one probe in sediment.
<3	-	Unacceptable	

Listings of the Data: Individual listings of the temperature and depth data are given for each station. Depths and corresponding in situ and potential temperatures (computed from Wüst, 1961) are given. At some stations malfunction of either the water probe or pressure gauge obviated any measurement, in such cases the listing of water temperatures is omitted.

Sediment conductivity values are listed with the depth of measurement in the sediment. Conductivity values followed by an "F" are measurements made in sediment sucked into the pipe by the piston after full penetration was reached. This sediment, "flow-in," is highly disturbed and measurements in it should not be used in calculating heat-flow values.

Plots of Geothermal Data: The listed data for each station is presented graphically on the page following the listings. A note about the conductivity presentation: each value is printed out at a depth corresponding to the distance from the top of the core to the point of measurement. This usually represents the true depth in the sediment within ± 10 cm.

NOTES ABOUT THE GEOTHERMAL DATA:

On the VEMA 23 Cruise a profile of thermograd stations, V23 9-16, was made across the southern end of the Labrador Sea. Another group comprises a detailed survey on the Reykjanes Ridge V23 20-24. These measurements have been reported in Talwani et al. (1970). The Reykjanes Ridge measurements are notable in that most of the sediment temperature profiles were strongly influenced by relatively large changes in bottom-water

temperature. Other stations in the Atlantic show similar influences, e.g. stations 12, 13, 19, 60, 62, and 70. It should be stressed that the evaluation numbers given in Table 1 refer only to the reliability of the gradient and conductivity measurements and do not indicate any effects such as transient heat flow that could affect the representativeness of the heat flow value of the region where the measurement was made.

Stations V23 47-56 are in the Norwegian Sea. The measurements are the first reported in the eastern part of this sea. Three measurements near the mid-oceanic ridge have values well above the oceanic average. Conductivity measurements in the sediments in the Norwegian Sea are all abnormally high. We have reasons to believe that these high values are inaccurate and were due to a malfunction of the measuring equipment on the ship. Further geothermal measurements in the Norwegian Sea were made on VEMA 27 in 1969. The VEMA 27 conductivity values are consistently lower than the VEMA 23 values. The average of 18 VEMA 27 values is 2.51 mcal/cm sec°C. This average is significantly lower than the average of VEMA 23 values.

Water contents of sediment cores taken in the Norwegian Sea were made available by David Horn of this laboratory. The water content can be used to make an estimate of the thermal conductivity, K, through the empirical relation,

$$K = (95 + 7.41 \times W)^{-1} \quad (\text{Lachenbruch and Marshall, 1967});$$

where W is the water content. The average value of conductivity based on

the water content of 28 core samples is 2.65, which is in fair agreement with the VEMA 27 values. To calculate heat flow in Table 1 we have used assumed values of thermal conductivity based on nearby VEMA 27 stations. However, in the individual station listings and plots of conductivity values we have indicated the original value.

The remainder of the stations V23 60-77 form a transatlantic profile. Several of these stations show evidence of transient disturbances as noted earlier. One very high value was measured near the axis of the Mid-Atlantic Ridge.

Acknowledgements: This work was supported by the Office of Naval Research under Contract N00014-67-A-0108-0004.

Chief scientist aboard ship during the VEMA 23 Cruise when geothermal measurements were made were, Charles Windisch, Manik Talwani and John Ewing. The measurements were made by Egon Nepf. Thomas Trout assisted Mr. Nepf on the first two legs of the cruise. H. C. Kohler, Captain of the VEMA, as usual made an important contribution to the success of the scientific program of the cruise.

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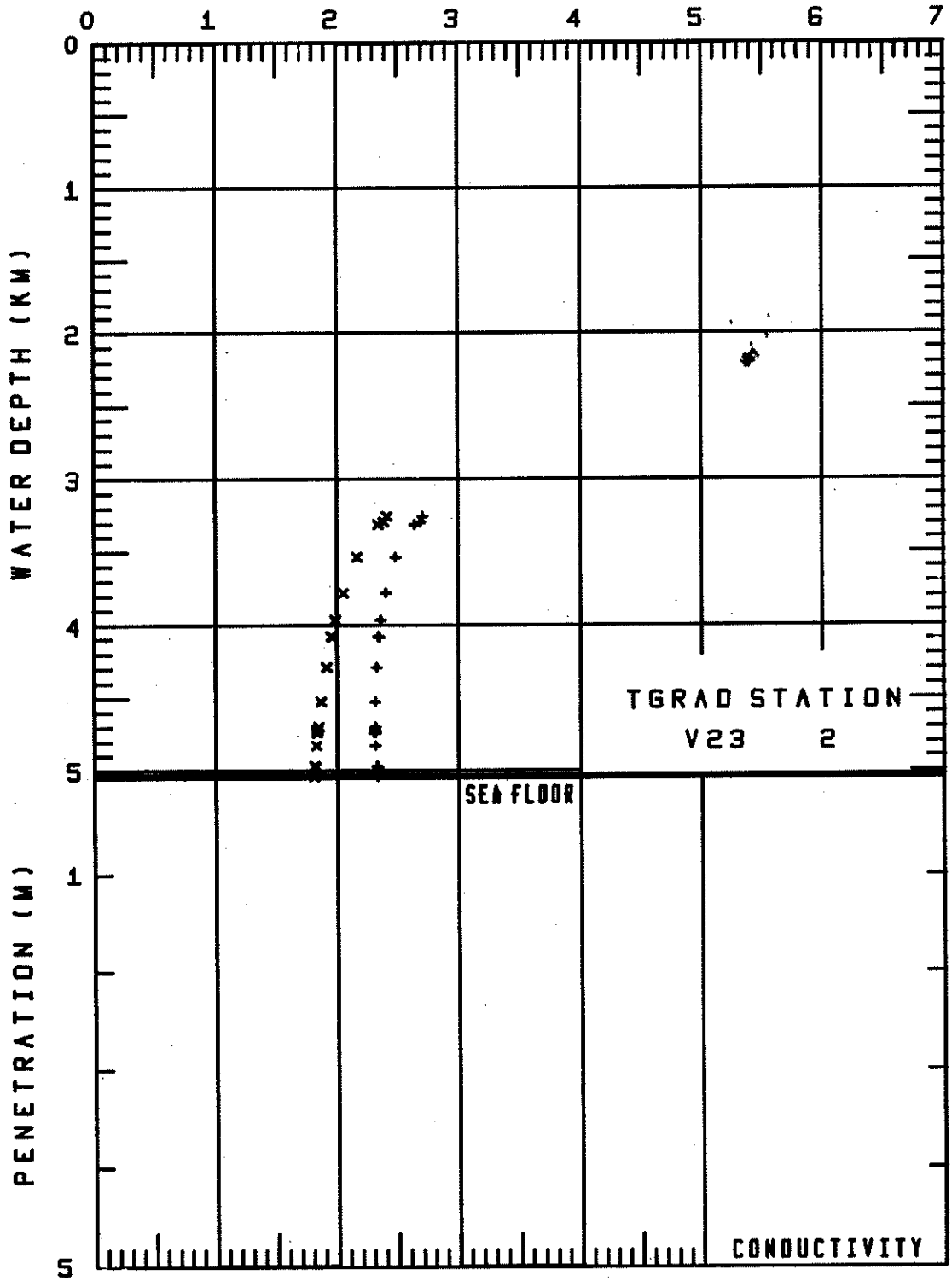
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TGRAD STATION V23 2

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
3252.	2.71	2.41
3290.	2.68	2.38
3308.	2.64	2.34
3535.	2.49	2.17
3777.	2.41	2.06
3964.	2.36	1.99
4079.	2.35	1.96
4078.	2.34	1.95
4286.	2.33	1.91
4522.	2.31	1.87
4698.	2.31	1.84
4734.	2.31	1.84
4726.	2.31	1.84
4736.	2.31	1.83
4713.	2.31	1.83
4823.	2.31	1.82
4965.	2.32	1.81
4970.	2.33	1.82
5038.	2.33	1.81

TEMPERATURE (C)



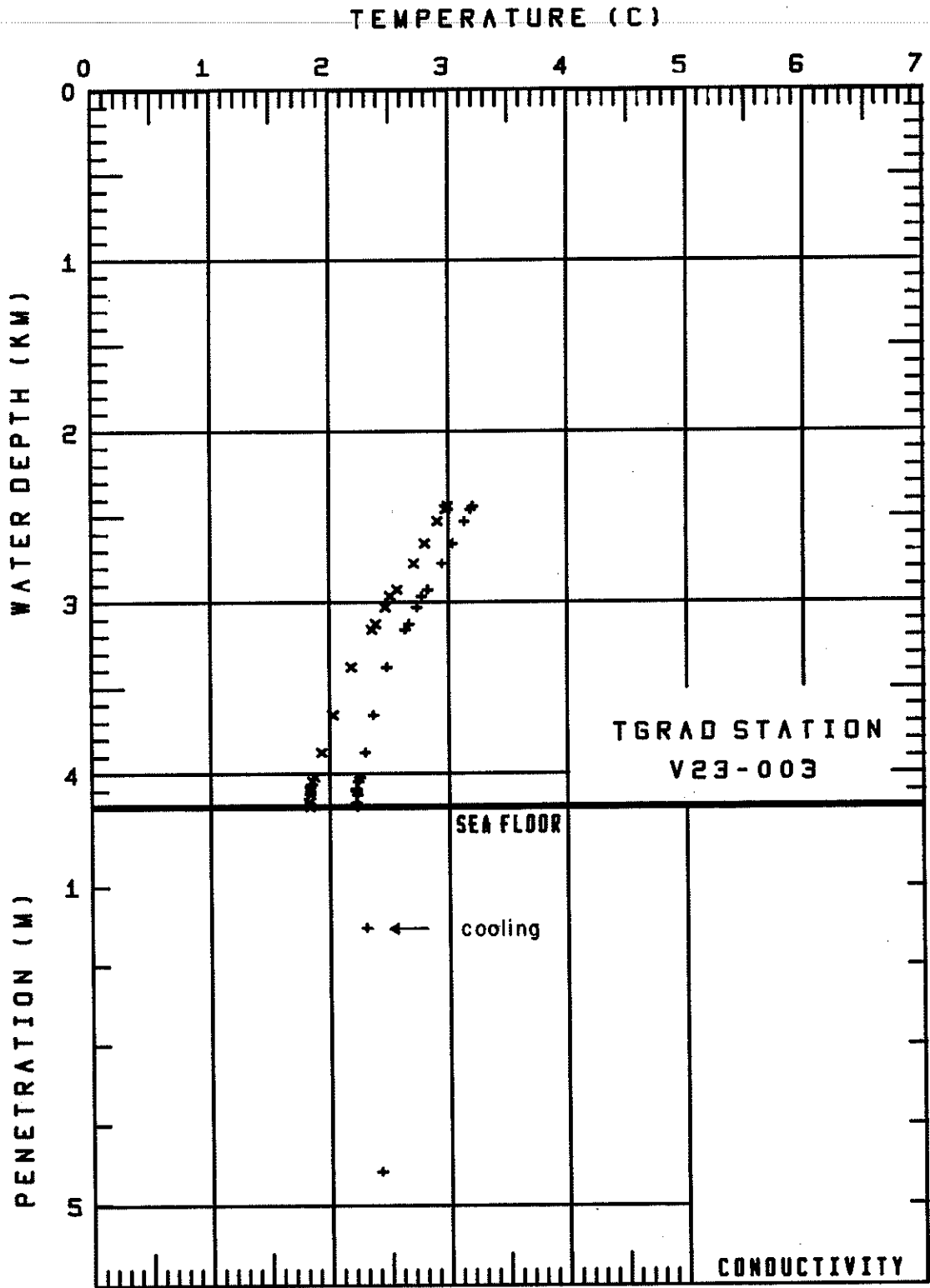
TGRAD STATION V23-003

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
2436.	3.21	3.00
2455.	3.19	2.97
2522.	3.13	2.91
2655.	3.03	2.80
2771.	2.95	2.70
2925.	2.82	2.56
2959.	2.77	2.51
3028.	2.74	2.47
3125.	2.67	2.39
3156.	2.63	2.35
3376.	2.48	2.18
3656.	2.36	2.03
3872.	2.29	1.93
4019.	2.25	1.87
4042.	2.23	1.86
4095.	2.22	1.84
4096.	2.22	1.83
4081.	2.22	1.84
4119.	2.23	1.84
4168.	2.22	1.83
4190.	2.23	1.83

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.52	2.30
4.58	2.41



TGRAD STATION V23-004

WATER TEMPERATURES

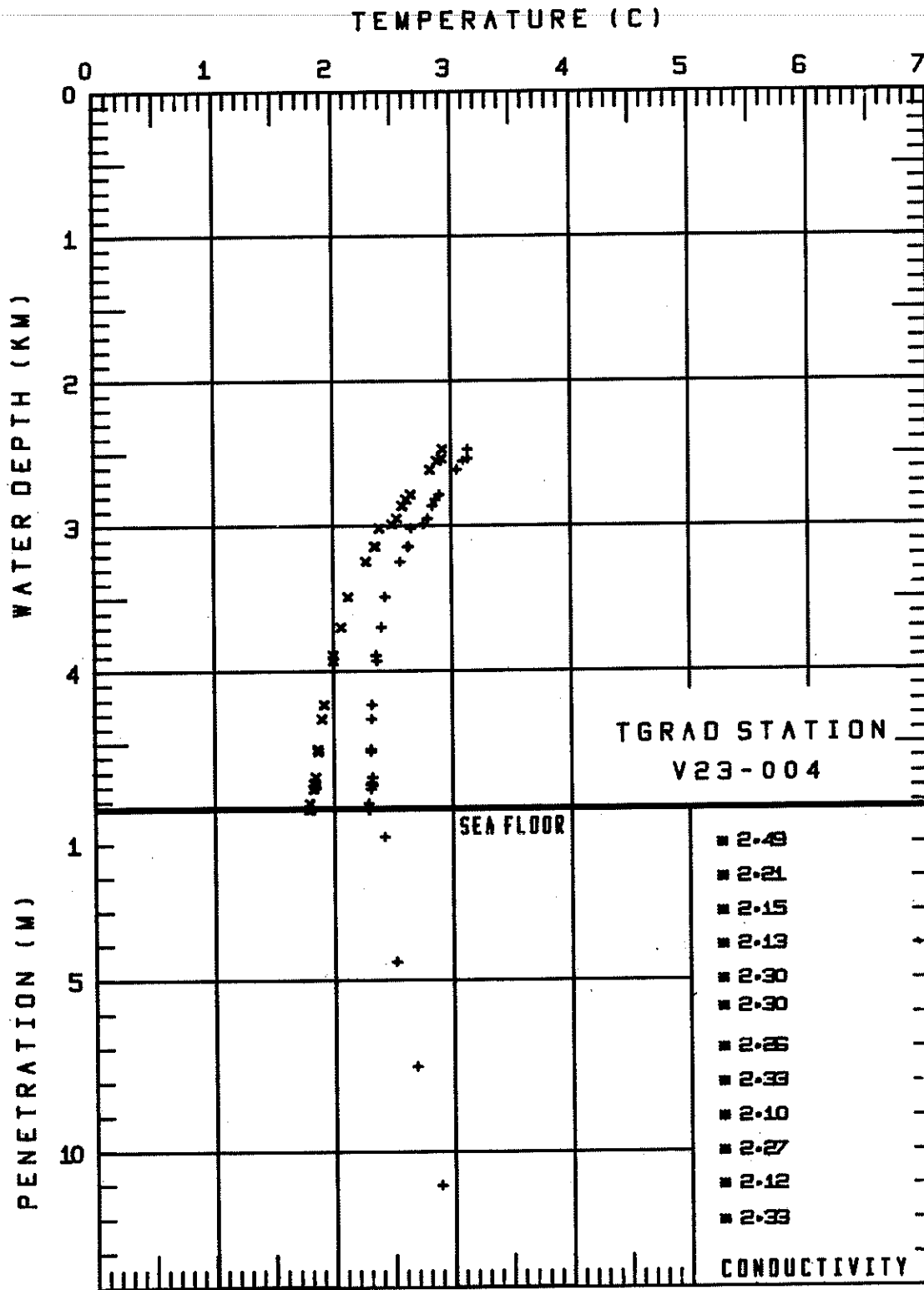
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
2466.	3.14	2.93
2528.	3.14	2.92
2544.	3.10	2.88
2604.	3.05	2.82
2777.	2.90	2.66
2812.	2.87	2.62
2856.	2.84	2.59
2941.	2.80	2.54
2981.	2.77	2.50
3008.	2.66	2.39
3136.	2.64	2.36
3135.	2.63	2.35
3242.	2.57	2.28
3483.	2.44	2.13
3691.	2.40	2.06
3922.	2.37	2.00
3881.	2.36	2.00
4227.	2.33	1.92
4322.	2.32	1.90
4550.	2.31	1.86
4532.	2.31	1.86
4725.	2.32	1.85
4807.	2.31	1.83
4767.	2.32	1.84
4761.	2.32	1.84
4778.	2.33	1.84
4772.	2.32	1.83
4907.	2.29	1.79
4950.	2.29	1.79
4950.	2.30	1.80

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.80	2.43
4.46	2.52
7.52	2.69
10.98	2.89

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.49
2.00	2.21
3.00	2.15
4.00	2.13
5.00	2.30
5.80	2.30
7.00	2.26
8.00	2.33
9.00	2.10
10.00	2.27
11.00	2.12
12.05	2.33

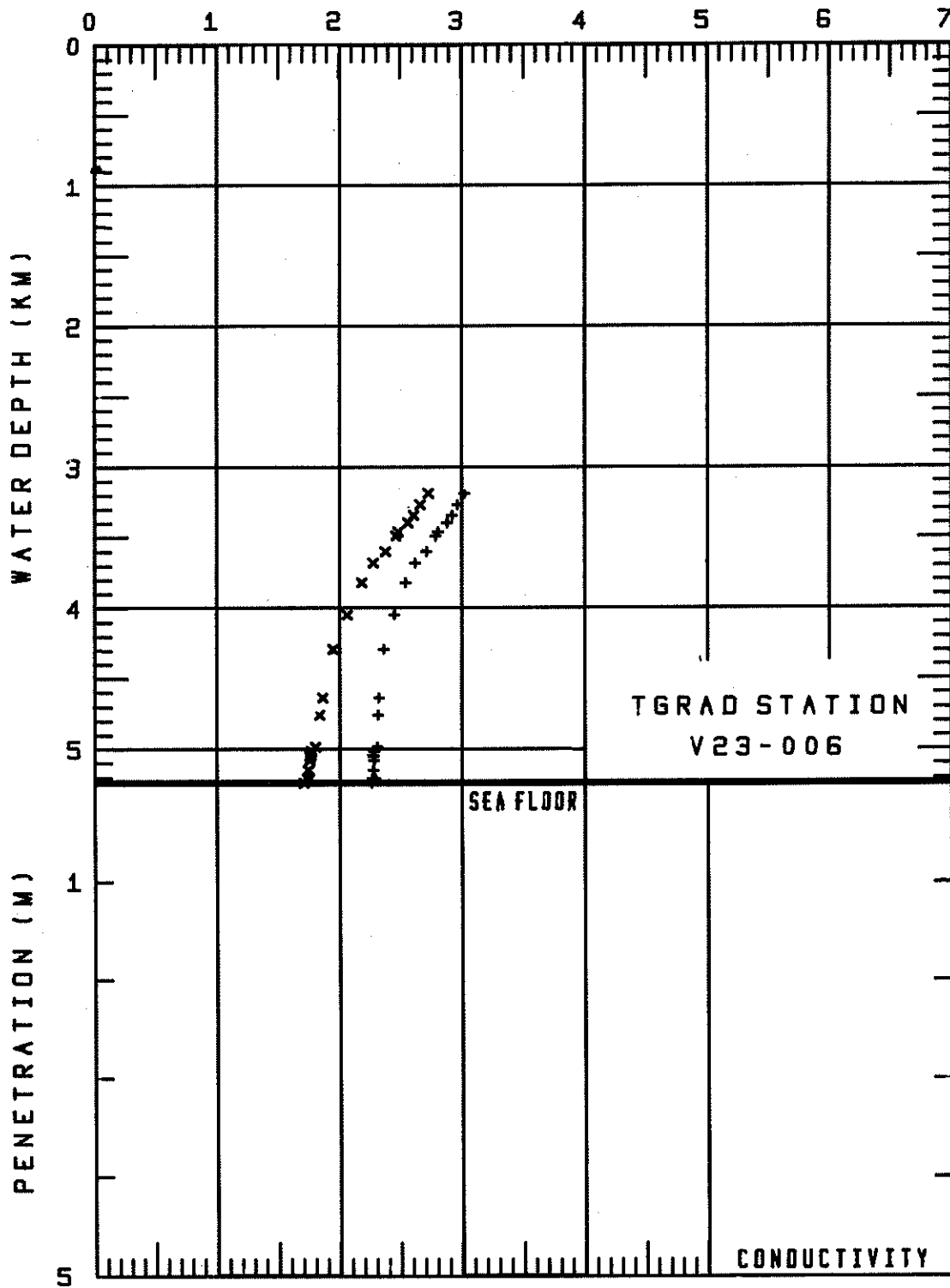


TGRAD STATION V23-006

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
3184.	3.02	2.73
3266.	2.96	2.66
3340.	2.92	2.60
3391.	2.88	2.56
3457.	2.80	2.48
3488.	2.78	2.46
3595.	2.71	2.37
3677.	2.62	2.27
3819.	2.54	2.18
4046.	2.45	2.06
4289.	2.36	1.94
4635.	2.32	1.86
4756.	2.31	1.83
4980.	2.31	1.80
5201.	2.29	1.74
5077.	2.28	1.76
5037.	2.28	1.76
5013.	2.28	1.77
5048.	2.27	1.75
5144.	2.28	1.74
5202.	2.27	1.73
5238.	2.26	1.71

TEMPERATURE (C)

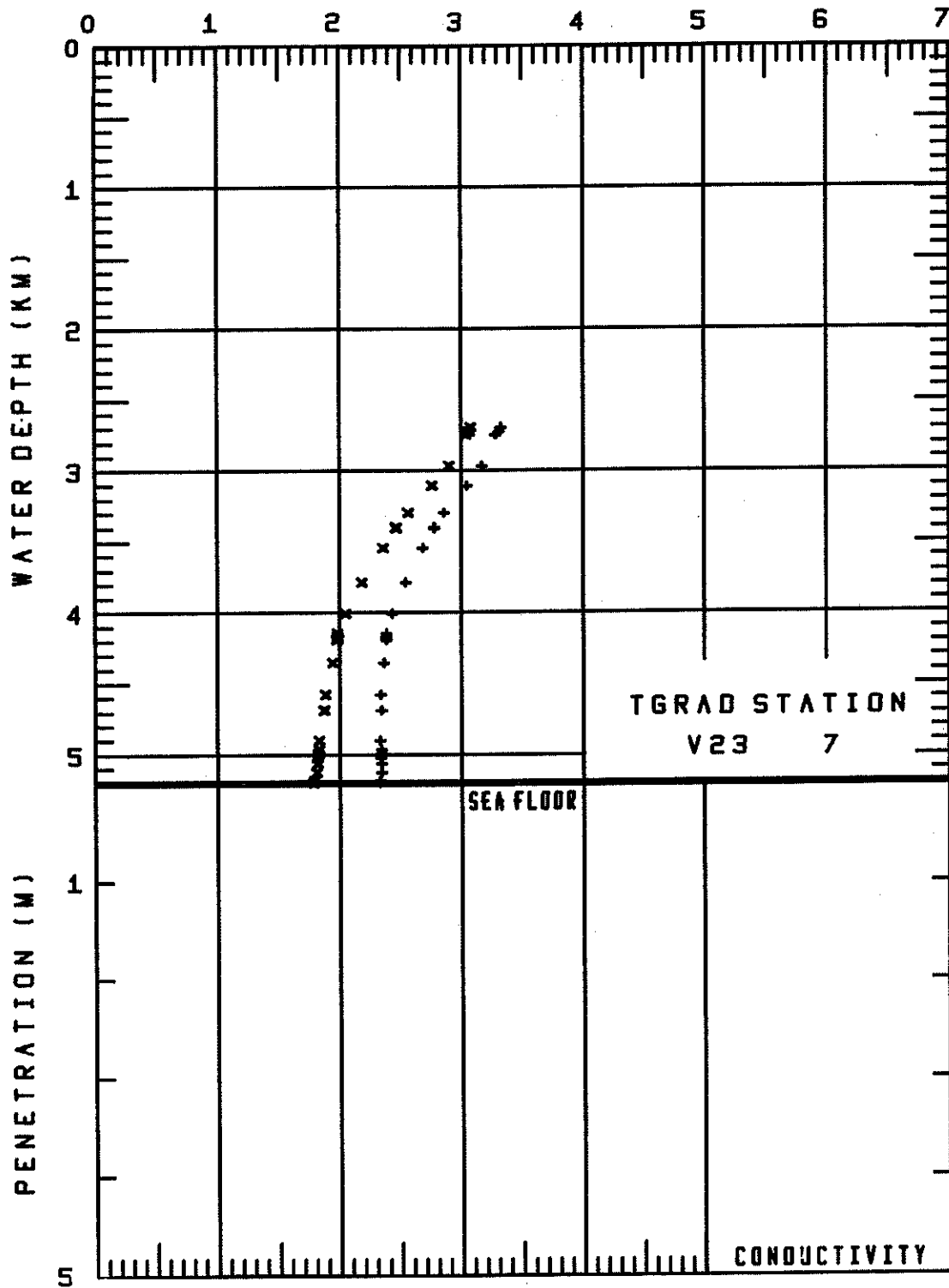


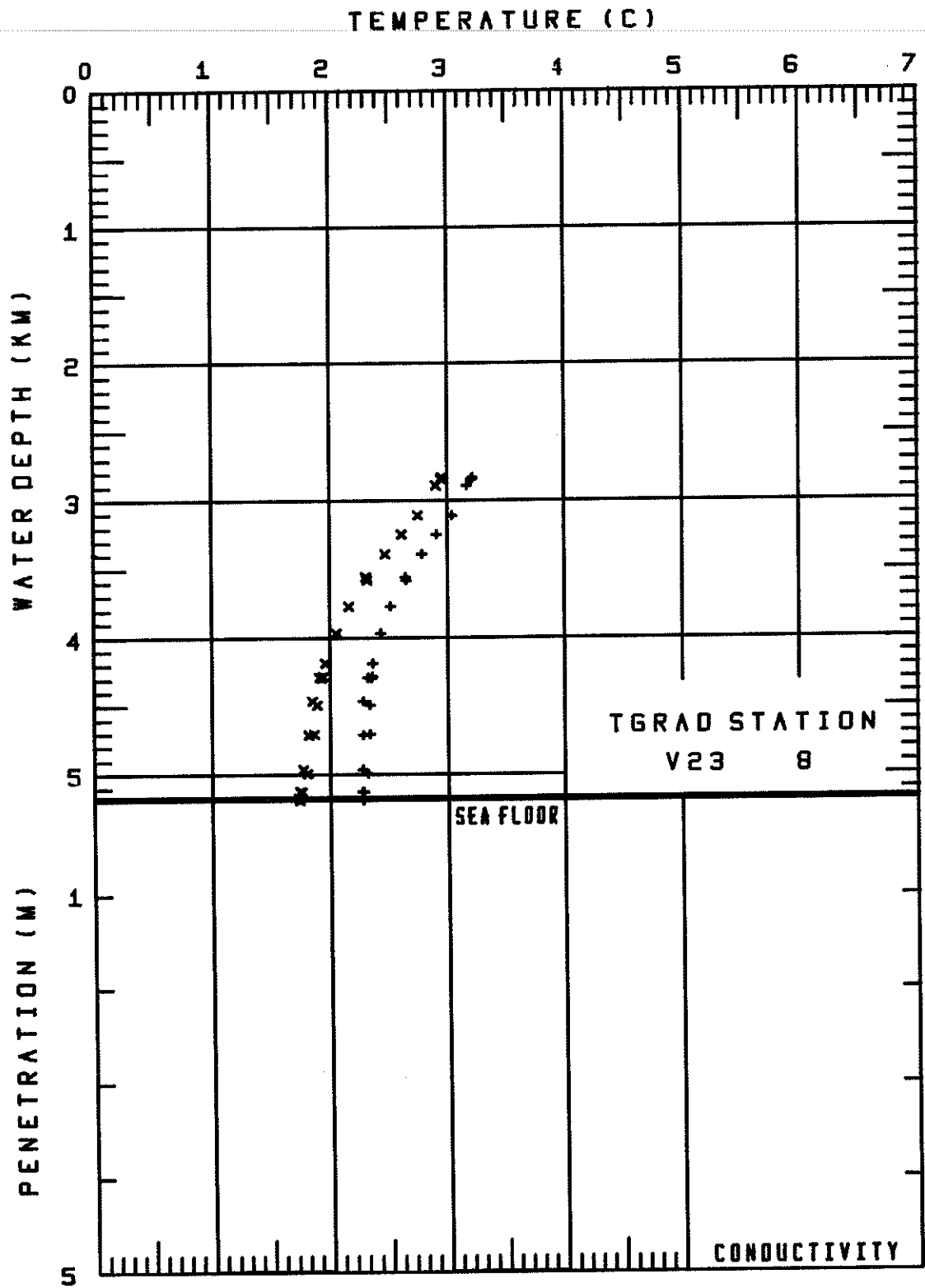
TGRAD STATION V23 7

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
2693.	3.33	3.08
2718.	3.31	3.06
2745.	3.29	3.04
2965.	3.18	2.90
3099.	3.05	2.76
3294.	2.86	2.56
3404.	2.78	2.46
3396.	2.78	2.46
3543.	2.68	2.35
3785.	2.54	2.18
4000.	2.43	2.05
4163.	2.38	1.98
4189.	2.38	1.97
4184.	2.38	1.98
4139.	2.38	1.98
4348.	2.36	1.94
4574.	2.34	1.88
4684.	2.34	1.87
4682.	2.34	1.87
4900.	2.33	1.82
4996.	2.33	1.82
5017.	2.33	1.81
4993.	2.34	1.82
4960.	2.34	1.83
5059.	2.34	1.81
5121.	2.34	1.80
5179.	2.32	1.78
5199.	2.33	1.78

TEMPERATURE (C)





TGRAD STATION V23-009

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
2623.	3.33	3.09
2665.	3.29	3.05
2704.	3.27	3.03
2743.	3.27	3.02
2979.	3.09	2.81
3238.	2.93	2.63
3442.	2.75	2.42
3506.	2.69	2.36
3517.	2.68	2.35
3670.	2.59	2.24
3691.	2.57	2.22
3784.	2.52	2.16
3883.	2.46	2.09
4090.	2.37	1.98
4292.	2.33	1.92
4402.	2.31	1.88
4384.	2.31	1.89
4512.	2.32	1.87
4731.	2.31	1.83
4765.	2.30	1.82
4753.	2.30	1.83

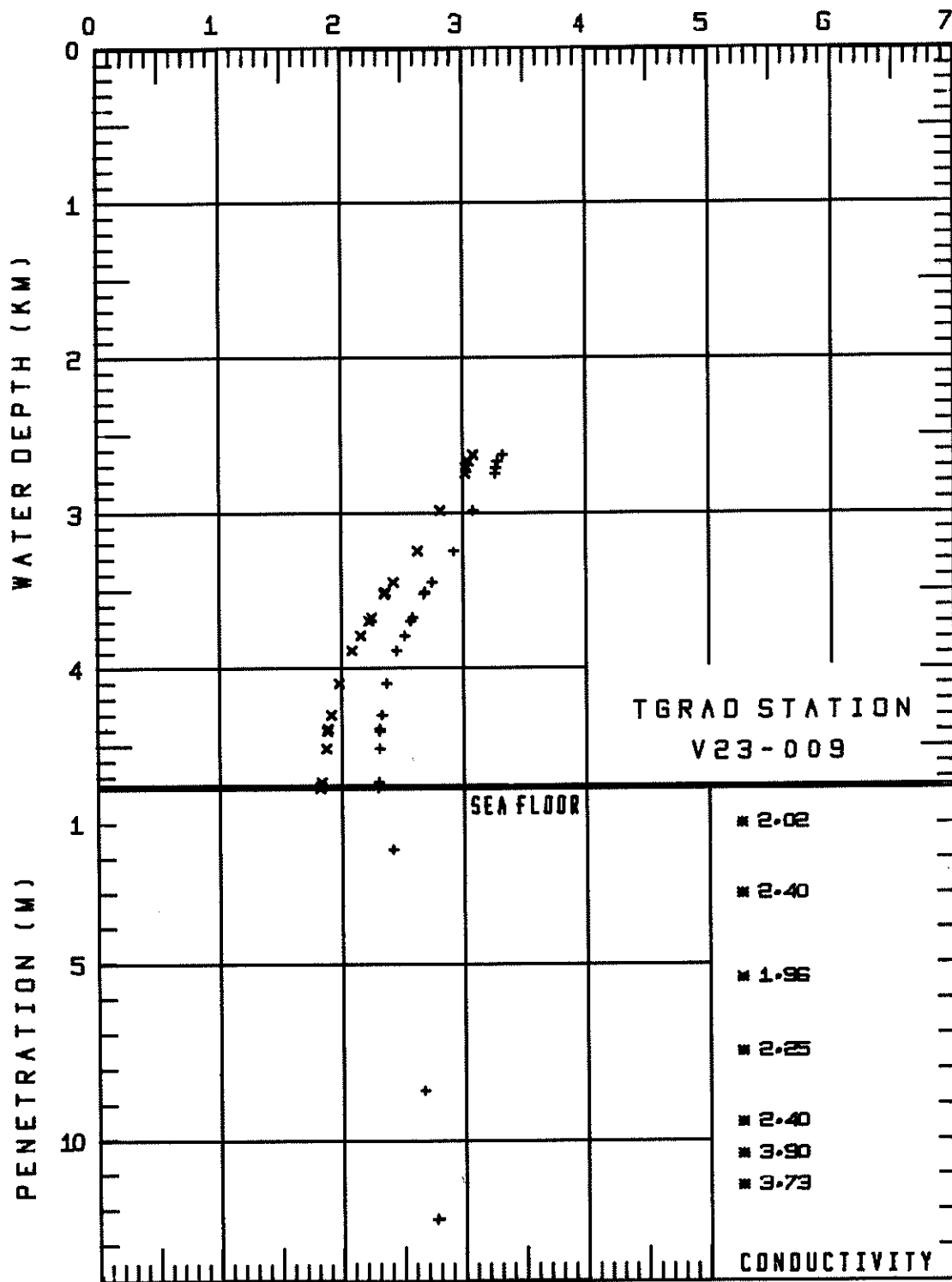
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.75	2.42
8.59	2.67
12.20	2.76

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.02
3.00	2.40
5.40	1.96
7.50	2.25
9.50	2.40
10.40	3.90
11.30	3.73

TEMPERATURE (C)



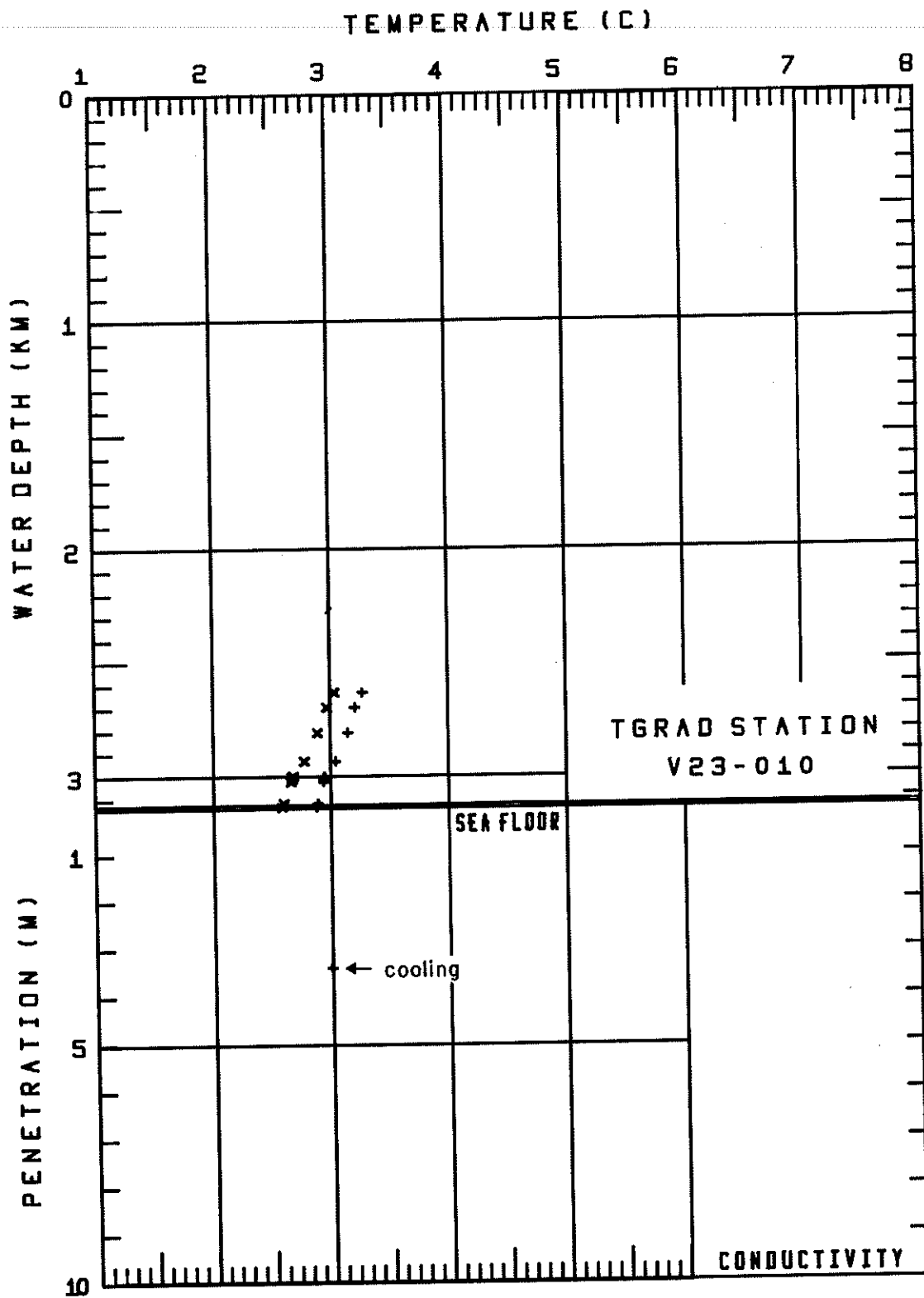
TGRAD STATION V23-010

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
2629.	3.27	3.03
2694.	3.21	2.97
2806.	3.14	2.89
2929.	3.04	2.77
2255.	2.97	2.78
2995.	2.95	2.68
3002.	2.95	2.67
3001.	2.94	2.67
3011.	2.94	2.66
3022.	2.93	2.66
3114.	2.89	2.60
3132.	2.87	2.58

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.38	2.99



TGRAD STATIONV23-011

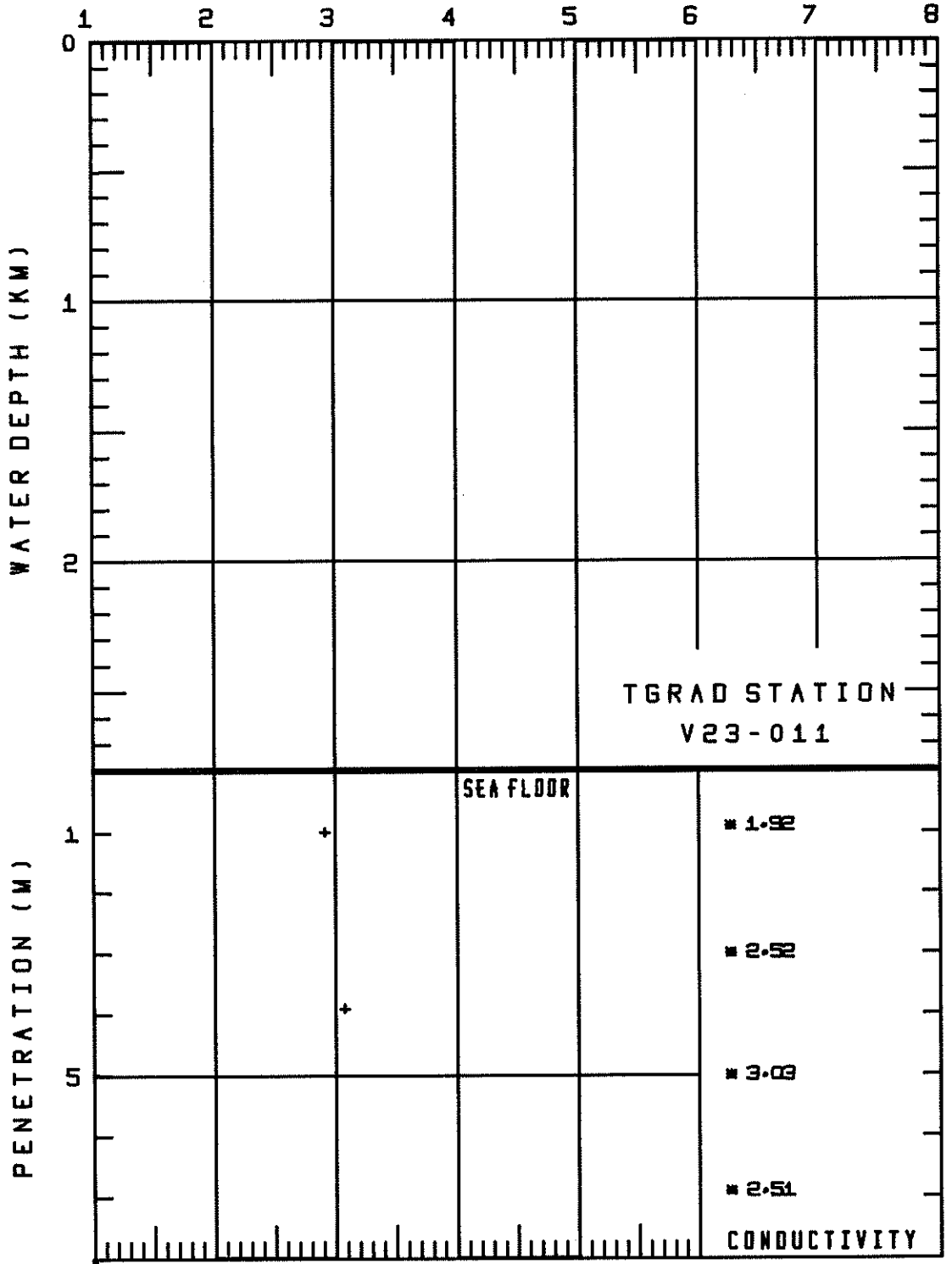
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.00	2.92
3.90	3.07

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
0.90	1.92
3.00	2.52
5.00	3.03
6.90	2.51

TEMPERATURE (C)



TGRAD STATION V23-012

WATER TEMPERATURES

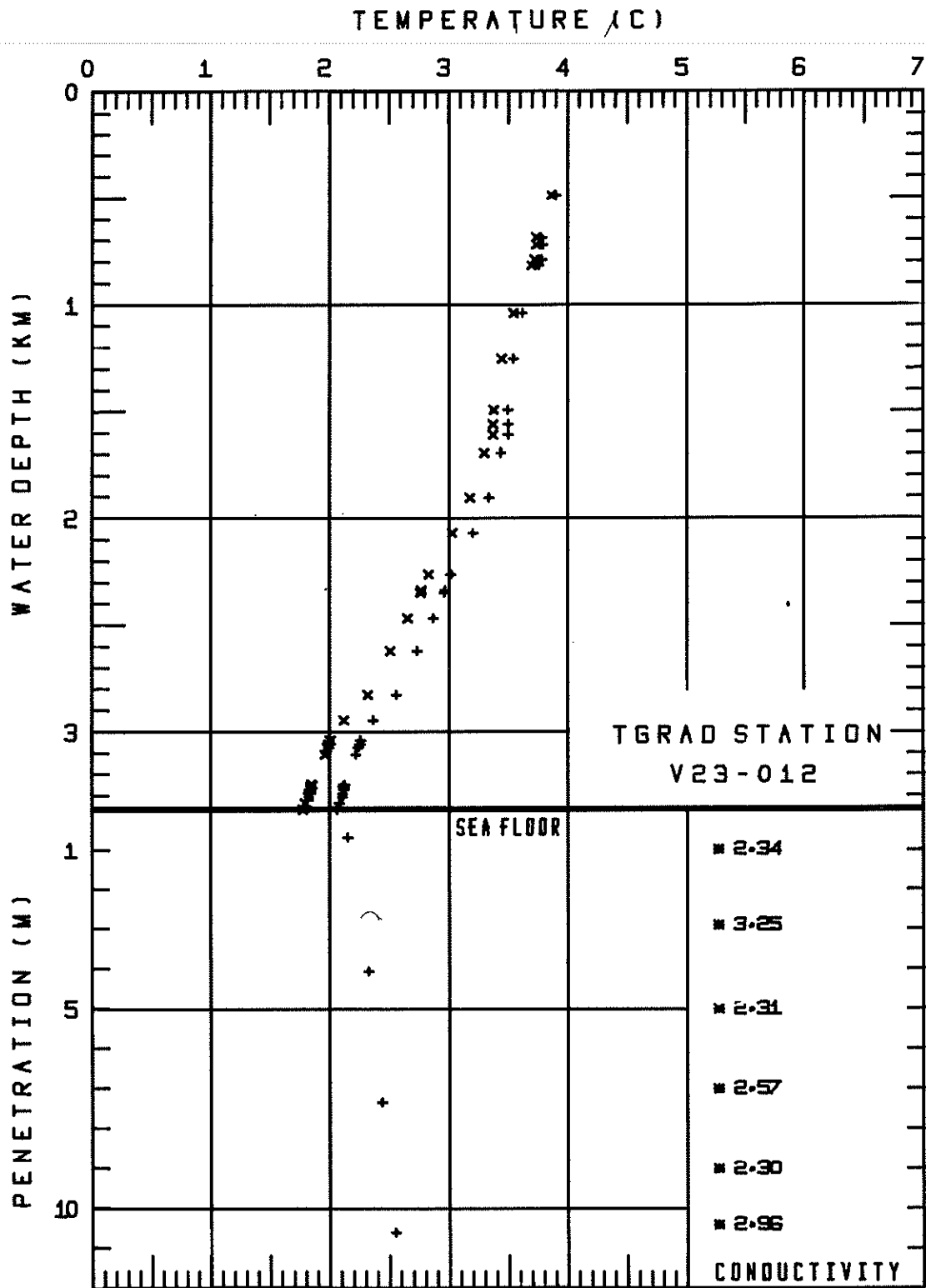
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
486.	3.90	3.86
683.	3.78	3.73
718.	3.79	3.74
787.	3.78	3.72
815.	3.75	3.69
1038.	3.62	3.54
1251.	3.54	3.44
1490.	3.50	3.37
1559.	3.49	3.36
1608.	3.50	3.36
1692.	3.44	3.30
1900.	3.33	3.17
2068.	3.20	3.03
2259.	3.02	2.83
2335.	2.96	2.77
2346.	2.96	2.76
2466.	2.86	2.65
2620.	2.73	2.51
2824.	2.56	2.32
2944.	2.37	2.12
3037.	2.26	2.00
3056.	2.25	1.99
3072.	2.24	1.98
3106.	2.22	1.96
3246.	2.13	1.85
3262.	2.12	1.84
3268.	2.12	1.84
3255.	2.11	1.84
3253.	2.12	1.84
3245.	2.12	1.84
3289.	2.11	1.83
3303.	2.10	1.82
3333.	2.08	1.79
3363.	2.06	1.77

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.70	2.16
4.05	2.33
7.33	2.44
10.60	2.55

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.34
2.90	3.25
5.00	2.31
7.00	2.57
9.00	2.30
10.40	2.96



TGRAD STATION V23-013

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
620.	3.96	3.91
665.	3.98	3.93
705.	3.91	3.85
922.	3.81	3.74
1124.	3.69	3.60
1177.	3.65	3.56
1215.	3.67	3.58
1322.	3.60	3.50
1431.	3.57	3.46
1495.	3.62	3.50
1526.	3.60	3.48
1518.	3.62	3.49
1771.	3.53	3.38
1994.	3.41	3.24
2209.	3.30	3.11
2319.	3.22	3.02
2320.	3.20	3.00
2445.	3.17	2.96
2475.	3.13	2.91
2542.	3.07	2.85
2691.	2.91	2.67
2876.	2.63	2.38
3041.	2.54	2.27
3044.	2.53	2.27
3270.	2.43	2.14
3465.	2.30	1.99
3729.	2.16	1.82
3746.	2.16	1.82
3886.	2.11	1.75
3858.	2.12	1.77
3863.	2.12	1.77
3844.	2.11	1.77
3833.	2.13	1.78
3857.	2.12	1.77
3875.	2.11	1.76
3824.	2.13	1.78
3876.	2.10	1.75
3968.	2.09	1.72
4040.	2.01	1.64
4065.	2.00	1.63
4106.	2.01	1.63

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.85	2.16
5.22	2.31
8.57	2.42
11.73	2.55

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	1.74
3.00	1.51
5.00	2.38
7.00	2.18
8.30	2.54

TEMPERATURE (C)

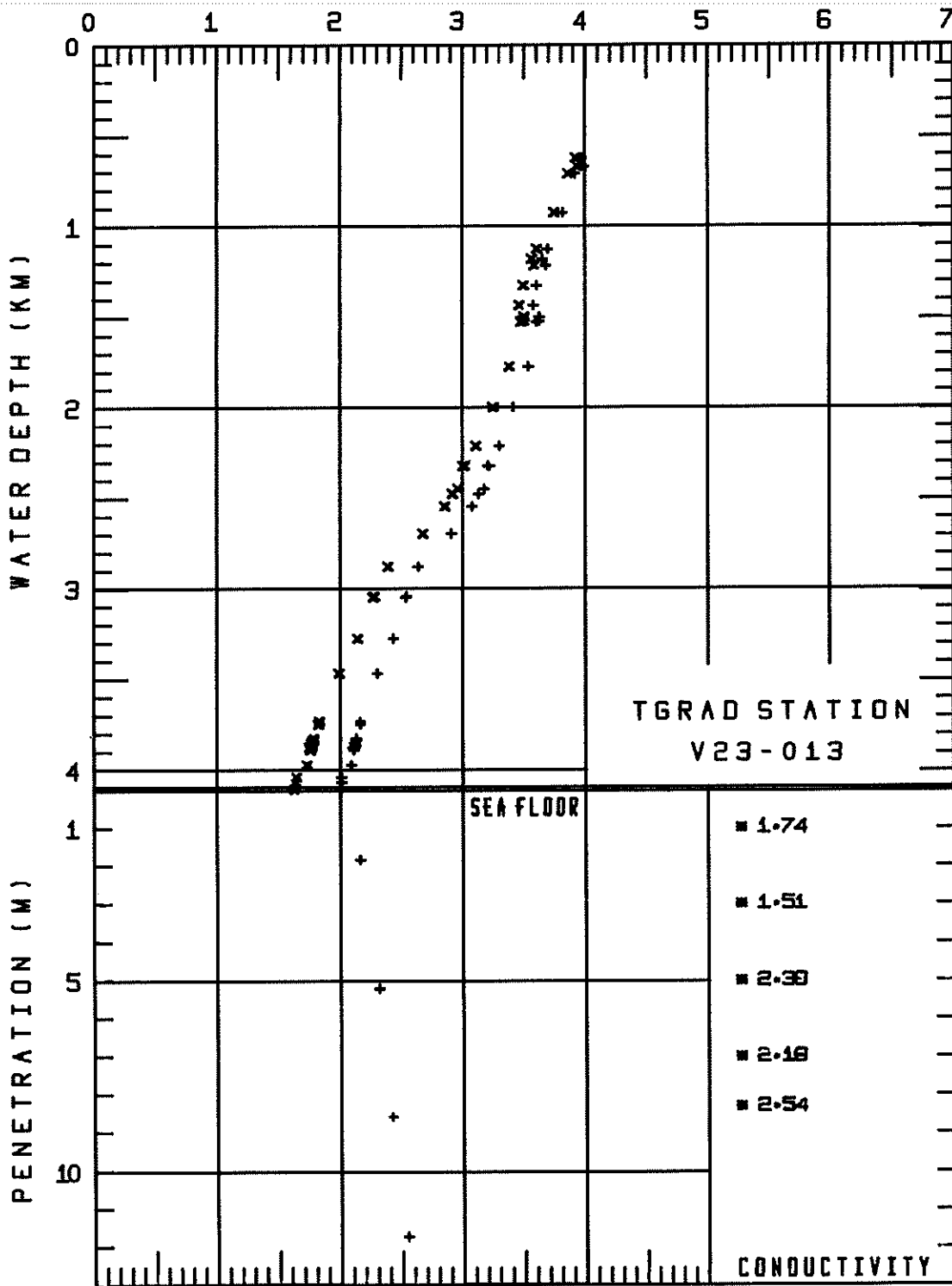


TABLE 1: VEMA 23 GEOTHERMAL DATA

Latitude North	Longitude West	Depth Meters	Gradient	Conduct.	Heat Flow	Eval.	T' Grad Number	Core Number	Year
61° 38'	27° 35'	1251	0.95	2.51(M)	2.38	10	34	45	1966
61° 53'	27° 45'	1348	0.74	2.44(M)	1.81	10	35	46	1966
61° 36'	28° 13'	1558	0.42	2.63(M)	1.10	10	36	47	1966
62° 13'	27° 13'	1439	0.75	2.16(M)	1.62	10	37	48	1966
60° 09'	29° 27'	1097	0.59	2.30(M)	1.36	10	38	49	1966
62° 23'	29° 09'	1134	0.34	2.39(M)	0.81	10	39	50	1966
60° 32'	28° 54'	1088	0.80	2.06(M)	1.65	10	40	51	1966
59° 50'	29° 17'	1287	0.73	2.14(M)	1.56	10	43	54	1966
62° 52'	27° 14'	1378	0.49	2.35(M)	1.15	10	44	55	1966
74° 02'	7° 24' E	1928	1.90	2.35(A)	4.47	8	47	61	1966
74° 54'	1° 37' E	3713	-	2.92(M)	-	-	48	62	1966
77° 57'	0° 12' E	3052	0.71	2.89(M)	2.05	8	49	63	1966
77° 52'	7° 16' E	2531	0.29	2.60(A)	0.75	3	50	64	1966
76° 59'	7° 05' E	2941	1.94	2.42(A)	4.69	8	51	66	1966
75° 36'	0° 17' E	2511	-	2.77(M)	-	-	52	67	1966
72° 04'	1° 24' E	2360	2.86	2.24(A)	6.41	9	53	69	1966
70° 59'	6° 41' E	3043	1.11	2.44(A)	2.74	8	54	70	1966
64° 48'	1° 19' W	2930	0.32	2.55(A)	0.82	10	55	75	1966
63° 39'	1° 22' E	1743	0.13	2.55(A)	0.33	5	56	76	1966
60° 56'	17° 34' W	2445	-	2.62(M)	-	-	57	79	1966
24° 07'	17° 26'	1934	-	2.50(M)	-	-	59	97	1966
23° 07'	19° 18'	3508	0.24	2.17(M)	0.52	7	60	98	1966
21° 18'	22° 41'	4576	0.35	2.64(M)	0.92	8	61	100	1966
18° 33'	28° 09'	4649	0.63	2.87(M)	1.81	7	62	102	1966

Water Temperature Profiles VEMA 23

Latitude North	Longitude West	Depth Meters	T'Grad Number	Core Number	Year
37° 36'	64° 36'	5026	2	2	1966
38° 38'	53° 03'	5323	6	10	1966
38° 09'	51° 21'	5399	7	11	1966
37° 49'	48° 48'	5359	8	12	1966
57° 05'	43° 26'	3479	17	24	1966
59° 43'	42° 03'	1739	18	26	1966

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SEA FLOOR GEOTHERMAL MEASUREMENTS FROM VEMA CRUISE 23

by

Marcus G. Langseth, Jr.

Isabel Malone

Dee Breger

November 1970

Technical Report No 2 CU-2-70

ONR Contract N00014-67-A-0108-0004

NSF Grant GA 5356

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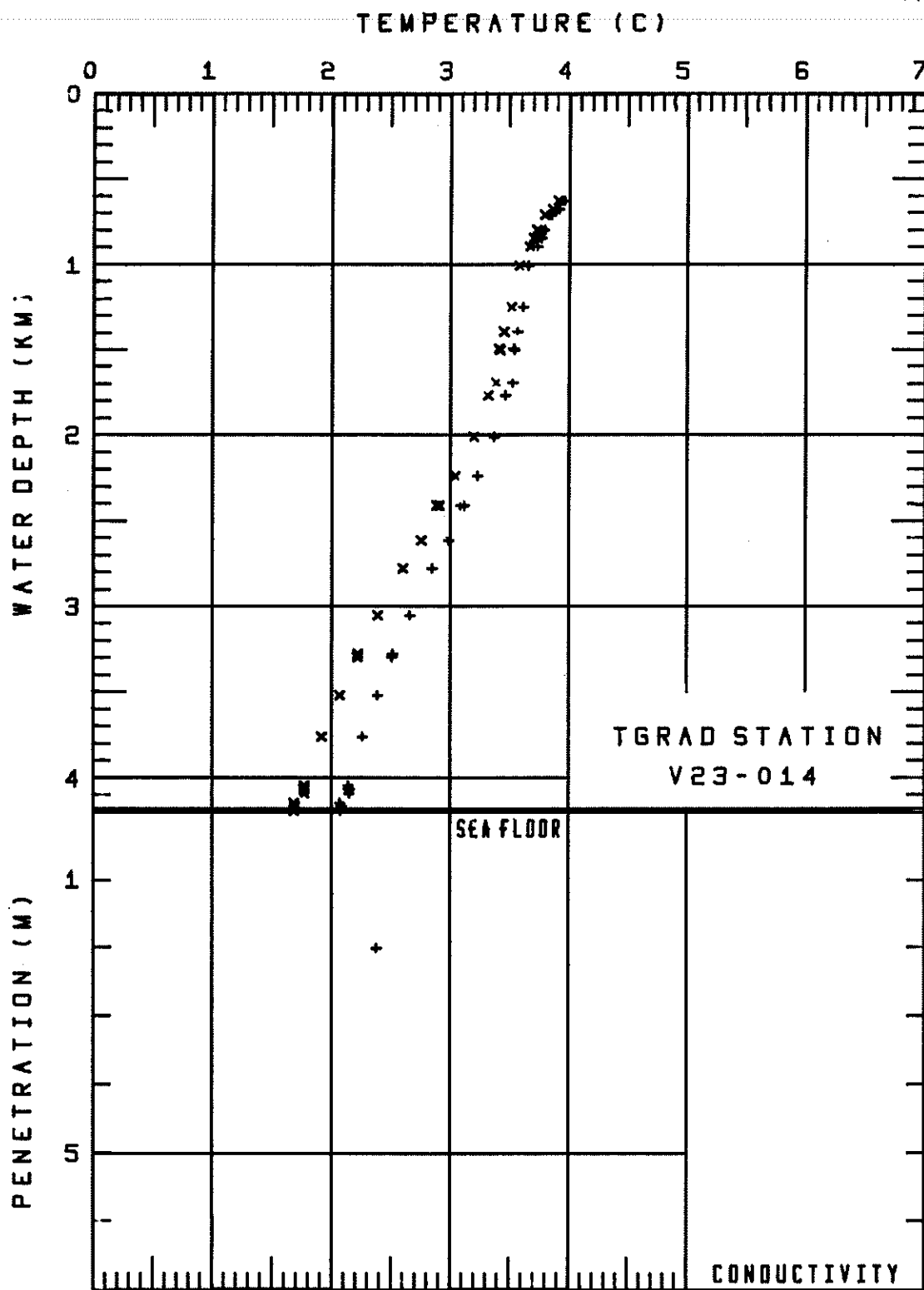
TGRAD STATION V23-014

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
624.	3.95	3.91
676.	3.91	3.86
710.	3.85	3.79
798.	3.79	3.73
845.	3.76	3.70
894.	3.73	3.67
1004.	3.65	3.58
1248.	3.61	3.51
1393.	3.57	3.46
1499.	3.54	3.42
1489.	3.53	3.41
1692.	3.53	3.38
1763.	3.47	3.32
2009.	3.37	3.20
2236.	3.23	3.04
2410.	3.09	2.88
2410.	3.12	2.91
2613.	2.98	2.76
2774.	2.84	2.60
3053.	2.66	2.39
3294.	2.51	2.21
3277.	2.51	2.22
3515.	2.38	2.07
3760.	2.26	1.92
4063.	2.14	1.76
4065.	2.15	1.77
4089.	2.15	1.77
4062.	2.15	1.77
4045.	2.14	1.76
4146.	2.06	1.68
4166.	2.08	1.69
4193.	2.07	1.68

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.01	2.38



TGRAD STATION V23-015

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
469.	4.00	3.97
526.	3.93	3.89
585.	3.87	3.83
849.	3.73	3.67
889.	3.73	3.66
1074.	3.63	3.55
1317.	3.59	3.48
1455.	3.56	3.45
1513.	3.58	3.46
1608.	3.56	3.43
1781.	3.52	3.37
1859.	3.50	3.35
1804.	3.50	3.35
2105.	3.36	3.18
2407.	3.17	2.96
2690.	3.06	2.82
2773.	3.06	2.81
2811.	3.05	2.80
2903.	3.00	2.74
2940.	2.99	2.73
2928.	2.97	2.70
2972.	2.96	2.69
3092.	2.87	2.59
3298.	2.73	2.43
3353.	2.73	2.42
3384.	2.67	2.36
3507.	2.60	2.28
3505.	2.60	2.27
3478.	2.59	2.27
3481.	2.60	2.28
3481.	2.61	2.28
3475.	2.60	2.28
3474.	2.61	2.29
3519.	2.57	2.24
3564.	2.52	2.19
3593.	2.49	2.16

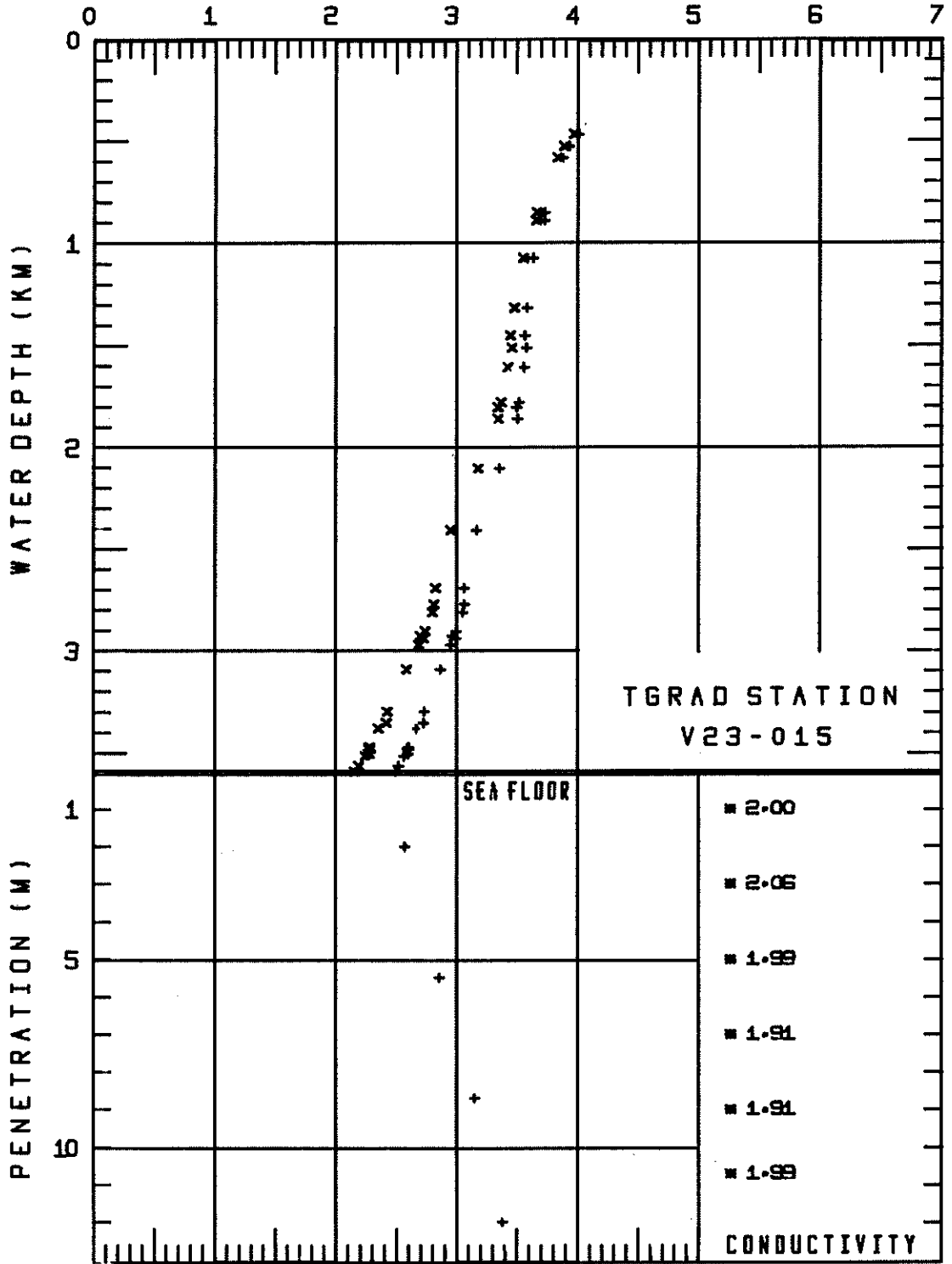
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.00	2.57
5.48	2.86
8.68	3.15
11.99	3.39

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.00
3.00	2.06
5.00	1.99
7.00	1.91
9.00	1.91
10.70	1.99

TEMPERATURE (C)



TGRAD STATION V23-016

WATER TEMPERATURES

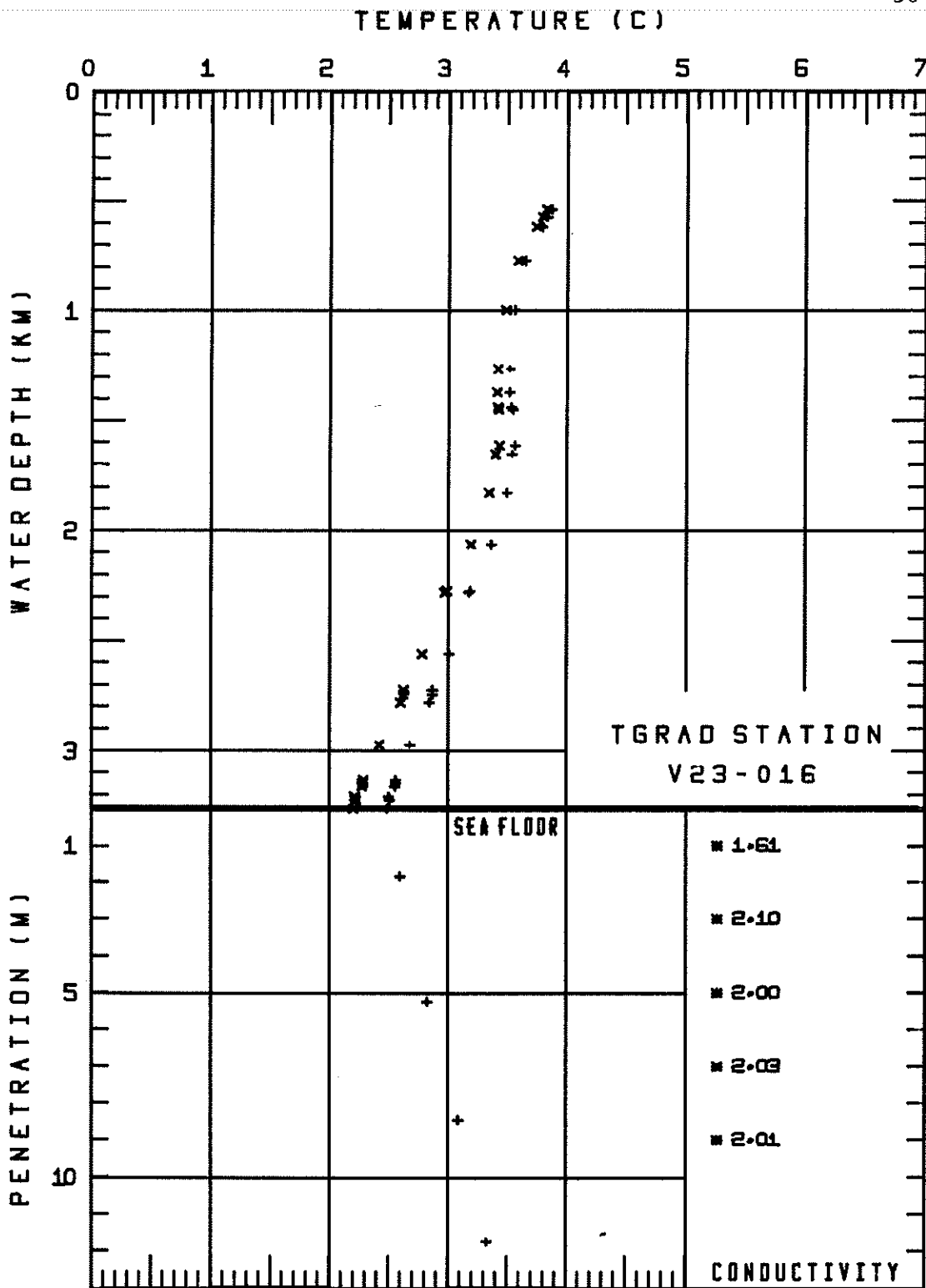
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
536.	3.86	3.82
571.	3.83	3.78
615.	3.78	3.73
772.	3.64	3.58
997.	3.55	3.48
1264.	3.51	3.41
1371.	3.52	3.41
1450.	3.54	3.42
1440.	3.53	3.41
1613.	3.56	3.43
1654.	3.53	3.40
1826.	3.49	3.34
2064.	3.36	3.19
2278.	3.17	2.97
2271.	3.18	2.98
2558.	3.00	2.78
2722.	2.86	2.63
2745.	2.87	2.63
2724.	2.86	2.63
2781.	2.84	2.60
2972.	2.68	2.42
3147.	2.56	2.28
3160.	2.55	2.27
3133.	2.56	2.28
3206.	2.50	2.22
3221.	2.50	2.22
3262.	2.49	2.20

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.85	2.60
5.24	2.83
8.44	3.09
11.75	3.33

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	1.61
3.00	2.10
5.00	2.00
7.00	2.03
9.00	2.01

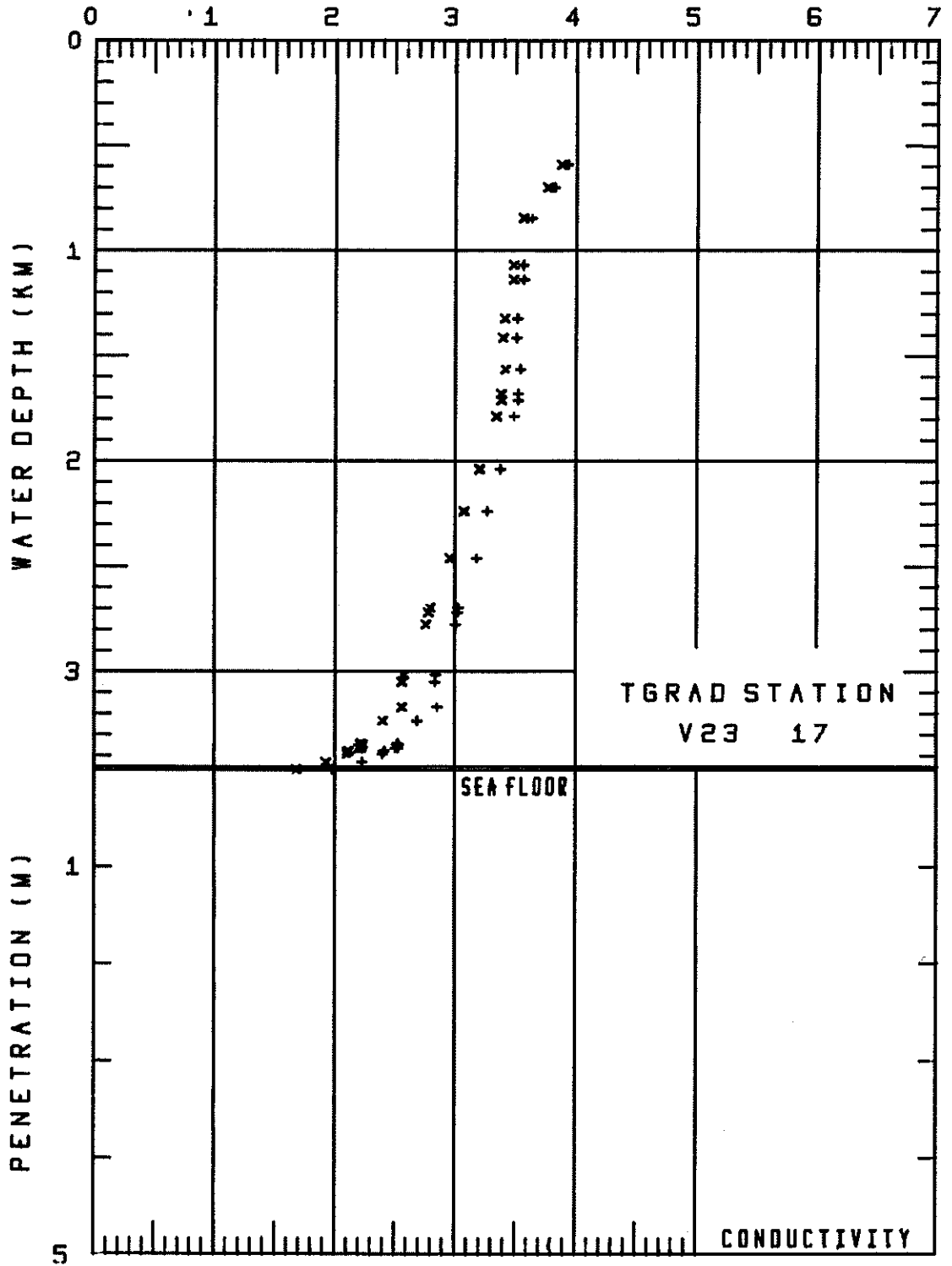


TGRAD STATION V23 17

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
590.	3.92	3.88
697.	3.81	3.76
842.	3.63	3.56
1066.	3.56	3.48
1136.	3.57	3.48
1321.	3.51	3.41
1412.	3.51	3.40
1562.	3.54	3.41
1677.	3.52	3.38
1710.	3.52	3.38
1786.	3.49	3.34
2034.	3.37	3.20
2234.	3.27	3.07
2457.	3.18	2.96
2692.	3.03	2.79
2715.	3.02	2.78
2775.	3.01	2.76
3014.	2.84	2.57
3046.	2.83	2.56
3167.	2.85	2.56
3233.	2.69	2.40
3345.	2.53	2.23
3362.	2.52	2.22
3348.	2.52	2.22
3340.	2.52	2.22
3342.	2.52	2.22
3347.	2.52	2.22
3363.	2.50	2.20
3378.	2.41	2.11
3374.	2.42	2.11
3388.	2.40	2.10
3428.	2.23	1.92
3463.	1.98	1.68

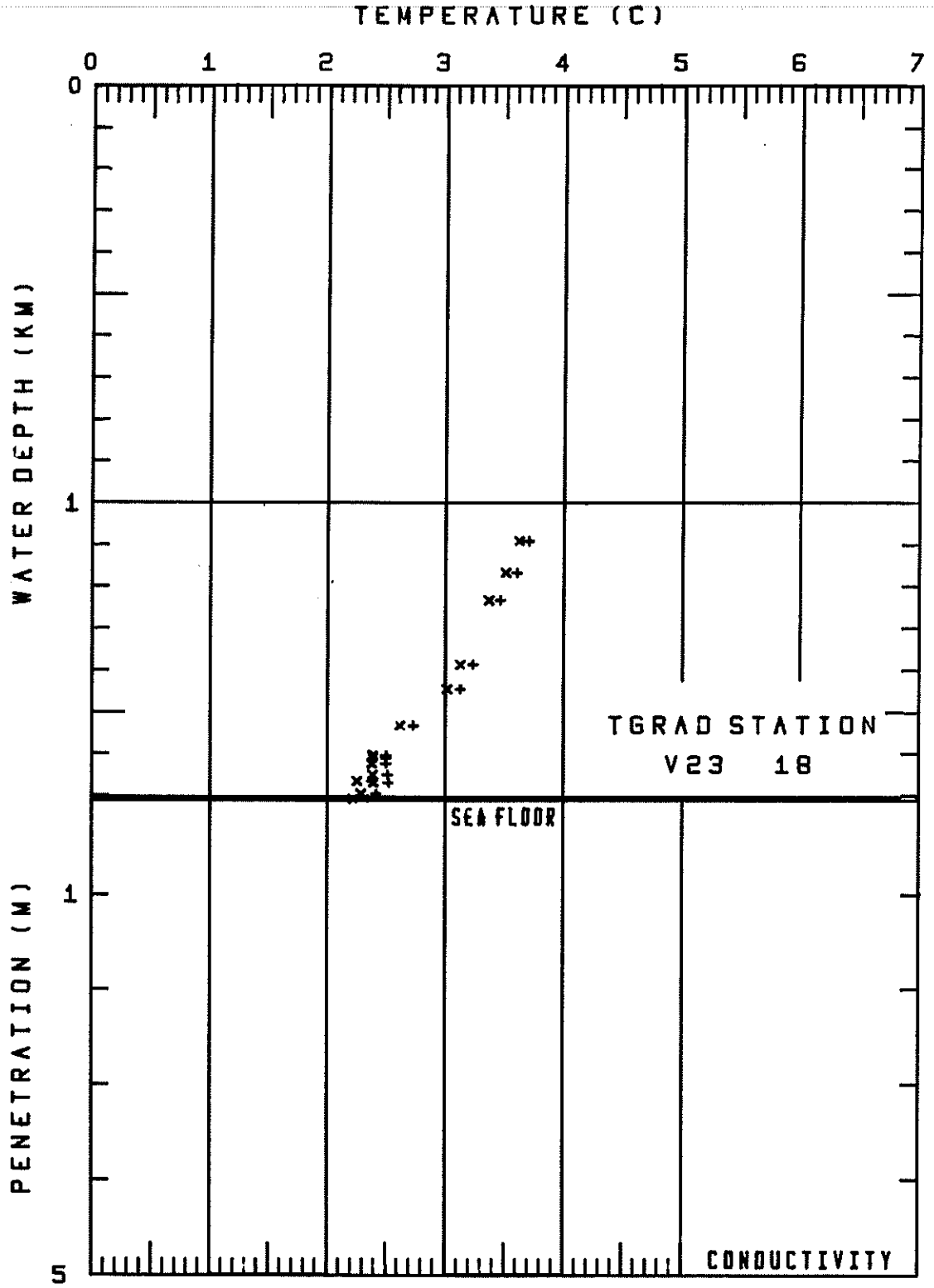
TEMPERATURE (C)



TGRAD STATION V23 18

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1090.	3.70	3.62
1166.	3.60	3.51
1231.	3.46	3.37
1386.	3.23	3.13
1443.	3.13	3.02
1531.	2.73	2.62
1667.	2.52	2.40
1650.	2.51	2.39
1608.	2.50	2.39
1603.	2.50	2.39
1622.	2.50	2.38
1664.	2.38	2.26
1695.	2.41	2.29
1708.	2.35	2.22



TGRAD STATION V23-019

WATER TEMPERATURES

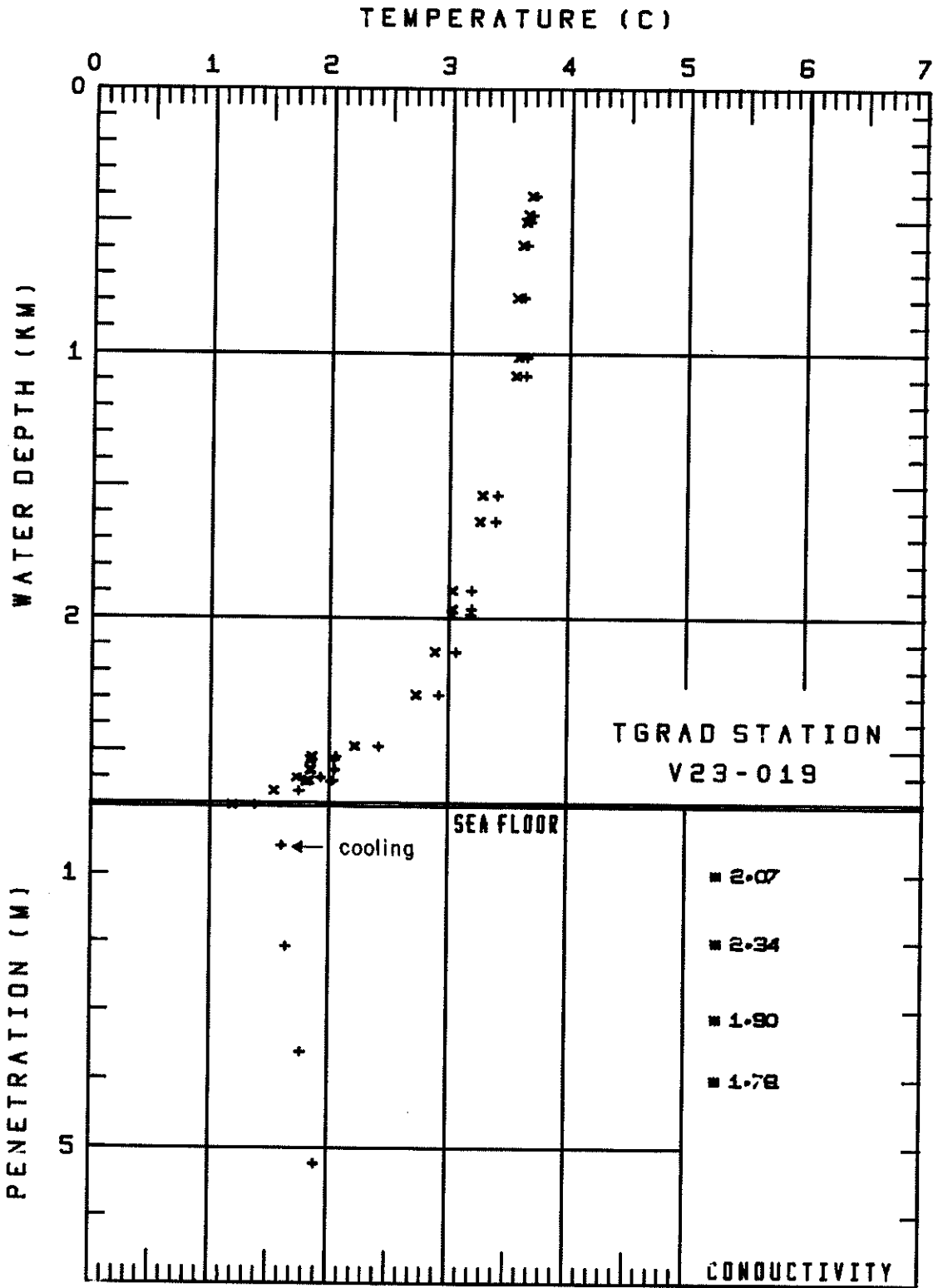
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
402.	3.69	3.67
476.	3.67	3.64
503.	3.66	3.62
589.	3.64	3.59
787.	3.61	3.56
1014.	3.64	3.56
1083.	3.63	3.55
1535.	3.40	3.28
1632.	3.39	3.26
1962.	3.19	3.03
1895.	3.18	3.03
1985.	3.18	3.02
2125.	3.06	2.88
2288.	2.92	2.73
2483.	2.41	2.21
2613.	2.03	1.83
2574.	2.04	1.84
2534.	2.04	1.84
2569.	2.04	1.84
2522.	2.05	1.85
2615.	2.01	1.81
2600.	1.93	1.73
2651.	1.74	1.54
2706.	1.38	1.18

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.60	1.61
2.06	1.65
3.61	1.78
5.24	1.90

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.07
2.00	2.34
3.10	1.90
4.00	1.78



TGRAD STATION V23-020

WATER TEMPERATURES

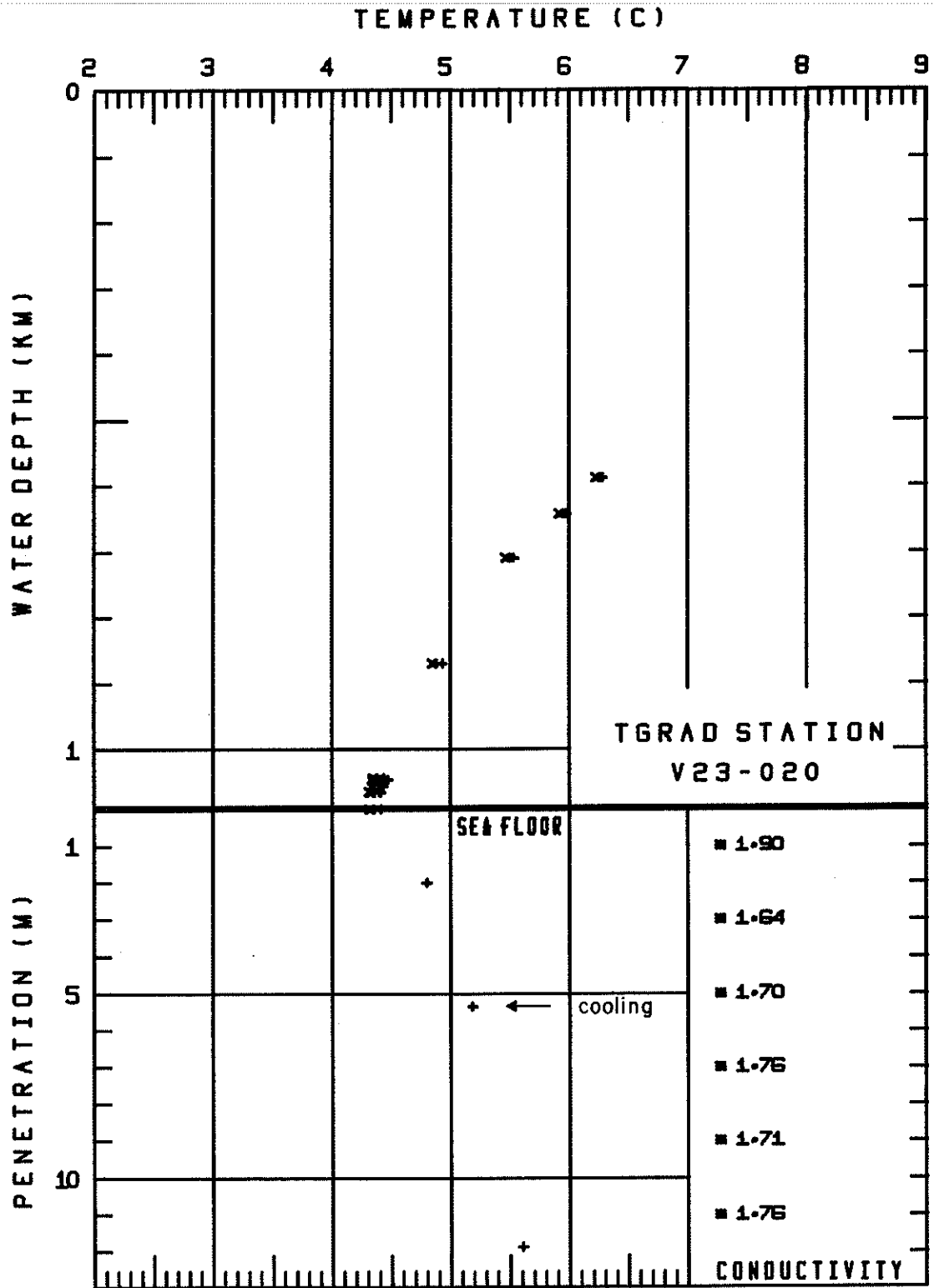
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
588.	6.27	6.22
642.	5.97	5.91
709.	5.53	5.46
868.	4.92	4.85
1046.	4.47	4.38
1065.	4.41	4.32
1055.	4.43	4.34
1048.	4.44	4.35
1043.	4.43	4.35
1065.	4.40	4.31
1091.	4.41	4.32

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.00	4.80
5.36	5.18
11.88	5.61

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	1.90
3.00*	1.64
5.00	1.70
7.00	1.76
9.00	1.71
11.00	1.76



TGRAD STATION V23-021

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
742.	6.26	6.19
801.	5.88	5.80
864.	5.60	5.52
1078.	4.74	4.64
1283.	3.97	3.86
1321.	3.92	3.81
1310.	3.95	3.84
1307.	3.95	3.84
1330.	3.90	3.79
1365.	3.80	3.69

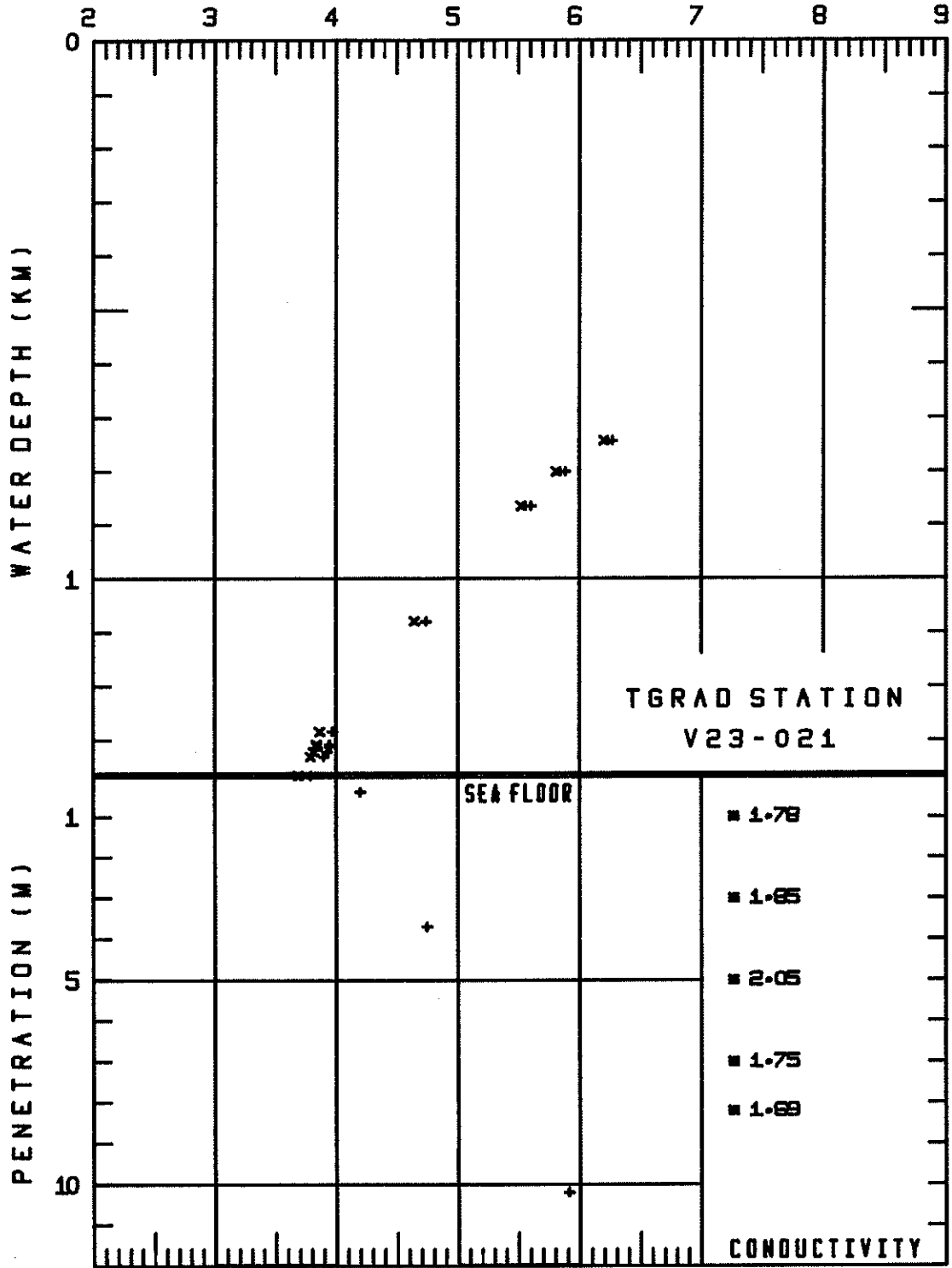
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.40	4.20
3.70	4.75
10.20	5.91

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	1.78
3.00	1.85
5.00	2.05
7.00	1.75
8.20	1.69

TEMPERATURE (C)



TGRAD STATION V23-023

WATER TEMPERATURES

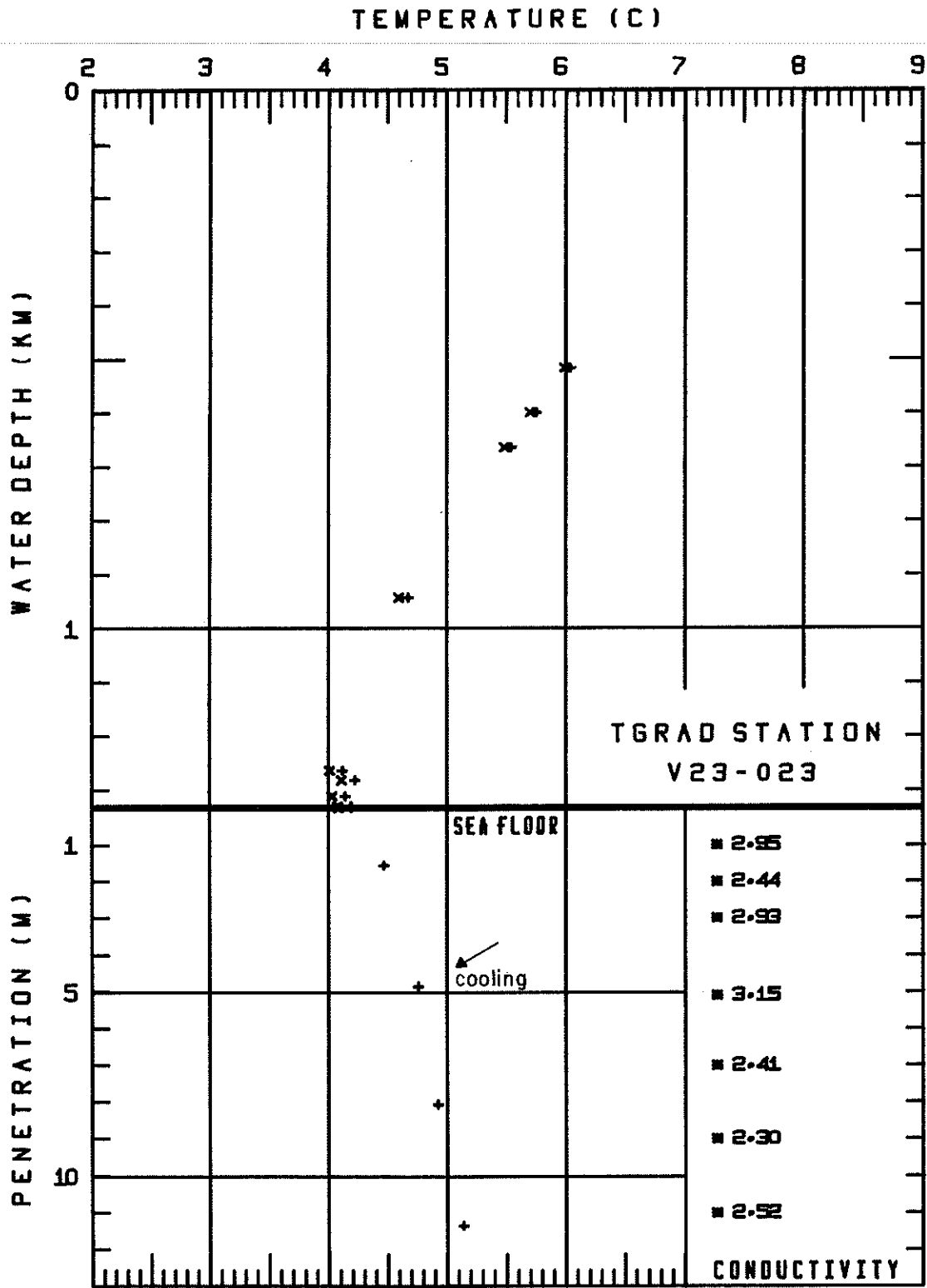
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
516.	6.03	5.99
598.	5.75	5.69
663.	5.54	5.48
942.	4.67	4.59
1263.	4.11	4.01
1280.	4.22	4.11
1333.	4.19	4.08
1330.	4.18	4.07
1311.	4.14	4.03

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.55	4.47
4.86	4.76
8.06	4.93
11.36	5.14

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.95
2.00	2.44
3.00	2.93
5.10	3.15
7.00	2.41
9.00	2.30
11.00	2.52



TGRAD STATION V23-024

WATER TEMPERATURES

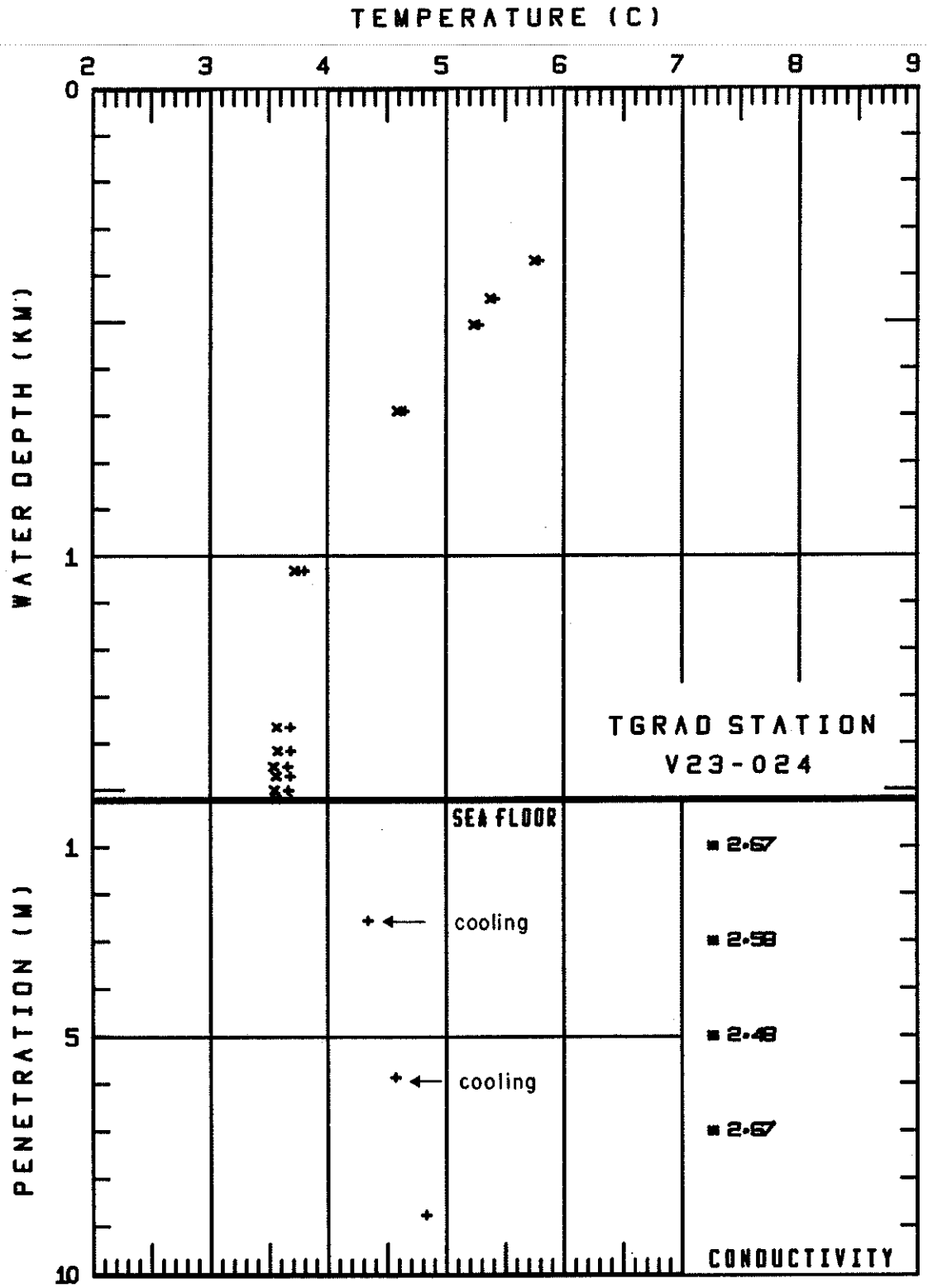
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
370.	5.78	5.75
451.	5.41	5.37
507.	5.28	5.23
692.	4.64	4.59
1033.	3.80	3.72
1366.	3.68	3.57
1451.	3.66	3.54
1471.	3.68	3.56
1418.	3.69	3.57
1502.	3.67	3.54
1520.	3.69	3.56

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.56	4.34
5.87	4.58
8.77	4.83

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.67
3.00	2.58
5.00	2.48
7.00	2.67



TGRAD STATION V23-025

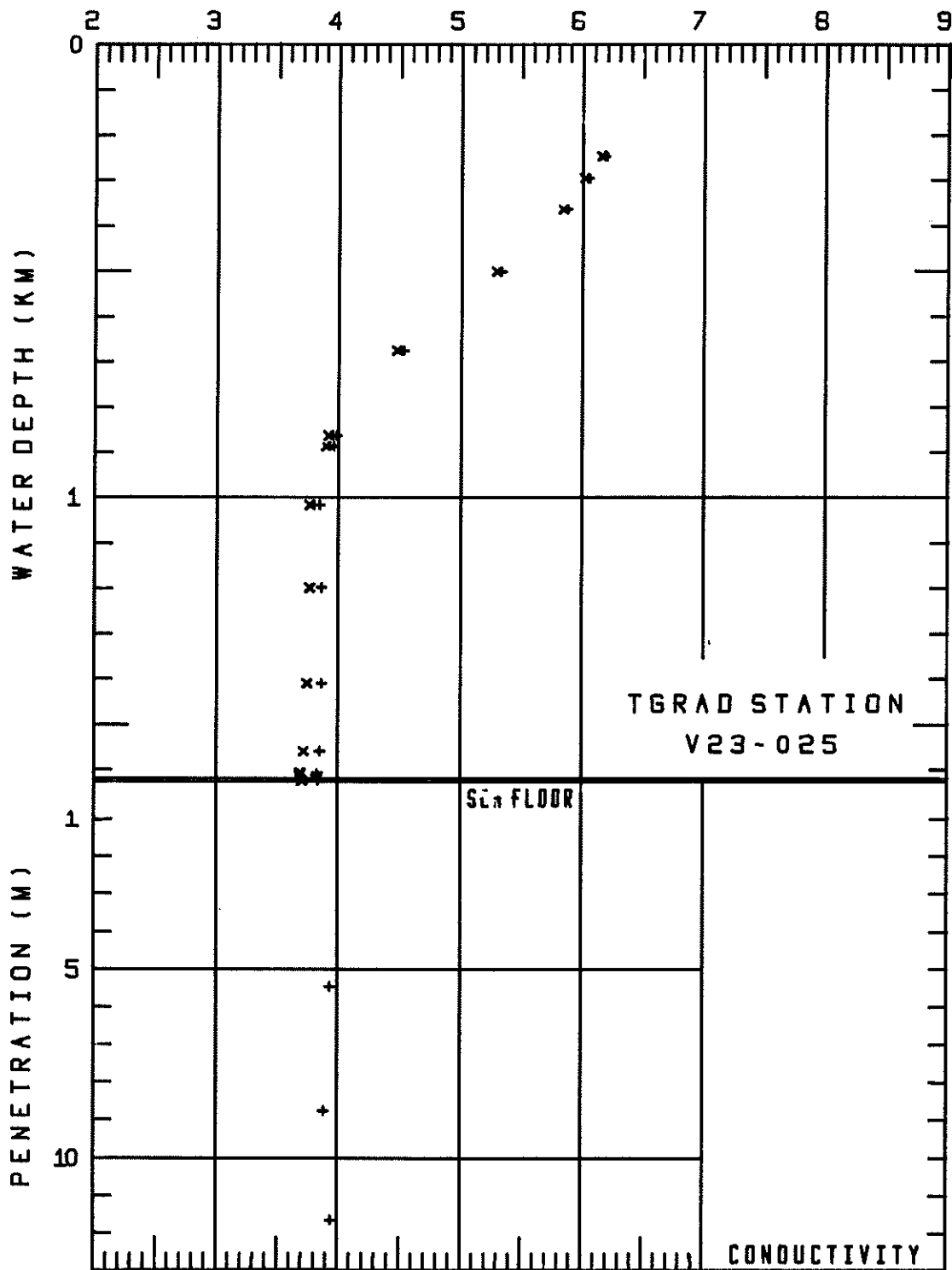
WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
245.	6.17	6.15
294.	6.04	6.01
363.	5.87	5.83
500.	5.33	5.29
674.	4.52	4.47
862.	3.98	3.91
885.	3.96	3.89
1016.	3.84	3.76
1198.	3.86	3.76
1409.	3.86	3.74
1558.	3.84	3.71
1623.	3.84	3.70
1605.	3.82	3.69
1610.	3.82	3.68

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
5.45	3.93
8.75	3.88
11.65	3.94

TEMPERATURE (C)



TGRAD STATION V23-026

WATER TEMPERATURES

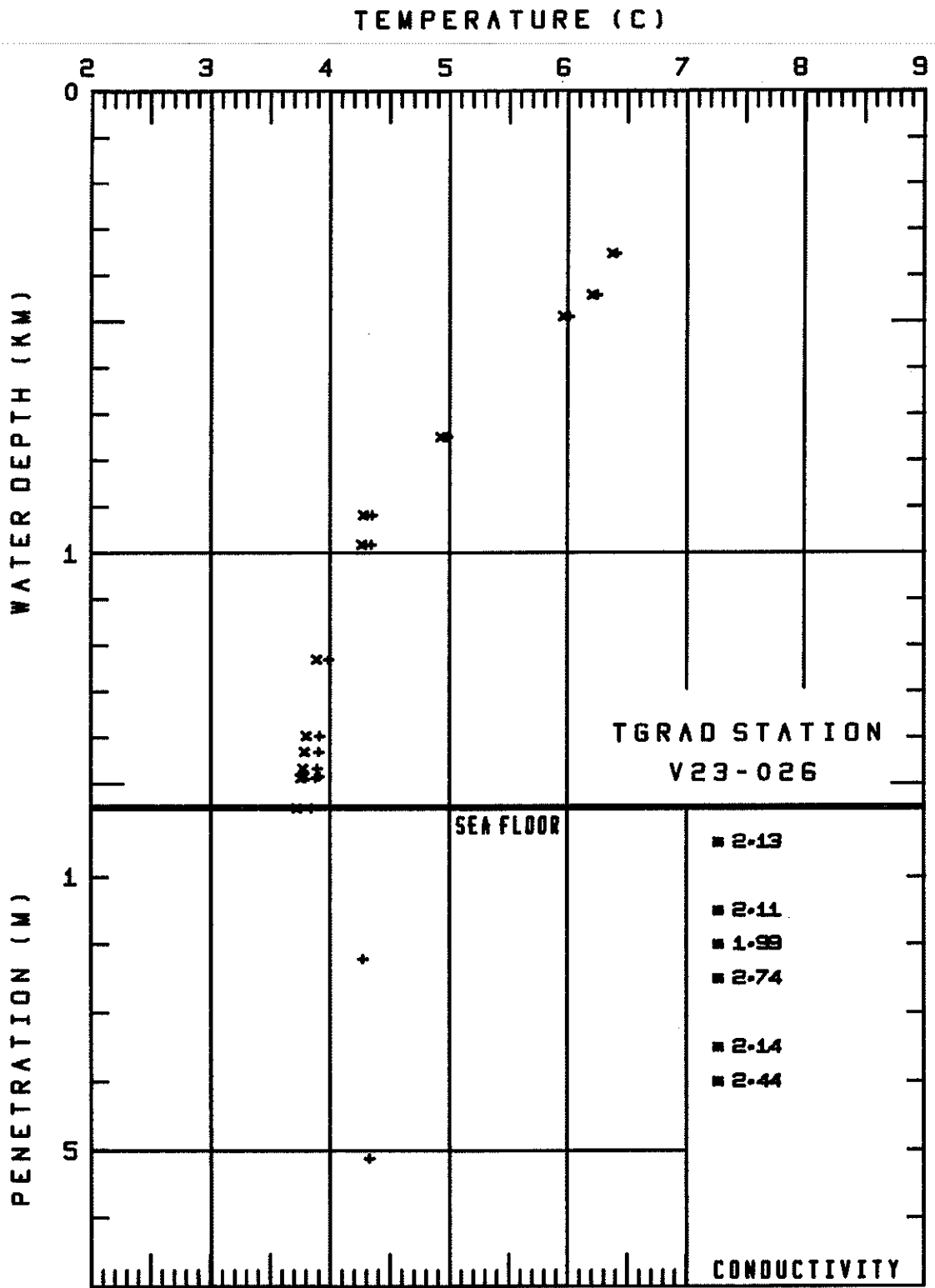
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
351.	6.40	6.37
441.	6.24	6.20
489.	6.00	5.96
748.	4.98	4.92
917.	4.35	4.27
982.	4.34	4.26
1229.	3.99	3.88
1429.	3.91	3.79
1396.	3.92	3.80
1465.	3.89	3.77
1483.	3.91	3.78
1487.	3.88	3.75
1552.	3.85	3.72

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.20	4.28
5.12	4.33

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
0.50	2.13
1.50	2.11
2.00	1.99
2.50	2.74
3.50	2.14
4.00	2.44



TGRAD STATION V23-027

WATER TEMPERATURES

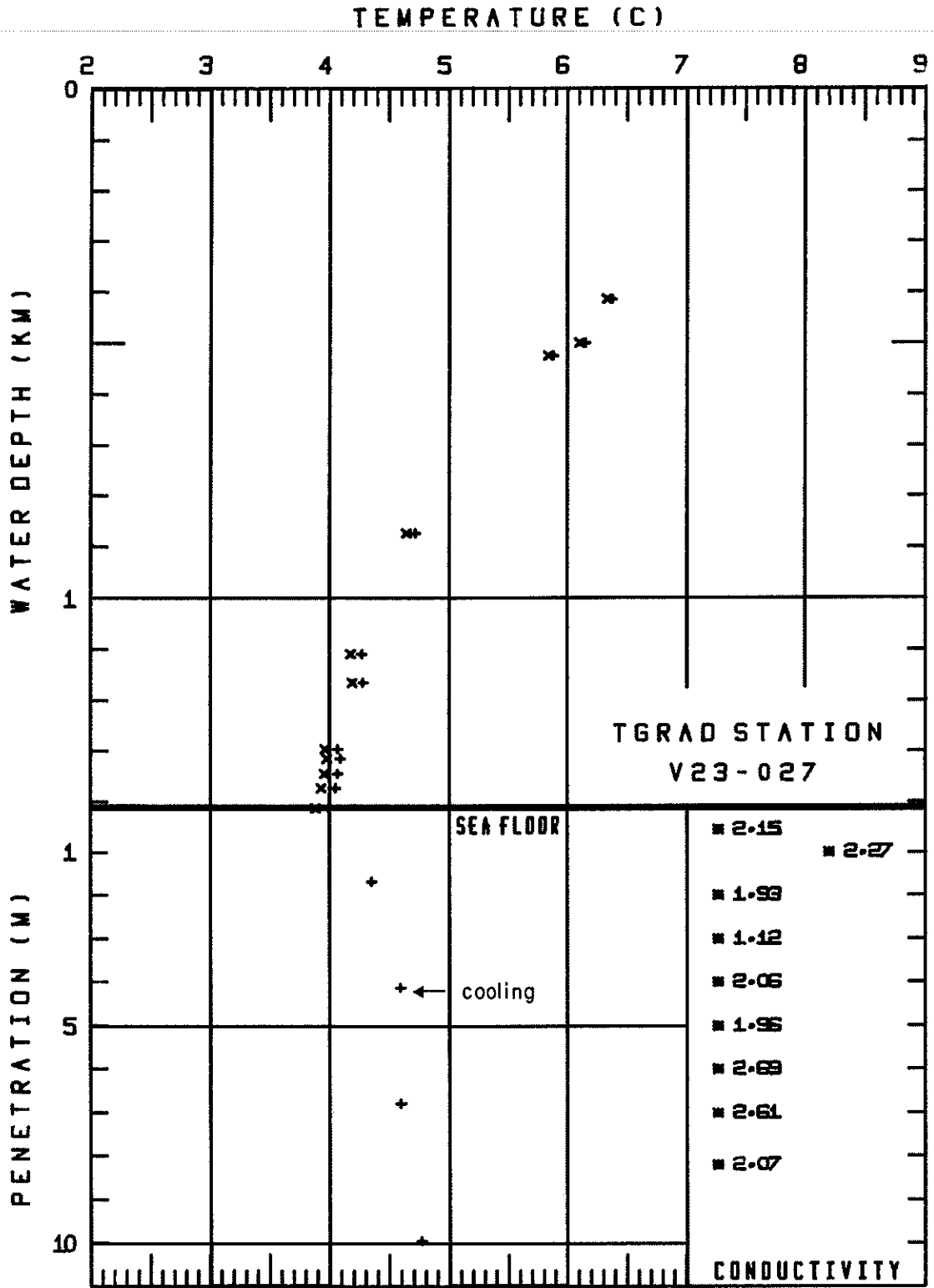
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
413.	6.36	6.33
498.	6.15	6.10
523.	5.88	5.83
871.	4.71	4.64
1108.	4.26	4.17
1164.	4.28	4.18
1313.	4.08	3.98
1294.	4.07	3.96
1343.	4.07	3.96
1371.	4.04	3.93
1411.	4.00	3.88

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.68	4.35
4.12	4.59
6.78	4.59
9.93	4.76

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
0.50	2.15
1.00	2.27
2.00	1.93
3.00	1.12
4.00	2.06
5.00	1.96
6.00	2.69
7.00	2.61
8.20	2.07



TGRAD STATION V23-028

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
276.	5.76	5.74
323.	5.57	5.54
389.	5.48	5.45
709.	4.58	4.52
1072.	4.11	4.02
1319.	4.02	3.91
1322.	4.00	3.88
1333.	4.01	3.90
1385.	4.00	3.88
1313.	4.00	3.89
1347.	3.99	3.87
1386.	3.95	3.83

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.06	4.27
4.86	4.21
7.72	4.26

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	1.98
2.00	2.01
3.00	2.18
4.00	2.92
5.00	2.00
5.70	2.10

TGRAD STATION V23-029

WATER TEMPERATURES

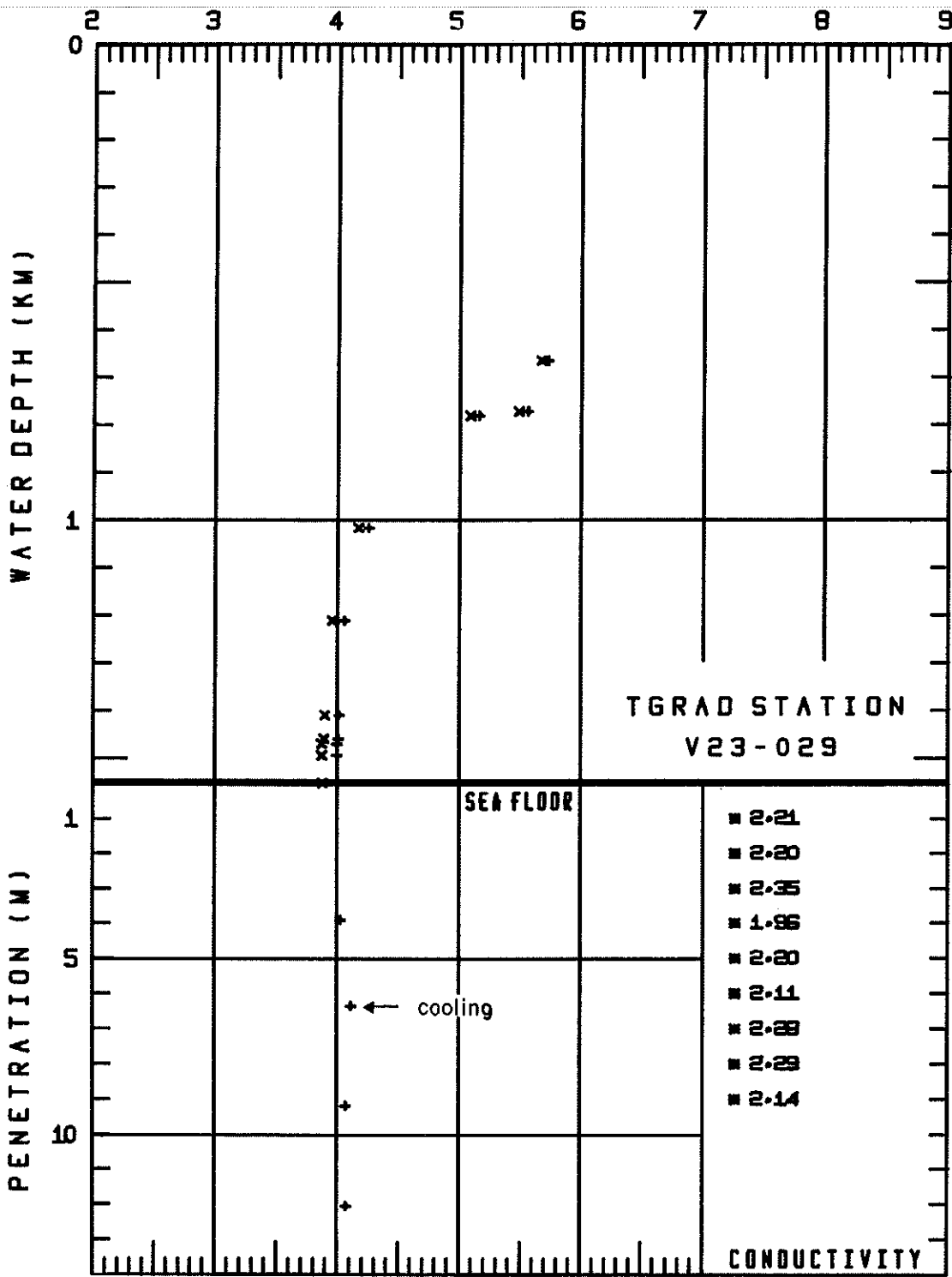
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
663.	5.72	5.66
770.	5.55	5.48
779.	5.16	5.09
1015.	4.25	4.17
1209.	4.05	3.95
1408.	4.01	3.90
1459.	4.01	3.88
1468.	3.99	3.87
1493.	4.00	3.87
1551.	4.00	3.87

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.90	4.03
6.34	4.11
9.20	4.07
12.04	4.07

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.21
2.00	2.20
3.00	2.35
4.00	1.96
5.00	2.20
6.00	2.11
7.00	2.28
8.00	2.29
9.00	2.14



TGRAD STATION V23-030

WATER TEMPERATURES

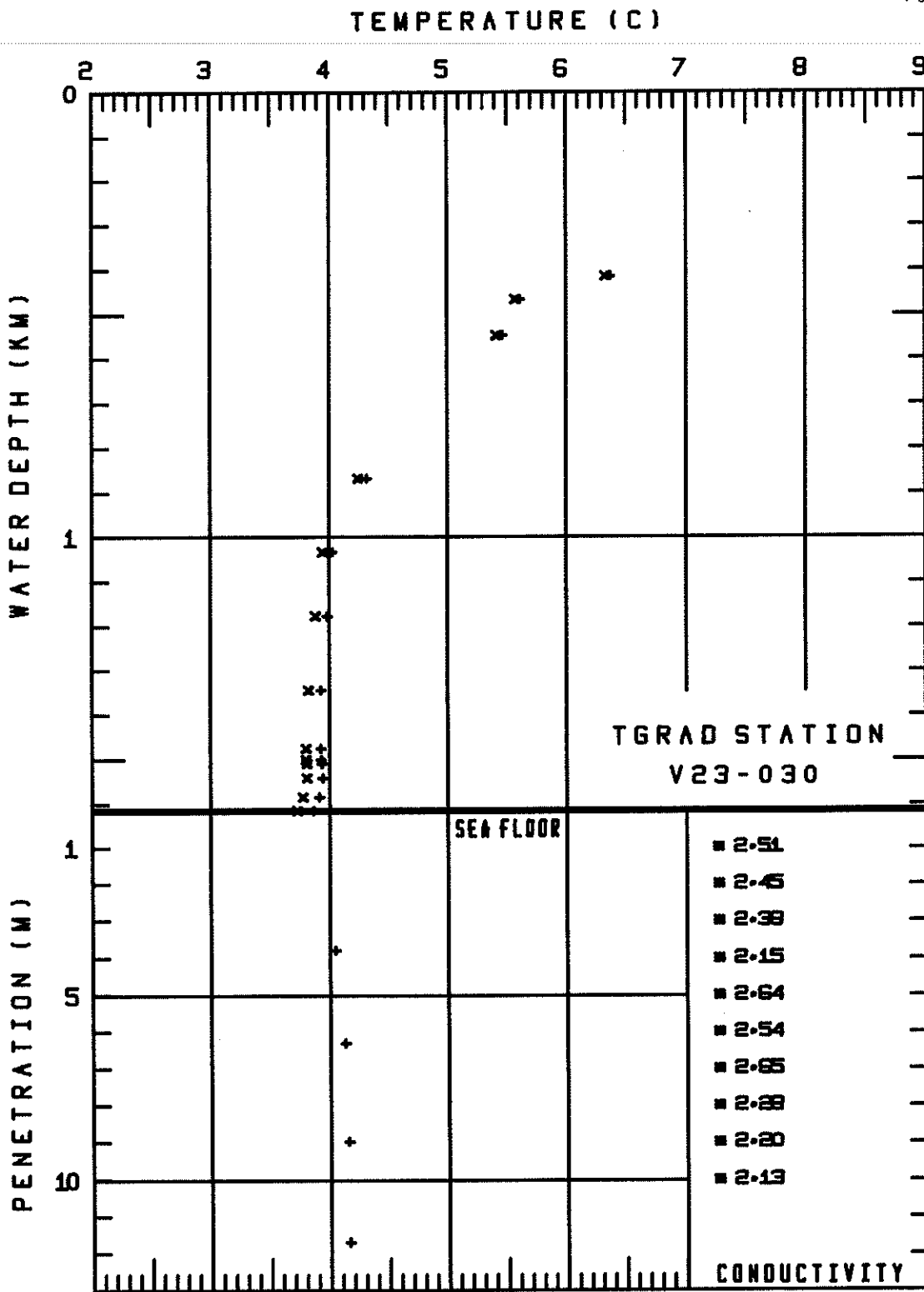
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
415.	6.36	6.32
466.	5.60	5.56
547.	5.46	5.41
869.	4.31	4.24
1033.	4.02	3.94
1177.	3.98	3.88
1345.	3.93	3.82
1476.	3.92	3.80
1500.	3.93	3.80
1509.	3.94	3.81
1541.	3.94	3.81
1585.	3.91	3.78
1615.	3.87	3.73

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.80	4.04
6.30	4.13
8.98	4.16
11.70	4.16

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.51
2.00	2.45
3.00	2.38
4.00	2.15
5.00	2.64
6.00	2.54
7.00	2.65
8.00	2.28
9.00	2.20
10.00	2.13



TGRAD STATION V23-031

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
158.	6.31	6.30
219.	6.10	6.08
309.	6.15	6.12
337.	5.98	5.95
436.	5.44	5.41
501.	5.31	5.27
559.	5.32	5.28
940.	4.07	4.00
1116.	4.04	3.95
1300.	3.91	3.80
1387.	3.89	3.78
1381.	3.89	3.77
1382.	3.90	3.78
1386.	3.89	3.77
1398.	3.89	3.78
1434.	3.85	3.74
1452.	3.83	3.71

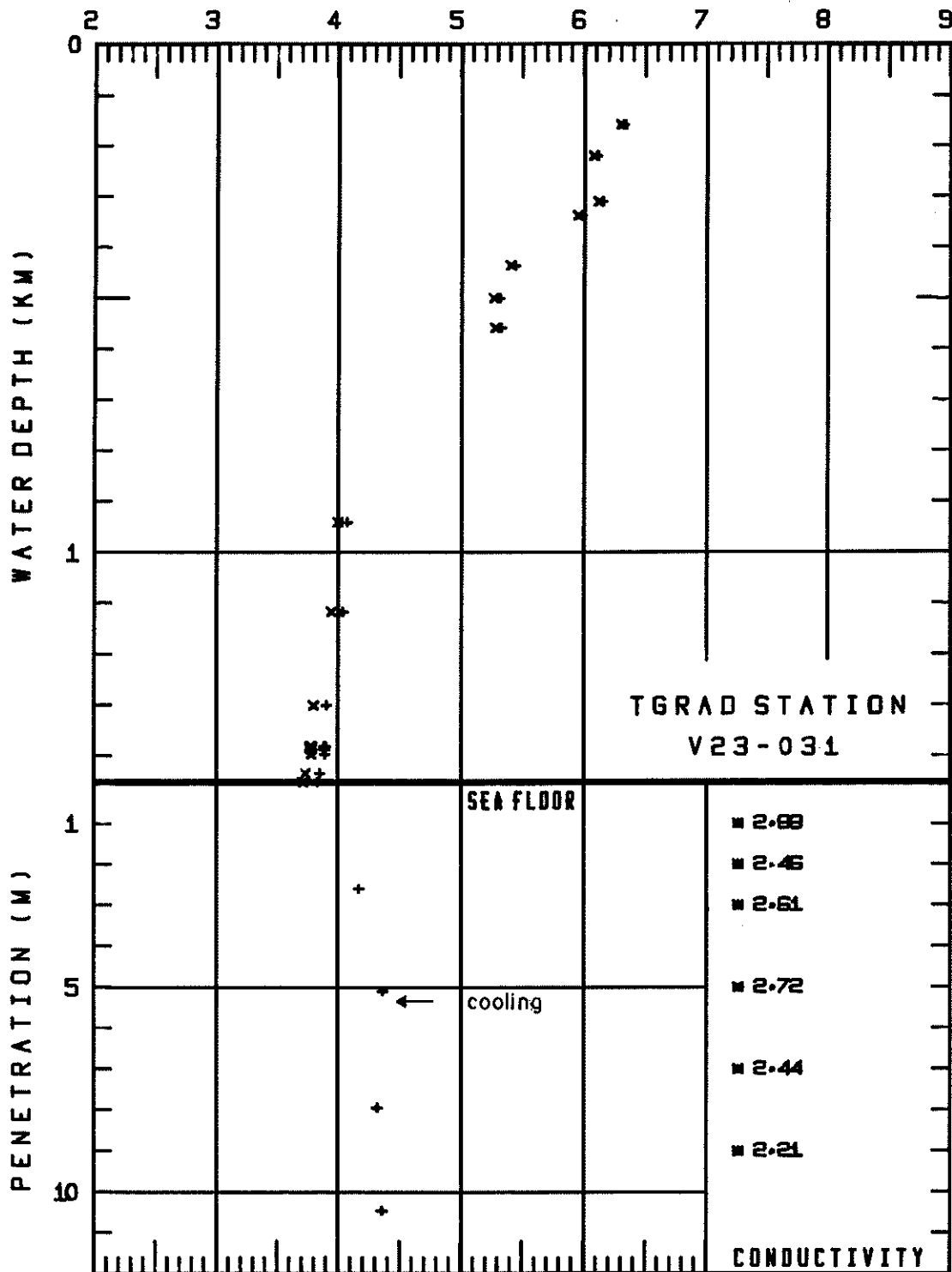
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.60	4.17
5.10	4.36
7.94	4.32
10.46	4.36

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.88
2.00	2.46
3.00	2.61
5.00	2.72
7.00	2.44
9.00	2.21

TEMPERATURE (C)



TGRAD STATION V23 32

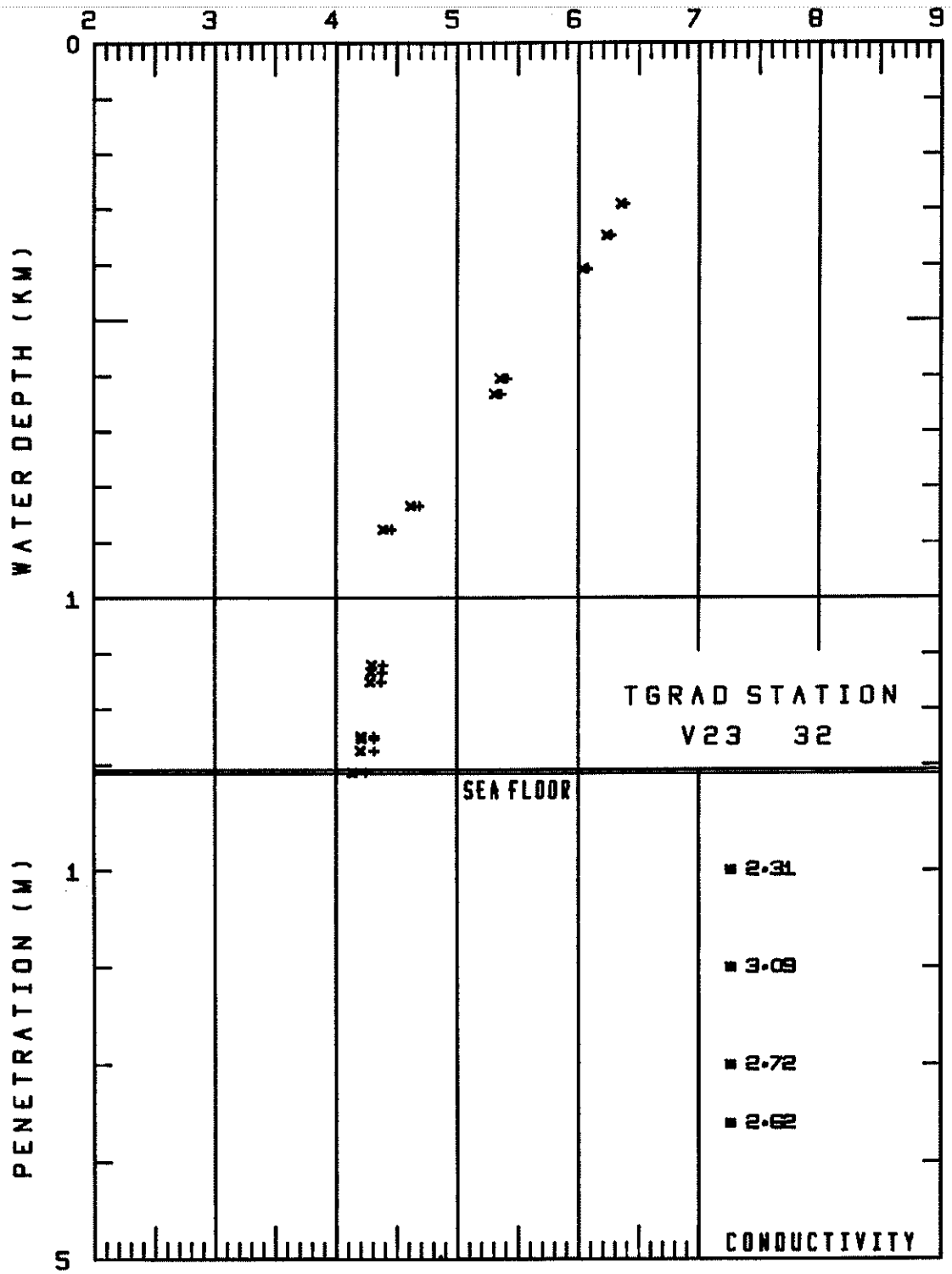
WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
290.	6.37	6.35
348.	6.26	6.23
408.	6.06	6.03
605.	5.40	5.35
632.	5.36	5.31
834.	4.68	4.61
877.	4.46	4.38
1120.	4.39	4.29
1152.	4.38	4.28
1134.	4.38	4.28
1250.	4.31	4.21
1254.	4.31	4.21
1276.	4.31	4.20
1315.	4.25	4.13

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.31
2.00	3.09
3.00	2.72
3.60	2.62

TEMPERATURE (C)



TGRAD STATION V23-033

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
254.	6.32	6.30
443.	5.77	5.73
505.	5.46	5.41
588.	5.28	5.23
669.	5.04	4.99
1030.	4.56	4.47
1073.	4.42	4.33
1149.	4.45	4.35
1160.	4.43	4.34
1190.	4.44	4.33
1192.	4.44	4.34
1237.	4.44	4.34

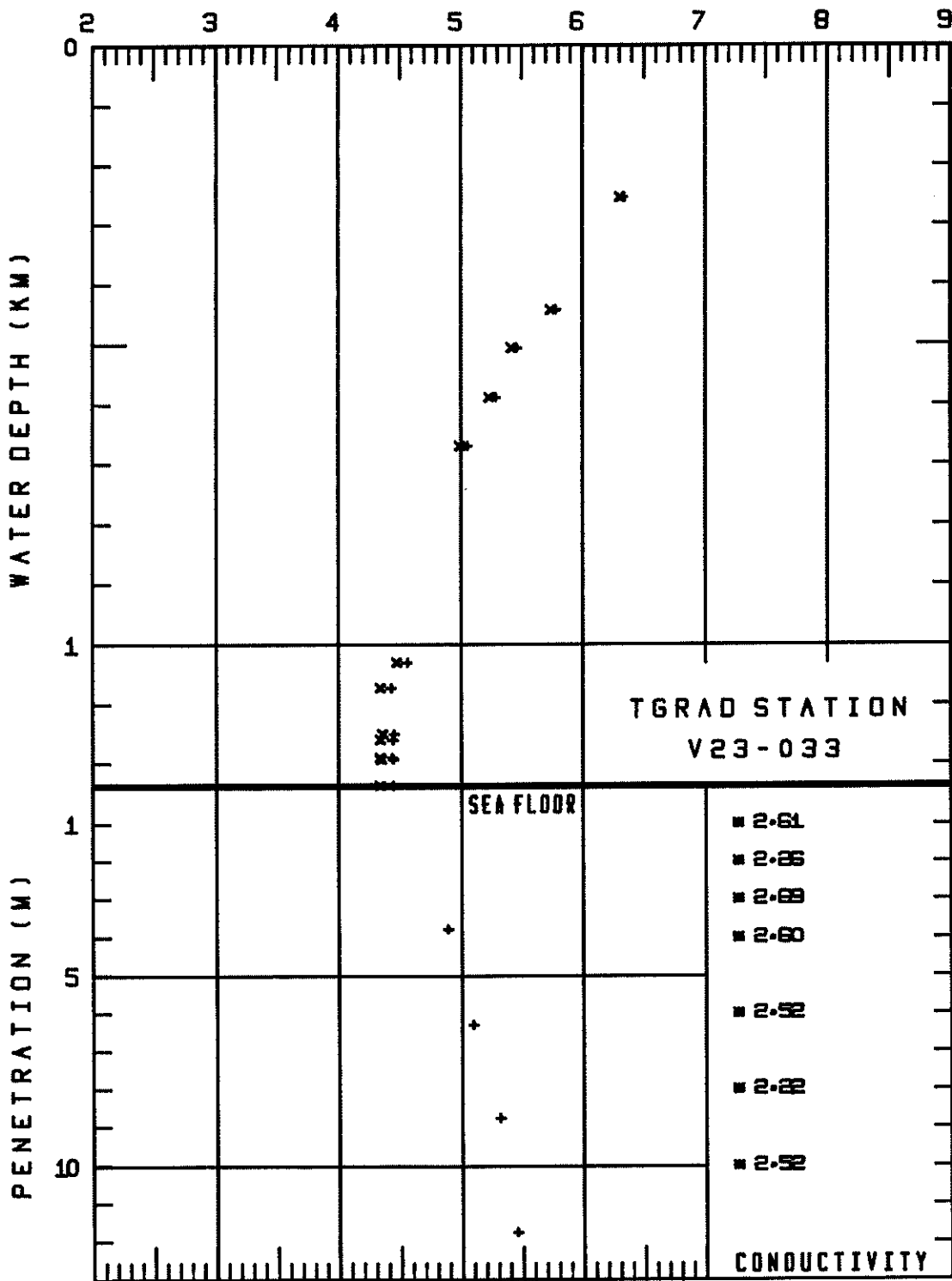
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.80	4.88
6.30	5.10
8.75	5.31
11.77	5.46

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.61
2.00	2.26
3.00	2.69
4.00	2.60
6.00	2.52
8.00	2.22
10.00	2.52

TEMPERATURE (C)



TGRAD STATION V23-034

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
241.	6.31	6.29
310.	6.05	6.02
418.	5.83	5.80
743.	4.95	4.89
950.	4.72	4.64
979.	4.69	4.61
1130.	4.65	4.55
1134.	4.64	4.54
1124.	4.61	4.52
1170.	4.62	4.52

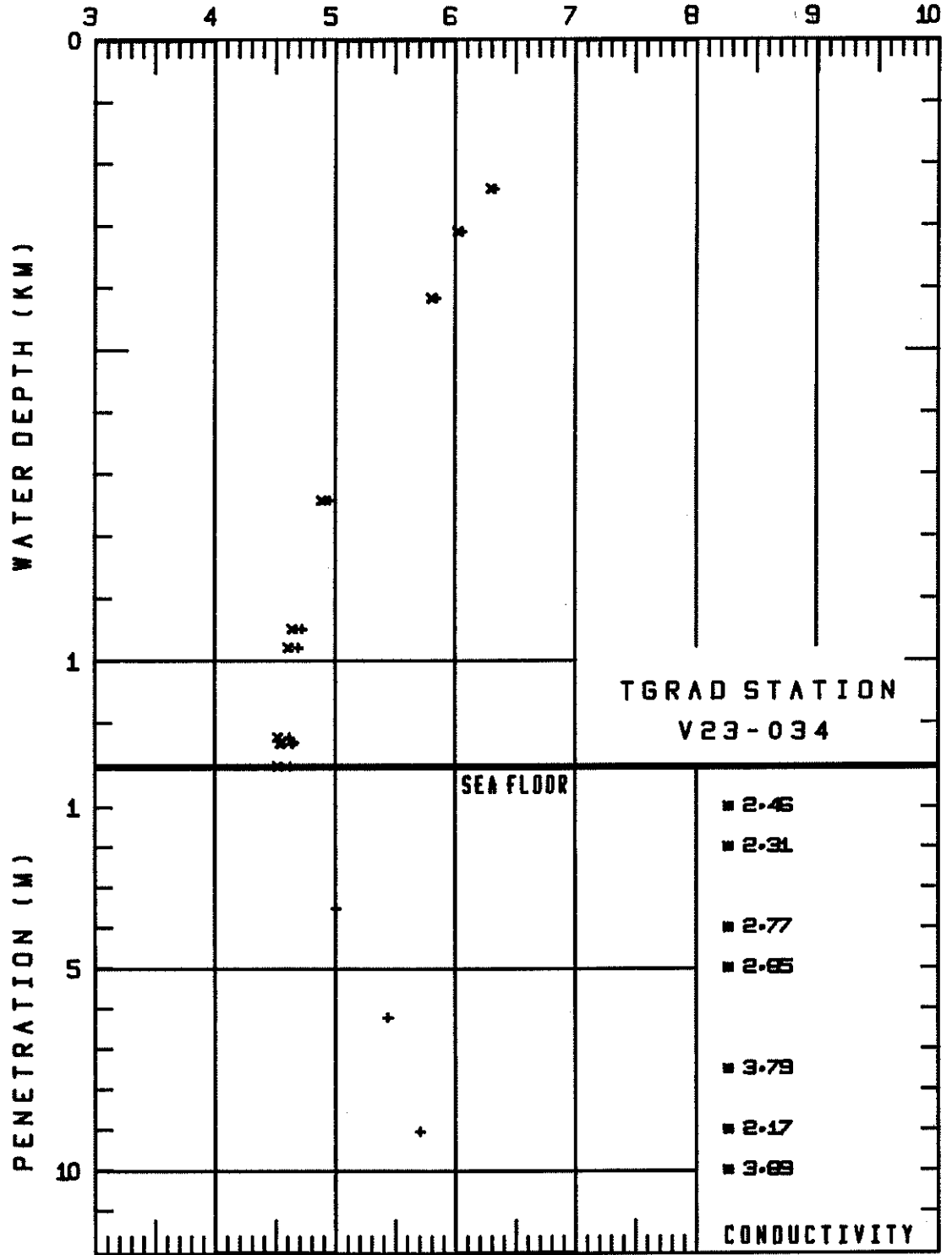
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.52	5.01
6.21	5.44
9.03	5.71

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.46
2.00	2.31
4.00	2.77
5.00	2.85
7.50	3.79
9.00	2.17
10.00	3.89

TEMPERATURE (C)



TGRAD STATION V23-035

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
454.	5.57	5.53
542.	5.41	5.36
615.	5.16	5.10
865.	4.46	4.39
1053.	4.20	4.11
1173.	4.14	4.04
1164.	4.13	4.03
1180.	4.12	4.02
1238.	4.11	4.01

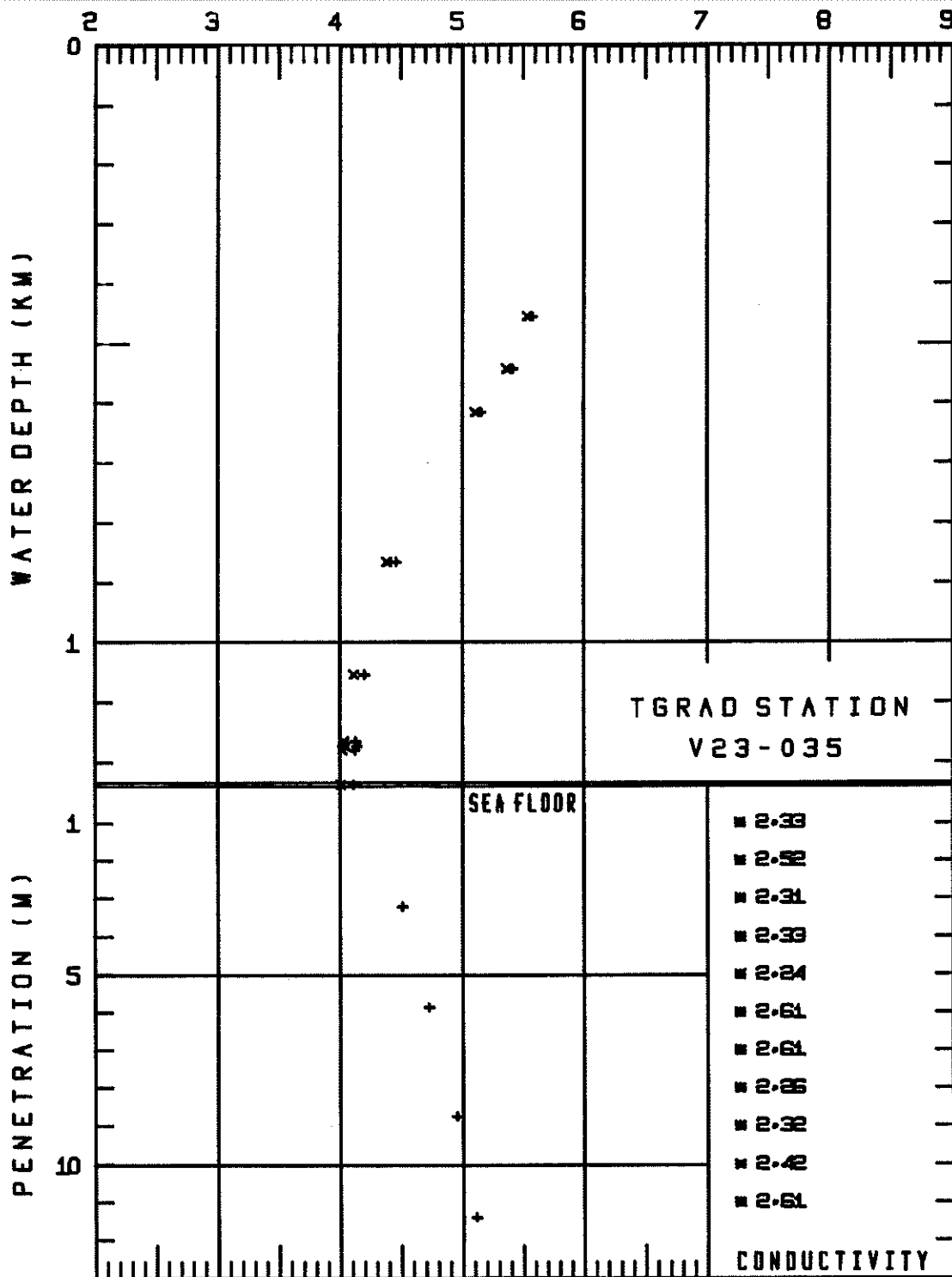
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.20	4.52
5.85	4.73
8.74	4.95
11.39	5.12

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.33
2.00	2.52
3.00	2.31
4.00	2.33
5.00	2.24
6.00	2.61
7.00	2.61
8.00	2.26
9.00	2.32
10.00	2.42
11.00	2.61

TEMPERATURE (C)



TGRAD STATION V23-036

WATER TEMPERATURES

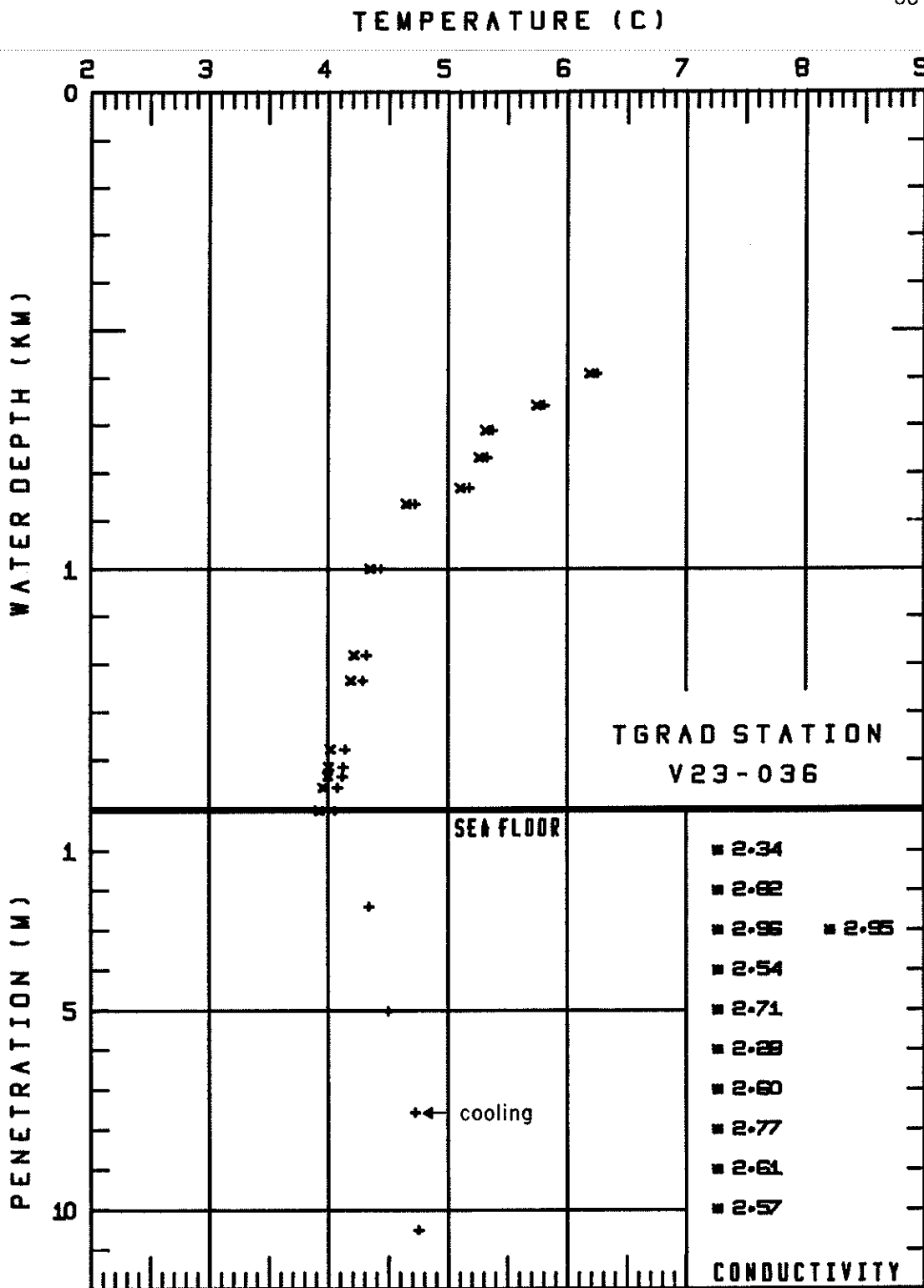
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
591.	6.24	6.18
657.	5.80	5.74
710.	5.37	5.31
767.	5.33	5.26
830.	5.17	5.10
864.	4.72	4.64
1000.	4.43	4.35
1180.	4.31	4.21
1232.	4.29	4.18
1377.	4.14	4.02
1414.	4.13	4.00
1433.	4.12	4.00
1457.	4.08	3.96
1506.	4.06	3.93

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.40	4.34
5.02	4.50
7.55	4.73
10.49	4.75

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.34
2.00	2.82
3.00	2.96
4.00	2.54
5.00	2.71
6.00	2.28
7.00	2.60
8.00	2.77
9.00	2.61
10.00	2.57



TGRAD STATION V23-037

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
319.	6.45	6.42
368.	6.18	6.15
428.	6.02	5.98
648.	5.25	5.20
714.	5.14	5.08
773.	5.01	4.94
823.	4.80	4.73
1011.	4.46	4.38
1164.	4.37	4.27
1326.	4.23	4.12
1326.	4.24	4.13
1308.	4.22	4.11

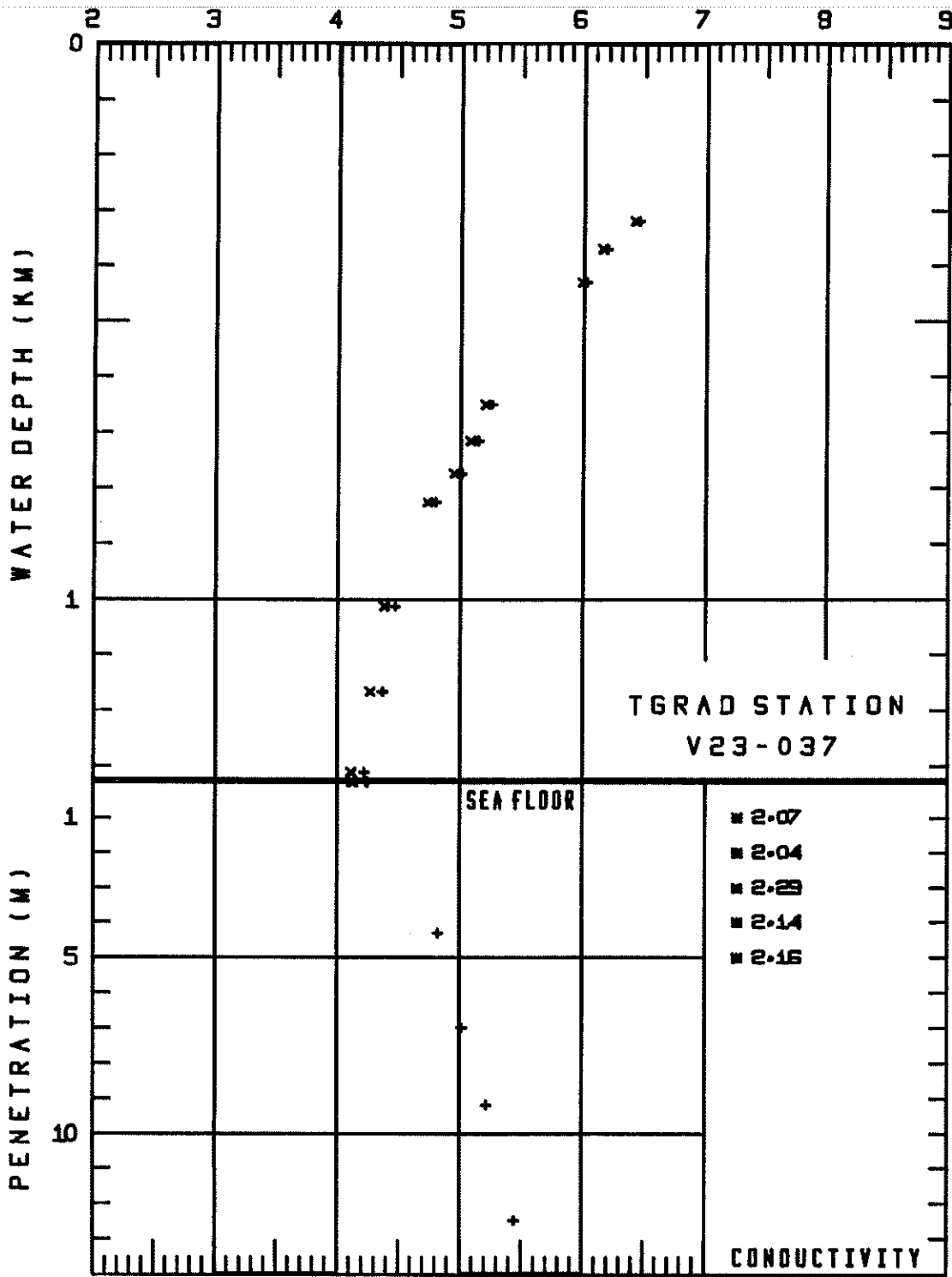
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
4.30	4.83
6.98	5.02
9.18	5.22
12.45	5.45

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.07
2.00	2.04
3.00	2.29
4.00	2.14
5.00	2.16

TEMPERATURE (C)



TGRAD STATION V23-038

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
443.	6.16	6.12
529.	5.95	5.90
687.	5.34	5.28
764.	5.03	4.96
909.	4.75	4.67
960.	4.80	4.72
996.	4.79	4.70

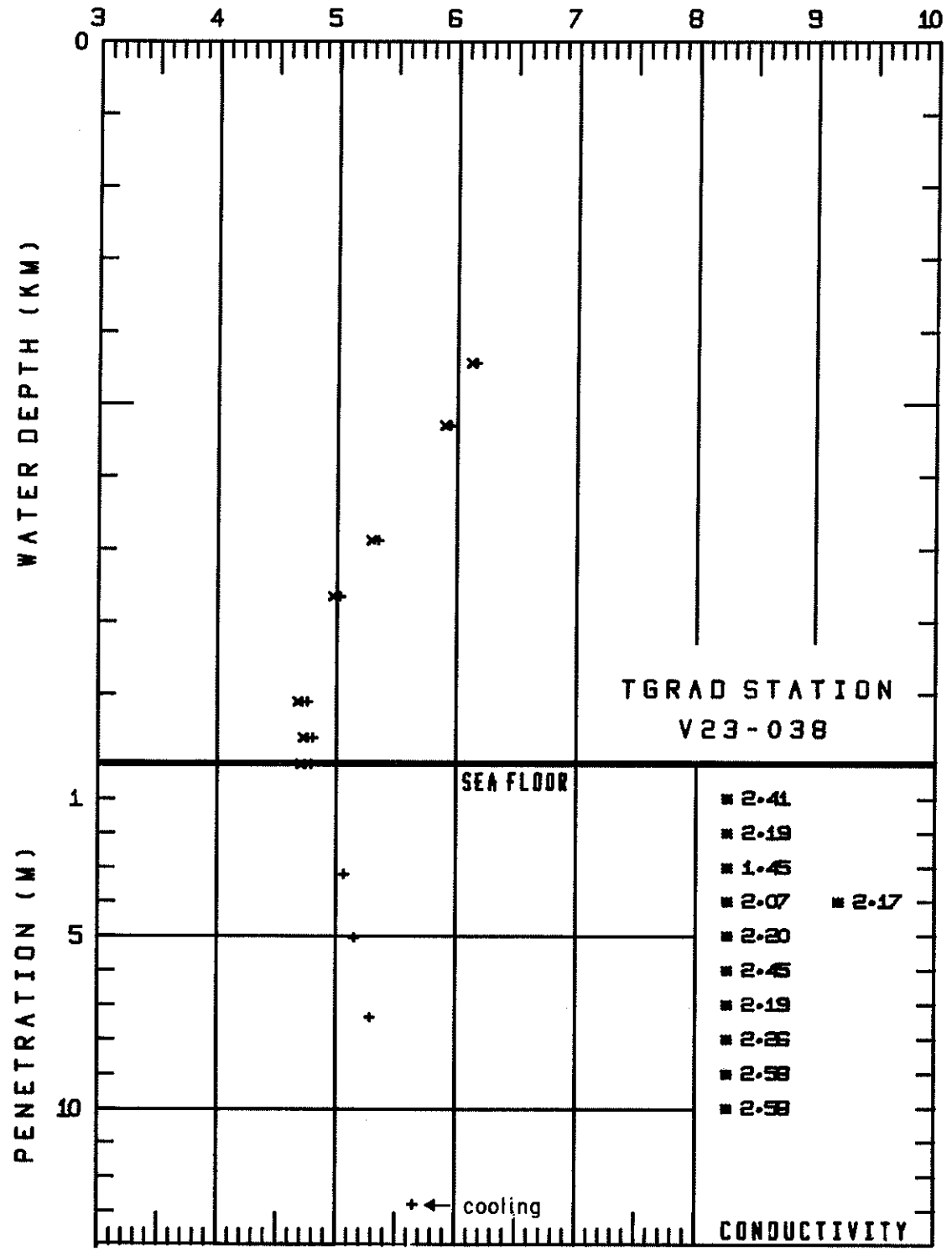
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.20	5.07
5.04	5.15
7.34	5.29
12.78	5.65

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.41
2.00	2.19
3.00	1.45
4.00	2.07
4.00	2.17
5.00	2.20
6.00	2.45
7.00	2.19
8.00	2.26
9.00	2.58
10.00	2.58

TEMPERATURE (C)



TGRAD STATION V23 39

WATER TEMPERATURES

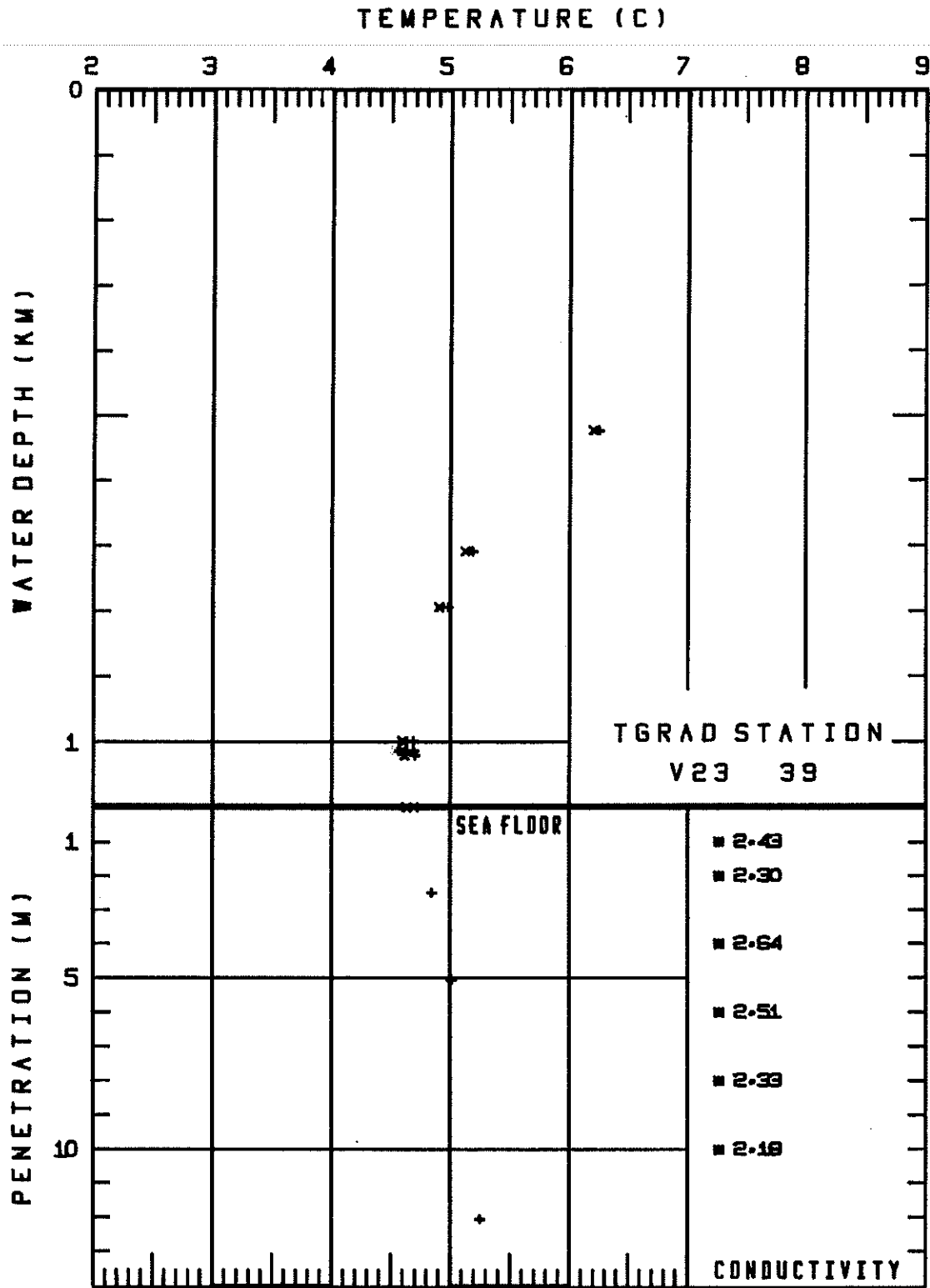
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
521.	6.25	6.20
707.	5.19	5.13
792.	4.98	4.91
998.	4.69	4.60
1012.	4.56	4.47
1019.	4.70	4.61
1013.	4.68	4.60
1099.	4.73	4.63

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.50	4.85
5.05	5.01
12.05	5.25

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.43
2.00	2.30
4.00	2.64
6.00	2.51
8.00	2.33
10.00	2.18



TGRAD STATIONV23-040

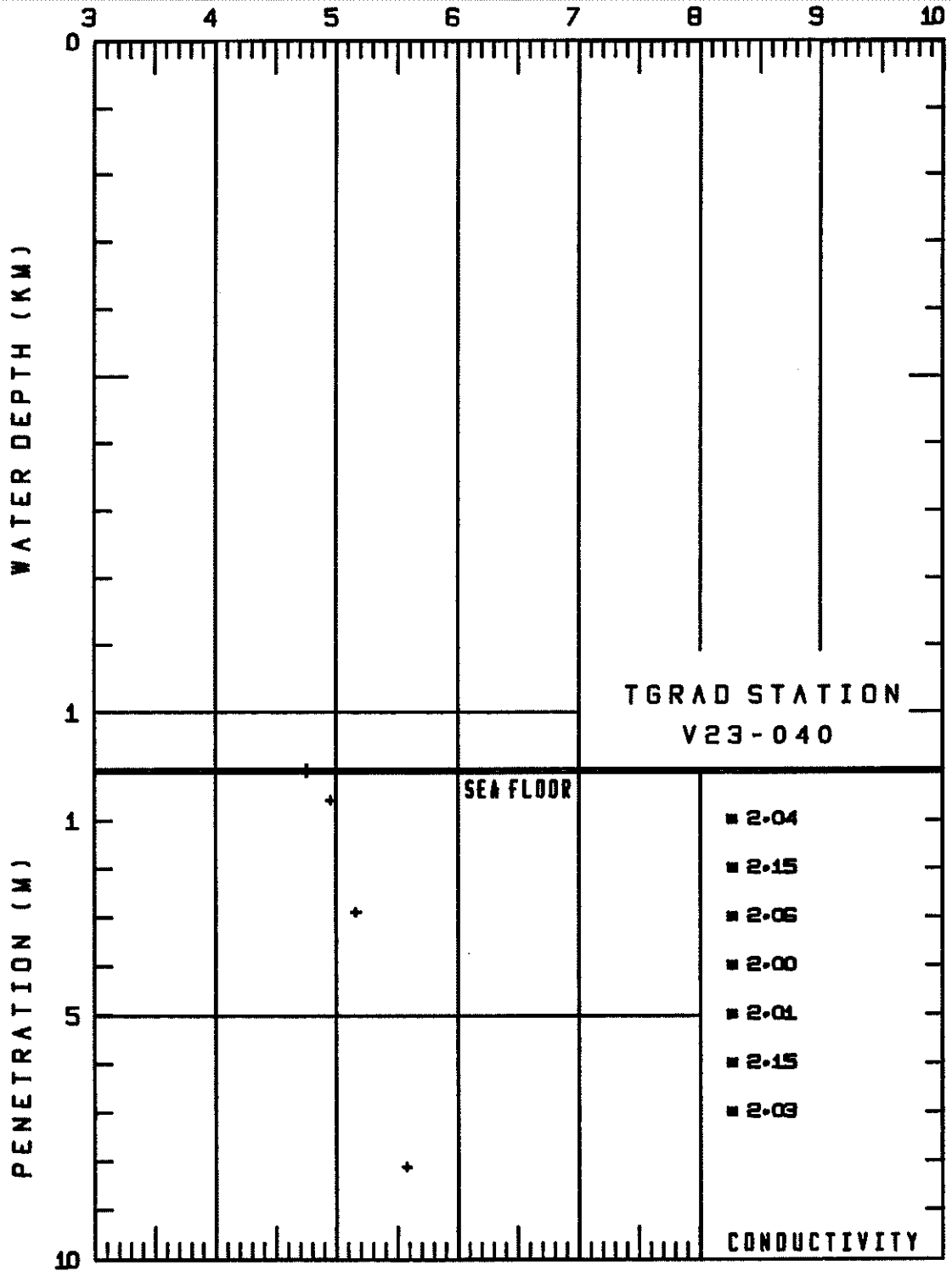
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.60	4.95
2.90	5.16
8.12	5.57

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.04
2.00	2.15
3.00	2.06
4.00	2.00
5.00	2.01
6.00	2.15
7.00	2.03

TEMPERATURE (C)



TGRAD STATIONV23-043

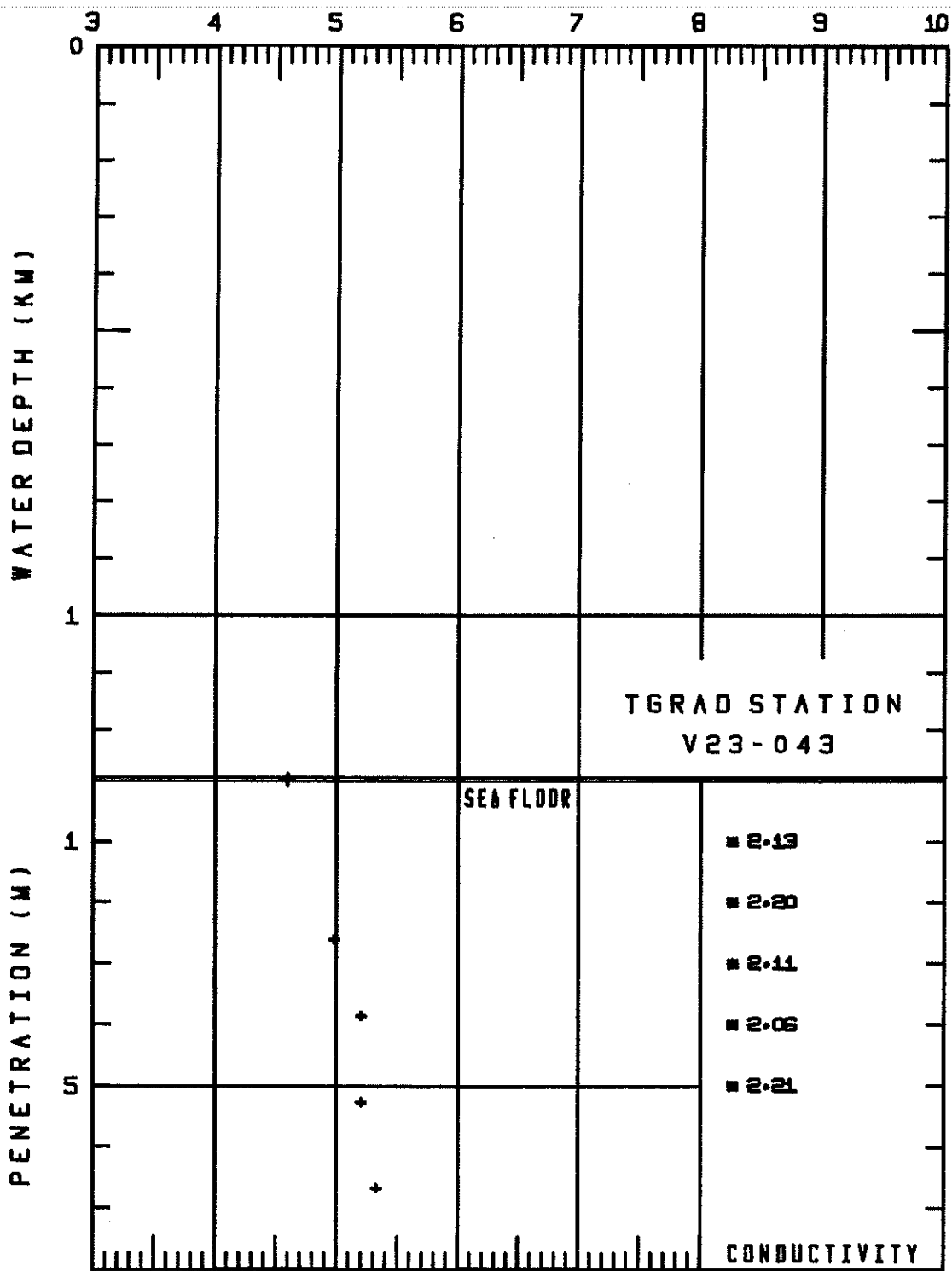
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.60	4.98
3.85	5.20
5.26	5.20
6.67	5.33

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.13
2.00	2.20
3.00	2.11
4.00	2.06
5.00	2.21

TEMPERATURE (C)



TGRAD STATIONV23-044

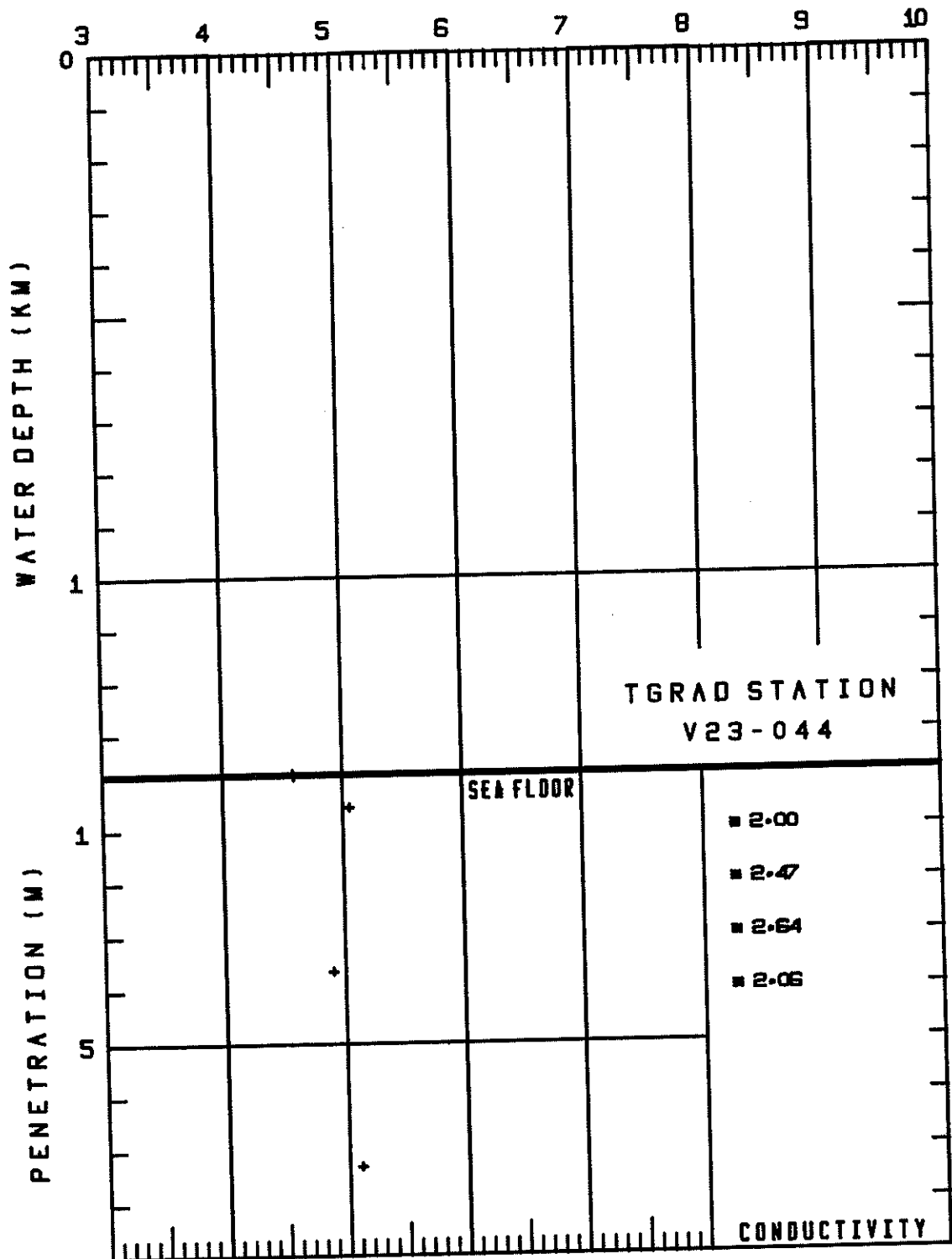
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.60	5.05
3.66	4.89
7.30	5.11

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.00
2.00	2.47
3.00	2.64
4.00	2.06

TEMPERATURE (C)



TGRAD STATION V23-047

WATER TEMPERATURES

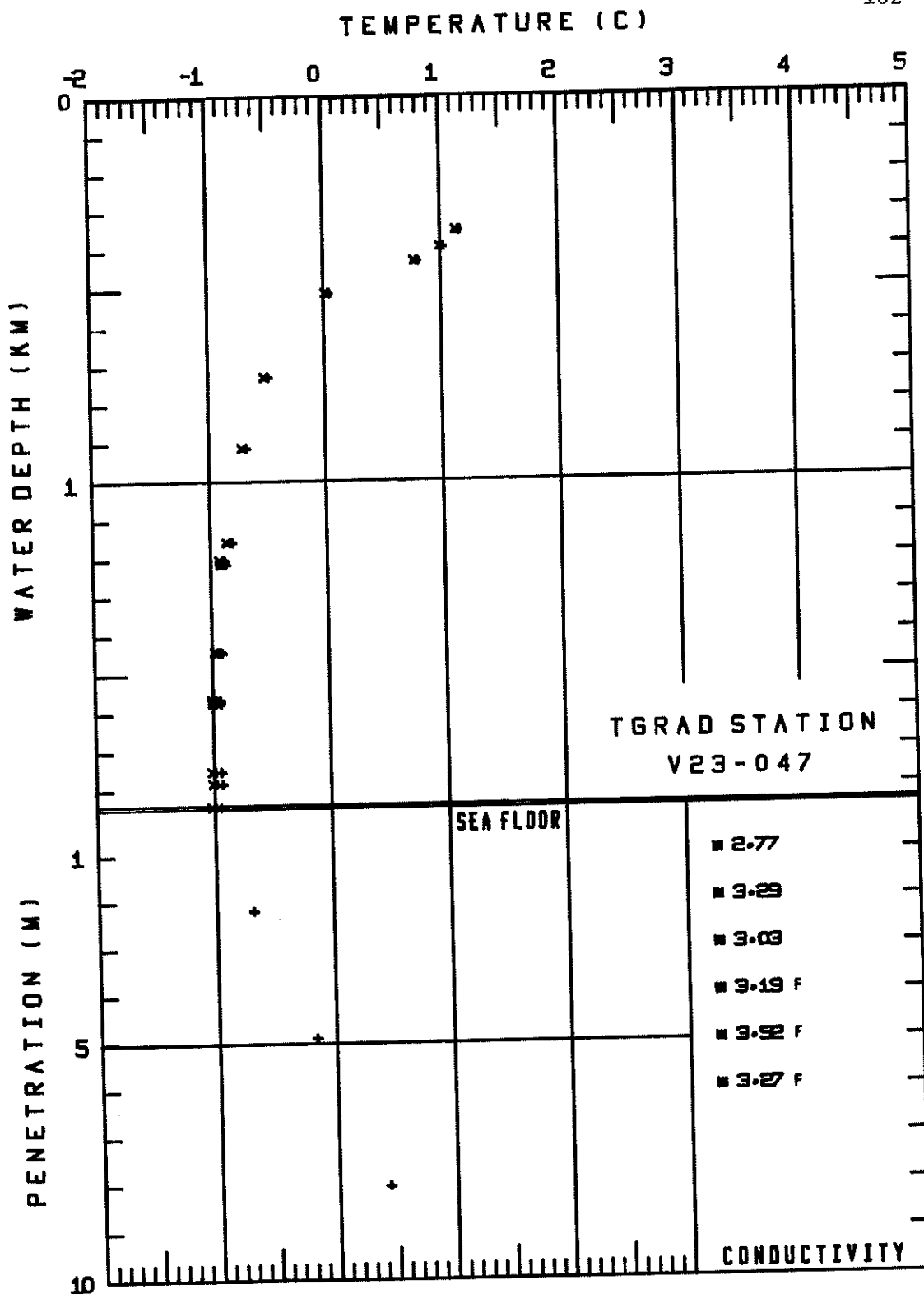
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
349.	1.15	1.14
391.	1.02	1.00
427.	0.80	0.78
509.	0.04	0.02
728.	-0.48	-0.50
911.	-0.67	-0.70
1156.	-0.81	-0.85
1203.	-0.87	-0.91
1214.	-0.86	-0.90
1443.	-0.90	-0.96
1441.	-0.91	-0.96
1565.	-0.93	-0.99
1575.	-0.92	-0.99
1752.	-0.93	-1.00
1783.	-0.92	-1.00
1844.	-0.93	-1.01

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.20	-0.67
4.90	-0.15
8.04	0.43

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.77
2.00	3.29
3.00	3.03
4.00	3.19 F
5.00	2.52 F
6.00	3.27 F

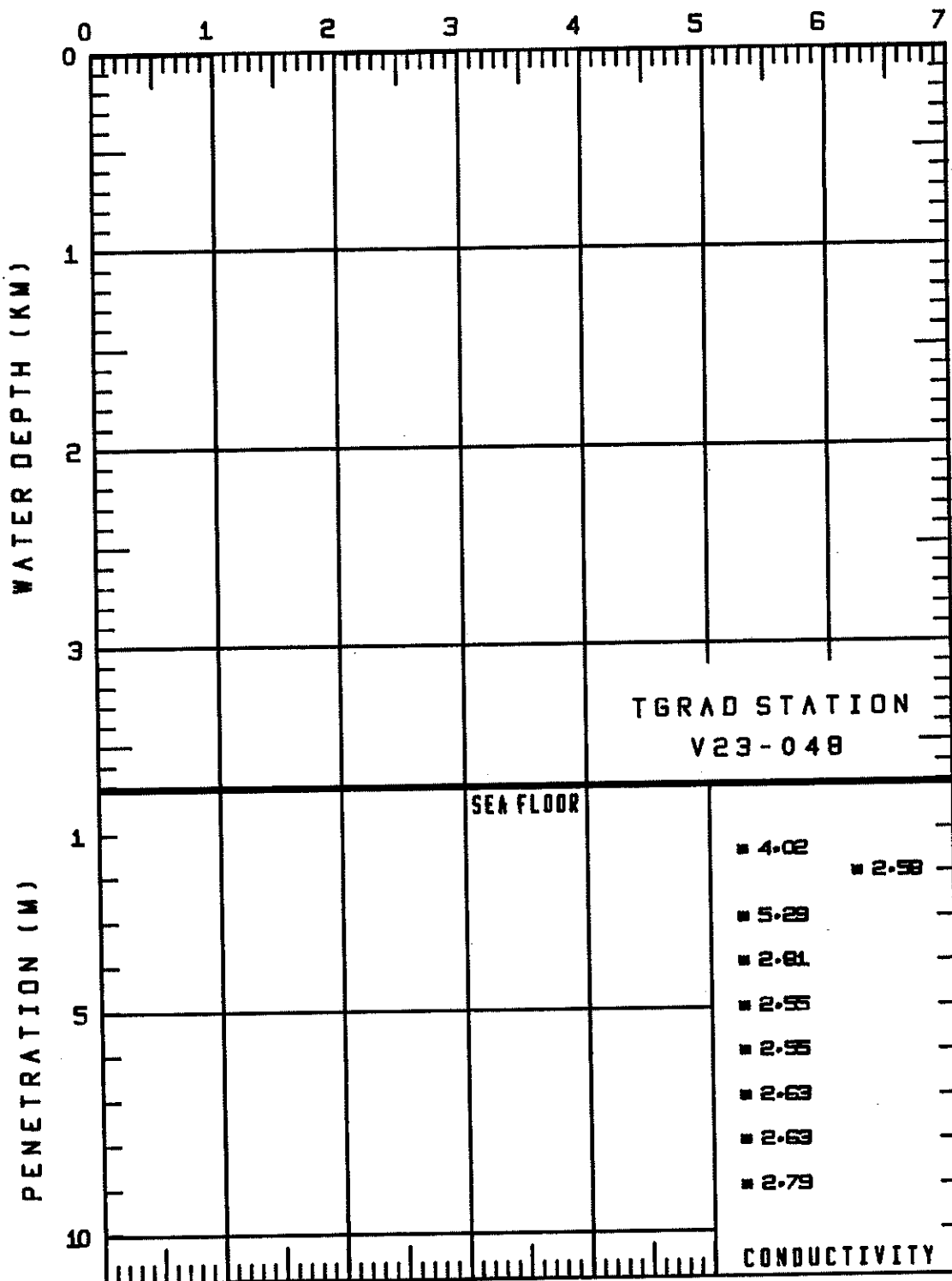


TGRAD STATIONV23-048

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.50	4.02
2.00	2.58
3.00	5.29
4.00	2.81
5.00	2.55
6.00	2.55
7.00	2.63
8.00	2.63
9.00	2.79

TEMPERATURE (C)



TGRAD STATION V23-049

WATER TEMPERATURES

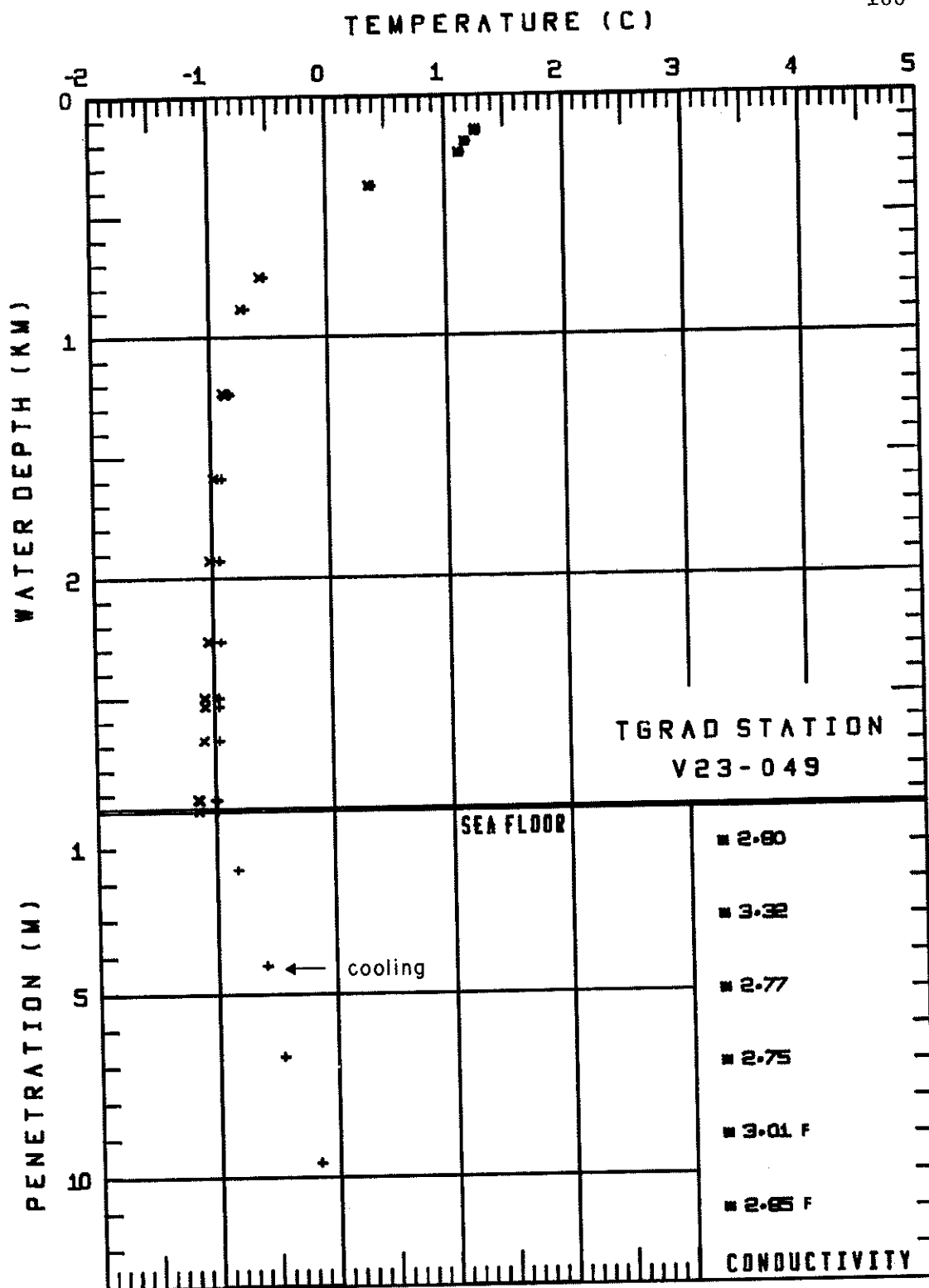
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
149.	1.27	1.26
141.	1.27	1.26
190.	1.18	1.18
237.	1.13	1.12
373.	0.38	0.37
747.	-0.53	-0.56
881.	-0.69	-0.72
1230.	-0.84	-0.88
1236.	-0.83	-0.87
1584.	-0.90	-0.97
1924.	-0.92	-1.01
2261.	-0.92	-1.03
2495.	-0.95	-1.07
2530.	-0.95	-1.07
2671.	-0.95	-1.08
2920.	-0.99	-1.14
2916.	-0.99	-1.14
2916.	-0.98	-1.13
2918.	-0.98	-1.13
2966.	-0.98	-1.14

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.60	-0.81
4.22	-0.58
6.72	-0.45
9.63	-0.15

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.80
3.00	3.32
5.00	2.77
7.00	2.75
9.00	3.01 F
11.00	2.85 F



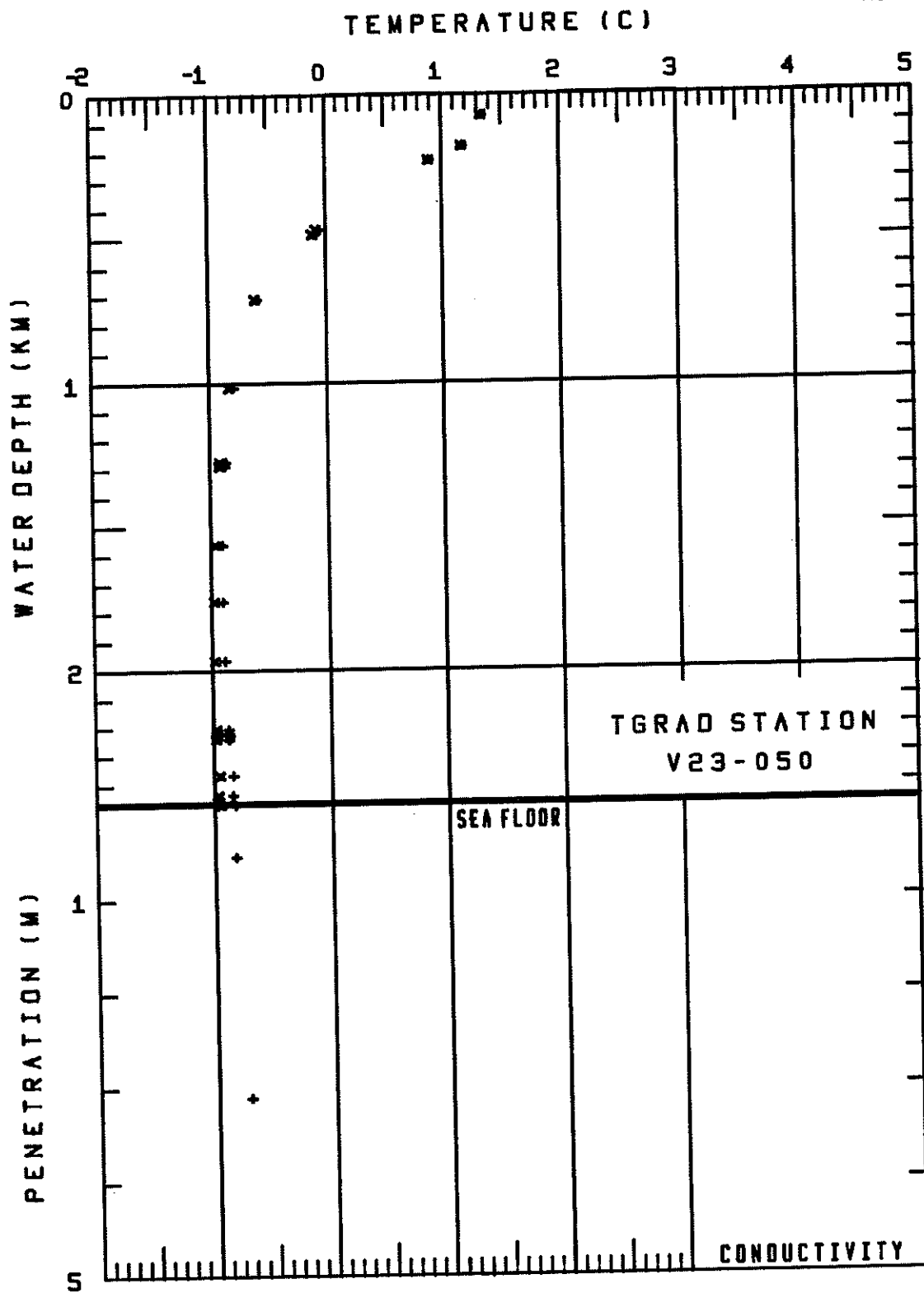
TGRAD STATION V23-050

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
72.	1.33	1.33
178.	1.16	1.16
229.	0.89	0.88
466.	-0.06	-0.08
482.	-0.09	-0.11
708.	-0.58	-0.60
1014.	-0.79	-0.83
1273.	-0.86	-0.91
1287.	-0.87	-0.92
1561.	-0.90	-0.96
1758.	-0.90	-0.97
1965.	-0.88	-0.97
2202.	-0.86	-0.96
2218.	-0.86	-0.96
2224.	-0.86	-0.96
2238.	-0.87	-0.97
2364.	-0.83	-0.94
2435.	-0.84	-0.95
2457.	-0.84	-0.96
2469.	-0.82	-0.94

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.55	-0.81
3.10	-0.71



TGRAD STATION V23-051

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
471.	0.19	0.17
688.	-0.34	-0.37
860.	-0.61	-0.64
1211.	-0.78	-0.83
1540.	-0.87	-0.93
1807.	-0.89	-0.97
1833.	-0.90	-0.98
2041.	-0.90	-0.99
2252.	-0.87	-0.97
2494.	-0.86	-0.98
2637.	-0.85	-0.98
2618.	-0.83	-0.96
2621.	-0.84	-0.97
2631.	-0.83	-0.96
2675.	-0.83	-0.98
2787.	-0.84	-0.97
2815.	-0.82	-0.97
2849.	-0.83	-0.97

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.70	-0.70
3.12	-0.23
5.87	0.44

SEDIMENT CONDUCTIVITIES

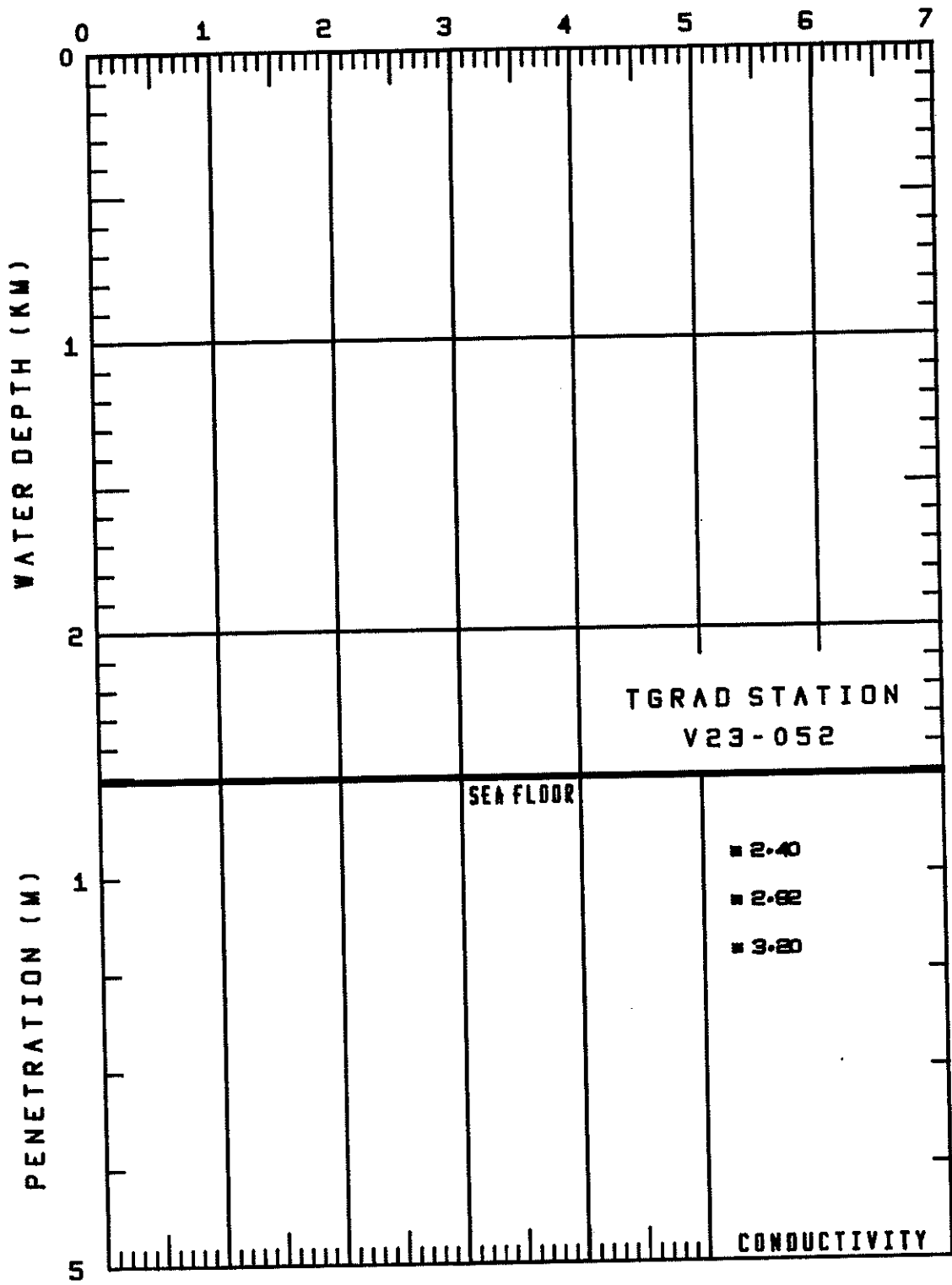
DEPTH	CONDUCTIVITY
1.00	3.89
2.00	3.60
3.00	3.13
4.00	4.30

TGRAD STATIONV23-052

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
0.80	2.40
1.30	2.82
1.80	3.20

TEMPERATURE (C)



TGRAD STATION V23-053

WATER TEMPERATURES

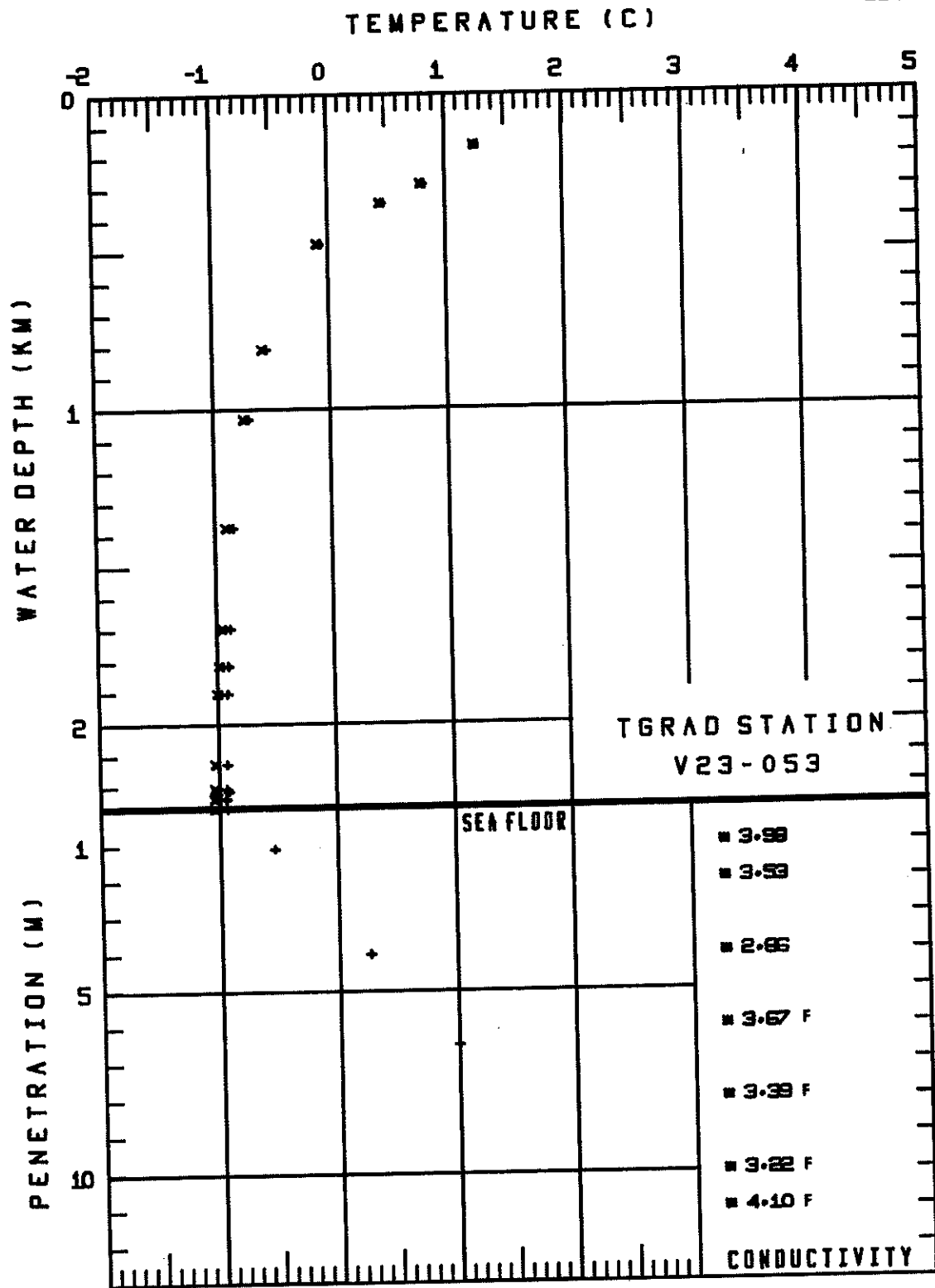
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
162.	1.25	1.25
286.	0.81	0.79
345.	0.46	0.45
474.	-0.06	-0.08
806.	-0.53	-0.56
1028.	-0.69	-0.73
1372.	-0.84	-0.89
1693.	-0.87	-0.94
1811.	-0.89	-0.97
1900.	-0.90	-0.99
2123.	-0.92	-1.02
2234.	-0.93	-1.03
2200.	-0.92	-1.02
2208.	-0.91	-1.01
2267.	-0.92	-1.03

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.10	-0.52
4.00	0.27
6.50	1.00

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	3.98
2.00	3.53
4.00	2.86
6.00	3.67 F
8.00	3.39 F
10.00	3.22 F
11.00	4.10 F



TGRAD STATION V23-054

WATER TEMPERATURES

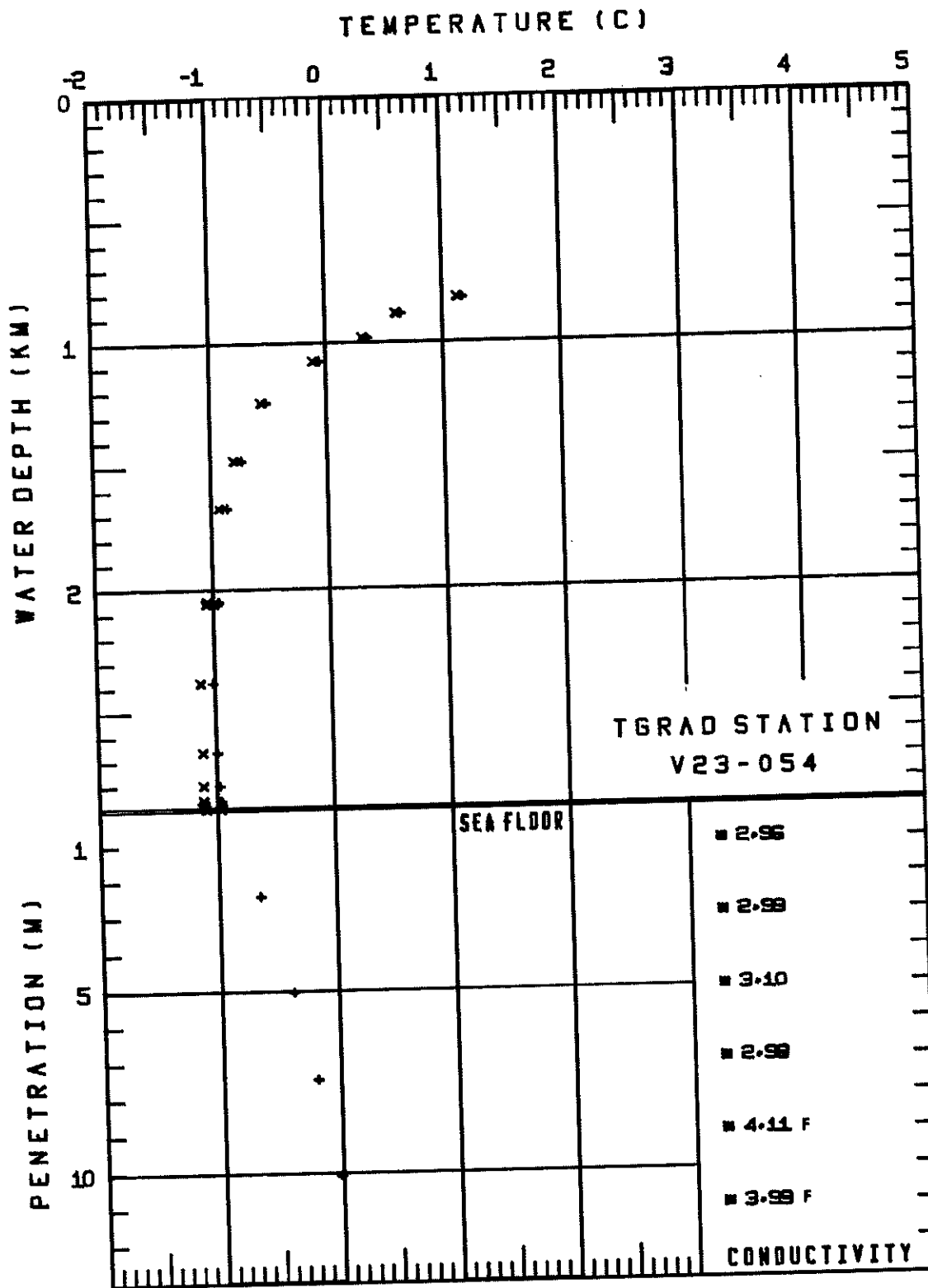
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
817.	1.17	1.12
879.	0.65	0.61
982.	0.36	0.32
1073.	-0.05	-0.09
1240.	-0.50	-0.55
1473.	-0.73	-0.79
1668.	-0.85	-0.92
2056.	-0.96	-1.05
2047.	-0.94	-1.03
2378.	-1.00	-1.11
2660.	-0.97	-1.11
2795.	-0.96	-1.10
2882.	-0.97	-1.12
2856.	-0.96	-1.10
2872.	-0.95	-1.10
2892.	-0.93	-1.08

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.40	-0.63
5.05	-0.37
7.45	-0.18
10.09	-0.00

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.96
3.00	2.99
5.00	3.10
7.00	2.98
9.00	4.11 F
11.00	3.99 F



TGRAD STATIONV23-055

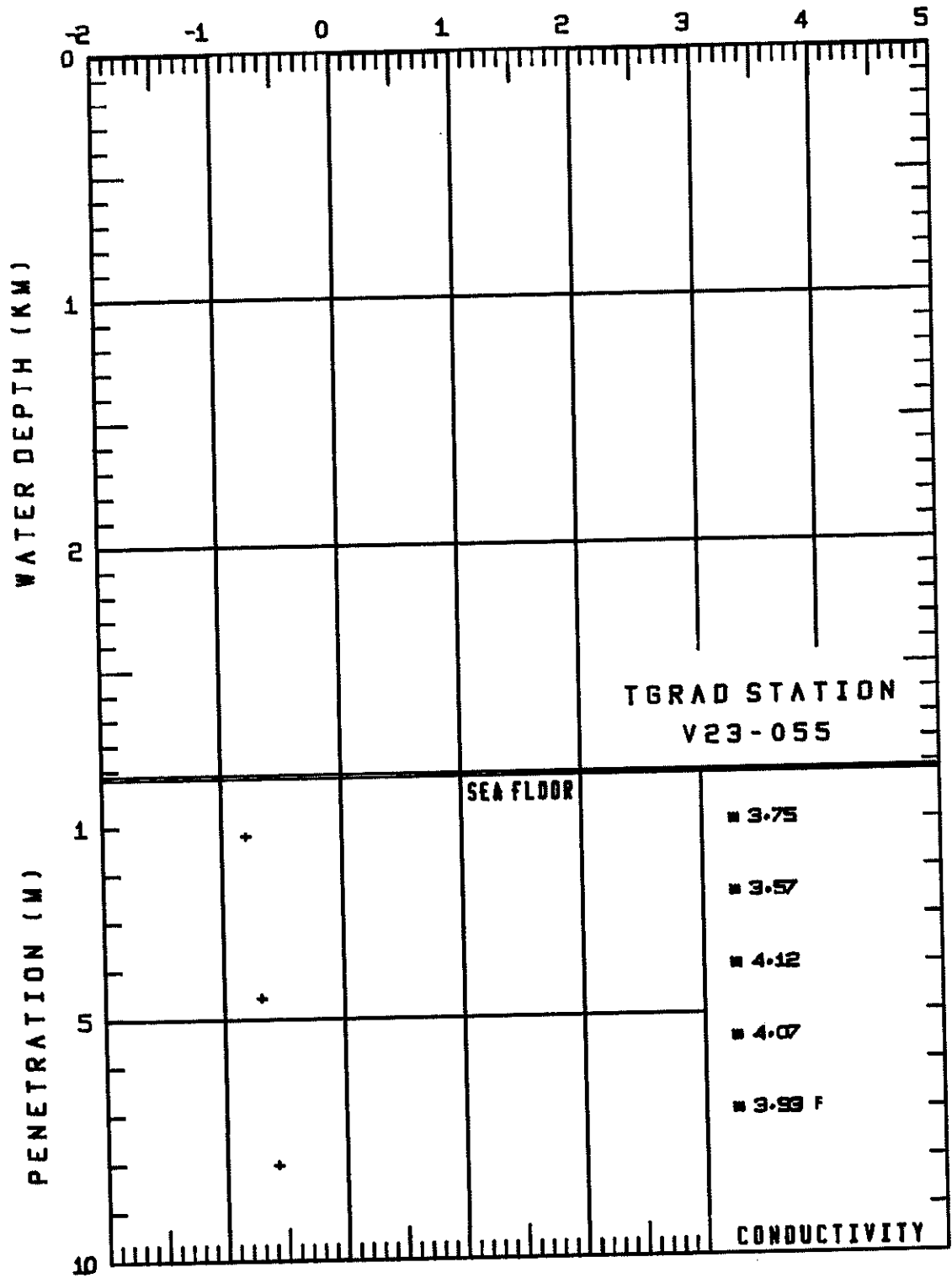
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.20	-0.79
4.56	-0.68
8.02	-0.57

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	3.75
2.50	3.57
4.00	4.12
5.50	4.07
7.00	3.93 F

TEMPERATURE (C)



TGRAD STATIONV23-056

WATER TEMPERATURES

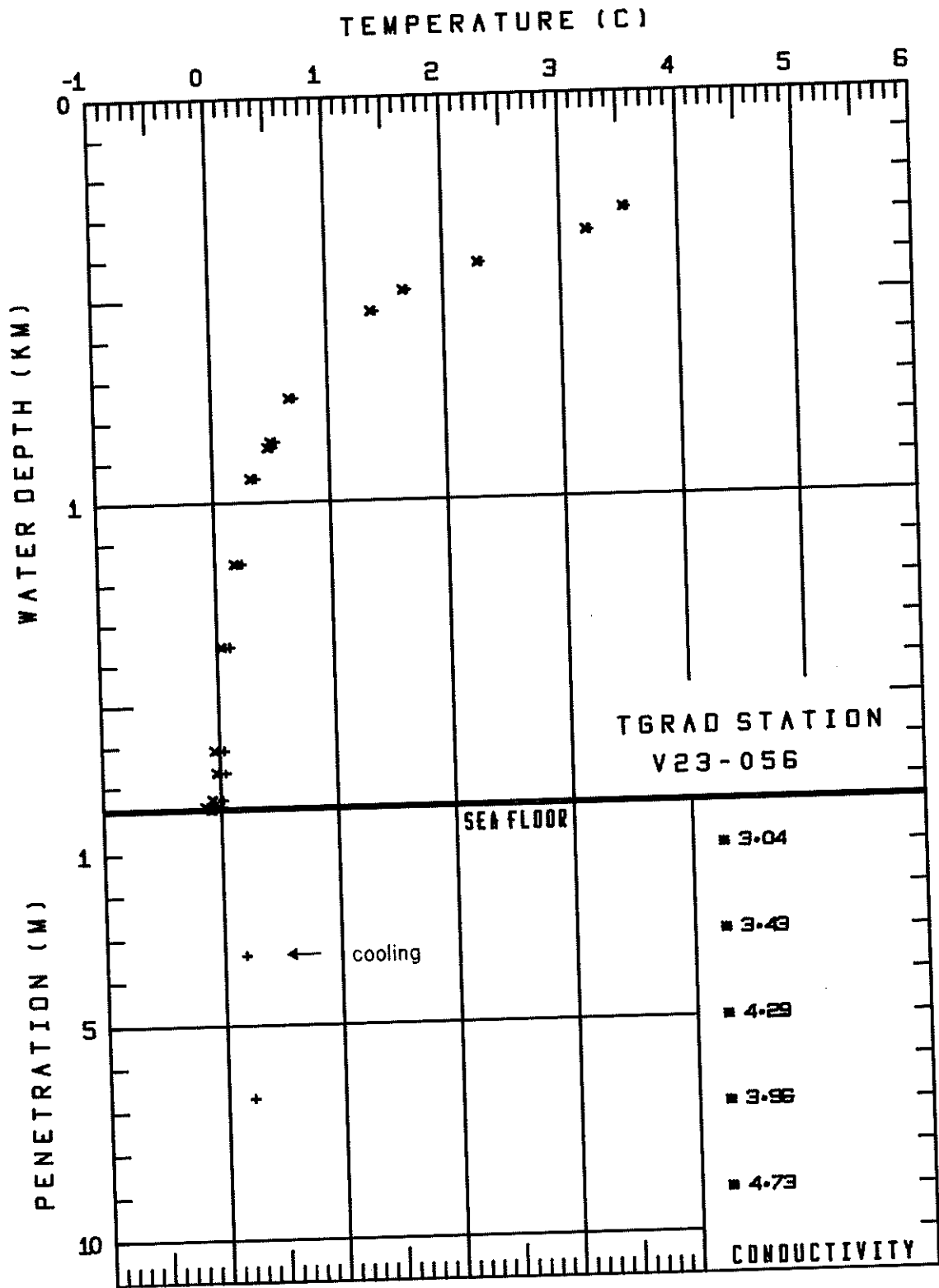
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
	3.56	3.54
286.	3.25	3.23
342.	2.31	2.29
417.	1.69	1.66
480.	1.41	1.38
531.	0.70	0.67
742.	0.51	0.47
863.	0.54	0.50
849.	0.37	0.32
939.	0.23	0.17
1151.	0.11	0.04
1355.	0.04	-0.03
1611.	0.06	-0.02
1665.	0.01	-0.07
1757.	0.01	-0.06
1749.	0.01	-0.12
1749.	-0.03	-0.12
1732.	0.02	-0.06

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.40	0.19
6.71	0.23

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	3.04
3.00	3.43
5.00	4.29
7.00	3.96
9.00	4.73

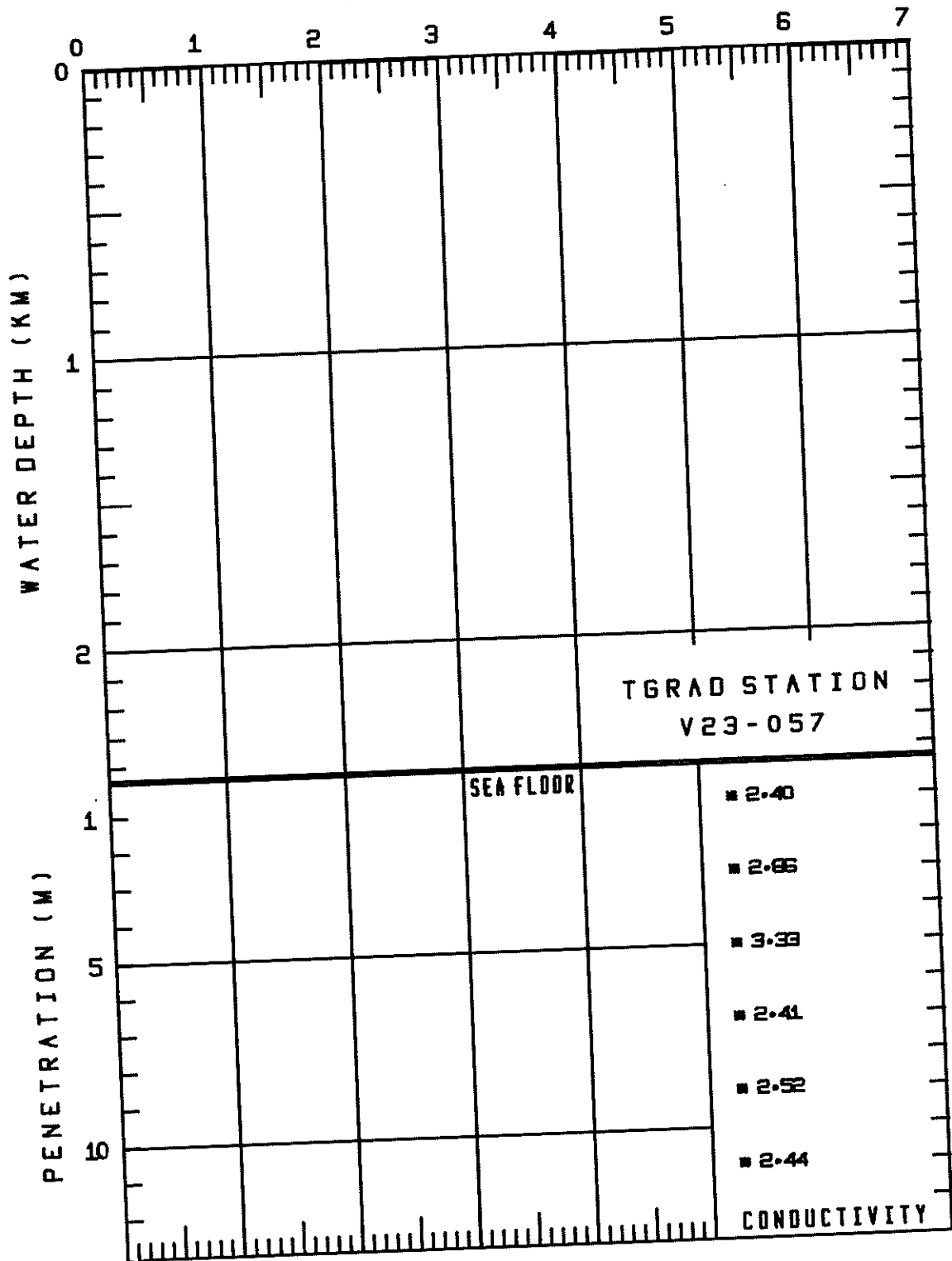


TGRAD STATIONV23-057

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.40
3.00	2.86
5.00	3.33
7.00	2.41
9.00	2.52
11.00	2.44

TEMPERATURE (C)



TGRAD STATION V23-059

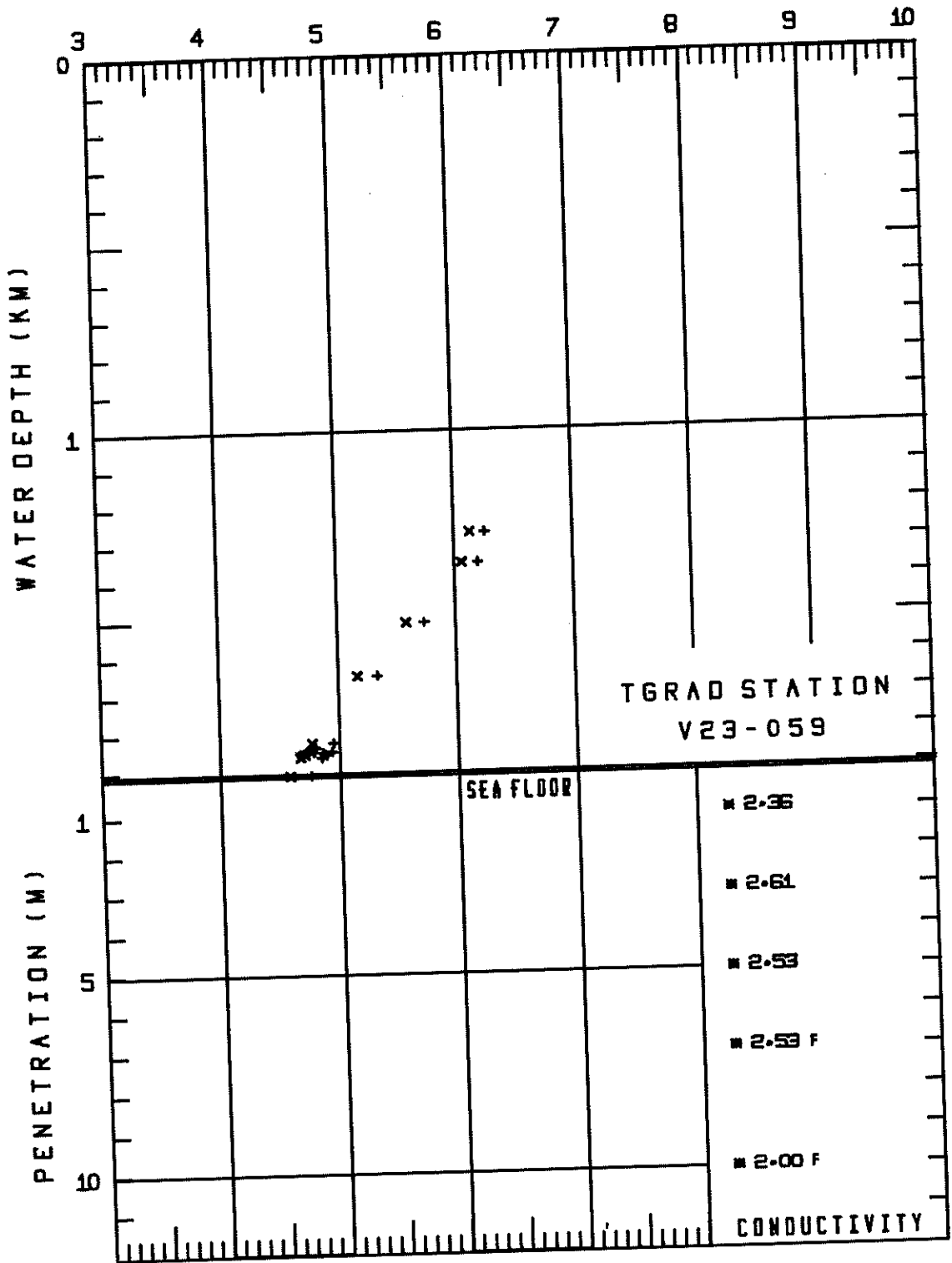
WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1269.	6.26	6.13
1350.	6.20	6.06
1507.	5.73	5.58
1648.	5.32	5.16
1824.	4.94	4.77
1862.	4.85	4.67
1838.	4.79	4.62
1834.	4.79	4.61
1847.	4.93	4.75
1850.	4.86	4.68
1857.	4.89	4.71
1911.	4.76	4.58

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.36
3.00	2.61
5.00	2.53
7.00	2.53 F
10.00	2.00 F

TEMPERATURE (C)



TGRAD STATION V23 060

WATER TEMPERATURES

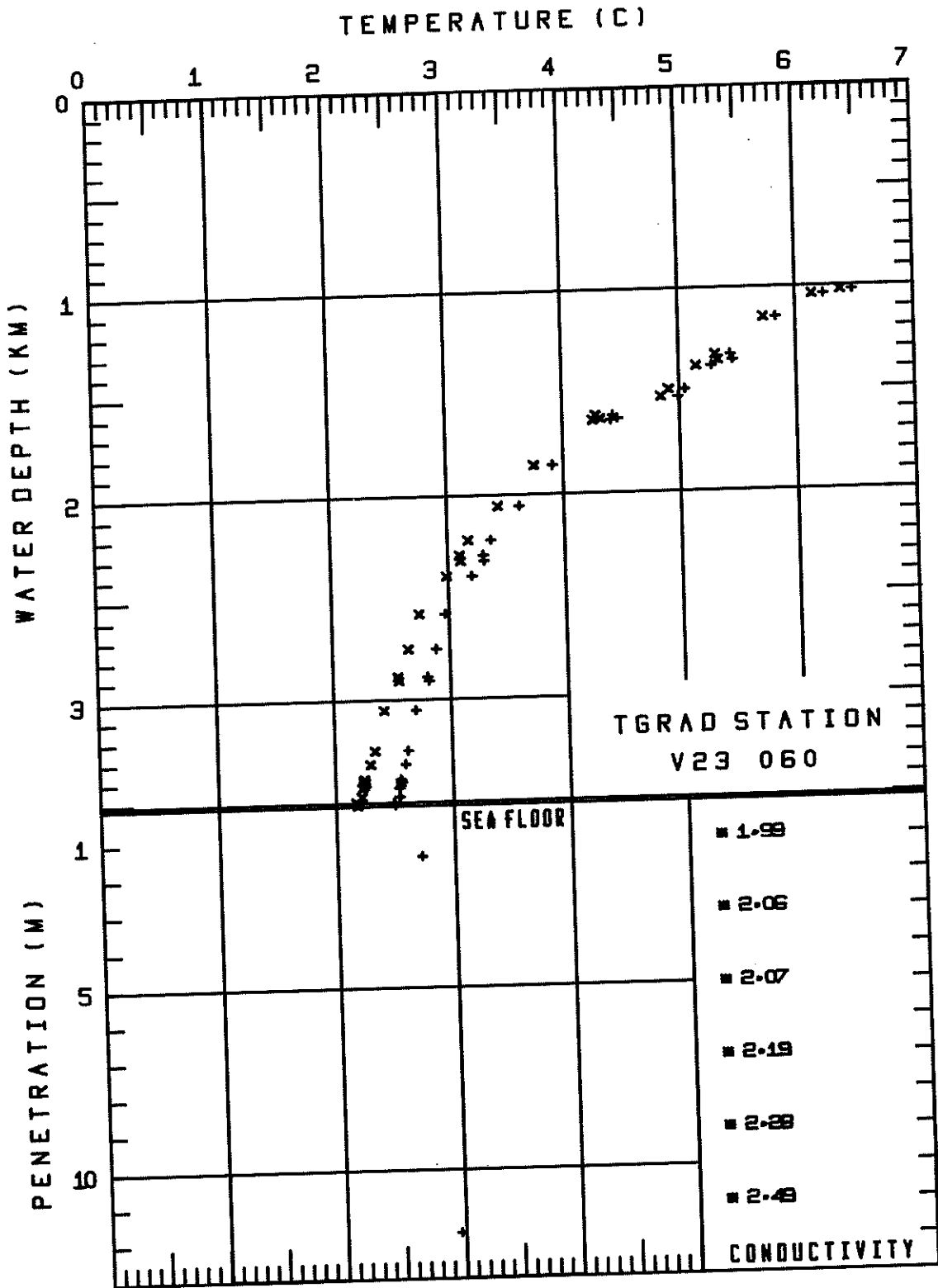
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
	6.48	6.38
1016.	6.24	6.14
1035.	5.83	5.72
1147.	5.44	5.31
1326.	5.46	5.33
1352.	5.28	5.15
1381.	5.06	4.92
1491.	4.99	4.85
1527.	4.47	4.33
1627.	4.41	4.26
1636.	4.43	4.28
1612.	3.91	3.74
1852.	3.61	3.43
2049.	3.37	3.17
2214.	3.31	3.10
2318.	3.30	3.10
2289.	3.20	2.99
2390.	2.97	2.75
2576.	2.89	2.65
2747.	2.82	2.56
2905.	2.80	2.55
2883.	2.70	2.43
3048.	2.63	2.34
3248.	2.55	2.24
3388.	2.56	2.25
3402.	2.60	2.30
3313.	2.56	2.25
3390.	2.55	2.24
3417.	2.56	2.25
3403.	2.54	2.23
3432.	2.54	2.22
3474.	2.50	2.18
3516.	2.49	2.17
3500.		

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.40	2.72
11.75	2.96

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	1.99
3.00	2.06
5.00	2.07
7.00	2.19
9.00	2.28
11.00	2.49



TGRAD STATION V23-061

WATER TEMPERATURES

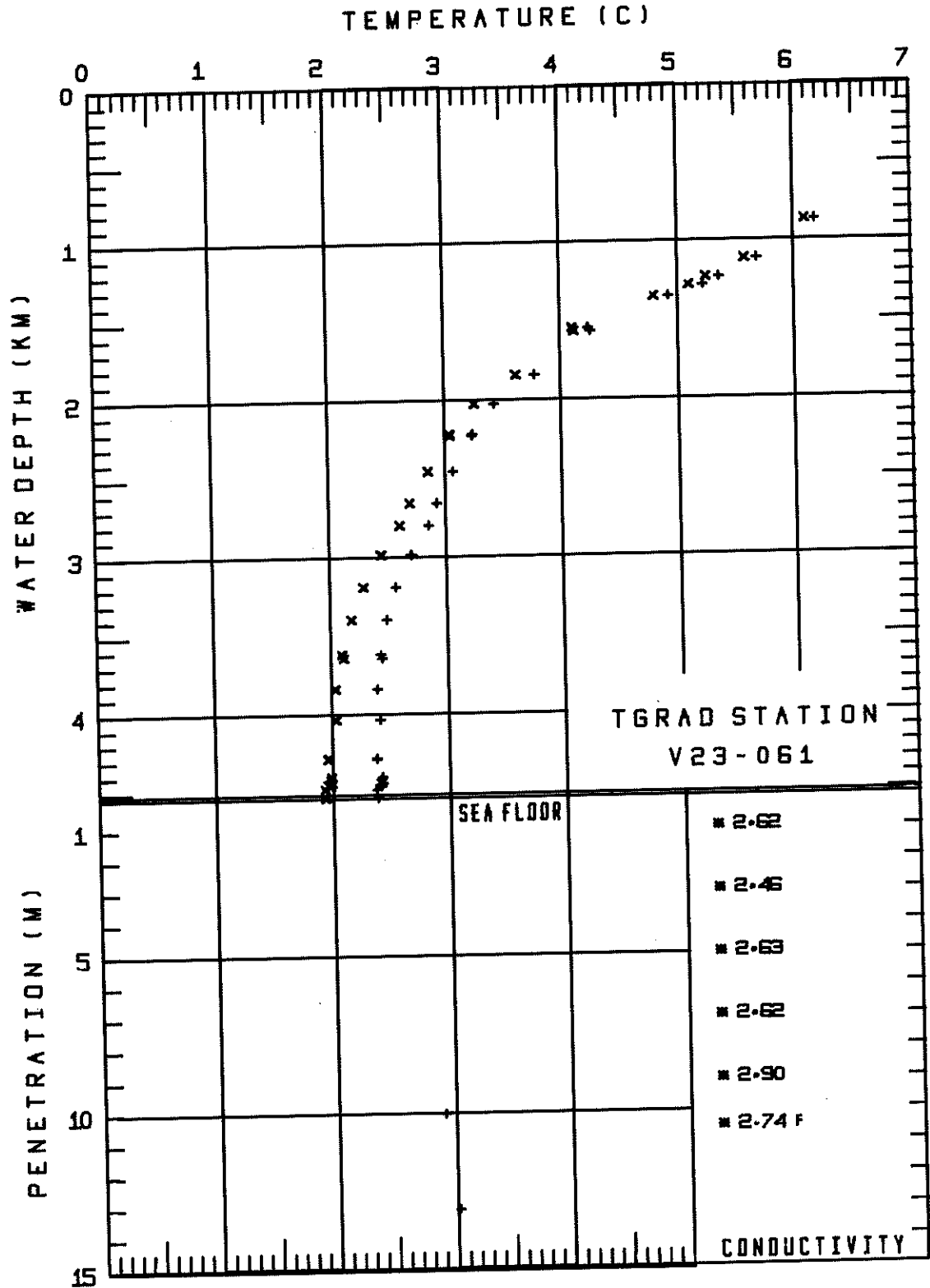
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
861.	6.17	6.09
1107.	5.67	5.57
1226.	5.35	5.24
1275.	5.20	5.08
1345.	4.91	4.79
1543.	4.23	4.09
1560.	4.25	4.11
1841.	3.77	3.61
2019.	3.42	3.25
2212.	3.22	3.03
2223.	3.22	3.03
2450.	3.06	2.85
2653.	2.92	2.69
2790.	2.85	2.60
2978.	2.70	2.44
2978.	2.69	2.43
3182.	2.56	2.28
3391.	2.48	2.17
3613.	2.42	2.09
3637.	2.44	2.10
3833.	2.38	2.03
4033.	2.41	2.03
4284.	2.37	1.95
4280.	2.37	1.96
4449.	2.39	1.96
4412.	2.41	1.97
4401.	2.42	1.98
4440.	2.42	1.98
4461.	2.41	1.96
4482.	2.37	1.92
4535.	2.38	1.93

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
10.05	2.91
13.08	3.01

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.62
3.00	2.46
5.00	2.63
7.00	2.62
9.00	2.90
10.50	2.74 F



TGRAD STATIONV23-062

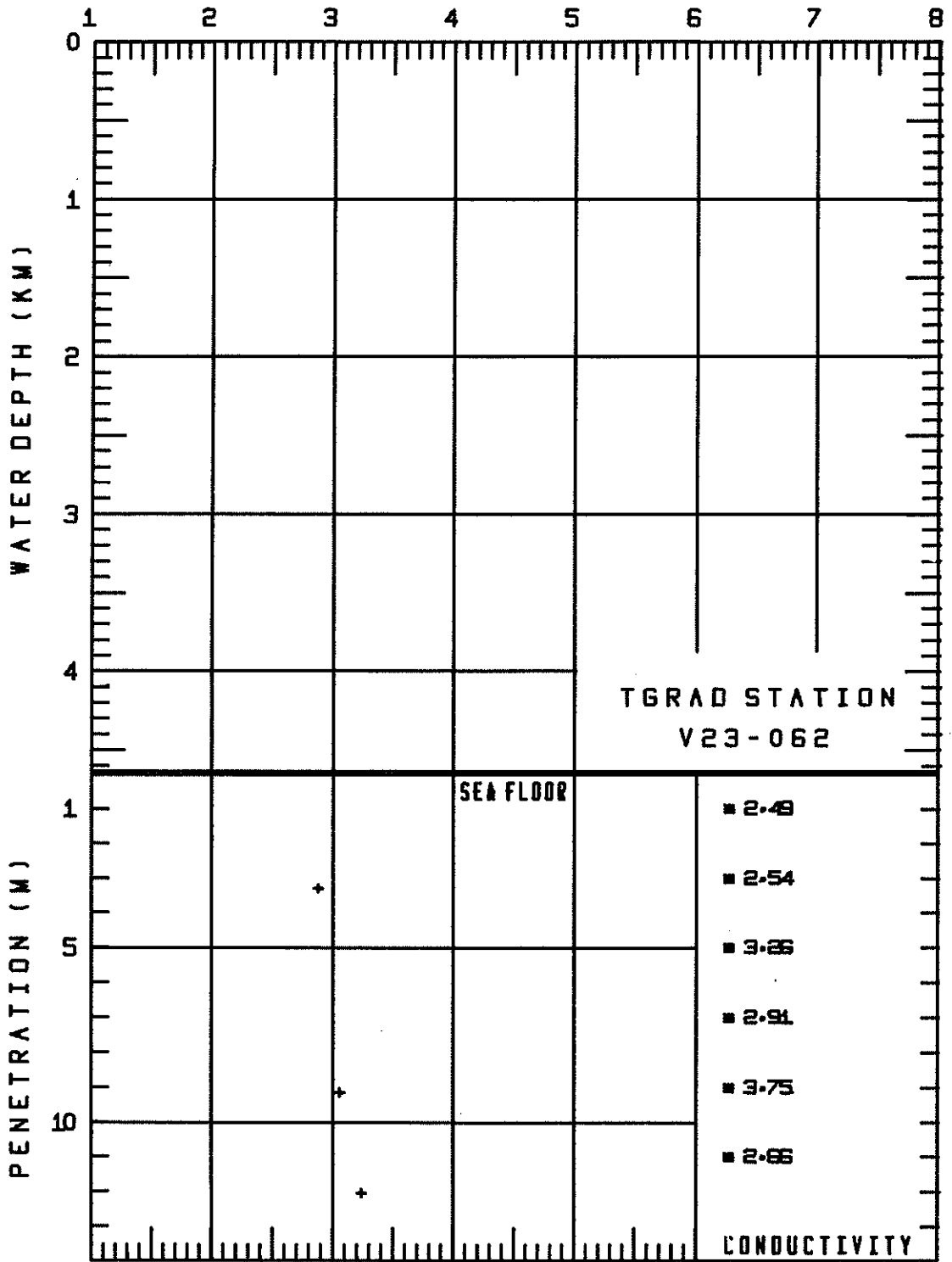
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.30	2.87
9.15	3.06
12.05	3.23

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.49
3.00	2.54
5.00	3.26
7.00	2.91
9.00	3.75
11.00	2.66

TEMPERATURE (C)



TGRAD STATION V23-063

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
908.	6.06	5.97
1003.	5.78	5.68
1001.	5.77	5.67
1031.	5.72	5.63
1074.	5.66	5.55
1302.	5.13	5.01
1449.	4.78	4.65
1437.	4.70	4.57
1650.	4.18	4.04
1846.	3.81	3.65
2046.	3.56	3.38
2175.	3.39	3.20
2184.	3.35	3.16
2375.	3.17	2.96
2577.	3.03	2.80
2780.	2.92	2.67
2836.	2.87	2.62
2861.	2.85	2.60
3049.	2.74	2.46
3239.	2.64	2.34
3375.	2.57	2.26
3496.	2.47	2.15
3517.	2.46	2.14
3712.	2.39	2.05
3887.	2.37	2.00
4042.	2.35	1.97
4114.	2.35	1.96
4123.	2.34	1.95
4217.	2.34	1.93
4388.	2.35	1.92
4537.	2.37	1.92
4565.	2.36	1.91
4574.	2.37	1.91
4558.	2.38	1.93
4647.	2.36	1.90
4653.	2.38	1.92

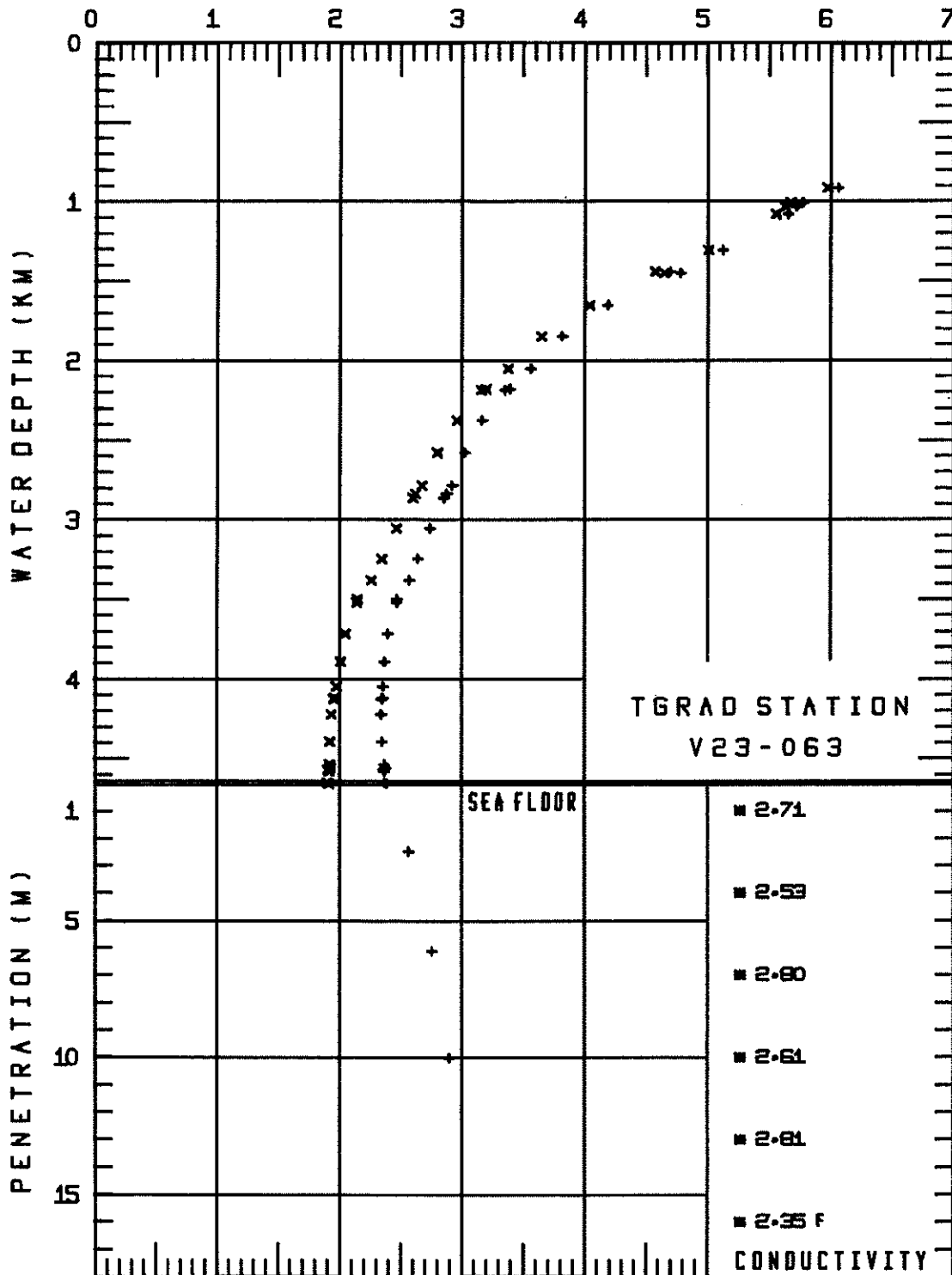
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.50	2.57
6.12	2.76
10.01	2.90

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.71
4.00	2.53
7.00	2.80
10.00	2.61
13.00	2.81
16.00	2.35 F

TEMPERATURE (C)



TGRAD STATION V23-064

WATER TEMPERATURES

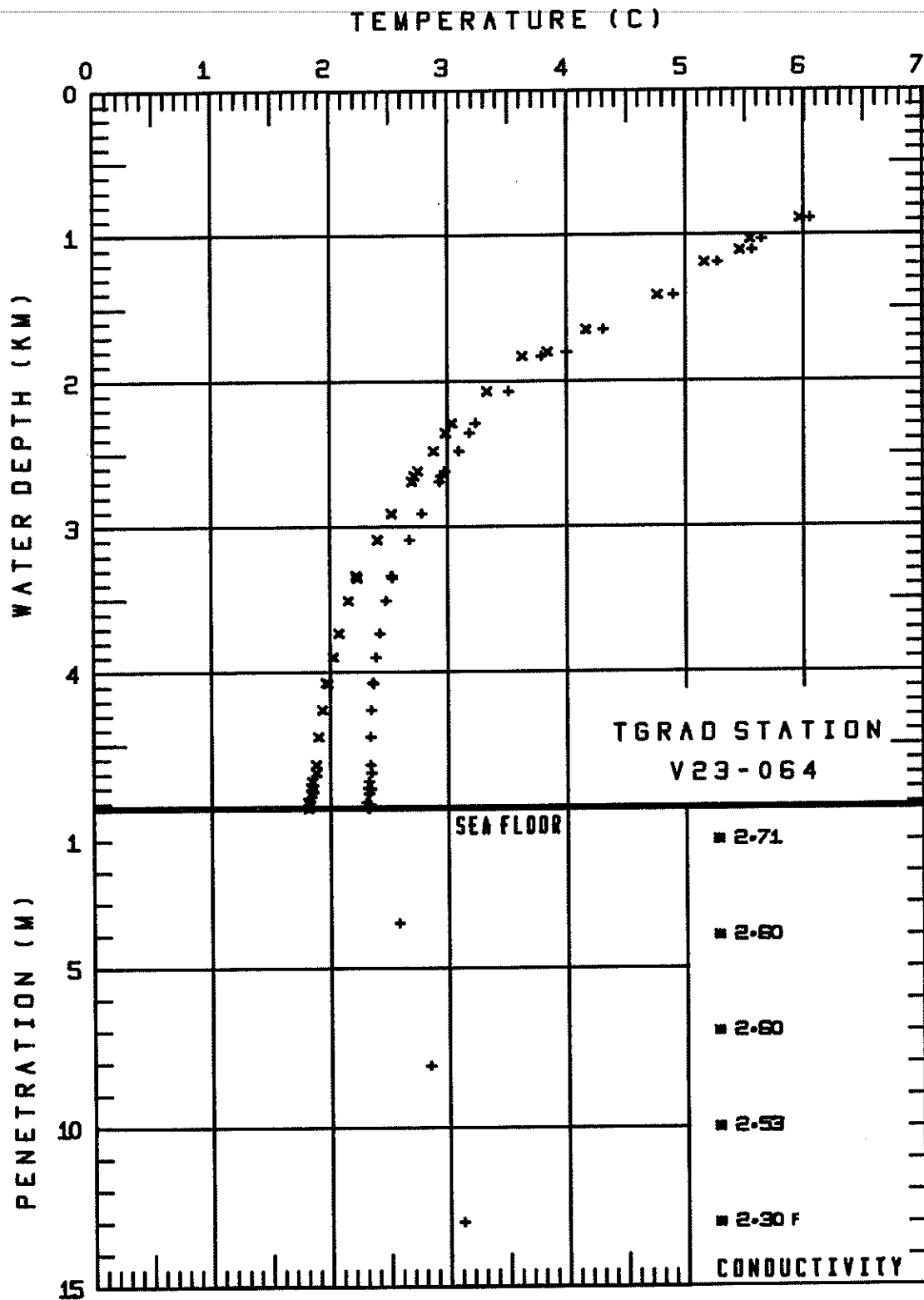
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
885.	6.05	5.96
1023.	5.64	5.54
1102.	5.56	5.45
1186.	5.26	5.15
1409.	4.89	4.76
1646.	4.31	4.16
1797.	3.99	3.83
1825.	3.78	3.62
2068.	3.50	3.32
2284.	3.23	3.03
2355.	3.18	2.98
2481.	3.09	2.88
2615.	2.97	2.75
2648.	2.94	2.71
2688.	2.93	2.69
2909.	2.78	2.52
3086.	2.67	2.40
3351.	2.53	2.23
3336.	2.52	2.22
3506.	2.48	2.16
3728.	2.42	2.07
3894.	2.39	2.02
4072.	2.37	1.98
4072.	2.36	1.97
4255.	2.34	1.93
4440.	2.34	1.90
4634.	2.34	1.88
4688.	2.35	1.88
4751.	2.33	1.85
4801.	2.34	1.85
4796.	2.34	1.85
4792.	2.32	1.84
4829.	2.33	1.84
4894.	2.31	1.81
4909.	2.33	1.83
4935.	2.32	1.81

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
3.60	2.58
8.07	2.84
12.97	3.11

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.71
4.00	2.60
7.00	2.60
10.00	2.53
13.00	2.30 F



TGRAD STATION V23-065

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
899.	6.01	5.93
1036.	5.70	5.60
1172.	5.48	5.37
1410.	4.84	4.71
1637.	4.13	3.99
1822.	3.80	3.65
1835.	3.75	3.59
2068.	3.46	3.28
2306.	3.25	3.05
2496.	3.12	2.90
2645.	3.01	2.77
2706.	2.96	2.73
2901.	2.83	2.57
3110.	2.68	2.40
3331.	2.58	2.28
3448.	2.56	2.24
3491.	2.53	2.21
3706.	2.46	2.11
3900.	2.39	2.02
4080.	2.35	1.97
4149.	2.35	1.95
4164.	2.35	1.96
4278.	2.35	1.93
4464.	2.32	1.89
4631.	2.29	1.83
4792.	2.32	1.83
4837.	2.31	1.82
4889.	2.29	1.79
4899.	2.28	1.78
4885.	2.28	1.79
4911.	2.29	1.79
4885.	2.29	1.79
4954.	2.28	1.77
4994.	2.27	1.76
5000.	2.29	1.77

SEDIMENT TEMPERATURES

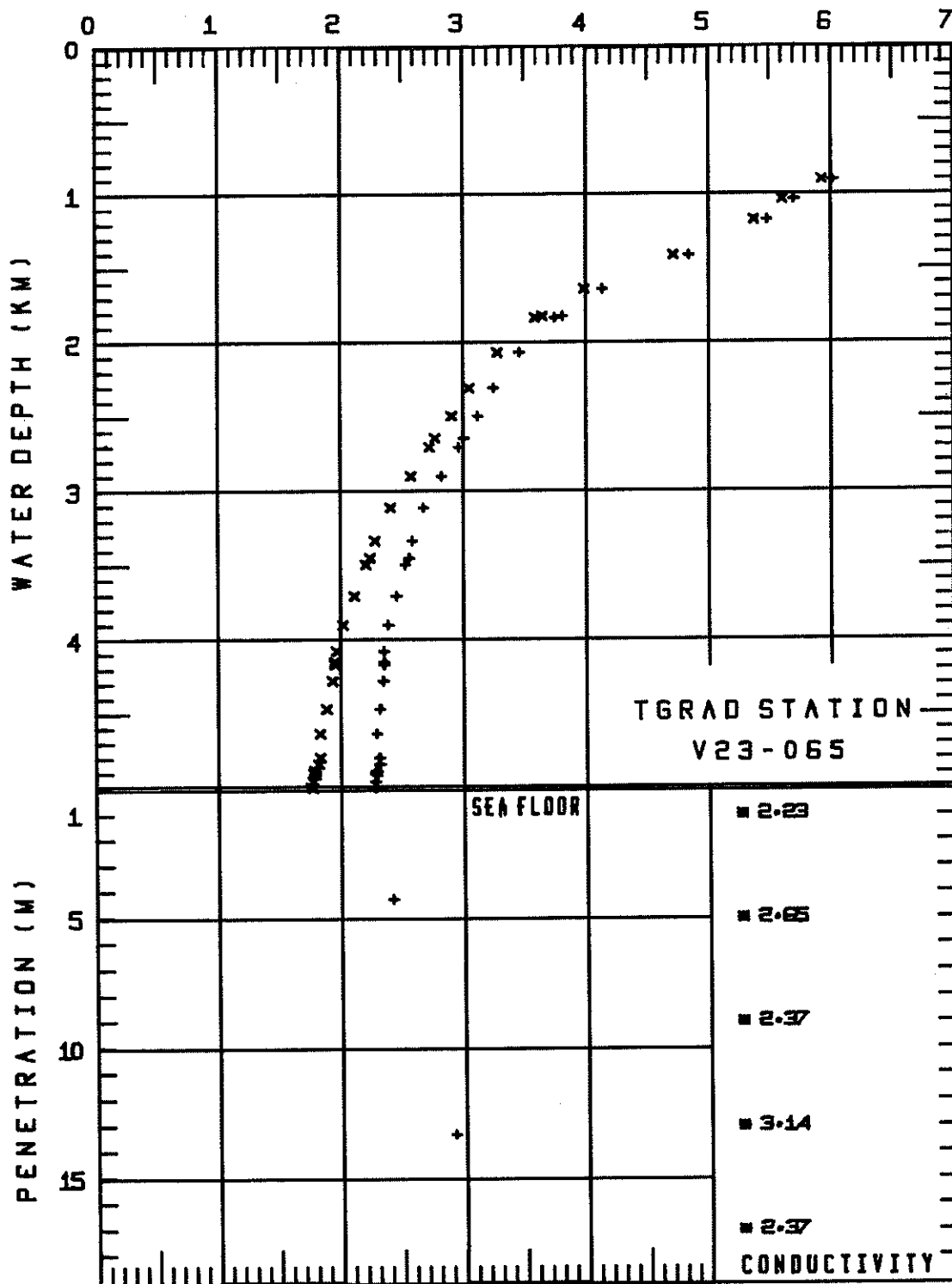
DEPTH	TEMPERATURE
4.26	2.42
13.33	2.92

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.23
5.00	2.65

9.00	2.37
13.00	3.14
17.00	2.37

TEMPERATURE (C)



TGRAD STATION V23-066

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
811.	5.97	5.90
934.	5.60	5.51
1127.	5.38	5.28
1290.	5.01	4.89
1565.	4.33	4.19
1813.	3.77	3.62
1932.	3.58	3.42
1924.	3.55	3.38
1973.	3.46	3.29
2240.	3.22	3.02
2480.	3.02	2.81
2729.	2.90	2.66
2838.	2.82	2.57
2856.	2.79	2.54
2937.	2.76	2.50
3144.	2.65	2.37
3375.	2.58	2.27
3585.	2.52	2.19
3640.	2.51	2.18
3644.	2.50	2.17
3840.	2.46	2.10
4039.	2.42	2.03
4241.	2.38	1.97
4387.	2.37	1.94
4413.	2.36	1.93
4631.	2.33	1.87
4829.	2.31	1.82
4974.	2.30	1.79
4954.	2.34	1.83
4961.	2.32	1.81
5071.	2.31	1.79
5068.	2.32	1.80
5094.	2.31	1.78

SEDIMENT TEMPERATURES

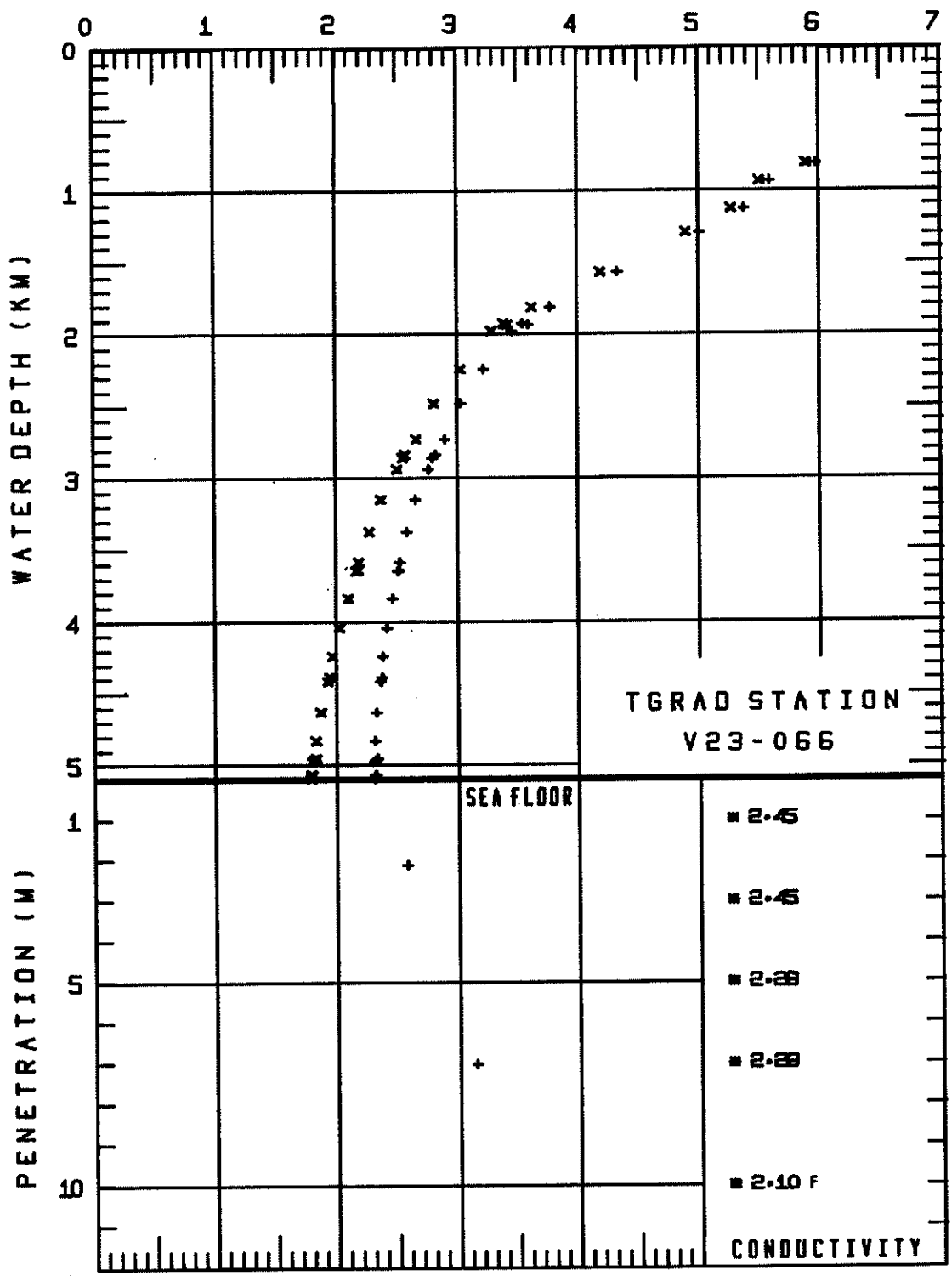
DEPTH	TEMPERATURE
2.11	2.58
7.01	3.14

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.45
3.00	2.45
5.00	2.28
7.00	2.28

10.00	2.10 F
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TEMPERATURE (C)



TGRAD STATION V23 67

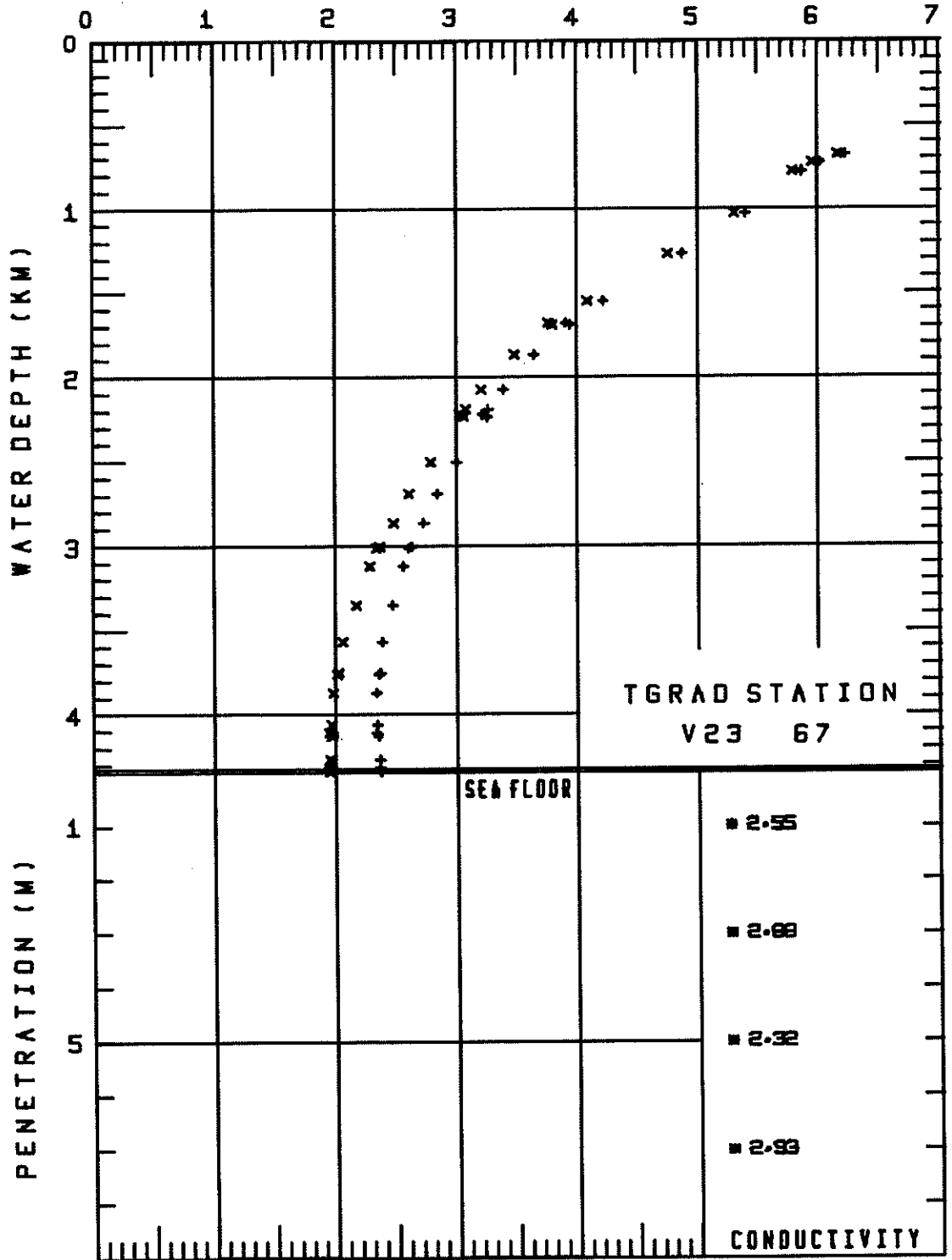
WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
672.	6.23	6.17
725.	6.02	5.95
776.	5.86	5.79
1028.	5.40	5.31
1269.	4.87	4.76
1547.	4.22	4.09
1678.	3.91	3.76
1687.	3.94	3.80
1864.	3.64	3.48
2069.	3.39	3.21
2188.	3.27	3.08
2217.	3.22	3.03
2232.	3.25	3.06
2502.	3.00	2.78
2687.	2.84	2.60
2863.	2.73	2.48
3011.	2.61	2.34
3003.	2.63	2.36
3116.	2.56	2.28
3348.	2.48	2.18
3565.	2.39	2.06
3757.	2.36	2.01
3747.	2.38	2.03
3865.	2.34	1.98
4055.	2.35	1.97
4121.	2.36	1.97
4112.	2.42	2.02
4106.	2.34	1.95
4124.	2.36	1.97
4265.	2.37	1.96
4313.	2.37	1.95
4335.	2.37	1.95

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.55
3.00	2.88
5.00	2.32
7.00	2.93

TEMPERATURE (C)



TGRAD STATION V23- 68

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
674.	6.30	6.24
771.	5.93	5.86
849.	5.80	5.73
956.	5.39	5.31
1005.	5.31	5.22
1051.	5.22	5.13
1312.	4.72	4.60
1593.	4.12	3.98
1732.	3.89	3.74
1739.	3.79	3.64
1848.	3.67	3.51
2109.	3.35	3.17
2367.	3.14	2.94
2614.	2.93	2.70
2720.	2.80	2.57
2746.	2.73	2.50
2863.	2.69	2.44
3132.	2.62	2.34
3366.	2.56	2.25
3613.	2.53	2.20
3748.	2.53	2.18
3952.	2.52	2.15
4090.	2.51	2.11
4243.	2.50	2.08
4250.	2.51	2.09
4271.	2.48	2.06
4312.	2.44	2.02

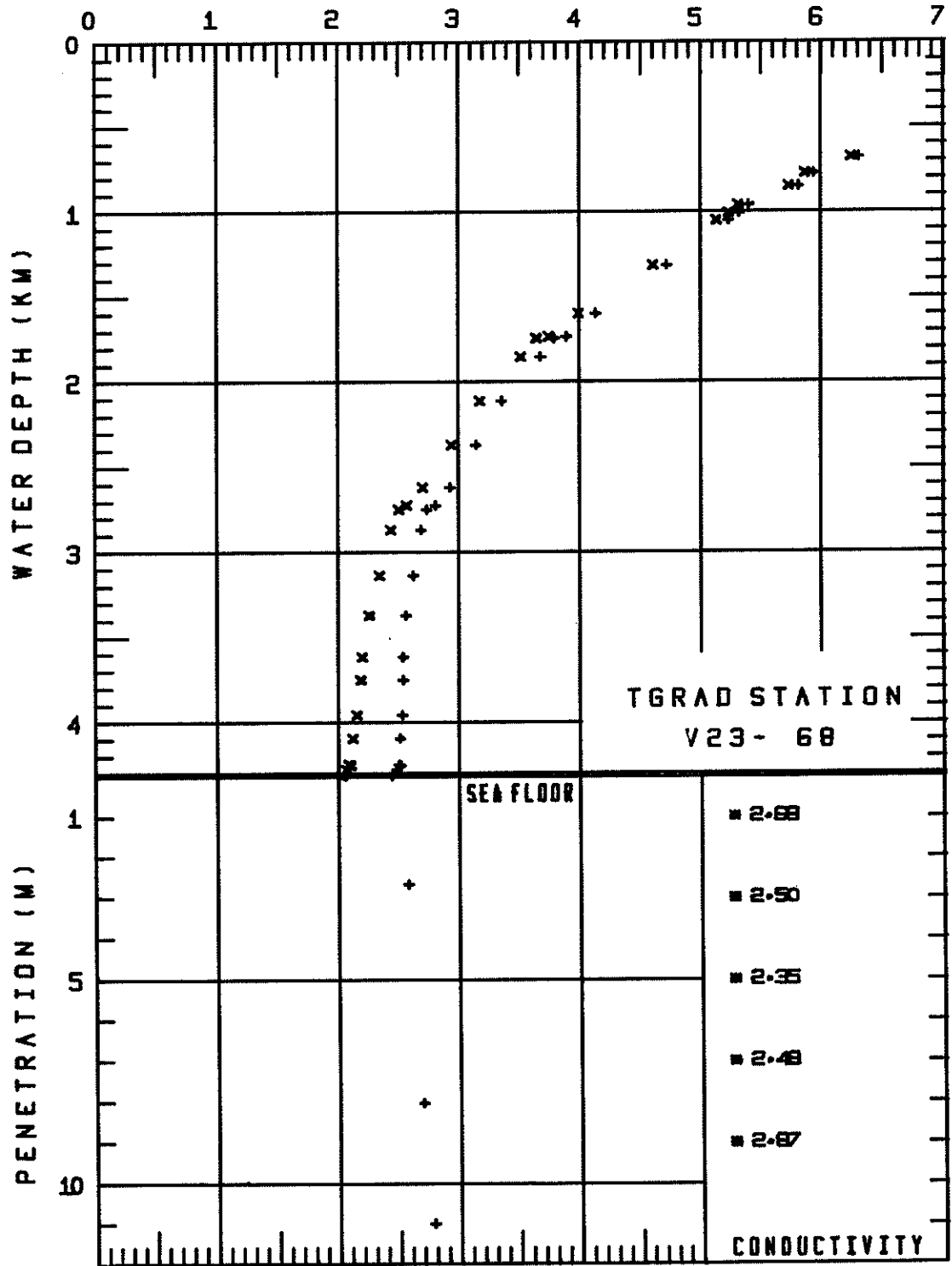
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.65	2.57
8.01	2.70
10.97	2.78

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.68
3.00	2.50
5.00	2.35
7.00	2.49
9.00	2.87

TEMPERATURE (C)



TGRAD STATION V23 69

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
800.	5.73	5.65
826.	5.52	5.45
862.	5.46	5.39
1087.	5.01	4.91
1316.	4.58	4.46
1562.	4.10	3.96
1801.	3.61	3.45
1803.	3.62	3.46
1986.	3.26	3.10
2206.	3.12	2.94
2387.	2.92	2.72
2624.	2.82	2.59
2669.	2.80	2.57
2660.	2.81	2.58
2687.	2.80	2.57
2692.	2.79	2.56
2693.	2.80	2.57
2799.	2.77	2.52
2799.	2.77	2.53
2841.	2.76	2.51

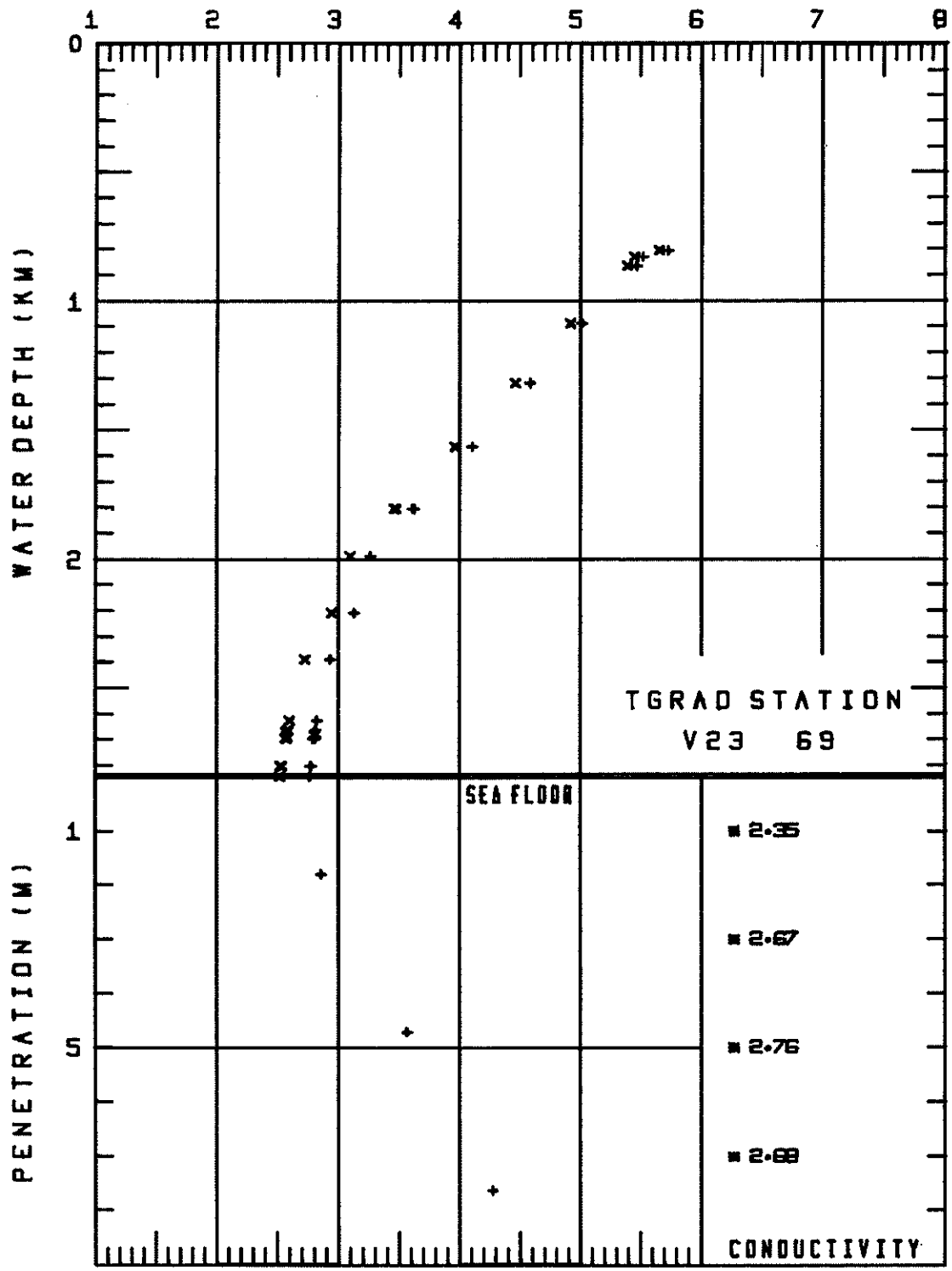
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
1.80	2.85
4.71	3.56
7.62	4.27

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.35
3.00	2.67
5.00	2.76
7.00	2.68

TEMPERATURE (C)



TGRAD STATIONV23-070

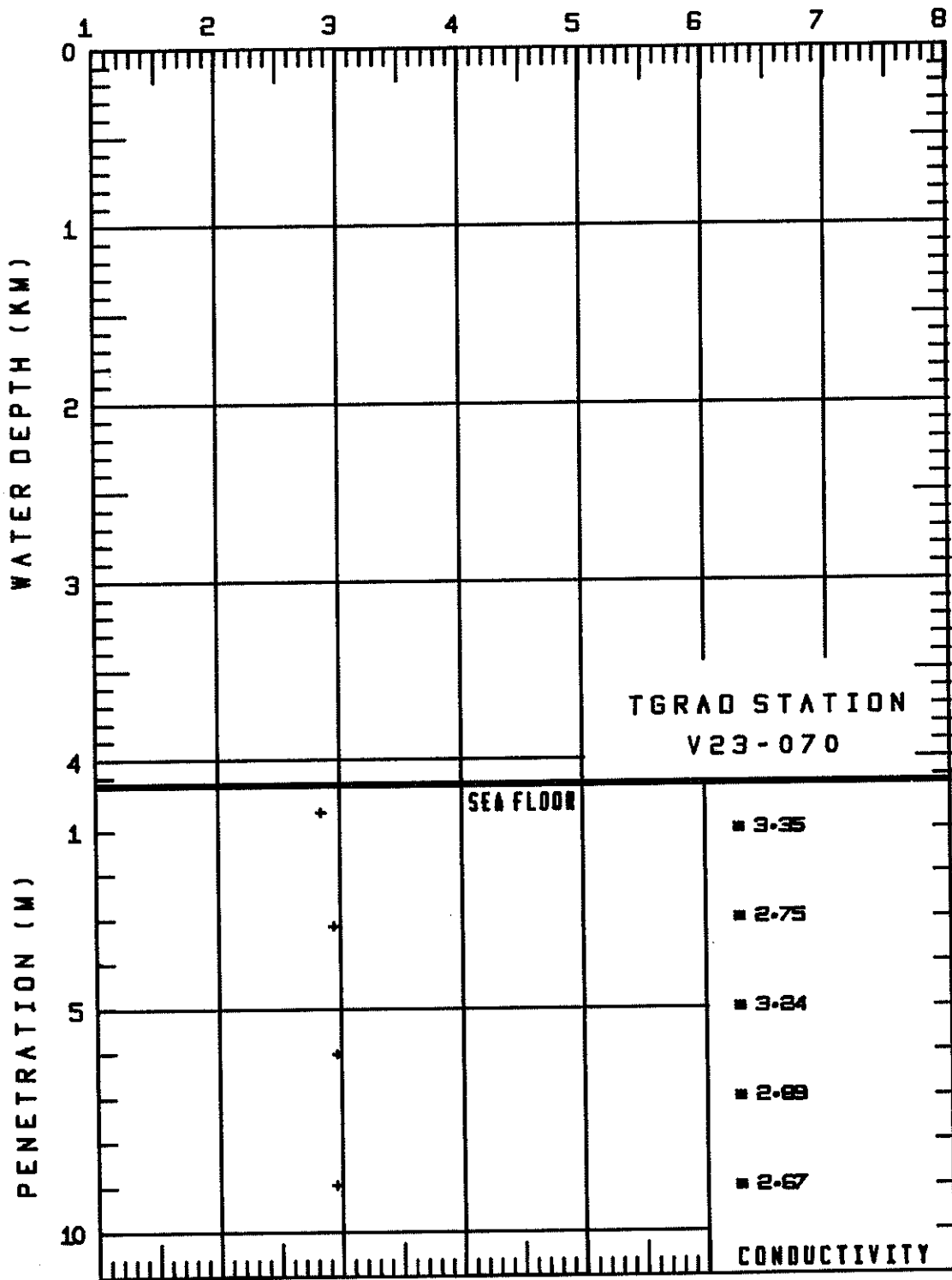
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.60	2.84
3.15	2.94
6.02	2.96
8.94	2.95

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	3.35
3.00	2.75
5.00	3.24
7.00	2.89
9.00	2.67

TEMPERATURE (C)

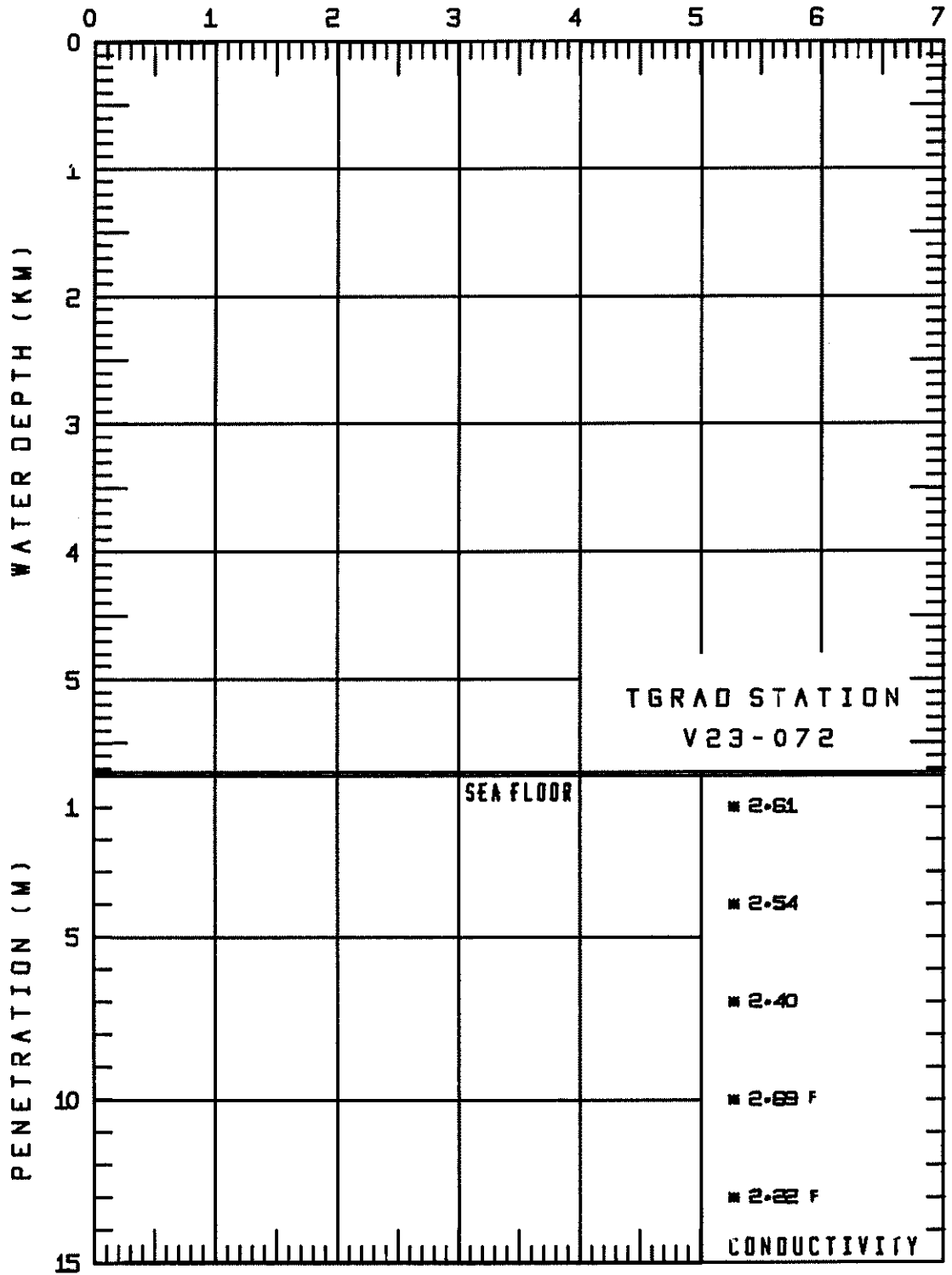


TGRAD STATIONV23-072

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.61
4.00	2.54
7.00	2.40
10.00	2.69 F
13.00	2.22 F

TEMPERATURE (C)



TGRAD STATION V23-073

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1188.	5.38	5.27
1266.	5.18	5.06
1319.	4.95	4.83
1472.	4.55	4.42
1730.	4.09	3.94
1971.	3.68	3.51
2216.	3.44	3.24
2480.	3.23	3.01
2884.	3.13	2.87
2981.	3.03	2.76
3049.	2.95	2.67
3165.	2.85	2.56
3289.	2.76	2.46
3634.	2.76	2.42
3970.	2.65	2.26
4383.	2.57	2.13
4867.	2.54	2.03
5342.	2.41	1.84
5588.	2.37	1.76
5584.	2.37	1.77
5790.	2.38	1.74
5824.	2.38	1.74
5811.	2.40	1.76
5812.	2.41	1.77

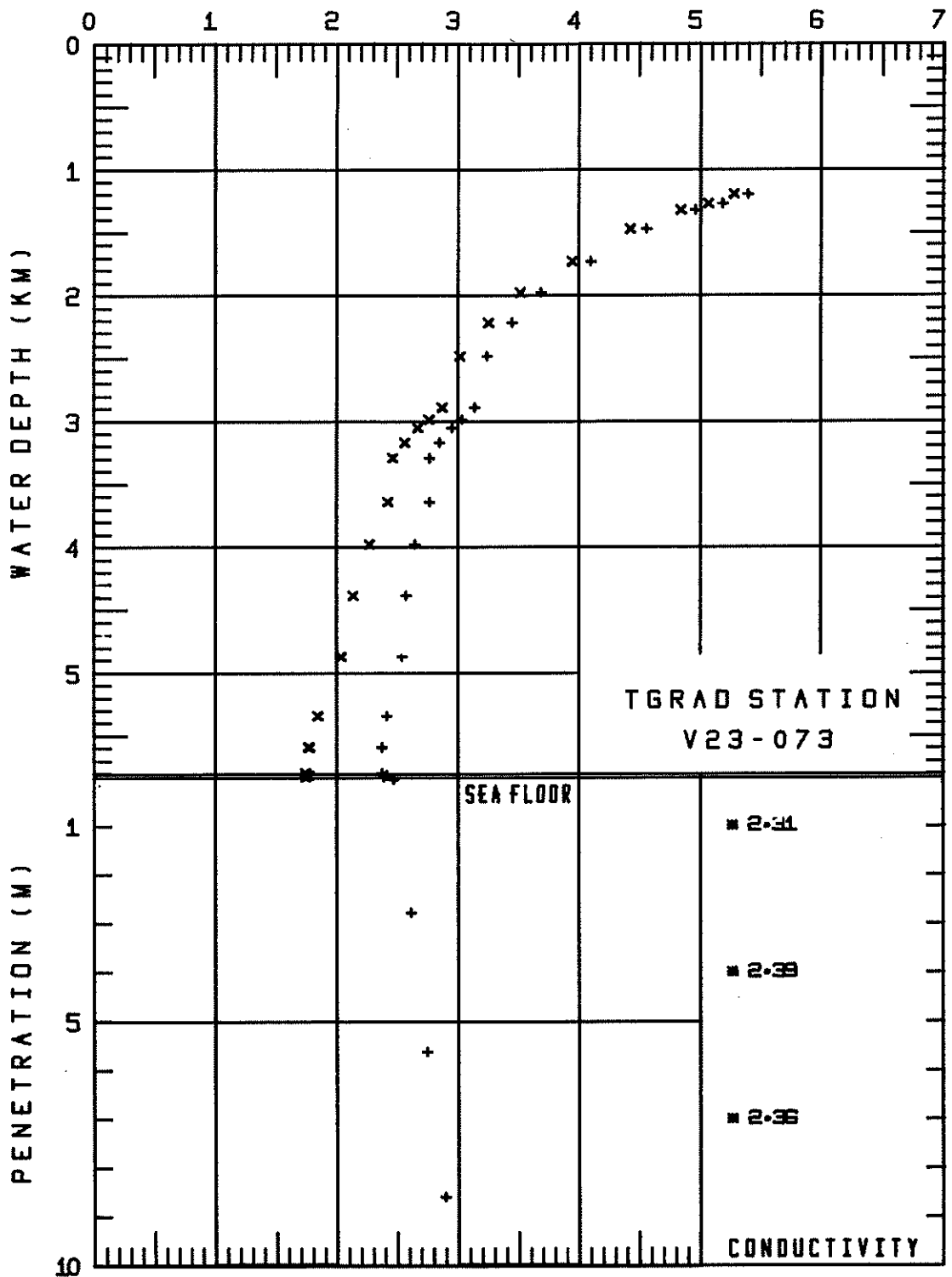
SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
0.05	2.46
2.78	2.61
5.63	2.75
8.60	2.89

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.31
4.00	2.39
7.00	2.36

TEMPERATURE (C)



TGRAD STATION V23-074

WATER TEMPERATURES

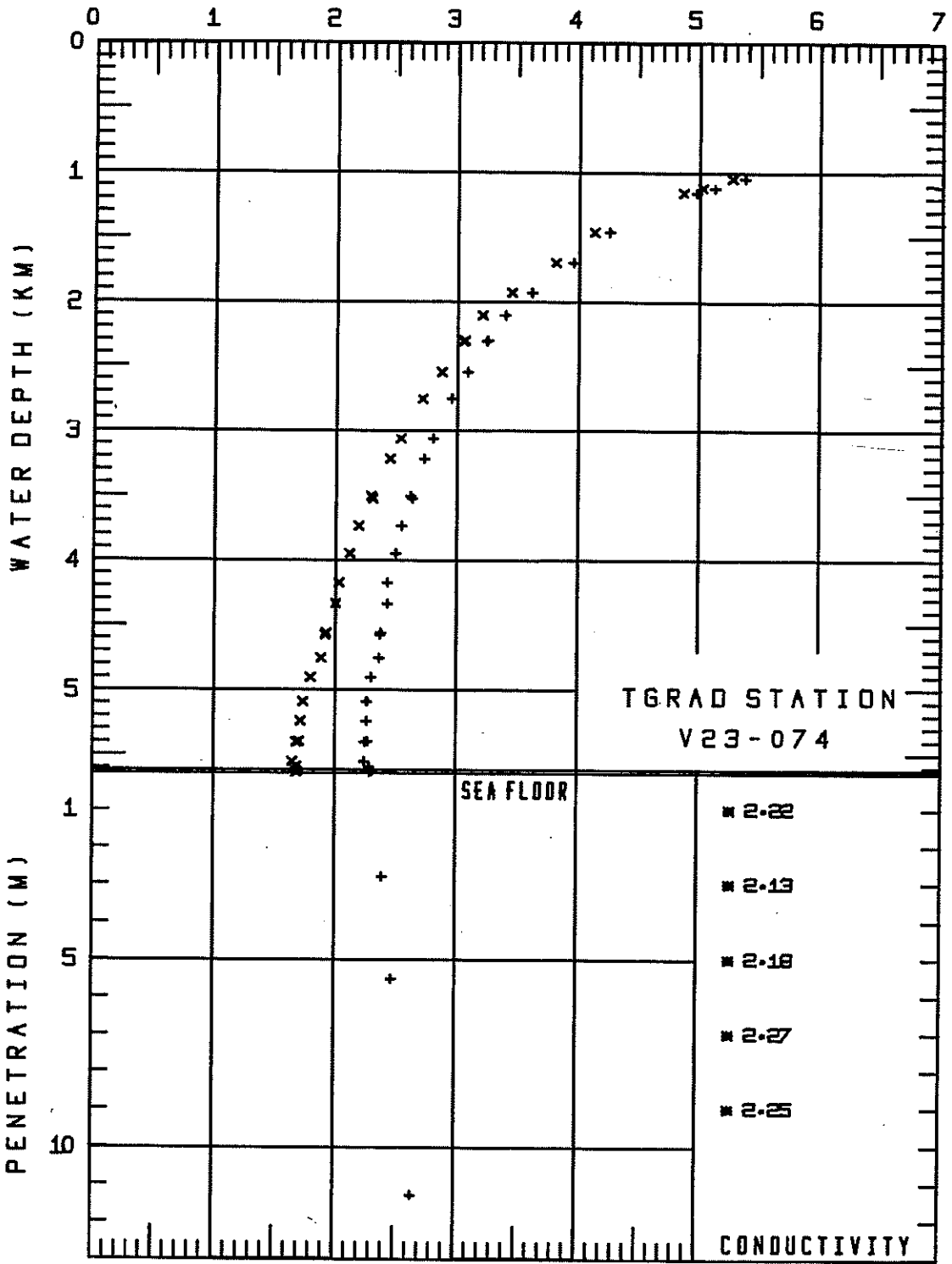
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1038.	5.36	5.27
1117.	5.13	5.03
1153.	4.97	4.87
1458.	4.25	4.13
1698.	3.95	3.81
1926.	3.61	3.45
2103.	3.39	3.21
2297.	3.26	3.06
2304.	3.25	3.04
2543.	3.09	2.86
2749.	2.95	2.71
3055.	2.80	2.53
3209.	2.73	2.44
3502.	2.61	2.29
3520.	2.63	2.30
3732.	2.54	2.19
3941.	2.49	2.11
4167.	2.43	2.02
4329.	2.43	2.00
4559.	2.38	1.92
4571.	2.37	1.92
4752.	2.36	1.88
4904.	2.29	1.79
5089.	2.26	1.74
5238.	2.26	1.71
5404.	2.25	1.68
5395.	2.27	1.70
5551.	2.24	1.65
5590.	2.28	1.68
5591.	2.28	1.68
5625.	2.30	1.69
5633.	2.29	1.68

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
2.80	2.39
5.53	2.47
11.29	2.64

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.22
3.00	2.13
5.00	2.18
7.00	2.27
9.00	2.25



TGRAD STATION V23-075

WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1083.	5.20	5.10
1150.	4.97	4.86
1191.	4.89	4.78
1212.	4.89	4.78
1367.	4.44	4.32
1553.	4.17	4.04
1778.	3.98	3.83
1943.	3.86	3.69
2230.	3.69	3.48
2225.	3.68	3.48
2438.	3.42	3.21
2658.	3.21	2.97
2846.	3.01	2.75
3061.	2.82	2.54
3237.	2.63	2.34
3442.	2.48	2.17
3454.	2.50	2.19
3645.	2.37	2.04
3862.	2.30	1.94
4058.	2.27	1.89
4265.	2.27	1.86
4456.	2.28	1.84
4500.	2.28	1.84
4514.	2.27	1.83
4519.	2.27	1.83
4616.	2.28	1.82
4644.	2.27	1.81
4686.	2.29	1.82
4711.	2.27	1.80

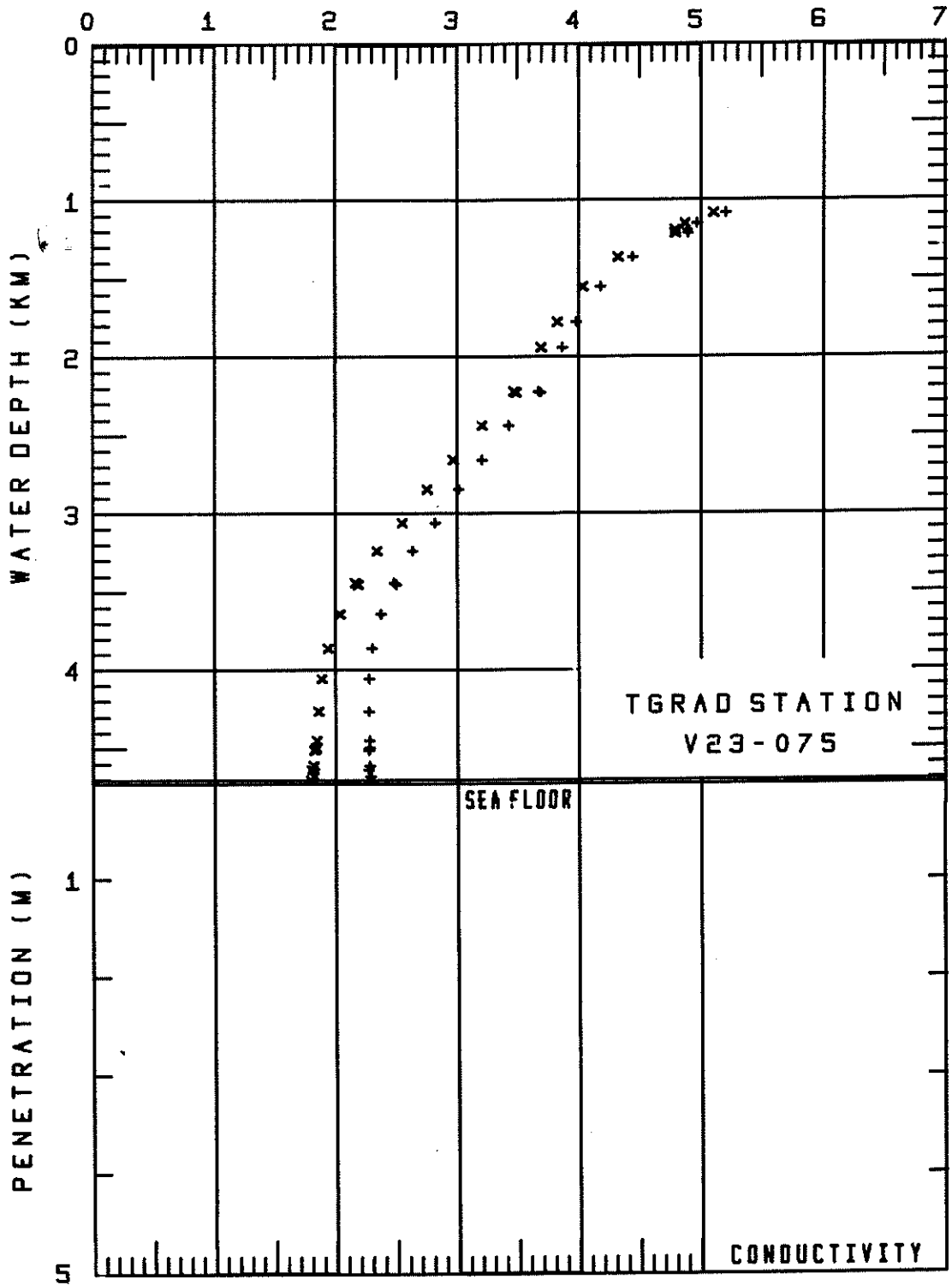
161(a)

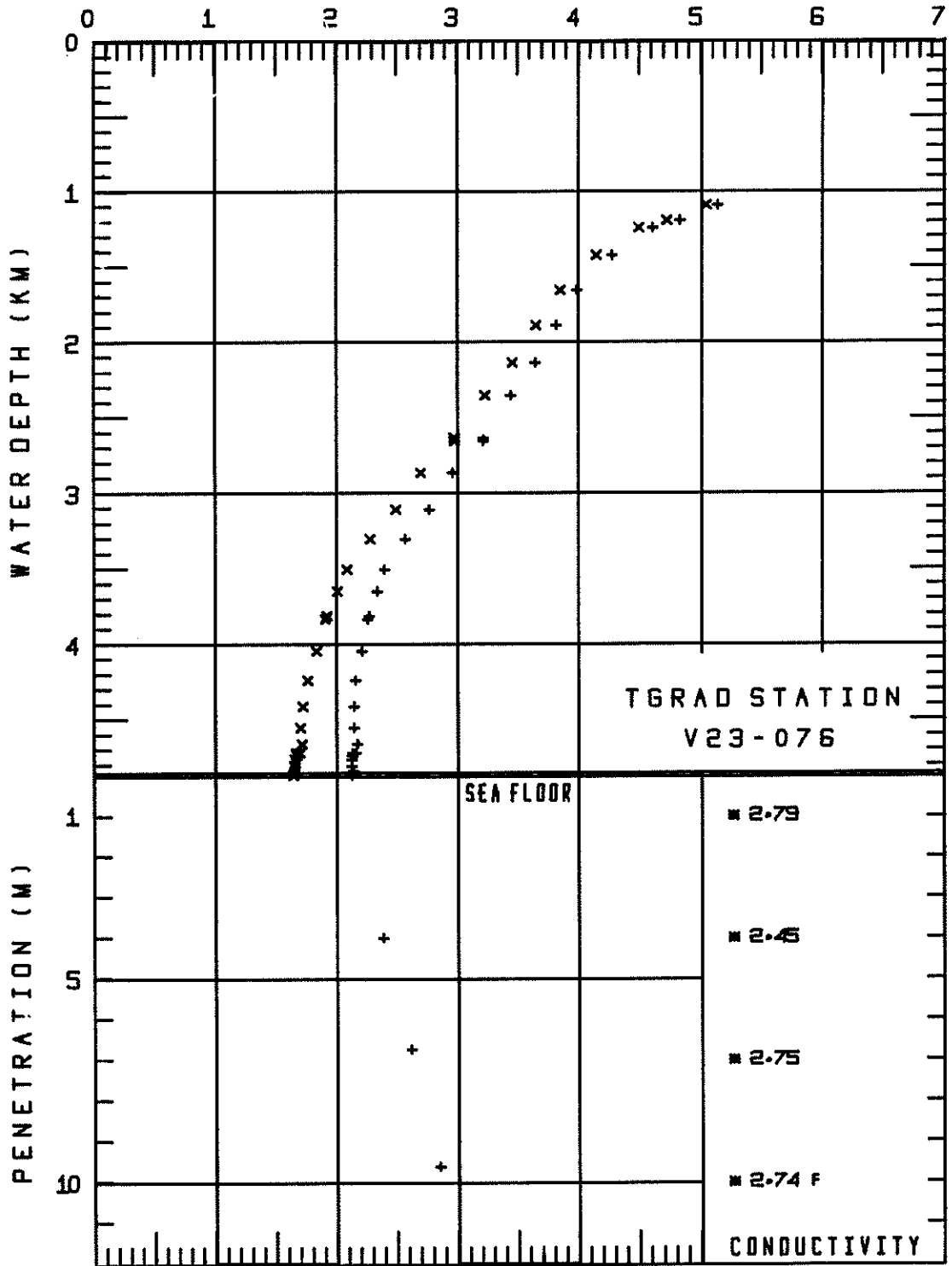
T'Grad Station V23-075

Sediment Temperatures

Depth	Temperature
4.40	2.54
6.95	2.69
12.78	3.05

TEMPERATURE (C)





TGRAD STATION V23-077

WATER TEMPERATURES

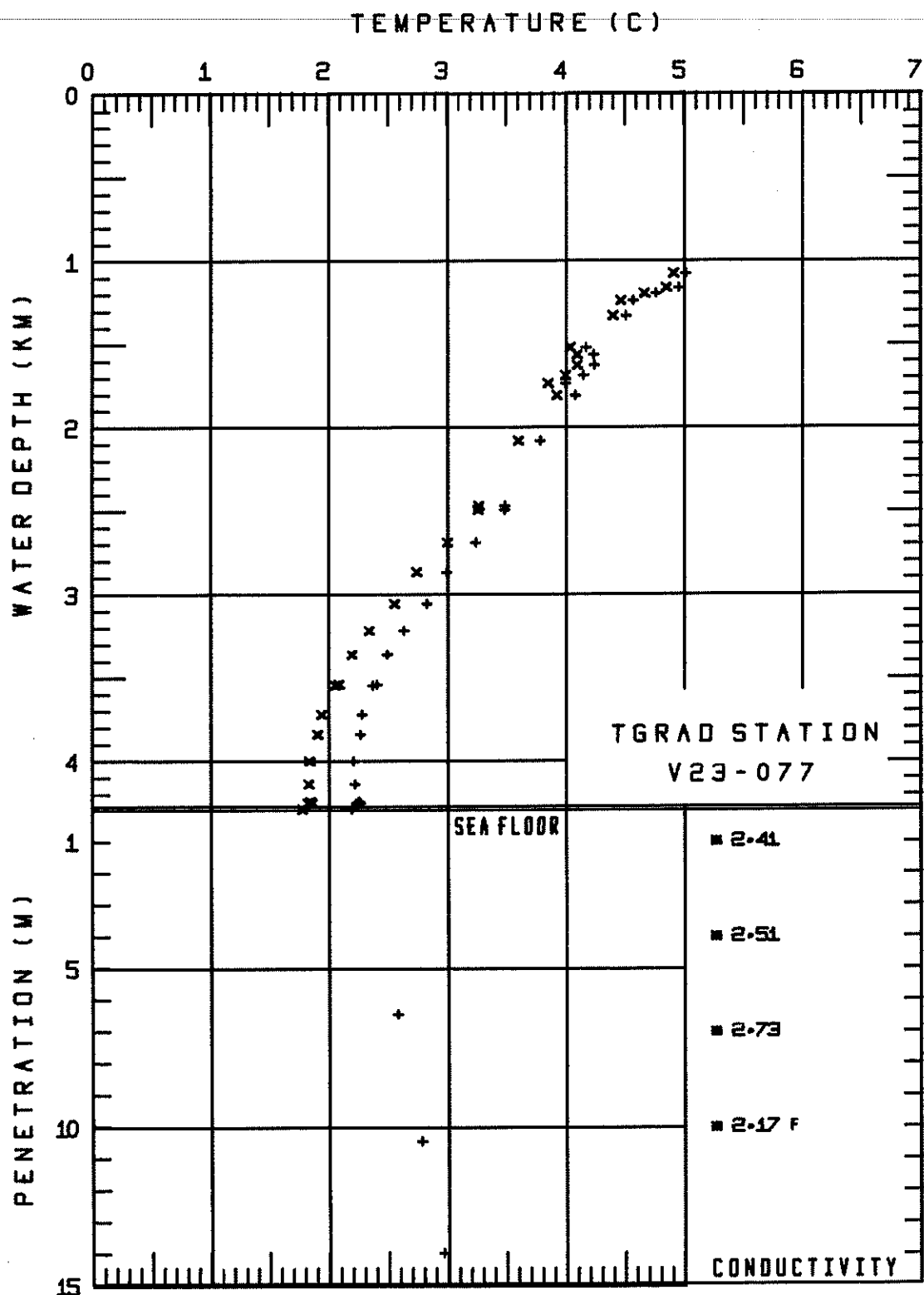
DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1074.	5.00	4.91
1160.	4.95	4.85
1191.	4.76	4.66
1237.	4.57	4.46
1327.	4.51	4.39
1517.	4.17	4.03
1559.	4.23	4.09
1620.	4.24	4.09
1683.	4.14	4.00
1730.	4.00	3.84
1801.	4.08	3.92
2072.	3.78	3.60
2466.	3.49	3.26
2489.	3.48	3.26
2684.	3.24	3.00
2863.	3.00	2.74
3051.	2.83	2.55
3213.	2.63	2.34
3359.	2.50	2.19
3545.	2.37	2.05
3536.	2.41	2.08
3721.	2.28	1.94
3837.	2.26	1.91
3999.	2.21	1.84
4136.	2.22	1.83
4253.	2.23	1.83
4252.	2.24	1.83
4291.	2.19	1.78
4243.	2.25	1.84
4249.	2.26	1.85
4251.	2.26	1.86

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
6.45	2.58
10.46	2.78
13.98	2.97

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.41
4.00	2.51
7.00	2.73
10.00	2.17 F



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WATER TEMPERATURES

DEPTH	IN SITU TEMPERATURE	POTENTIAL TEMPERATURE
1086.	5.13	5.04
1192.	4.82	4.72
1239.	4.60	4.50
1421.	4.27	4.15
1656.	3.99	3.84
1886.	3.81	3.65
2133.	3.64	3.45
2351.	3.44	3.23
2635.	3.21	2.98
2653.	3.21	2.97
2869.	2.96	2.70
3111.	2.77	2.49
3303.	2.58	2.28
3501.	2.40	2.09
3652.	2.34	2.01
3813.	2.27	1.92
3834.	2.26	1.90
4047.	2.21	1.83
4238.	2.16	1.76
4414.	2.14	1.72
4554.	2.14	1.70
4663.	2.17	1.72
4720.	2.16	1.69
4763.	2.13	1.66
4720.	2.13	1.67
4737.	2.13	1.67
4806.	2.12	1.65
4838.	2.14	1.66
4867.	2.12	1.64

SEDIMENT TEMPERATURES

DEPTH	TEMPERATURE
4.00	2.38
6.74	2.62
9.61	2.85

SEDIMENT CONDUCTIVITIES

DEPTH	CONDUCTIVITY
1.00	2.79
4.00	2.45
7.00	2.75
10.00	2.74 F