

# CRUISE REPORT



*R/V Aranda*

Cruise 1/2021

Combine1/2021 Leg 1  
18<sup>th</sup> – 22<sup>nd</sup> January, 2021

# Cruise 1/2021, Combine1, Leg 1

18<sup>th</sup> – 22<sup>nd</sup> January, 2021

Chief scientist: Harri T. Kankaanpää

## INTRODUCTION

This cruise was focused to monitoring of hydrography, nutrients and oil contamination in the Gulf of Finland as part of the national EU MSFD programme and HELCOM/MONAS Combine programme (Combine 1). Additionally, water and sediment samples for monitoring of harmful substances were collected and underwater sound pressure (noise) monitoring was begun. Altogether 20 research stations and two wave buoy retrieval sites were explored in the Gulf of Finland (Figure 1, Table 1). At every station CTD (salinity, temperature, fluorescence, O<sub>2</sub> concentration profile and pressure), pH, ammonia/ammonium concentration and nutrient concentrations were measured using rosette-bottled samples. In addition to the CTD/rosette profile, these parameters were also measured from near-bottom water samples (1 m above the seafloor). Total sulfide (hydrogen sulfide) concentrations were analysed at sites with oxygen concentrations below the limit of hypoxia. Oil contamination was examined using subsurface water from one metre depth at selected stations. Additional water samples for quality assurance measurements were taken at stations LL9 and JONTKA.



Fig. 1. Location of research stations and the approximate route of R/V Aranda along the course of the Combine1 leg (Helsinki – Hango) within the Gulf of Finland and its western entrance during January 18 – 22, 2021.

## OBSERVATION STATIONS AND MEASUREMENTS

Total number of stations during the cruise was 22. The various activities are listed in Table 1.

Station	CTD	Hydrography (pH, O <sub>2</sub> , sulfides, SAL, NH <sub>3</sub> /NH <sub>4</sub> <sup>+</sup> )	Nutrients	Oil	Water for harmful substances	Sediment for harmful substances	Sound pressure hydrophone deployment	Other activities
AALTO_STADI								wave buoy retrieval
39A	x	x	x					
AALTO_HKI								wave buoy retrieval
LL5	x	x	x					
XIV3	x	x	x					
LL3A	x	x	x	x	x	x		
K19_SED	x						x	
XV1	x	x	x	x	x	x		
BIAS19							x	
GF2	x	x	x					
LL6A	x	x	x					
LL7	x	x	x	x	x			
GF1	x	x	x					about 700 litres of surface water
LL9	x	x	x					
LL9LAATU	x	x	x					
XII3	x	x	x					
JML	x	x	x			x		
JONTKA	x	x	x					
JONTKALA	x	x	x					
F62	x	x	x					
LL11	x	x	x					
LANGDEN	x	x	x					

Table 1. List of stations, monitoring activities and additional operations.

## SUMMARY OF PHYSICAL AND CHEMICAL STATUS

The chemical status of the Gulf of Finland had declined slightly from the conditions during January 2020. This was the case especially for oxygen and total sulfide concentrations and the deeps of the western Gulf of Finland were depleted of dissolved oxygen. Stratification of the water column was pronounced as usual. Phosphorus concentration in the surface layers of the Gulf of Finland remains high, although in the past four years, the concentration has slightly declined in places. In water near the bottom of the Gulf of Finland, phosphorus concentration was clearly higher than in the previous winter, and at F62 (western Gulf of Finland) the highest wintertime near-bottom phosphorus concentration since 1990 occurred. Surface-water nitrogen nutrient concentration near the Finnish coast was higher than usual. Contributing to this were recent river water outflows with a high nitrate concentration spreading to surface layers of the sea. Highest near-bottom temperature since 1991 were measured in the western Gulf of Finland (JML), reflecting integrated contributions by warm winter 2019-2020, climate change and movement of deep water. Overall changes are depicted in Figures 2-9 and CTD profiles in Appendix 1.

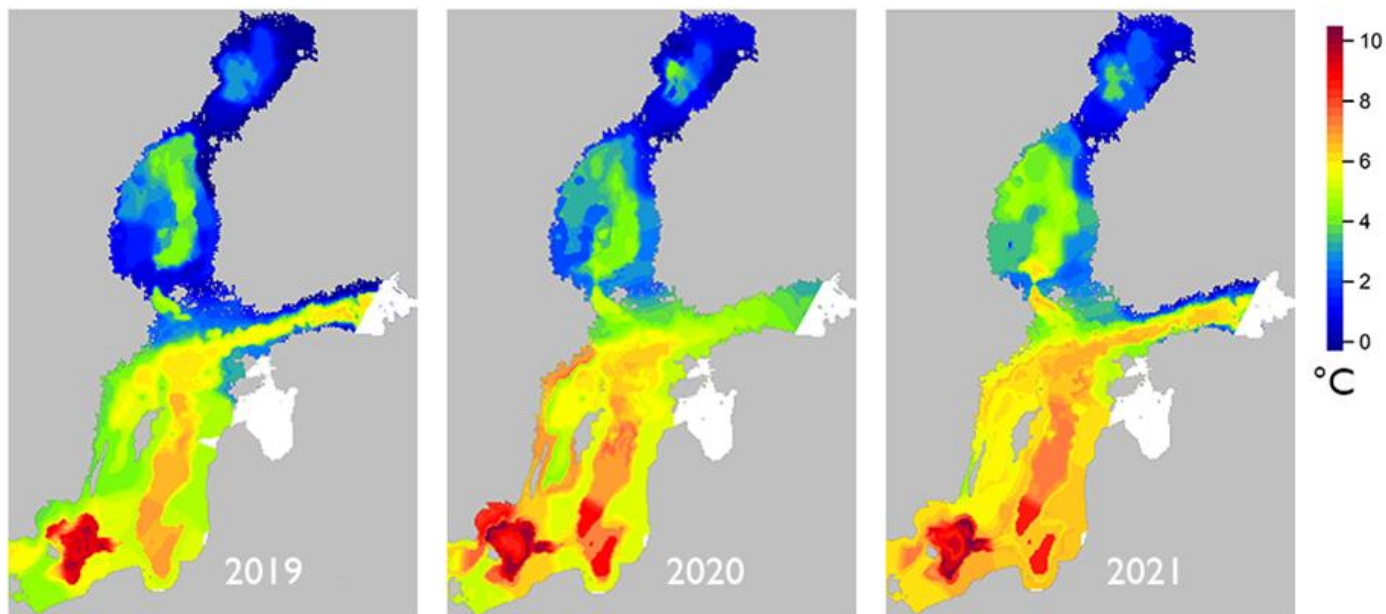


Fig. 2. Interpolated temperature (°C) at 1 m above seafloor in 2019, 2020 and 2021. Source: SYKE, Finnish Meteorological Institute and SMHI.

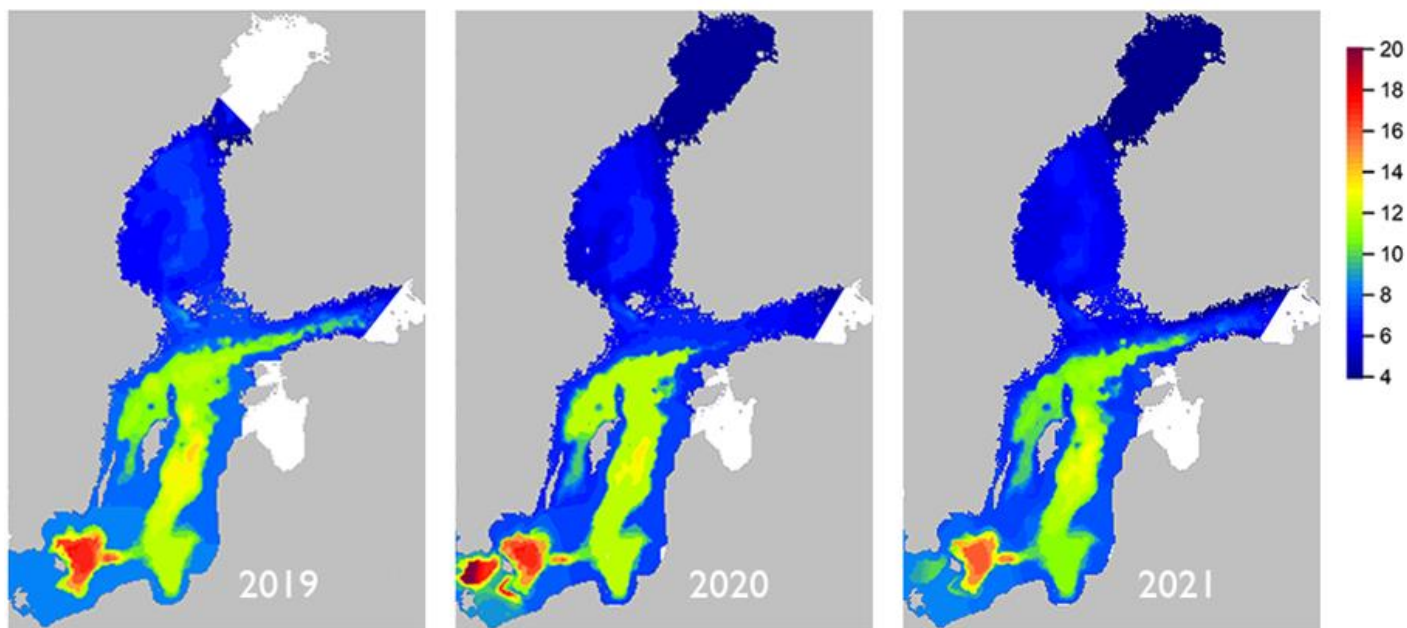


Fig. 3. Interpolated salinity at 1 m above seafloor in 2019, 2020 and 2021. Source: SYKE, Finnish Meteorological Institute and SMHI.

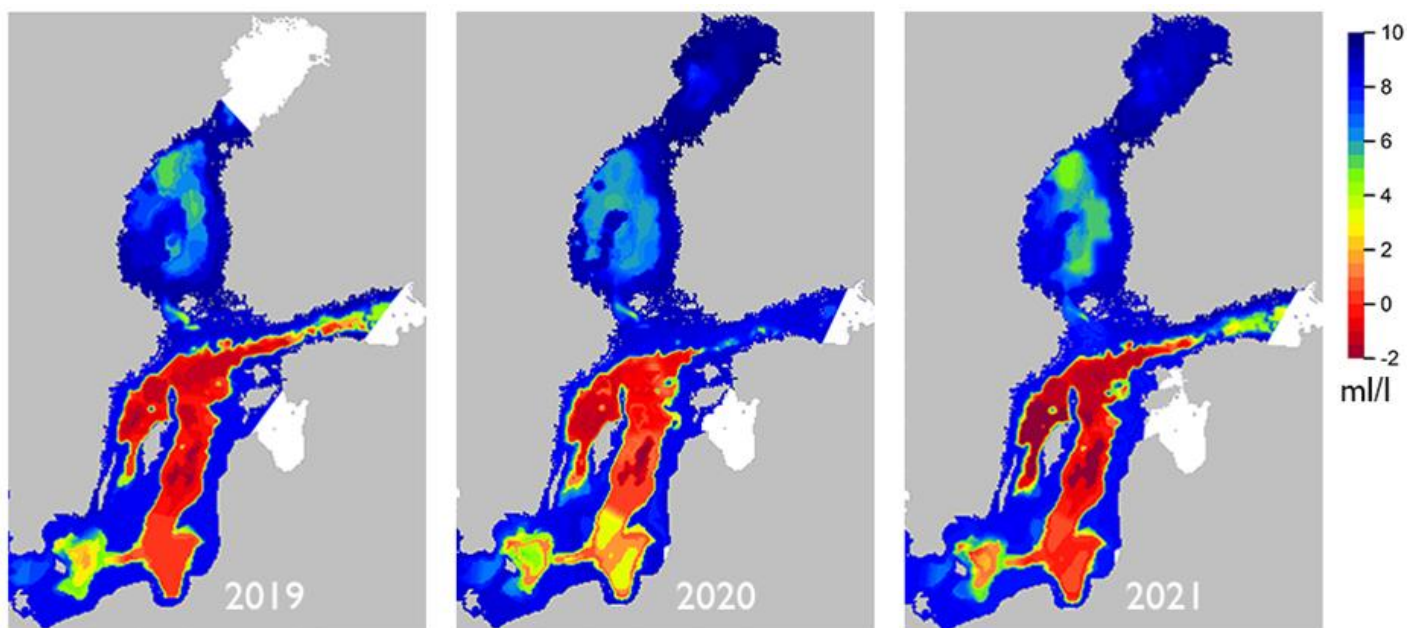


Fig. 4. Oxygen at 1 m above seafloor in January 2019, 2020 and 2021. Source: SYKE, Finnish Meteorological Institute and SMHI.

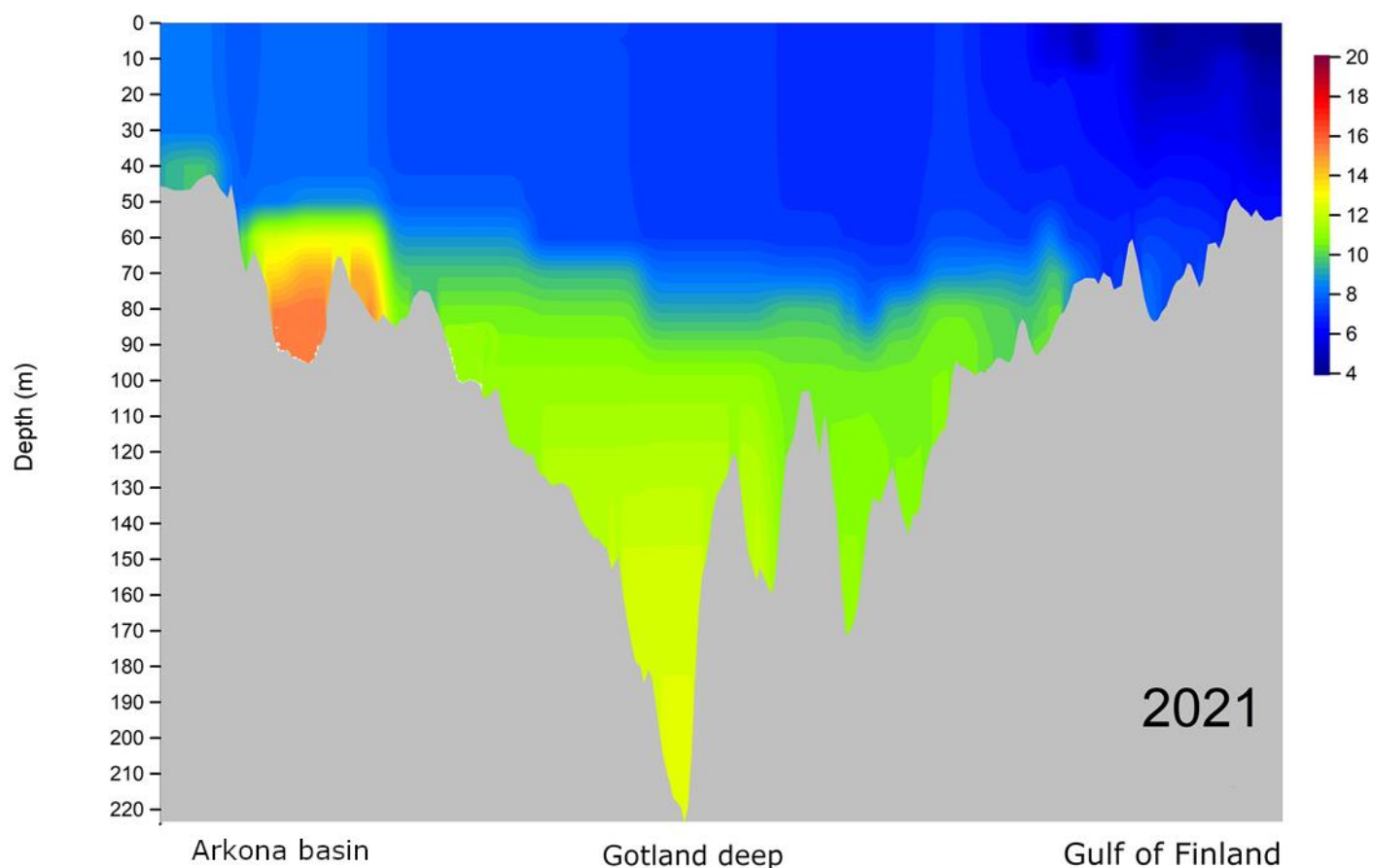


Fig. 5. A cross section of salinity stratification along a transect between and Arkona basin and Gulf of Finland in January 2021. Data outside Gulf of Finland is based on Combine 1 leg 2 data (separate cruise reports) and includes also data generated by the Swedish meteorological and hydrological institute (SMHI).

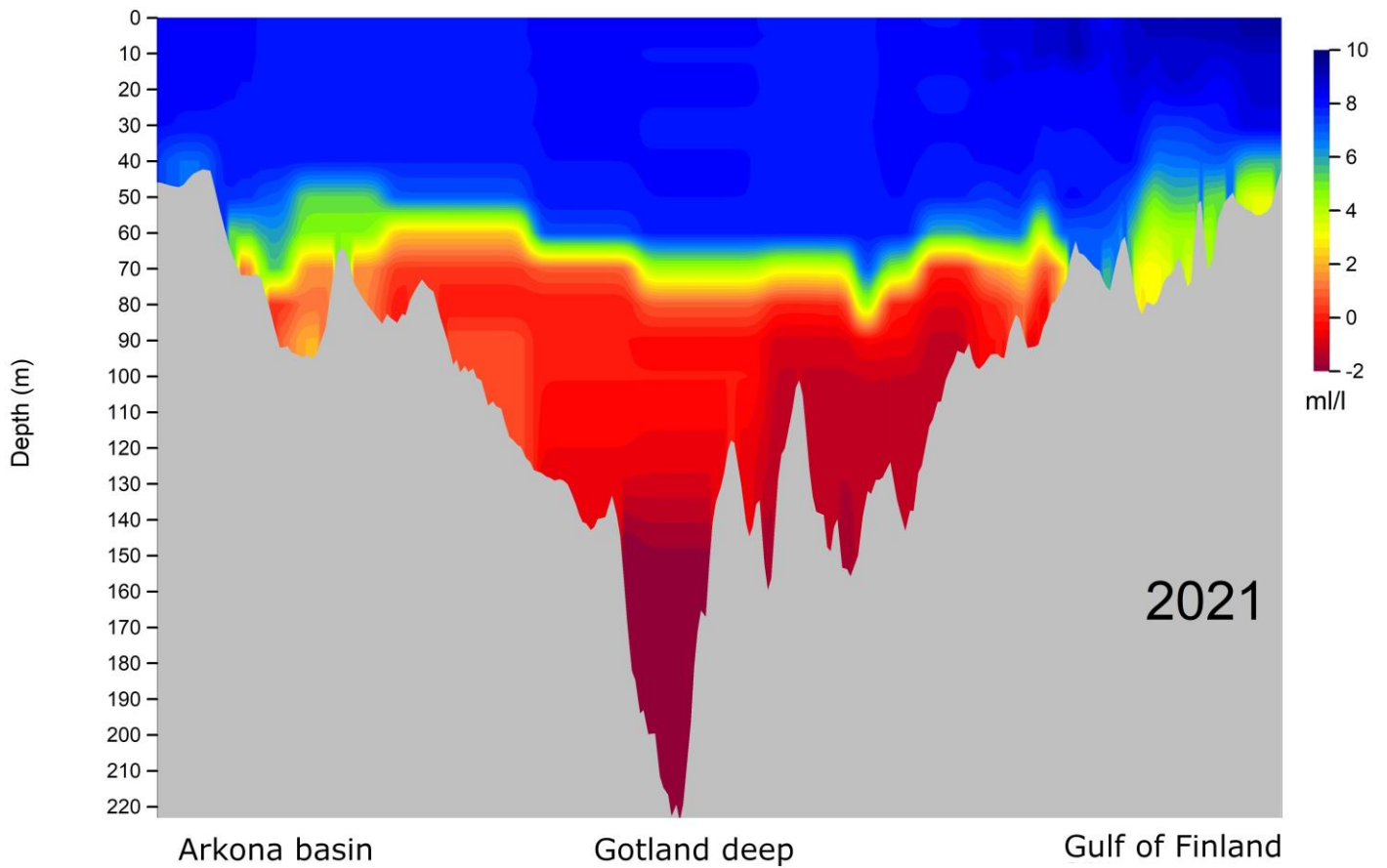


Fig. 6. A cross section of dissolved oxygen stratification along a transect between Arkona Basin and Gulf of Finland in January 2021. Data outside Gulf of Finland is based on Combine 1 leg 2 data (separate cruise reports) and includes also data generated by the Swedish meteorological and hydrological institute (SMHI).

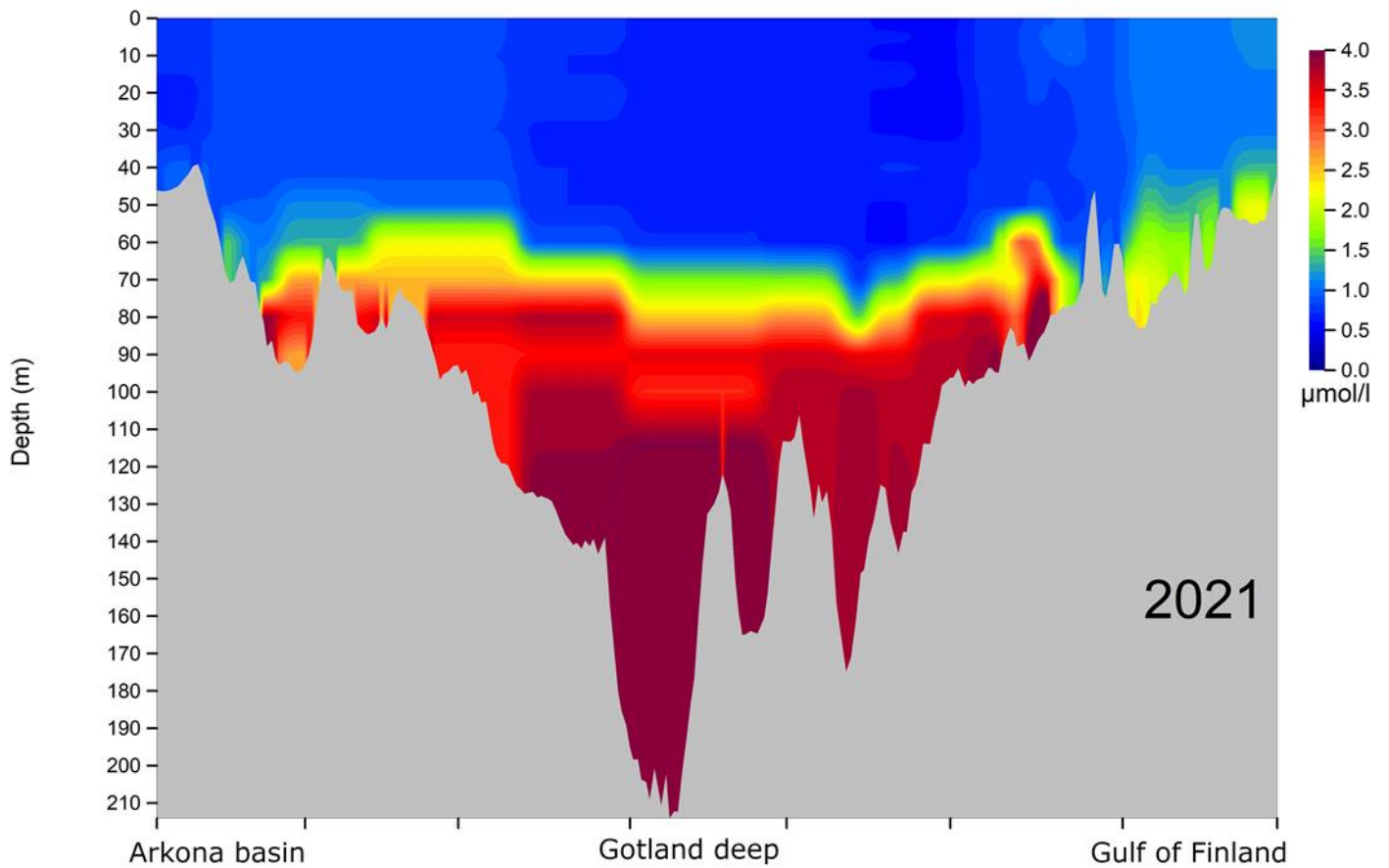


Fig. 7. A cross section of dissolved phosphate stratification along a transect between Arkona Basin and Gulf of Finland in January 2021. Data outside Gulf of Finland is based on Combine 1 leg 2 data (separate cruise reports) and includes also data generated by the Swedish meteorological and hydrological institute (SMHI).

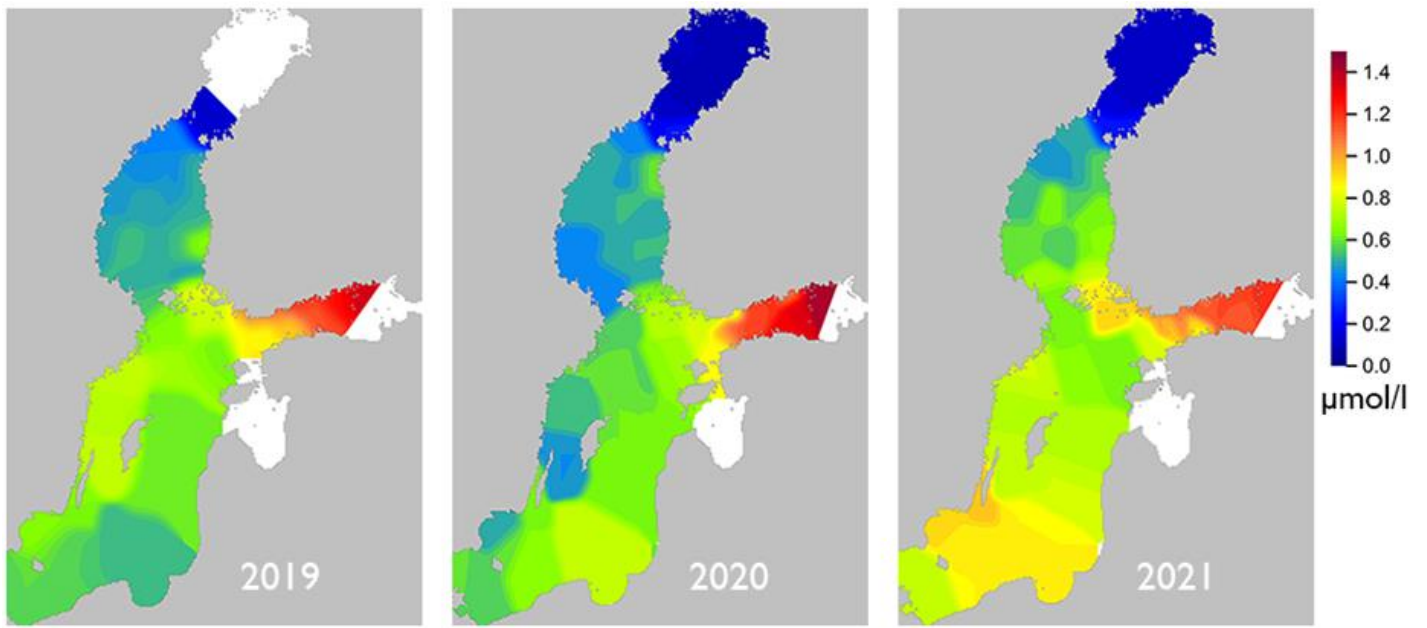


Fig. 8. Interpolated surface-layer phosphate concentrations ( $\mu\text{M}$ ) during winters 2017, 2018 and 2020. Source: SYKE and SMHI.



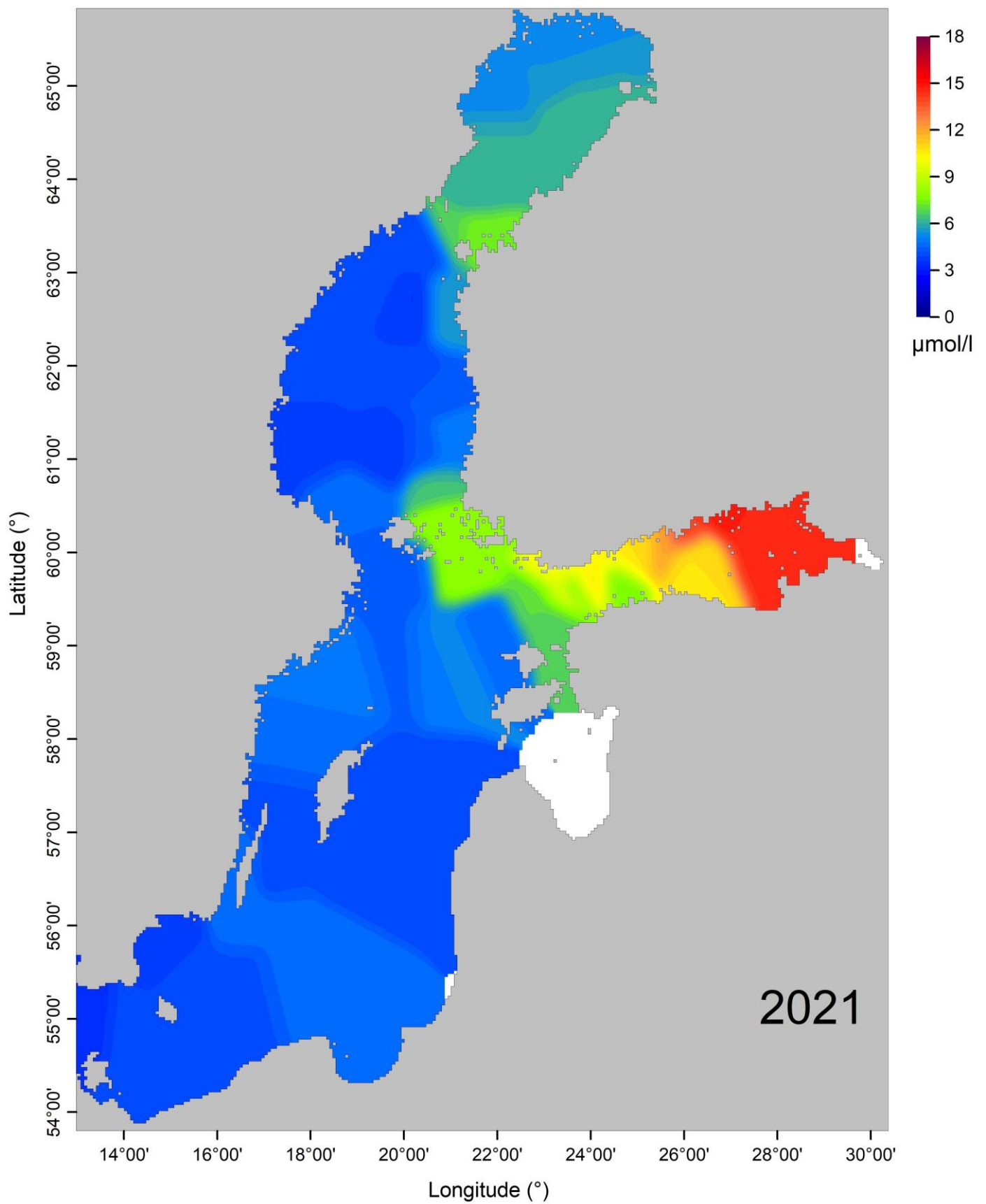


Fig. 9. Interpolated and extrapolated concentrations of dissolved nitrate ion in surface water in January 2021. Source: SYKE and SMHI.

### *Oil in the uppermost water column*

The concentrations of dissolved and dispersed oil at 1 m depth were analysed onboard and fell all below the 1.0 µg l<sup>-1</sup> threshold value set by the Intergovernmental Oceanographic Commission. Additionally 10 replicate samples taken from a 30-litre water sampler (station LL9) were analysed for quality control purposes.

## **SCIENTIFIC STAFF**

Chief scientist:

Kankaanpää Harri T.

Participants:

Räike Antti  
Kinnunen Tanja  
Hänninen Panu  
Kovru Olga  
Outinen Okko  
Lastumäki Ilkka  
Riikonen Jere  
Jalli Heini  
Hietala Riikka  
Roine Tuomo

Master: Thord Vaenerberg

Departure from Helsinki on Tuesday January 18, 2020 at 13:35 local time

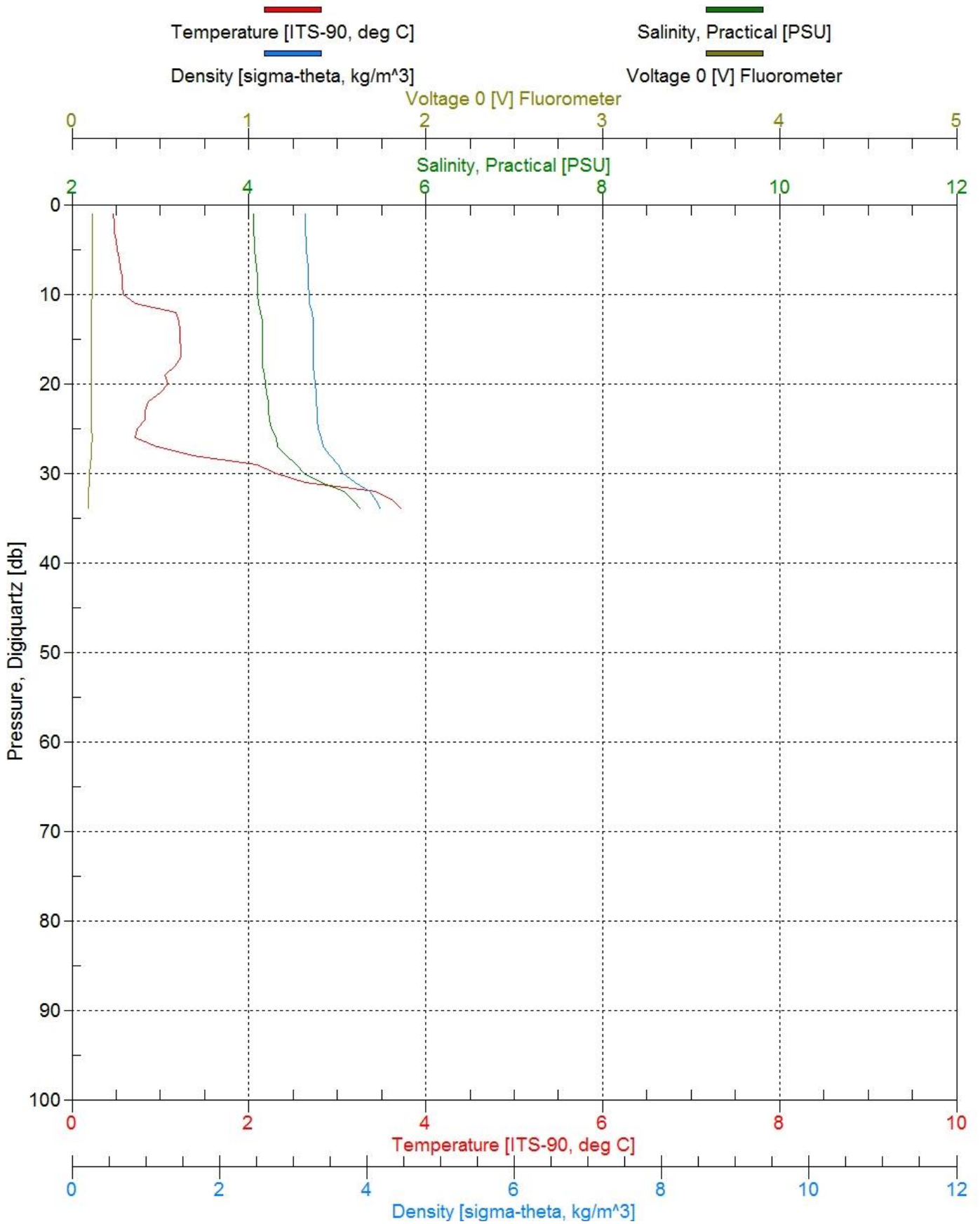
Arrival to Hanko on Friday January 22, 2021 at 01:30 local time

**LIST OF STATIONS (all coordinates are given in WGS-84 in degrees.minutes.minute decimals)**

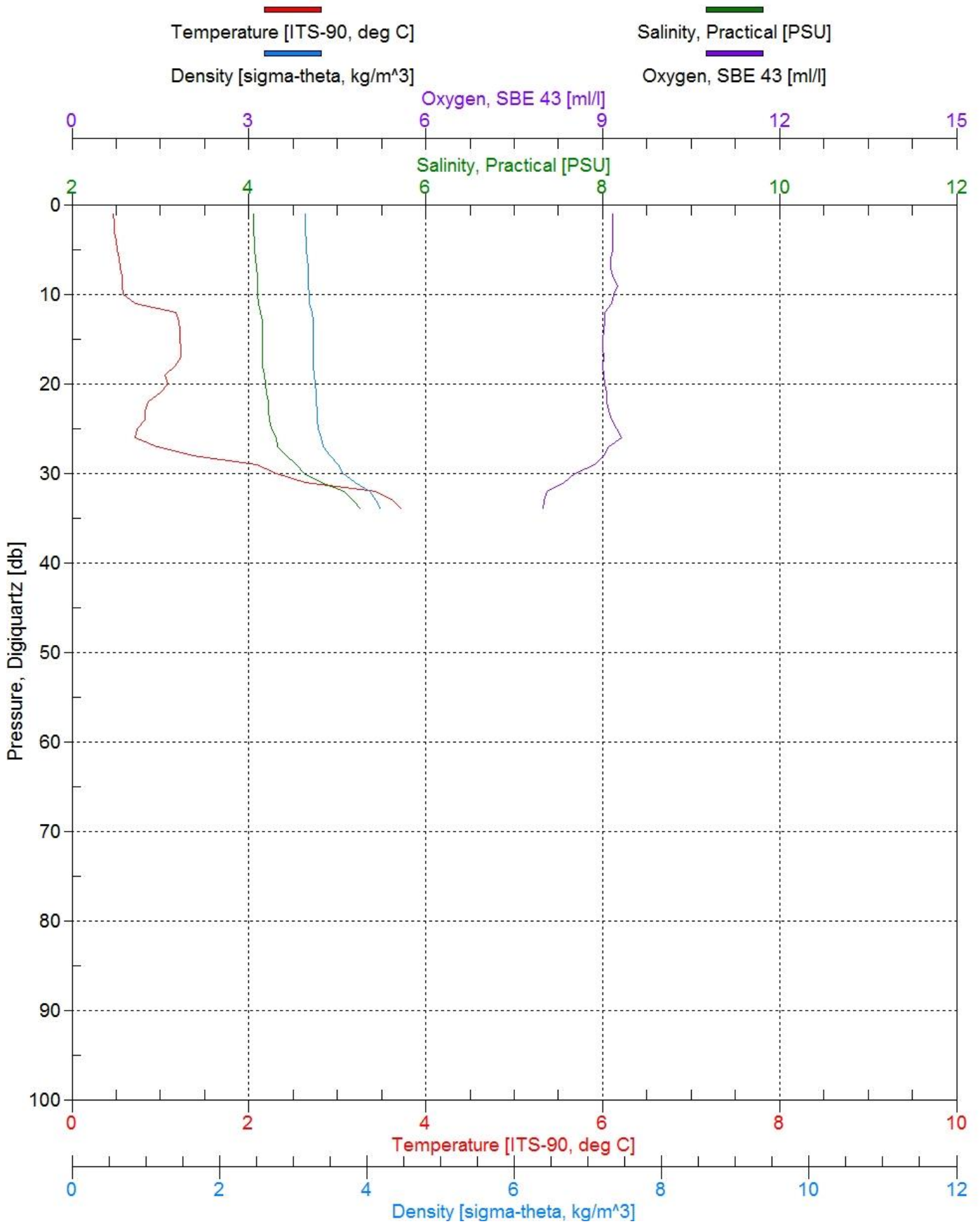
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01	0003	AALTO_HKI	N59.5786	E025.1407	63.00	20210118	1725
01	0004	LL5	N59.5501	E025.3582	68.00	20210118	1851
01	0005	XIV3	N60.1219	E026.1158	79.00	20210118	2305
01	0006	LL3A	N60.0396	E026.2067	67.00	20210119	0337
01	0007	K19_SED	N60.1941	E026.5293	40.00	20210119	0956
01	0008	XVI	N60.1500	E027.1483	64.00	20210119	1254
01	0009	BIAS19	N60.1499	E027.1485	66.00	20210119	1634
01	0010	GF2	N59.5031	E025.5142	84.00	20210119	2222
01	0011	LL6A	N59.5501	E025.0182	72.00	20210120	0211
01	0012	LL7	N59.5079	E024.5026	101.00	20210120	0455
01	0013	GF1	N59.4230	E024.4092	83.00	20210120	0802
01	0014	LL9	N59.4200	E024.0182	66.00	20210120	1252
01	0015	LL9LAATU	N59.4200	E024.0182	66.00	20210120	1456
01	0016	XII3	N59.5185	E023.5914	35.00	20210121	0047
01	0017	JML	N59.3491	E023.3762	80.00	20210121	0343
01	0018	JONTKA	N59.3188	E023.2939	118.00	20210121	1005
01	0019	JONTKALA	N59.3188	E023.2939	118.00	20210121	1120
01	0020	F62	N59.2001	E023.1580	96.00	20210121	1442
01	0021	LL11	N59.3501	E023.1781	66.00	20210121	1821
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Appendix 1. CTD profiles acquired during the cruise.

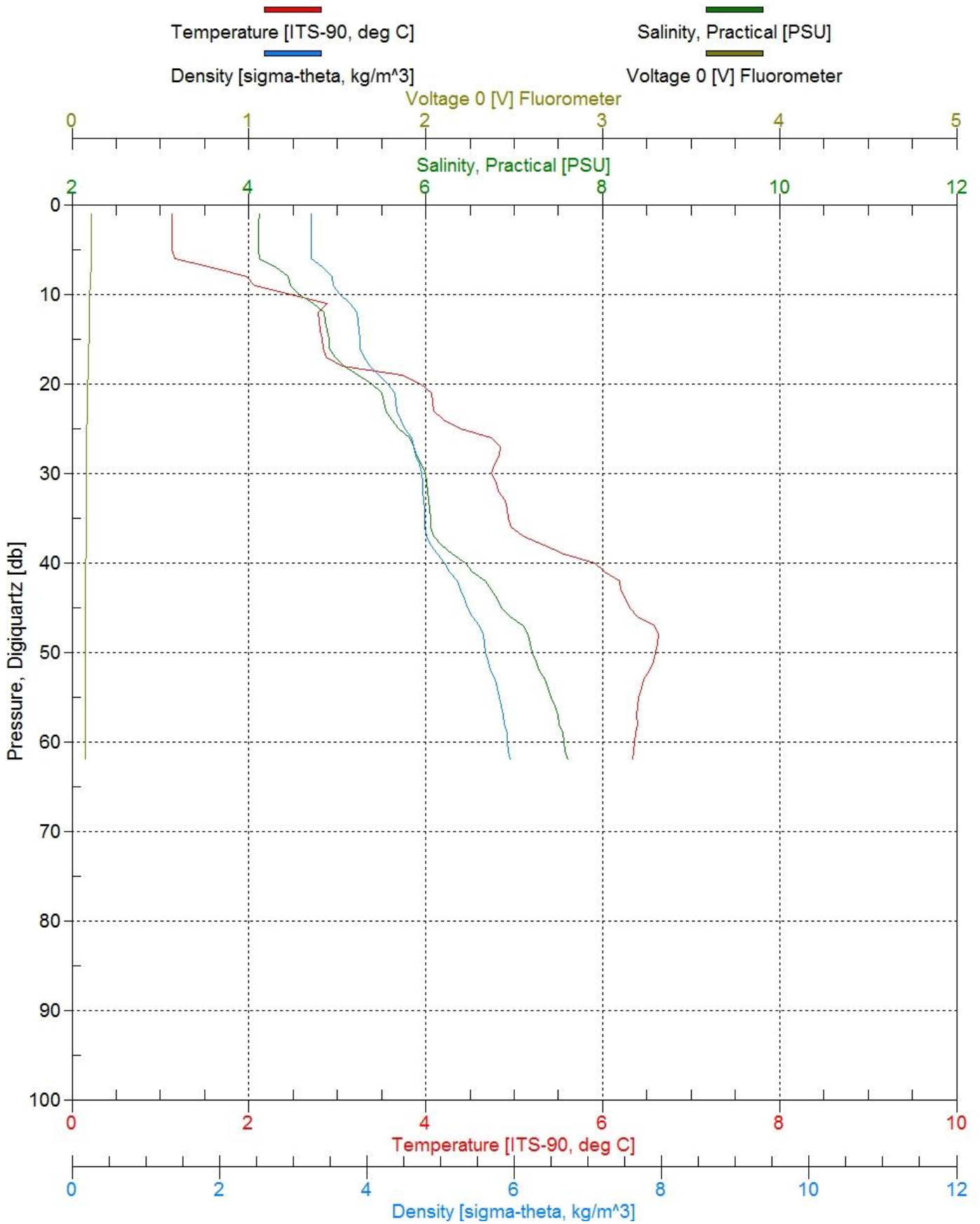
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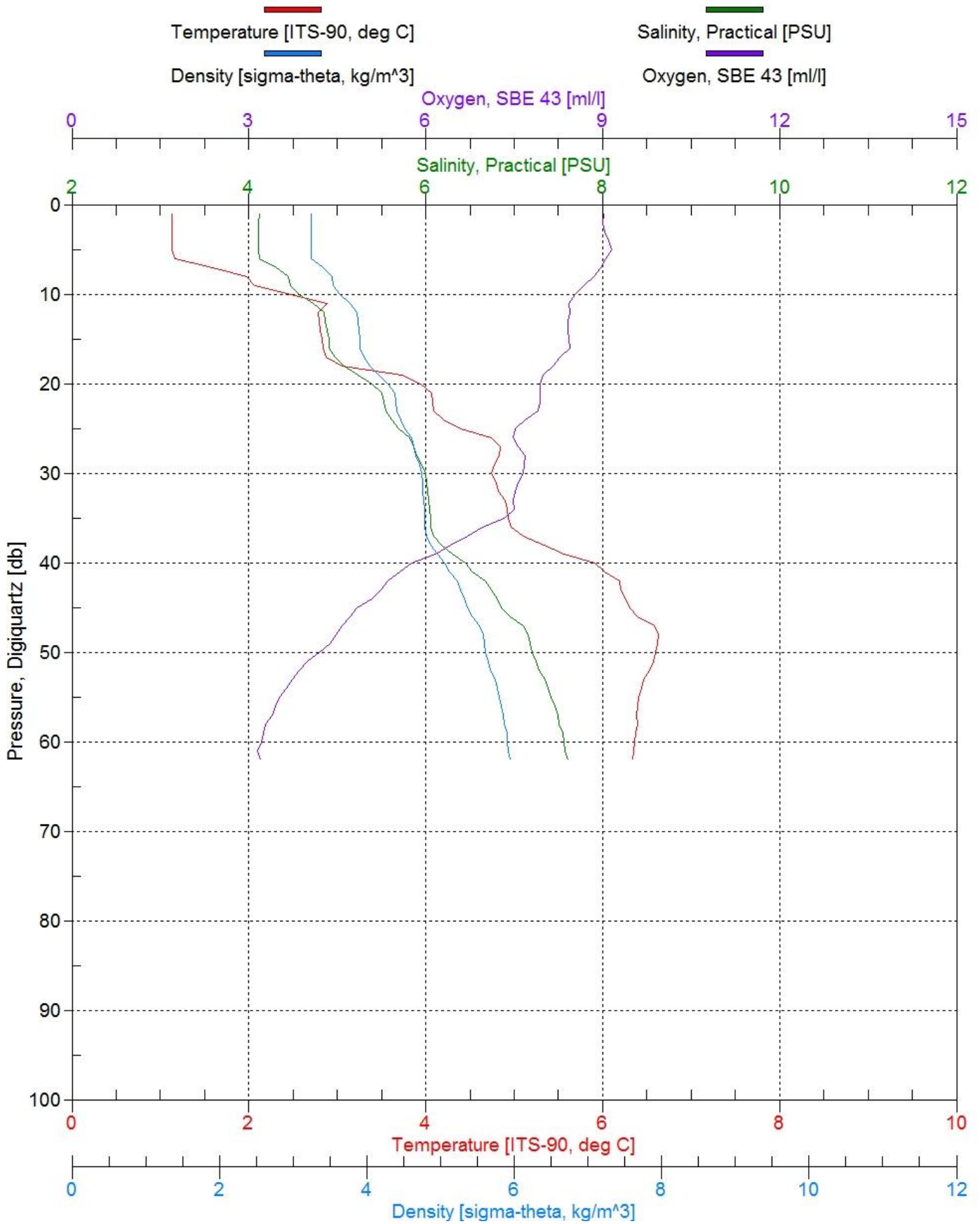
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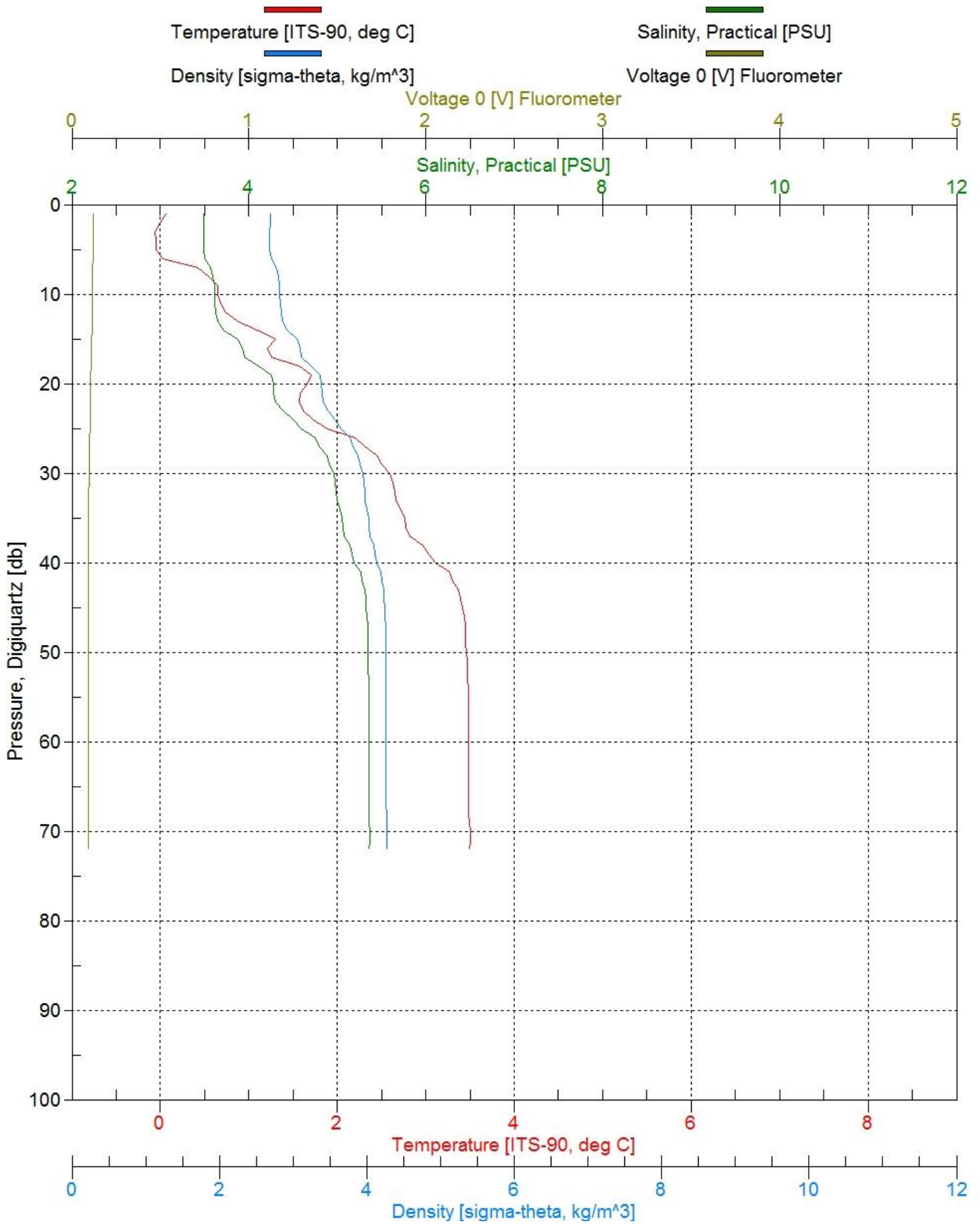


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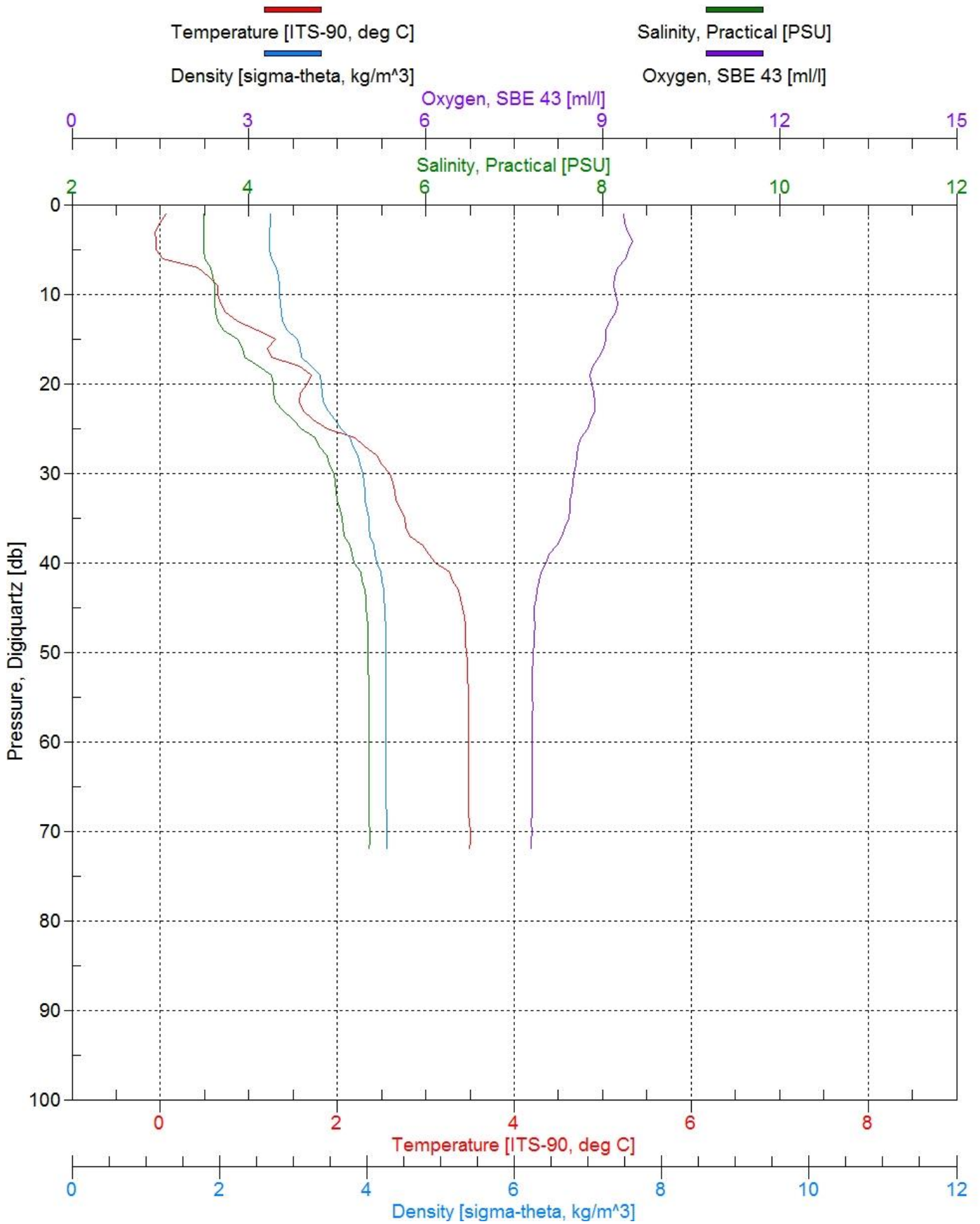




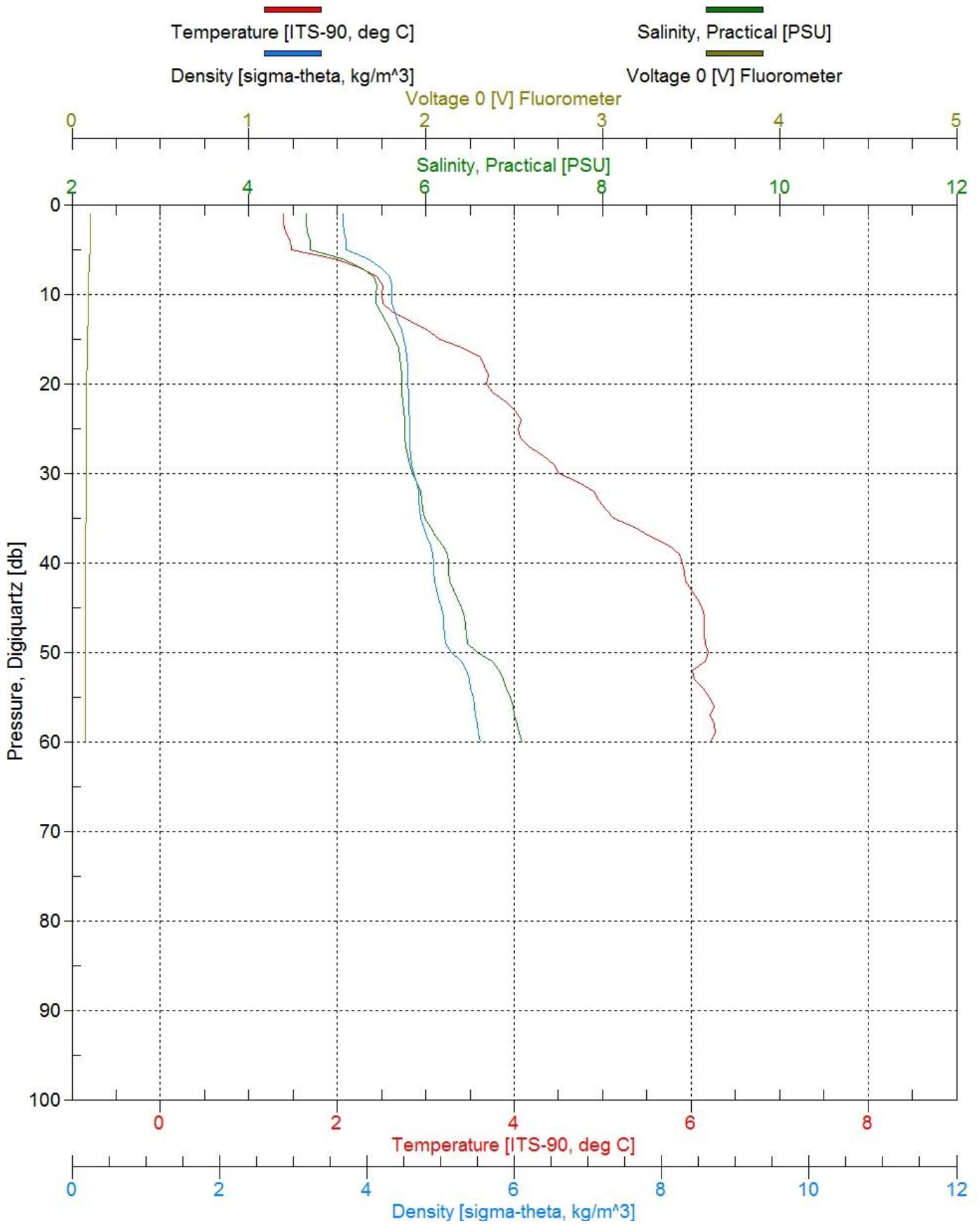
XIV3 18.01.2021 23.54, a210005.cnv



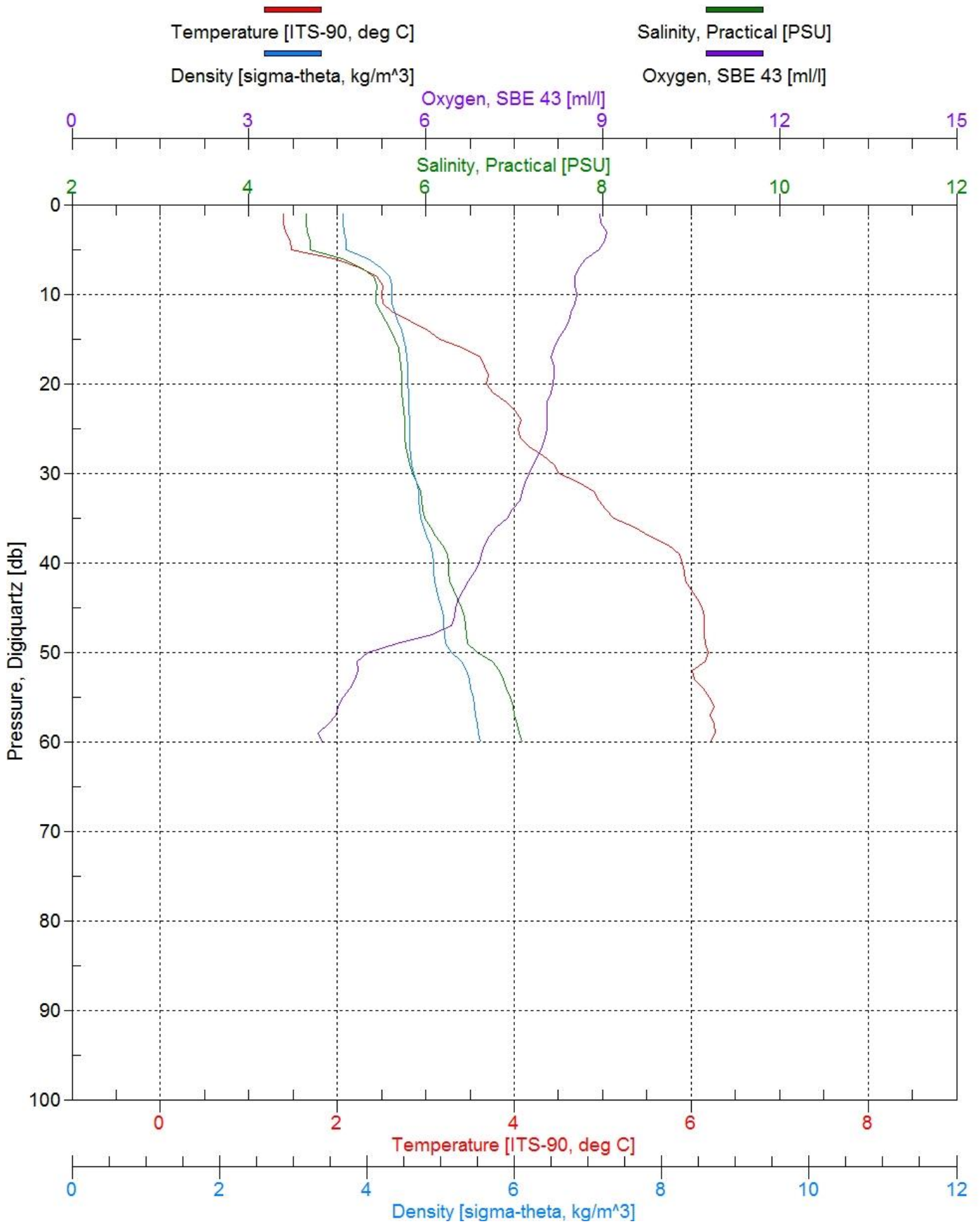
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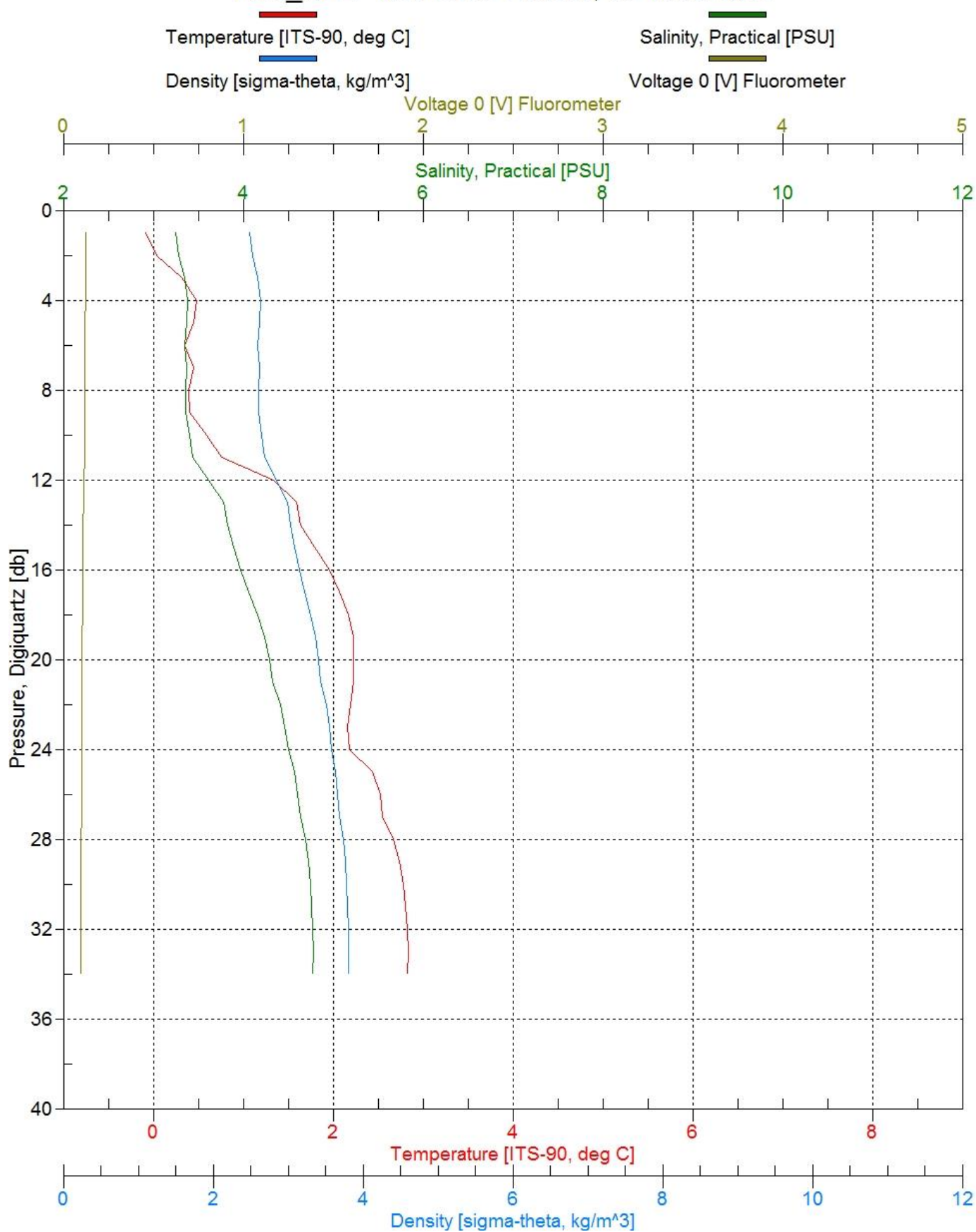
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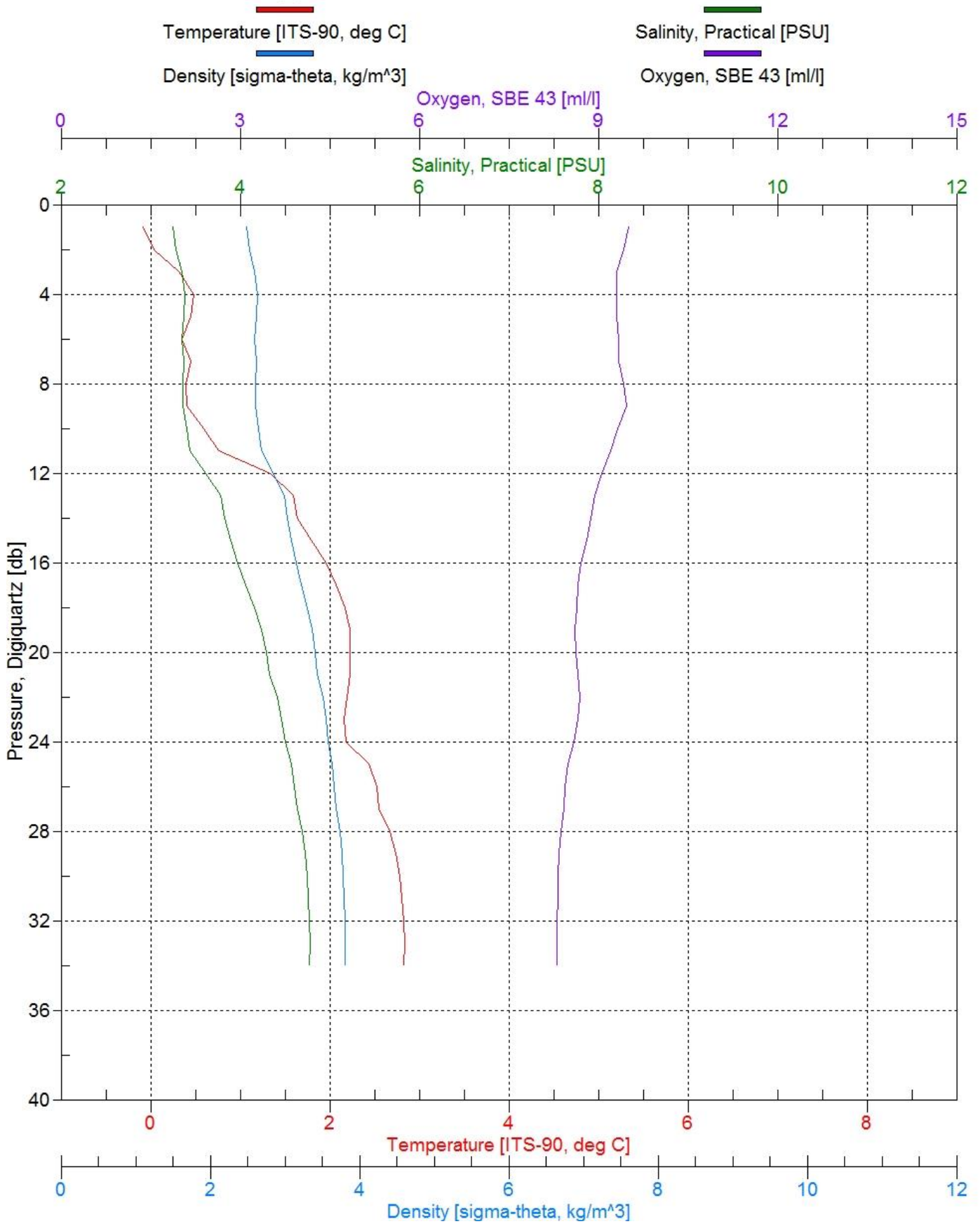
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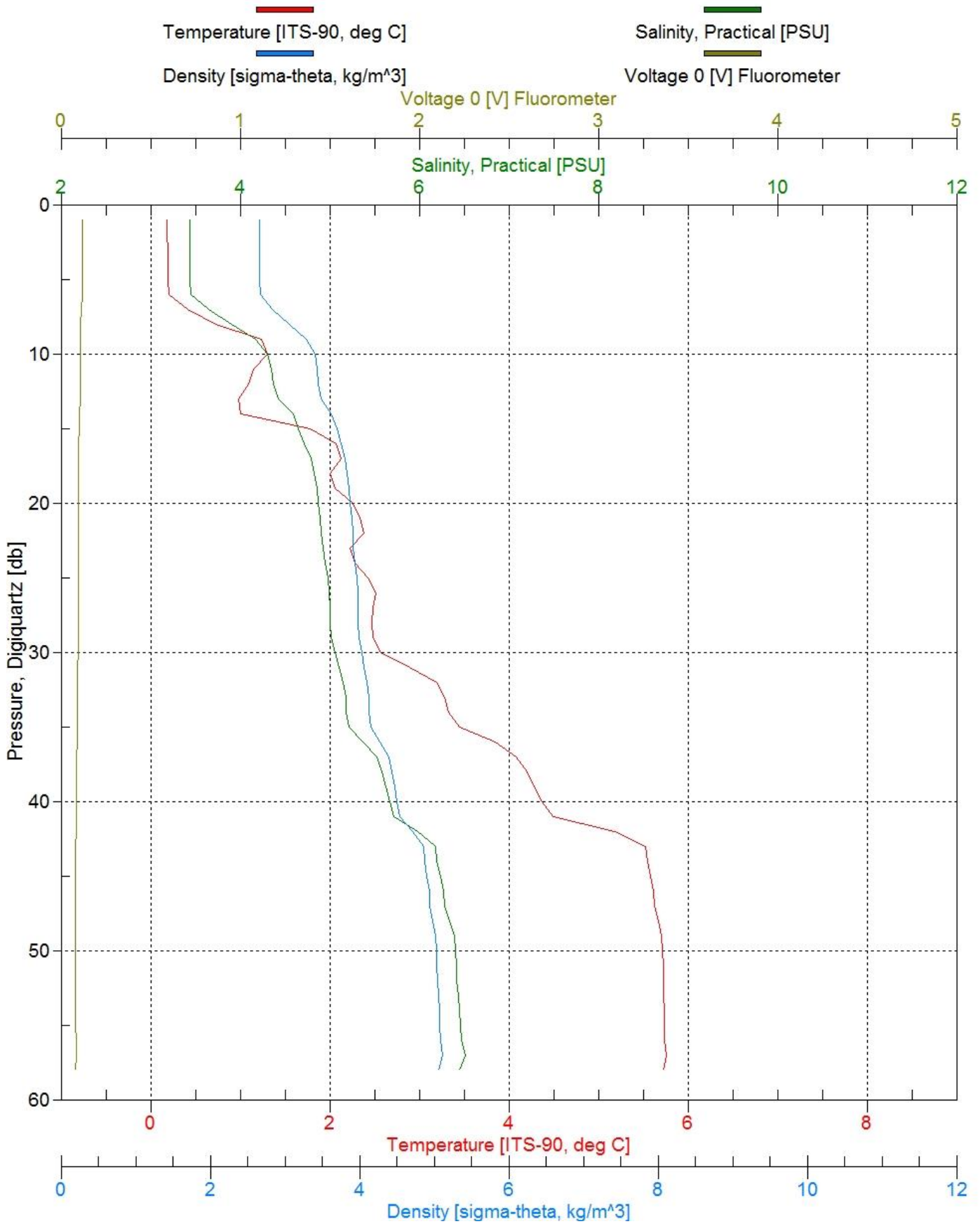
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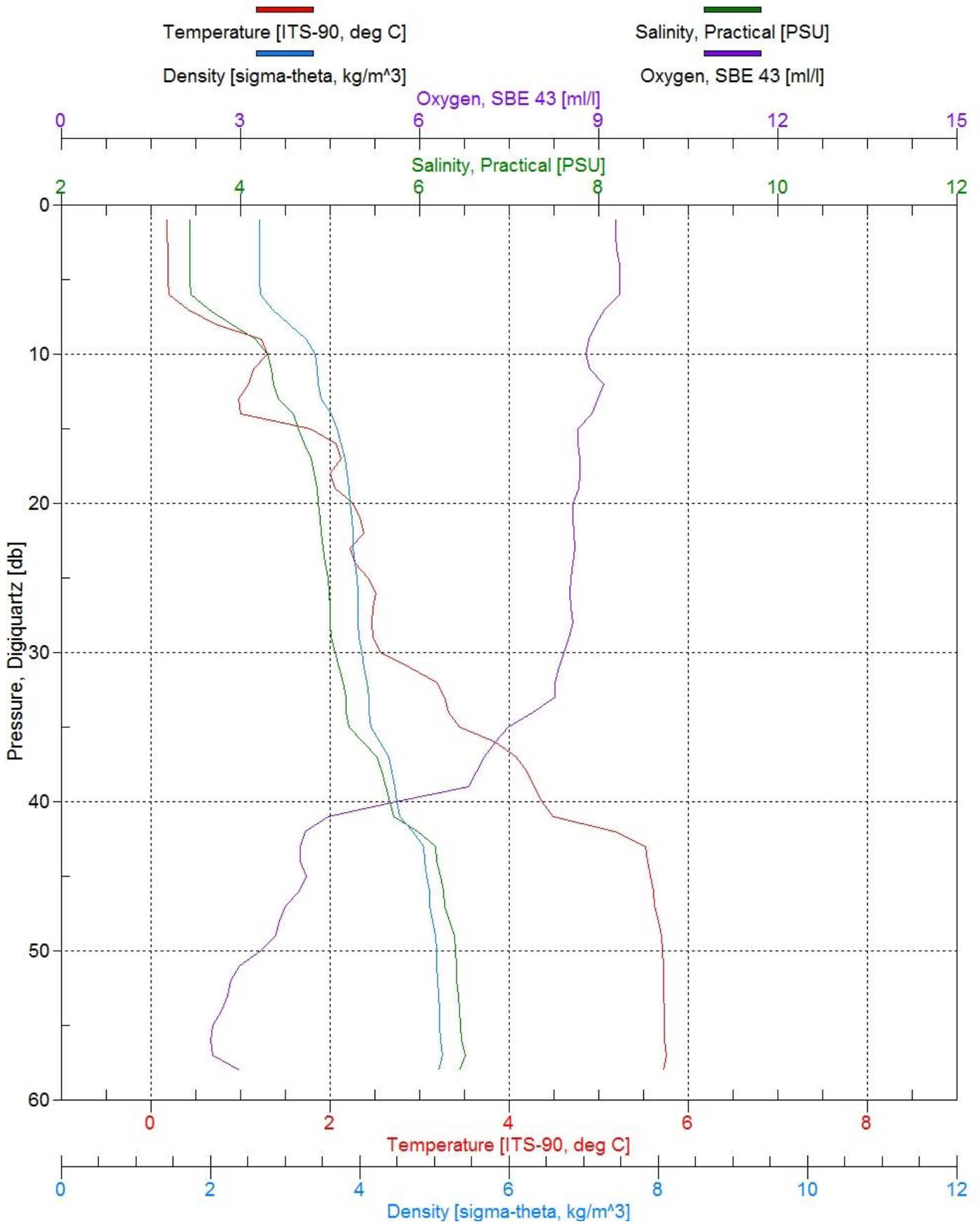
# K19\_SED 19.01.2021 09.55, a210007.cnv



# XVI 19.01.2021 12.51, a210008.cnv

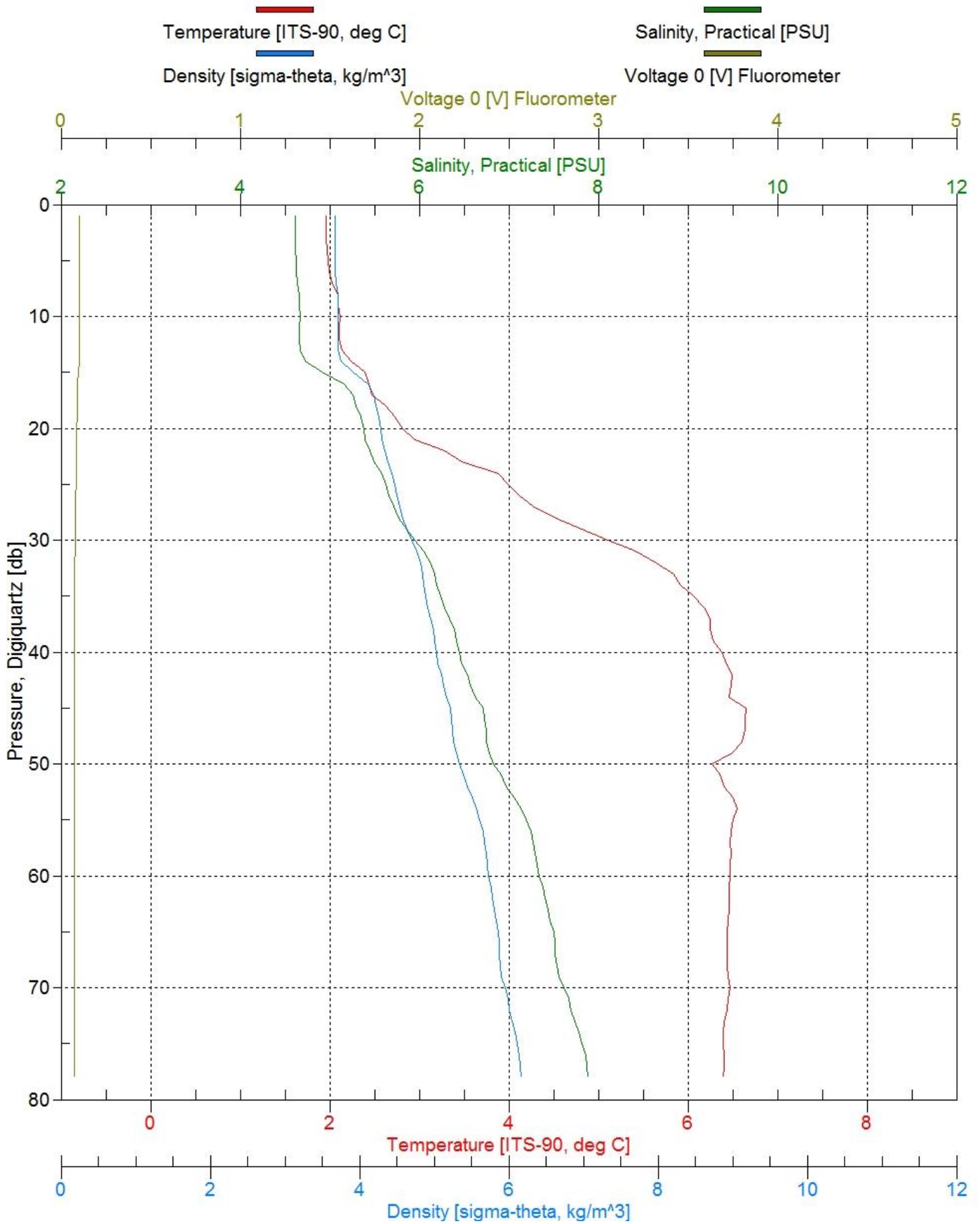


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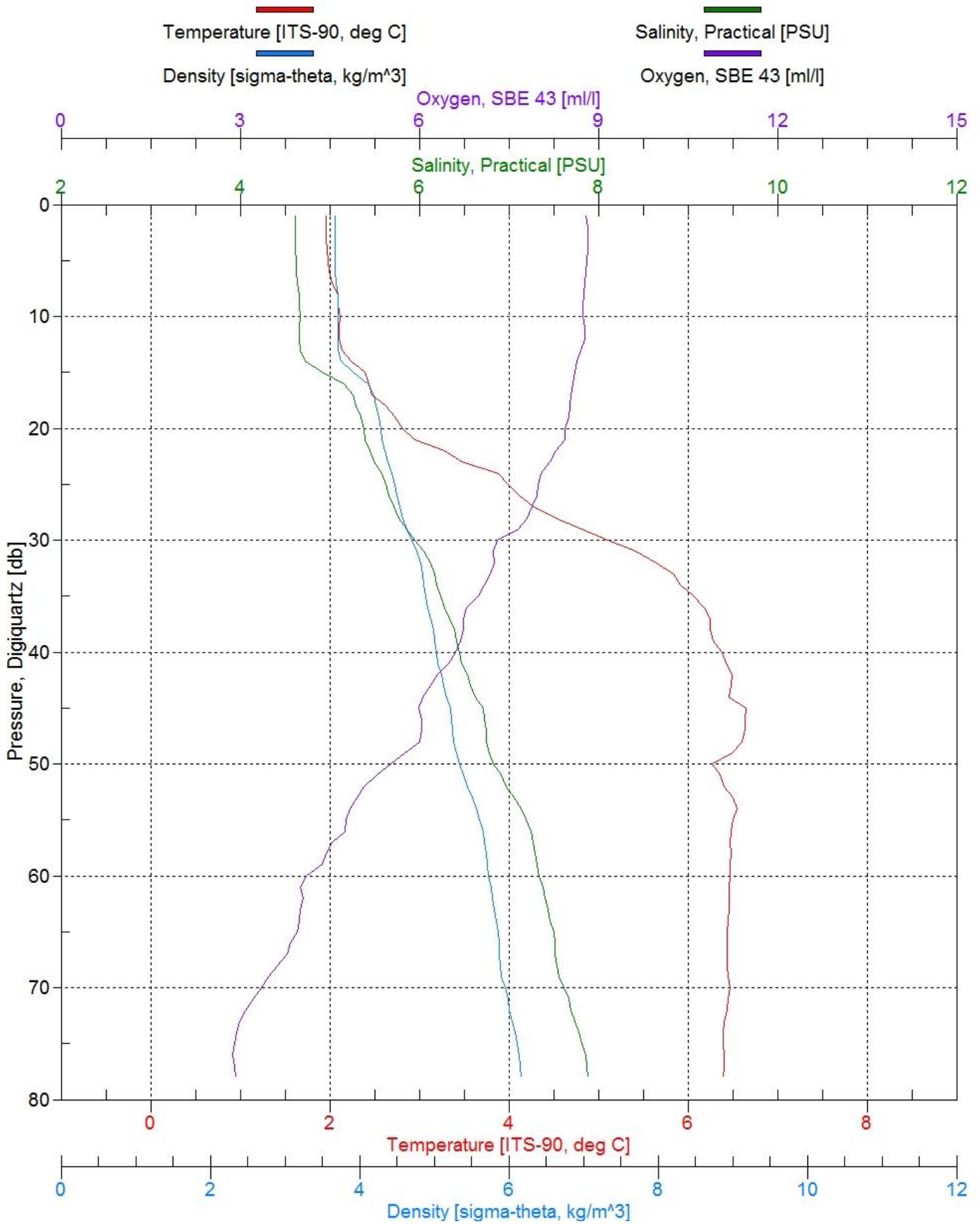




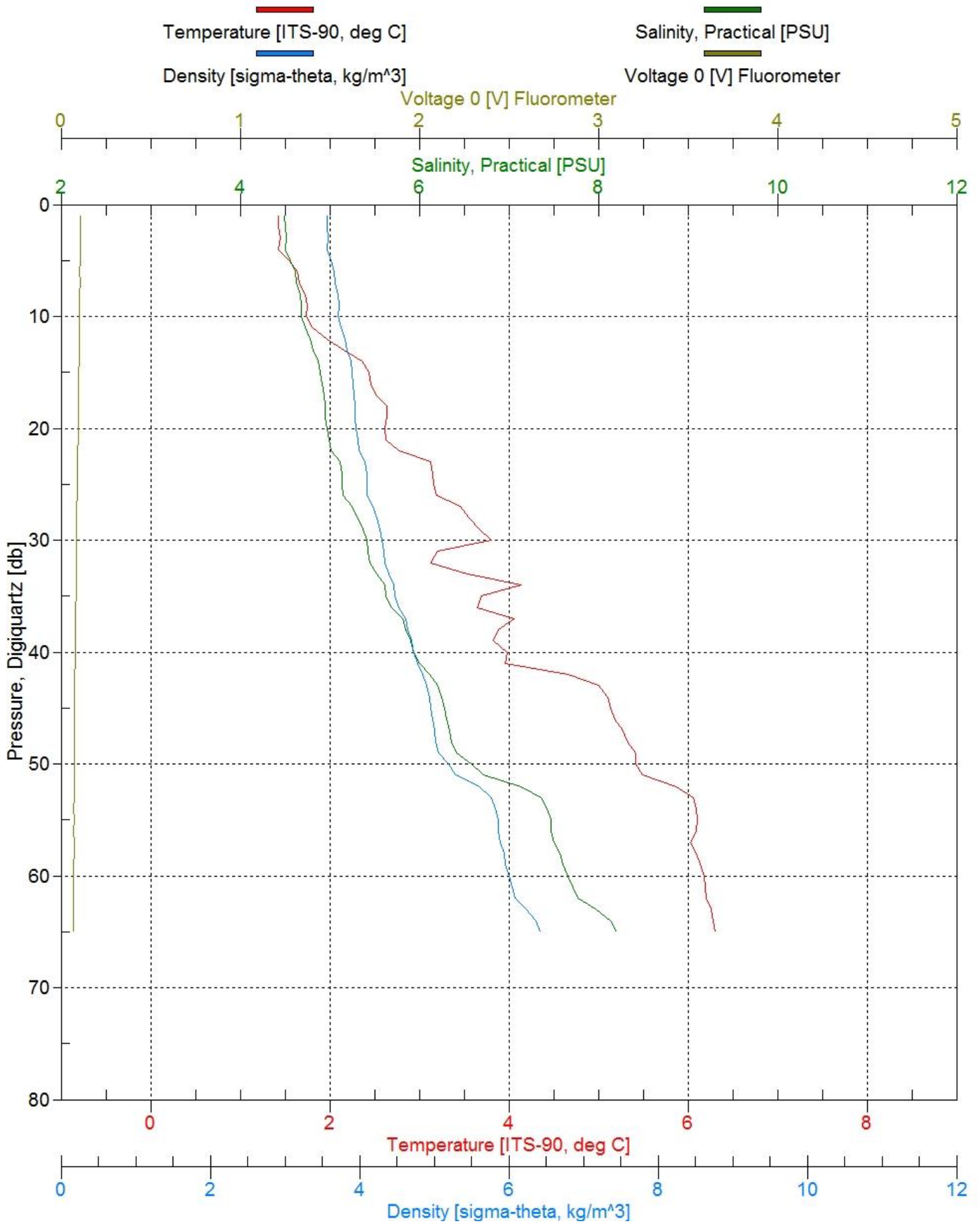
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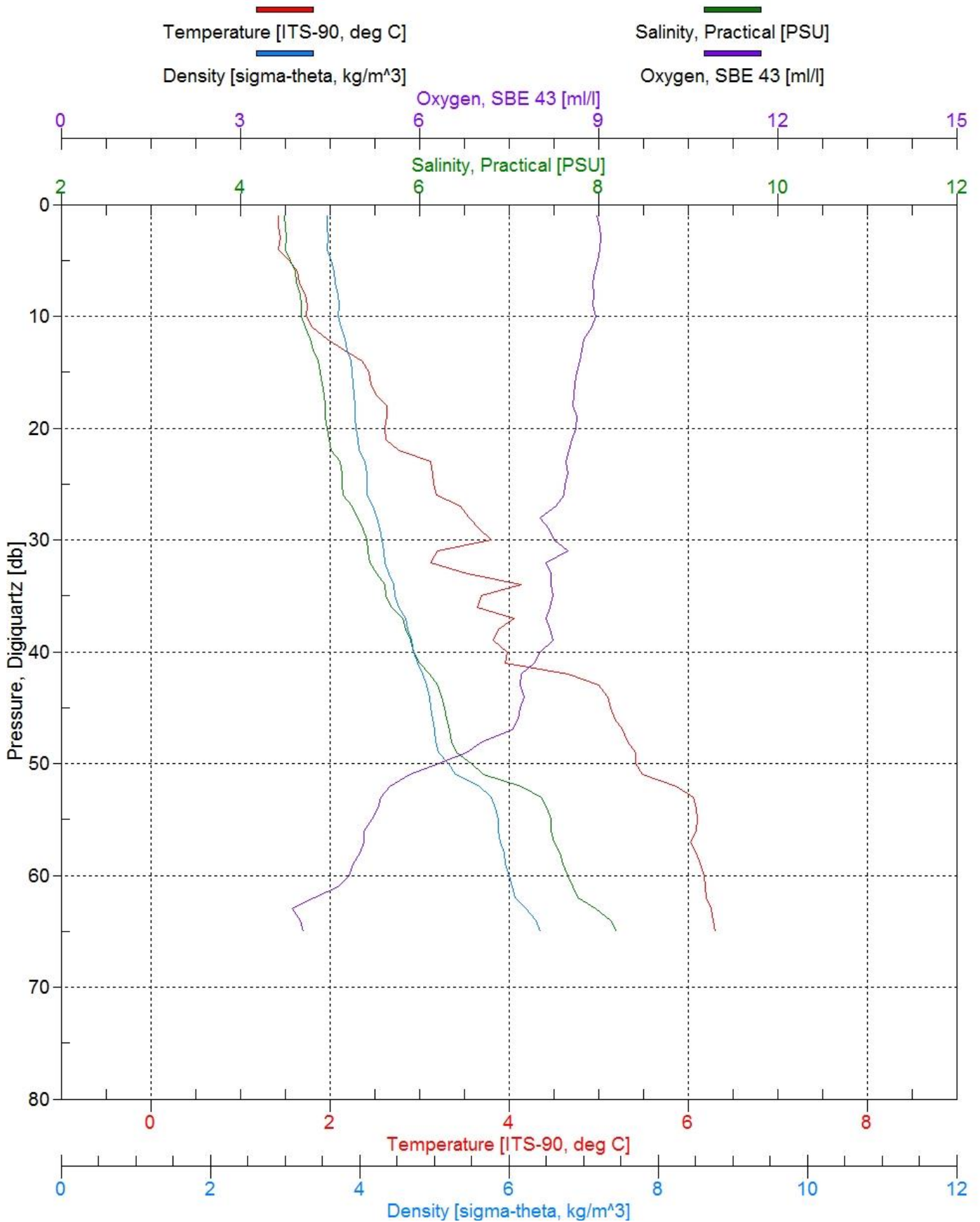
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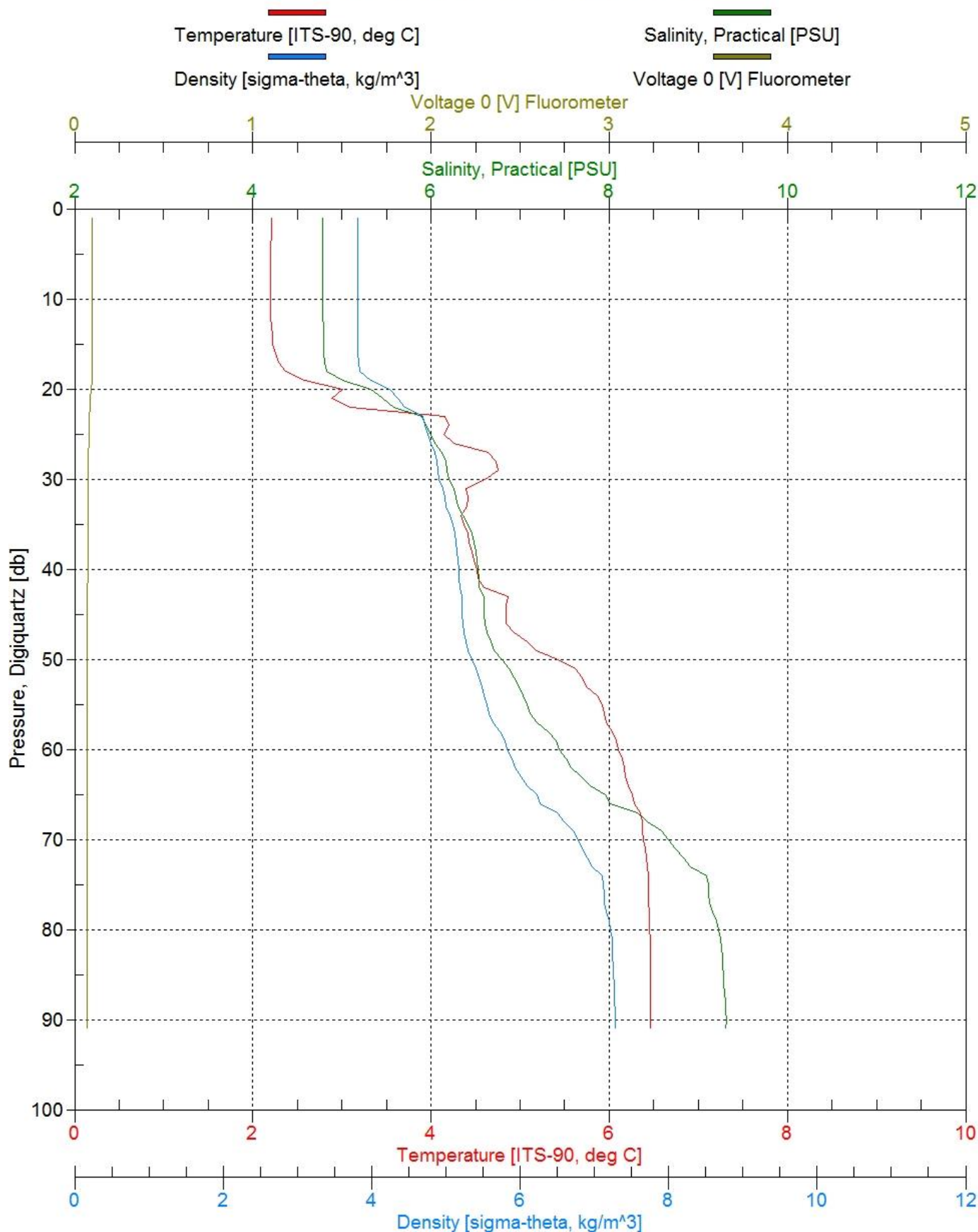
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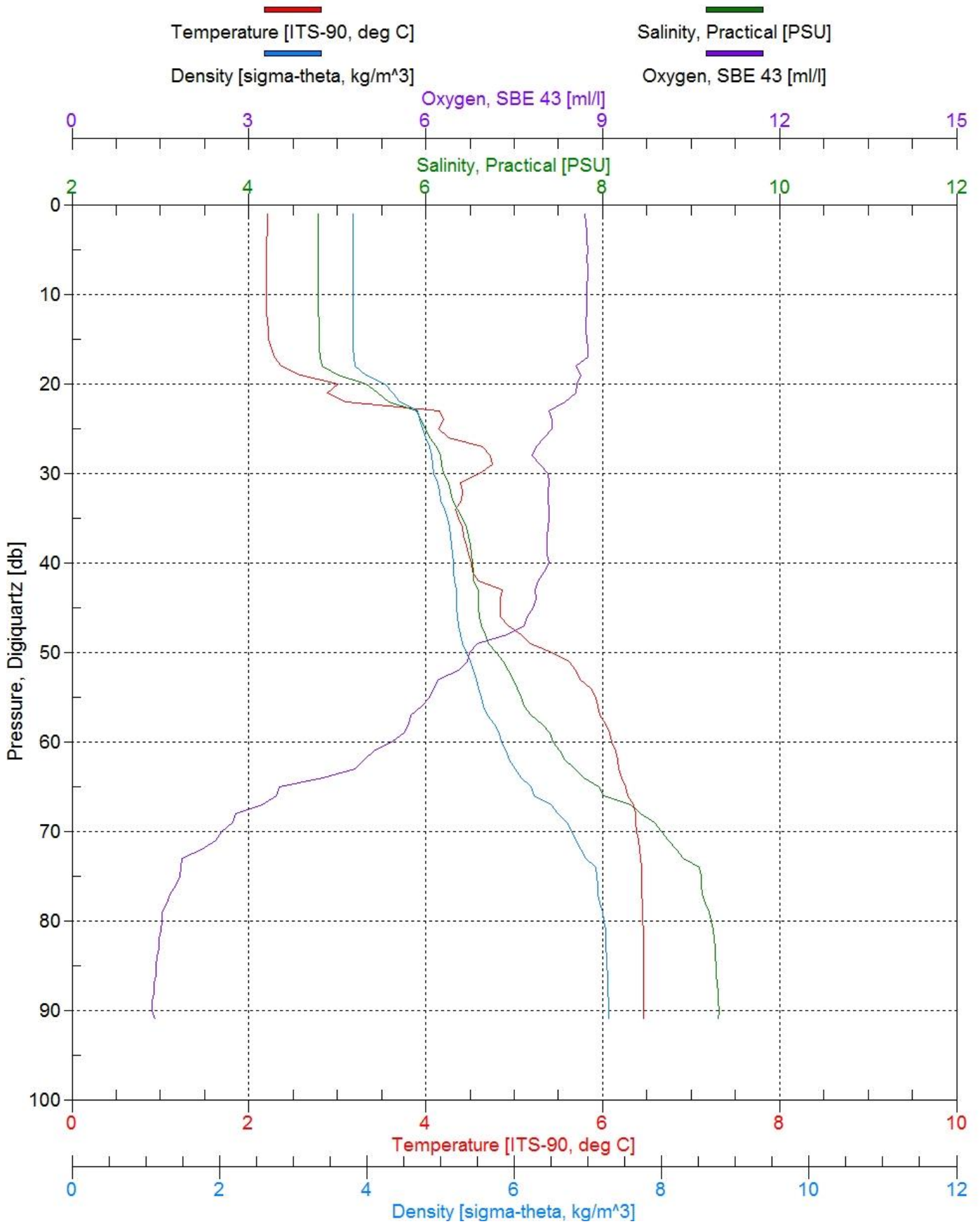
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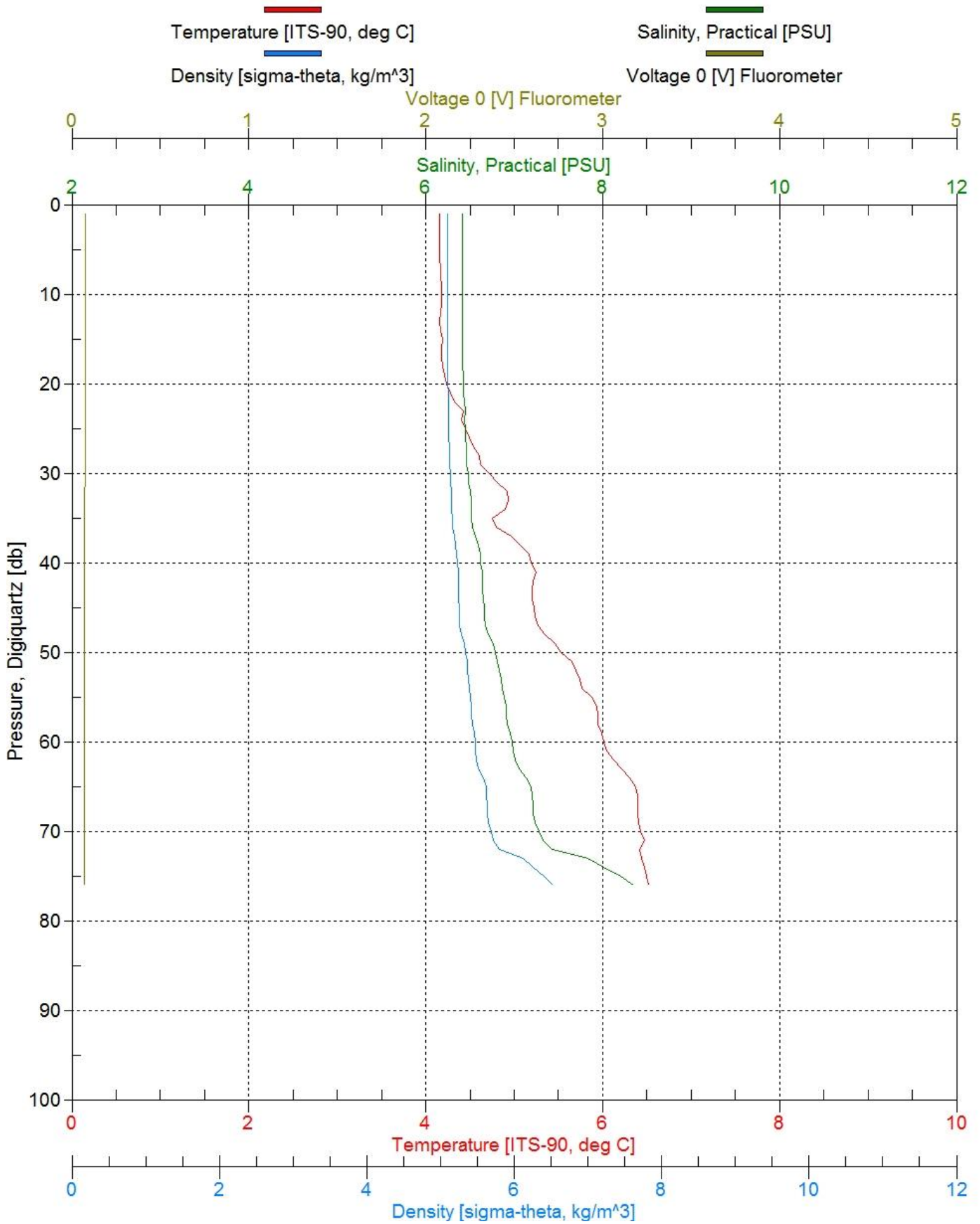
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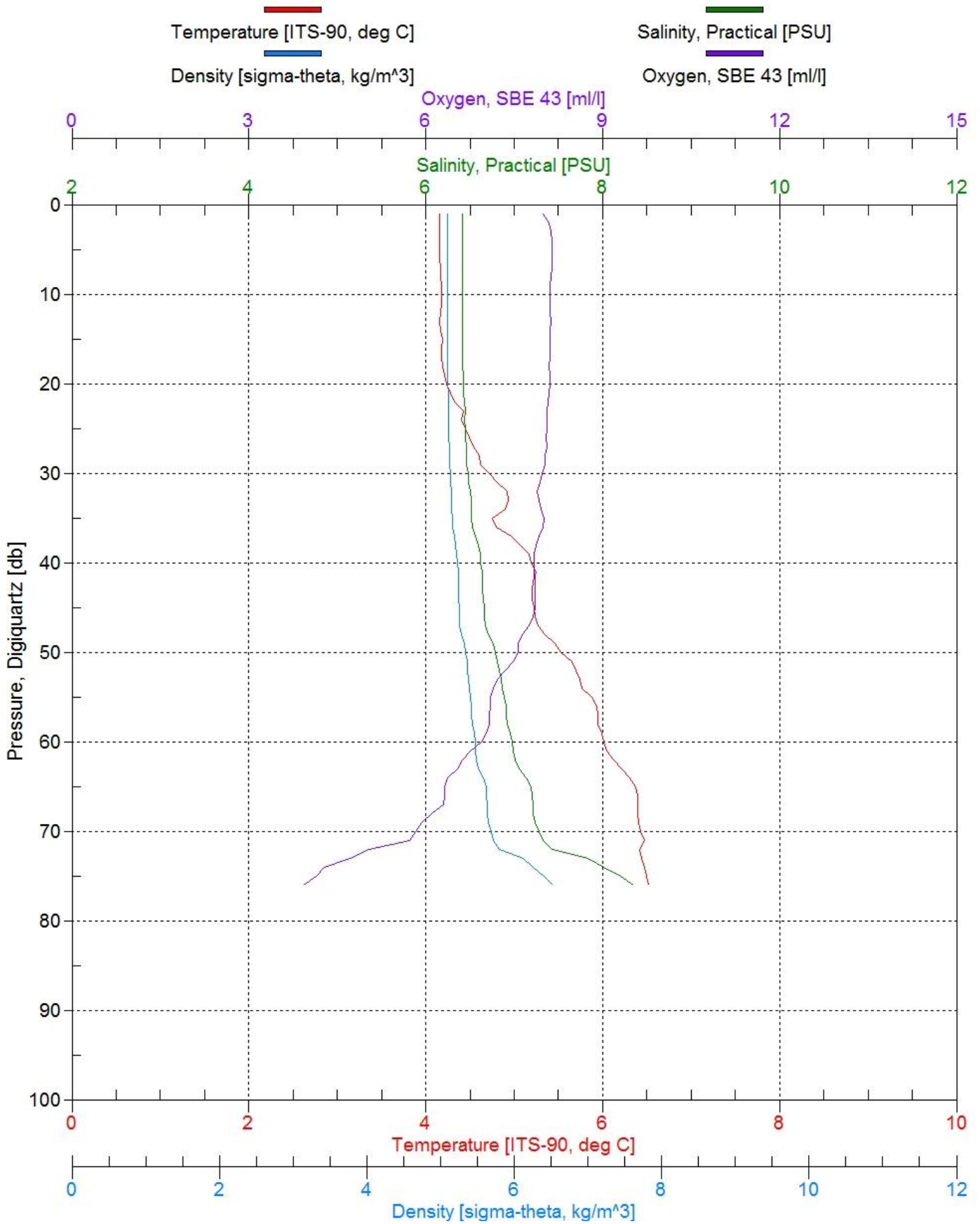
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# GF1 20.01.2021 08:00, a210013.cnv

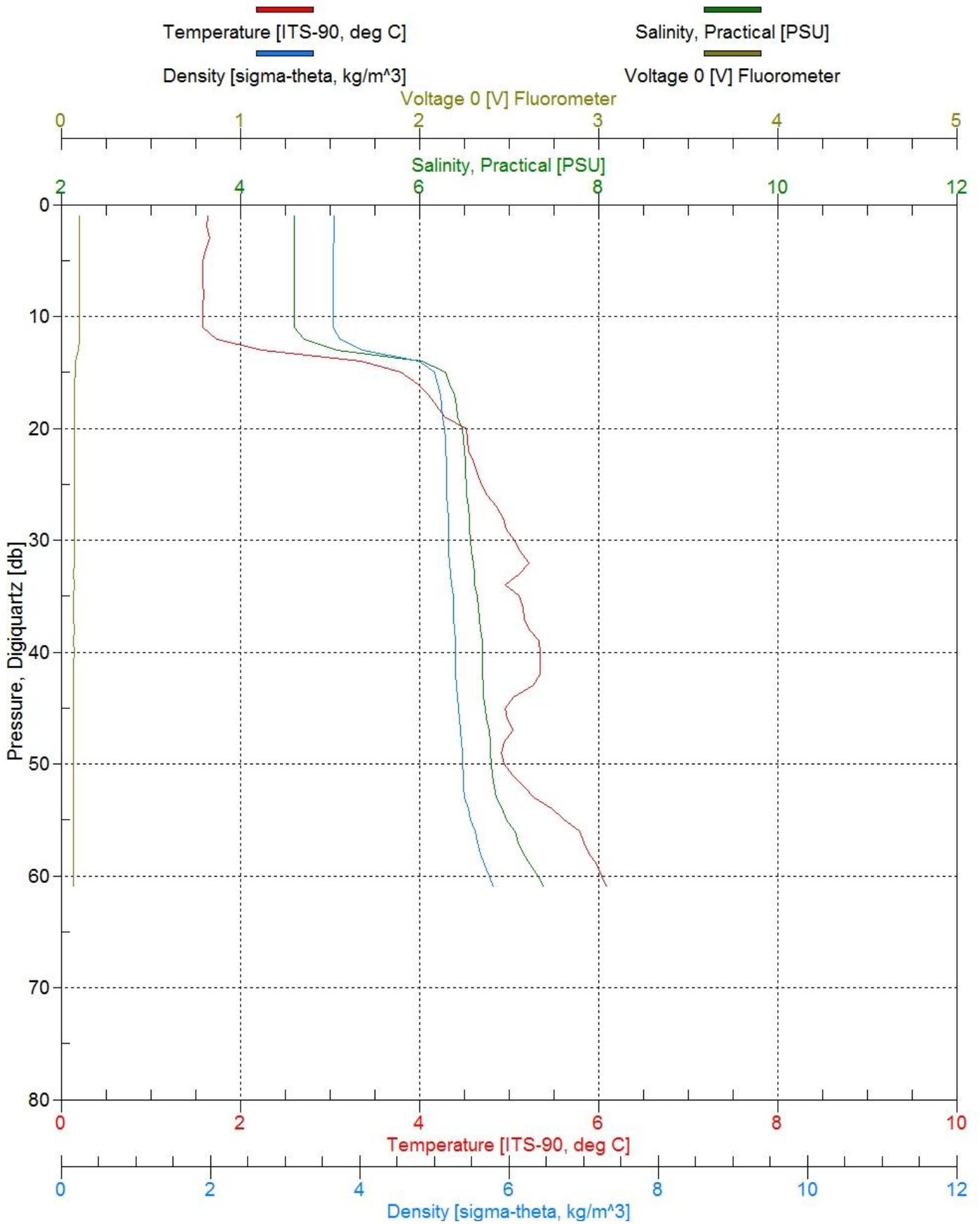


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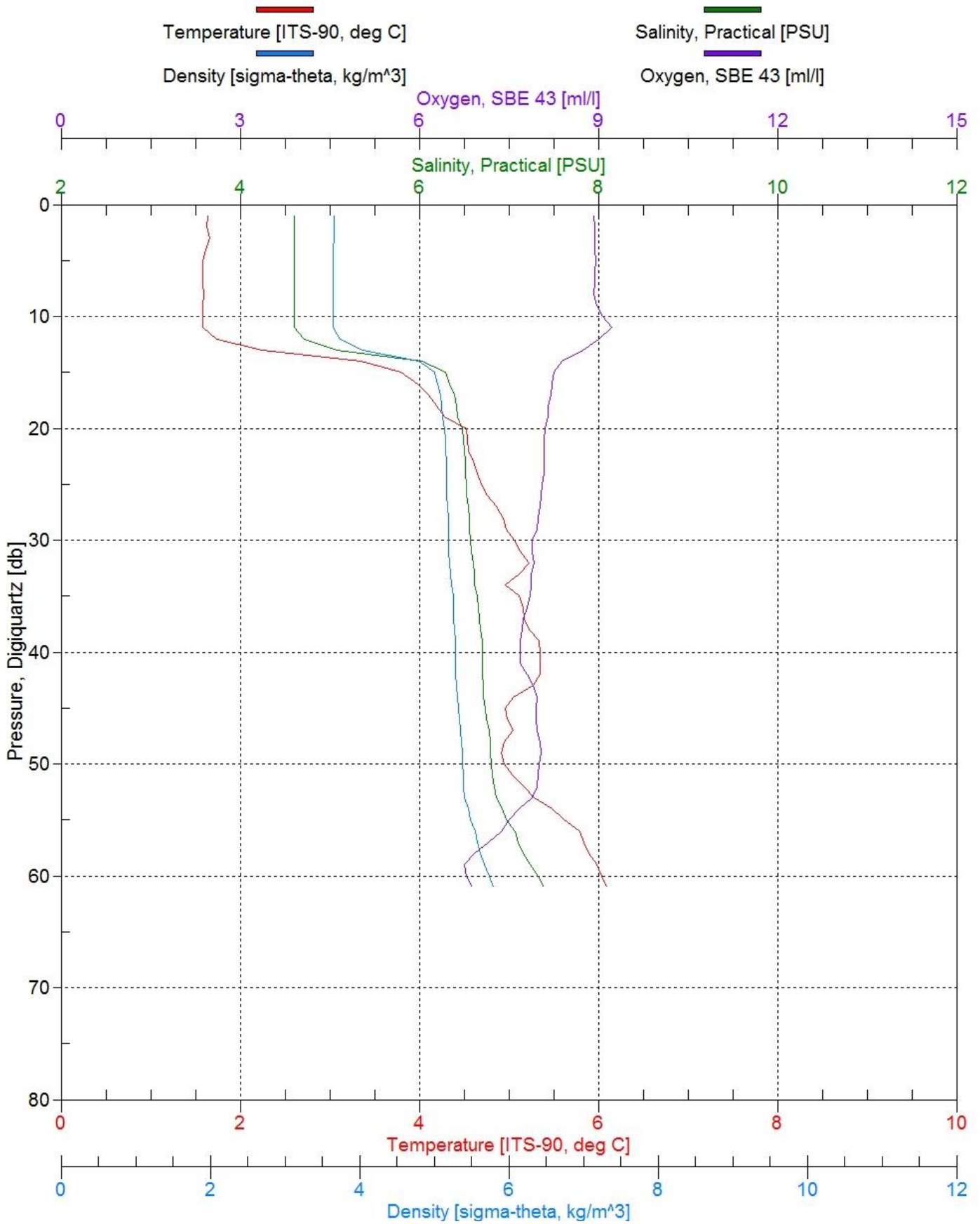




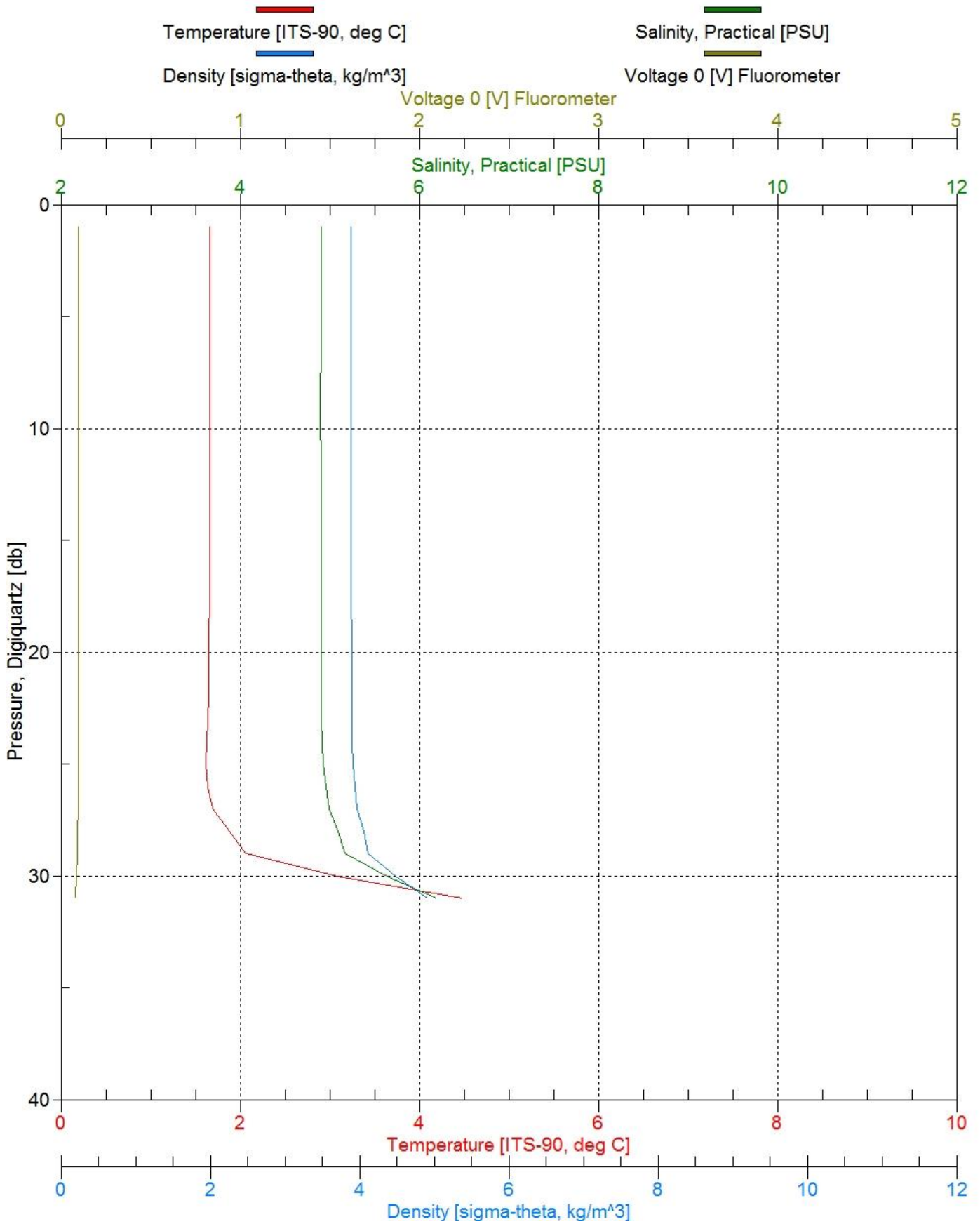
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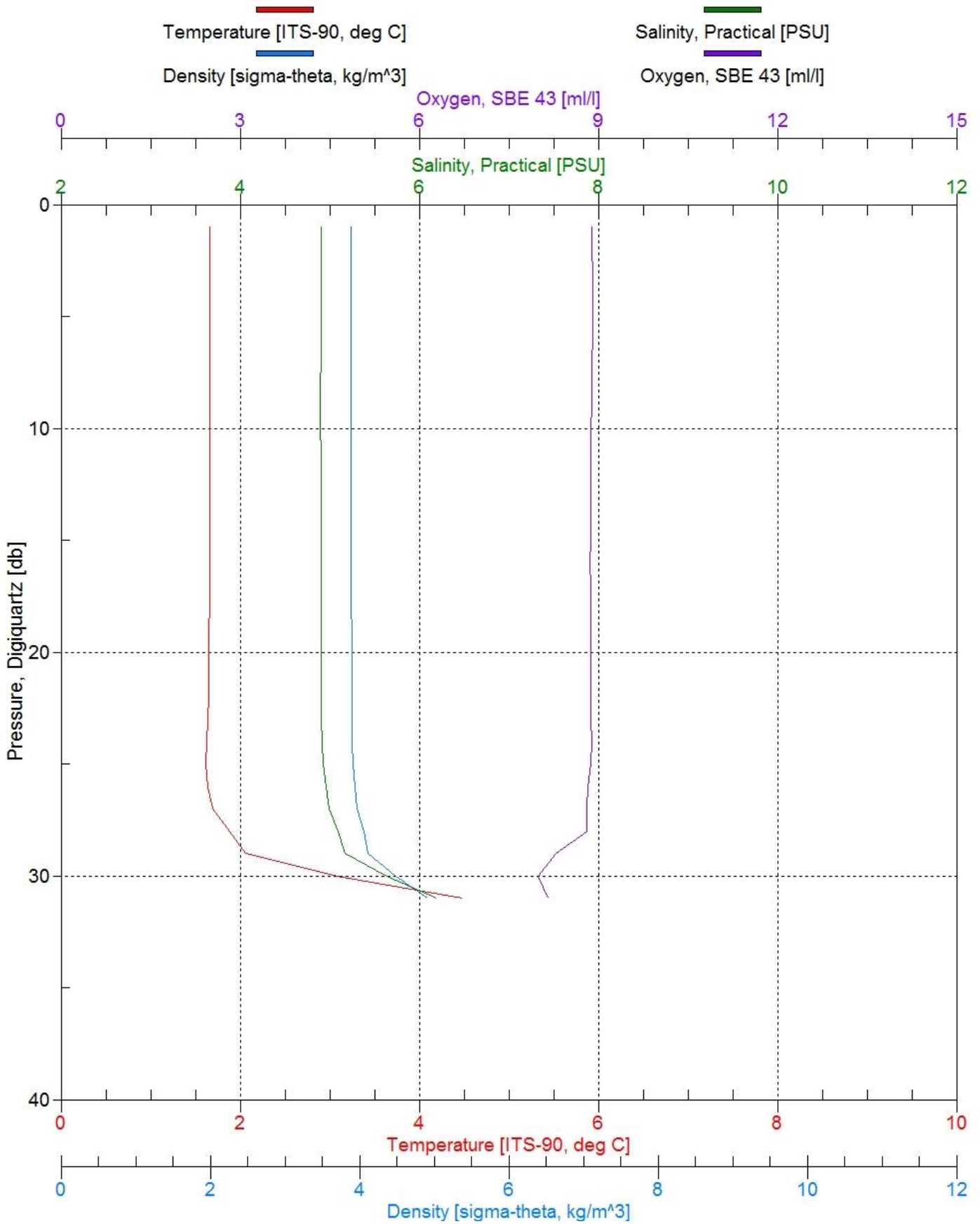
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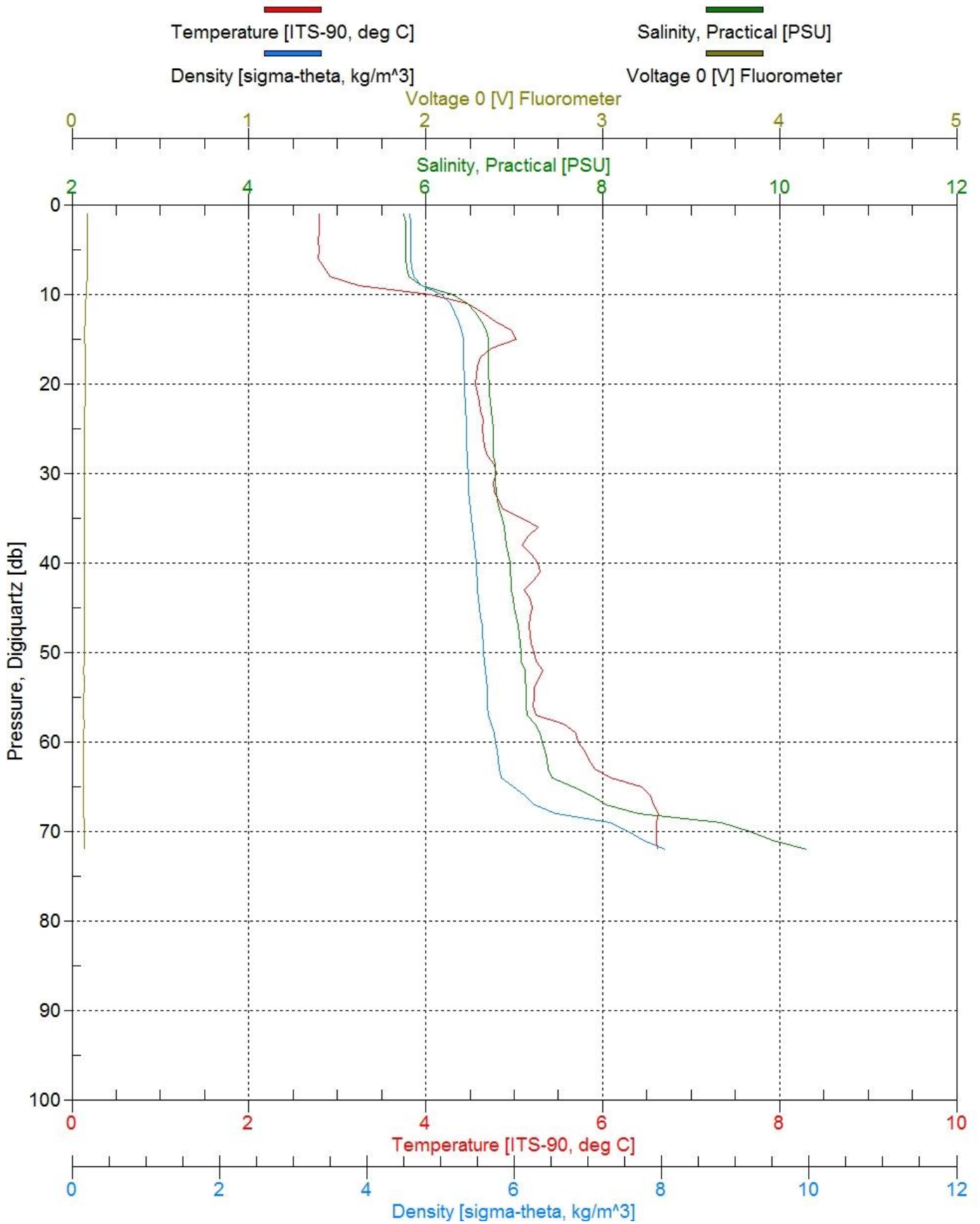
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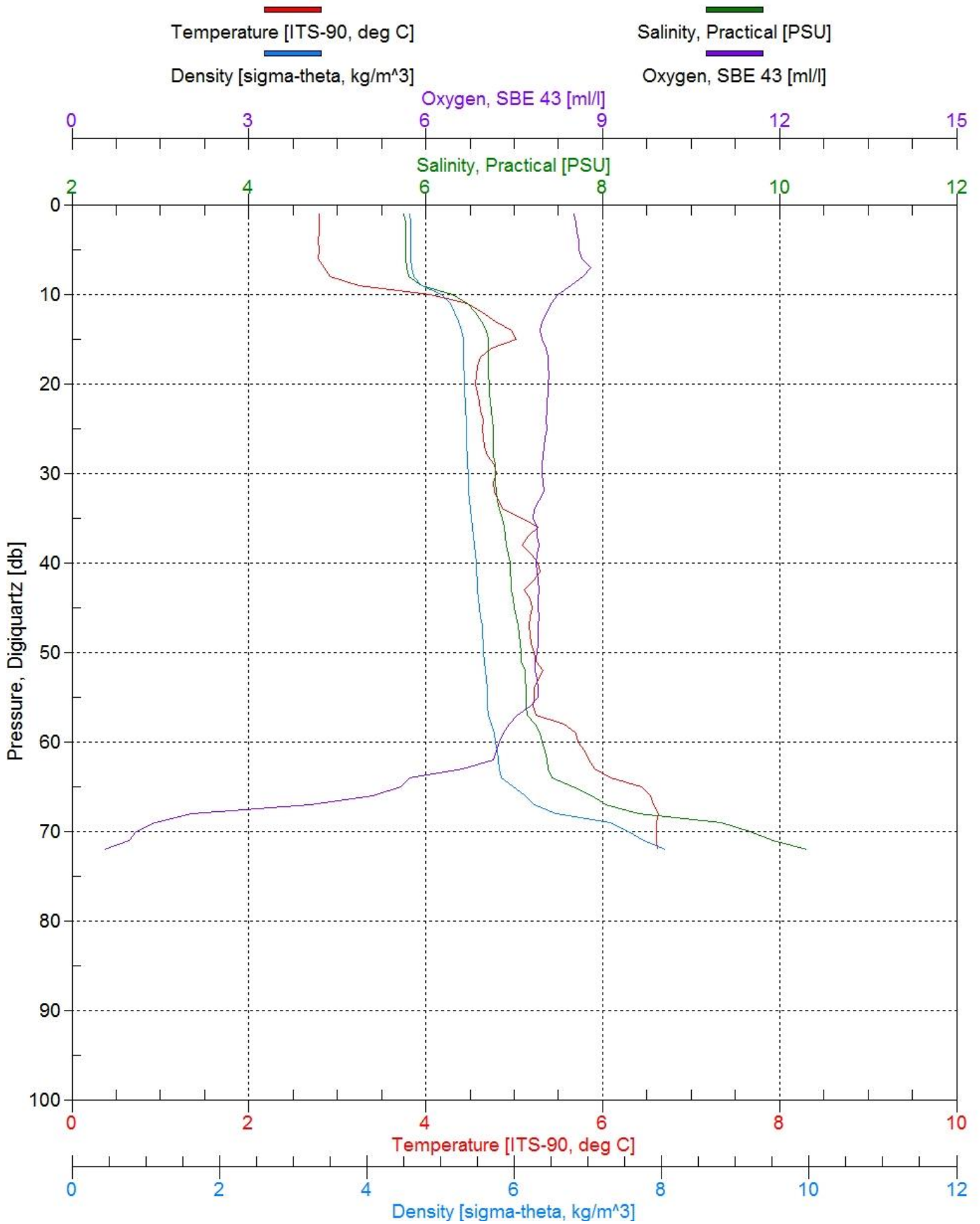
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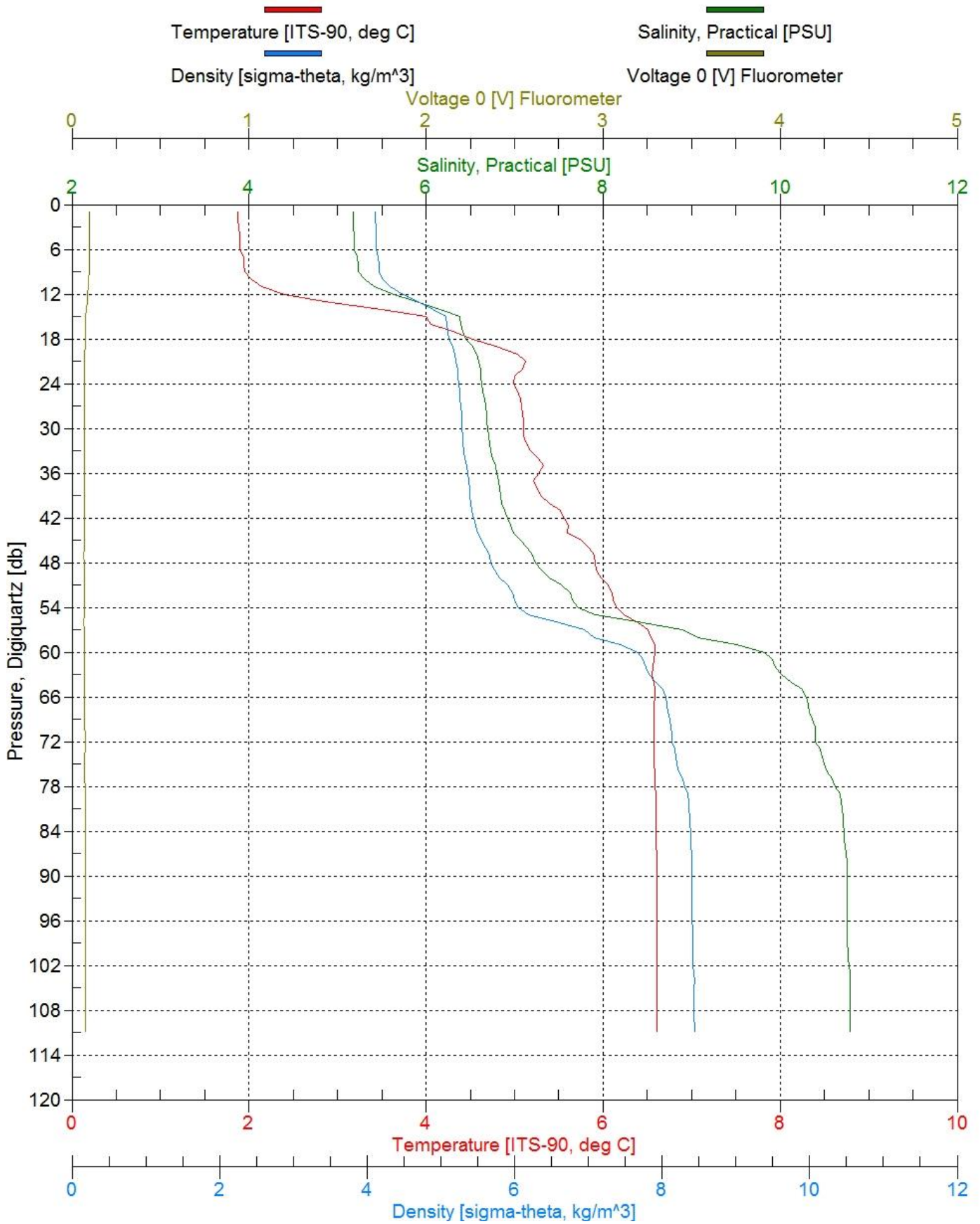
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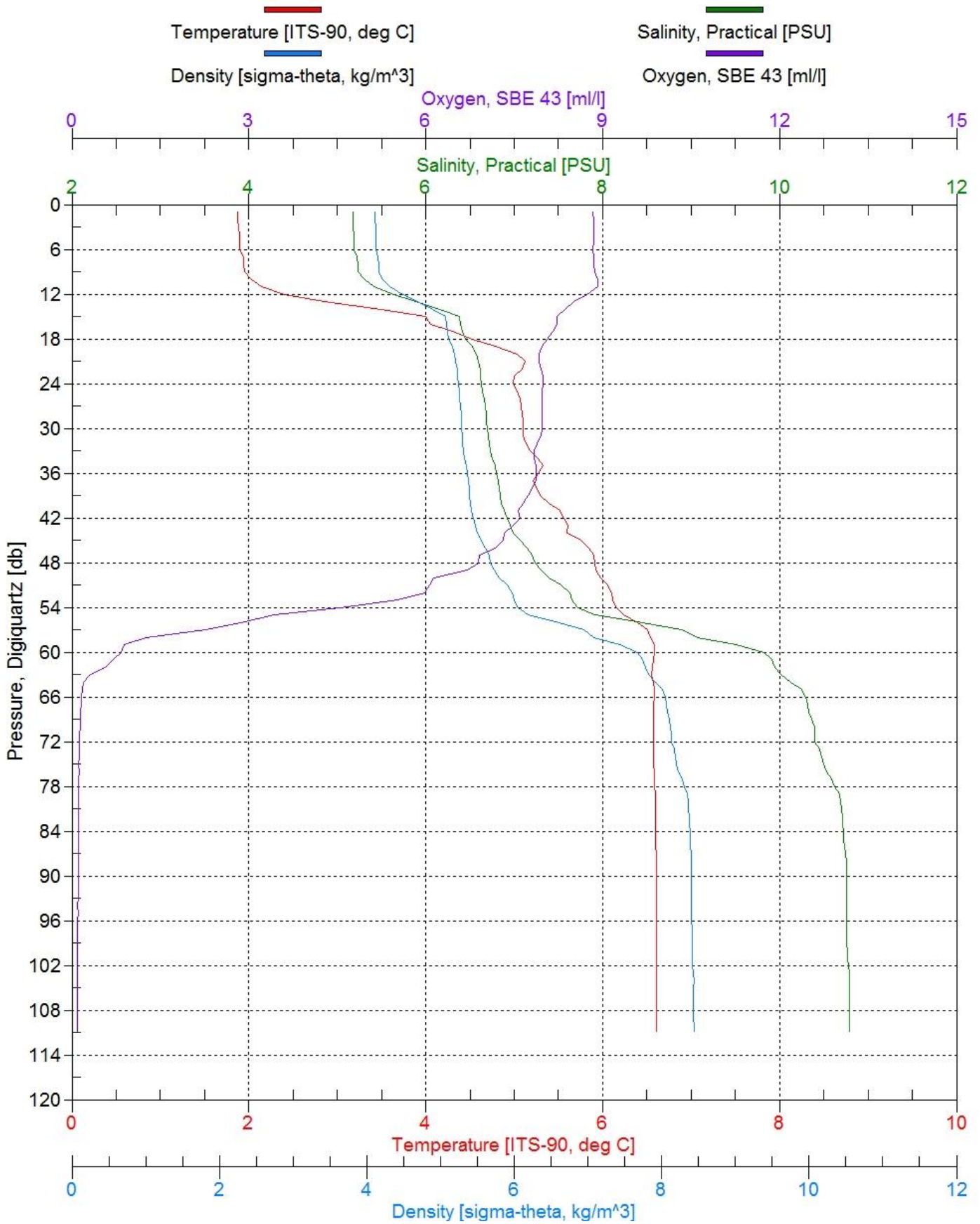
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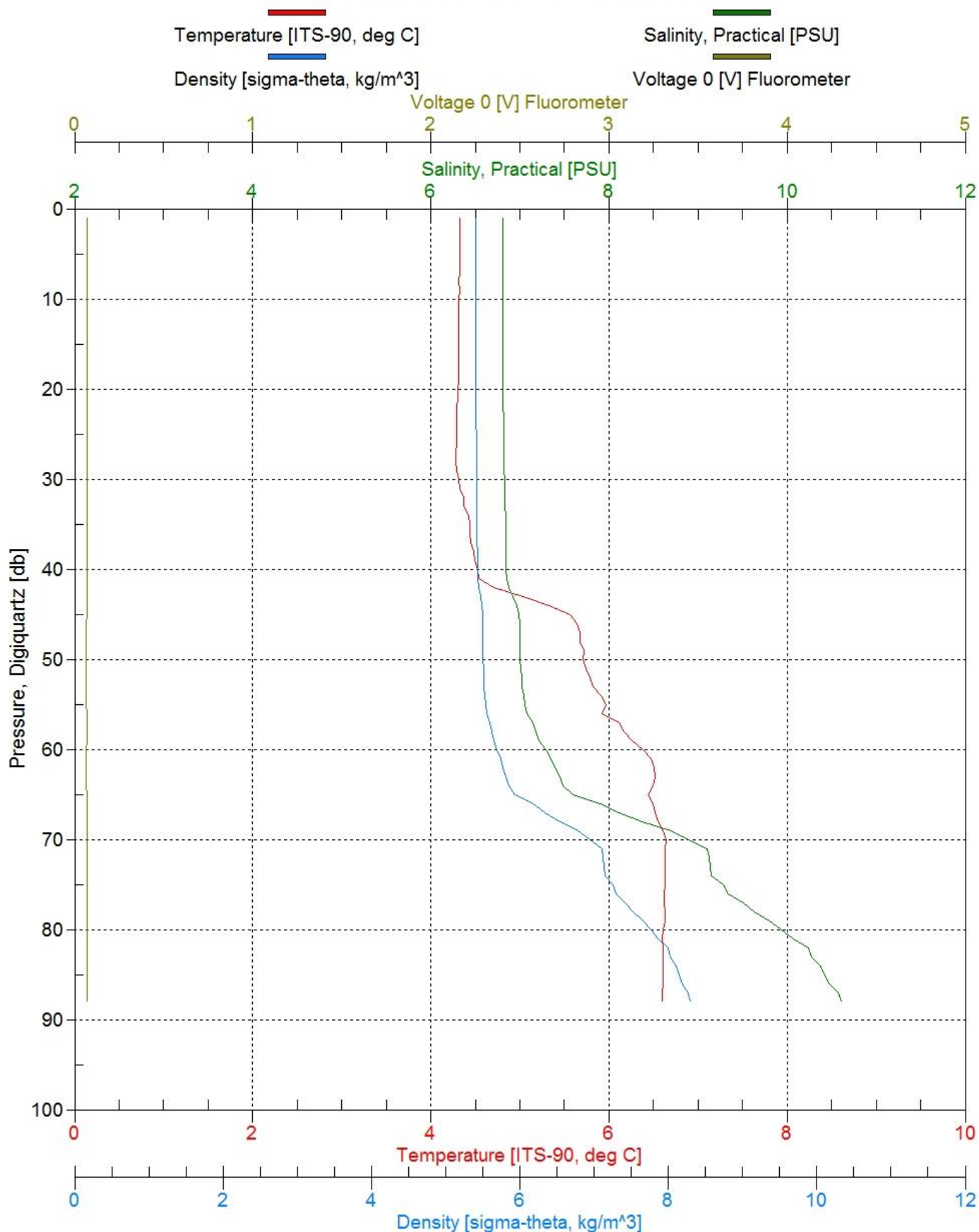


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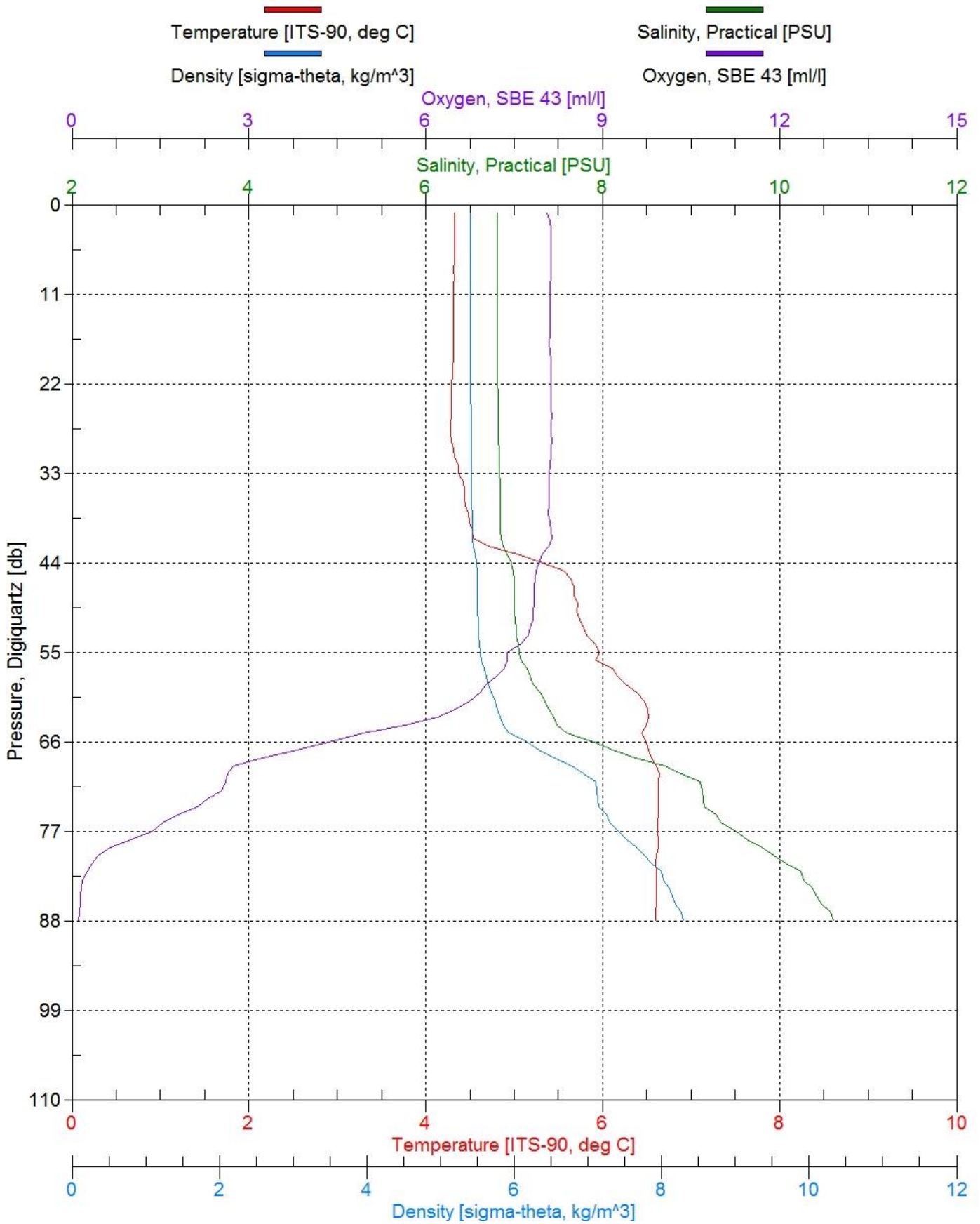




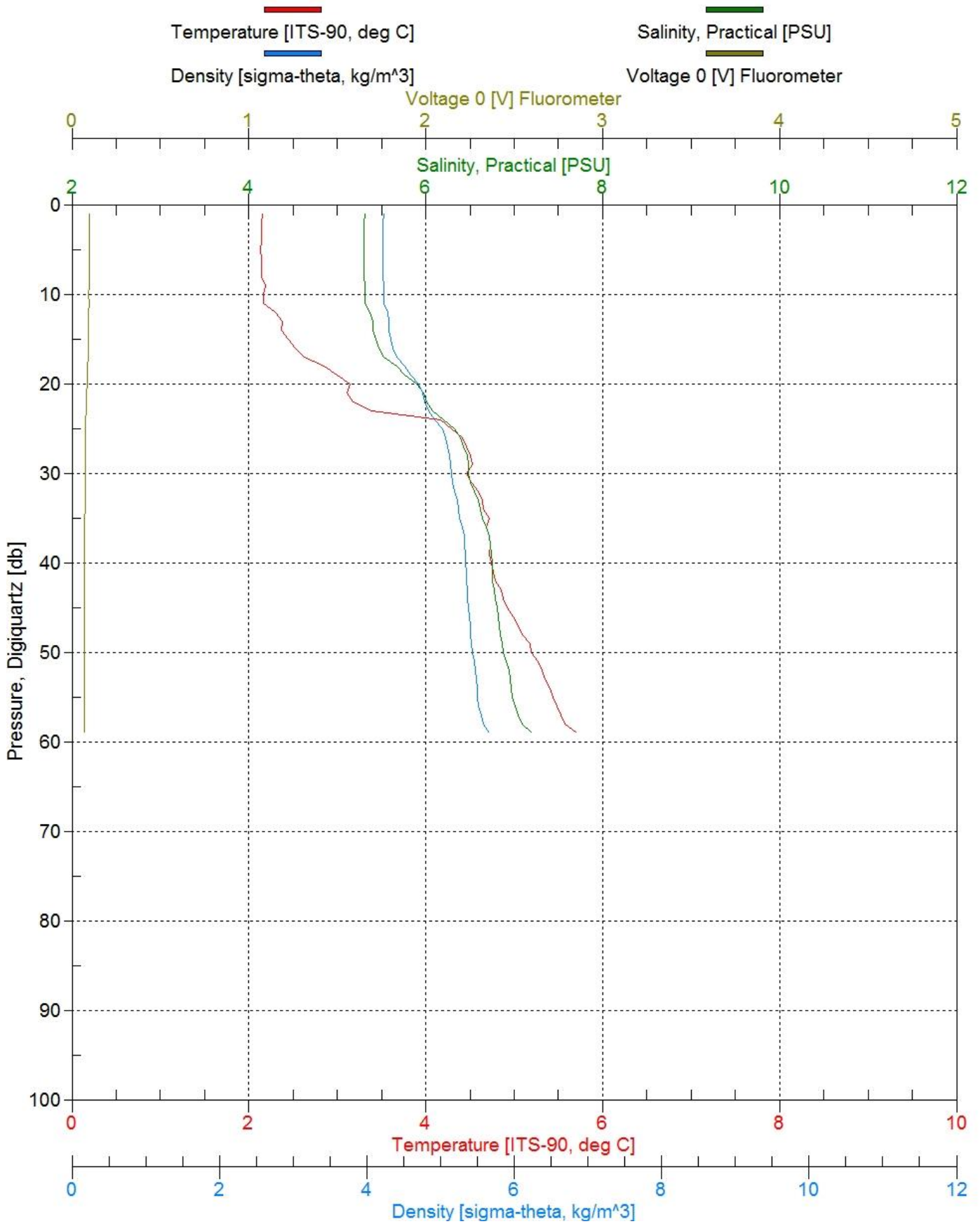
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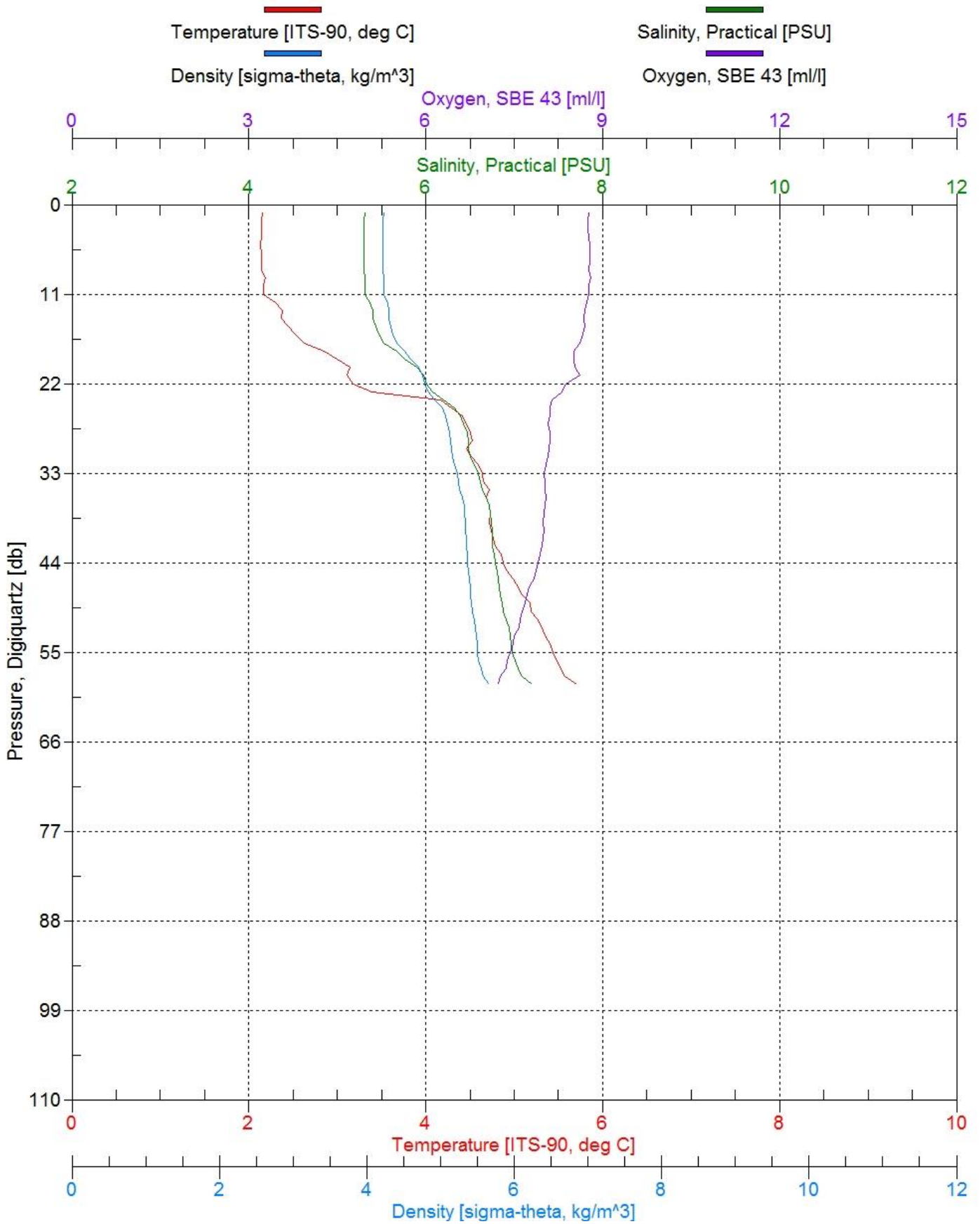
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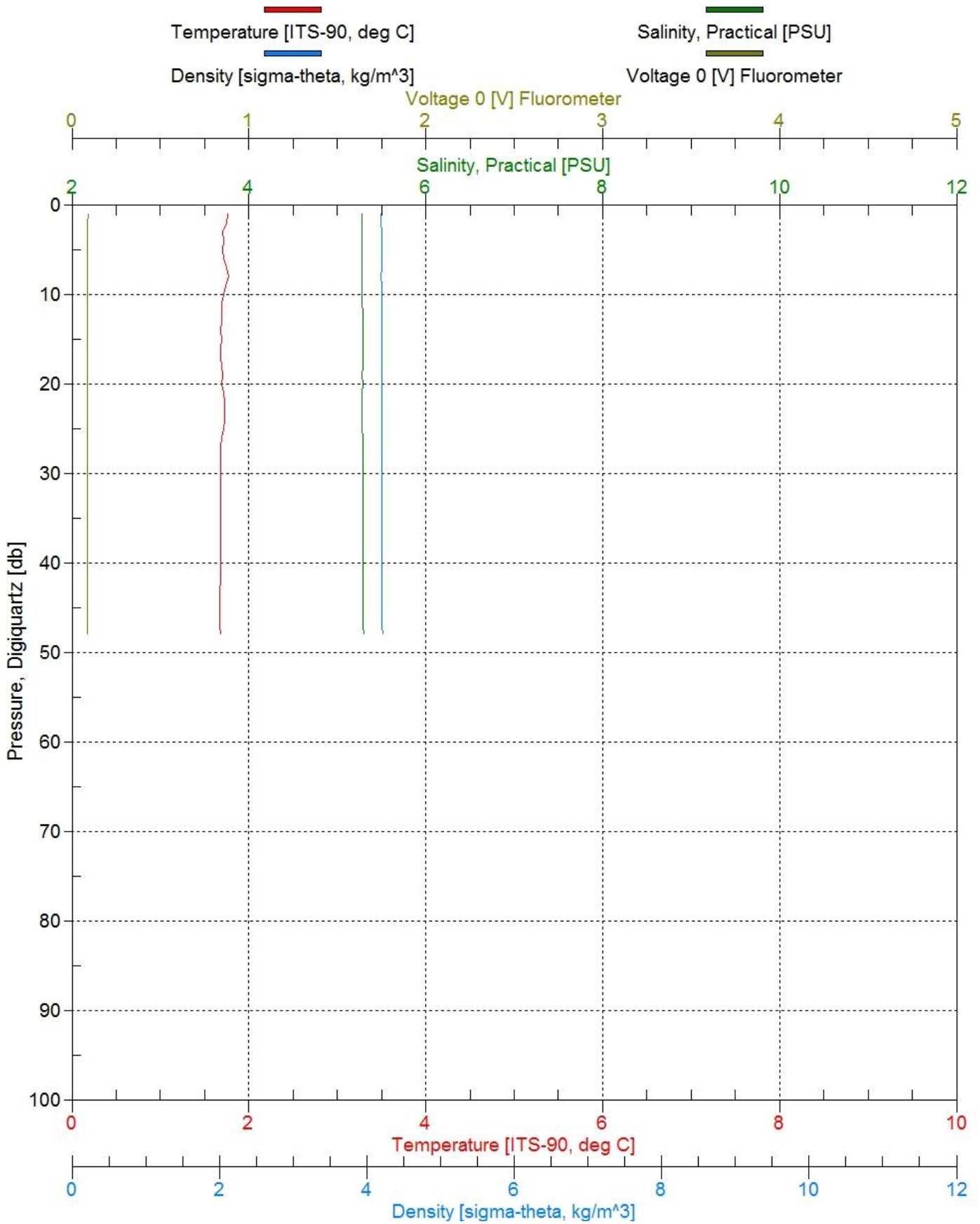
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LL11 21.01.2021 18:20, a210021.cnv



LANGDEN 21.01.2021 20:35, a210022.cnv



# LANGDEN 21.01.2021 20:35, a210022.cnv

