Additional information to the
Brief descriptions of the physical and chemical data
(Marine Hydrophysical Institute)

A. Physical data

1. Measured parameters.

Depth (H) of the measurement, temperature (T) and salinity (S) were obtained with Nansen Bottles, and CTD-systems.

2. Units.

2.1. Temperature - Celcium degrees, Salinity - practical salinity units (PSU), Depth - meters.

2.2. These temperature scales were used during the measurements:
from 1948 to 1970 year - IPTS-1948;
from 1970 to 1990 year - IPTS-1968.
And next salinity scales were used:
before 1969 year - Knudsen's scale with salinity calculated from chlorine measurement (Cl, promille).

$$Sk = 1{,}805\ Cl + 0{,}03 \quad \text{(promille)}; \qquad (1)$$

from 1970 to 1982 year - R.Cox's salinity scale (1969) with salinity calculated from relative conductivity R15:

$$S = -0.08996 + 28.29720*(R15) + 12.80832*(R15)^2 - 10.67869*(R15)^3 + 5.98624*(R15)^4 - 1.32311*(R15)^5 \qquad (2)$$

3. Methods and devices

3.1. The standard hydrological methods were used to produce the hydrological data:
- Nansen Bottles with deep-sea reversing thermometers;
- CTD-sounding systems.

3.2. For salinity determination before 1969 the argenometric titration from the chlorine was used with salinity calculated from Knudsen's formula (1). The finish of reaction was obtained from visual observation of the indicator color change. Errors of estimation of the chlorine observations on aboard condition were no more than +-0.015 promille, and from salinity - no more than 0.025 promille with confidential probability 0.95.

From 1969 year salinity was determined by means of laboratory electrical salinity-meter GM-65 and it was also calculated from formula (2). Error of estimation of the salinity in water sample was no more +-0.02 promille with confidential probability 0.95.

3.3. Temperature observation during batometric casts was provided by means of Deep-sea reversing thermometers - DSRT.

Root mean deviation of the temperature observation was 0.015 degrees. Total temperature observation error was +-0.04 degrees with confidential probability 0.95.

3.4. Depth observation during batometric casts was provided by means of DSRT. Root mean deviation of the depth observation was 3-5 meters from 0 to 1000 meters depth and 0.5 percents from over 1000 meters depth.

3.5. CTD-sounding systems were used for temperature, salinity and depth observations from 0 to 2000 meters depth. Device types are ISTOK-3, ISTOK-4, and ISTOK-5. General characteristics of those are in table 1.

Table 1.

Parameters	: ISTOK - 3; ISTOK - 4 :	: ISTOK - 5 :
1. Pressure, dBar		
- Range	0 - 2000	0 - 6000
- Sensibility	0.5	0.5
- error, %, at confidential probability a=0.95	0.25	0.25
2. Temperature, Deg.C		
- Range	-2...+35	-2...+35
- Sensibility	0.01	0.0025
- Static error at confidential probability a=0.95	+-0.03	+- 0.025
- Temperature sensor inertia, sec	0.4 - 1.0	0.2 - 0.4
3. Relative conductivity		
- Range	0 - 1.6	0 - 1.5
- Sensitivity	0.0004	0.00006
- Error at confidential probability a=0.95	+-0.001	+-0.0007
4. Salinity, UPS (calculated value)		
- Range	0 - 40	0 - 40
- Sensitivity	0.018	0.003
- Static error at confidential probability a= 0.95	no more 0.04	no more 0.03
5. Sampling Frequency, Hz	0.7	4

4. Expert's estimations criteria

4.1. Temperature and salinity profiles were subject of the expert's estimation.

Main criteria used:

- static vertical stability of the water mass:
- excess of the dinamical error of salinity measurements over the predefined level (the dynamical error is the error due to the different inertia of the salinity and temperature sensors).

The static stability was determined using additionally calculated density anomaly Astp. If the difference between values Astp(i+1)-Astp(i) is negative and absolute value of it is > 0,02 kg/m^3, then quality flag "4" was introduced for the (i+1) value ((i+1) value corresponds to the bigger depth).

The same quality flag was introduced if one or more values differed from upper and lower values more than 0,02 kg/m^3 (positive spikes).

** All values with quality flag "4" are wrong and cannot be ** used!

If the negative difference of the adjacent values was in the range (0.02 .... 0.01) kg/m^3 then quality flag "3" was introduced. It can be natural variability or instrumental error of the CTD-probe.

Negative density differences with value below 0.010-0.007 kg/m^3 didn't mark for ISTOK-3 CTD-probe system.

Negative density difference with value below 0.007-0.004 kg/m^3 didn't mark for ISTOK-5 CTD-sounding system.

Values were marked also with quality flag "3", where dynamical error of salinity measurement could be more than +-0.04 PSU without density inversions. These marks, in general, are in seasonal and main thermocline.

Data with quality flag "3" can be used depending on the user tasks.

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B. Optical sounding device

Logarithmic Photometer-Transparency Meter

Logarithmic Photometer-Transparency Meter (LFP) was developed at the Laboratory of Optical Oceanography of Marine Hydrophysical Institute, Sevastopol. This instrument is used for measuring the attenuation coefficient of directed light (transparency) of seawater within narrow diapasons of visible and near ultraviolet regions of the spectrum. With the aim of reducing systematic errors of measurement due to the secondary dispersion of light in water, the optical circuit "lens pin hole" is used, which permits the angle of vision of the receiver to be brought up to 15-30 min.

The seawater attenuation meter is designed for taking profile of optical properties of ocean water. The output of the meter is analogous signal proportional to the seawater attenuation coefficient. The instrument is designed as double-beam photometer with the single photo-receiver alternately irradiated with a measuring and a reference light beams. The photometer allows to record vertical profiles of attenuation coefficient c(z) in eight narrow intervals in visible range dependent on depth.

Absolute values of the attenuation coefficient are given in 1/meter at the decimal logarithm base.

SPECIFICATIONS

1. Range of measured attenuation,	1/m	0.01 - 1.0
2. Used wavelength,	mkm	0.36 - 0.65
3. Spectral bandwidth,	mkm	0.01
4. Error,	1/m	0.01
5. Instrument optical base,	m	2
6. Field-of-vision angle of photoreceiver, angular	min	30
7. Depth of submergence,	m	1000
8. Power consumption,	w	15
9. Weight,	kg	45

C. Hydrochemical data

Hydrochemical information of R/V "Mikchail Lomonosov" and R/V "Academician Vernadsky" of Marine Hydrophysical institute, received in the Indian ocean from 1966 to 1981 (9 cruises), is presented in this data set. In general, hydrochemical data include information on dissolved oxygen (O2), inorganic phosphates (PO4), silicates (Si), nitrates (NO3), nitrites (NO2), pH values (pHv), and total alkalinity

Verification of data sets on PC computer has been done to receive the answers for two questions:

- Are there any misprints? (Misprints have been corrected immediately);
- Are there any disagreement between the vertical distribution of parameters on individual oceanographic stations and our understandings of processes responsible for the hydrochemical structure? (As result of this work some data in data sets have been noted as not very reliable).

In general, the amount of data, noted as not reliable, is low (2 - 5 points for individual hydrochemical parameters for every cruise). The highest amount of such "not reliable" data has been revealed for the 11-th cruise of R/V "Academician Vernadsky" (about 20 points).

Different methods were used to determine the same hydrochemical parameter in different cruises and it should be recognized to analyze and compare information of this general data set correctly.

The next methods were used:

1. Dissolved oxygen was determined by Winkler's method according to guidance [1]. Since the 1978 modification of Winkler's method [2] has been used.

2. The method of Denige and Atkins (with SnCl2 as a reducer of phosphomolibdate complex) was used since 1966 to 1975 (4 cruises) to determine inorganic phosphates [1]. Since 1979 (5 cruises) the method of Murphy and Riley [2] (with ascorbic acid as reducer) has been using.

3. The method of Mullin and Riley (with methol-salphite solution as reducer of silicomolibdic acid) was used since 1966 to 1980 (7 cruises) [1]. In 22-nd and 24-th cruises of the R/V "Academician Vernadsky" (1980 and 1981) modification of above mentioned method was applied (with ascorbic acid as reducer) [2].

4. The method of Morris and Riley with reducing of nitrates with copper-coated cadmium grains in glass burette was used in all cruises.

5. The method of Griess-Ilosvay was used to determine nitrites [1,2].

6. pHv value was determined by visual comparison with the Serensen scale in the 19-th cruise of R/V "Mikchail Lomonosov". The reproducibility is+-0.1 [1].

In the other cruises pH-meters "pH-262" and "pH-340" were used to determine pH value. The reproducibility is+-0.05 [2].

7. Total alkalinity was determined by volumetric method of Bruevich (titration of sample of water with hydrochloric acid and flushing it with CO2-free air). The end point of titration was controlled visually. The reproducibility is+-0.005 mM/l [1,2].

FEK-m, FEK, or FEK-56 (the type of photometer) was used to measure the absorbency of all color solutions.

Units:
O2 - milliliters/liter
Alk - millimoles/liter
Other parameters - micromoles/liter

Literature

1. "Guidance on the routine hydrochemical methods for oceanographic investigations in the International Geophysical Year", IO RAS (edited by S.V.Bruevich), 1957.
2. "Methods on the hydrochemical investigations of the ocean", Moscow, Nauka, 1978.