Exchange Format Description

Release 1.2.0

Andrew M. Barna, James H. Swift, Stephen C. Diggs

2022-03-22

CONTENTS

CHAPTER

ONE

INTRODUCTION

This document will describe the WHP-Exchange formats used by the CCHDO for CTD and bottle. The WHP-exchange formats provide simplified exchange and improved readability of hydrographic data. WHP-exchange data files carry the essential information from CTD and water sample profiles. WHP-exchange is a rigorously-described comma-delimited (csv) format designed to ease data exchange and simplify data import.

1.1 Overview

The WHP-exchange bottle and CTD data formats include these features:

- UTF-8 Encoded
- Spreadsheet-like
- Comma-delimited values (csv)
- No special meaning to blank/empty spaces
- Station information in every line in the file (bottle) or in the top lines in each file (CTD)
- Only one missing data value defined for all parameters
- Positions in decimal degrees
- Dates in ISO 8601 YYYYMMDD format

1.2 File Types and Names

There are three types of WHP-exchange format files, each with a unique 8-character suffix:

Data Type	Filename Suffix	Description
CTD data	_ct1.csv	One CTD profile in WHP-exchange format
CTD data	_ct1.zip	Zip archive containing one or more _ct1.csv WHP-exchange CTD files
Bottle data	_hy1.csv	Data from one or more bottle profiles in WHP-exchange format

1.3 Requirement Levels

The key words “MUST”, “MUST NOT”, “REQUIRED”, “SHALL”, “SHALL NOT”, “SHOULD”, “SHOULD NOT”, “RECOMMENDED”, “MAY”, and “OPTIONAL” in this document are to be interpreted as described in **RFC 2119**.

1.4 About Text Encodings and UTF-8

1.4.1 Text on Computers

As strange as it may seem, there is no such thing in computing as ‘plain text’. Computers only understand binary, on or off, commonly represented by zeros and ones. For a series of zeros and ones to have meaning to humans, there needs to be an agreed upon standard for what any specific set of binary data represents. As an example, in 8-bit ASCII (ANSI X3.4-1986) the capital letter A is represented by the binary 01000001 (hex 41). 7-bit ASCII is limited to representing 127 characters, which is fine for most English speaking countries.

As the use of computers spread to non english speaking countries, it became necessary to extend the encodings to support other characters needed. However, most systems still only supported 8-bit bytes, with a maximum of 255 different characters it could represent. With more characters needing to be represented than space available, a proliferation of incompatible encoding standards occurred. There are at least 15 parts of ISO 8859, 6 JIS standards for Japanese, 3 for Chinese, 9 encodings specific to the Windows operating system, and 16 DOS code pages. Unicode was created to provide a unified way of representing all the characters which occur in most writing systems, including those of dead languages.

The unicode standard itself is not an encoding standard, but rather a list characters with a number assigned to each one, these numbers are what are called code points. For example, the capital letter A is the 65th letter in unicode, usually written in the hex 41. In the standard way of writing code points, this would be written as U+0041. You may notice that the unicode point for the capital letter A is the same as in ASCII, this feature was exploited to create the most common text encoding on the internet, UTF-8.

Character encodings were created to represent, in binary, all the code points allowed within unicode. One encoding in particular has become the dominant one for text on the internet[1], UTF-8. UTF-8 is a variable length encoding, meaning a character can take anywhere from 1 to 6 bytes to represent. In UTF-8 the first 127 characters of unicode are encoded with only byte. Since the first 127 code points in unicode are exactly the same as ASCII, the UTF-8 representation of any unicode character less than 128 is ASCII. This allows forward compatibility of ASCII with UTF-8, and if containing only code points below 128, a UTF-8 file to be backwards compatible with ASCII.

1.4.2 Unicode Representation in this Document

Character in this document will be defined as unicode points in the format U+#### where the # symbols are hexadecimal numbers. Since exchange files are defined to be UTF-8 encoded, this unambiguously specifies the exact bits which must occur in a file.

[1] As of May 2020, 95.0% of the text on the internet is encoded with UTF-8.

CHAPTER

TWO

COMMON FORMAT FEATURES

Certain format specifications are shared between the bottle and CTD WHP-exchange files. Those common features are described in this section.

2.1 File Requirements

2.1.1 Encoding

WHP-exchange text files MUST be UTF-8 encoded.

Note: UTF-8 was chosen as the encoding for WHP-Exchange files because it is backwards compatible with ASCII. Valid ASCII files are also valid UTF-8 files. UTF-8 allows for the full range of unicode points to display non ASCII text.

Warning: Be careful if editing or creating files on Windows as the default text encoding is UTF-16. UTF-16 is not compatible with UTF-8 or ASCII.

2.1.2 Byte Order Marks

The UTF-8 encoded files MUST NOT include a BYTE ORDER MARK (U+FEFF).

Note: Not including a byte order mark ensures backwards compatibility with ASCII when the file contains only code points less than U+007F.

2.1.3 Line Endings

Lines in an exchange text file MUST end with a LINE FEED (U+000A) \n. Lines MUST NOT use any other form of line ending.

Changed in version 1.3: Disallow non “unix style” line endings.

2.2 File Format Indicator

The first bytes of a WHP-exchange file MUST contain a file identifier and SHOULD have a creation stamp separated by a COMMA (U+002C) `,`.

2.2.1 Bottle File Indicator

The first bytes of a WHP-exchange bottle file must be the following 6 byte sequence `42 4F 54 54 4C 45`. This is equivalent to `BOTTLE` when encoded in UTF-8.

2.2.2 CTD File Indicator

The first bytes of a WHP-exchange CTD file must be the following 3 byte sequence `43 54 44`. This is equivalent to `CTD` when encoded in UTF-8.

Note: If while attempting to read a WHP-exchange file and the first line does not start with either byte sequence listed above an attempt to read the rest of the file will likely fail. When writing a WHP-exchange format reader, always check if this identification stamp is present and has a valid value.

2.2.3 Creation Stamp Convention

The creation stamp SHOULD contain the following information in the order presented, using the stamp `20140716CCHSIOSCD` as an example:

1) **20140716**CCHSIOSCD: A date stamp in the from of YYYYMMDD (ISO 8601)
2) 20140716**CCH**SIOSCD: The division (or group) of the institution that wrote the file, typically three characters. The CCHDO uses CCH as the division.
3) 20140716CCH**SIO**SCD: The institution that the group is associated with, typically three characters. The CCHDO is located at the Scripps Institution of Oceanography, thus SIO is used.
4) 20140716CCHSIO**SCD**: The initials of the person who wrote the file, typically three characters. Use only code points U+0041 to U+005A and for the initials. In this example, SCD.

Warning: Do not rely on the creation stamp to be the same length in every WHP-exchange file. While all the same elements SHOULD be present, their lengths may vary.

2.2.4 Examples

A bottle file identifier including a creation stamp might look like:

```
BOTTLE,20140716CCHSIOSCD
```

A CTD file identifier including a creation stamp might look like:

```
CTD,20140716CCHSIOSCD
```

Changed in version 1.3: Made explicit the exact bytes which should appear at the start of a file. Demote the file creation stamp to a strong reccomendation.

2.3 Optional Comment Lines

After the *File Identification Stamp* any number of comment line, including none may appear. Comment lines start with a NUMBER SIGN (U+0023) #. Comment lines typically contain information about the file history and will often contain data citation information.

An example:

```
# This is one line of comments
# An additional line of comments
```

An example of the beginning of a file, including the *File Identification Stamp*:

```
BOTTLE,20140716CCHSIOSCD
# This is a comment line
# BOTTLE,20130215CCHSIOSCD
```

Note: Notice that an older *File Identification Stamp* is in a comment line. This is a convention often used by the CCHDO to record when changes were made to files

Warning: Comments may contain UTF-8 encoded code points above U+007F, especially in proper names that may be present with data citation information. If writing your own WHP-exchange reader, ensure that it can handle code points above U+007F or have it skip comment lines without trying to read them.

2.4 Parameter and Unit Lines

Warning: There are additional headers specific to CTD WHP-exchange files. See the *Additional CTD Headers* section for details on these additional headers.

After any format specific headers, the parameter and unit lines are next. The parameter names are first, units are second.

Parameter names are COMMA (U+002C) , separated values that define the columns the exchange file will contain. The names must be unique, capitalized, contain no empty fields, and not end with a trailing comma. The parameter names must contain only code points in the range U+0021 to U+007E except a COMMA (U+002C) ,. A trailing comma, or a comma that occurs at the end of the line with nothing else after it, MUST NOT be included on the parameter line. Certain parameter names, or parameter combinations, are required to be present. See the respective sections on *Required Bottle Parameters* and *CTD required headers* for information specific to each format.

The unit line contains information for the units of each parameter listed in the parameter line. The unit line, like the parameters, are comma separated values. Like the parameter names, units must contain only code points in the range U+0021 to U+007E except a COMMA (U+002C) ,. A trailing comma MUST NOT be included in the unit line. Units may contain empty fields if the parameter has no units. Units for a parameter must be in the same column as that parameter, essentially, the same number of commas occur before the parameter name and its unit.

Warning: Parameter names and units MUST NOT contain commas as part of the name or unit. Commas are reserved for separating the, names, units, and data into columns.

The parameter and unit lines of a CTD file might look like this:

```
CTDPRS,CTDPRS_FLAG_W,CTDTMP,CTDSAL,CTDOXY
DBAR,,ITS-90,PSS-78,UMOL/KG
```

Note the presence of quality flag column (suffixed with `_FLAG_W`) which has the corresponding units of nothing denoted by two commas next to each other. For more information on quality flags, see the *Quality Codes* section. White space MUST have no meaning in the exchange format so it may be included for purely aesthetic reasons. The parameter and units could very easily have looked like:

```
CTDPRS, CTDPRS_FLAG_W, CTDTMP, CTDSAL, CTDOXY
  DBAR,              , ITS-90, PSS-78, UMOL/KG
```

Note: Some technical details for formatting the whitespace.

While not strictly required, parameter, units, and data lines may contain whitespace matching the length of the print format of the parameter. This is a convention followed by the CCHDO to ease reading of files by humans. Quality flag columns usually have a 1 character width which will often cause the parameter/units and data to not be aligned into pretty columns.

2.5 Data Lines

The data lines occur directly after the unit line. Each line of data contains COMMA (U+002C) `,` separated values of related data. Each data point of the data line may contain any combination of characters from U+0020 to U+007F except a COMMA (U+002C) `,`. Like the *Parameter and Unit Lines*, a trailing comma MUST NOT be included at the end of each line. Data points for each parameter of the *Parameter and Unit Lines* must be in the same column as that parameter, i.e. the same number of commas occur before the parameter label and the datum.

Numeric data which occurs on the data lines MUST only contain numbers, spaces, an optional decimal marker, and an optional negative sign. All whitespace within data lines has no semantic meaning. Integers may be represented as bare numerals with no decimal marker. All real numeric data (i.e. data that are real numbers) MUST be decimal and MUST represent their decimal mark using a FULL STOP (U+002E) `.`. For both negative real numbers and integers, prepend a HYPHEN-MINUS (U+002D) `-` to the numeric portion, positive real numbers MUST NOT be prefixed by a PLUS SIGN (U+002B) +.

The validity of each datum is determined by the parameter column in which it occurs. For example, the *EXPOCODE* column may contain any combination of letter, numbers, or symbols (except a comma). A *CTDPRS* column may only contain real decimal numbers (U+0030 to U+0039) using a FULL STOP (U+002E) `.` as the decimal mark.

Note: Parameters may have a different precision depending on how the measurement was made. The CCHDO maintains a list of parameter names which includes precisions for historic reasons. Previous versions of the Exchange format specification stated the CCHDO would pad "meaningless" zeros to the end of any data without enough precision. Newer software allows the CCHDO to keep the precision as reported, both less and more precise. For these and other reasons, a mix of precisions may occur in a column of data.

Always report the precision as measured.

Warning: The exchange format currently has no support for quoted strings within the parameter, unit, and data lines. This means it is not possible for any meaningful whitespace to be included.

After all data lines, the end of the data is indicated by a line containing only `END_DATA`. Here is a short example of what exchange data might look like:

```
2.0,2,  19.1840,  34.6935,    220.8
4.0,2,  19.1992,  34.6924,    220.7
6.0,2,  19.2002,  34.6922,    220.5
8.0,2,  19.2022,  34.6920,    220.5
END_DATA
```

2.5.1 Missing Data Values

Missing data may occur in any position of a column of data, including all positions. When data are missing from a column, a fill value must be used to indicate "no data". The fill value in exchange files is HYPHEN-MINUS (U+002D) `-` followed by three DIGIT NINE (U+0039) `9`, i.e. `-999`. No other characters other than whitespace should occur within the missing data position.

Missing data values MAY still have *Quality Codes* associated which can give information as to why the data are missing.

Here is an example of exchange data with missing values:

```
2.0,2,  19.1840,  34.6935,    220.8
4.0,2,     -999,  34.6924,    220.7
6.0,2,  19.2002,  34.6922,     -999
8.0,2,  19.2022,  34.6920,    220.5
END_DATA
```

Note: Previous versions of the exchange format specified that the fill value should be in the precision of the rest of the column. For example, if a salinity was missing from a column, it would have the fill value of `-999.0000`. This has changed for several reasons:

- The precision of the data within a column is not fixed.
- A few parameters have valid range which includes -999 as a numeric value.

When encountering older exchange files, the fill value might contain the extra zeros after the decimal point. In the majority of cases, these are fill values and not numeric values.

2.6 Post Data Content

After the `END_DATA` line, any additional content may be included without format restriction. Additional content after `END_DATA` MUST continue to be UTF-8 encoded.

2.7 Examples

Full examples of data in exchange format are presented in their specific sections:

- *Example Bottle Data*
- *Example CTD Data*

CHAPTER

THREE

BOTTLE SPECIFIC

Exchange Bottle files follow all the common format specifications for their structure. The *File Format Indicator* of an exchange bottle file starts with `BOTTLE`. Each *data line* in an exchange bottle file represents a single bottle closure.

When ctd parameters are encountered within exchange bottle files (e.g. *CTDPRS*) they represent the corrected values being read by the CTD at the time of bottle closure, usually averaged over some interval.

In bottle files, specific parameters are REQUIRED to be present and have non fill values.

3.1 Required Bottle Parameters

The following parameters are REQUIRED to be present in exchange bottle files where the parameter name occurs within the *Parameter and Unit Lines* and their values be present in the *Data Lines*.

- *EXPOCODE*
- *STNNBR*
- *CASTNO*
- *DATE*
- *LATITUDE*
- *LONGITUDE*
- *CTDPRS*
- *SAMPNO*

Changed in version 1.3: Removed *BTLNBR* as being one of two options for required columns.

3.2 Unique Line Identification

Since each *data line* of an exchange bottle file represents a single bottle closure, enough information must be present on each line to uniquely identify closure event. This is to allow the integration of all the measurements of samples taken from that bottle at a later time. The identification is done by requiring a combination of values from specific parameters to be unique throughout the file.

The following combination of parameters must have unique values:

- *EXPOCODE*
- *STNNBR*
- *CASTNO*

- *SAMPNO*

Changed in version 1.3: Removed *BTLNBR* as a being a valid identifier for samples.

3.2.1 Unique Line Identification Examples

In these examples, the long parameter, unit, and data lines truncated by `[...]`.

The following example exchange bottle data is all from the same cruise indicated by the expocode: `33RO20131223`, the same station: `1`, the same cast `2`, but the bottle number and sample numbers differ (`24` and `23`).

```
BOTTLE,20150327CCHSIORJL
# From submitted file a16s_2013_final_discrete_o2.csv:
# Merged parameters: OXYGEN_FLAG_W
EXPOCODE,STNNBR,CASTNO,SAMPNO,BTLNBR[...]
,,,,[...]
33RO20131223,       1,          2,          24,         24[...]
33RO20131223,       1,          2,          23,         23[...]
END_DATA
```

The following example shows an example of duplicated unique identification parameter values. More than one line contains the exact same values for *EXPOCODE*, *STNNBR*, *CASTNO*, and *SAMPNO*.

```
BOTTLE,20150327CCHSIORJL
# From submitted file a16s_2013_final_discrete_o2.csv:
# Merged parameters: OXYGEN_FLAG_W
EXPOCODE,STNNBR,CASTNO,SAMPNO,BTLNBR[...]
,,,,[...]
33RO20131223,       1,          2,          24,         24[...]
33RO20131223,       1,          2,          24,         23[...]
END_DATA
```

3.3 Example Bottle Data

An example bottle exchange file is provided on the next page.

```
BOTTLE,20150327CCHSIORJL
# From submitted file a16s_2013_final_discrete_o2.csv:
# Merged parameters: OXYGEN_FLAG_W
#|
#|
#| Analysis                 Institution    Principal Investigator   email
#| ____________________________________________________________________________
#| Chief Scientist          AOML           Rik Wanninkhof           rik.wanninkhof@noaa.gov
#| Co-Chief Scientist       AOML/CIMAS     Leticia Barbero          leticia.barbero@noaa.gov
#| CTDO                     NOAA/PMEL      Gregory Johnson          Gregory.C.Johnson@noaa.gov
#|                          NOAA/AOML      Molly Baringer           Molly.Baringer@noaa.gov
#| Salinity                 NOAA/AOML      Molly Baringer           Molly.Baringer@noaa.gov
#| UW & Discrete pCO2       NOAA/AOML      Rik Wanninkhof           Rik.Wanninkhof@noaa.gov
#| Total CO2 (DIC)          NOAA/PMEL      Richard Feely            Richard.A.Feely@noaa.gov
#|                          NOAA/AOML      Rik Wanninkhof           Rik.Wanninkhof@noaa.gov
#| Nutrients                NOAA/AOML      Jia-Zhong Zhang          Jia-Zhong.Zhang@noaa.gov
#|                          NOAA/PMEL      Calvin Mordy             Calvin.W.Mordy@noaa.gov
#| Dissolved O2             NOAA/AOML      Molly Baringer           Molly.Baringer@noaa.gov
#|                          RSMAS          Chris Langdon            clangdon@rsmas.miami.edu
#| Total Alkalinity/pH      RSMAS          Frank Millero            fmillero@rsmas.miami.edu
#| CFCs/SF6                 NOAA/PMEL      John Bullister           John.L.Bullister@noaa.gov
#| 3He/Tritium              LDEO           Peter Schlosser          peters@ldeo.columbia.edu
#|                          WHOI           William Jenkins          wjenkins@whoi.edu
#| CDOM                     UCSB/MSI       Craig Carlson            carlson@lifesci.ucsb.edu
#| Chipod                   OSU            Jonathan Nash            nash@coas.oregonstate.edu
#| ADCP/Lowered ADCP        U Hawaii       Eric Firing              efiring@hawaii.edu
#| Trace Metals             FSU            William Landing          wlanding@fsu.edu
#|                          UH             Chris Measures           measures@hawaii.edu
#| 14C/DIC                  WHOI           Ann McNichols            amcnichol@whoi.edu
#|                          PU             Robert Key               key@princeton.edu
#| DOC                      RSMAS          Dennis Hansell           dhansell@rsmas.miami.edu
#| Data Management          SIO            James Swift              jswift@ucsd.edu
#|                          SIO            Susan Becker             sbecker@ucsd.edu
#|
#|  Following American Geophysical Union recommendations, the data should be
#|  cited as: "data provider(s), cruise name or cruise ID, data file name(s),
#|  CLIVAR and Carbon Hydrographic Data Office, La Jolla, CA, USA, and data
#|  file date." For further information, please contact one of the parties
#|  listed above or cchdo@ucsd.edu. Users are also requested to acknowledge
#|  the NSF/NOAA-funded U.S. Repeat Hydrography Program in publications resulting
#|  from their use.
#|
#
EXPOCODE,SECT_ID,STNNBR,CASTNO,SAMPNO,BTLNBR,BTLNBR_FLAG_W,DATE,TIME,LATITUDE,LONGITUDE,DEPTH,CTDPRS,CTDTMP,CTDSAL,CTDSAL_FLAG_W,SALNTY,SALNTY_FLAG_W,CTDOXY,CTDOXY_FLAG_W,OXYGEN,OXYGEN_FLAG_W
,,,,,,,,,,,METERS,DBAR,ITS-90,PSS-78,,PSS-78,,UMOL/KG,,UMOL/KG,
33RO20131223,       A16S,       1,          2,          24,         24,2,20131226,      0706,    -6.0016,   -24.9998,      5809,     3.9,  26.2239,  36.3097,2,  36.3082,2,    199.1,2,   201.2,2
33RO20131223,       A16S,       1,          2,          23,         23,2,20131226,      0704,    -6.0016,   -24.9998,      5809,    22.5,  26.2331,  36.3090,2,  36.3171,2,    199.4,2,   201.3,2
33RO20131223,       A16S,       1,          2,          22,         22,2,20131226,      0702,    -6.0016,   -24.9998,      5809,    47.4,  26.2335,  36.3078,2,  36.3080,2,      200,2,   201.9,2
33RO20131223,       A16S,       1,          2,          21,         21,2,20131226,      0700,    -6.0016,   -24.9998,      5809,    72.1,  26.2112,  36.3044,2,  36.3055,2,    200.6,2,     201,2
33RO20131223,       A16S,       1,          2,          20,         20,2,20131226,      0658,    -6.0016,   -24.9998,      5809,    97.5,  24.2160,  36.1165,2,  36.1258,2,    193.2,2,   190.1,2
33RO20131223,       A16S,       1,          2,          19,         19,2,20131226,      0656,    -6.0016,   -24.9998,      5809,   147.3,  15.5167,  35.6384,2,  35.6247,2,    104.9,2,   103.3,2
33RO20131223,       A16S,       1,          2,          18,         18,2,20131226,      0654,    -6.0016,   -24.9998,      5809,   222.8,  12.0808,  35.1686,2,  35.1586,2,    109.3,2,   108.6,2
33RO20131223,       A16S,       1,          2,          17,         17,2,20131226,      0651,    -6.0016,   -24.9998,      5809,   296.4,   9.8716,  34.8809,2,  34.8809,2,      124,2,     125,2
33RO20131223,       A16S,       1,          2,          16,         16,2,20131226,      0648,    -6.0016,   -24.9998,      5809,   406.5,   8.4675,  34.7567,2,  34.7520,2,     83.8,2,    81.4,2
33RO20131223,       A16S,       1,          2,          15,         15,2,20131226,      0645,    -6.0016,   -24.9998,      5809,   517.9,   7.1433,  34.6371,2,  34.6366,2,     93.8,2,    88.6,2
33RO20131223,       A16S,       1,          2,          14,         14,2,20131226,      0642,    -6.0016,   -24.9998,      5809,   647.7,   5.5545,  34.5066,2,  34.5046,2,    139.4,2,   130.5,2
33RO20131223,       A16S,       1,          2,          13,         13,2,20131226,      0638,    -6.0016,   -24.9998,      5809,   791.9,   4.6390,  34.4845,2,  34.4826,2,    158.6,2,   148.5,2
33RO20131223,       A16S,       1,          2,          12,         12,2,20131226,      0633,    -6.0016,   -24.9998,      5809,  1047.4,   4.2414,  34.6431,2,  34.6429,2,    163.9,2,   163.7,2
33RO20131223,       A16S,       1,          2,          11,         11,2,20131226,      0627,    -6.0016,   -24.9998,      5809,  1347.9,   4.3278,  34.8700,2,  34.8698,2,    197.4,2,   197.1,2
33RO20131223,       A16S,       1,          2,          10,         10,2,20131226,      0619,    -6.0016,   -24.9998,      5809,  1747.8,   3.8921,  34.9665,2,  34.9664,2,    238.6,2,   238.3,2
33RO20131223,       A16S,       1,          2,           9,          9,2,20131226,      0611,    -6.0016,   -24.9998,      5809,  2147.8,   3.2522,  34.9412,2,  34.9420,2,    242.7,2,   243.6,2
33RO20131223,       A16S,       1,          2,           8,          8,2,20131226,      0602,    -6.0016,   -24.9998,      5809,  2597.5,   2.8568,  34.9202,2,  34.9188,2,    242.6,2,   242.3,2
33RO20131223,       A16S,       1,          2,           7,          7,3,20131226,      0553,    -6.0016,   -24.9998,      5809,  3097.5,   2.6784,  34.9194,2,  34.9176,2,    251.1,2,   251.7,2
33RO20131223,       A16S,       1,          2,           6,          6,3,20131226,      0544,    -6.0016,   -24.9998,      5809,  3598.4,   2.4902,  34.9073,2,  34.9727,4,    255.1,2,   235.6,4
33RO20131223,       A16S,       1,          2,           5,          5,2,20131226,      0534,    -6.0016,   -24.9998,      5809,  4098.5,   1.8197,  34.8364,2,  34.8340,2,    242.3,2,   243.2,2
33RO20131223,       A16S,       1,          2,           4,          4,2,20131226,      0524,    -6.0016,   -24.9998,      5809,   4598,   0.9865,  34.7443,2,  34.7432,2,    225.6,2,   226.4,2
33RO20131223,       A16S,       1,          2,           3,          3,2,20131226,      0515,    -6.0016,   -24.9998,      5809,  5097.2,   0.7993,  34.7170,2,  34.7167,2,    220.1,2,   221.9,2
33RO20131223,       A16S,       1,          2,           2,          2,2,20131226,      0505,    -6.0016,   -24.9998,      5809,  5597.3,   0.7292,  34.7031,2,  34.7024,2,    219.8,2,   219.9,2
33RO20131223,       A16S,       1,          2,           1,          1,3,20131226,      0459,    -6.0016,   -24.9998,      5809,  5904.3,   0.7651,  34.7023,2,  34.7049,2,    219.9,2,   220.9,2
33RO20131223,       A16S,       2,          1,          24,         24,2,20131226,      1421,    -6.4977,   -24.9999,      5628,     3.1,  26.2387,  36.2430,2,  36.2424,2,    201.5,2,   202.1,2
33RO20131223,       A16S,       2,          1,          23,         23,2,20131226,      1419,    -6.4977,   -24.9999,      5628,    27.9,  26.1705,  36.2402,2,  36.2394,2,    202.2,2,   202.2,2
33RO20131223,       A16S,       2,          1,          22,         22,3,20131226,      1417,    -6.4977,   -24.9999,      5628,    67.9,  26.1326,  36.2369,2,  36.2353,2,    201.5,2,   202.3,2
33RO20131223,       A16S,       2,          1,          21,         21,2,20131226,      1415,    -6.4977,   -24.9999,      5628,   107.1,  22.8199,  36.1452,2,  36.1454,2,    168.2,2,   170.3,2
33RO20131223,       A16S,       2,          1,          20,         20,2,20131226,      1412,    -6.4977,   -24.9999,      5628,   172.4,  15.2580,  35.6092,2,  35.6393,4,      112,2,   112.6,2
33RO20131223,       A16S,       2,          1,          19,         19,2,20131226,      1410,    -6.4977,   -24.9999,      5628,   257.5,  10.8796,  35.0258,2,  35.0261,2,     92.4,2,    92.3,2
33RO20131223,       A16S,       2,          1,          18,         18,2,20131226,      1407,    -6.4977,   -24.9999,      5628,   367.8,   9.2106,  34.8337,2,  34.8338,2,     75.2,2,    75.6,2
END_DATA
```

The basic strucutre is:

- Line 1: *File Format Indicator* starting with `BOTTLE`
- Line 2, 3: *Optional Comment Lines*
- Lines 3, 4: *Parameter and Unit Lines*
- Lines 6-11: *Data Lines*.

CHAPTER

FOUR

CTD SPECIFIC

Exchange CTD files follow all the common format specifications with the addition of some header information. They MUST only contain one profile per file.

4.1 Additional CTD Headers

Rather than encode information which would remain constant throughout the cast with the *Data Lines*, Exchange CTD files store this information in headers that appear after the *Optional Comment Lines*, but before the *Parameter and Unit Lines*. These headers follow the basic form:

```
PARAM = VALUE
```

Where the `PARAM` is some parameter name (e.g. `DEPTH`) and the `VALUE` is the value for that parameter (e.g. `4523`). The `PARAM`, with the exception of *NUMBER_HEADERS*, MAY be any parameter in the *Parameters* section. The format of `VALUE` must conform to the data type listed for the parameter in the *Parameters* section. The `PARAM` and `VALUE` are separated by a EQUALS SIGN (U+003D) =, there is no meaning to any whitespace. Each param-value pair ends end with a line-ending character. There is no limit to how many headers may be present, as long the *NUMBER_HEADERS* value is set correctly.

Note: Any parameter which has a constant value for the entire cast MAY appear in the CTD Headers if the parameter has the "profile" scope in the parameters database.

Here is an example of a complete set of CTD headers (note that we have included line numbers, these are not part of the header):

```
1  NUMBER_HEADERS = 10
2  EXPOCODE = 318M20130321
3  SECT_ID = P02W
4  STNNBR = 1
5  CASTNO = 2
6  DATE = 20130322
7  TIME = 2205
8  LATITUDE =  32.5068
9  LONGITUDE =  133.0297
10 DEPTH =   166
```

Notice three things: the special `NUMBER_HEADERS` parameter, the parameter names are all caps, and none of the parameters have units.

The units for each parameter are defined by convention rather than explicitly stated in each file, see the *CTD required headers* for information on which headers are required.

4.2 CTD required headers

The following CTD headers are REQUIRED, see the *Parameters* section for the description of each, except for the *NUMBER_HEADERS* which is described below:

- *NUMBER_HEADERS*
- *EXPOCODE*
- *STNNBR*
- *CASTNO*
- *DATE*
- *LATITUDE*
- *LONGITUDE*

Note: *TIME* is not a required parameter, this is not an omission from the list above.

Warning: There is no support for including units in the CTD headers it is not recommended that any parameters which could have multiple units be included in the CTD headers.

Usually the optional *DEPTH* parameter is the only one with units commonly found in CTD headers, it MUST be in meters when included in the CTD headers.

4.2.1 NUMBER_HEADERS

The `NUMBER_HEADERS` parameter is an integer describing how many lines the headers will be before the parameter and unit lines. The value of `NUMBER_HEADERS` includes itself it is REQUIRED and MUST be the first line after any *Optional Comment Lines*.

Warning: The most common mistake with Exchange CTD Headers is not including the `NUMBER_HEADERS` line in the calculation of the number of lines the headers occupy. It would be incorrect in the above example to have `NUMBER_HEADERS = 9`.

4.3 CTD Optional Headers

The following CTD headers are optional, but encountered frequently within ctd exchange files:

- *SECT_ID*
- *TIME*
- *DEPTH*

4.4 Preferred Header Order

The only header which must come first is NUMBER_HEADERS. Other header parameters may come in any order, however, there is a preferred order. The preferred order after NUMBER_HEADERS is:

```
EXPOCODE
SECT_ID
STNNBR
CASTNO
DATE
TIME
LATITUDE
LONGITUDE
DEPTH
```

4.5 User Headers

Previous versions of this document allowed any number of extra "user defined" headers to appear including undocumented ones. This was found to cause problems for implementations which only expected certain specific headers to be present. Use the comments field for this extra information.

4.6 Example CTD Data

Here is an example of a complete exchange CTD file (though a very shallow profile):

```
CTD,20130709ODF
# REPORTED CAST DEPTH IS CTD_DEPTH + DISTANCE_ABOVE_BOTTOM AT MAX PRESSURE
NUMBER_HEADERS = 10
EXPOCODE = 318M20130321
SECT_ID = P02W
STNNBR = 1
CASTNO = 2
DATE = 20130322
TIME = 2205
LATITUDE =  32.5068
LONGITUDE =  133.0297
DEPTH =   166
CTDPRS,CTDPRS_FLAG_W,CTDTMP,CTDTMP_FLAG_W,CTDSAL,CTDSAL_FLAG_W,CTDOXY,CTDOXY_FLAG_W
DBAR,,ITS-90,,PSS-78,,UMOL/KG,
      2.0,2,  19.1840,2,  34.6935,2,    220.8,2
      4.0,2,  19.1992,2,  34.6924,2,    220.7,2
      6.0,2,  19.2002,2,  34.6922,2,    220.5,2
      8.0,2,  19.2022,2,  34.6919,2,    220.5,2
     10.0,2,  19.2033,2,  34.6918,2,    220.6,2
     12.0,2,  19.2039,2,  34.6919,2,    220.8,2
     14.0,2,  19.2033,2,  34.6919,2,    220.9,2
     16.0,2,  19.2029,2,  34.6916,2,    220.6,2
END_DATA
```

The structure is:

- Line 1: *File Format Indicator*
- Line 2: *Optional Comment Lines*
- Lines 3-12: *Additional CTD Headers*
- Lines 13, 14: *Parameter and Unit Lines*
- Lines 15-23: *Data Lines*.

4.7 Structure of ZIP CTD Archives

Since exchange CTD files only contain one profile, it is convent to package them into entire an archive containing an entire cruise. The archive format exchange uses is zip, specifically PKZIP 2.0. The zip archive allows for a large variety of structure so it is necessary to define the structure here.

Exchange CTD zip files MUST contain a flattened structure, that is, only files with no directory paths. The files within the zip SHOULD be in the same order in which the stations were done. Usually this means the filenames contain numerical information regarding the station order. All the files within the zip MUST have the `_ct1.csv` file extension.

Here is an example a correct ctd exchange zip archive (the output of `unzip -l`):

```
Archive:  33RO20131223_ct1.zip
  Length     Date   Time    Name
 --------    ----   ----    ----
   401802  04-10-14 17:27   33RO20131223_00001_00002_ct1.csv
   388950  04-10-14 17:27   33RO20131223_00002_00001_ct1.csv
   385278  04-10-14 17:27   33RO20131223_00003_00002_ct1.csv
   400573  04-10-14 17:27   33RO20131223_00004_00001_ct1.csv
   395069  04-10-14 17:27   33RO20131223_00005_00002_ct1.csv
 --------                   -------
  1971672                   5 files
```

Notice the lack of directory paths in the archive names, it is simply filenames. The following is an example of an incorrectly packaged archive, which has archive names containing directory structure (notice the `/` in the names):

```
Archive:  33RO20131223_ct1.zip
  Length     Date   Time    Name
 --------    ----   ----    ----
   401802  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00001_00002_ct1.csv
   388950  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00002_00001_ct1.csv
   385278  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00003_00002_ct1.csv
   400573  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00004_00001_ct1.csv
   395069  04-10-14 17:27   33RO20131223_ct1/33RO20131223_00005_00002_ct1.csv
 --------                   -------
  1971672                   5 files
```

Note: Currently, the behavior when other files or directories are present is undefined. The recommended behavior when encountering directories or other (non _ct1.csv) files is to ignore the extra files while warning the user of their presence.

CHAPTER

FIVE

QUALITY CODES

Most parameters may also have an associated column of numeric quality flags. Quality flag columns appear as a normal parameter in the *Parameter and Unit Lines*, they MUST NOT have any associated units. The quality flag parameter name are constructed and require parsing to determine which parameter they need to be associated with.

The basic formula for constructing a quality flag parameter name is:

```
<PARAMETER_NAME>_FLAG_W
```

where <PARAMETER_NAME> is the parameter for which the quality flags are for.

For example, the quality column for the parameter *CTDOXY* would be CTDOXY_FLAG_W.

The meaning of the flags is determined by the type of measurement it is. Bottles have *Bottle Quality Codes*, measurements from CTD based instruments use the *CTD Quality Codes*, and discrete measurements from bottle use the *Water Quality Codes*. The quality codes to use for any specific parameter is also *listed with each parameter* in the parameters section.

All quality flag codes are single digit integers.

The following descriptions of each quality code is taken from the WOCE manual.

5.1 WOCE Bottle Quality Codes

1 Bottle information unavailable.

2 No problems noted.

3 Leaking.

4 Did not trip correctly.

5 Not reported.

(6) (Significant discrepancy in measured values between Gerard and Niskin bottles.)

(7) (Unknown problem.)

(8) (Pair did not trip correctly. Note that the Niskin bottle can trip at an unplanned depth while the Gerard trips correctly and vice versa.)

9 Samples not drawn from this bottle.

5.2 WOCE Water Sample Quality Codes

1 Sample for this measurement was drawn from water bottle but analysis not received.

2 Acceptable measurement.

3 Questionable measurement.

4 Bad measurement.

5 Not reported.

6 Mean of replicate measurements (Number of replicates should be specified in the .DOC file and the replicate data tabulated there).

7 Manual chromatographic peak measurement.

8 Irregular digital chromatographic peak integration.

9 Sample not drawn for this measurement from this bottle.

Note: Note that if water is drawn for any measurement from a water bottle, the quality code for that parameter should be set equal to 1 initially to help ensure that all water samples are accounted for.

5.3 WOCE CTD Quality Codes

1 Not calibrated.

2 Acceptable measurement.

3 Questionable measurement.

4 Bad measurement.

5 Not reported.

6 Interpolated over a pressure interval larger than 2 dbar.

7 Despiked.

(8) Not used for CTD data.

9 Not sampled.

CHAPTER

SIX

PARAMETERS

6.1 About Parameters

The CCHDO works frequently with many parameters common in hydrography. Provided here is a description of many common parameters encountered in exchange files.

Warning: This list may not contain every parameter which may be encountered in an exchange file. CCHDO is working on providing a machine readable list of ALL parameters which may be encountered in all files. This list will include parameters which CCHDO lacks a description for (known unknown parameters).

Until that time, parameters may appear in exchange formats from the CCHDO which are not documented here. No undocumented parameter or field will cause data integrity or usefulness issues (i.e. all undocumented parameters may be safely ignored).

6.1.1 Definitions

Provided with each parameter is a set of information in a table, the information included in that table should be interpreted as follows:

Units These are the common units encountered for this parameter as it will appear in the exchange document itself. The special units of "None" means the field will be either blank or contain only whitespace.

Data Type Specifies the allowed type of data in the data records for this parameter. There are three types of data, string (str), integers (int), and decimal. String data types may be any printing character except a comma `,` which is the field seperator. Integer data types may only contain numbers without a decimal point, quality flags are usually integers. Decimal data types may be any real number (including an integer) and may include decimal point, the precision is not specified.

Quality Flags Specifies which set of quality flag definitions should be used to interpret a quality flag column for this parameter (if present). Current quality flags are: *bottle*, *water*, *ctd*. See the *Quality Codes* section for more information

Error Column Label A parameter might contain an error or uncertanty value associated with it. The column which contains the error/uncertanty values for this parameter will have the name listed in this field.

CF/netCDF Attributes When this parameter appears in a CF netCDF file, the units and standard name are determined by the units of the WHP parameter. Not all parameter/unit pairs have CF standard names yet. Some WHP units are not allowed in the units attribute of valid CF netCDF files, of particular note are the temperature units of ITS-90 and IPTS-68 which are both mapped to degC in CF files.

These "units" will instead appear in a `reference_scale` attribute of the variable rather than in the `units` attribute.

6.2 Unlisted Parameters

Otherwise valid exchange files which contain parameters, units, or parameter/unit pairs that are not listed in the *Parameters* list SHALL NOT cause the file to be invalid so long as the rest of the specification is adhered to.

6.2.1 Pass Through

Authors of software which read and write exchange files SHOULD pass though unlisted parameters, units, parameter/unit pairs, and the associated data columns.

Note: This section is intended for software which is used in data management, it does not impose a requirement on authors only wishing to do analysis.

6.3 Parameters

This section was generated automatically from a `machine readable list of parameters`, there is also a `validation schema` for the parameters json.

- *EXPOCODE*
- *SECT_ID*
- *STNNBR*
- *CASTNO*
- *BIOS_CASTID*
- *SAMPNO*
- *GEOTR_EVENT*
- *GEOTR_SAMPNO*
- *BIONBR*
- *EVENT_NUMBER*
- *BTLNBR*
- *DATE*
- *TIME*
- *LATITUDE*
- *LONGITUDE*
- *DEPTH*
- *CTDPRS*
- *CTDRAW*
- *CTDTMP*
- *CTDSAL*
- *CTDSA*
- *CTDCT*
- *SALNTY*
- *DNSSAL*
- *CTDSVLSAL*
- *CTDOXY*
- *OXYGEN*
- *SILCAT*
- *NH4*
- *NITRAT*
- *CTDNITRATE*
- *NITRIT*
- *PHSPHT*
- *NO2+NO3*
- *CFC-11*
- *CFC-12*
- *CFC113*
- *SF6*
- *TCARBN*
- *ALKALI*
- *FCO2*
- *FCO2IN*
- *FCO2TMP*
- *PCO2*
- *PCO2TMP*
- *PH_TOT*
- *PH_SWS*
- *PH_TMP*
- *DOC*
- *TRITUM*
- *HELIUM*
- *DELHE3*
- *REFTMP*
- *REVPRS*
- *REVTMP*
- *DELC13*
- *DELC14*
- *DON*
- *TOC*
- *POC*
- *PON*
- *TDN*
- *TON*
- *NEON*
- *DELO18*
- *CCL4*
- *NI*
- *ALUMIN*
- *BARIUM*
- *CU*
- *FE*
- *MN*
- *CTDFLUOR*
- *PAR*
- *I-129*
- *PLUTO*
- *RA-226*
- *RA-228*
- *CTDXMISS*
- *CTDBEAMCP*
- *CTDTURB*

- *AR-39*
- *CS-137*
- *KR-85*
- *SR-90*
- *N2O*
- *RA-8/6*
- *QUALT1*
- *QUALT2*
- *MCHFRM*
- *IODATE*
- *IODIDE*
- *CHLORA*
- *PPHYTN*
- *CH3CL*
- *CH4*
- *DMS*
- *N2*
- *CALCIUM*
- *ARGON*
- *14C-DOC*
- *13C-DOC*
- *D15N_NO3*
- *D15N_NO2+NO3*
- *D18O_NO2+NO3*
- *D18O_NO3*
- *UREA*
- *TOT_CHL_A*
- *TOT_CHL_B*
- *TOT_CHL_C*
- *ALPHA-BETA-CAR*
- *BUT-FUCO*
- *HEX-FUCO*
- *ALLO*
- *DIADINO*
- *DIATO*
- *HFUCO*
- *PERID*
- *ZEA*
- *MV_CHL_A*
- *DV_CHL_A*
- *CHLIDE_A*
- *MV_CHL_B*
- *DV_CHL_B*
- *CHL_C1C2*
- *CHL_C3*
- *LUT*
- *NEO*
- *VIOLA*
- *PHYTIN_A*
- *PHIDE_A*
- *PRAS*
- *GYRO*
- *BTL_DATE*
- *BTL_TIME*
- *BTL_LAT*
- *BTL_LON*
- *CTDNOBS*
- *CTDETIME*
- *INSTRUMENT_ID*
- *SAMPLING_RATE*
- *THETA*
- *AOU*
- *ARABI*
- *BACT*
- *SYN*
- *PEUK*
- *PROC*
- *BLACKC*
- *BRDU*
- *CH3BR*
- *CH3I*
- *DCNS*
- *DELO17*
- *FUCO*
- *GALA*
- *GLUC*
- *MAN*
- *RHAM*
- *LAB_DEN*
- *PIGMENTS*
- *SALTREF*
- *SF5CF3*
- *DWNPRS*
- *DWNOXY*
- *SIG0*
- *SOMSAL*
- *HPLC*
- *MICROGELS*
- *N2/ARGON*
- *N2/ARGON_UNSTRIPPED*
- *D15N_N2*

6.3.1 EXPOCODE

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
expocode	None	None	None

The expedition code, assigned by the CCHDO or generated by the user. Used as the unique identifier for the cruise. Usual generation formula is ICES 4 character platform code then the cruise departure date in YYYYMMDD format. The underscore _ character may also be present.

6.3.2 SECT_ID

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
section_id	None	None	None

If a repeat of a WOCE section, this is the WHP section identifier. Examples include: `A12`, `A13.5`, `P02`.

Note: There may be inconsistency in the how line numbers are represented. For example, `P02` might be present as `P2`, these represent the same SECT_ID. Two digit zero padded line numbers are the canonical representation, please inform the CCHDO if non zero padded line numbers are encountered.

6.3.3 STNNBR

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
station	None	None	None

The originator's station identifier. Allowed characters are U+0030 to U+0039, U+0041 to U+005A, U+0061 to U+007A, and U+005F (`0-9`, `a-z`, `A-Z`, and `_`)

Note: Numeric-only station identifiers are preferred by many data users, but provision for non numeric station identifiers is retained to maintain compatibility with WOCE records.

6.3.4 CASTNO

Units

- None

Data Type integer

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
cast	None	None	None

The originator's cast number.

Note: Where cast number is unknown a default value of 1 MAY be inserted by data processors.

6.3.5 BIOS_CASTID

Units

- None

Data Type integer

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bios_castid	None	None	None

BIOS cast number. Used by the Bermuda Institute of Ocean Sciences in the BATS and Hydrostation S timeseries.

6.3.6 SAMPNO

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
sample	None	None	None

The sample number. Often it is the rosette position, however, groups may use their own sampling identification scheme. Allowed characters are U+0030 to U+0039, U+0041 to U+005A, U+0061 to U+007A, and U+005F (0-9, a-z, A-Z, and _)

Warning: The value may not be numeric, ensure that any software reading the file can handle UTF-8 data of the specified allowed code points.

6.3.7 GEOTR_EVENT

Units

- None

Data Type integer

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
geotraces_event	None	None	None

The GEOTRACES Event number. Along with the GEOTRACES sample number, it is used by the GEOTRACES community for sample identification.

6.3.8 GEOTR_SAMPNO

Units

- None

Data Type integer

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
geotraces_sample	None	None	None

The GEOTRACES Sample number. Along with the GEOTRACES Event number, it is used by the GEOTRACES community for sample identification.

6.3.9 BIONBR

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bionbr	None	None	None

Sample identification number used by the Bedford Institute of Oceanography (BIO)

6.3.10 EVENT_NUMBER

Units

- None

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
event_number	None	None	None

Non program specific event number. Some cruises or programs keep track of sequential events that occur on a cruise or across multiple cruises of the same program. There exists program specific event number names of GEOTR_EVENT, BIONBR, and BIOS_CASTID that should be used if they are more appropriate.

6.3.11 BTLNBR

Units

- None

Data Type string

BTLNBR_FLAG_W Definitions *WOCE Bottle Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bottle_number	None	None	None

The bottle identification number. This is intended to be a permanent, unique serial number fixed to the sampling device. It may also be the an identifier fixed for the duration of a single expedition. Allowed characters are U+0030 to U+0039, U+0041 to U+005A, U+0061 to U+007A, and U+005F (`0-9`, `a-z`, `A-Z`, and `_`)

Note: The bottle number MAY have quality flags.

Warning: Despite the name, the value IS NOT numeric, ensure that any software reading the file can handle UTF-8 data of the specified allowed code points. The CF/netCDF files force the data type to be char, but for historic reasons, the variable name is maintained as bottle_number.

6.3.12 DATE

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
date	None	None	None

The UTC date in zero padded YYYYMMDD format. The date reported is usually cast bottom for Bottle files and cast start for CTD files. Valid range for YYYY: 0001-9999. Valid range for MM: 01-12. Valid range for DD: 01-31 (depends on month and year). The format of dates corresponds to the C-strftime format of `%Y%m%d`.

The date should be read as a string, but be able to be cast unambiguously to an integer. To convert from integer representation, left pad zeros to match the date format description. For example, the integer `8020202` is the date `08020202` or Feb 2nd, 802. This is a very unlikely situation.

6.3.13 TIME

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
time	None	None	None

The UTC time in zero padded hhmm format. A single time should be reported for each cast, usually the time at cast bottom (deepest) is used. The order of preference for the reported time is: cast bottom, cast start, cast end (i.e if cast bottom is not available, the cast start time should be used).

Valid range for hh: 00-24 Valid range for mm: 00-59 The format of times corresponds to the C-strftime format of `%H%M`.

The time should be read as a string, but be able to be cast unambiguously into an integer. To convert from an integer, left pad zeros to match the time format description.

Note: Times represented as integers will be present in whp COARDS netcdf files. Times in netcdf files will be anywhere from 1 to 4 digits. E.g. a time of 6 as in integer represents 6 minutes after midnight or 0006

Midnight is a special case in that it has two valid representations: `0000` and `2400`. The date `20140202` at time `0000` is the same instant as the date `20140201` at time `2400`. This corresponds to times allowed by ISO 8601.

Use *BTL_TIME* to report the time of individual bottle closures.

CF netCDF files will use the standard Time Coordinate as specified in the conventions

---

Warning: Time is not a required parameter! If time is not present, then the temporal resolution of the data is reduced to a 24 hour period. It is the responsibility of the user of the data to omit files/casts which do not meet their temporal resolution requirements.

6.3.14 LATITUDE

Units

- None

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
latitude	None	None	latitude

The latitude as a signed decimal number. By convention, is positive in the northern hemisphere and negative in the southern hemisphere. Positive values do not include a + character (U+002B), negative values are prefixed with a - character (U+002D).

Note: Only one latitude SHOULD be reported for a cast, typically this is the ship position when the cast is at the bottom (deepest), but this is not guaranteed.

Use *BTL_LAT* to include positions of individual bottle closures.

Warning: Since this parameter has no units, the positive in the northern hemisphere and negative in the southern hemisphere MUST be strictly adhered to.

The geographic coordinate system is not currently reported.

6.3.15 LONGITUDE

Units

- None

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
longitude	None	None	longitude

The longitude as a signed decimal number. By convention, is positive in the eastern hemisphere and negative in the western hemisphere. Positive values do not include a + character (U+002B), negative values are prefixed with a - character (U+002D).

Note: Only one longitude SHOULD be reported for a cast, typically this is the ship position when the cast is at the bottom (deepest), but this is not guaranteed.

Use *BTL_LON* to include positions of individual bottle closures.

The longitudes of -180 and 180 describe the same meridian.

Warning: Since this parameter has no units, the positive in the eastern hemisphere and negative in the western hemisphere convention MUST be strictly adhered to.

The geographic coordinate system is not currently reported.

6.3.16 DEPTH

Units

- METERS

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
btm_depth	METERS	meters	sea_floor_depth_below_sea_surface

The reported depth to the bottom. Corrected depths are preferred to uncorrected depths.

Note: Documentation should be provided describing how the depth was calculated/corrected, typically in the comment fields.

Warning: This is NOT the depth of bottle closures.

6.3.17 CTDPRS

Units

- DBAR

Data Type decimal

CTDPRS_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
pressure	DBAR	dbar	sea_water_pressure

The corrected pressure as measured by the CTD.

Note: Typically does not have quality flags.

6.3.18 CTDRAW

Units

- DBAR

Data Type decimal

CTDRAW_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_pressure_raw	DBAR	dbar	sea_water_pressure

The uncorrected pressure as measured by the CTD. Uncorrected means that no processing has been done (e.g. deck pressure offsets) other than manufacturer calibrations applied.

Note: Typically does not have quality flags.

6.3.19 CTDTMP

Units

- ITS-90
- IPTS-68
- DEG C

Data Type decimal

CTDTMP_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_temperature	ITS-90	degC	sea_water_temperature
ctd_temperature_68	IPTS-68	degC	sea_water_temperature
ctd_temperature_unk	DEG C	degC	sea_water_temperature

The corrected temperature as measured by the CTD.

Note: Typically does not have quality flags.

6.3.20 CTDSAL

Units

- PSS-78

Data Type decimal

CTDSAL_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_salinity	PSS-78	1	sea_water_practical_salinity

The corrected practical salinity as measured (calculated) by the CTD.

6.3.21 CTDSA

Units

- G/KG

Data Type decimal

CTDSA_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_absolute_salinity	G/KG	g/kg	sea_water_absolute_salinity

Absolute salinity calculated using TEOS-10

Warning: This is provided as a convienence, the TEOS-10 manual strongly recomends against including this in observational data.

6.3.22 CTDCT

Units

- ITS-90

Data Type decimal

CTDCT_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_conservative_temperature	ITS-90	degC	sea_water_conservative_temperature

Conservative temperature calcualted using TEOS-10

Warning: This is provided as a convienence, the TEOS-10 manual strongly recomends against including this in observational data.

6.3.23 SALNTY

Units

- PSS-78

Data Type decimal

SALNTY_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bottle_salinity	PSS-78	1	sea_water_practical_salinity

The practical salinity measured from a bottle sample.

6.3.24 DNSSAL

Units

- G/KG

Data Type decimal

DNSSAL_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
density_salinity	G/KG	g/kg	sea_water_absolute_salinity

Absolute salinity calculated from direct density measurements, also called absolute salinity.

6.3.25 CTDSVLSAL

Units

- G/KG

Data Type decimal

CTDSVLSAL_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_sound_velocity_salinity	G/KG	g/kg	sea_water_absolute_salinity

Absolute salinity calculated from sound velocity and temperature, also called absolute salinity.

6.3.26 CTDOXY

Units

- UMOL/KG
- ML/L
- UMOL/L

Data Type decimal

CTDOXY_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_oxygen	UMOL/KG	umol/kg	moles_of_oxygen_per_unit_mass_in_sea_water
ctd_oxygen_ml_l	ML/L	ml/l	volume_fraction_of_oxygen_in_sea_water
ctd_oxygen_umol_l	UMOL/L	umol l-1	mole_concentration_of_dissolved_molecular_oxygen_in_sea_water

The corrected oxygen measured by the CTD.

6.3.27 OXYGEN

Units

- UMOL/KG
- ML/L

Data Type decimal

OXYGEN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
oxygen	UMOL/KG	umol/kg	moles_of_oxygen_per_unit_mass_in_sea_water
oxygen_ml_l	ML/L	ml/l	volume_fraction_of_oxygen_in_sea_water

The dissolved oxygen measured in a discrete sample, typically using the Winkler test for dissolved oxygen.

6.3.28 SILCAT

Units

- UMOL/KG

Data Type decimal

SILCAT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label SILUNC

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
silicate	UMOL/KG	umol/kg	moles_of_silicate_per_unit_mass_in_sea_water

The concentration of dissolved silicate in sea water.

6.3.29 NH4

Units

- UMOL/KG

Data Type decimal

NH4_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ammonium	UMOL/KG	umol/kg	None

The concentration of dissolved ammonium in sea water.

6.3.30 NITRAT

Units

- UMOL/KG

Data Type decimal

NITRAT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label NRAUNC

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
nitrate	UMOL/KG	umol/kg	moles_of_nitrate_per_unit_mass_in_sea_water

The concentration of dissolved nitrate in sea water. The chemical formula for the nitrate anion is NO3-.

6.3.31 CTDNITRATE

Units

- UMOL/KG

Data Type decimal

CTDNITRATE_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_nitrate	UMOL/KG	umol/kg	moles_of_nitrate_per_unit_mass_in_sea_water

The concentration of dissolved nitrate in sea water measured by an in situ sensor. The chemical formula for the nitrate anion is NO3-.

6.3.32 NITRIT

Units

- UMOL/KG

Data Type decimal

NITRIT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label NRIUNC

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
nitrite	UMOL/KG	umol/kg	moles_of_nitrite_per_unit_mass_in_sea_water

The concentration of dissolved nitrite in sea water. The chemical formula for the nitrite anion is NO2-.

6.3.33 PHSPHT

Units

- UMOL/KG

Data Type decimal

PHSPHT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label PHPUNC

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
phosphate	UMOL/KG	umol/kg	moles_of_phosphate_per_unit_mass_in_sea_water

The concentration of dissolved phosphate in sea water. The chemical formula for the nitrite anion is NO2-.

6.3.34 NO2+NO3

Units

- UMOL/KG

Data Type decimal

NO2+NO3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
nitrite_nitrate	UMOL/KG	umol/kg	moles_of_nitrate_and_nitrite_per_unit_mass_in_sea_water

The concentration of dissolved nitrate plus nitrite in sea water. The chemical formula for the nitrite anion is NO2-.

Note: Most modern techniques for determining dissolved nitrate return a value of nitrate (NO3) plus nitrite (NO2). A separate determination is then done for nitrite and the result subtracted by the data originator to obtain nitrate. If no separate nitrite determination was carried out - or in rare cases the nitrite number was not subtracted - data providers should list the result as NO2+NO3. Because nitrite values are in most regions small compared to nitrate, most data users will not adversely affect their results by relabeling NO2+NO3 as NITRAT.

6.3.35 CFC-11

Units

- PMOL/KG

Data Type decimal

CFC-11_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label CF11ER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
cfc_11	PMOL/KG	pmol/kg	moles_of_cfc11_per_unit_mass_in_sea_water

The concentration of dissolved CFC11 in sea water. The chemical formula of CFC11 is CFCl3. The IUPAC name for CFC11 is trichloro(fluoro)methane.

6.3.36 CFC-12

Units

- PMOL/KG

Data Type decimal

CFC-12_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label CF12ER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
cfc_12	PMOL/KG	pmol/kg	None

The concentration of dissolved CFC12 in sea water. The chemical formula for CFC12 is CF2Cl2. The IUPAC name for CFC12 is dichloro(difluoro)methane.

6.3.37 CFC113

Units

- PMOL/KG

Data Type decimal

CFC113_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label CF113ER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
cfc_113	PMOL/KG	pmol/kg	None

The concentration of dissolved CFC113 in sea water. The chemical formula of CFC113 is CCl2FCClF2. The IUPAC name for CFC113 is 1,1,2-trichloro-1,2,2-trifluoroethane.

6.3.38 SF6

Units

- FMOL/KG

Data Type decimal

SF6_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
sulfur_hexifluoride	FMOL/KG	fmol/kg	None

The concentration of SF6 (Sulfur hexafluoride) in sea water.

6.3.39 TCARBN

Units

- UMOL/KG

Data Type decimal

TCARBN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
total_carbon	UMOL/KG	umol/kg	moles_of_dissolved_inorganic_carbon_per_unit_mass_in_sea_water

None

6.3.40 ALKALI

Units

- UMOL/KG

Data Type decimal

ALKALI_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
total_alkalinity	UMOL/KG	umol/kg	None

The total alkalinity equivalent concentration (including carbonate, nitrogen, silicate, and borate components).

6.3.41 FCO2

Units

- UATM

Data Type decimal

FCO2_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
fco2	UATM	uatm	fugacity_of_carbon_dioxide_in_sea_water

The fugacity is the measured pressure (or partial pressure) of a real gas corrected for the intermolecular forces of that gas, which allows that corrected quantity to be treated like the pressure of an ideal gas in the ideal gas equation PV = nRT. The partial pressure of a dissolved gas in sea water is the partial pressure in air with which it would be in equilibrium. The partial pressure of a gaseous constituent of air is the pressure that it would exert if all other gaseous constituents were removed, assuming the volume, the temperature, and its number of moles remain unchanged. The chemical formula for carbon dioxide is CO2.

6.3.42 FCO2IN

Units

- UATM

Data Type decimal

FCO2IN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
fco2_in_situ	UATM	uatm	fugacity_of_carbon_dioxide_in_sea_water

In situ fugacity of CO2 gas

Note: Usually calcualted

6.3.43 FCO2TMP

Units

- DEG C

Data Type decimal

FCO2TMP_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
fco2_temperature	DEG C	degC	temperature_of_analysis_of_sea_water

None

6.3.44 PCO2

Units

- UATM

Data Type decimal

PCO2_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
partial_pressure_of_co2	UATM	uatm	partial_pressure_of_carbon_dioxide_in_sea_water

The partial pressure of a dissolved gas in sea water is the partial pressure in air with which it would be in equilibrium. The partial pressure of a gaseous constituent of air is the pressure that it would exert if all other gaseous constituents were removed, assuming the volume, the temperature, and its number of moles remain unchanged. The chemical formula for carbon dioxide is CO2.

6.3.45 PCO2TMP

Units

- DEG C

Data Type decimal

PCO2TMP_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
partial_co2_temperature	DEG C	degC	temperature_of_analysis_of_sea_water

None

6.3.46 PH_TOT

Units

- None

Data Type decimal

PH_TOT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ph_total_h_scale	None	None	sea_water_ph_reported_on_total_scale

The measure of acidity of seawater, defined as the negative logarithm of the concentration of dissolved hydrogen ions plus bisulfate ions in a sea water medium; when measured the scale is defined according to a series of buffers prepared in artificial seawater containing bisulfate. The quantity may be written as pH(total) = -log([H+](free) + [HSO4-]).

6.3.47 PH_SWS

Units

- None

Data Type decimal

PH_SWS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ph_sws	None	None	None

None

6.3.48 PH_TMP

Units

- DEG C

Data Type decimal

PH_TMP_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ph_temperature	DEG C	degC	temperature_of_analysis_of_sea_water

None

6.3.49 DOC

Units

- UMOL/KG

Data Type decimal

DOC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dissolved_organic_carbon	UMOL/KG	umol/kg	None

Dissolved organic carbon

6.3.50 TRITUM

Units

- TU

Data Type decimal

TRITUM_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label TRITER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
tritium	TU	1e-18	None

None

Note: 1 TU is 1 tritium atom per 10^{18} hydrogen atoms

6.3.51 HELIUM

Units

- NMOL/KG

Data Type decimal

HELIUM_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label HELIER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
helium	NMOL/KG	nmol/kg	None

None

6.3.52 DELHE3

Units

- PERCNT

Data Type decimal

DELHE3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label DELHER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
delta_helium_3	PERCNT	percent	None

None

6.3.53 REFTMP

Units

- ITS-90
- DEG C

Data Type decimal

REFTMP_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ref_temperature	ITS-90	degC	sea_water_temperature
ref_temperature_c	DEG C	degC	sea_water_temperature

Sea water temperature as measured by a reference thermometer, such as an SBE35. These typically only measure when a bottle is triggered and are part of the discrete data stream rather than the CTD one.

6.3.54 REVPRS

Units

- DBAR

Data Type decimal

REVPRS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
rev_pressure	DBAR	dbar	sea_water_pressure

Sea water pressure as determined via a pair of reversing thermometers.

6.3.55 REVTMP

Units

- ITS-90
- IPTS-68
- DEG C

Data Type decimal

REVTMP_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
rev_temperature_90	ITS-90	degC	sea_water_temperature
rev_temperature	IPTS-68	degC	sea_water_temperature
rev_temperature_c	DEG C	degC	sea_water_temperature

Sea water temperature as determined via a reversing thermometer.

6.3.56 DELC13

Units

- /MILLE

Data Type decimal

DELC13_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label C13ERR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
del_carbon_13_dic	/MILLE	1e-3	None

Enrichment of ^{13}C vs ^{12}C in dissolved inorganic carbon (DIC or TCARBN) compared to a reference standard usually VPDB. This is usually written as lower case delta ^{13}C.

6.3.57 DELC14

Units

- /MILLE

Data Type decimal

DELC14_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label C14ERR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
del_carbon_14_dic	/MILLE	1e-3	None

Enrichment of ^{14}C vs ^{12}C in dissolved inorganic carbon (DIC or TCARBN) compared to a reference standard usually VPDB. This ratio has been corrected for isotopic fractionation and is usually written as upper case delta ^{14}C.

6.3.58 DON

Units

- UMOL/KG

Data Type decimal

DON_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dissolved_organic_nitrogen	UMOL/KG	umol/kg	None

Dissolved organic nitrogen in sea water. 'Dissolved organic nitrogen' describes the nitrogen held in carbon compounds in solution. These are mostly generated by plankton excretion and decay.

6.3.59 TOC

Units

- UMOL/KG

Data Type decimal

TOC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
total_organic_carbon	UMOL/KG	umol/kg	None

None

6.3.60 POC

Units

- UG/KG

Data Type decimal

POC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
particulate_organic_carbon	UG/KG	ug/kg	None

Particulate organic carbon

6.3.61 PON

Units

- UG/KG

Data Type decimal

PON_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
particulate_organic_nitrogen	UG/KG	ug/kg	None

Particulate organic nitrogen

6.3.62 TDN

Units

- UMOL/KG

Data Type decimal

TDN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
total_dissolved_nitrogen	UMOL/KG	umol/kg	None

None

6.3.63 TON

Units

- UMOL/KG

Data Type decimal

TON_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
total_organic_nitrogen	UMOL/KG	umol/kg	None

None

6.3.64 NEON

Units

- NMOL/KG

Data Type decimal

NEON_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label NEONER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
neon	NMOL/KG	nmol/kg	None

None

6.3.65 DELO18

Units

- /MILLE

Data Type decimal

DELO18_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label O18ERR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
del_oxygen_18	/MILLE	1e-3	None

Enrichment of the 18O/16O isotopic ratio of the sea water itself compared to VSMOW (Vienna Standard Mean Ocean Water).

6.3.66 CCL4

Units

- PMOL/KG

Data Type decimal

CCL4_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label CCL4ER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
carbon_tetrachloride	PMOL/KG	pmol/kg	None

Carbon tetrachloride

6.3.67 NI

Units

- UMOL/L

Data Type decimal

NI_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
nickel	UMOL/L	umol l-1	None

None

6.3.68 ALUMIN

Units

- NMOL/L

Data Type decimal

ALUMIN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dissolved_aluminum	NMOL/L	nmol/l	None

None

6.3.69 BARIUM

Units

- NMOL/KG

Data Type decimal

BARIUM_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
barium	NMOL/KG	nmol/kg	None

None

6.3.70 CU

Units

- UMOL/L

Data Type decimal

CU_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
copper	UMOL/L	umol l-1	None

None

6.3.71 FE

Units

- NMOL/L

Data Type decimal

FE_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
iron	NMOL/L	nmol/l	mole_concentration_of_dissolved_iron_in_sea_water

None

6.3.72 MN

Units

- NMOL/L

Data Type decimal

MN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
manganese	NMOL/L	nmol/l	None

None

6.3.73 CTDFLUOR

Units

- MG/M^3
- VOLTS
- None

Data Type decimal

CTDFLUOR_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_fluor	MG/M^3	mg/m^3	mass_concentration_of_chlorophyll_in_sea_water
ctd_fluor_raw	VOLTS	volts	None
ctd_fluor_arbitrary	None	None	None

None

6.3.74 PAR

Units

- UMOL/M^2/SEC
- VOLTS

Data Type decimal

PAR_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
par	UMOL/M^2/SEC	umol m-2 s-1	downwelling_photosynthetic_photon_flux_in_sea_water
par_raw	VOLTS	volts	None

Photosynthetically active radiation. The downwelling photon flux of photons with a wavelength between 400nm and 700nm.

6.3.75 I-129

Units

- BQ/M^3

Data Type decimal

I-129_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label I129ER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
iodine_129	BQ/M^3	Bq m-3	None

None

6.3.76 PLUTO

Units

- MBQ/M^3

Data Type decimal

PLUTO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label PLUTOER

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
plutonium	MBQ/M^3	mBq m-3	None

Plutonium decay rate from all isotopes

6.3.77 RA-226

Units

- DM/.1MG

Data Type decimal

RA-226_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label RA-226E

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
radium_226	DM/.1MG	0.000166 Bq/kg	None

None

Note: units are disintegrations per minute per 100kg

6.3.78 RA-228

Units

- DM/.1MG

Data Type decimal

RA-228_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
radium_228	DM/.1MG	0.000166 Bq/kg	None

None

Note: units are disintegrations per minute per 100kg

6.3.79 CTDXMISS

Units

- %TRANS
- VOLTS

Data Type decimal

CTDXMISS_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_transmissometer	%TRANS	1e-2	None
ctd_transmissometer_raw	VOLTS	volts	None

None

6.3.80 CTDBEAMCP

Units

- /METER

Data Type decimal

CTDBEAMCP_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_beamcp	1/METER	m^-1	volume_beam_attenuation_coefficient_of_radiative_flux_in_sea_water_correc

Radiative flux is the sum of shortwave and longwave radiative fluxes. In accordance with common usage in geophysical disciplines, "flux" implies per unit area, called "flux density" in physics. The volume scattering/absorption/attenuation coefficient is the fractional change of radiative flux per unit path length due to the stated process. Coefficients with canonical units of m2 s-1 i.e. multiplied by density have standard names with specific_ instead of volume_. The scattering/absorption/attenuation coefficient is assumed to be an integral over all wavelengths, unless a coordinate of radiation_wavelength is included to specify the wavelength. Attenuation is the sum of absorption and scattering. Attenuation is sometimes called "extinction". Beam attenuation refers to the decrease of radiative flux along the direction of the incident path. It is distinguished from attenuation of the downwelling component of radiative flux from any incident direction, also called "diffuse" attenuation. Corrected for pure water attendance means the attenuation coefficient has been adjusted/calibrated to remove the influence of absorption/scattering from the water itself.

6.3.81 CTDTURB

Units

- FTU
- NTU

Data Type decimal

CTDTURB_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_turbidity_ftu	FTU	1	None
ctd_turbidity_ntu	NTU	1	None

Turbidity describes the light scattered back (or passed though depending on units) depending on particle loading in the water. It is a dimensionless quantity.

6.3.82 AR-39

Units

- PCTMOD

Data Type decimal

AR-39_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
argon_39	PCTMOD	1e-2	None

None

Note: The units mean '% modern'

6.3.83 CS-137

Units

- DM/.1MG
- BQ/M^3

Data Type decimal

CS-137_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
cesium_137	DM/.1MG	0.000166 Bq/kg	None
cesium_137_bq	BQ/M^3	Bq m-3	None

None

Note: units are disintegrations per minute per 100kg

6.3.84 KR-85

Units

- DM/MG

Data Type decimal

KR-85_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
krypton_85	DM/MG	0.0000166 Bq/kg	None

None

Note: units are disintegrations per minute per 1000kg

6.3.85 SR-90

Units

- DM/.1MG

Data Type decimal

SR-90_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
strontium_90	DM/.1MG	0.000166 Bq/kg	None

None

Note: units are disintegrations per minute per 100kg

6.3.86 N2O

Units

- NMOL/KG

Data Type decimal

N2O_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
nitrous_oxide	NMOL/KG	nmol/kg	None

Nitrous oxide

6.3.87 RA-8/6

Units

- None

Data Type decimal

RA-8/6_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label RA-8/6E

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
radium_228_226	None	None	None

None

6.3.88 QUALT1

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
quality_word_one	None	None	None

Quality code 1, this is not used in exchange files. In WOCE SEA and CTD files it represents the quality code assigned by the investigator responsible for the measurement. The quality code from QUALT1 is used as the FLAG_W in exchange files if *QUALT2* is not available

6.3.89 QUALT2

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
quality_word_two	None	None	None

Quality code 2, this is not used in exchange files. In WOCE SEA and CTD files it represents the quality code assigned by an independent data quality evaluator (DQE). When available this is the code used in exchange file FLAG_W columns.

6.3.90 MCHFRM

Units

- PMOL/KG

Data Type decimal

MCHFRM_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
methyl_chloroform	PMOL/KG	pmol/kg	None

The concentration of dissolved methyl chloroform in sea water. The IUPAC name for methyl chloroform is 1,1,1-Trichloroethane.

6.3.91 IODATE

Units

- NMOL/KG

Data Type decimal

IODATE_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
iodate	NMOL/KG	nmol/kg	None

None

6.3.92 IODIDE

Units

- NMOL/KG

Data Type decimal

IODIDE_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
iodide	NMOL/KG	nmol/kg	None

None

6.3.93 CHLORA

Units

- UG/KG
- UG/L

Data Type decimal

CHLORA_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
chlorophyll_a_ug_kg	UG/KG	ug/kg	mass_fraction_of_chlorophyll_a_in_sea_water
chlorophyll_a	UG/L	ug/l	mass_concentration_of_chlorophyll_a_in_sea_water

chlorophyll-a. Chlorophylls are the green pigments found in most plants, algae and cyanobacteria; their presence is essential for photosynthesis to take place. There are several different forms of chlorophyll that occur naturally. All contain a chlorin ring (chemical formula C20H16N4) which gives the green pigment and a side chain whose structure varies. The naturally occurring forms of chlorophyll contain between 35 and 55 carbon atoms. Chlorophyll-a is the most commonly occurring form of natural chlorophyll. The chemical formula of chlorophyll-a is C55H72O5N4Mg.

6.3.94 PPHYTN

Units

- UG/KG
- UG/L

Data Type decimal

PPHYTN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
phaeophytin	UG/KG	ug/kg	None
phaeophytin_ug_l	UG/L	ug/l	None

Phaeophytin

6.3.95 CH3CL

Units

- PMOL/KG

Data Type decimal

CH3CL_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
methyl_chloride	PMOL/KG	pmol/kg	None

Concentration of Methyl Chloride

6.3.96 CH4

Units

- NMOL/KG

Data Type decimal

CH4_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
methane	NMOL/KG	nmol/kg	None

Methane

6.3.97 DMS

Units

- NMOL/L

Data Type decimal

DMS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dimethyl_sulfide	NMOL/L	nmol/l	None

The chemical formula for dimethyl sulfide is (CH3)2S. Dimethyl sulfide is sometimes referred to as DMS.

6.3.98 N2

Units

- UMOL/KG

Data Type decimal

N2_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label N2_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
nitrogen	UMOL/KG	umol/kg	None

Dissolved elemental nitrogen gas (N2) in sea water.

6.3.99 CALCIUM

Units

- MMOL/KG

Data Type decimal

CALCIUM_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
calcium	MMOL/KG	mmol kg-1	None

None

6.3.100 ARGON

Units

- UMOL/KG

Data Type decimal

ARGON_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
argon	UMOL/KG	umol/kg	None

None

6.3.101 14C-DOC

Units

- /MILLE

Data Type decimal

14C-DOC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label 14C-DOCERR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dissolved_organic_carbon_14	/MILLE	1e-3	None

Enrichment of ^{14}C vs ^{12}C in DOC compared to a reference standard usually VPDB. This ratio has been corrected for isotopic fractionation and is usually written as upper case delta ^{14}C.

6.3.102 13C-DOC

Units

- /MILLE

Data Type decimal

13C-DOC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label 13C-DOCERR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dissolved_organic_carbon_13	/MILLE	1e-3	None

Enrichment of ^{13}C vs ^{12}C in DOC compared to a reference standard usually VPDB. This is usually written as lower case delta ^{13}C.

6.3.103 D15N_NO3

Units

- /MILLE

Data Type decimal

D15N_NO3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label D15N_NO3_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
d15n_no3	/MILLE	1e-3	None

None

6.3.104 D15N_NO2+NO3

Units

- /MILLE

Data Type decimal

D15N_NO2+NO3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label D15N_NO2+NO3_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
d15n_nitrite_nitrate	/MILLE	1e-3	None

Ratio of 15N to 14N of nitrite+nitrate in the sample vs the ratio of 15N to 14N in a reference standard (VMSOW)

6.3.105 D18O_NO2+NO3

Units

- /MILLE

Data Type decimal

D18O_NO2+NO3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label D18O_NO2+NO3_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
d18o_nitrite_nitrate	/MILLE	1e-3	None

Ratio of 18O to 16O of nitrite+nitrate in the sample vs the ratio of 18O to 16O of a reference standard (VMSOW)

6.3.106 D18O_NO3

Units

- /MILLE

Data Type decimal

D18O_NO3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label D18O_NO3_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
d18o_nitrate	/MILLE	1e-3	None

Ratio of 18O to 16O of nitrate in the sample vs the ratio of 18O to 16O of a reference standard (VMSOW)

6.3.107 UREA

Units

- UMOL/KG

Data Type decimal

UREA_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
urea	UMOL/KG	umol/kg	None

Urea has the chemical formula $CO(NH_2)_2$

6.3.108 TOT_CHL_A

Units

- MG/M^3

Data Type decimal

TOT_CHL_A_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_tot_chl_a	MG/M^3	mg/m^3	mass_concentration_of_chlorophyll_a_in_sea_water

Total chlorophyll a measured using HPLC

SeaBass Description:HPLC DV_Chl_a + MV_Chl_a + Chlide_a + Chl_a_allom + Chl_a_prime

Note: A different measurement than *CHLORA*

6.3.109 TOT_CHL_B

Units

- MG/M^3

Data Type decimal

TOT_CHL_B_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_tot_chl_b	MG/M^3	mg/m^3	mass_concentration_of_chlorophyll_b_in_sea_water

HPLC DV_Chl_b + MV_Chl_b

6.3.110 TOT_CHL_C

Units

- MG/M^3

Data Type decimal

TOT_CHL_C_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_tot_chl_c	MG/M^3	mg/m^3	mass_concentration_of_chlorophyll_c_in_sea_water

HPLC chl_c1 + chl_c2 (chl_c1c2) + chl_c3

6.3.111 ALPHA-BETA-CAR

Units

- MG/M^3

Data Type decimal

ALPHA-BETA-CAR_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_alpha_beta_carotenes	MG/M^3	mg/m^3	mass_concentration_of_carotene_in_sea_water

HPLC Alpha (Beta,epsilon) + Beta (Beta,beta) Carotenes

6.3.112 BUT-FUCO

Units

- MG/M^3

Data Type decimal

BUT-FUCO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_19butanoyloxyfucoxanthin	MG/M^3	mg/m^3	mass_concentration_of_19_butanoyloxyfucoxanthin_in_sea_wat

HPLC 19'-Butanoyloxyfucoxanthin

6.3.113 HEX-FUCO

Units

- MG/M^3

Data Type decimal

HEX-FUCO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_19_hexanoyloxyfucoxanthin	MG/M^3	mg/m^3	mass_concentration_of_19_hexanoyloxyfucoxanthin_in_sea_wat

HPLC 19'-Hexanoyloxyfucoxanthin

6.3.114 ALLO

Units

- MG/M^3

Data Type decimal

ALLO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_alloxanthin	MG/M^3	mg/m^3	None

HPLC Alloxanthin

6.3.115 DIADINO

Units

- MG/M^3

Data Type decimal

DIADINO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_diadinoxanthin	MG/M^3	mg/m^3	mass_concentration_of_diadinoxanthin_in_sea_water

HPLC Diadinoxanthin

6.3.116 DIATO

Units

- MG/M^3

Data Type decimal

DIATO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_diatoxanthin	MG/M^3	mg/m^3	None

HPLC Diatoxanthin

6.3.117 HFUCO

Units

- MG/M^3

Data Type decimal

HFUCO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_fucoxanthin	MG/M^3	mg/m^3	mass_concentration_of_fucoxanthin_in_sea_water

HPLC Fucoxanthin

6.3.118 PERID

Units

- MG/M^3

Data Type decimal

PERID_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_peridinin	MG/M^3	mg/m^3	mass_concentration_of_peridinin_in_sea_water

HPLC Peridinin

6.3.119 ZEA

Units

- MG/M^3

Data Type decimal

ZEA_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_zeaxanthin	MG/M^3	mg/m^3	mass_concentration_of_zeaxanthin_in_sea_water

HPLC Zeaxanthin

6.3.120 MV_CHL_A

Units

- MG/M^3

Data Type decimal

MV_CHL_A_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_monovinyl_chlorophyll_a	MG/M^3	mg/m^3	mass_concentration_of_monovinyl_chlorophyll_a_in_sea_water

HPLC Monovinyl Chlorophyll a

6.3.121 DV_CHL_A

Units

- MG/M^3

Data Type decimal

DV_CHL_A_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_divinyl_chlorophyll_a	MG/M^3	mg/m^3	mass_concentration_of_divinyl_chlorophyll_a_in_sea_water

HPLC Divinyl Chlorophyll a

6.3.122 CHLIDE_A

Units

- MG/M^3

Data Type decimal

CHLIDE_A_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_chlorophyllide_a	MG/M^3	mg/m^3	mass_concentration_of_chlorophyllide_a_in_sea_water

HPLC Chlorophyllide a

6.3.123 MV_CHL_B

Units

- MG/M^3

Data Type decimal

MV_CHL_B_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_monovinyl_chlorophyll_b	MG/M^3	mg/m^3	None

HPLC Monovinyl Chlorophyll b

6.3.124 DV_CHL_B

Units

- MG/M^3

Data Type decimal

DV_CHL_B_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_divinyl_chlorophyll_b	MG/M^3	mg/m^3	None

HPLC Divinyl Chlorophyll B

6.3.125 CHL_C1C2

Units

- MG/M^3

Data Type decimal

CHL_C1C2_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_chlorophyll_c1_c2	MG/M^3	mg/m^3	mass_concentration_of_chlorophyll_c1_and_chlorophyll_c2_in_sea_

HPLC Chlorophyll c1 + c2

6.3.126 CHL_C3

Units

- MG/M^3

Data Type decimal

CHL_C3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_chlorophyll_c3	MG/M^3	mg/m^3	mass_concentration_of_chlorophyll_c3_in_sea_water

HPLC Chlorophyll c3

6.3.127 LUT

Units

- MG/M^3

Data Type decimal

LUT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_lutein	MG/M^3	mg/m^3	mass_concentration_of_lutein_in_sea_water

HPLC Lutein

6.3.128 NEO

Units

- MG/M^3

Data Type decimal

NEO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_neoxanthin	MG/M^3	mg/m^3	None

HPLC Neoxanthin

6.3.129 VIOLA

Units

- MG/M^3

Data Type decimal

VIOLA_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_violaxanthin	MG/M^3	mg/m^3	mass_concentration_of_violaxanthin_in_sea_water

HPLC Violaxanthin

6.3.130 PHYTIN_A

Units

- MG/M^3

Data Type decimal

PHYTIN_A_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_pheophytin_a	MG/M^3	mg/m^3	None

HPLC Pheophytin a

6.3.131 PHIDE_A

Units

- MG/M^3

Data Type decimal

PHIDE_A_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_pheophorbide_a	MG/M^3	mg/m^3	None

HPLC Pheophorbide a

6.3.132 PRAS

Units

- MG/M^3

Data Type decimal

PRAS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_prasinoxanthin	MG/M^3	mg/m^3	mass_concentration_of_prasinoxanthin_in_sea_water

HPLC Prasinoxanthin

6.3.133 GYRO

Units

- MG/M^3

Data Type decimal

GYRO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_gyroxanthin_diester	MG/M^3	mg/m^3	None

HPLC Gyroxanthin-Diester

6.3.134 BTL_DATE

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bottle_date	None	None	None

Date of an individual bottle closure in the same format as *DATE*, for the canonical reported station date, use *DATE*

6.3.135 BTL_TIME

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bottle_time	None	None	None

Time of an individual bottle closure in the same format as *TIME*, for the canonical reported station time, use *TIME*

6.3.136 BTL_LAT

Units

- None

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bottle_latitude	None	None	latitude

Latitude (ship position) of an individual bottle closure in the same format as *LATITUDE*, for the canonical reported station latitude, use *LATITUDE*

6.3.137 BTL_LON

Units

- None

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bottle_longitude	None	None	longitude

Longitude (ship position) of an individual bottle closure in the same format as *LONGITUDE*, for the canonical reported station longitude, use *LONGITUDE*

6.3.138 CTDNOBS

Units

- None

Data Type integer

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_number_of_observations	None	None	number_of_observations

The number of discrete observations from which the values of another data variable have been derived

6.3.139 CTDETIME

Units

- SECONDS

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_elapsed_time	SECONDS	seconds	None

The elapsed time of CTD pressure bin

6.3.140 INSTRUMENT_ID

Units

- None

Data Type string

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
instrument_id	None	None	None

The serial number of the CTD. In the case of SBE9plus, this is the serial number of the main housing, not the sensors.

6.3.141 SAMPLING_RATE

Units

- HZ

Data Type decimal

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
ctd_sampling_rate	HZ	1/s	None

The sampling rate of the CTD

6.3.142 THETA

Units

- DEG C
- ITS-90
- IPTS-68

Data Type decimal

THETA_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
potential_temperature_c	DEG C	degC	sea_water_potential_temperature
potential_temperature	ITS-90	degC	sea_water_potential_temperature
potential_temperature_68	IPTS-68	degC	sea_water_potential_temperature

Sea water potential temperature is the temperature a parcel of sea water would have if moved adiabatically to sea level pressure.

Note: Typically does not have quality flags.

6.3.143 AOU

Units

- UMOL/KG

Data Type decimal

AOU_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
apparent_oxygen_utilization	UMOL/KG	umol/kg	apparent_oxygen_utilization

Apparent Oxygen Utilization (AOU) is the difference between measured dissolved oxygen concentration in water, and the equilibrium saturation concentration of dissolved oxygen in water with the same physical and chemical properties.

6.3.144 ARABI

Units

- NMOL/KG

Data Type decimal

ARABI_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
arabinose	NMOL/KG	nmol/kg	None

Concentration of Arabanose after hydrolysis

6.3.145 BACT

Units

- E8/L

Data Type decimal

BACT_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
bacterial_cell_count	E8/L	1e8 l-1	None

Cell count of non pigmented heterotrophic bacterioplankton through FCM

6.3.146 SYN

Units

- E6/L

Data Type decimal

SYN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
synechococcus_cell_count	E6/L	1e6 l-1	None

Synechococcus Cell Count

6.3.147 PEUK

Units

- E6/L

Data Type decimal

PEUK_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
picoeukaryote_cell_counts	E6/L	1e6 l-1	None

Pigmented Picoeukaryotes cell count

6.3.148 PROC

Units

- E7/L

Data Type decimal

PROC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
prochlorophyte_cell_count	E7/L	1e7 l-1	None

Prochlorophyte Cell Count

6.3.149 BLACKC

Units

- UMOL/L

Data Type decimal

BLACKC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
black_carbon	UMOL/L	umol l-1	None

Black carbon (e.g. soot) concentration

6.3.150 BRDU

Units

- UMOL/L/H

Data Type decimal

BRDU_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
brdu_uptake	UMOL/L/H	umol l-1 h-1	None

Bacterial Production via BrdU (Bromodeoxyuridine) uptake Method

6.3.151 CH3BR

Units

- PMOL/KG

Data Type decimal

CH3BR_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
methyl_bromide	PMOL/KG	pmol/kg	None

Concentration of Methyl Bromide

6.3.152 CH3I

Units

- PMOL/KG

Data Type decimal

CH3I_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
methyl_iodide	PMOL/KG	pmol/kg	None

Concentration of Methyl Iodide

6.3.153 DCNS

Units

- NMOL/KG

Data Type decimal

DCNS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
dcns	NMOL/KG	nmol/kg	None

Dissolved Combined Neutral Sugars

6.3.154 DELO17

Units

- /MILLE

Data Type decimal

DELO17_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
del_oxygen_17	/MILLE	1e-3	None

Enrichment of the 17O/16O isotopic ratio of the sea water itself compared to VSMOW (Vienna Standard Mean Ocean Water).

6.3.155 FUCO

Units

- NMOL/KG

Data Type decimal

FUCO_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
fucose	NMOL/KG	nmol/kg	None

Concentration of Fucose after hydrolyses

6.3.156 GALA

Units

- NMOL/KG

Data Type decimal

GALA_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
galactose	NMOL/KG	nmol/kg	None

Concentration of Galactose after hydrolysis

6.3.157 GLUC

Units

- NMOL/KG

Data Type decimal

GLUC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
glucose	NMOL/KG	nmol/kg	None

Concentration of Glucose after hydrolysis

6.3.158 MAN

Units

- NMOL/KG

Data Type decimal

MAN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
mannose	NMOL/KG	nmol/kg	None

Concentration of Mannose after hydrolysis

6.3.159 RHAM

Units

- NMOL/KG

Data Type decimal

RHAM_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
rhamnose	NMOL/KG	nmol/kg	None

Concetration of Rhamnose after hydrolysis

6.3.160 LAB_DEN

Units

- KG/M^3

Data Type decimal

LAB_DEN_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
density	KG/M^3	kg m-3	None

Density measured in a lab, not calcualted from temperature, salinity, and pressure

6.3.161 PIGMENTS

Units

- None

Data Type decimal

PIGMENTS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
pigments	None	None	None

Phytoplankton pigments

Note: This is almost always a placeholder for samples collected for HPLC analysis later, the results of which are published at NASA SeaBASS

6.3.162 SALTREF

Units

- G/KG

Data Type decimal

SALTREF_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
reference_salinity	G/KG	g/kg	sea_water_reference_salinity

Salinity reported on the Reference-Composition Salinity Scale, reported in units of "absolute salinity" (g/kg). If a sea water sample has the Reference Composition (defined in Millero et al., 2008), then its Reference Salinity is the best available estimate of its Absolute Salinity. For general purposes, Reference Salinity is (35.16504 g kg-1)/35 times Practical Salinity. Reference: www.teos-10.org; Millero et al., 2008 doi: 10.1016/j.dsr.2007.10.001.

Note: See "The composition of Standard Seawater and the definition of the Reference-Composition Salinity Scale" by Millero et. al (2007) 10.1016/j.dsr.2007.10.001

6.3.163 SF5CF3

Units

- FMOL/KG

Data Type decimal

SF5CF3_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
trifluoromethylsulfur_pentafluoride	FMOL/KG	fmol/kg	None

Concentration of Trifluoromethyl Sulfur Pentafluoride

6.3.164 DWNPRS

Units

- DBAR

Data Type decimal

DWNPRS_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
downcast_pressure	DBAR	dbar	sea_water_pressure

Pressure on the downcast for the same isopycnal as the upcast

6.3.165 DWNOXY

Units

- UMOL/KG

Data Type decimal

DWNOXY_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
downcast_oxygen	UMOL/KG	umol/kg	moles_of_oxygen_per_unit_mass_in_sea_water

CTD Oxygen on the downcast for the same isopycnal as the upcast

6.3.166 SIG0

Units

- KG/M^3

Data Type decimal

SIG0_FLAG_W Definitions *WOCE CTD Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
sigma0	KG/M^3	kg m-3	sea_water_sigma_theta

Potential density anomaly referenced to 0 dbar (ocean surface)

6.3.167 SOMSAL

Units

- PSS-78

Data Type decimal

SOMSAL_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
somma_salinity	PSS-78	1	sea_water_practical_salinity

Salinity measured by a Single-Operator Multiparameter Metabolic Analyzer (SOMMA), used in sea water CO2 analysis

6.3.168 HPLC

Units

- None

Data Type string

HPLC_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
hplc_placeholder	None	None	None

High-performance liquid chromatography

Note: This is a placeholder parameter which indicates water collected from a bottle for analysis

Warning: These data do not get submitted to CCHDO, most are sent to NASA SeaBASS

6.3.169 MICROGELS

Units

- 1E6 GELS/L

Data Type decimal

MICROGELS_FLAG_W Definitions *WOCE Water Sample Quality Codes*

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
microgel_abundance	1E6 GELS/L	1e6 l-1	None

Count of microgels per liter (abundance). Microgels are small organic particles formed by self-assembly and ionic bridging between organic macromolecules.

6.3.170 N2/ARGON

Units

- None

Data Type decimal

N2/ARGON_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label N2/ARGON_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
n2_argon_ratio	None	None	None

Ratio of dissolved elemental nitrogen to dissolved argon

6.3.171 N2/ARGON_UNSTRIPPED

Units

- None

Data Type decimal

N2/ARGON_UNSTRIPPED_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label N2/ARGON_UNSTRIPPED_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
n2_argon_ratio_unstripped	None	None	None

Ratio of dissolved elemental nitrogen to dissolved argon that has not been stripped of dissolved oxygen

Note: This is still fundamentally an N2/ARGON measurement and is a variation on an analytical technique. If following the corrections described in Charoenpong et al 2014 (DOI: 10.4319/lom.2014.12.323) then this should be comparable with any other N2/ARGON measurement but have a slightly larger uncertainty.

6.3.172 D15N_N2

Units

- /MILLE

Data Type decimal

D15N_N2_FLAG_W Definitions *WOCE Water Sample Quality Codes*

Error Column Label D15N_N2_ERROR

CF/netCDF Attributes

nc_var name	whp_unit	units	standard_name
d15n_n2	/MILLE	1e-3	None

Enrichment of the 15N/14N isotopic ratio of dissolved elemental nitrogen. The usual reference material is the atmosphere of Earth (AIR).

CHAPTER

SEVEN

CHANGELOG

7.1 2022-03-22

Update CCHDO params list to 0.1.17

7.2 2022-01-25

This is a list of all the relevant changes which have occurred since the last time this log was edited, it was shamefully neglected by the lead author.

7.2.1 Major Changes

- Added parameter scope as a property, parameters must now have a scope of "cruise", "profile", or "sample". Cruise scoped parameters must be constant for an entire cruise (currently no parameters have this property, including Expocode) Profile scoped parameters must be constant for an entire profile (e.g. date, time, lat, lon, etc..). Sample scoped parameters may vary within a profile, these are normal data. Parameters appearing in CTD headers are now required to have a "profile" scope. This removes the ability for undocumented "user" headers to appear in the CTD headers section. Use comments instead for these extra bits of information.
- Removed "ARBITRARY" as a valid unit for any parameter. This was originally added to deal with some turbidity parameters which had "arbitrary" units, this was later discovered to be FNU/NTU which, while "arbitrary", are very specific. Additionally "ARBITRARY" was starting to be used erroneously for parameters which are unitless (e.g. counts and ratios). Going forward, specific parameters, if any, will be documented as ARBITRARY on a case by case basis in the parameters database.
- The parameters database was spun off into a separate project (parameter updates are documented elsewhere now)

7.2.2 Minor Changes

- Added digit characters to allowed list of chars in STNNBR, SAMPNO, and BTLNBR.
- Added GEOTR_EVENT and GEOTR_SAMPNO parameter names
- A bunch of technical changes to how the params list page is generated.
- Misc spelling corrections
- Added CTDXMISSCP as a name
- Prefixed most ctd parameters with CTD
- Removed BTLNBR as part of the sample identifying composite key to align with WOCE documentation

- Added BIOS_CASTID definition
- Linked a parameters uncertainty name to the parameter itself (e.g. DELC14 and C14ERR)
- Added a bunch of CF standard names
- Added some WHP Parameter ID numbers, these are the numbers seen in sumfiles.
- Added a "reference_scale" attribute to temperature and practical salinity parameters.
- Started on a table to display the various options/known units for each parameter.

7.3 2016-01-08 (1.2)

- Add section on missing values (-999). This was a major omission from the 1.0 release.

7.4 2016-01-06 (1.1)

- Add an `ARBITRARY` unit that any parameter MAY use.

7.5 2015-11-16 (1.0.1)

- Added Parameters
  - XMISS [0-5VDC]
  - FLUOR [0-5VDC]
  - CTDNOBS
  - CTDETIME [SECONDS]

7.6 2015-10-29

- Organized the text encoding requirements better.
- Added note about requirement levels following RFC 2119.

7.7 2015-04-27

- Define the structure of a `_ct1.zip` archive.

7.8 2015-01-21

- Parameters no longer will have a print format, now will just have a data type

7.9 2014-08-18

- Less restrictive parameter names and units.
- Specify how numerical data should appear.
- CCHDO now keeps numerical precision of data found in files

7.10 2014-07-24

- Require parameter names in an exchange file to be unique.

7.11 2014-07-16

- Changed stated file encoding to UTF-8 rather than ASCII. Some of the WHP-exchange bottle files have non-ASCII in the citations.

INDEX

R