ANT XXIV/3

Data Report: CFC and noble gas measurements

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RV Polarstern, ANT XXIV/3
Cape Town – Prime Meridian, Weddell Sea – Punta Arenas
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Datafile (ascii):

ANT-XXI4/3
2008-02-08-to-2008-04-16
Station
Cast
Bottle number
Bottle depth
Latitude
Longitude
CFC-11 [pmol/kg]
CFC-11-Flag
CFC-12 [pmol/kg]
CFC-12-Flag

The tracer data set was carefully checked for accurate measurements and outliers. According to the WOCE standards the following flags were applied to each measurement:

flag 2 = good
flag 3 = doubtful
flag 4 = bad
flag 6 = mean of replicates
flag 9 = no measurement (then, the data value is set to -9.000)

Methods

During the cruise a total of 1620 samples on 97 CTD/water bottle stations were collected for chlorofluorocarbons (CFC-11 and CFC-12); 32 stations were occupied along the Greenwich Meridian section, 37 stations along the Weddell Sea section, and 28 stations across the Drake Passage. The water samples from the CTD/rosette system were collected into 100 ml glass ampoules and sealed off after a CFC free headspace of pure nitrogen had been applied. The CFC samples will be analysed in the CFC-laboratory at the IUP in Bremen. The determination of CFC concentration will be accomplished by purge and trap sample pre-treatment followed by gas chromatographic (GC) separation on a capillary column and electron capture detection (ECD). The amount of CFC degassing into the headspace will be accounted for during the measurement procedure in the lab. The system will be calibrated by analyzing several different volumes of a known standard gas. Additionally the blank of the system is analyzed regularly.

Chlorofluorocarbons (CFC-11, CFC-12)

The Chlorofluorocarbon (CFC-11 and CFC-12) water samples from the CTD-bottle-system are stored in glass ampoules without contact to the atmosphere during the tapping. Immediately after sampling the ampoules are flame sealed after a CFC free headspace of pure nitrogen had been applied.

The loss of CFCs into the headspace is considered by a careful equilibration between liquid and gas phase under controlled conditions before the sealed ampoules are opened and a precise measurement of the volume of the headspace. The determination of CFC concentrations in the IUP Bremen gas chromatography lab is accomplished by purge and trap sample pre-treatment followed by gas chromatographic (GC) separation on a capillary column and electron capture detection (ECD). The system is calibrated by analyzing several different volumes of a known standard gas. CFC concentrations are calibrated on SIO98 scale (Prinn et al., 2000). A more detailed description of the measurement system is given by Bulsiewicz et at. (1998).

Bulsiewicz, K., H. Rose, O. Klatt, A. Putzka, W. Roether (1998). A capillary-column chromatographic system for efficient chlorofluoromethane measurement in ocean waters. Journal of Geophysical Research, Vol. 103 (C8), 15959-15970, DOI: 10.1029/98JC00140.

Prinn, R. G., R. F. Weiss, P. J. Fraser, P. G. Simmonds, D. M. Cunnold, F. N. Alyea, S. O'Doherty, P. Salameh, B. R. Miller, J. Huang, R. H. J. Wang, D. E. Hartley, C. Harth, L. P. Steele, G. Sturrock, P. M. Midgley, A. McCulloch (2000). A history of chemically and radiatively important gases in air deduced from ALE/GAGE/AGAGE. Journal of Geophysical Research, Vol. 105, 17.751-17.792, DOI: 10.1029/2000JD900141.

Accuracy (i.e. uncertainties of calibrated sample volume, calibration curve, extraction efficiency, standard and working gas, water blank, etc.):

CFC-12 < 1.8 %
CFC-11 < 2.8 %

Precision (i.e. mean error from 19 replicate samples):

CFC-12 < 0.007 pmol/kg or < 0.9% (which ever is greater) (n=6)

We do not give a value for the precision of CFC-11. Offline sample chromatograms regularly show a negative peak in the vicinity of the CFC-11 peak, which decreases the accuracy of CFC-11 in comparison to CFC-12, and which does not allow giving an objective estimate of a precision for CFC-11.

CFC-11 data between stations 140 and 193 (south of 61°S on the Prime Meridian and east of 28°W on the Weddell Sea section) are not reliable due to a possible hidden peak below the CFC-11 peak and possible problems with the measurement unit during that time (K. Bulsiewicz, personal communication, 2010). We flag these CFC-11 data generally as doubtful (3).

Acknowledgment

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