

**Sea Surface fCO₂ measurements in the Tropical-Equatorial Pacific Ocean
obtained during the French JGOFS-FLUPAC cruise
on board L'Atalante, 26/09-30/10/94
(Chief Scientist, R. Le Borgne IRD/FRANCE)**

Prepared by N.Metzl

**Laboratoire de Biogéochimie et Chimie Marines (LBCM), UMR 7094
Institut Pierre Simon Laplace
Université P. et M. Curie - Case 134
4, place Jussieu - 75252 PARIS Cedex 5 - FRANCE
<http://www.lbcm.jussieu.fr/>**

Method

The sea surface fugacity of CO₂ (fCO₂) was measured onboard the research vessel L'Atalante (IFREMER) during the JGOFS/EPOPE/FLUPAC cruise by C.Brunet, A.Poisson and B.Schauer (LBCM, Paris). The fCO₂ measurements technique has been described in details in the cruise report (LeBorgne et al, 1996) and for other cruises conducted during years 1990-1995 in the Indian and Southern Ocean (Poisson *et al.*, 1993; Metzl *et al.* 1995, 1998, 1999). This instrumentation was also used by our group during the international at-sea intercomparison of fCO₂ systems conducted in 1996 in the North-Atlantic (Kortzinger *et al.*, 2000).

In short, sea surface water is continuously equilibrated using a "thin film" type equilibrator thermostated with surface seawater. The CO₂ in the dried gas is measured with a non-dispersive infrared analyser (NDIR, Siemens Ultramat 5F). Standard gases for calibration (280, 350, 490 ppm) and atmospheric CO₂ are measured every 7 hours. To correct measurements to in situ data, we used polynomials given by Weiss and Price (1980) for vapour pressure and by Copin-Montégut (1988, 1989) for temperature. On average, the temperature in the thermostated equilibrium cell was 0.2°C warmer than SST during FLUPAC cruise. Based on different cruises analysis, the oceanic fCO₂ data are accurate to about $\pm 0.7 \mu\text{atm}$. All parameters presented in this data-set correspond to the average of about 60 records obtained during 10 minutes.

The fCO₂ data obtained during FLUPAC cruise have been presented by Metzl et al. (1995, 1996) and Poisson et al. (1996), and have been included in synthesis studies of air-sea CO₂ fluxes at regional scale in the equatorial Pacific (Boutin et al., 1999; Feely et al., 2002), for

constructing global scale pCO₂ climatologies (Takahashi et al., 2002) and for comparing and/or validating global carbon ocean models (e.g. LeQuéré et al., 2000).

File description

The file **FLUCO2W.xls** contains all the results of sea surface fCO₂ measurements (and associated properties) made onboard during the cruise EPOPE/FLUPAC. The columns of the file include: Date (dd/mm/yy), time (hh:mm), Latitude (degre.degre), Longitude (degree.degree), atmospheric pressure (mb), sea surface water fCO₂ fugacity (µatm), temperature in the equilibrium cell (°C), sea surface temperature (°C), and sea surface salinity (PSU). The first date, first line of the data set, is 26/09/94 at 01:46.

This file is a companion file of the OLICO2W.xls which contains the measurements obtained during the french JGOFS EPOPE/OLIPAC cruise conducted after FLUPAC in November 1994 onboard L'Atalante.

For more information or if you have questions concerning these data, please contact N.Metzl (metzl@ccr.jussieu.fr)

References:

- Boutin J., J. Etcheto, Y. Dandonneau, D.C.E. Bakker, R.A. Feely, H.Y. Inoue, M. Ishii, R.D. Ling, P.D. Nightingale, N. Metzl and R. Wanninkhof, 1999. Satellite Sea Surface Temperature: A useful tool for interpreting in situ pCO₂ measurements in the equatorial Pacific Ocean, *Tellus*, 51B, 490-508.
- Copin-Montégut, C., 1988. A new formula for the effect of temperature on the partial pressure of CO₂ in seawater. *Mar. Chem.*, 25, 29-37.
- Copin-Montégut, C., 1989. A new formula for the effect of temperature on the partial pressure of CO₂ in seawater. Corrigendum. *Mar. Chem.*, 27, 143-144.
- Feely, R. J.Boutin, C.Cosca, Y.Dandonneau, J.Etcheto, H.Inoue, M. Ishii, C. LeQuere, D. Mackey, M. McPhaden, N.Metzl, A. Poisson and R.Wanninkhof, 2002. Seasonal and Interannual Variability of CO₂ in the Equatorial Pacific. *Deep Sea Res.* Vol 49, N 13-14, 2443-2469
- Kortzinger, A., L. Mintrop, D.W.R. Wallace, K.M. Johnson, C. Neill, B. Tilbrook, P. Towler, H.Y. Inoue, M. Ishii, G. Shaffer, R.F. Torres Saavedra, E. Ohtaki, E. Yamashita, A. Poisson, C. Brunet, B. Schauer, C. Goyet, G. Eiseid, The international at-sea intercomparison of fCO₂ systems during the R/V Meteor Cruise 36/1 in the North Atlantic Ocean, *Marine Chemistry*, 2(2-4), 171-192., 2000.
- LeBorgne, R., Brunet, C., Eldin, G., Radenac, M.-H., Rodier, M., 1995. In: Campagne océanographique FLUPAC. Recueil de données, Tome 1. Archives Sciences de la Mer, Océanographie, N_1, ORSTOM, 337 pp.
- Le Quéré C., J. C. Orr, P. Monfray, O. Aumont and G. Madec, Interannual variability of the oceanic sink of CO₂ from 1979 through 1997, *Global Biogeochemical Cycles*, 14(4), 1247-1265, 2000.
- Metzl, N., A.Poisson, F. Louanchi, C. Brunet, B. Schauer, 1995. Spatio-temporal distributions of air-sea fluxes of CO₂ in the Indian and Antarctic Oceans: a first step. *Tellus*, 47B, 56-69.
- Metzl, N., A. Poisson, C. Larose, C. Brunet, B. Schauer and B. Brès, 1995. Air-Sea CO₂ gradients in the Western and Central Tropical Pacific during the October-November 1994 FLUPAC/OLIPAC cruises. *JGOFS First International Science Symposium*, Villefranche/mer, FRANCE, 9-12 Mai, 1995.
- Metzl, N., F.Louanchi et A.Poisson, 1996. Variations Interannuelles du CO₂ océanique. in *Atelier JGOFS-Modélisation/PNEDC-CO₂, Paris, Juin 1996. Rapport JGOFS-France N° 24* (ed. by N.Metzl), pp 87-93.
- Metzl, N., F.Louanchi and A.Poisson, 1998. Seasonal and interannual variations of sea surface carbon dioxide in the subtropical Indian Ocean. *Marine Chem.*, 60, 131-146.

- Metzl, N., B.Tilbrook, A.Poisson, 1999. The annual $f\text{CO}_2$ cycle and the air-sea CO_2 fluxes in the sub-Antarctic Ocean *Tellus*, 51B, 4, 849-861.
- Poisson, A., N. Metzl, C. Brunet, B. Schauer, B. Brès, D. Ruiz-Pino and F. Louanchi, 1993. Variability of sources and sinks of CO_2 and in the Western Indian and Southern Oceans during the year 1991. *J. Geophys. Res.*, 98, C12, 22759-22778.
- Poisson, A., N.Metzl, C. Larose, C. Brunet, B. Schauer and B. Brès, 1995. DpCO_2 in the Central and Western Equatorial Pacific during September-Novembre 1994. *NATO Adv. Res. Workshop on "Carbon Cycle of the Equatorial Pacific"*, Nouméa, 19-23 Juin 1995.
- Takahashi, T., S C. Sutherland, C. Sweeney, A.Poisson, N.Metzl, B.Tilbrook, N.Bates, R.Wanninkhof, R.A. Feely, C.Sabine and J.Olafsson and Y. Nojiri, 2002. Global Sea-Air CO_2 Flux Based on Climatological Surface Ocean pCO_2 , and Seasonal Biological and Temperature Effect. *Deep Sea Res. II*, Vol 49, N 9-10, 1601-1622.
- Weiss, R.F. and B.A. Price, 1980. Nitrous oxide solubility in water and seawater. *Marine Chem.*, 8, 347-359.