



University of California, San Diego  
Marine Physical Laboratory, 0902  
9500 Gilman Drive  
La Jolla, CA 92093-0902

# Certificate of Analysis

## Reference material for oceanic CO<sub>2</sub> measurements

Batch #2 (Bottled on October 1, 1990)

This reference material consists of natural sea water sterilized by a combination of filtration, ultra-violet radiation and addition of mercuric chloride.

### Analysis Results

The various procedures used for these analyses are detailed overleaf.

Salinity	33.363	
Total dissolved inorganic carbon		$1978.70 \pm 0.90 \mu\text{mol}\cdot\text{kg}^{-1}$ (9)
Total alkalinity *		$2248.27 \pm 0.94 \mu\text{mol}\cdot\text{kg}^{-1}$ (10)
Phosphate	0.38	$\mu\text{mol}\cdot\text{kg}^{-1}$
Silicate	2.36	$\mu\text{mol}\cdot\text{kg}^{-1}$
Nitrite	0.01	$\mu\text{mol}\cdot\text{kg}^{-1}$
Nitrate	0.11	$\mu\text{mol}\cdot\text{kg}^{-1}$

The cited uncertainties represent the standard deviation. Figures in parentheses are the number of analyses made. The nutrient levels may change on storage, their stability has not been examined; CO<sub>2</sub> analyses were performed over a period of time to confirm that the batch is stable.

The 95% confidence limits for the mean of these certified analyses are thus:

Total dissolved inorganic carbon	$1978.70 \pm 0.69 \mu\text{mol}\cdot\text{kg}^{-1}$
Total alkalinity *	$2248.27 \pm 0.67 \mu\text{mol}\cdot\text{kg}^{-1}$

STORAGE: The bottles should be stored out of direct sunlight, and preferably at or below room temperature (25 °C). They should not be allowed to freeze!

Andrew G. Dickson

\* Total alkalinity was not measured when the batch was originally certified; the total alkalinity value is based on measurements performed on archived samples of the batch.

## **Analytical Methods Used**

### *Salinity*

The salinity was determined by measuring its conductivity relative to IAPSO Standard Sea Water using a Guildline Model 8410 Portasal<sup>®</sup> conductive salinometer. The procedure is described in an in-house technical manual of the Marine Life Research Group, Scripps Institution of Oceanography, entitled, "Portasal Instructions for Guildline Portasal Model 8410".

### *Total dissolved inorganic carbon*

The total dissolved inorganic carbon was assayed in Dr. C. D. Keeling's laboratory at the Scripps Institution of Oceanography by the vacuum extraction/ manometric procedure. The weighed sample is acidified with phosphoric acid; the CO<sub>2</sub> evolved is then extracted under vacuum and condensed in a trap cooled by liquid nitrogen. The water and CO<sub>2</sub> are separated from one another by sublimation and the CO<sub>2</sub> is transferred into a mercury column manometer. There its pressure, volume and temperature are measured and the amount of CO<sub>2</sub> separated is computed from the virial equation of state.

### *Alkalinity*

The total alkalinity was assayed by a two-stage, potentiometric, open-cell titration using coulometrically analyzed hydrochloric acid. A weighed sample of reference material is acidified to a pH between 3.5 and 4.0 with an aliquot of titrant. The solution is stirred for a period of time to allow the evolved CO<sub>2</sub> to escape. The titration is then continued to a pH of about 3.0 and the equivalence point evaluated from titration points in the pH region 3.0–3.5 using a modified Gran procedure that corrects for the reactions with sulfate and fluoride ions.

### *Nutrients*

Nutrient levels were determined by standard manual colorimetric techniques. The procedures are similar to those described in Parsons T. R., Y. Maita & C. M. Lalli (1984) *A manual of chemical and biological methods for seawater analysis*, Pergamon Press, Oxford, 173 pp.