



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 #35 (Bottled on August 6, 1996)

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	35.661	
Total dissolved inorganic carbon	2111.62 ± 0.82 μmol·kg <sup>-1</sup>	(11)
Total alkalinity	2354.05 ± 0.50 μmol·kg <sup>-1</sup>	(34; 13)
Phosphate	0.45 μmol·kg <sup>-1</sup>	
Silicate	2.85 μmol·kg <sup>-1</sup>	
Nitrite	0.08 μmol·kg <sup>-1</sup>	
Nitrate	0.74 μmol·kg <sup>-1</sup>	

The cited uncertainties represent the standard deviation. Figures in parentheses are the number of analyses made. (In the case of the alkalinity analyses, the second figure is the number of separate bottles analysed.) The nutrient levels may have changed 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	2111.62 ± 0.55 μmol·kg <sup>-1</sup>
Total alkalinity	2354.05 ± 0.17 μmol·kg <sup>-1</sup>

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  
December 12, 1996

## **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.