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# Certificate of Analysis

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

Batch #43 (Bottled on March 25, 1998)

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	33.598	
Total dissolved inorganic carbon	1988.64 ± 0.95 μmol·kg <sup>-1</sup>	(10;10)
Total alkalinity	2202.86 ± 0.97 μmol·kg <sup>-1</sup>	(27;11)
Phosphate	0.15 μmol·kg <sup>-1</sup>	
Silicate	2.07 μmol·kg <sup>-1</sup>	
Nitrite	0.03 μmol·kg <sup>-1</sup>	
Nitrate	0.14 μmol·kg <sup>-1</sup>	

The cited uncertainties represent the standard deviation. Figures in parentheses are the number of analyses made (total number of analyses; number of separate bottles analysed). The nutrient levels may have changed on storage; their stability has not been examined. DIC and alkalinity analyses were performed over a period of time to confirm that the batch is stable.

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

Total dissolved inorganic carbon	1988.64 ± 0.68 μmol·kg <sup>-1</sup>
Total alkalinity	2202.86 ± 0.38 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  
May 26, 1998

## **Analytical Methods Used**

### *Salinity*

The salinity was determined by measuring its conductivity relative to IAPSO Standard Sea Water using a Guildline Autosol Model 8400 conductive salinometer. The procedure is described in an in-house technical manual of the Oceanographic Data Facility (ODF), Scripps Institution of Oceanography, entitled "Autosal Operating Procedures", dated 10-Dec-1993, revised 10-Jan-1994.

### *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.