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Water quality — Sampling —

Part 26: Guidance on sampling for the parameters of the oceanic carbon dioxide system

Qualité de l'eau – Echantillonnage —

Partie 26: Lignes directrices pour l'échantillonnage d'eau de mer en vue de l'analyse des formes du carbone

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee SC 6, *Sampling (general methods)*.

A list of all parts in the ISO 5667 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ocean is currently absorbing about one quarter of the carbon dioxide that humans are emitting. When carbon dioxide combines with seawater, chemical reactions occur that reduce the seawater pH, hence the term ocean acidification. Acidification can affect many marine organisms, but especially those that build their shells and skeletons from calcium carbonate. Over the past few years, several high-profile reports have highlighted the urgent need to better understand the effects of changes in carbonate chemistry on marine organisms and ecosystems. Research in this field was limited to a few groups around the world until recently but the number of scientists involved in ocean acidification research has been rapidly rising over the past few years. The reliable characterization and manipulation of the carbonate system involves good analytical skills and measuring facilities and continuous monitoring of seawater chemistry in the field and during experimentation. The predictive power of field surveys and the robustness of results from experiments critically depend on proper sampling and experimental protocols.

The oceanic carbonate system can be described by measuring at least two parameters of the following four parameters, total dissolved inorganic carbon (C_T), total alkalinity (A_T), fugacity of carbon dioxide (f_{CO2}) and pH in seawater. This document describes how to collect and preserve discrete seawater samples, from a Niskin bottle or other water samplers, for the analysis of four measurable inorganic carbon parameters including: C_T, A_T, f_{CO2} and pH, according to highest standard levels accepted by global ocean carbon community.

NOTE This document is based on Reference [5].

Water quality — Sampling —

Part 26: Guidance on sampling for the parameters of the oceanic carbon dioxide system

1 Scope

This document specifies how to collect discrete seawater samples, from a Niskin or other water sampler, that are suitable for the analysis of the four measurable inorganic carbon parameters: total dissolved inorganic carbon, total alkalinity, pH and CO_2 fugacity.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5667-14, *Water quality — Sampling — Part 14: Guidance on quality assurance and quality control of environmental water sampling and handling*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
total alkalinity
A_T
<sea water> number of moles of hydrogen ion equivalent to the excess of proton acceptors (bases formed from weak acids with a dissociation constant K ≤ $10^{-4,5}$ at 25 °C and zero ionic strength) over proton donors (acids with K > $10^{-4,5}$) in 1 kg of sample

Note 1 to entry: The formula to determine A_T is:

$$A_T = \left[HCO_3^-\right] + 2\left[CO_3^{2-}\right] + \left[B(OH)_4^-\right] + \left[OH^-\right] + \left[HPO_4^{2-}\right] + 2\left[PO_4^{3-}\right] + \left[SiO(OH)_3^-\right] + [NH_3] + \left[HS^-\right] + \ldots - \left[H^+\right]_F - \left[HSO_4^-\right] - [HF] - [H_3PO_4] - \ldots$$

Note 2 to entry: The brackets represent total concentrations of these constituents in solution, $[H^+]_F$ is the free concentration of hydrogen ion and the ellipses stand for additional minor acid or base species that are either unidentified or present in such small amounts that they can be safely neglected. In open ocean water, the concentrations of NH_3 and HS^- are typically so low that they can be neglected; they may, however, be significant in anoxic environments.