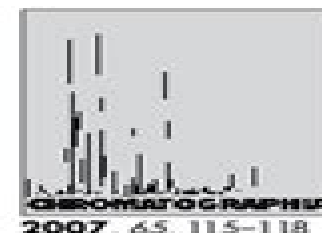


Determination of Bromate and Bromide in Seawater by Ion Chromatography, with an Ammonium Salt Solution as Mobile Phase, and Inductively Coupled Plasma Mass Spectrometry



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Abstract

A method has been developed for determination of bromate and bromide in water containing high concentrations of chloride (e.g. seawater). Separation of bromate and bromide on an anion-exchange column was followed by ICP-MS detection. To reduce interference of chloride with determination of bromate and bromide, and to avoid clogging, ammonium salts, for example $\text{NH}_4\text{H}_2\text{PO}_4$, $(\text{NH}_4)_2\text{HPO}_4$, $(\text{NH}_4)_2\text{CO}_3$, and NH_4NO_3 were examined as mobile-phase components. It was found that mobile phase containing 20 mM NH_4NO_3 at pH 5.80 was compatible with the anion-exchange column and enabled reasonable resolution and separation of bromate and bromide within 7 min. Detection limits for bromate and bromide ranged from 2.0 to 3.0 $\mu\text{g L}^{-1}$ for direct injection of 50 μL sample without matrix elimination. The proposed method was used for analysis of bromate and bromide in seawater.

Keywords

Column liquid chromatography
Ion chromatography-ICP-MS
Ammonium buffers
Bromate and bromide in seawater

Introduction

Among the wide variety of techniques available for determination of bromine species, anion-exchange chromatography (IC) with a variety of detection methods, including conductivity, spectrophotometry, and inductively coupled plasma mass spectrometry (ICP-MS), is often used [1]. Suppressed IC with conductivity detection, the most common procedure for

analysis of bromate, bromide, and other anions [1–3], is based on suppression of the conductivity of the mobile phase by use of a suppressor column. Chloride is often present in 100-fold excess over bromide in seawater and, because the column is overloaded when the chloride concentration is very large, it interferes by eluting very near to bromate and bromide. Although an approach based on post-column reaction (PCR) and UV

detection is an attractive alternative for determination of bromine species [4–7], these methods may not be suitable for analysis of seawater, in which chloride is present in very large excess over bromide [8]. A new mode of IC separation, electrostatic IC, has recently been used for analysis of seawater to avoid the matrix problem [9, 10].

IC coupled with ICP-MS has been used for the determination of inorganic anions [1] because ICP-MS has several advantages, for example high selectivity in SIM mode and a wide linear dynamic range of detection [11]. IC-ICP-MS with both suppressed ion chromatography [12–16] and non-suppressed anion chromatography has recently been successfully used for determination of bromate and bromide in a variety of matrices [17–21]. Although IC-ICP-MS methods are useful for determination of bromate and bromide, they have not yet been used for analysis of bromide in seawater.

For these reasons we have investigated use of a variety of ammonium salts as mobile phase components for determination of bromate and bromide in seawater. Because seawater contains a high concentration of Cl^- , it might be difficult to separate Cl^- from bromate by anion-exchange chromatography. Because ICP-MS is highly specific and sensitive, however, in contrast with conventional detection in IC, for example conductivity and UV, even at high matrix concentrations it is possible to use

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Analysis of Seawater Crompton, 2012-12-02 Analysis of Seawater deals with the investigation of the micro constituents in seawater in terms of nutrient content and environmental concerns The book describes sampling determination of anions analysis of dissolved gases and metal preconcentration techniques The book also deals with monitoring radioactive elements the determination of seawater organics organometallic compounds and the oxygen demand parameters in seawater It describes in detail surface and deep water sampling the types of devices used storage preservation and prevention of contamination during sample analysis In examining dissolved gases the investigator can use the amperometric titrimetric method with some reservations on chlorine the ultraviolet method on ozone electron capture gas chromatography on nitric oxide and also the flow injection analysis on hydrogen sulphide The methods for determining metals in seawater concern either for single element or for groups of elements The investigator should always initiate various pre concentration techniques when determining metals due to their low concentration and occurrence in seawater The investigator uses various methods to determine different radioactive compounds such as uranium polonium thorium radium barium radon plutonium strontium 90 and cesium 137 The book can be beneficial for meteorologists environmentalists marine ecologists biologists oceanographers

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The Distribution of Bromide in Water in the Floridan Aquifer System, Duval County, Northeastern Florida E. R. German, George Fred Taylor, 1995 Methods of Seawater Analysis Klaus Grasshoff, Klaus Kremling, Manfred Ehrhardt, 2009-07-30 Since the book first appeared in 1976 Methods of Seawater Analysis has found widespread acceptance as a reliable and detailed source of information Its second extended and revised edition published in 1983 reflected the rapid pace of instrumental and methodological evolution in the preceding years The development has lost nothing of its momentum and many methods and procedures still suffering their teething troubles then have now matured into dependable tools for the analyst This is especially evident for trace and ultra trace analyses of organic and inorganic seawater constituents which have diversified considerably and now require more space for their description than before Methods to determine volatile halocarbons dimethyl sulphide photosynthetic pigments and natural radioactive tracers have been added as well as applications of X ray fluorescence spectroscopy and various electrochemical methods for trace metal analysis Another method not previously described deals with the determination of the partial pressure of carbon dioxide as part of standardised procedures to describe the marine CO₂ system **HDBK OF ION EXCHANGE RESINS** Johann Korkisch, 1988-12-31 The six volume CRC Handbook of Ion Exchange Resins reviews the application of ion exchange resins to inorganic analytical chemistry Extracted from over 6 000 original publications it presents the information in over 1 000 tables complemented by concise descriptions of analytical methods involving virtually all the elements of the periodic table Also the ion exchange characteristics of the elements as well as other important information required by analysis using ion exchange resins are presented in separate tables The methods that allow the multi element analysis of complex matrices are emphasized This work includes a general discussion of the theoretical instrumental and other principles underlying the

various applications of ion exchange resins in inorganic analytical chemistry with special attention focused on techniques based on ion chromatography Tracing Earth Surface Processes Using Novel Isotopic Approaches Kang-Jun Huang,Heng Chen,Wang Zheng,Mao-Yong He,2023-02-27 **Analytical Methods for Drinking Water** Philippe Quevauviller,K. Clive Thompson,2005-12-13 Drinking water policies and research are intimately linked It is thanks to the scientific progress made over the last 25 years in identifying and controlling toxic products in drinking water that regulations have developed in such a way that the protection of public health from waterborne diseases has drastically improved The integration of research outputs into the policy making progress requires close cooperation among the scientific and policy communities which is not always straightforward Exchanges among scientific and policy making communities are certainly representing key elements of progress for a better environmental protection In this respect analytical developments linked to drinking water are at the core of the science policy debate This book *Analytical Methods for Drinking Water Advances in Sampling and Analysis* reflects this awareness in joining recent analytical developments with policy considerations A first chapter gives an overview of EU and US drinking water policies as well as on standardization Analytical developments are described in depth in the second chapter focusing on bromate in drinking water The third chapter deals with the development of a sampling protocol for lead in drinking water thus mixing analytical development with standardization needs Finally the fourth chapter focuses on standardization aspects pre normative research related to materials in contact with drinking water This book written by experts in the field of drinking water policy and analysis illustrates recent scientific advances in this area which have contributed to policy development and will be of direct use to policy makers water scientists researchers and analytical laboratories **Handbook of Ion Chromatography** Joachim Weiss,2016-06-24 This three volume handbook is the standard reference in the field unparalleled in its comprehensiveness It covers every conceivable topic related to the expanding and increasingly important field of ion chromatography The fourth edition is completely updated and revised to include the latest developments in the instrumentation now stretching to three volumes to reflect the current state of applications Ion chromatography is one of the most widely used separation techniques of analytical chemistry with applications in fields such as medicinal chemistry water chemistry and materials science Consequently the number of users of this method is continuously growing underlining the need for an up to date reference A true pioneer of this method Joachim Weiss studied chemistry at the Technical University of Berlin Germany where he also received his PhD degree in Analytical Chemistry In 2002 he did his habilitation in Analytical Chemistry at the Leopold Franzens University in Innsbruck Austria where he is also teaching liquid chromatography Since 1982 Dr Weiss has worked at Dionex now being part of Thermo Fisher Scientific where he currently holds the position of Technical Director for Dionex Products within the Chromatography and Mass Spectrometry Division CMD of Thermo Fisher Scientific located in Dreieich Germany Cumulated Index Medicus ,1993

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