Preface

In 2014, it is 30 years ago that the Ph.D. thesis written by Ronald Kaufmann "Chlorine in Ground Water: Stable Isotope Distribution" was published. This thesis definitely is the landmark publication of all articles, book chapters, conference proceedings, and other papers written on halogen stable isotopes as it, for the very first time, showed that natural chlorine stable isotope variations were clearly, and actually easily, measurable. Earlier papers were published on chlorine (and even bromine) isotopes, but these were published at a very low frequency of less than one paper per year on average. These papers, mostly aimed at the development of analytical methods and experimentally measuring fractionation in the laboratory, showed that, unfortunately, natural variations were too small to be detected. Ronald Kaufmann was the first to develop a method by which it was shown that not only natural variations existed, but also that they showed clear systematics.

Once it was proven that small natural chlorine isotope variations could be measured, it was expected that the number of published studies would rise significantly and quickly. However, it took 10 years until the average number of chlorine isotope publications rose above five per year. Even today, after 30 years, the total number of papers on chlorine and, since the year 2000, bromine isotopes is only about 300, recently averaging at about 20 papers per year.

As a result, it is possible to contain almost the whole combined knowledge on stable chlorine and bromine isotope geochemistry into one small volume in the series "Advances in Isotope Geochemistry". In this volume, I present the development of our knowledge on chlorine and bromine stable isotope geochemistry. The book starts with an introduction on chlorine and bromine, their history, chemistry, and isotope behavior. A large part of the book is filled with the numerous methods that have been developed to analyze chlorine and bromine stable isotope ratios. Striking with this regard is that several methods have been developed within laboratories that presented very little scientific chlorine or bromine isotope work thereafter. It could be questioned what would be the reason for this striking observation.

The book then describes the various processes that fractionate chlorine and bromine isotopes. It is important to realise that chlorine and bromine are predominantly present on earth in the -I oxidation state as chloride and bromide ions, and as a result oxidation–reduction processes that impose large isotope fractionation on other light stable isotope systems are mostly absent.

The range of measured isotope ratios goes rarely beyond 10 ‰, and about 80 % of all chlorine and bromine isotope measurements are between −1 and +1 ‰ of the internationally accepted standard (ocean chloride and ocean bromide). Finally, the book describes the chlorine and bromine isotope variation that has been observed. This includes not only observations on chloride and bromide samples from earth, but also extra-terrestrial material such as meteorites and moon rocks and samples with different oxidation states such as perchlorates and organic molecules.

The number of laboratories that has been involved in chlorine and bromine isotope studies has never been very large. I believe the number has hardly been over 10 worldwide at any one time. It is hoped that the data provided in this book will increase the interest in the study of chlorine and bromine isotopes, and that more laboratories are going to realise the opportunities that investing time and resources in the study of chlorine and bromine isotopes can give a healthy reward. The equipment is present in virtually every isotope laboratory, and with only small adoptions and a small investment every isotope geochemist who wishes can become part of the halogen isotope community.

Hans Eggenkamp

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Eggenkamp, H.

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