



Progress update on IUPAC Project 2009-046-2-200: Terminology and definition of quantities related to the isotope distribution in elements with more than two stable isotopes

Jan Kaiser (1), Alon Angert (2), Bridget Bergquist (3), Willi Brand (4), Shuhei Ono (5), Thomas Röckmann (6), and Joël Savarino (7)

(1) Centre for Ocean and Atmospheric Sciences, School of Environmental Sciences, University of East Anglia, Norwich, UK, (2) Earth Science Institute, Hebrew University of Jerusalem, Israel, (3) Department of Geology, University of Toronto, Canada, (4) Max Planck Institute for Biogeochemistry, Jena, Germany, (5) Department of Earth, Atmospheric, and Planetary Sciences, MIT, Cambridge, MA, USA, (6) Institute for Marine and Atmospheric Research Utrecht, Utrecht University, Netherlands, (7) Laboratoire de Glaciologie et Géophysique de l'Environnement, Grenoble, France

The objective of IUPAC Project 2009-046-2-200 (<http://www.iupac.org/web/ins/2009-046-2-200>) is to define terminology and to identify the most suitable definitions of quantities that characterise the isotope distribution in elements with more than two stable isotopes, including so-called mass-independent fractionation, non-mass dependent fractionation, isotope anomaly, ^{17}O excess, etc.

Most atmospheric oxygen-bearing species show deviations in their triple oxygen isotope ratios from mass-dependent fractionation (MDF) relationships predicted by the theories of Urey, Bigeleisen and Mayer. Similar deviations have also been found in sulphur and other elements with more than two stable isotopes (e.g. Hg, Cd, Zn), often preserved in non-atmospheric reservoirs, including rocks, minerals, soils, ice and waters.

Despite the ubiquity of this type of isotope anomaly, there has never been an attempt to clearly define the terminology and physical quantities used to measure these anomalies and the processes that lead to their formation. Terms like mass-independent fractionation, non-mass dependent fractionation, isotope anomaly, isotope excess etc. have been used in the historic and recent literature, but are often not carefully distinguished. The realisation that MDF comprises a range of possible relationships between the isotopes of one element led to further complications because it meant that apparent isotope anomalies could be created by a combination of different MDF processes.

At the moment, at least four different definitions to quantify isotope anomalies are being used. Furthermore, coefficients used in these definitions vary, which makes the comparison of data from different sources very difficult, even for experts.

A consistent set of recommendations on how to express and quantify the isotope distribution in elements with more than two stable isotopes is highly warranted. From our experience as academic teachers, we are woefully aware how impenetrable the field is for young researchers at the moment because of the lack of consistency and the lack of understanding between different groups. This project seeks to alleviate this.