

CIAAW

COMMISSION ON ISOTOPIC ABUNDANCES AND ATOMIC WEIGHTS

Johanna Irrgeher and Jochen Vogl

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THE COMMISSION

The Commission on Isotopic Abundances and Atomic Weights (CIAAW) is an international scientific committee of IUPAC under its Inorganic Chemistry Division.

The idea of creating CIAAW came in 1897 from soon-to-be Nobel Laureate Hermann Emil Fischer. Since 1899, CIAAW is entrusted with periodic critical evaluation of atomic weights of elements. Since the 1970s, CIAAW evaluates other cognate data, such as the isotopic composition of elements. Evaluation of data is not always simple or trivial and CIAAW relies on the judgement of volunteer experts to make decisions on the quality of published data. Since 1902, the International Committee has been shaped by 120+ volunteers.

CIAAW is recognized as the international authority in the VIM and its recommendations are used throughout science. For example, the current definition of the kelvin relies on CIAAW data.

SUBCOMMITTEES & PROJECTS

CIAAW conducts most of its work through its three major subcommittees or in dedicated projects:

- Subcommittee on Isotopic Abundance Measurements
- Subcommittee on Stable Isotope Reference Material Assessment
- Subcommittee on Natural Assessment of Fundamental Understanding of Isotopes



John Dalton (1766-1844) published the first atomic-weight table of the elements in the early 19th century. Source: Wikipedia Commons



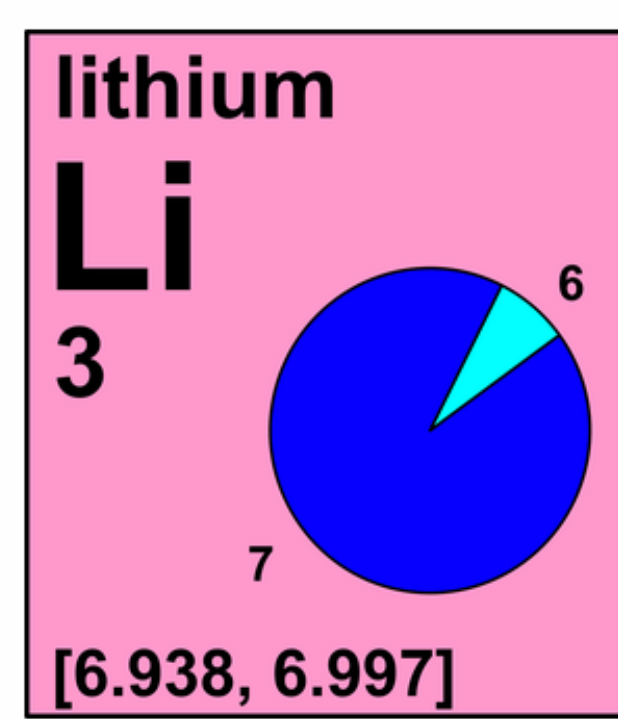
The 2021 Atomic Weights Commission biennial meeting (virtual) © CIAAW

Isotope	Atomic mass (Da)	Isotopic abundance (amount fraction)
⁶ Li	6.015 122 89(1)	[0.019, 0.078]
⁷ Li	7.016 003 44(3)	[0.922, 0.981]

Although Li occurs in diverse geological associations and although the relative mass difference of the isotopes is large, the variability of the atomic-weight values of lithium in most terrestrial sources appears to be smaller than 0.002. The lowest ⁷Li abundance reported for a naturally occurring sample is from dissolved lithium in groundwater from a coastal aquifer in South Carolina with $x(^7\text{Li}) = 0.9227$ and $A_r(\text{Li}) = 6.9387$. The highest ⁷Li abundance reported in a naturally occurring sample is from lithium in pore water from a marine sediment core with $x(^7\text{Li}) = 0.9278$ and $A_r(\text{Li}) = 6.9438$.

The minor isotope ⁶Li is a potentially valuable nuclear source material for tritium production, an important component in hydrogen bombs, and a neutron absorber for the nuclear-fusion reaction. Lithium depleted in ⁶Li may be distributed in commerce, with abundances of ⁶Li as low as 2% and atomic weights in excess of 6.99. This is the justification for the '7r' annotation. In 1999, the Commission expressed concern about the availability on the commercial market of such depleted materials and decided to put the atomic-weight value and uncertainty between square brackets and to add a dagger symbol to warn that, if a more accurate value is required, it must be determined on a sample of the material concerned.

In 1999, the Commission recommended that all $\delta(^7\text{Li})$ values be reported relative to the lithium carbonate reference material LSVEC.

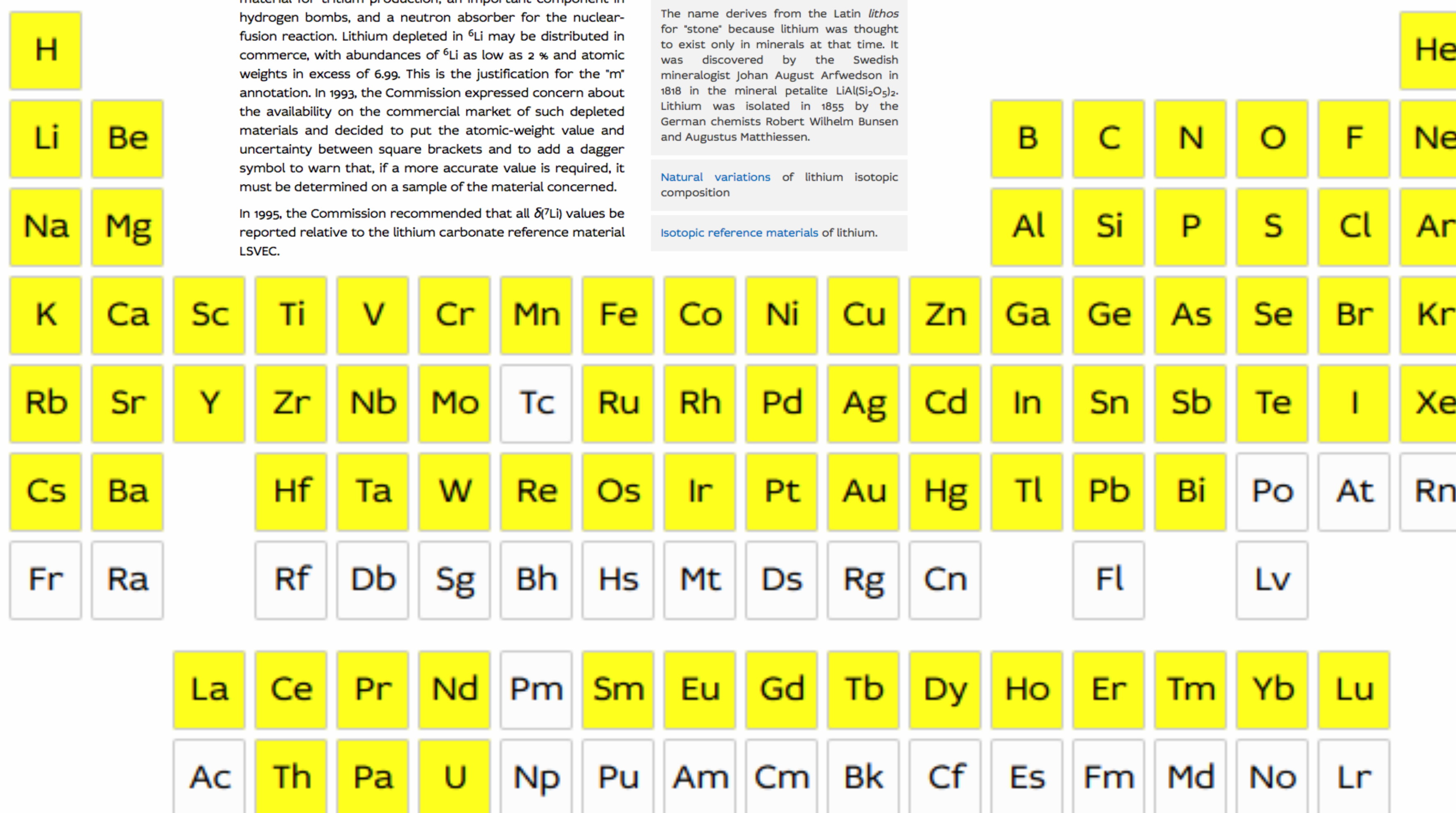


Lithium $A_r(\text{Li}) = [6.938, 6.997]$ since 2009

The name derives from the Latin lithos for 'stone' because lithium was thought to exist only in minerals at that time. It was discovered by the Swedish mineralogist Johan August Arfwedson in 1818 in the mineral petalite $\text{LiAlSi}_4\text{O}_{10}$. Lithium was isolated in 1855 by the German chemists Robert Wilhelm Bunsen and Augustus Matthiessen.

Natural variations of lithium isotopic composition

Isotopic reference materials of lithium.



PRINCIPAL TASKS

Nowadays, CIAAW accounts for critical evaluation of published atomic weight, isotope ratio, and isotopic abundance data and is in charge for publications related to

- Standard Atomic Weights
- Isotopic Compositions of the Elements
- Isotopic Reference Materials
- Natural Variations of Isotopic Composition

Before 1947, CIAAW was responsible for matters relating to the names and symbols of the elements.



Francis W. Aston (1877-1945) received the 1922 Nobel Prize in Chemistry while member of the Commission.



Marie Curie (1867-1934) was a member of the Commission from 1930 until her death in 1934.



Georgii Flerov (1913-1990) was a member of the Commission during the 1970s. Element 114, flerovium, bears his name.



Jules Guéron (1907-1990) was the Secretary of the Commission during the 1950s. He played a key role in the development of atomic energy in France.



Henri Moissan (1852-1907) was one of the early members of the Commission, elected in 1903. He was awarded the 1906 Nobel Prize in Chemistry for his work on fluorine compounds.



Marguerite Perey (1909-1975) was a doctoral student of Marie Curie, and was a member of the Commission from 1950-1963. She discovered the element francium and became the first woman in the French Academy of Sciences.



Theodore W. Richards (1868-1928) was the first US scientist to be awarded the Nobel Prize in chemistry for his accurate determinations of atomic weights.



Frederick Soddy (1877-1956) was awarded the 1921 Nobel Prize in Chemistry for his work on isotopes and radioactivity, and he was elected member of the Commission same year.



Georges Urbain (1872-1938) discovered lutetium, and was first to isolate dysprosium. Urbain was the Chairman of the Commission from 1922-1929.

PUBLICATIONS BY CIAAW (www.ciaaw.org)

DE GRUYTER DOI 10.1515/pac-2013-1023 Pure Appl. Chem. 2014; 86(3): 425-467

IUPAC Technical Report

Willi A. Brand*, Tyler B. Coplen, Jochen Vogl, Martin Rosner and Thomas Prohaska

Assessment of international reference materials for isotope-ratio analysis (IUPAC Technical Report)¹

DE GRUYTER Pure Appl. Chem. 2022; 94(5): 573-600

IUPAC Technical Report

Thomas Prohaska*, Johanna Irrgeher, Jacqueline Benfield, John K. Böhlke, Lesley A. Chesson, Tyler B. Coplen, Tipping Ding, Philip J. H. Dunn, Manfred Gröning, Norman E. Holden, Harro A. J. Meijer, Heiko Moossen, Antonio Possolo, Yoshio Takahashi, Jochen Vogl, Thomas Walczyk, Jun Wang, Michael E. Wieser, Shigekazu Yoneda, Xiang-Kun Zhu and Juris Meija

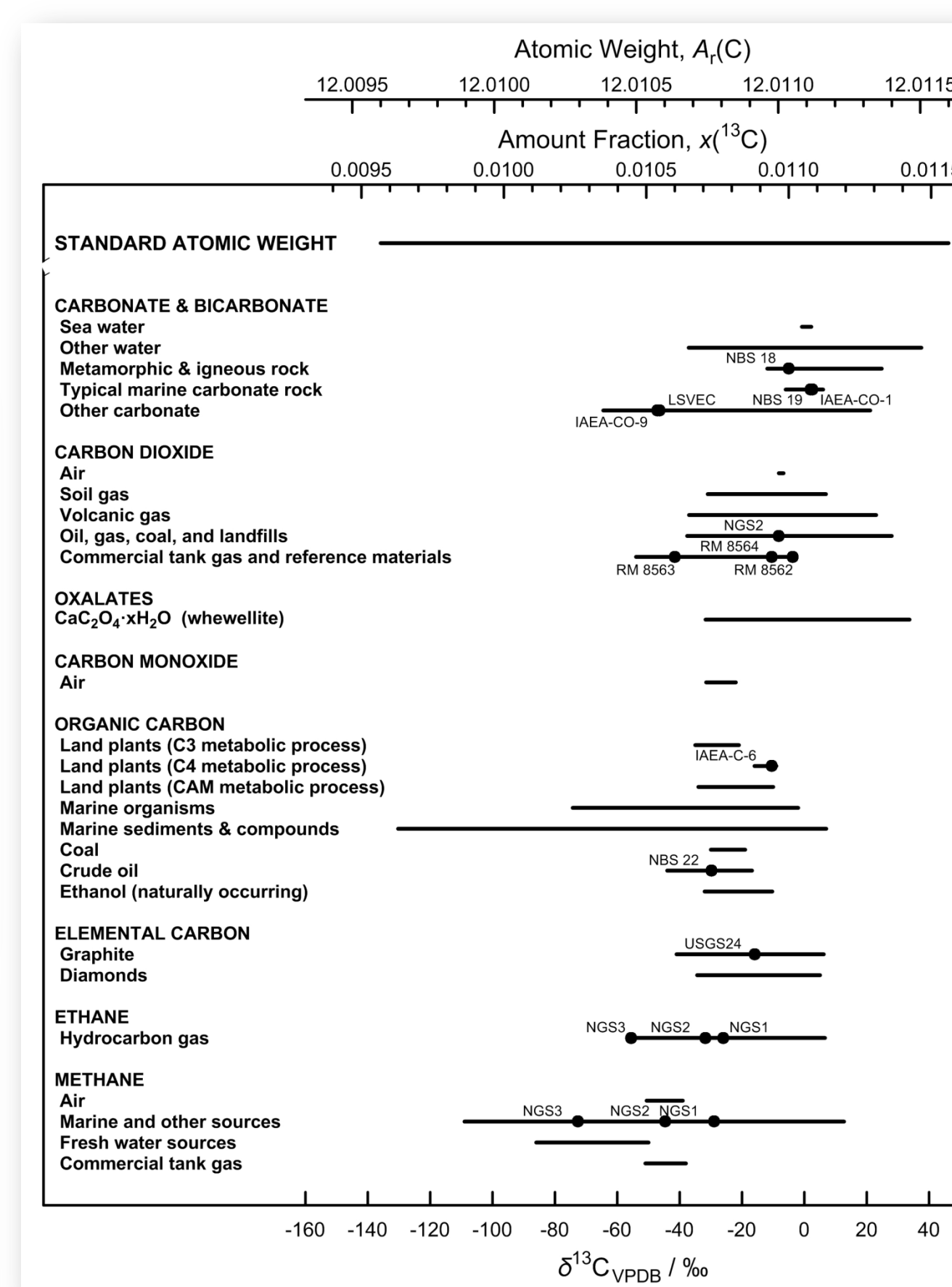
Standard atomic weights of the elements 2021 (IUPAC Technical Report)

DE GRUYTER Pure Appl. Chem. 2016; 88(3): 293-306

IUPAC Technical Report

Juris Meija*, Tyler B. Coplen, Michael Berglund, Willi A. Brand, Paul De Bièvre, Manfred Gröning, Norman E. Holden, Johanna Irrgeher, Robert D. Loss, Thomas Walczyk and Thomas Prohaska

Isotopic compositions of the elements 2013 (IUPAC Technical Report)



CURRENT PROJECTS & ACTIVITIES (selection)

- Project 2014-002-1-200 Assessment of Stable Isotopic Reference Materials
- Project 2014-016-2-200 Compilation of the variation of the isotopic composition of the elements via crowdsourcing
- Project 2015-030-2-200 Assessment of fundamental understanding of isotopic abundances and atomic weights of the chemical elements (2016-2017)
- Project 2015-037-2-200 IUPAC Molecular Weight Calculator
- Project 2017-017-2-200 Evaluated Published Isotope Ratio Data
- Project 2017-023-2-200 Collection, compilation and evaluation of elemental and isotopic data of calcium carbonate and hydroxyapatite materials
- Project 2019-020-2-024 Machine-Accessible Periodic Table
- Project 2019-024-1-200 Statistical Models and Data Reductions to Estimate Standard Atomic Weights and Isotopic Ratios for the Elements, and to Evaluate the Associated Uncertainties
- Project 2020-013-1-200 Assessment of absolute isotope ratios for the international isotope delta measurement standards

MEDIA COVERAGE

Our work has been covered or highlighted by many press outlets and institutions throughout the world.



Web: www.ciaaw.org

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