

What is the standard atomic weight of an element?

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Isotope abundances and atomic weights of the elements are evaluated biennially by the Commission on Isotopic Abundances and Atomic Weights (CIAAW), a standing commission of the International Union of Pure and Applied Chemistry (IUPAC) [1, 2]. For these evaluations, a well-defined set of criteria is used to evaluate the quality of published isotope abundance data that includes the extent to which random and systematic effects have been assessed and documented in the report (e.g. mass spectrometer linearity, mass bias caused by the instrument, memory, baseline, interference between ions, sample purity, preparation effects). Proper statistical treatment of the data is equally important to assess the quality of the published isotope abundance measurements [3]. The Standard Atomic Weights and their uncertainties are intended to apply to almost all samples from natural terrestrial occurrences as well as to samples found in laboratories involved in chemical investigations, technological applications, or in materials of commerce. In recommending atomic weights, CIAAW attempts to find a single value and symmetrical uncertainty that includes all substances likely to be encountered, especially in the laboratory and in industry. A recent proposal was made to CIAAW to delist recommended atomic weight values and follow modern metrological science in recommending, instead of a single value with a range, an interval in which the actual value of atomic weight would be considered to reside based on the variation of its isotopic abundances [4]. This would emphasize the difficulty of providing one single value of atomic weight when natural variations are a predominant factor in the measurement of atomic weight values. It would emphasize to users that atomic weights are not a constant of nature as was previously assumed.

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Element partitioning during core formation

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High-pressure metal-silicate partitioning experiments demonstrate that the mantle contents of some moderately siderophile elements (Ni, Co, P, W, Mo, V) are consistent with core-mantle equilibration at high pressures and high temperatures (e.g. [1-7]). This conclusion is one of the bases for the magma ocean model, in which molten core materials segregate through a largely molten silicate mantle. To constrain further such a model, one should ask whether these conditions of core formation are consistent with the mantle contents of other elements. In addition to pressure and temperature, composition is a key factor that can affect element distribution during core formation. In particular, the degree of oxidation of the planetary building materials, which depends on composition, has been shown to be a critical parameter.

Here, we review the experimentally determined partitioning behaviour between Fe-rich molten metal and silicate melts of siderophile elements and other elements normally regarded as moderately volatile and refractory lithophile. We will show how these data help us constrain the composition of the core and bulk silicate Earth. Uncertainties on current core formation and composition models and future directions for work will also be presented.

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