Element abundance chart

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The abundance of chemical elements in the universe is dominated by the large amounts of hydrogen and helium which were produced during Big Bang nucleosynthesis. Remaining elements, making up only about 2% of the universe, were largely produced by supernova nucleosynthesis. Elements with even atomic numbers are generally more common than their neighbors in the periodic table, due to their favorable energetics of formation, described by the Oddo-Harkins rule.

Hydrogen is the most abundant element in the Universe; helium is second. All others are orders of magnitude less common. After this, the rank of abundance does not continue to correspond to the atomic number. Oxygen has abundance rank 3, but atomic number 8.

The abundance of the lightest elements is well predicted by the standard cosmological model, since they were mostly produced shortly (i.e., within a few hundred seconds) after the Big Bang, in a process known as Big Bang nucleosynthesis. Heavier elements were mostly produced much later, in stellar nucleosynthesis.

Hydrogen and helium are estimated to make up roughly 74% and 24% of all baryonic matter in the universe respectively. Despite comprising only a very small fraction of the universe, the remaining "heavy elements" can greatly influence astronomical phenomena. Only about 2% (by mass) of the Milky Way galaxy"s disk is composed of heavy elements.

These other elements are generated by stellar processes.[7][8][9] In astronomy, a "metal" is any element other than hydrogen or helium. This distinction is significant because hydrogen and helium are the only elements that were produced in significant quantities in the Big Bang. Thus, the metallicity of a galaxy or other object is an indication of stellar activity after the Big Bang.

Heavier elements, beginning with carbon, have been produced in dying or supernova stars by buildup from alpha particles (helium nuclei), contributing to an alternatingly larger abundance of elements with even atomic numbers (these are also more stable). The effect of odd-numbered chemical elements generally being more rare in the universe was empirically noticed in 1914, and is known as the Oddo-Harkins rule.

Modern astronomy relies on understanding the abundance of elements in the Sun as part of cosmological models. Abundance values are difficult to obtain: even photospheric or observational abundances depend upon models of solar atmospherics and radiation coupling.[12] These astronomical abundance values are reported as logarithms of the ratio with hydrogen. Hydrogen is set to an abundance of 12 on this scale.

The Sun"s photosphere consists mostly of hydrogen and helium; the helium abundance varies between about 10.3 and 10.5 depending on the phase of the solar cycle;[13] carbon is 8.47, neon is 8.29, oxygen is 7.69[14] and iron is estimated at 7.62.[15]

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The Earth formed from the same cloud of matter that formed the Sun, but the planets acquired different compositions during the formation and evolution of the Solar System. In turn, the history of Earth led to parts of the planet having differing concentrations of the elements.

The mass of the Earth is approximately 5.97x1024 kg. By mass, it is composed mostly of iron (32.1%), oxygen (30.1%), silicon (15.1%), magnesium (13.9%), sulfur (2.9%), nickel (1.8%), calcium (1.5%), and aluminium (1.4%); with the remaining 1.2% consisting of trace amounts of other elements.[16]

The bulk composition of the Earth by elemental mass is roughly similar to the gross composition of the solar system, with the major differences being that Earth is missing a great deal of the volatile elements hydrogen, helium, neon, and nitrogen, as well as carbon which has been lost as volatile hydrocarbons.

The remaining elemental composition is roughly typical of the "rocky" inner planets, which formed "inside" the "frost line" close to the Sun, where the young Sun"s heat and stellar wind drove off volatile compounds into space.

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