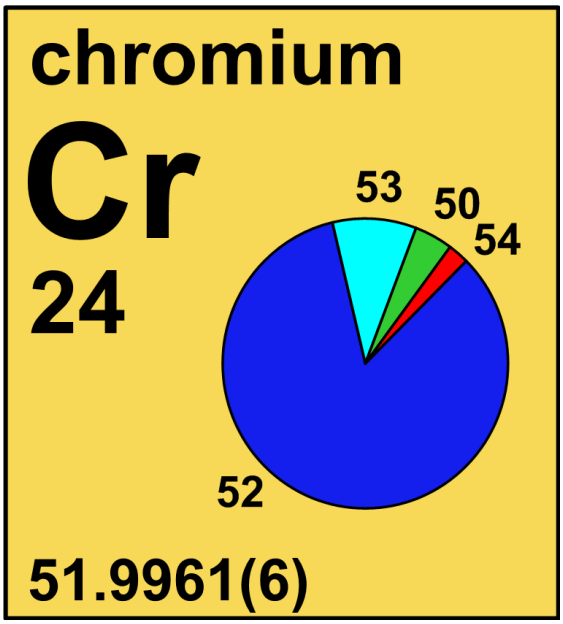
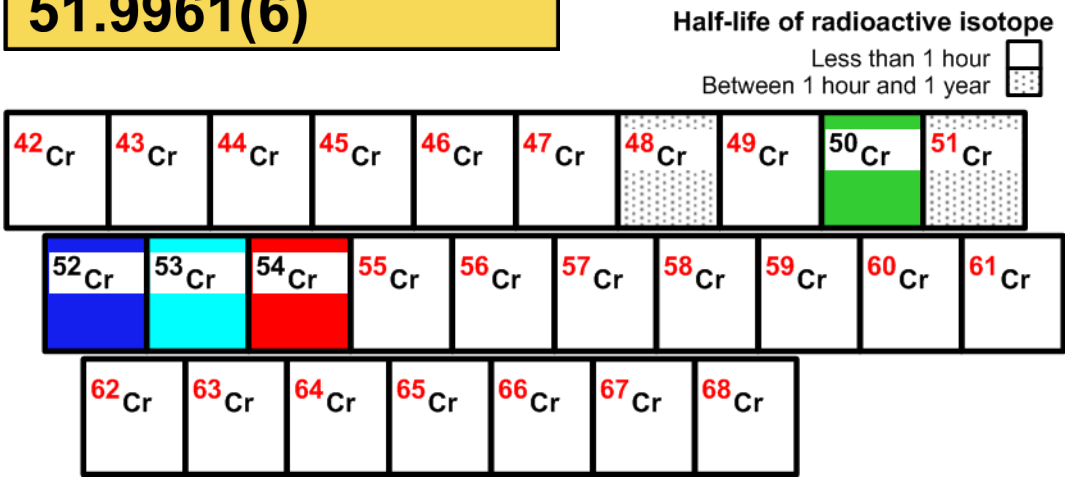
1.

4.24 chromium



Stable isotope	Relative atomic mass	Mole fraction
^{50}Cr	49.946 042	0.043 45
^{52}Cr	51.940 506	0.837 89
^{53}Cr	52.940 648	0.095 01
^{54}Cr	53.938 879	0.023 65



4.24.1 Chromium isotopes in Earth/planetary science

Molecules, atoms, and ions of the **stable isotopes** of chromium possess slightly different physical and chemical properties, and they commonly will be fractionated during physical, chemical, and biological processes, giving rise to variations in **isotopic abundances** and in **atomic weights**. There are measureable variations in the **isotopic abundances** of chromium in natural terrestrial materials (Figure 4.24.1).

SiC grains are formed in very high-temperature events that occurred before the formation of the Solar System. The chemical and **isotopic composition** of certain **elements** in these grains, such as chromium, provides insights into the origin of the Solar System. The ^{54}Cr nucleus is only produced by **supernovae**. Excess amounts of this **isotope** in the SiC grains (relative to terrestrial isotopic composition) in primitive **meteorites** suggest a heterogeneous distribution of ^{54}Cr in the

early Solar System and different sources of material to our Solar System [203]. The early **solar nebula** was divided into two components. One contained chromium depleted in the lighter isotopes and the other contained heavier chromium isotopes. Isotopic studies indicate these components formed a homogeneous mixture in the early Earth, but they separated during partitioning of the Earth's core (Figure 4.24.1) [204, 205].

Mobility and toxicity of chromium metal depend largely on the oxidation state of the element. Isotopes of chromium are fractionated by **reduction-oxidation (redox)** chemical reactions. The isotopic composition has been used to trace the origin of the element in the environment and provide information on reduction-oxidation chemical processes [206].

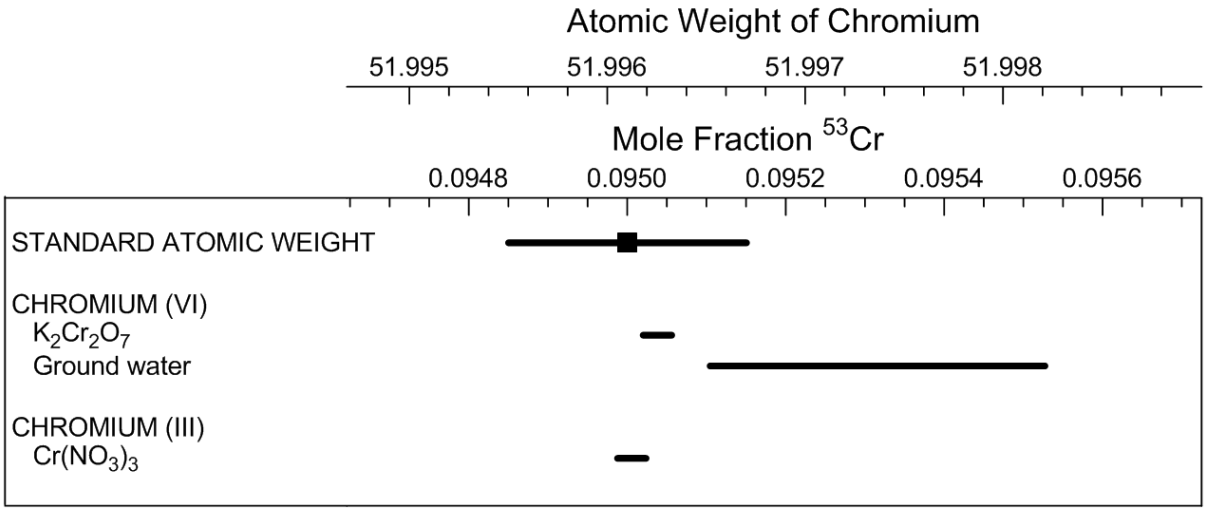


Fig. 4.24.1: Variation in **atomic weight** with **isotopic composition** of selected chromium-bearing materials (modified from [14]).

4.24.2 Chromium isotopes in medicine

Stable isotopes of chromium are used to investigate the **metabolism** of chromium (III), which is an essential nutrient. Chromium stable isotopes (^{53}Cr and ^{54}Cr) have been administered to patients and the relative metabolic activity of each isotope is measured to study insulin function in patients suffering from diabetes (a disease in which the body is unable to produce any or enough insulin, and/or is not able to properly use the insulin that it does produce, resulting in elevated levels of glucose in the blood) [207]. ^{51}Cr and ^{53}Cr have been used to label red blood cells to determine blood volume and life-time of red blood cells in the body [207].