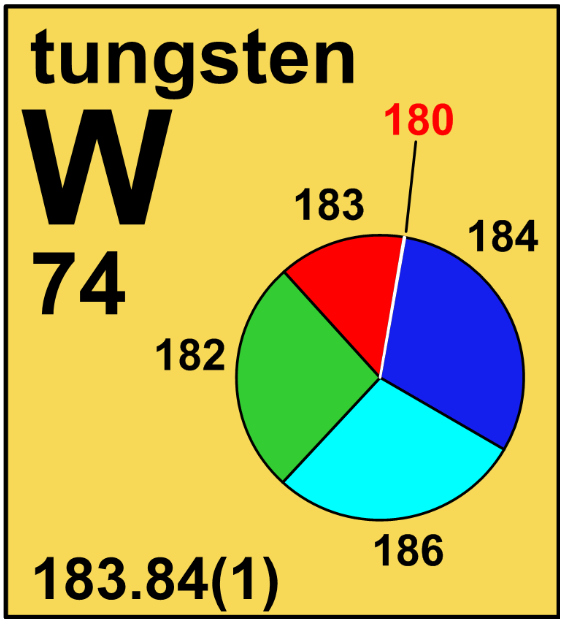
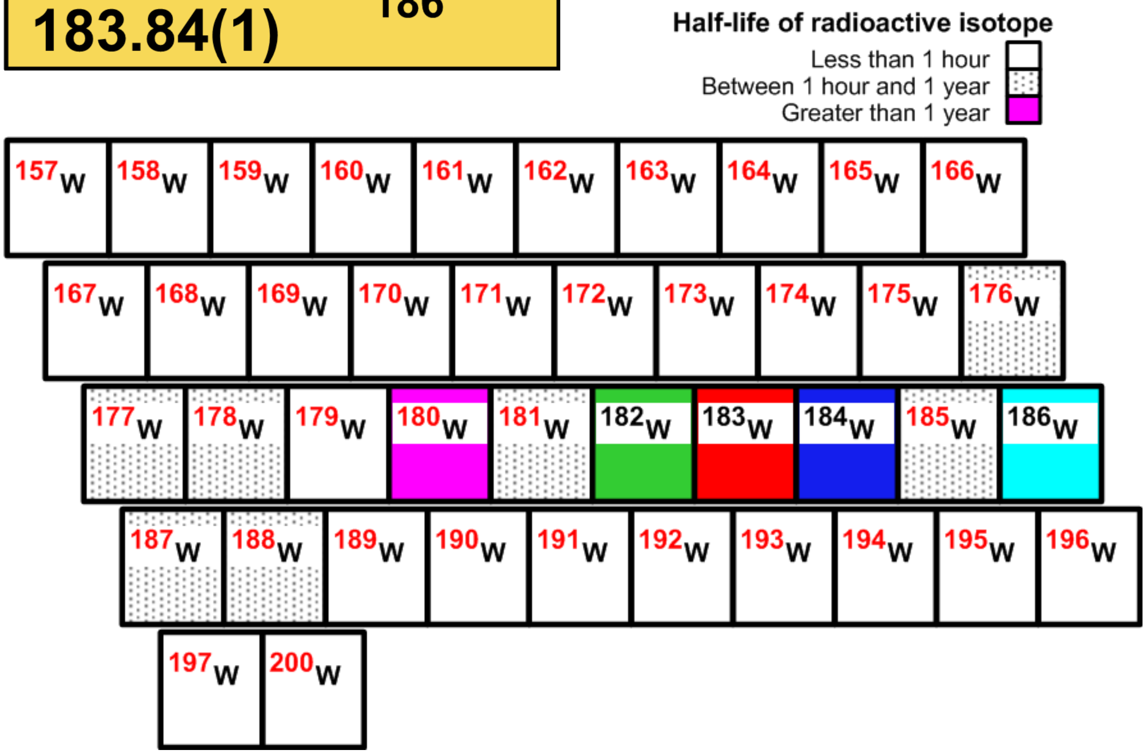
4.74 tungsten



Stable isotope	Relative atomic mass	Mole fraction
$^{180}W^{\dagger}$	179.946 71	0.0012
^{182}W	181.948 204	0.2650
^{183}W	182.950 223	0.1431
^{184}W	183.950 931	0.3064
^{186}W	185.954 36	0.2843

† **Radioactive isotope** having a relatively long **half-life** (1.5×10^{18} years) and a characteristic terrestrial **isotopic composition** that contributes significantly and reproducibly to the determination of the **standard atomic weight** of the **element** in **normal materials**.



4.74.1 Tungsten isotopes in Earth/planetary science

^{182}W is the stable product of the decay of ^{182}Hf, which has a half-life of 8.9×10^6 years. Although ^{182}Hf was present at the dawn of the Solar System, this **isotope** has long since decayed. During the formation of the planets, including Earth, the **elements** hafnium and tungsten were partitioned into silicate minerals (rock forming minerals with silicon-oxygen bonds that constitute more than 90 percent of the Earth's crust) and metal phases, respectively. The measurement of excessive amounts of ^{182}W, arising from the decay of ^{182}Hf that accumulated in silicate minerals, has been used to estimate the time that elapsed between the formation of the Solar System and accretion of the planets (Figure 4.74.1) [509, 510].

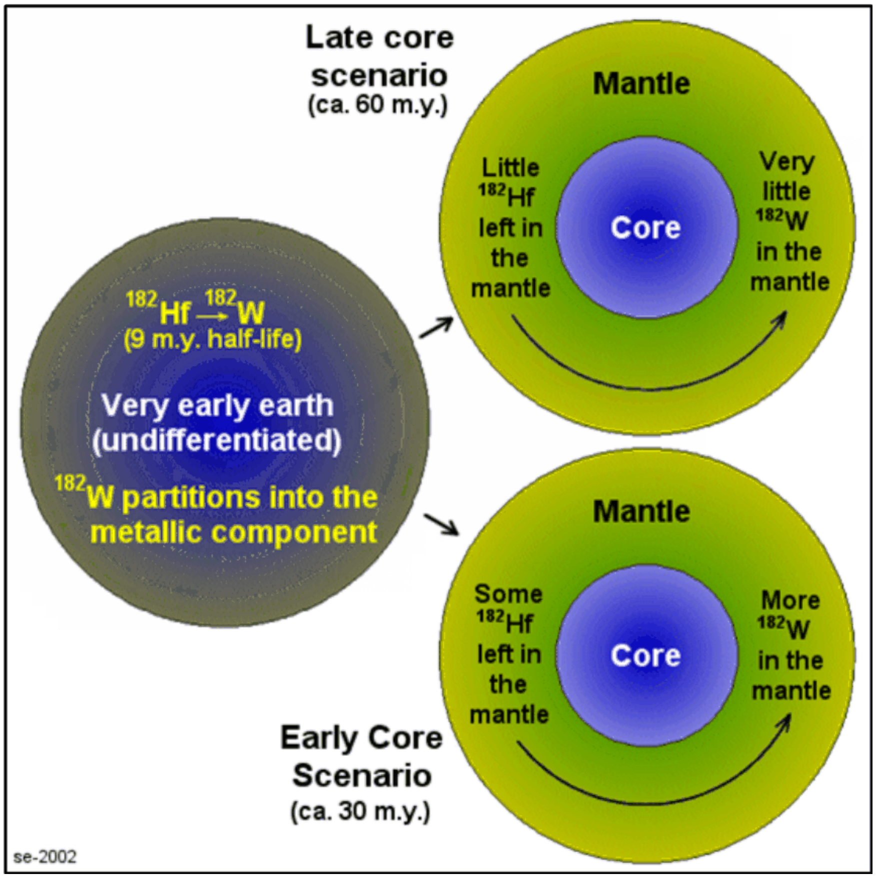


Fig. 4.74.1: Core formation scenarios. ^{182}Hf is produced during the end stages of a **supernova** explosion and decays to ^{182}W. The Early Core Scenario shows that when a core forms relatively early after a supernova explosion, a small amount of ^{182}Hf will be present in the mantle that will produce a significant amount of ^{182}W. The Late Core Scenario shows that ^{182}Hf was produced and decays to ^{182}W prior to the formation of the metallic core. Once the metallic core begins to form, it will attract tungsten because it is strongly attracted to metals. Almost all of the ^{182}W is partitioned into the metallic core and only a small amount will be left in the mantle. (Diagram Source: Steven Earle, Vancouver Island University) [511].

4.74.2 Tungsten isotopes used as a source of radioactive isotope(s)

^{180}W is used to produce ^{181}W, via the ^{180}W (n, γ) ^{181}W reaction. Tungsten-rhenium generators use ^{188}W, which is produced from ^{186}W, via the following double **neutron** capture reaction ^{186}W (n, γ) ^{187}W (n, γ) ^{188}W.