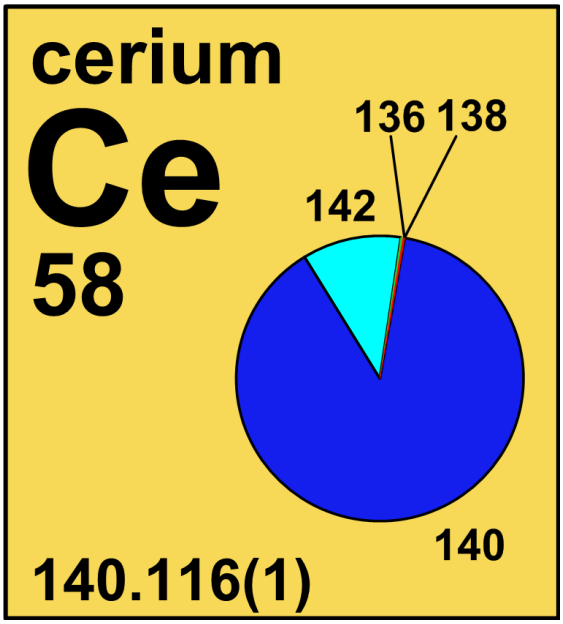
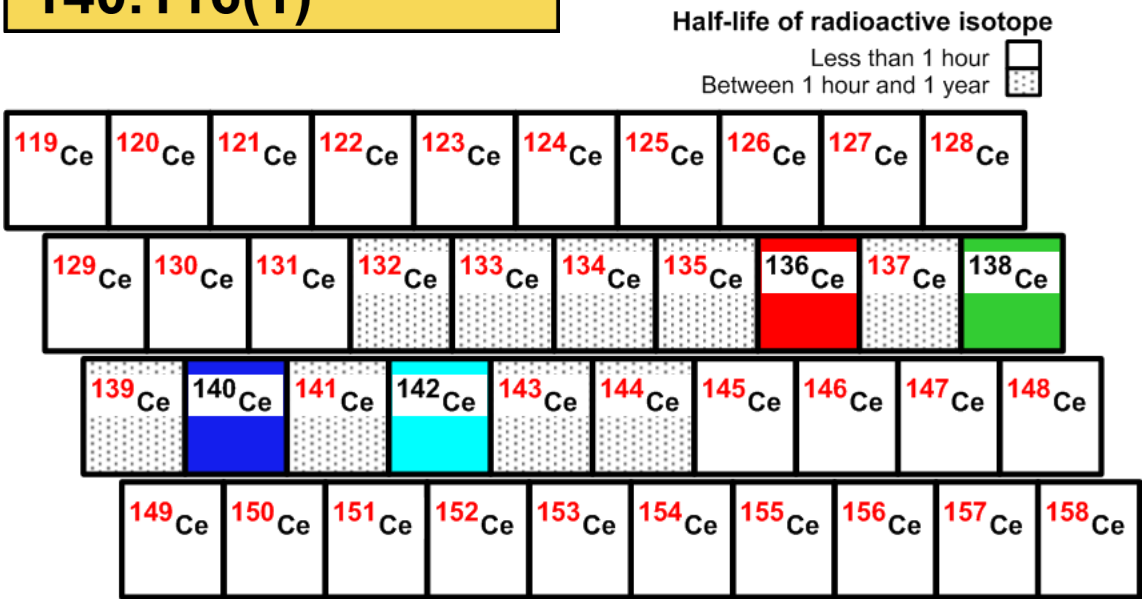
4.58 cerium



Stable isotope	Relative atomic mass	Mole fraction
^{136}Ce	135.907 129	0.001 86
^{138}Ce	137.905 99	0.002 51
^{140}Ce	139.905 44	0.884 49
^{142}Ce	141.909 25	0.111 14



4.58.1 Cerium isotopes in Earth/planetary science

When combined, ^{138}La–^{138}Ce and ^{147}Sm–^{143}Nd are two decay systems that are useful for studying processes affecting the light-rare-earth **elements** (lanthanum, cerium, praseodymium, neodymium, and samarium) and the **igneous** evolution of the Moon and Earth because different igneous materials have different cerium **isotopic compositions** (Figure 4.48.1) and can be used in mass balance investigations [416, 417].

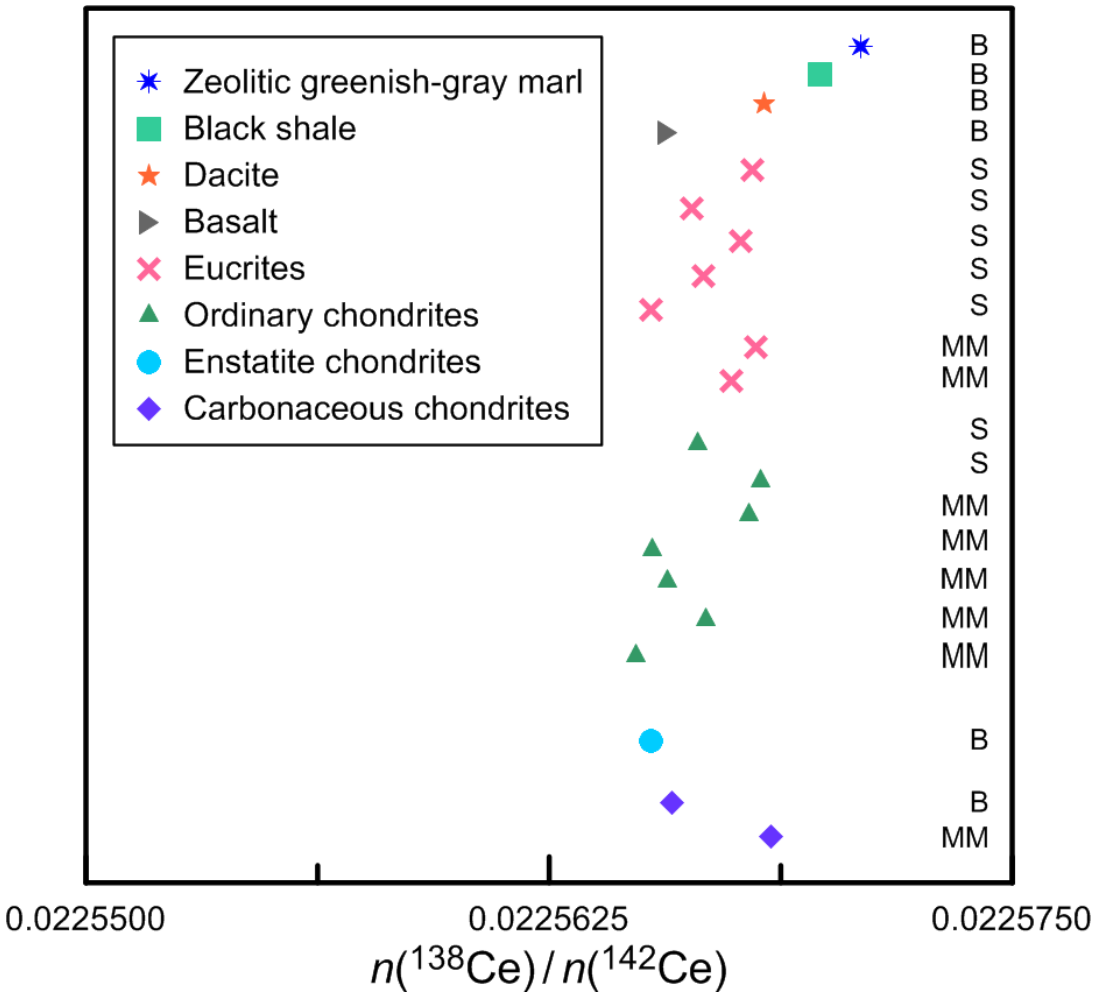


Fig. 4.58.1: Cerium **isotope-amount ratios** of selected terrestrial and extraterrestrial materials (modified from [418]. Data sources: B, [418]; MM, [419]; S, [420].

4.58.2 Cerium isotopes in geochronology

^{138}Ce is a **radiogenic isotope** produced by decay of ^{138}La, with a **half-life** of 1.06×10^{11} years, one of the longest clocks in geochronology. Thus, the **isotope-amount ratio** $n(^{138}\text{Ce})/n(^{142}\text{Ce})$ can be used for dating rocks on long time scales (billions of years) and can also be used as a chemical **tracer** in geochemical studies.

4.58.3 Cerium isotopes in medicine

^{144}Ce (with a half-life of 0.78 year) has been used for **brachytherapy** applications in cells and vessels of the body. The half-life and specific activity of ^{144}Ce give it a potential advantage over the commonly used isotope ^{192}Ir of higher dose rate at shorter distances and lower irradiation of organs outside the tumor [421]. ^{144}Ce enables the treatment of larger arteries as compared with ^{32}P, another isotope commonly used for this style of **radiotherapy**.