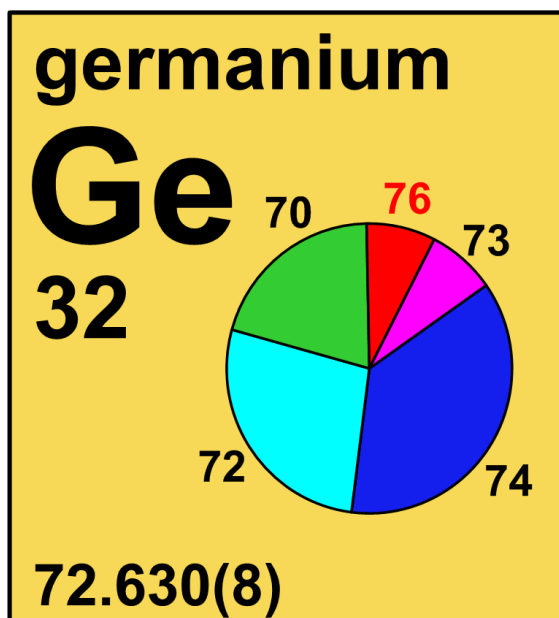


4.32 germanium



Stable isotope	Relative atomic mass	Mole fraction
^{70}Ge	69.924 249	0.2052
^{72}Ge	71.922 0758	0.2745
^{73}Ge	72.923 4590	0.0776
^{74}Ge	73.921 177 76	0.3652
$^{76}\text{Ge}^\dagger$	75.921 4027	0.0775

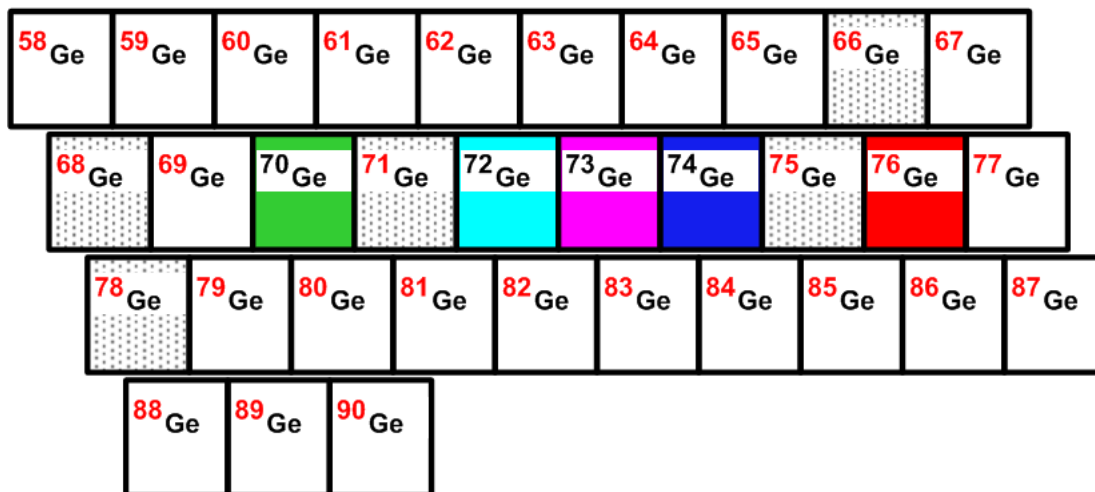
[†] **Radioactive isotope** having a relatively long **half-life** (1.5×10^{21} years) and a characteristic terrestrial **isotopic composition** that contributes significantly and reproducibly to the determination of the **standard atomic weight** of the **element** in **normal materials**.

Half-life of radioactive isotope

Less than 1 hour

Between 1 hour and 1 year

Greater than 1 year



4.32.1 Germanium isotopes in Earth/planetary science

Because molecules, atoms, and ions of the **stable isotopes** of germanium possess slightly different physical and chemical properties, they commonly will be fractionated during physical, chemical, and biological processes, giving rise to variations in **isotopic abundances** and in **atomic weights**. There are measurable variations in the isotopic abundances of germanium in terrestrial materials (Figure 4.32.1).

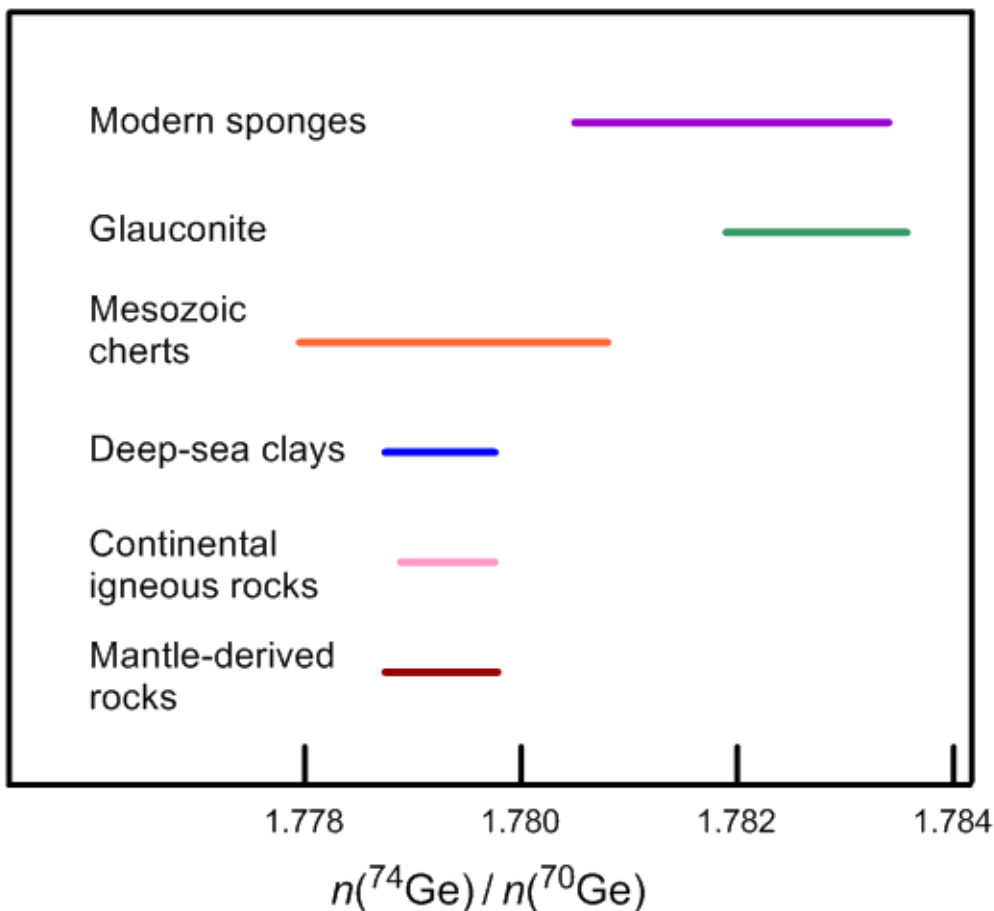


Fig. 4.32.1: Variation in the **isotope-amount ratio** $n(^{74}\text{Ge})/n(^{70}\text{Ge})$ of selected germanium-bearing rocks and marine precipitates (modified from [263], assuming a measured $n(^{74}\text{Ge})/n(^{70}\text{Ge})$ isotope-amount ratio of 1.7794 [264]).

4.32.2 Germanium isotopes in medicine

^{68}Ge is used to calibrate **positron emission tomography (PET)** scanners, which have been used for medical diagnostic procedures [265].

4.32.3 Germanium isotopes used as a source of radioactive isotope(s)

^{72}Ge and ^{74}Ge are used to produce the **radioactive isotopes** ^{72}As and ^{74}As , with half-lives of 26 hours and 17.8 days, respectively. The arsenic nuclei can attach to tumors and the decay of these **isotopes** is used to image the location of cancerous tumors *in vivo* via the $^{72}\text{Ge}(\text{n}, \text{p})^{72}\text{As}$ reaction and the $^{74}\text{Ge}(\text{n}, \text{p})^{74}\text{As}$ reaction [266]. ^{70}Ge , ^{72}Ge , and ^{74}Ge have all been used to produce the medical **radioisotope** ^{73}Se via the $^{70}\text{Ge}(\text{He}, \text{n})^{73}\text{Se}$ reaction, via the $^{72}\text{Ge}(\text{He}, 3\text{n})^{73}\text{Se}$ reaction and via the reaction $^{74}\text{Ge}(\text{He}, 5\text{n})^{73}\text{Se}$, respectively [266].