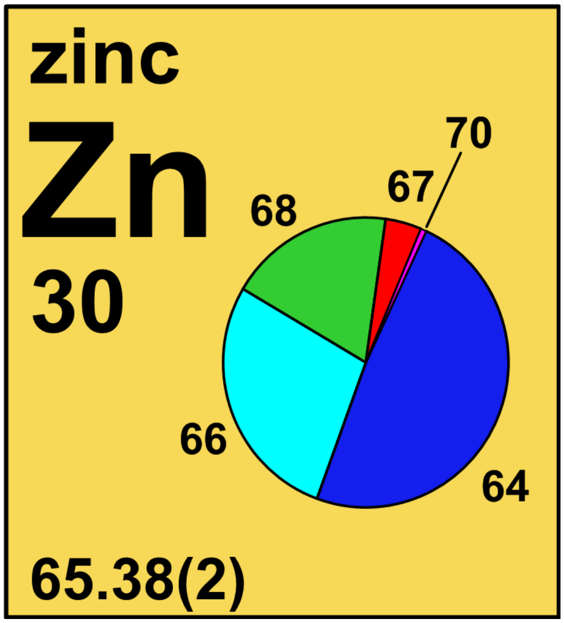
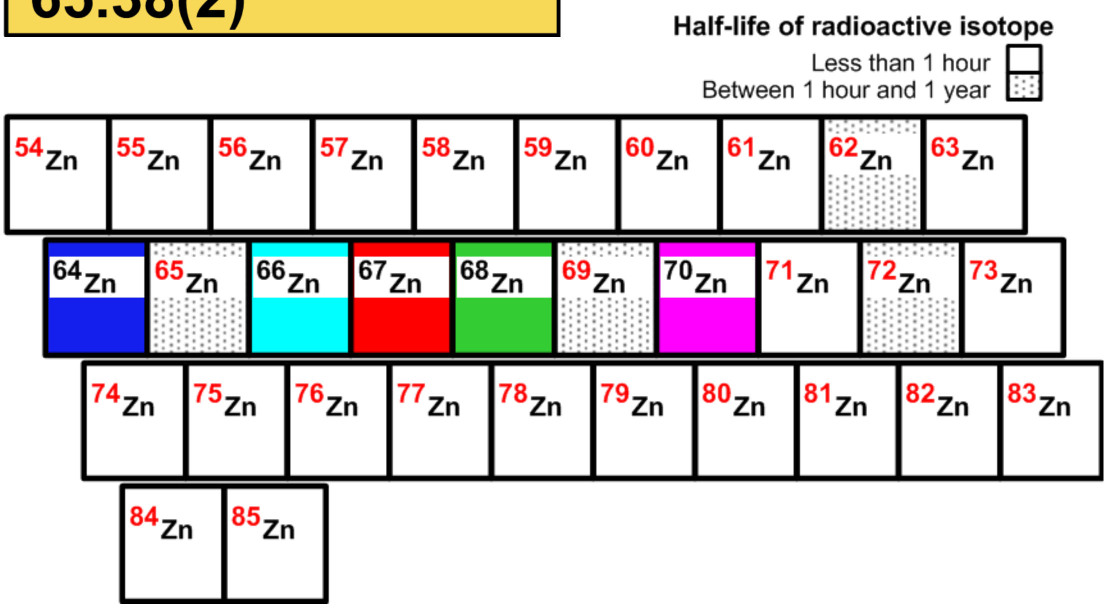
4.30 zinc



Stable isotope	Relative atomic mass	Mole fraction
^{64}Zn	63.929 142	0.4917
^{66}Zn	65.926 034	0.2773
^{67}Zn	66.927 128	0.0404
^{68}Zn	67.924 845	0.1845
^{70}Zn	69.925 32	0.0061



4.30.1 Zinc isotopes in Earth/planetary science

Molecules, atoms, and ions of the **stable isotopes** of zinc 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 zinc in natural terrestrial materials (Figure 4.30.1). Stable zinc **isotopes** have been used as tracers to investigate biogeochemical and chemical processes in environmental contamination sites [240]. The

isotope-amount ratio $n(^{66}Zn)/n(^{64}Zn)$ can be used as an environmental tracer for detecting the pathways of **anthropogenic** zinc [241-243].

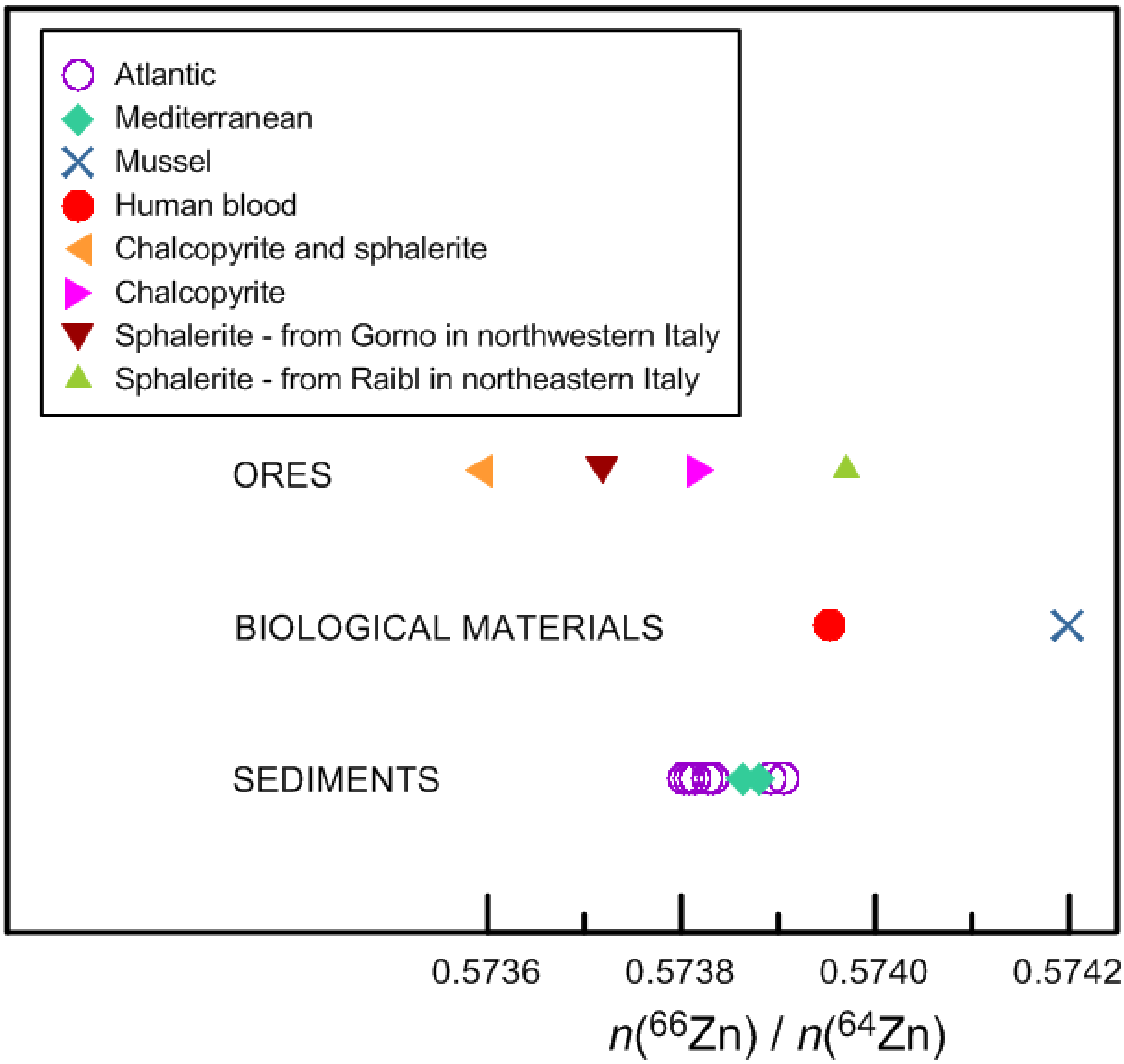


Fig. 4.30.1: Variation in the **isotope-amount ratio** $n(^{66}Zn)/n(^{64}Zn)$ of selected zinc-bearing materials (modified from [244], assuming a $n(^{66}Zn)/n(^{64}Zn)$ value of 0.57372 for a Johnson–Mattey zinc solution [245]).

4.30.2 Zinc isotopes in medicine

Oral **tracers** of enriched ^{67}Zn and **intravenous**ly injected stable isotopic tracers with enriched ^{70}Zn are used simultaneously to determine the fraction of dietary zinc absorbed in humans, maintaining the amount or concentration of a nutrient or biomolecule in organs and body fluids.

For example, zinc-isotope tracers can be administered to humans to determine if zinc absorption in their bodies may be impaired by ingestion of certain foods, food components, or dietary supplements. One such study conducted with Peruvian women showed that prenatal iron supplements affected the absorption of zinc during pregnancy. Another isotope tracer study investigated zinc deficiency in children with Crohn's disease (an inflammatory disease of the intestines, especially the colon and ileum) [246, 247]. Zinc **radioisotopes** (e.g. ^{65}Zn, with a **half-life** of 244 days) can also be used for determining zinc absorption in humans, but they are now used rarely because of radiation hazards [248, 249]. ZnO nanoparticles enriched with ^{67}Zn have been used as biological/environmental nanotoxicity tracers [250].

4.30.3 Zinc isotopes used as a source of radioactive isotope(s)

The ^{68}Zn (p, 2p) ^{67}Cu (with a half-life of 62 hours) reaction in which targets with zinc enriched in ^{68}Zn are irradiated and the **neutron** induced reaction ^{67}Zn (n, p) ^{67}Cu are both processes for producing ^{67}Cu for **radiotherapy** [251]. Irradiation of ^{64}Zn (with a half-life of 12.7 hours) with a deuteron (the nucleus of ^{2}H, consisting of a **proton** and a neutron) in a **cyclotron** will produce the radioisotope ^{64}Cu, which can be used for therapeutic applications and diagnosis with **positron emission tomography** (**PET**) via the ^{64}Zn (d, 2p) ^{64}Cu reaction [252].