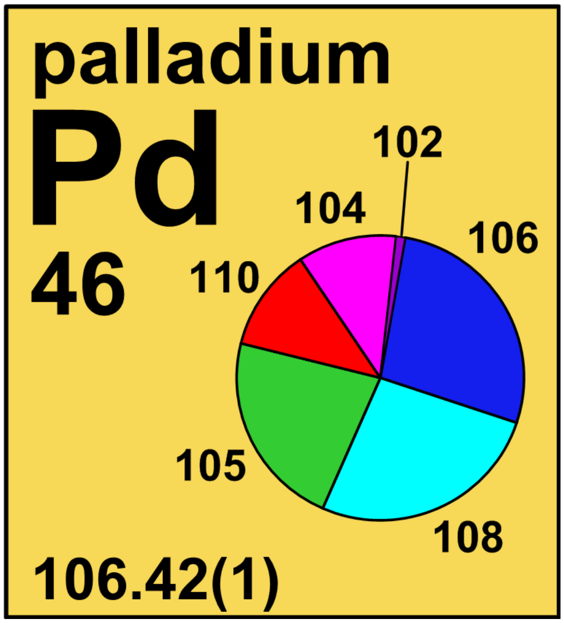
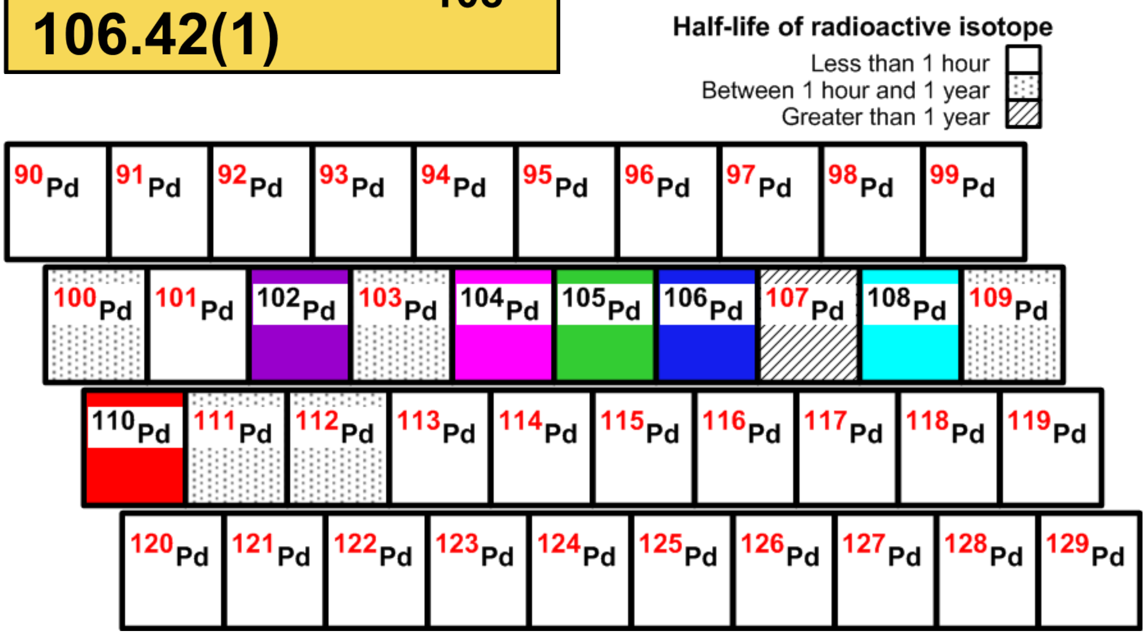
4.46 palladium



Stable isotope	Relative atomic mass	Mole fraction
^{102}Pd	101.905 60	0.0102
^{104}Pd	103.904 031	0.1114
^{105}Pd	104.905 080	0.2233
^{106}Pd	105.903 480	0.2733
^{108}Pd	107.903 892	0.2646
^{110}Pd	109.905 172	0.1172



4.46.1 Palladium isotopes in Earth/planetary science

Small palladium **nucleosynthetic** anomalies in **isotopic composition** (related to **s-process** variability) were identified in type IVB iron **meteorites** [337]. These nucleosynthetic isotope anomalies may represent spatial and/or temporal heterogeneity in the early **solar nebula** or may be due to chemical processing within the solar nebula [324, 338]. Palladium and molybdenum isotopic compositions on selected iron meteorites are correlated (Figure 4.46.1). One possible conclusion is that "a common presolar carrier must have been thermally processed on which the more volatile (a measure of the tendency of a substance to vaporize) Pd was lost and homogenized in the solar nebula, resulting in the deviation from the s-process" variability [339]. Because these palladium (and other **element**) anomalies are persistent throughout the measured iron meteorites, the thermal processing must have occurred prior to the formation of the parent body that produced iron meteorites [339].

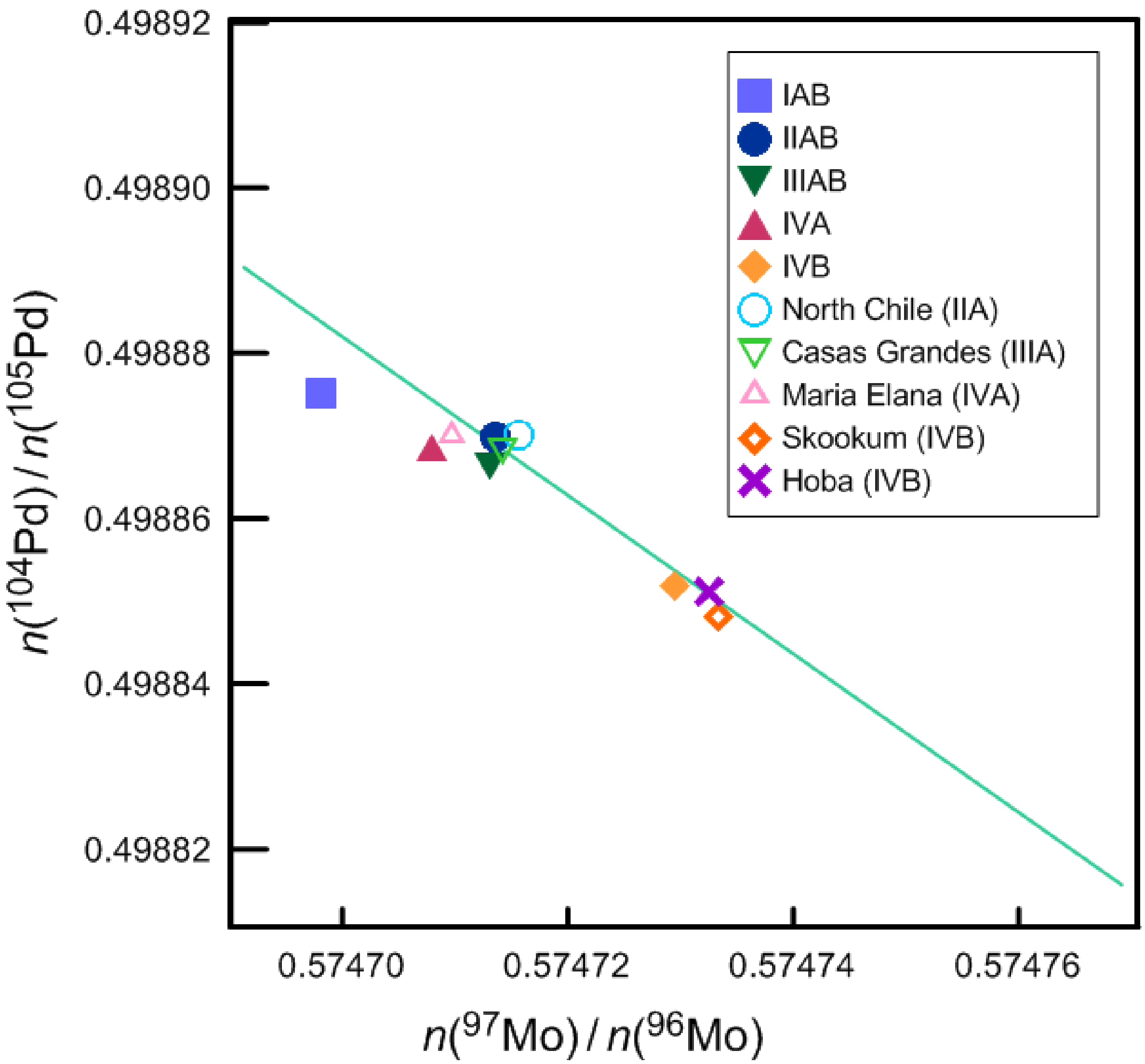


Fig. 4.46.1: Cross plot of $n(^{104}\text{Pd})/n(^{105}\text{Pd})$ and $n(^{97}\text{Mo})/n(^{96}\text{Mo})$ **isotope-amount ratios** of selected **meteorites** (modified from [339], assuming a measured $n(^{104}\text{Pd})/n(^{105}\text{Pd})$ isotope-amount ratio of 0.498 88 in terrestrial material [340] and a measured $n(^{97}\text{Mo})/n(^{96}\text{Mo})$ isotope-amount ratio of 0.574 70 in terrestrial material [315].

4.46.2 Palladium isotopes in geochronology

The **isotope-amount ratio** $n(^{107}Pd)/n(^{107}Ag)$ is used in geochronology to help date major thermal events in the Solar System. Although ^{107}Ag is naturally occurring, ^{107}Ag is also the **daughter product** of the **beta decay** of ^{107}Pd. If both excess ^{107}Ag and ^{107}Pd (with a **half-life** of 6.5×10^6 years) are present in a sample of extraterrestrial origin, then the material would have formed sometime after ^{107}Pd decayed. The $n(^{107}Pd)/n(^{107}Ag)$ **mole ratio** can be measured to help determine when the ^{107}Pd decay process began and how much time has elapsed since the material was formed [341-345].

4.46.3 Palladium isotopes in medicine

Seeds of the **radioactive isotope** ^{103}Pd are internally placed in the body to fight prostate and other cancers locally. ^{103}Pd has a half-life of 16.99 days and releases energy at about 80 **X-rays** and 186 **Auger electrons** per 100 decays of ^{103}Pd. Therefore, this makes this **isotope** an ideal candidate for internal **radiotherapy** for the treatment of cancers [346].

The **radioisotope** ^{109}Pd (with a half-life of 13.5 hours) can be used as a form of cancer therapy. For example, ^{109}Pd-labeled **porphyrins** or porphyrin-like substances are used as diagnostic and therapeutic techniques to help locate and address areas of tumorous growth. Porphyrins accumulate in tumors of the body and when **radiolabeled** porphyrins are introduced to the body, the X-rays and energy released can help determine the location and even treat the cancerous tumors [347].

4.46.4 Palladium isotopes used as a source of radioactive isotope(s)

^{104}Pd is the major target used for **cyclotron** production of the medically important radioactive isotope ^{103}Pd via the reaction ^{104}Pd (p, p n) ^{103}Pd [346].