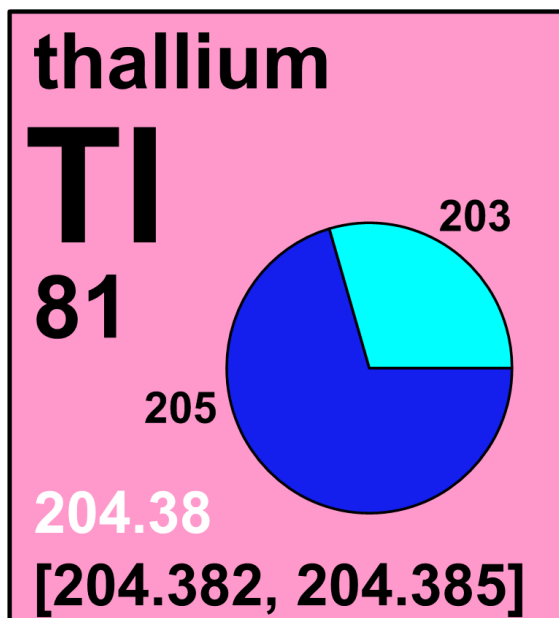





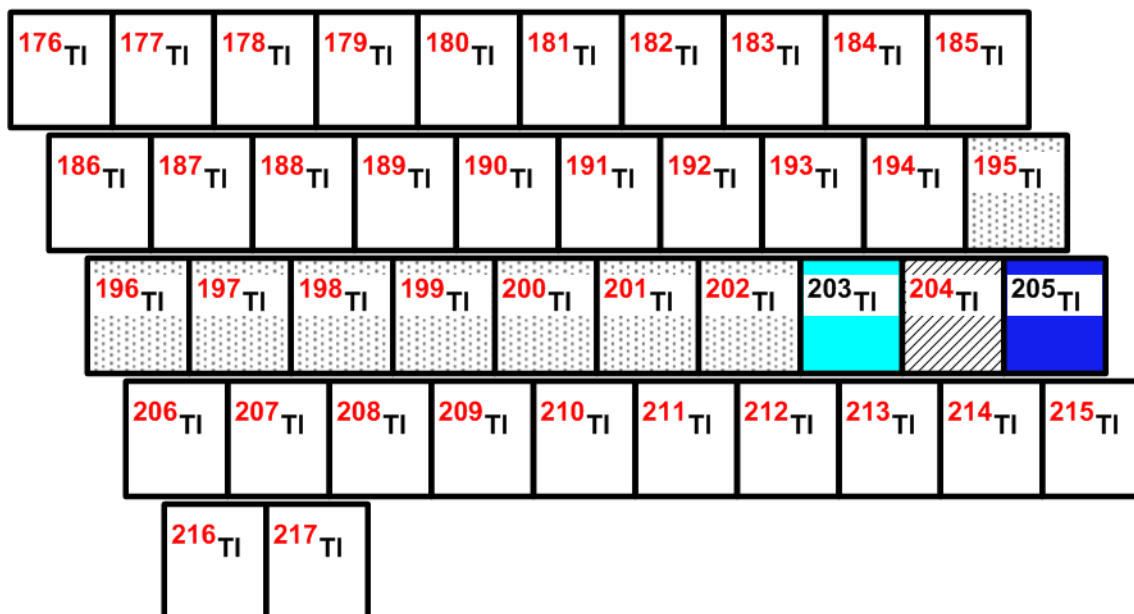
## 4.81 thallium



Stable isotope	Relative atomic mass	Mole fraction
$^{203}\text{Tl}$	202.972 345	[0.2944, 0.2959]
$^{205}\text{Tl}$	204.974 428	[0.7041, 0.7056]

## Half-life of radioactive isotope

Less than 1 hour   
 Between 1 hour and 1 year   
 Greater than 1 year 

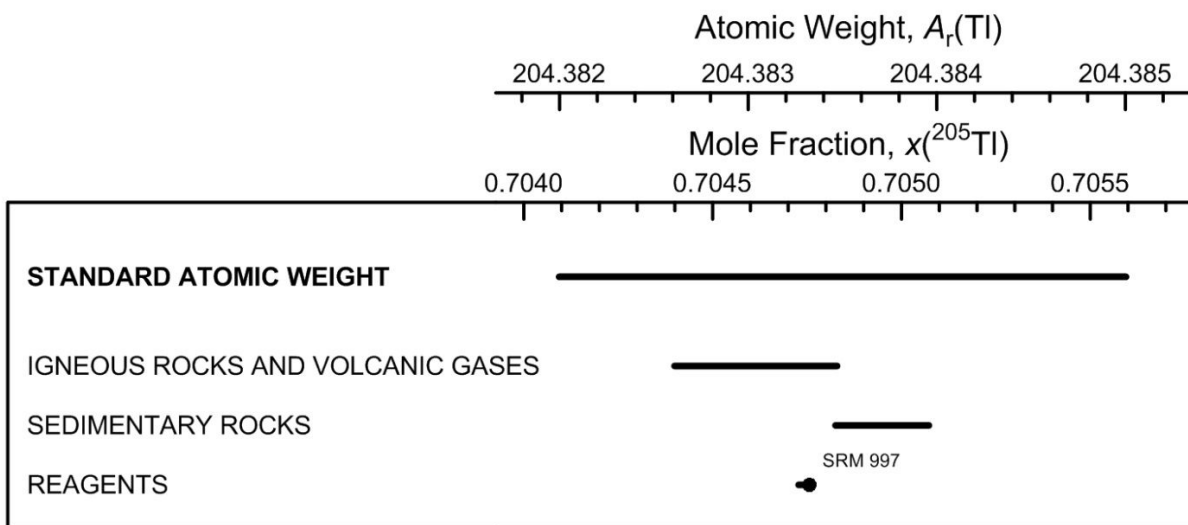


## 4.81.1 Thallium isotopes in Earth/planetary science

Because molecules, atoms, and ions of the **stable isotopes** of thallium 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**

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**weights.** There are substantial variations in the isotopic abundances of thallium in natural terrestrial materials (Figure 4.81.1). These variations are useful in investigating the origin of substances and studying environmental, hydrological, and geological processes [535]. The **isotope-amount ratio**  $n(^{205}\text{Tl})/n(^{203}\text{Tl})$  has been used to study how trace metals are transported and distributed in hydrothermal fluids [535]. The  $n(^{205}\text{Tl})/n(^{203}\text{Tl})$  ratio has also been used to study the cycling, distribution and behavior of thallium in the marine environment [535].

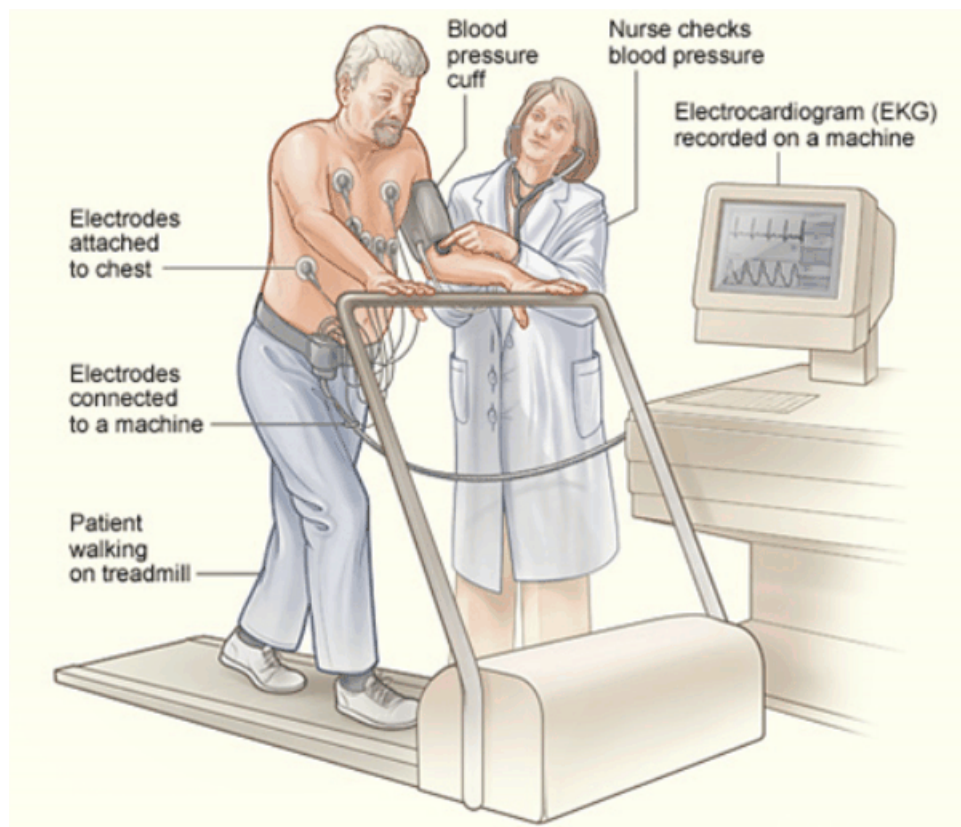


**Fig. 4.81.1:** Variation in **atomic weight** with **isotopic composition** of selected thallium-bearing materials (modified from [10, 14]).

### 4.81.2 Thallium isotopes in medicine

$^{201}\text{Tl}$  **scintigraphy** is used to detect coronary artery disease [536].  $^{201}\text{Tl}$  (with a **half-life** of 3 days) imaging can be used for exercise **perfusion tests** of the myocardium (muscular tissue of the heart), which determines damage to the heart caused by a heart attack or heart disease (Figure 4.81.2) [536].

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**Fig. 4.81.2:** During exercise myocardium (muscular tissue of the heart) **perfusion tests**, a patient will exercise on a treadmill until they have reached their maximal exercise point (determined by heart rate and age). Once they reach their maximal exercise point, a **radionuclide** (usually of thallium or technetium) is injected into the **intravenous** line in their arm, and the patient continues to exercise for a few more minutes. Once the radionuclide reaches the heart, the patient lies flat on a table and a **gamma camera** takes pictures of the heart for about 30 minutes. The areas of decreased blood flow or damaged tissue will be illuminated by the radionuclide. (Image source: National Heart Lung and Blood Institute, Diseases and Conditions Index, National Institutes of Health) [537].

### 4.81.3 Thallium isotopes used as a source of radioactive isotope(s)

$^{203}\text{Tl}$  is used in the production of  $^{201}\text{Tl}$  via the  $^{203}\text{Tl} (p, 3n) ^{201}\text{Pb} \rightarrow ^{201}\text{Tl}$  reaction.  $^{205}\text{Tl}$  is used as an alternative target in the production of  $^{201}\text{Tl}$ .