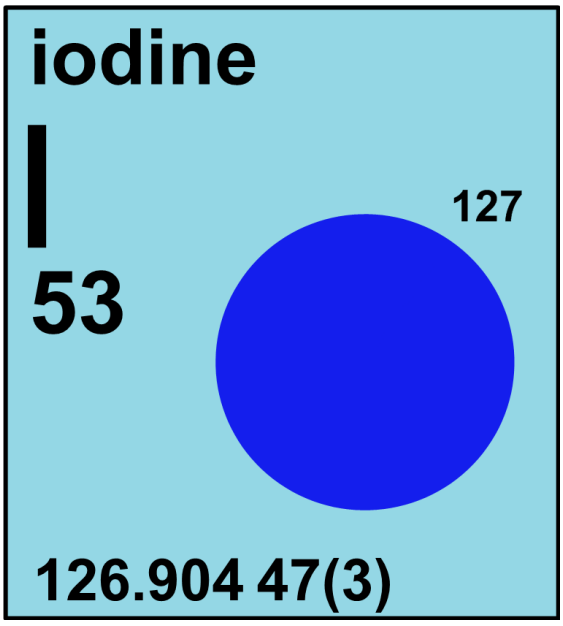
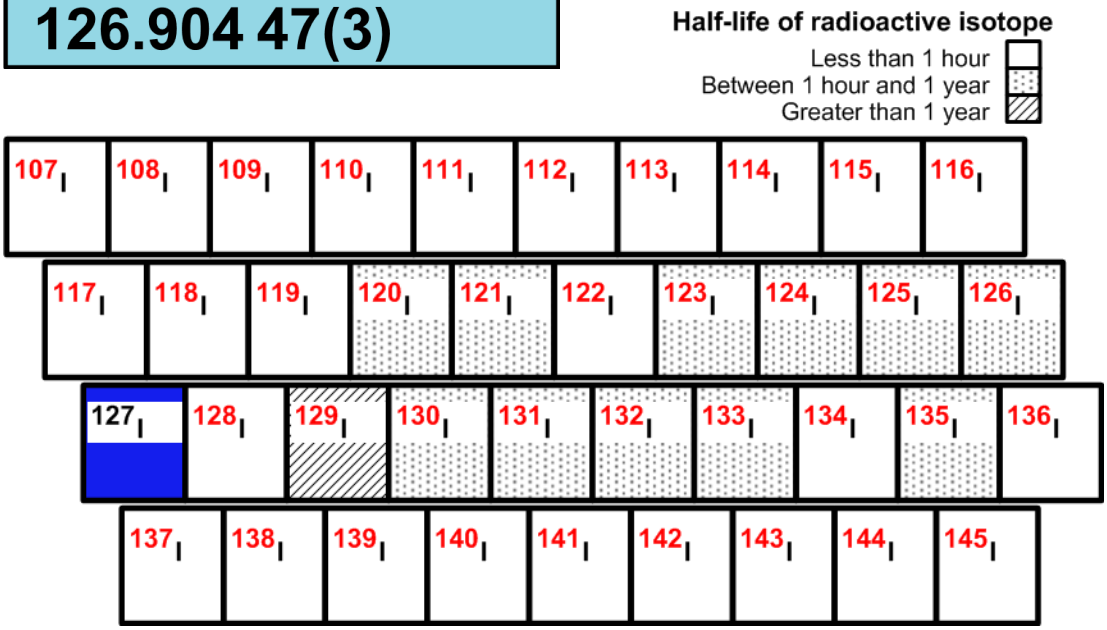
4.53 iodine



Stable isotope	Relative atomic mass	Mole fraction
^{127}I	126.904 47	1



4.53.1 Iodine isotopes in forensic science and anthropology

^{131}I (with a **half-life** of about 8 days) and ^{129}I are both **fission** products; ^{129}I is a long-lived fission product with a half-life of 1.7×10^7 years that can be helpful in the detection of the movement of radiation after a radioactive event, such as occurred at the Japanese reactors at Fukushima. In nuclear reactors and weapons tests, uranium and plutonium undergo fission processes in which one of the fission products is the long-lived **isotope** ^{129}I. This isotope has been used as a groundwater **tracer** to determine evidence of nuclear fission, and it can also be tracked in rainwater as evidence of a fission event in the air (weapons explosion; Figure 4.53.1) [387-389].

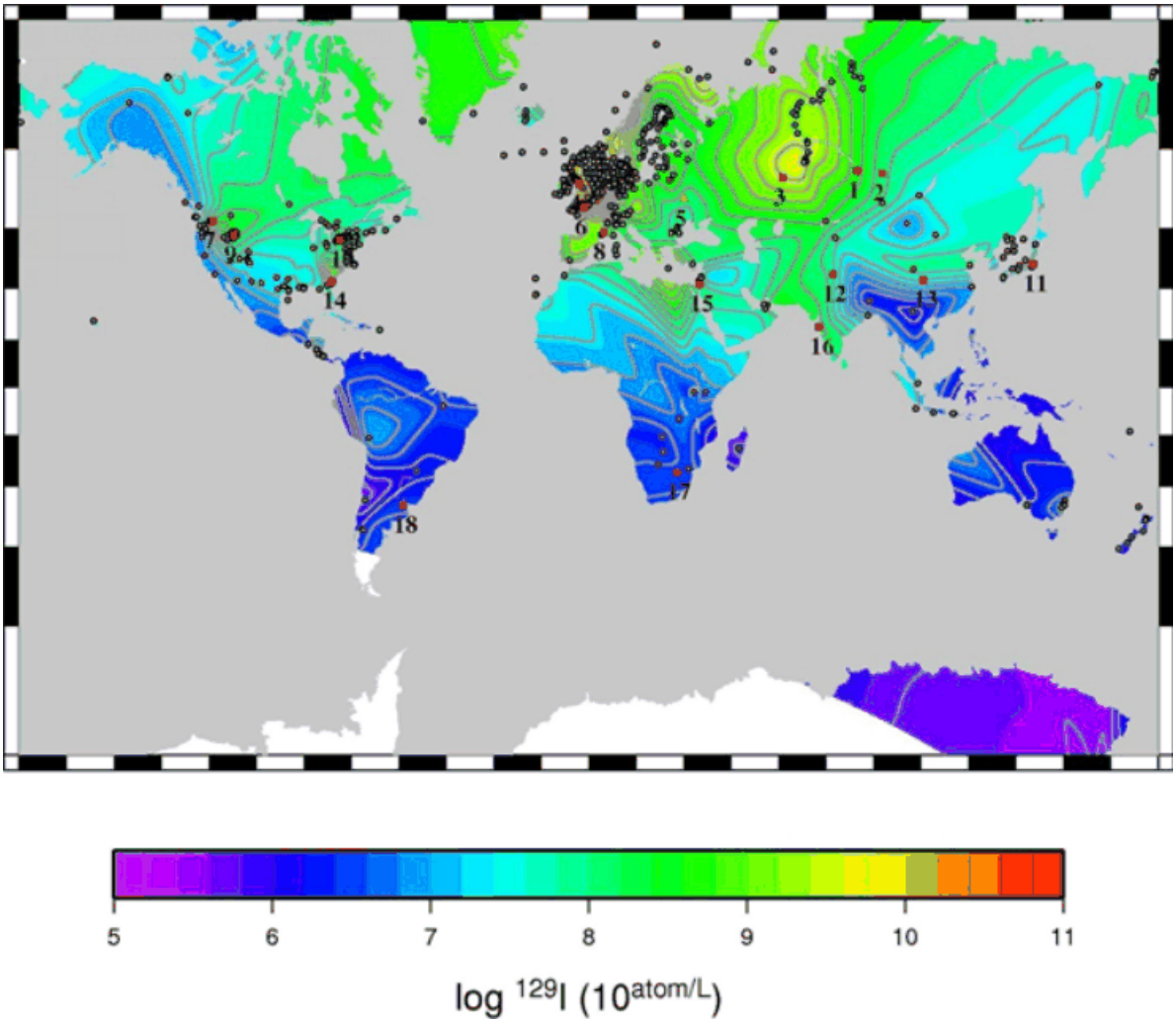


Fig. 4.53.1: Global distribution of ^{129}I before the Fukushima disaster in Japan. Scale spans 1×10^5 atoms ^{129}I/L to 1×10^{11} atoms ^{129}I/L. (Image Source: Snyder, G., A. Aldahan, and G. Possnert, 2010) [389].

4.53.2 Iodine isotopes in geochronology

Natural **cosmogenic** ^{129}I enters groundwater and other terrestrial environments from the atmosphere and then decays to ^{129}Xe. The **isotope-amount ratio** $n(^{129}\text{I})/n(^{127}\text{I})$ can be used as a clock to estimate time since cosmogenic ^{129}I entered the system. The amount of product ^{129}Xe in such cases is too small to measure; however, excess quantities of ^{129}Xe can be found in **meteorites** and other very old samples that contained extinct **primordial** ^{129}I. Younger water bodies also can be differentiated from older water bodies by determining the amount of **anthropogenic** ^{129}I released since the 1960s from sources such as nuclear bomb tests [390, 391].

4.53.3 Iodine isotopes in medicine

^{125}I, which has a **half-life** of about 59 days, is used encapsulated in **radiotherapy** to target and treat sites of cancerous tumors [392]. ^{120g}I (with a half-life of 1.36 hours), where the "g" indicates ground state, and ^{124}I (with a half-life of 100 hours) are **radioactive isotopes** that emit **positrons** and they are used in quantitative, diagnostic imaging of the body using **positron emission tomography** (**PET**) [380-382, 384-386]. ^{123}I and ^{131}I (with half-lives of 0.55 day and 8 days, respectively) are used with **single-photon emission computed spectroscopy** (SPECT) for basic three-dimensional imaging [383, 392]. Radioactive iodine isotopes are produced from radioactive tellurium isotope (see Section 4.52.3).