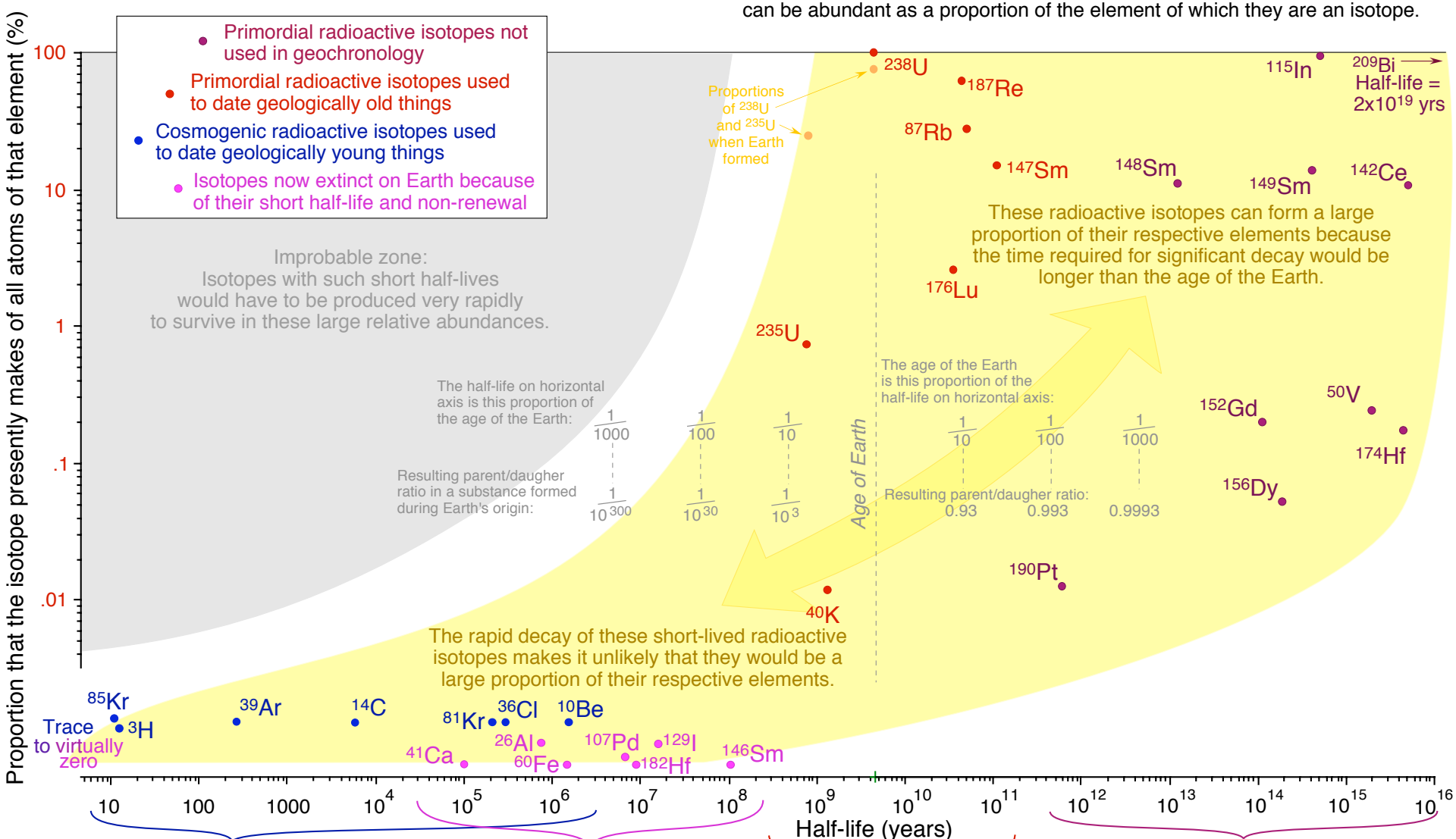
This is a diagram to show why the radioactive isotopes like ^{14}C used to date young things must be cosmogenic nuclides that are very scarce. On the other hand, the radioactive isotopes like ^{238}U used to date geologically old things are primordial (i.e., were incorporated in the Earth at its formation) and can be abundant as a proportion of the element of which they are an isotope.



Extant radioactive isotopes with these relatively short half-lives must be cosmogenic, because any primordial isotope (isotope present at Earth's formation) with such a short half-life would be extinct now. These isotopes are useful for dating relatively young Earth features, such as landscape surfaces (^{10}Be), recent life (^{14}C), and groundwater (^{3}H).

These isotopes, which have geologically short half-lives and are not renewed cosmogenically to any significant extent, are now essentially extinct on Earth. However, their decay products alllow us to understand processes that took place early in Earth history when these isotopes still existed on our planet.

These isotopes with half-lives near the age of the Earth are useful for dating geologically old things, including Earth's oldest rocks and minerals

Radioactive isotopes with these very long half-lives are of little use in radiometric dating on Earth because Earth's age provides little time for decay to produce a significant proportion of daughter nuclides.

Sources: *Environmental Isotopes in Hydrogeology* by Clark & Fritz, *Principles of Isotope Geology* by Faure, *CRC Handbook of Radionuclides* by Wang, Zinner (2003 *Science* 300:265-267), and (re U isotopes) Coogan & Cullen (2009, *GSA Today*)

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