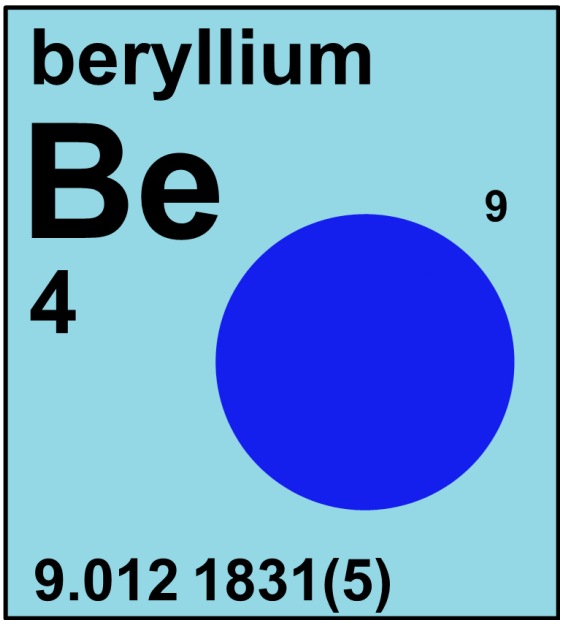
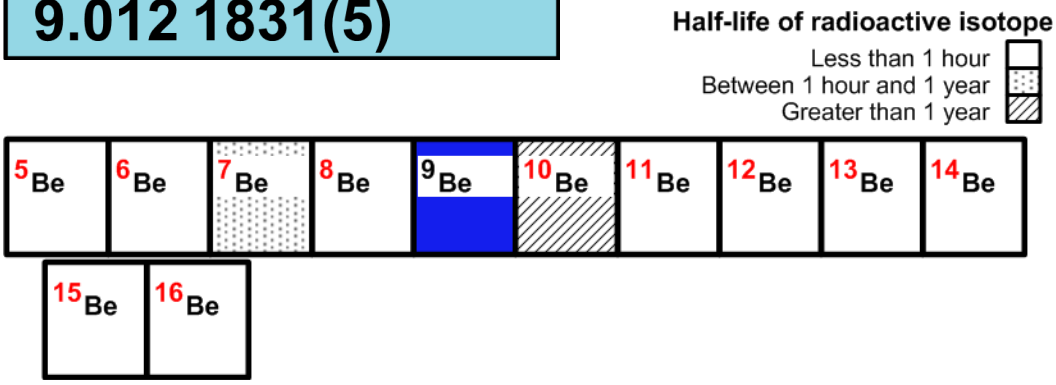
4.4 beryllium



Stable isotope	Relative atomic mass	Mole fraction
^{9}Be	9.012 1831	1



4.4.1 Beryllium isotopes in geochronology

Cosmogenic ^{10}Be and ^{7}Be **isotopes** are produced in the atmosphere, largely by **cosmic-ray spallation** of nitrogen and oxygen. Because of its relatively short **half-life** (^{7}Be, half-life = 53 days, compared to that of ^{10}Be, half-life = 1.39×10^{6} years), measurements of cosmogenic ^{7}Be, and especially the **isotope-amount ratio** $n(^{7}\text{Be})/n(^{10}\text{Be})$, have been used to study rates of atmospheric circulation, mixing, formation of aerosols (fine solids or liquids suspended in a gas; e.g., smoke and mist are aerosols), and particle deposition [41]. Cosmogenic atmospheric beryllium isotopes (^{7}Be and ^{10}Be) are deposited on the Earth's surface where they accumulate in soils, sediments, and snow while decaying away. Thus, measurements of cosmogenic beryllium isotopes in such deposits are used to explore rates of soil formation, erosion, sedimentation, and snow accumulation on time scales ranging from months (^{7}Be) to millions of years (^{10}Be) [42, 43]. The minerals in rocks at the Earth's surface interact with cosmic rays and form substantial quantities of ^{10}Be and ^{7}Be, thus providing a tool to determine ages of geologic processes. In some situations, it is possible to estimate "exposure ages" for rocks in eroding terrains [44-46]. By comparing measured ^{10}Be concentrations with estimated rates of in place cosmogenic ^{10}Be

production, the rate of rock erosion and formation of canyons and other geologic features can be determined (Figure 4.4.1).

Anthropogenic ^{10}Be was produced by nuclear bomb explosions largely through reaction of fast **neutrons** (neutrons produced by nuclear **fission** having high kinetic energy) with ^{13}C via the ^{13}C (n, alpha) ^{10}Be reaction in atmospheric CO_2. Although the quantity of ^{10}Be produced in this way is small, its presence above natural background concentrations in some environmental samples can potentially provide information about bomb-related processes and contamination [47].

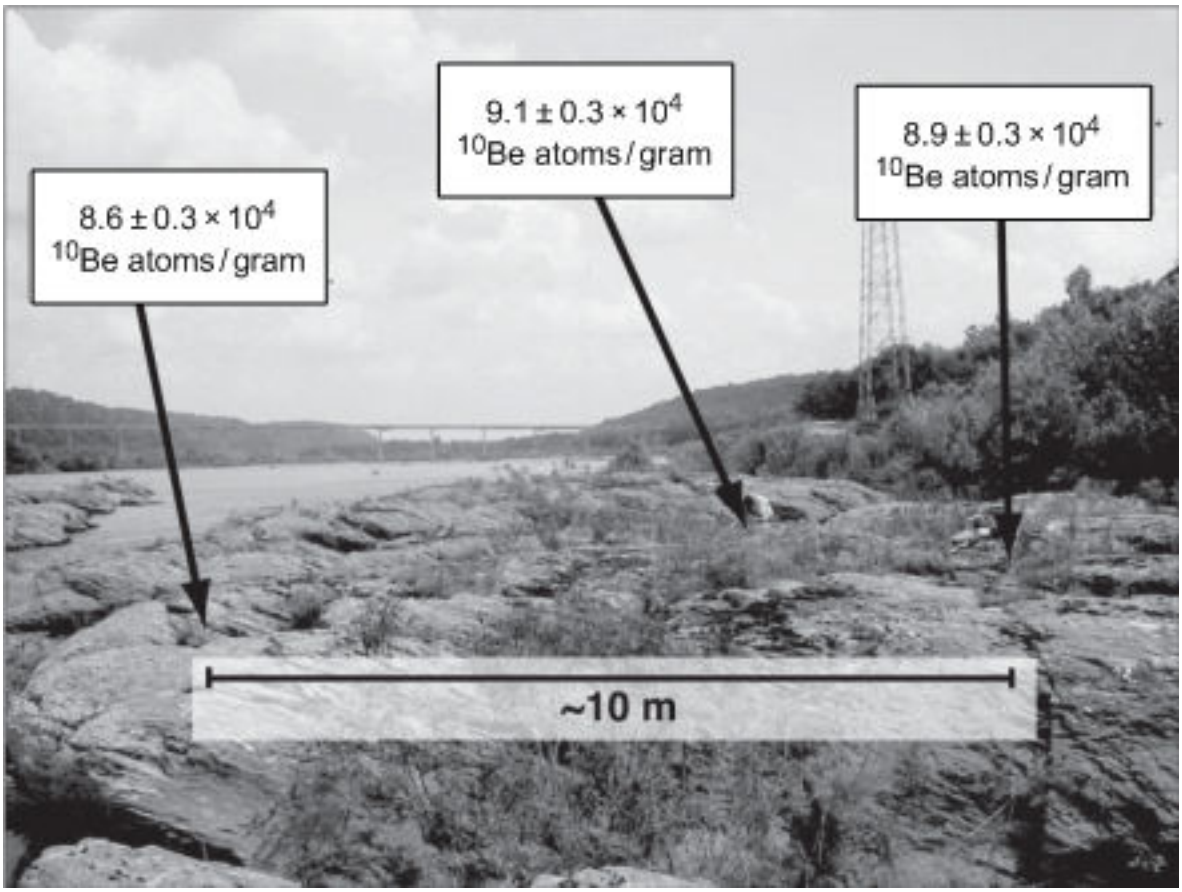


Fig. 4.4.1: Variability in ^{10}Be production as a result of the interaction of **cosmic rays** with exposed rocks at three sites on the Level 2 terrace in upper Holtwood Gorge, Pennsylvania, approximately 50 km upstream of Chesapeake Bay [46].