The Possibility of Airborne Radioactivity from Wildland Fires

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Abstract

Trees and other biomass burned during wildland fires may have significant levels of radioactivity present in their tissues that has been accumulated and concentrated from the soil during growth. Some of these radioactive components may be released to the atmosphere during wildland fires.

We have measured the radioactivity of the wood samples using an ultra-low background high-volume high purity germanium gamma ray spectrometer. This detector employs a sodium iodide (Tl doped) anti-coincidence shield and multi-layer shielding arrangement in a concrete shielded laboratory to reduce the background count rate to an extremely low level. We also employed conventional sodium iodide gamma spectrometers in a 'nearly $4\text{-}\pi$' configuration to measure total activity of the samples. The samples were counted for 24 hours and analyzed both for specific gamma ray lines and total radioactivity. We present the results of these experiments taken using Douglas fir, Ponderosa pine and Rocky Mountain juniper wood samples from the Bitterroot Study Forest in Montana. We will measure the airborne radioactivty from a wildland fire using a high volume air sampler during the Spring of 2003.

Concept

We have used conventional low-background gamma ray counting techniques to measure the radioactivity of samples of common wood species from the Rocky Mountains of the United States. The wood samples consisted of 7.5 cm cubes from freshly cut trees. Gamma radiation spectra were acquired and analyzed for total radioactivity and specific activity in several line features.

Two gamma spectrometer systems were used detectors were used to study the wood radioactivity. On system used a dual detector with ~ 3 pi steradian counting solid angle that employs two 7.5 cm diameter X 7.5 cm NaI cylindrical shell detector employed as an anti-coincidence jacket. This detector configuration is shown in Figure 2. Background-subtracted data from the large solid angle NaI dtectors is shown for two different wood samples in Figures 3 and 4.

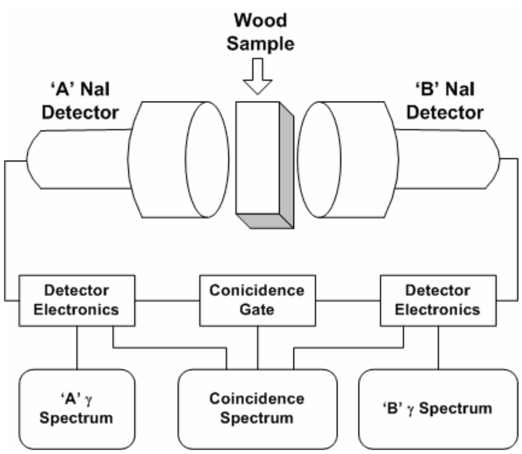

Figure 1 - Sodium iodide gamma spectrometer

The two 7.5cm X 7.5cm detector crystals cover about 3p steradians for efficient detection of weak lines. We use the detectors singly and in coincidence to look for gamma decay and positron emission coincidence events. The spectra are recorded with a FAST™ computer-based multichannel scanner system. Not shown is the multi-element shield that surrounds the detectors and samples during counting.

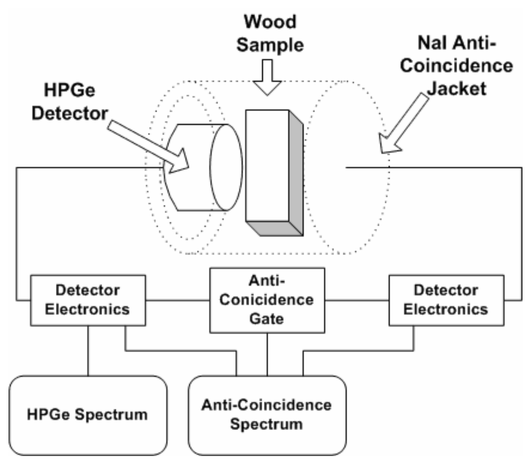

Figure 2 - High purity germanium detector with anti-coincidence jacket

The cylindrical NaI crystal is used to reduce background in anti-coincidence. This system is less sensitive than the NaI detector due to a smaller detector volume and reduced solid angle ($< 2\pi$) but has very low background and very high spectral resolution. Not shown is the multi-element shield that surrounds the detectors and samples during counting.

Figure 3 - Gamma spectrum from Douglas fir

An integral gamma spectrum from the detectors in Figure 1 for a XXX gm sample of Douglas fir. Note the prominent peaks blah blah

Figure 4 - Gamma spectrum from Rocky Mountain juniper

An integral gamma spectrum from a XXX gm sample of Rocky Mountain juniper.