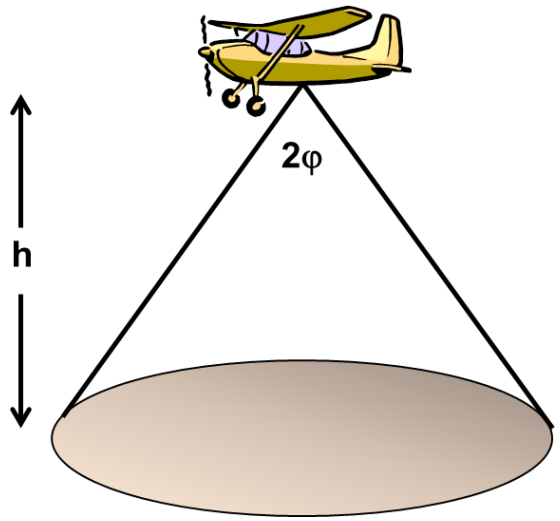
Fields of view for airborne gamma-ray detectors

One of the characteristics of gamma radiation is that it is quite penetrating—gamma-rays from the radioactive decay of K, U and Th in the ground can penetrate through hundreds of metres of air before being completely absorbed in the atmosphere. This raises the question of what the "footprint" of an airborne gamma-ray measurement is. Or, put another way, what is the "field of view" of an airborne detector at a given height. To get an insight into this, we can calculate what percentage of the detected gamma radiation originates from within a circle of specified diameter beneath the detector.

Consider a 2-layer model with the earth as an infinite half-space with uniform density and radioelement concentrations overlain by non-radioactive air. Grasty (1987) and others have shown that the radiation due to a thick circular source expressed as a percentage of the radiation due to an infinite source is given by

$$P = 100\left(\frac{E_2(\mu h) - \cos\varphi E_2(\frac{\mu h}{\cos\varphi})}{E_2(\mu h)}\right)$$



where h is the detector height above ground level, μ is the linear attenuation coefficient of the gamma rays due to either K, U or Th in air, E_2 is the exponential integral of the second kind, and the circular source subtends an angle of 2φ at the detector.

The equation above is for a spherical detector. Tewari and Raghuwanshi (1987) give the expression for the rectangular detectors (40.6×10.2×10.2 cm) in common use today. The figures on the next 3 pages show the field of view for K, U and Th for rectangular detectors over a range of detector heights. These show that the "field of view" represented by a typical airborne sample is much larger than the 60-70 m interval over which 1-s airborne gamma-ray samples are typically acquired.

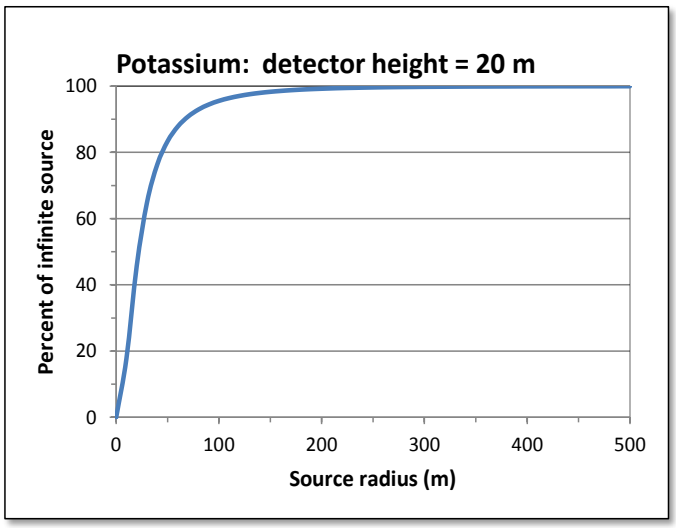
References

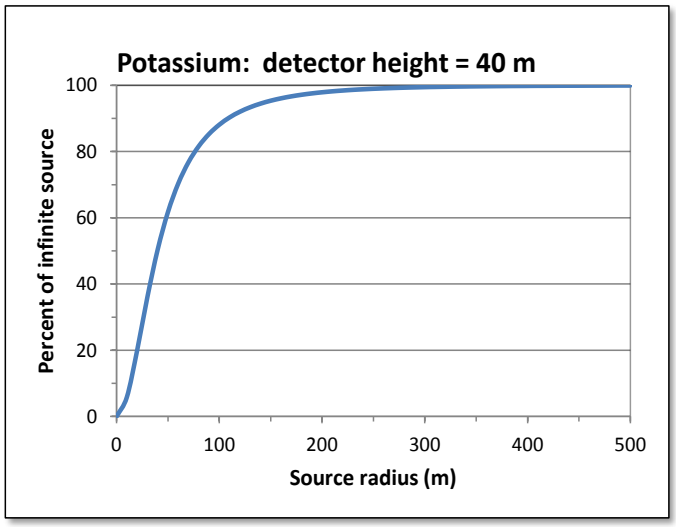
Grasty, R.L., 1987, Gamma-ray spectrometric methods in uranium exploration—theory and operational procedures. Geological Survey Canada Economic Geology Report 31, 147-161.

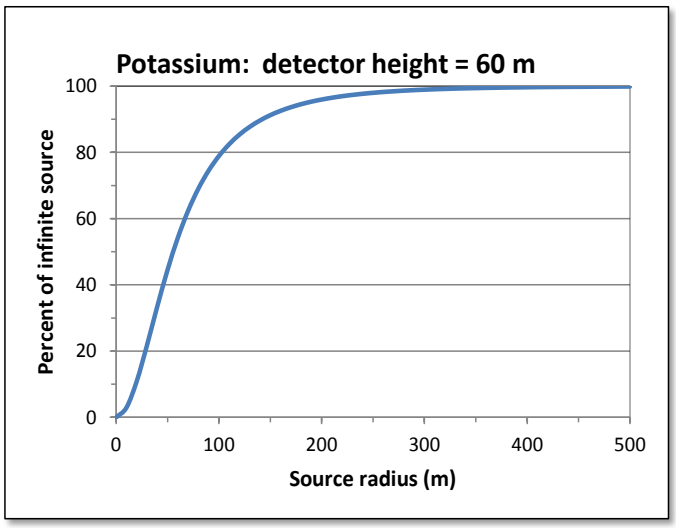
Tewari, S.G., Raghuwanshi, S.S., 1987, Some problems on the range of investigation in airborne gamma-ray spectrometry. Uranium, 4(1), 67-82.

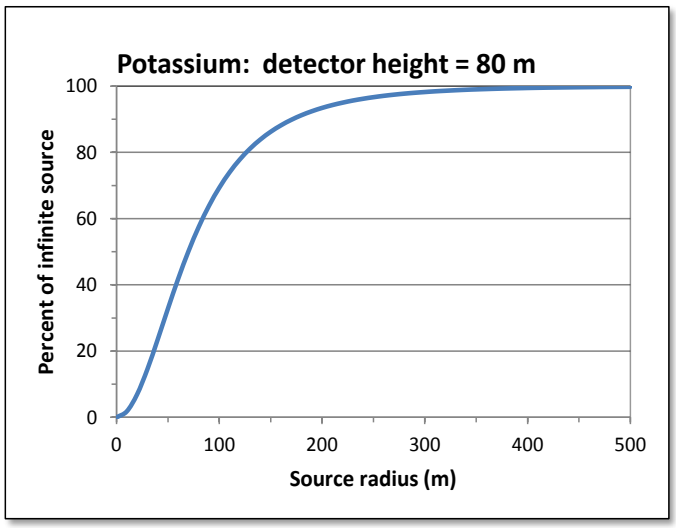
FIELDS OF VIEW

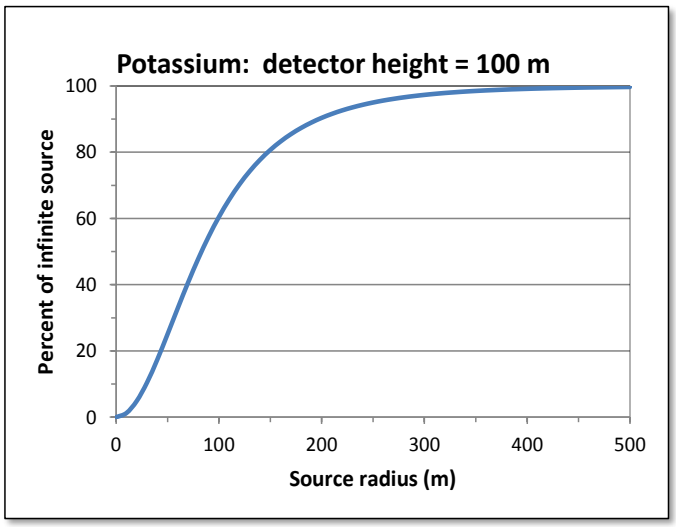
POTASSIUM

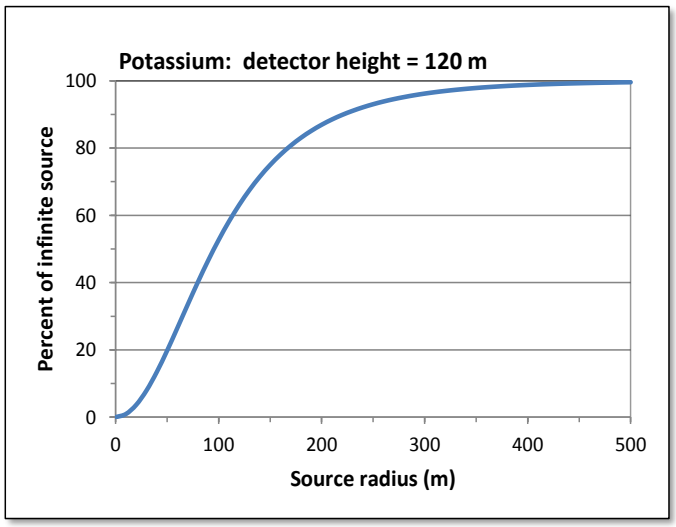






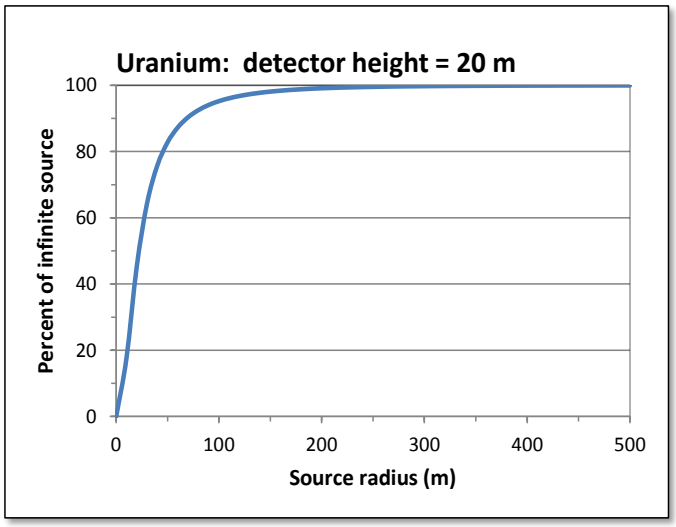


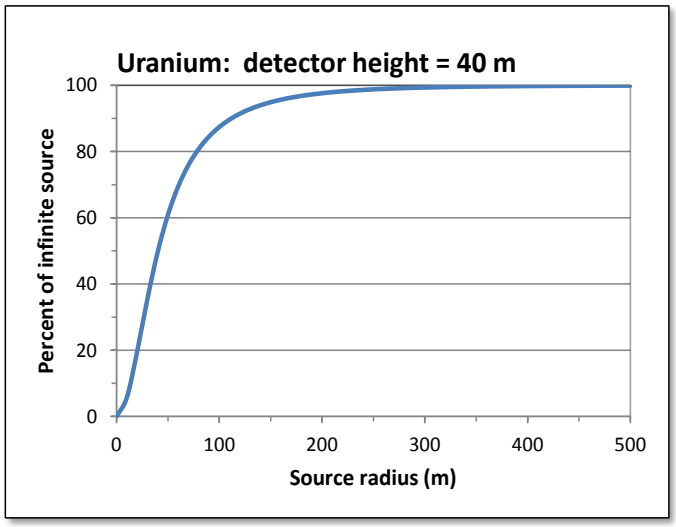


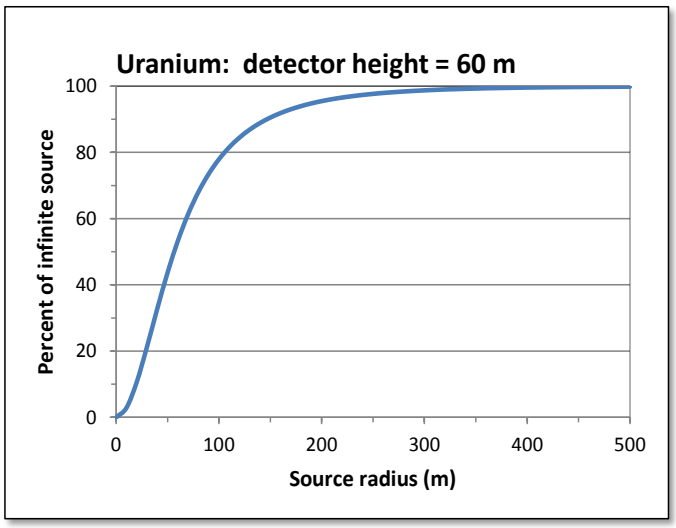


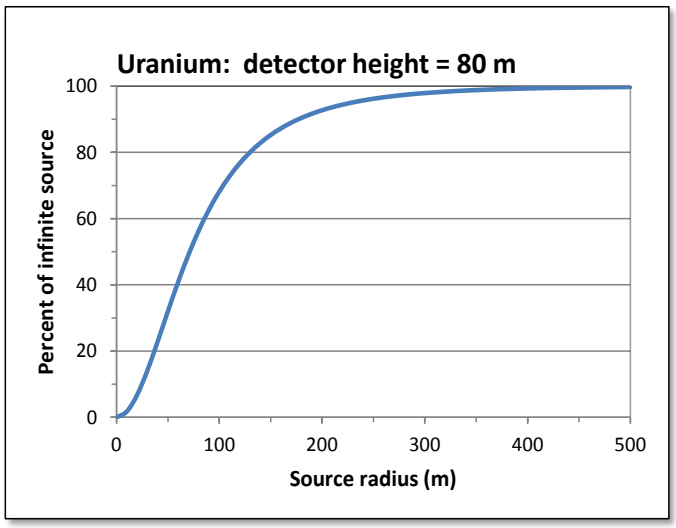
FIELDS OF VIEW

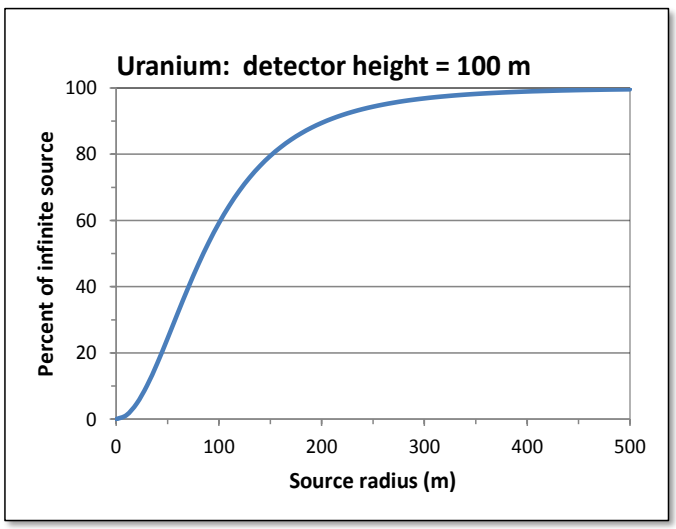
URANIUM

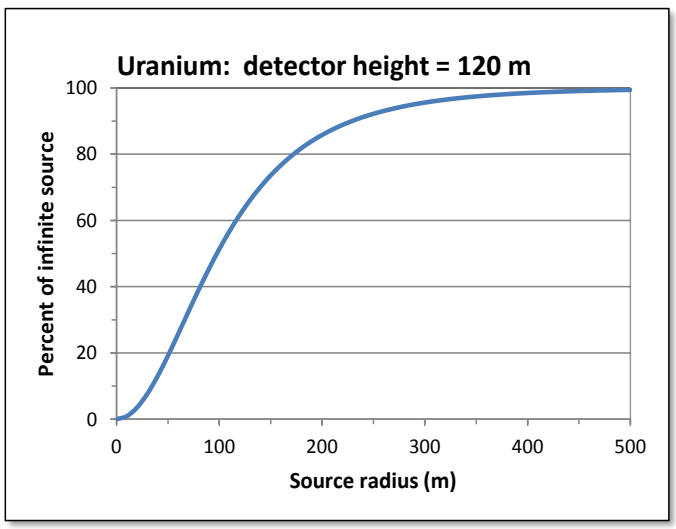












FIELDS OF VIEW

THORIUM