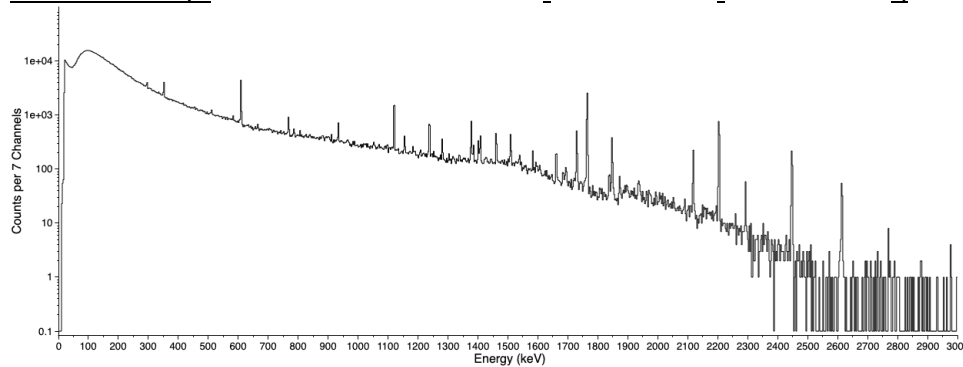*Figure 1* Overview of spectrum collected by 40% HPGe detector.

A law enforcement officers personal radiation detector alarmed in a vehicle parking lot. The officer isolated the source to being located underneath the concrete. A spectrum of the source was then taken with a 40% HPGe detector directly above the hotspot, with the detector face 2 cm above the pavement. From a nearby pothole it was estimated the cement is 4 cm thick. No background is provided, and there was no effort to use $1/r^2$ to estimate source depth.

Information you will need:
The file "buried_source_40%_HPGe.n42" shown in Figure 1 is the item of interest spectrum.

For this problem you can assume:
- Concrete has an areal density of 2.3 g/cm² and an effective atomic number of 11.3.
- Soil has a 35% water content, giving an areal density of 1.6 g/cm², and effective atomic number of 9.8.
    - See InterSpec shielding database for "Concrete" and "Wet Soil (35% H2O)".
- You can use the "HPGe 40%" detector response function (DRF) included in the N42 file (if opened in InterSpec), or the similar DRF included with InterSpec is acceptable.
- For other programs, you can assume the detector has a face diameter of 6.6 cm, and an *intrinsic efficiency* equation of: $exp(-2.0333 - 0.657987 * ln(x) + 0.0331352 * ln(x)^2 - 0.176174 * ln(x)^3 - 0.077921 * ln(x)^4 + 0.010443 * ln(x)^5 + 0.00134222 * ln(x)^6)$ (x is in MeV)
    Detector calibration data available at: https://github.com/sandialabs/InterSpec/tree/master/tutorials/make_drf/cal_data_HPGe

Questions:
a) What isotope is present?
b) How far below the pavement is the source buried?
c) What is the activity of the source?

Hint:
- You can use the relative attenuation of different energy photo-peaks to determine the amount of soil between the source and concrete.
- InterSpec's "Activity/Shielding Fit" tool allows using multiple shielding materials, and selecting whether to fit their thickness using the relative attenuation.