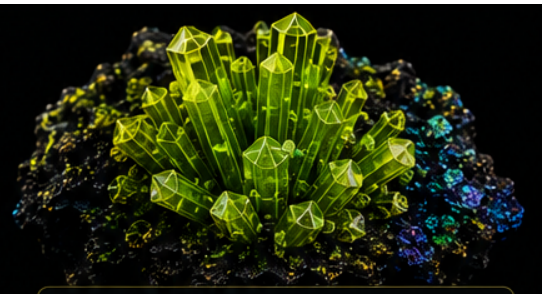
U-ROCKS
Uranium Specimens & Scientific Samples

IDENTIFICATION GUIDE
IN GAMMA SPECTROSCOPY



IDENTIFY URANIUM MINERALS WITH CONFIDENCE

Gamma spectroscopy is a powerful, non-destructive tool for identifying a uranium minerals by their unique gamma-ray "fingerprints." This guide explains the key gamma emitters, signature peaks, and best practices for accurate mineral identification.

NON-DESTRUCTIVE
Preserves your specimen's integrity.

HIGHLY SENSITIVE
Detects and identifies elemental signatures.

ACCURATE
Unique gamma-ray fingerprints.

EFFICIENT
Fast analysis with reliable results.

SCIENTIFIC
Data you can trust and document.

KEY GAMMA EMITTERS IN URANIUM MINERALS

^{238}U Series (Uranium)
- ^{234}Th
- ^{214}Bi
- ^{214}Pb

^{235}U Series (Uranium)
- ^{207}Tl

^{232}Th Series (Thorium)
- ^{228}Ac
- ^{208}Tl

Primary Indicator
Common Indicator
Variable/Daughter

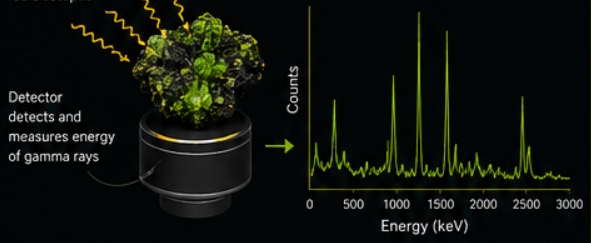
Note: Peak intensities depend on secular equilibrium, matrix effects, and detector efficiency.

1. HOW GAMMA SPECTROSCOPY WORKS

Gamma rays emitted by naturally occurring radioisotopes

Detector detects and measures energy of gamma rays

Spectrum shows peaks at specific energies (keV) that act as a fingerprint.

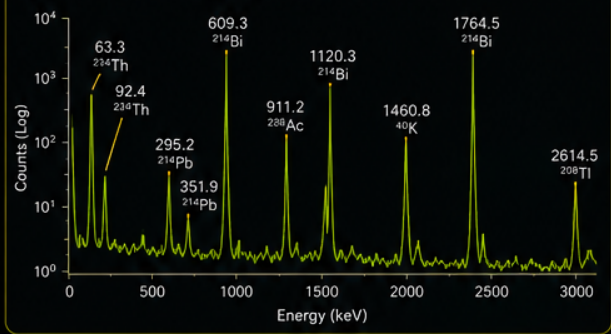


2. KEY GAMMA-RAY ENERGIES (KEV)

Radionuclide (Source)	Gamma Energy (keV)	Intensity (Relative)	Use for Identification
^{234}Th	63.3	Medium	Uranium series indicator
^{234}Th	92.4	Medium	Uranium series indicator
^{214}Pb	295.2	High	Uranium series indicator
^{214}Pb	351.9	High	Uranium series indicator
^{214}Bi	609.3	Very High	Strong uranium indicator
^{214}Bi	1120.3	High	Strong uranium indicator
^{214}Bi	1764.5	High	Strong uranium indicator
^{207}Tl	583.2	Medium	U-235 series indicator
^{228}Ac	911.2	Medium	Thorium series indicator
^{208}Tl	583.2	Medium	Thorium series indicator
^{40}K	1460.8	High	Common background

Note: Energies may vary slightly depending on calibration.

3. TYPICAL URANIUM SPECTRUM



4. IDENTIFICATION STRATEGY

1. **CALIBRATE YOUR SYSTEM**
   Use a multi-nuclide reference source to calibrate energy and efficiency.
2. **ACQUIRE A BACKGROUND SPECTRUM**
   Measure background in the same environment and subtract or account for peaks.
3. **MEASURE THE SPECIMEN**
   Ensure proper geometry and counting time to get good statistics.
4. **IDENTIFY KEY PEAKS**
   Match observed peaks to the table of key energies. Look for multiple lines.
5. **CONFIRM WITH PATTERN**
   A true identification is based on a pattern of multiple peaks, not a single line.

5. COMMON URANIUM MINERALS & GAMMA SIGNATURES

Mineral	Chemical Formula	Key Gamma Indicators (keV)	Notes
Autunite	$Ca(UO_2)_2(PO_4)_2 \cdot 10\text{–}12H_2O$	295.2, 351.9, 609.3, 1120.3, 1764.5	High U, often strong peaks
Torbernite	$Cu(UO_2)_2(PO_4)_2 \cdot 8\text{–}12H_2O$	295.2, 351.9, 609.3, 1120.3, 1764.5	Similar to autunite
Uraninite	UO_{2-x}	295.2, 351.9, 609.3, 1120.3, 1764.5	Matrix effects common
Carnotite	$K_2(UO_2)_2(VO_4)_2 \cdot 3H_2O$	295.2, 351.9, 609.3, 1120.3, 1764.5	May show elevated 1460.8
Brannerite	$(U,Th,Ti)_2O_6$	295.2, 351.9, 609.3, 1120.3, 1764.5	May include Th peaks
Zeunerite	$Cu(UO_2)_2(AsO_4)_2 \cdot 12H_2O$	295.2, 351.9, 609.3, 1120.3, 1764.5	Often weak/variable peaks

TIP: Many uranium minerals contain varying amounts of ^{238}U and may be out of secular equilibrium. Use multiple peaks and ratios for the most reliable ID.

6. BEST PRACTICES

- Use a high-purity germanium (HPGe) detector for best resolution.
- Keep consistent geometry between samples and standards.
- Count longer for weak or low-activity specimens.
- Consider self-absorption and matrix effects.
- Document all spectra with settings and conditions.
- When in doubt, corroborate with other methods (XRF, XRD, chemical tests).

SAFETY FIRST: Always follow radiation safety guidelines. Use shielding, distance, and dosimetry as appropriate.

7. EQUIPMENT ESSENTIALS

HPGe Detector
High resolution for precise peak identification.

Multi-Channel Analyzer (MCA)
Processes and displays the spectrum.

Lead Shielding
Reduces background and improves detection limits.

Sample Holder
Consistent positioning improves accuracy and repeatability.

Calibration Sources
Use certified multi-nuclide sources for energy and efficiency calibration.