South Valley University

Faculty of Science

Geology Department

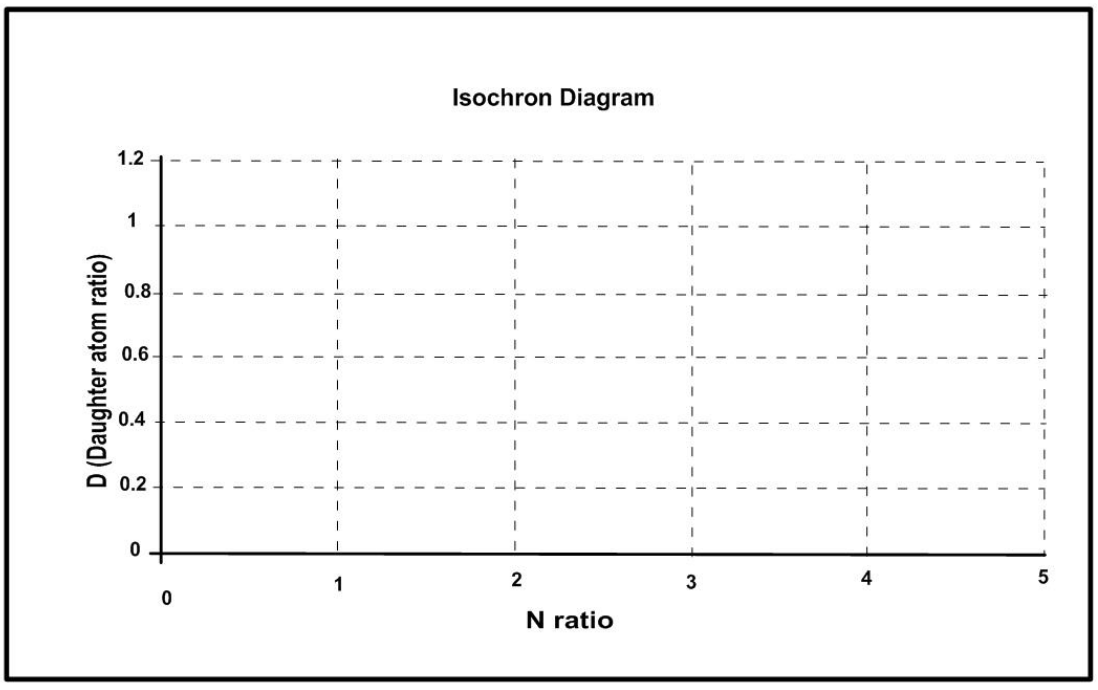
Practical radiometry for 4th Year Geophysics students

Lab No. (1)

Suppose you found granite with datable minerals in it like uranite (uranium-bearing minerals). What is the age of the granite?

You choose to use the U238-Pb206 dating method where t 1/2 =4500000000 years, D=0.11, N=0.12, parent and daughter isotope ratios are given in the following table

N(U238/U237)	D(Pb206/U237)
1	0.4
2	0.6
3	0.8
5	1.2



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Lab No. (2)

1. Using MS Xcel enter the following real data and calculate the age of the sample The decay constant is

$$\lambda = 1.42 \times 10^{-11} yr^{-1}$$

$$\frac{^{87}Sr}{^{86}Sr} = \left(\frac{^{87}Sr}{^{86}Sr}\right)_{\circ} + \frac{^{87}Rb}{^{86}Sr}(e^{\lambda t} - 1)$$

Y = b + x (m)

Sm-Nd, Rb-Sr, and U-Pb geochronology of the Guichicovi Complex, Precambrian Research 96, 245-262 (1999)

Sample	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	$^{147}Sm/^{144}Nd$	$^{143}Nd/^{144}Nd$
G08-4	0.3759	0.71058	0.1071	0.51204
G09–6	0.8837	0.71779	0.1132	0.51208
G23	0.0433	0.71152	0.1086	0.51208
G11	0.1571	0.71128	0.1609	0.51248
Mx05a	0.1771	0.70930	0.1755	0.51263
Mx10-1	0.1696	0.70521	0.1817	0.51275
G09–4	0.1232	0.70875	0.1278	0.51220
Mx05-2	0.2420	0.70883	0.1546	0.51248
Mx09	0.0149	0.70984	0.1229	0.51213
Mx04a	0.0619	0.70433	0.1188	0.51208
Mx06-2	0.1272	0.70632	0.1710	0.51252
Mx10-2	0.0567	0.70387	0.1310	0.51219
G01	1.1328	0.70818	0.1074	0.51205
G04-3	1.2365	0.73093	0.0886	0.51183
G18-2	1.9544	0.73706	0.1486	0.51242
G22	0.2626	0.70858	0.1244	0.51218
G03-3	0.1038	0.70535	0.1364	0.51220
G05-2	4.2842	0.76314	0.1388	0.51217
G21-4	0.2810	0.71338	0.1395	0.51230
G24	1.4007	0.73361	0.1294	0.51208
G29	4.7074	0.80336	0.1112	0.51174
G31	2.1819	0.73851	0.1343	0.51199
G35	2.6330	0.73480	0.1237	0.51204
G51	0.5537	0.71454	0.1328	0.51215

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Lab No.(3)

Calibration of portable gamma ray spectrometer

During a ground survey for searching for uranium , the measurements were 120, 90,and 30 cps in the windows of K, U, and Th respectively. If the background readings were 25, 20, and 10 cps for the windows of K,U and Th respectively , convert the count rates to elemental concentrations using the stripping ratio method.

The sensitivities of the spectrometer are in the table.

sensitivities	K window	U window	Th window
Counts/ s per 1% K	3.36	0	0
Counts / s per 1 PPm eU	0.250	0.325	0.011
Counts/ s per 1 ppm eTh	0.062	0.075	0.128

$\frac{s3u}{s2u}$ b = $\frac{s3k}{s1k}$ g = $\frac{s2k}{s1k}\frac{s1u}{s2u}$ **a** = = = $\frac{s2th}{s3th}$ β= $\frac{s1th}{s3th}$ γα

is the thorium into uranium stripping ratio, equal to the ratio of counts detected in α the uranium window to those detected in the thorium window from a pure thorium source.

β is the thorium into potassium stripping ratio for a pure thorium source.

γ is the uranium into potassium stripping ratio for a pure uranium source.

a is the reversed stripping ratio, uranium into thorium, equal to the ratio of counts detected in the thorium window to those detected in the uranium window from a pure source of uranium.

b is the potassium into thorium stripping ratio for a pure potassium source.

g is the potassium into uranium stripping ratio for a pure potassium source.

The stripping method uses the “stripping ratios” to estimate elemental count rates in each window before converting these to concentrations. Assuming that stripping ratios $b = g = 0$, the net count rates, $n_{ij,}$ of the j-th radioelement in a specific energy window, i, are given by

$$n3th = \frac{(n3 - n3Bg) - a\,(n2 - n2Bg)}{1 - \alpha\, a}$$

$$n\,2u = n2 - n2Bg - \alpha\, n3th$$

$$n1k = n1 - n1Bg - \beta\, n3th - \gamma\, n2u$$

and the **concentrations** are given by:

$$Ck = \frac{n1k}{s1k}$$

$$Cu = \frac{n2u}{s2u}$$

$$Cth = \frac{n3th}{s3th}$$

The concentration are in % K, ppm eU and ppm eTh.

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(Lab No 4)

Calibration of portable gamma ray spectrometer

During a ground survey for searching for uranium , the measurements were 100,80,and 25 cps in the windows of K, U, and Th respectively. If the background readings were 20, 15, and 12 cps for the windows of K,U and Th respectively , convert the count rates to elemental concentrations using the stripping ratio method.

The sensitivities of the spectrometer are in the table.

sensitivities	K window	U window	Th window
Counts/ s per 1% K	3.36	0	0
Counts / s per 1 PPm eU	0.250	0.325	0.011
Counts/ s per 1 ppm eTh	0.062	0.075	0.128

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Lab No.(5)

During airborne survey, the observed count rates were 110,85, and 31 cps in the windows of K, U, and Th respectively. The background readings were 25, 20, and 10 cps for the widows of K, U, and Th respectively. The flight height is 122 m, the instrument sensitivities are 90.98 cps/% for K, 9.14 cps/ppm for U, and 7.02 cps/ppm for Th.

The attenuation coefficients (per meter) of count rate with increasing height are 0.008255, 0.007963, 0.00645 for K, U, and Th respectively.

The stripping ratios at ground level are:

α	0.2527	a	0.0676
β	0.3616	b	0
γ	0.8155	g	0.0175

Variation (increase) of stripping ratios with height above ground (per meter) is 0.0004895, 0.0006469, and 0.0006874 for α, β, and γ respectively.

If the radar altimeter reading is 125 m, the ambient temperature is 25°C, and the barometric pressure is 100 kPa convert the observed count rates to elemental concentration.

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Lab No.(6)

During airborne survey, the observed count rates were 212.1,30.3, and 45.5 cps in the windows of K, U, and Th respectively. The background readings were 25, 20, and 10 cps for the widows of K, U, and Th respectively. The flight height is 122 m, the instrument sensitivities are 90.98 cps/% for K, 9.14 cps/ppm for U, and 7.02 cps/ppm for Th.

The attenuation coefficients (per meter) of count rate with increasing height are 0.008255, 0.007963, 0.00645 for K, U, and Th respectively.

The stripping ratios at ground level are:

α	0.2527	a	0.0676
β	0.3616	b	0
γ	0.8155	g	0.0175

Variation (increase) of stripping ratios with height above ground (per meter) is 0.0004895, 0.0006469, and 0.0006874 for α, β, and γ respectively.

If the radar altimeter reading is 125 m, the ambient temperature is 25°C, and the barometric pressure is 100 kPa convert the observed count rates to elemental concentration.

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Lab No.(7)

During airborne survey, the observed count rate was 100 cps and the flight height is 150 m where the nominal survey terrain clearance is 200 m, calculate the height-corrected count rate at air temperature = 30°C and barometric pressure 100 KPa (The attenuation coefficient (per meter) = 0.002).

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Lab No.(8)

The half-life of ^{235}U is 704 x 10^6 yr and of ^{238}U is 4468 x 10^6 yr . The ratio $^{235}U/^{238}U$ in a sample is 0.007257 . given that the ratio was 0.4 at the time of formation, calculate the sample's age .