

## Comparison of EPA duplicate samples to Brown and Caldwell samples for uranium

For locations that have sat undisturbed for longer than a year (such as soil samples where the contaminants have been in the soil for more than a year and only subject to normal weathering), thorium-234 can be assumed to be in radioactive equilibrium with uranium-234 and uranium-238. Since uranium-238 comprises 99.3% of the mass of natural uranium, the specific activity (pCi/g) of uranium-238 can be used to convert activity concentrations (pCi/g) to mass concentrations (mg/kg).

Assuming the uranium-238 activity is the same as the thorium-234 activity in the EPA samples and dividing by the specific activity of uranium-238,  $3.398 \times 10^5$  pCi/g, yields uranium mass concentration on a g/g basis. Multiplying this result by  $1 \times 10^6$  to convert it to mg/kg yields a value in comparable units to the samples taken by Brown and Caldwell.

Analysis of the duplicate sample data indicates the following:

- All samples and all duplicate samples are below the Industrial PRG for uranium by more than an order of magnitude.
- Sample:Duplicate ratio
  - Max: 1.28
  - Min: 0.23
  - Average: 0.58
  - Std Dev.: 0.23
- The relative values of the two samples for each location are reasonable given the differences in the analysis methodologies. There does appear to be a relative bias in that the thorium-234-based results are consistently higher which may warrant further investigation at a later date.

Location Name	Sample Name	ARC Primary Sample			EPA Split Sample			Calculated Result			
		Analyte	Result	Unit	Analyte	Result	Unit	Split Result (as Uranium)	Unit	Primary: Split ratio	%RPD
PA-EE14	PA-EE14-1	Uranium	1.2	mg/kg	Th-234	1.14	pCi/g	3.4	mg/kg	0.36	95
	PA-EE14-5	Uranium	1.2	mg/kg	Th-234	0.99	pCi/g	2.9	mg/kg	0.41	83
	PA-EE14-10	Uranium	1	mg/kg	Th-234	0.6	pCi/g	1.8	mg/kg	0.57	55
	PA-EE14-15	Uranium	4.9	mg/kg	Th-234	1.81	pCi/g	5.3	mg/kg	0.92	8
	PA-EE14-20	Uranium	2	mg/kg	Th-234	1.02	pCi/g	3.0	mg/kg	0.67	40
PA-HH10	PA-HH10-5	Uranium	1.3	mg/kg	Th-234	0.84	pCi/g	2.5	mg/kg	0.53	62
	PA-HH10-10	Uranium	2.1	mg/kg	Th-234	1.15	pCi/g	3.4	mg/kg	0.62	47
	PA-HH10-15	Uranium	2	mg/kg	Th-234	0.53	pCi/g	1.6	mg/kg	1.28	25
	PA-HH10-20	Uranium	1.7	mg/kg	Th-234	0.89	pCi/g	2.6	mg/kg	0.65	43
PA-HH11	PA-HH11-5	Uranium	1.4	mg/kg	Th-234	0.95	pCi/g	2.8	mg/kg	0.50	67
	PA-HH11-25	Uranium	1.6	mg/kg	Th-234	1.04	pCi/g	3.1	mg/kg	0.52	63
PA-HH8	PA-HH8-5	Uranium	1.6	mg/kg	Th-234	1	pCi/g	2.9	mg/kg	0.54	59
	PA-HH8-10	Uranium	1.8	mg/kg	Th-234	0.97	pCi/g	2.9	mg/kg	0.63	45
	PA-HH8-15	Uranium	2	mg/kg	Th-234	1.18	pCi/g	3.5	mg/kg	0.58	54
	PA-HH8-20	Uranium	1.7	mg/kg	Th-234	1.5	pCi/g	4.4	mg/kg	0.39	89
	PA-HH8-25	Uranium	1.1	mg/kg	Th-234	1.19	pCi/g	3.5	mg/kg	0.31	104
PA-P17	PA-P17-15	Uranium	1.4	mg/kg	Th-234	0.7	pCi/g	2.1	mg/kg	0.68	38
	PA-P17-25	Uranium	1.5	mg/kg	Th-234	0.93	pCi/g	2.7	mg/kg	0.55	58
PA-P19	PA-P19-20	Uranium	2.2	mg/kg	Th-234	3.2	pCi/g	9.4	mg/kg	0.23	124