LBL's Radioactive Survey Results to Date 20-April-1990

(see separate report for Schott Glass and Schott liner results)

Sample	Description	Weight (gm)	U (ppm)	Th(ppm)	K(percent)	other(as labelled)
1 (NaI)	Furnace Liner from Tanner white chalky fire-brick(?)	968	0.285±0.057	0.210±0.019	0.016±0.003	-
2 (NaI)	Philips PMT components enough for 3 tubes see separate list for full component listing	150	0.136±0.017	0.402±0.053	0.524±0.003	-
3 (NaI)	Corning spacers from (2)	14.2			5.33±0.08	-
4 (NaI)	Burle PMT components					
	Ceramic wafers (all white+green coated)	372	0.21±0.02	0.28±0.06	0.016±0.003	-
	Ceramic wafers (all white)	86	0.41±0.06	0.23±0.20	0.017±0.010	-
	Internal Hardware (enough for 2 PMT)	250	0.26±0.02	0.58±0.06	0.053±0.003	-
	Pin end assemblies (3): wires, ceramic rings broken glass ends	260	0.68±0.02	0.26±0.06	1.05±0.01	-
	Kovar (from 2.5 PMT) cut pieces	1150	0.002±0.003	0.036±0.008	0.0033±0.004	~2pCi ^{60}Co
	Ceramic Posts (96) off-white, glazed	187	1.24±0.05	2.49±0.15	0.076±0.007	-
5 (NaI)	Bases with pins (10) black plastic (I believe these are Ham)	373	0.92±.02	5.67±0.08	0.051±0.004	-
6 (NaI)	Large Ham PMT assemblies (1 of four)	764	0.19±0.01	0.22±0.02	0.021±0.001	-
7 (NaI)	Raw Materials from Omega Reflector					
	Magnesium Fluoride Aluminium Compound X (Pr-O)	184	3.77±0.12	1.16±0.28	0.049±0.016	-
8 (Ge)	Omega Reflector Sample (see attached note regarding this sample)	0.435	0.5 0.63±0.05(^{234}Th) 0.83±0.09(^{234m}Pa) <0.003(^{214}Bi)	0.5 <0.01(^{228}Ac) 0.36±0.02(^{208}Tl)	-	-

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Note 1: Measurements based on NaI counting. These measurements, above items 1-7, were done in a hurry-up fashion with the NaI(Tl) scintillation crystal γ-spectrometer at the LBL Low Background Facility. More accurate quantitative results can be obtained with our Ge-crystal systems, but will take much longer. These NaI results reflect the apparent uranium concentration, based on the ^{226}Ra content of the samples, the apparent thorium concentration, based on the ^{228}Th content and the true potassium concentrations.

Since the measured U-series and Th-series nuclides give rise to most of the potentially interfering g-rays, this information is directly useful to establishing limits on permissible concentrations.

Conversions to pCi quantities are:

1.0 g U = 0.336 pCi U 1.0 g Th = 0.109 pCi Th

Note 2: Some explanation is in order regarding Item 8, the Omega Reflector Sample. The U-values obtained from the ^{234}Th and ^{234m}Pa are reliable indicators for ^{238}U, provided the measurement is done at least 3 months following the most recent *serious* chemistry. The U-values obtained from ^{214}Bi are reliable indicators for ^{226}Ra ONLY, and need have nothing to do with the true U-content. In this case, we believe the aluminium-chemistry is highly selective to remove RADIUM, while allowing some (or all) of the THORIUM and URANIUM to pass through into the final product.

The Th-values obtained from ^{228}Ac are reliable indicators of ^{228}Ra ONLY, unless it is know the sample has not undergone *serious* chemistry for about 20 years. We do not have a direct measure of ^{232}Th content through γ-ray spectrometry. The Th-values obtained from ^{208}Tl are reliable indicators of ^{228}Th ONLY, with time constraints as mentioned above. If the aluminium is very young --if the ^{228}Ac lines are virtually absent-- then the ^{208}Tl determination will give nearly the correct ^{232}Th value. (^{228}Th half-life is 1.9 years.) In the present case, ^{228}Ac lines are virtually undetectable, and so the ^{208}Tl measurement should be reasonably accurate (always an underestimate).*(except, see below). Incidentally, this sample has the lowest relative ^{228}Ac activity (compared to ^{208}Tl line intensities) of any aluminium sample we have ever measured!

I do have a thought concerning the strange disagreement between the INAA and Direct Counting methods for ^{232}Th content of these aluminiums. I refer to the apparent (large) excess ^{228}Th compared to ^{232}Th. Recovery of metallic aluminium requires a process that formerly employed a natural mineral called cryolite. I believe the process now uses artificially produced "cryolite". It is possible this manufactured cryolite brings the excess ^{228}Th. Suppose the making of cryolite uses a chemistry which retains RADIUM, but excludes THORIUM. The *excess* ^{228}Th grows into the cryolite (from ^{228}Ra). Then, in the aluminium recovery, the RADIUM is excluded but the THORIUM is retained (^{228}Th); hence, the strange ratio of the two thorium isotopes.

I think this possibility needs clarification. It suggests we may be making serious overestimates (in the long term) for

intensity of the 2614 keV γ-ray, based on ^{208}Tl determinations. Such a study should follow the production of both aluminium and cryolite (or maybe some other component?) form raw materials right through to finished products. An LBL/Guelph collaboration sounds good to me.

signed
Al Smith