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NRDL MARSHALL ISLAND RESURVEY - 1956

RESULTS OF ANALYSES PERFORMED AT HASL

MEDICINE, HEALTH & SAFETY

470

Laboratory Report 56-7

by

E. P. Hardy

W. R. Collins

7238/3108/P02

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NRDL MARSHALL ISLAND RESURVEY - 1956

RESULTS OF ANALYSES PERFORMED AT HASL

During February of 1956 a survey team from the U. S. Naval Radiological Defense Laboratory collected samples of marine life, land plants, water and soil, and lagoon and ocean water on or near selected islands in the Marshall group. Some of the collected samples were sent to HASL for fission product analysis. In some cases portions of specimens were retained at NRDL for inter-laboratory cross-checking purposes. A complete listing of samples received including those selected for analysis is given in Table 1.

The marine, water, and urine samples were received in good condition but many of the vegetation specimens were in a severe state of decay upon arrival at HASL. Furthermore, some samples were received unsealed so that the contents had leaked out and were on the outside of their own and other containers. It was felt that this could be a source of cross contamination in addition to the loss of the leaking samples.(1) For this reason and because of limited time and manpower, only selected samples were subjected to analysis. However, all of the marine and vegetation samples received (with the exception of coconut shell) were wet-ashed using nitric acid, diluted to known volumes, and stored

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in polyethylene containers. Concentrations are based on the weight of the material at the time it was received at HASL. Consequently, all radiochemical and analytical results are reported here in terms of d/m or grams, per gram of material as received at HASL. Dr. H. Weiss has stated via letter(2) that the wet weights of the plant specimens were not recorded at the time of collection. He has proposed that the results be expressed in terms of d/m/kg of material as received at NRDL.

For determination of total beta activity an aliquot of the solution of wet-ashed material was transferred to a glass planchet, evaporated and dried under an infra-red lamp. Counts were converted to disintegrations by applying a geometry factor based on K^{40} as a standard. A self-absorption correction was also applied in each case.* Under the wet ashing and plating conditions used at HASL possible loss of volatile fission products such as Ru^{106} - Rh^{106} is avoided.(3) For practical reasons, the coconut outer and inner shells were dry ashed at 500°C prior to dissolution.

* For the particular specimen type under consideration, several values of activity vs. dry weight of the plated aliquot were plotted and a smooth curve fitted for the points. Another curve (based on extrapolation to zero mass) of activity ratio (A/A_o) was drawn and used for determining the self-absorption correction. See Figures 2 through 8.

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The procedure outlined in NYO-4617 was followed for the radiochemical analysis of Sr^{90}. The Cs^{137} analyses were performed by S. Tarras using a method which to date has not been documented. It involves the coprecipitation of cesium with ammonium alum to eliminate mixed fission products as well as potassium, then a final precipitation as the chloroplatinate. Radiochemical and gravimetric yields of 95% are attainable. The samples were analyzed for calcium by C. Baxter employing the oxalate-permanganate titration method(4).

As a check on radiochemical purity, beta absorption analyses were carried out by N. Hallden(5) on the Cs^{137} fractions of two pooled urine samples (specimens collected at Utirik and Likiep), one water sample (HASL #3457), and one soil (HASL #3462). In each case Cs^{137} was positively identified and there was no evidence of other interfering isotopes. The radioactive decay of the Y^{90} fractions of the urine samples was followed over a period of one hundred hours. Within statistical limits concurrence with the theoretical half-life was observed.

Analytical results are shown in Tables 2 through 6. The error term accompanying each absolute result represents one standard deviation due to the error in counting. The only available interlaboratory cross-check data are given in Table 7. These

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results were obtained from Dr. S. Cohn by phone on April 24, 1956. A follow-up letter from Dr. Cohn[6] expressed his idea that the discrepancy in the beta count probably lies in the conversion from c/m to d/m. NRDL used Sr^{90} - Y^{90} as a standard in this case and for purposes of comparison, the HASL results were also standardized against Sr^{90} - Y^{90}. It is felt that the use of K^{40} as a standard allows the best approximation of the energy for mixed fission products among the available long-lived isotopes[7].

As an aid in evaluating these data, Figure 1 and Table 8 are included.

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REFERENCES

1. Memorandum from Dr. J. H. Harley to Mr. M. Eisenbud, "Rongelap Resurvey Samples from NRDL", April 17, 1956.

2. Letter of May 9, 1956 from Dr. H. Weiss to Edward Hardy.

3. Memorandum from G. Hamada to Dr. J. H. Harley, "The Effect of the Wet Ashing Technique Used at HASL on Ruthenium Volatilization", March 29, 1956.

4. Private communication, Mr. I. B. Whitney.

5. "Analyzing Beta Absorption Graphically to Identify Emitters", J. H. Harley and N. Hallden, Nucleonics, 13, 1, January 55, pp 32-35.

6. Letter of May 2, 1956 from Dr. S. Cohn to Mr. I. B. Whitney.

7. HASL Laboratory Report 56-1, "Standardization and Operation of Fallout Counters", N. A. Hallden and J. H. Harley.

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TABLE 1

NRDL MARSHALL ISLAND RESURVEY - 1956

Samples Received at HASL

(samples analyzed at HASL shown in parenthesis)

MARINE ORGANISMS - 65 (23), received 3/6/56

	Rongelap	Gejen	Eniaetok	Eniwetak	Sifo	Utirik	Likiep	Kabelle
Fish - 37 (13)								
Unicorn	1			1				
Mullet	1							
Surgeon	1 (1)	1 (1)		1 (1)		2 (2)		
Damsel	1 (1)			1 (1)		2 (2)	1 (1)	1 (1)
Sea Cucumber	1							1
Bl. Tip Shark								1
Trigger								1
Siganus					1		1	1
Butterfly					1 (1)		1 (1)	1 (1)
Snapper		1		1	1			
Squirrel		1			1	1		
Parrot			1		1	1		
Angel			1		1			
Goat			1					
Sergeus					1			
Sea Bass							1	
Crab - 11	3	1	1		3	3		
Clam - 2	2							
Snail 9 (4)	2	4 (4)*				2		1
Coral 6 (6)	1 (1)	1 (1)	1 (1)			2 (2)	1 (1)	
LAND PLANTS - 77 (14), received 4/3/56								
Coconuts - 26 (5)	3 (3)	3	4	4	4	4 (1)*	4 (1)*	
Portulaca 6	1	1	1	1		1	1	
Pandanus - 18 (2)	3 (2)*	2	3	2	2	3	3	
Papaya - 9	3					3	3	
Arrowroot 14 (7)	2 (1)*	2 (1)*	2 (1)*	2 (1)*	2 (1)*	2 (1)*	2 (1)*	
Banana - 2							2	
Taro - 2							2	
SOIL - 21 (13), received 4/3/56	3	3 (2)*	3 (3)*	3 (2)*	3 (2)*	3 (2)*	3 (2)*	
LAND WATER - 7 (6), received 4/3/56								
Well - 4 (4)						2 (2)	2 (2)	
Cistern - 2 (1)	1 (1)					1 (1)*		
Lens - 1 (1)			1 (1)					
SEA WATER - 14 (14), received 4/3/56								
Ocean - 7 (7)	1 (1)*	1 (1)*	1 (1)*	1 (1)*	1 (1)*	1 (1)*	1 (1)*	
Lagoon - 7 (7)	1 (1)*	1 (1)*	1 (1)*	1 (1)*	1 (1)*	1 (1)*	1 (1)*	
URINE - 24 (24), received 3/29/56	5 (5) (Majuro)					10 (10)	9 (9)	

* Interlaboratory cross-check samples.

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TABLE 2

NRDL - MARSHALL ISLAND - RESURVEY - 1956

Results of Analyses Performed at HASL

MARINE ORGANISMS

HASL #	NRDL #	Sampling Location	Organism	Tissue	C-Date Total Activity	Total Activity d/m/gram*	Sr^{90} d/m/gram*	Cs^{137} d/m/gram*	Ca grams/gram*	S. U.	% Sr^{90}
3336	1519	Rongelap	Surgeon	Entire	4- 9-56	52± 6.4	±0.10				
3337	1512	Rongelap	Damsel	Entire	4- 9-56	37± 6.0					
3350	1541	Kabelle	Butterfly	Entire	4- 9-56	lost	lost				
3351	1542	Kabelle	Damsel	Entire	4- 9-56	125± 8.0	2.8 ±0.55		0.031	41 ± 8.1	2.3
3354	1622	Gegen	Surgeon	Entire	4- 9-56	235± 8.9					
3369	1555	Sifo	Butterfly	Entire	4- 9-56	95± 5.7	≤0.81		0.024	≤15	
3374	1564	Eniwetak	Damsel	Entire	4- 9-56	20± 6.2	≤0.15		0.033	≤ 2.1	
3376	1559	Eniwetak	Surgeon	Entire	4- 9-56	34± 6.9			0.033		
3379	1606	Likiep	Butterfly	Entire	4- 9-56	51± 6.2			0.023		
3380	1615	Likiep	Damsel	Entire	4- 9-56	11± 6.5	0.37±0.23		0.037	4.5± 2.8	3.4
3383	1593	Utirik	Surgeon	Entire	4- 9-56	22± 5.4			0.015		
3384	1574	Utirik	Damsel	Entire	4- 9-56	14±11			0.039		
3385	1577	Utirik	Damsel	Entire	4- 9-56	22± 6.7			0.038		
3387	1572	Utirik	Surgeon	Entire	4- 9-56	18± 6.0			0.022		
3346	1522	Rongelap	Coral		4-10-56	35±17					
3357	1635	Gejen	Coral		4-10-56	310±22	≤0.62		0.31	≤0.91	
3363	1534	Eniaetok	Coral		4-10-56	205±20	3.1 ±0.42		0.35	4.1± 0.55	1.5
3381	1617	Likiep	Coral		4-10-56	≤15	≤0.45		0.30	≤0.68	
3393	1601	Utirik	Coral		4-10-56	≤18	≤0.27		0.26	≤0.47	
3394	1589	Utirik	Coral		4-10-56	21±15	0.48±0.14		0.24	0.91±0.27	2.3
3326	1636	Gejen	Spider Snail	Entire	4-23-56	520±10	4.4 ±0.39	13 ±0.48	0.018	110 ± 9.8	0.85
3327	1637	Gejen	Spider Snail	Entire	4-23-56	2180±29	1.3 ±0.34	4.0±0.48	0.0072	82 ±21	0.061
3328	1638	Gejen	Scorpion Snail	Entire	4-23-56	23310±290	1.1 ±0.44	3.4±1.5	0.0085	57 ±24	0.0046
3329	1639	Gejen	Scorpion Snail	Entire	4-23-56	9800±120	1.5 ±0.58	7.1±1.1	0.0125	55 ±21	0.015

* Weight as received at HASL

TABLE 3

NRDL - MARSHALL ISLAND RESURVEY - 1956

Results of Analyses Performed at HASL

LAND PLANTS

HASL #	NRDL #	Sampling Location	Organism	Tissue	C-Date	Total Activity d/m/gram*	Sr^{90} d/m/gram*	Cs^{137} d/m/gram*	Ca grams/gram*	S. U.	% Sr^{90}	% Cs^{137}
3437	521	Rongelap	Coconut	Outer & Inner Shell	4-17-56	26±0.7	0.22 ±0.01		0.00022	450± 21	0.85	
				Milk	4-17-56	43±1.7	0.11 ±0.10	19 ±2.7	0.00020	260±230	0.26	44
3438	523	Rongelap	Coconut	Outer Husk	4-17-56	71±1.7			0.00038			
				Inner Shell	4-17-56	26±0.7	0.14 ±0.06		0.00013	480±210	0.52	
				Meat and Milk	4-17-56	99±2.2	0.047±0.039		0.00001	2140±1800	0.048	
3439	525	Rongelap	Coconut	Outer Husk	4-17-56	66±1.7	0.70 ±0.04		0.00085	375± 21	1.1	
				Inner Shell	4-17-56	35±0.7	0.081±0.071		0.00015	245±215	0.23	
				Meat and Milk	4-17-56	87±2.1	0.080±0.043		0.00020	186± 98	0.094	
3513	752	Utirik	Coconut	Entire	4-17-56	51±2.0	2.7 ±0.1		0.0096	104± 4.7	5.3	
3534	803	Likiep	Coconut	Entire	4-17-56	10±0.7	0.046±0.02		0.00031	67± 29	0.45	
3441	535	Rongelap	Pandanus	Entire	4-14-56	42±1.9	0.26 ±0.11	16 ±3.7	0.00010	1180±500	0.62	38
3442	536	Rongelap	Pandanus	Entire	4-14-56	30±1.5	≤0.16		0.00010	≤730		
3447	558	Rongelap	Arrowroot	Entire	4-14-56	lost	lost					
3456	856	Gegen	Arrowroot	Entire	4-14-56	300±4.1	3.6 ±0.15	250 ±5.4	0.0012	1370± 57	1.2	83
3476	580	Eniaetok	Arrowroot	Entire	4-14-56	180±3.8	1.4 ±0.82	54 ±1.6	0.00060	1050±620	0.77	30
3492	726	Eniwetak	Arrowroot	Entire	4-14-56	67±2.1	0.20 ±0.06	17 ±0.6	0.00060	155± 45	0.30	25
3505	674	Sifo	Arrowroot	Entire	4-14-56	59±2.2	0.19 ±0.03	36 ±1.0	0.0026	32± 5.2	0.31	61
3519	756	Utirik	Arrowroot	Entire	4-14-56	26±1.6	0.22 ±0.06	17 ±2.8	0.00003	3300±910	0.84	65
3541	807	Likiep	Arrowroot	Entire	4-14-56	7.3±1.1	≤0.13	3.8±2.1	0.00070	≤85		52

* Weight as received at HASL

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TABLE 4

NRDL - MARSHALL ISLAND RESURVEY - 1956

Results of Analyses Performed at HASL

HASL #	SOIL NRDL #	Sampling Location	Depth	C-Date Total Activity	Total Activity d/m/gram*	Sr^{90} d/m/gram*	Cs^{137} d/m/gram*	Ca grams/gram*	S. U.	% Sr^{90}	% Cs^{137}
3482	605	Eniaetok		4-21-56	65± 45	≤0.42		0.318	≤0.60		
3483	608	Eniaetok		4-21-56	≤41	1.6±0.42		0.286	2.6±0.67		
3431	600	Eniaetok		4-14-56	290± 40	20 ±0.8		0.314	29 ±1.2	6.9	
3549	819	Likiep		4-21-56	≤53	≤0.47		0.335	≤0.64		
3548	814	Likiep		4-21-56	≤65	1.2±0.71		0.275	2.0±1.2		
3494	734	Eniwetak		4-21-56	≤61	≤0.58		0.369	≤0.71		
3493	728	Eniwetak		4-14-56	3000± 93	80 ±1.4		0.347	104 ±1.8	2.7	
3463	847	Gegen		4-21-56	120± 69	1.0±0.48		0.348	1.3±0.63	0.84	
3462	842	Gegen		4-14-56	69400±470	1640 ±2.4	1535±60	0.305	2440 ±3.6	2.4	2.2
3530	768	Utirik		4-21-56	≤73	3.4±0.72		0.342	4.6±0.96		
3529	762	Utirik		4-14-56	1600± 92	49 ±1.3		0.281	79 ±0.21	3.1	
3507	682	Sifo		4-21-56	≤57	≤0.55		0.355	≤70		
3506	676	Sifo		4-14-56	620± 79	28 ±1.0		0.353	36 ±1.3	4.5	

* Weight as received at HASL.

TABLE 5

NRDL - MARSHALL ISLAND RESURVEY - 1956

Results of Analyses Performed at HASL

HASL #	WATER NRDL #	Sampling Location	Type	C-Date Total Activity	d/m/l Total Activity *	d/m/l Total Activity **	Sr^{90} d/m/l	Cs^{137} d/m/l	% Sr^{90}	% Cs^{137}
3457	543	Rongelap	Well or Cistern	5-8-56	2500±32	1530±32	590±21	310±20	24	12
3480	599	Eniaetok	Lens	5-8-56		560±23		130±12		
3526	785	Utirik	Well	5-8-56	37±15	≤20		44± 5.2		
3527	787	Utirik	Well	5-8-56	34±15	≤19		35±16		
3528	788	Utirik	Cistern	5-8-56		43±20		49±18		
3520	757	Utirik	Well	5-8-56		28±20		27± 4.6		
3547	830	Likiep	Well	5-8-56	18±16	≤20		34±13		
3458	1003	Rongelap	Lagoon	5-11-56		≤26		35± 5.4		
3459	1036	Gejen	Lagoon	5-11-56		≤21				
3478	1007	Eniaetok	Lagoon	5-11-56		≤20		22±16		
3497	1028	Eniwetak	Lagoon	5-11-56		≤19		32± 5.4		
3509	1023	Sifo	Lagoon	5-11-56		≤20		24±10		
3525	1030	Utirik	Lagoon	5-11-56		≤19				
3546	1032	Likiep	Lagoon	5-11-56		≤20		31±10		
3460	1002	Rongelap	Ocean	5-11-56		49±18		34± 2.2		
3461	1034	Gejen	Ocean	5-11-56		≤18				
3479	1008	Eniaetok	Ocean	5-11-56		≤23		39± 2.2		
3496	1027	Eniwetak	Ocean	5-11-56		25±19				
3510	1024	Sifo	Ocean	5-11-56		≤19				
3524	1029	Utirik	Ocean	5-11-56		≤21		41± 2.2		
3545	1031	Likiep	Ocean	5-11-56		45±19		43± 3.0		

* Sample directly plated

** Sample scavenged with $Fe(OH)_3$

TABLE 6

NRDL MARSHALL ISLAND RESURVEY - 1956

Results of Analyses Performed at HASL

HASL #	HUMAN URINE NRDL #	Sampling Location	Collection Date	Name	Age	Total Volume Received (ml)	C-Date Total Activity	Total Activity d/m/l *	Total Activity d/m/l **	Sr^{90} d/m/l	Cs^{137} d/m/l
3399	6	Utirik	2-11-56	Tonika	4	190	3-25-56	4800±240			
3400	1	Utirik	2-11-56	Milton	2	250	3-25-56	3600±280			
3401	4	Utirik	2-11-56	Isso	12	570	3-25-56	3360±320			
3402	9	Utirik	2-11-56	Kramer	27	440	3-25-56	3320±300			
3403	10	Utirik	2-11-56	Elas	22	135	3-25-56	7600±240		3.4±0.3	720±15
3404	7	Utirik	2-11-56	Deodor	5	180	3-25-56	4400±280			
3405	2	Utirik	2-11-56	Allick	16	285	3-25-56	8200±360	170±100		
3406	3	Utirik	2-11-56	Kai	6	310	3-25-56	2200±320			
3407	8	Utirik	2-11-56	Jamul	16	340	3-25-56	3480±240			
3408	11	Utirik	2-11-56	POOLED		620	3-25-56	7600±320	≤100	6.8±1.4	2540±63
3409	4	Likiep	2-11-56	Likimento		260	3-25-56	4400±320			
3410	1	Likiep	2-11-56	Matilna	3	360	3-25-56	4400±320			
3411	8	Likiep	2-11-56	Alma	8	160	3-25-56	4800±320			
3412	9	Likiep	2-11-56	Mela	1	225	3-25-56	4000±240			
3413	5	Likiep	2-11-56	Meork	26	235	3-25-56	4800±320		5.3±0.3	1487±23
3414	3	Likiep	2-11-56	Jodën	13	410	3-25-56	9600±360	600±100		
3415	2	Likiep	2-11-56	Klara	35	600	3-25-56	2920±280	≤100		
3416	7	Likiep	2-11-56	Wine	45	190	3-25-56	8800±320			
3417	10	Likiep	2-11-56	POOLED		990	3-25-56	9200±360	≤100	4.7±0.7	2862±45
3418	9	Majuro***	2-29-56	Billiet	24	980	3-25-56	2600±240			
3419	40	Majuro	2-29-56	John	31	990	3-25-56	2400±240			
3420	36	Majuro	2-29-56	Jekras	8	1000	3-25-56	1160±200		2.4±0.2	33±8
3421	26	Majuro	2-29-56	Iroji	13	930	3-25-56	2200±240			
3422	76	Majuro	2-29-56	Norrio	11	990	3-25-56	1360±280			
		CONTROL	3-26-56	(pooled sample collected at HASL)		1000		4250±250	≤100	1.6±0.4	29±8
		Control	June 1956	(pooled sample collected at HASL)		5000				1.4±0.2	
		Control	June 1956	(pooled sample collected at HASL)		5000				1.9±0.2	
		Control	June 1956	(pooled sample collected at HASL)		5000				1.0±0.2	
		Control	June 1956	(pooled sample collected at HASL)		2000					30±8

* Direct plating
** Carbonate precipitation
*** Rongelap natives

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TABLE 7

NRDL MARSHALL ISLAND RESURVEY - 1956

INTERLABORATORY COMPARISON

(Snail Solutions Prepared at NRDL from Specimens Collected on Gejen Island)

			Total β Activity (d/m/gram-wet)			Total γ Activity (d/m/gram-wet)	Sr^{90} (d/m/gram-wet)	
HASL #	NRDL #	Type	HASL*	HASL†	NRDL°	NRDL	HASL	NRDL
3326	1636	Spider	520 ± 10	570 ± 11	877	378	4.4 ± 0.39	
3327	1637	Spider	2180 ± 29	2400 ± 32	2965	1605	1.3 ± 0.34	
3328	1638	Scorpion	23310 ± 290	25600 ± 300	29700	9150	1.1 ± 0.44	
3329	1639	Scorpion	9800 ± 120	10800 ± 125	14250	4640	1.5 ± 0.58	

* Standardized against K^{40}

† Standardized against Sr^{90}- Y^{90}

o Standardized against Sr^{90}- Y^{90}

NOTE: Wet weights furnished by NRDL
NRDL results forwarded by phone to I. B. Whitney
from S. Cohn on April 24, 1956.

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TABLE 8

NRDL MARSHALL ISLAND RESURVEY - 1956

TOTAL β ACTIVITY - d/m/gram*

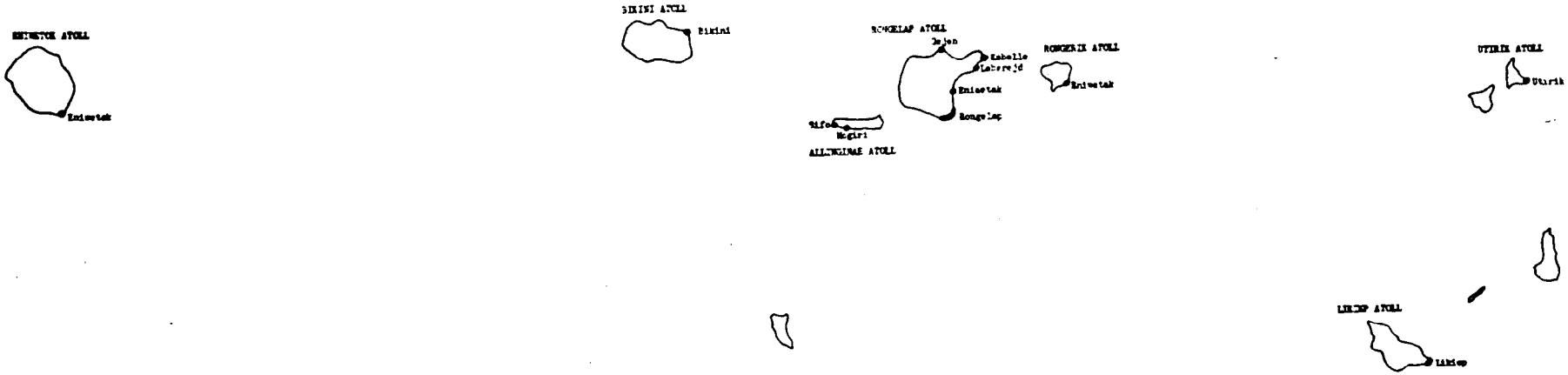
	Rongelap	Eniaetok	Kabelle	Gejen	Eniwetak	Sifo	Utirik	Likiep
FISH								
Surgeon	52				34		22; 18	
Damsel	37		120	230	20		14; 22	11
Butterfly						95		51
CORAL	35	200		310			≤18; 21	≤15
SNAILS								
Spider				520; 2200				
Scorpion				23,000; 9800				
LAND PLANTS								
Coconuts								
Outer Husk	71;66 } 26						} 51	} 10
Inner Shell	26;35 }							
Meat and Milk	98;87							
Milk	43							
Pandanus	42; 30							
Arrowroot	lost	180		300	67	59	26	7.3
SOIL		290; 65; ≤41		69,000; 120	3000; ≤61	620; ≤57	1600; ≤73	≤53; ≤65
LAND WATER**								
Well							≤20; ≤19; 28	≤20
Cistern	1500						43	
Lens		560						
SEA WATER**								
Ocean	49	≤23		≤18	25	≤19	≤21	45
Lagoon	≤26	≤20		≤21	≤19	≤20	≤19	≤20

* Weight of material as received at HASL

** Samples scavenged with $Fe(OH)_3$

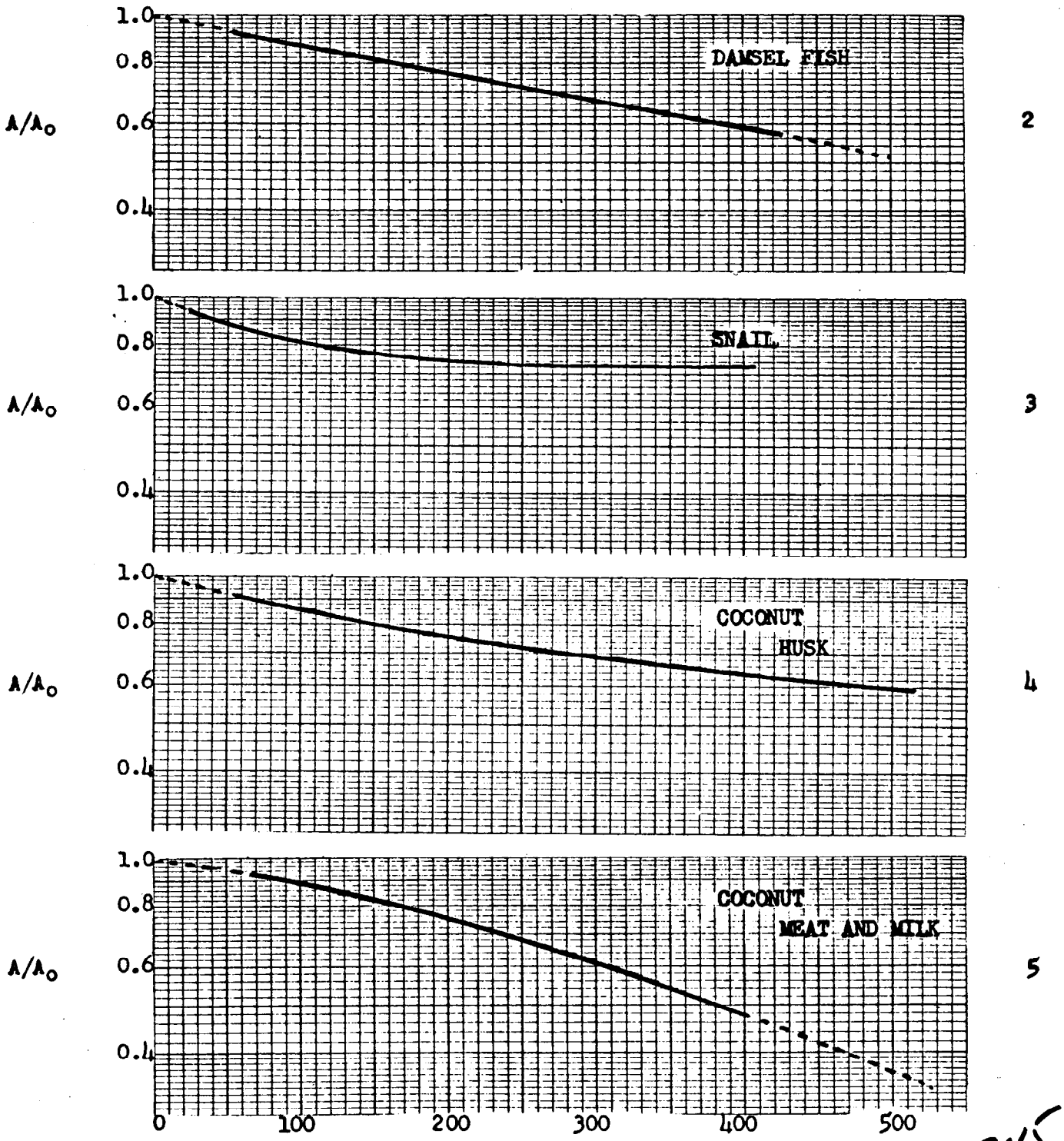
FIGURE 1

LAYOUT SKETCH OF PORTION OF MARSHALL ISLAND AREA



SELF-ABSORPTION CURVES

FIGURE



Residue Weights in Milligrams

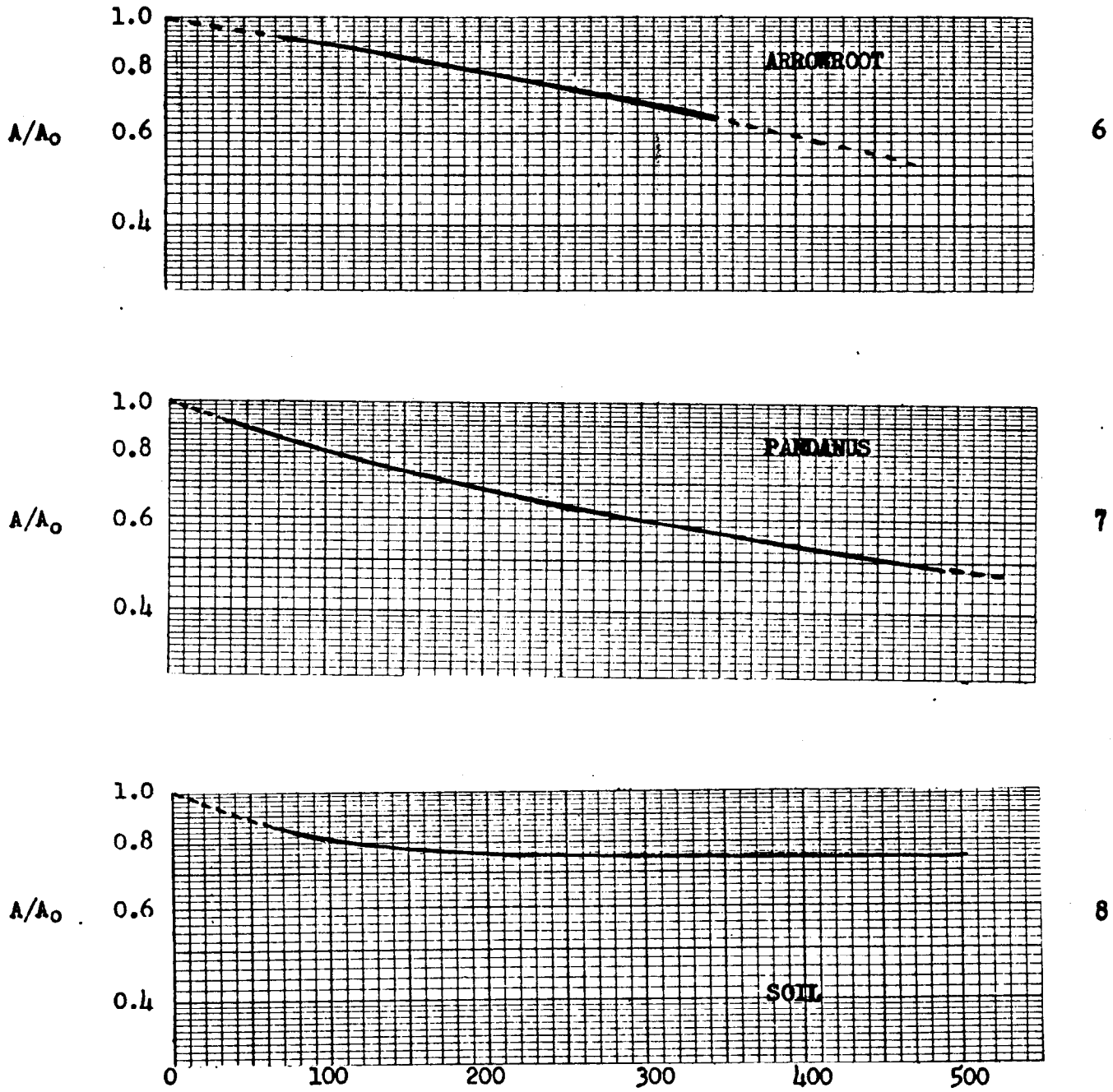
7238/3108/p01 3345

[redacted]

NRDL MARSHALL ISLAND RESURVEY - 1956

SELF-ABSORPTION CURVES

FIGURE



Residue Weights in Milligrams

3346

[redacted]

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