Table 1. Comparison of synthetic and catabolic rates in rabbits. The rates are expressed as the fractions of albumin in the plasma replaced by synthesis or broken down by catabolism per day.

Rabbit No.	Weight (kg)	Fractional synthetic rate	Fractional catabolic rate
727	2.18	.25	.28
728	2.30	.26	.21
731	2.33	.28	.27
788	3.10	.19	.24
733	2.42	.20	.24
Mean		.236	.248

tion of urea in t_0,t_1. By Eq. 2 the latter is readily determined. Thus the left hand side of Eq. 6 is measured, and when multiplied by n gives the total albumin synthesized in the interval t_0,t_1.

If $k_a(t)$ and $k_u(t)$ vary with time, then the above method holds only if $k_a(t)/k_u(t)$ remains constant during the experiment. If this is not so, the rate of albumin synthesis may still be measured. Since, however, the effective experimental time ranges between 1 and 3 hours this is believed short enough for k_a and k_u to remain essentially constant.

Brief technical details of the method are as follows. Immediately after the bladders are completely emptied, one to two hundred microcuries of *l*-arginine G-C^{14} (specific activity 13 mc/mmole) are injected into neomycin-treated rabbits. Blood samples and complete urine collections are then obtained at intervals. Albumin from the plasma is separated by a modification of Korner's method (*7*) and hydrolyzed with $6N$ HCl; the hydrolyzate is treated with arginase. Conway's method (*8*) is used to measure the urea content, and thus the arginine content, of the digest, and also the urea content of the plasma and urine. The C^{14} of arginine-G-C^{14} and urea-C^{14} is liberated as $C^{14}O_2$ by means of arginase and urease; it is absorbed in hyamine and measured in a liquid-scintillation counter.

Table 1 shows comparisons of measurements of the rate of synthesis made by this method with measurements of catabolic rate made with I^{131}-albumin (*5*). The albumin was labeled by the iodine monochloride method (*9*). Measurements of synthesis were made either during the course of the I^{131}-albumin measurements or 1 to 3 weeks before these were started. The average value for the ratio k_a/k_u was 0.0084 and over the course of 5 hours about 20 percent of the administered guanido-C^{14} entered the urea and albumin. Agreement is good considering that rates of synthesis are measured over a few hours but catabolic rates over 1 to 3 weeks.

Further technical details with some kinetic refinements will be described in a later report, but two points must be emphasized. First, the method depends on the assumption that the liver arginine, L, is equally available for the synthesis of urea and plasma albumin. The data of Table 1 offer strong evidence in favor of this assumption, for kinetic analysis shows that if albumin and urea were made at sites not sharing the same arginine "pool," then the probability of obtaining the results in Table 1 is very small. Thus, as noted by McFarlane (*10*) and confirmed by us, when the method is applied to gamma globulin, which is not made in the parenchymal cells of the liver, grossly erroneous results are obtained.

Second, the method requires the isolation of the plasma protein under study in sufficiently pure form. McFarlane's observations (*10*), confirmed by us, emphasize that the most dangerous contaminant is gamma globulin, which may have five to ten times the guanido-carbon specific activity of plasma albumin. Thus gamma globulin must be excluded from the protein being analyzed.

A possible source of error is significant extrahepatic arginase action. The experiments of Table 1 appear to exclude this in the neomycin-treated rabbit (*11*).

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11. The technical aspects of this work have been helped by fruitful discussions with A. S. McFarlane and by his participation in the experiment on rabbit 788. His generosity at the start of our experiments in allowing us to study some of his data, which indicated the common site for synthesis of urea and albumin, permitted the formulation of the kinetics from which our experimental studies followed. Supported by grant H-2262 from the National Heart Institute.

19 December 1962

Gamma Emitters in Marine Sediments near the Columbia River

Abstract. *Samples from sediment cores collected at 26 different locations 5 to 35 miles offshore in and around Astoria Submarine Canyon were analyzed for gamma emitters. Chromium-51 and zinc-65 were the principal radionuclides found, although several fission products and natural potassium-40 were also present. Radioactivity fell off sharply with distance from the mouth of the Columbia River, indicating that the river serves as a common source of the artificial radionuclides.*

The Columbia River is a low-level source of radionuclides formed by neutron activation of impurities in the river water used to cool the nuclear reactors at Hanford, Washington (*1*). Zinc-65 from the river has previously been reported in sessile marine organisms from the intertidal region adjacent to the river mouth (*2*) and in the oceanic plankton at some distance from the Columbia River (*3*). Gross (*4*) found both zinc-65 and chromium-51 in sediments taken off the Oregon-Washington coasts, but the present study is the first effort to measure local variations of the radioactivity in sediments from a restricted area. The area of investigation lies from 5 to 35 miles off the mouth of the Columbia River and includes the upper reaches of Astoria Canyon, a submarine canyon which heads at about 70 fathoms 10 miles offshore and extends some 60 miles to a depth of 1000 fathoms (*5*). Measurements were made on samples from both the submarine canyon and the continental shelf, in water depths ranging from 30 to 640 fathoms.

Sediment cores 1.5 inches in diameter were collected with a Phleger gravity corer from 39 different locations in and around Astoria Canyon from 22 to 24 August 1962; 26 were considered to have sufficiently undisturbed surface sediments of uniformly fine texture to be of use in our study. The samples analyzed range from silty sand to silty clay.

The sediment was carefully extruded about 0.25 inch from the plastic core liners, and the surface layers were removed evenly until the 13-cm^3 spectrometer "counting tube" was filled. Where excess sea water was present above the sediment in the plastic liner, it was carefully decanted to within an inch of the sediment. The remaining excess water was evaporated, but not to the point of drying the sediment. This precaution was taken to avoid pouring off any radioactive material not firmly attached to the sediment particles. All gamma-ray spectra were made with the Hanford low-background anticoincidence spectrometer (*6*), and spectrum analysis was carried out on an I.B.M. 1620 computer.

As a result of Hanford activities, approximately 38 c of zinc-65 (245 days half life) and 850 c of chromium-51 (27.8 days half life) pass Vancouver, Washington, daily enroute to the sea (*1*). Figure 1 shows that the total radioactivity in the sediments due to these two isotopes decreases rapidly with distance from the mouth of the river. Similarly, the total radioactivity due to fission products (zirconium-95, niobium-95, ruthenium-103, and cerium-141) diminishes with distance seaward. Although traces of these radionuclides occasionally are released to the Columbia River at Hanford, most of this material is probably due to radioactive fallout which has been washed into the river. The activity levels of the fission products in the sediments are much lower than were reported earlier for marine organisms taken from this area (*7*). Potassium-40 (1.2×10^9 years), the naturally radioactive isotope which constitutes 0.012 percent of the potassium found in nature, also decreased in a seaward direction, but was appreciably less in the canyon than on the adjacent continental slope and shelf.

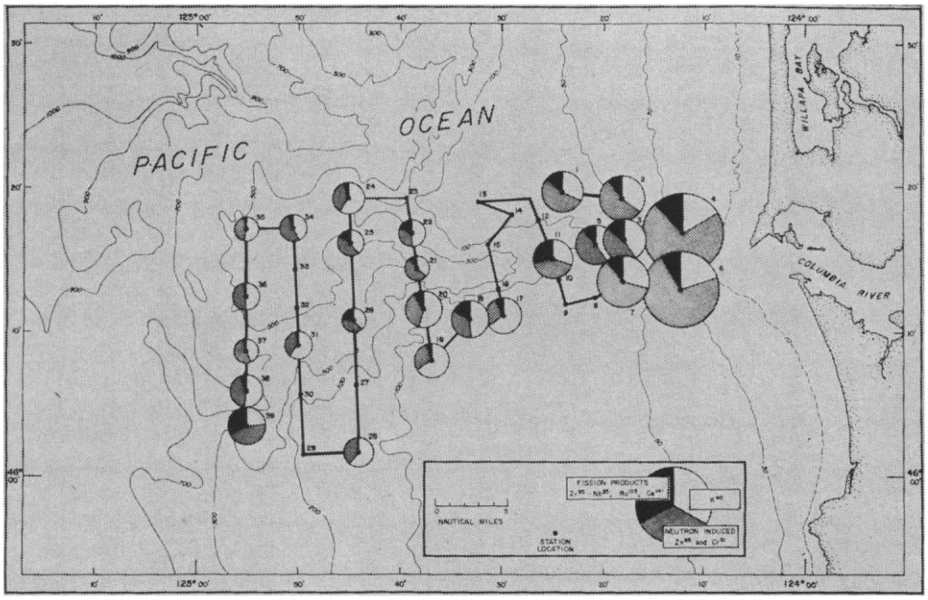

Fig. 1. The areas of the circles are proportional to the total amounts of gamma emitters in 13-cm^3 samples of wet sediments. See Table 1 for abundance of each radionuclide.

Table 1. Total number of picocuries of six gamma emitters in 13 cm^3 of marine sediment collected off the Columbia River. See Fig. 1 for location of samples. Errors listed have been increased by half-life corrections, and include additional statistical errors imposed by uncertainties in the effects of Compton continuum on the photopeaks of gamma emitters of lesser energy. Because of interference from the natural radioactivity of uranium and its daughter products, these techniques are best suited to samples fairly high in artificial gamma emitters.

Sample No.	Wet weight (g)	Abundance (pc)					
		Natural K^{40}	Neutron induced		Fission products		
			Cr^{51}	Zn^{65}	Zr^{95}–Nb^{95}	Ru^{103}	Ce^{141}
1	18.1	186 ± 20	223 ± 47	94 ± 5	38 ± 2	16 ± 2	32 ± 10
2	20.4	270 ± 22	247 ± 44	177 ± 6	38 ± 2	13 ± 5	32 ± 9
3	19.6	276 ± 22	170 ± 43	130 ± 5	46 ± 2	18 ± 5	42 ± 9
4*	20.7	421 ± 24	1183 ± 52	698 ± 9	158 ± 4	45 ± 6	101 ± 10
5	20.7	259 ± 21	191 ± 47	94 ± 5	30 ± 2	14 ± 6	24 ± 10
6	22.4	450 ± 24	1010 ± 51	616 ± 9	94 ± 3	22 ± 6	67 ± 10
7	21.6	311 ± 22	414 ± 45	226 ± 6	57 ± 3	25 ± 6	33 ± 9
11	15.9	132 ± 20	124 ± 40	59 ± 4	75 ± 3	13 ± 5	39 ± 8
17	23.1	352 ± 23	124 ± 44	30 ± 4	17 ± 2	6 ± 5	15 ± 9
18	20.9	262 ± 21	142 ± 47	49 ± 5	39 ± 2	22 ± 6	29 ± 10
19	19.5	279 ± 22	104 ± 43	22 ± 4	6 ± 2	3 ± 5	10 ± 9
20	23.2	302 ± 22	198 ± 48	14 ± 4	18 ± 2	11 ± 6	16 ± 10
21	14.2	54 ± 18	77 ± 37	0 ± 4	4 ± 2	3 ± 5	9 ± 8
22	17.0	101 ± 19	56 ± 43	10 ± 4	22 ± 2	5 ± 5	10 ± 9
24	20.2	197 ± 21	121 ± 41	2 ± 4	5 ± 2	7 ± 6	−3 ± 10
25	14.6	68 ± 19	75 ± 43	5 ± 4	15 ± 2	6 ± 5	4 ± 9
26	15.5	60 ± 18	63 ± 43	5 ± 4	16 ± 2	11 ± 5	10 ± 9
28	21.4	304 ± 22	100 ± 43	4 ± 4	10 ± 2	0 ± 5	2 ± 9
31	16.3	144 ± 20	90 ± 40	2 ± 4	0 ± 2	1 ± 5	4 ± 8
34	17.1	97 ± 19	117 ± 44	3 ± 4	5 ± 2	2 ± 5	6 ± 9
35	21.6	110 ± 19	89 ± 39	4 ± 4	1 ± 2	3 ± 5	1 ± 8
36	15.1	96 ± 19	92 ± 44	2 ± 4	2 ± 2	3 ± 5	0 ± 9
37	14.3	58 ± 18	71 ± 37	0 ± 4	1 ± 2	0 ± 5	4 ± 8
38	17.9	170 ± 20	136 ± 46	7 ± 4	6 ± 2	7 ± 6	5 ± 10
39	16.8	102 ± 19	185 ± 44	16 ± 4	79 ± 3	19 ± 6	45 ± 9

* This sample also had a trace of cobalt-60.

Zinc in sea water is thought to occur as Zn^{++} and ZnCl^{+}, while chromium probably is in its chromate form, CrO$_4^{--}$ (*8*). Owing to their different chemical natures, the two elements should behave differently, and, in fact, zinc-65 is greatly preferred by pelagic marine organisms near the river mouth (*9*). However, there is no such striking difference in amounts of these two radioisotopes in the sediments (Table 1).

Since an equal volume of sea water is comparatively free from radioactivity, the presence of Zn^{65} and Cr^{51} in the sediments must make the background radiation for benthic organisms considerably higher than it is for pelagic animals, although both isotopes are relatively innocuous. The existence of Zn^{65} and Cr^{51} at the mouth of the Columbia River under almost "steady state" conditions (that is, they are being removed by radioactive decay at the same rate that they are being replenished by Hanford activities) should constitute a valuable tool for radioecological studies of benthic organisms.

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10. Supported by the Office of Naval Research [contract NONR 1926(02)] and the Atomic Energy Commission [AT (45-1)1750]. We acknowledge the assistance of R. W. Perkins of General Electric's Hanford Laboratories, and D. R. Jensen, Department of Statistics, Oregon State University.

13 December 1962