

Table 1. Fission track ages of the basalt glass.

Sample No.	Fossil fission tracks	Induced fission tracks	Neutron flux ($\times 10^{15}/\text{cm}^2$)	(million years) Age
109	37	244	4.0	37 ± 6
91	13	200	8.4	34 ± 8
95	9	70	4.0	32 ± 10
Total	59	409*		$35 \pm 5^\dagger$

* Normalized to flux = 4.0×10^{15} . $\dagger$ Standard deviation based on standard deviation of number of tracks.

plastic, and polished the surface. They were etched for 6 minutes with 10 percent hydrogen fluoride, and fossil fission tracks were counted in transmitted light. The samples were etched again, 1 minute at a time for three more times, and tracks were counted after each etch. In all cases the track density remained the same within statistical error. The samples were then sent to a nuclear reactor for neutron irradiation. The neutron flux was calibrated both by beta-counting a 0.1 percent gold wire and by counting fission tracks induced in a calibration glass slide. The two methods agreed with each other within 10 percent. After the irradiation, the samples were again etched for 6 minutes and induced fission tracks were counted. The 6-minute etch dissolved more than 10 μm of surface glass, so that we were looking at what had been an internal surface during the neutron irradiation. To check on this, the samples were etched again twice, for 2 minutes each time, and the induced tracks were counted. In all cases the track count was the same within statistical errors. The data are shown in Table 1. Ages are calculated for each sample from the equation:

$$T = 6.21 \times 10^{-8} (N_f/N_i)F$$

where N_f is the number of fossil tracks; N_i , the number of neutron-induced tracks; and F , the neutron flux (10). The error in the ratio of fossil to induced tracks is the statistical limitation. This is the error that is listed in Table 1. Because all the ages are in agreement within the statistical limit set by the observed number of tracks, it is legitimate to sum these observations and then apply the above equation. This gives an age for the glass of 35 ± 5 million years. This fission track age is probably a very good approximation to the age of eruption of the rock since annealing of tracks (which is sometimes a serious problem in terrestrial materials) has been shown to be completely negligible for this time interval at ambient ocean

water temperatures of near 0°C (9). The three samples were taken at various distances from the surface within this crust. There was no correlation of either fossil or induced fission track density with distance, which shows that there have been no serious weathering effects.

The present sample probably represents the age of the original oceanic crust in the area for the following reasons: (i) It was recovered from a fault scarp that seismic evidence shows to have exposed the acoustic basement, or volcanic second layer, through vertical movement; and (ii) evidence of later volcanic activity on the fault scarp is meager at the dredge site, although postdepositional activity is significant in the vicinity (2).

The age determined for this sample is in agreement with that extrapolated by Heirtzler *et al.* for profile V-20 S.A. in the South Atlantic. According to the experimental error, the true age of the sample may be as young as 30 or as old as 40 million years. Taking the extrapolated age as 31.75 million years, the implied maximum deviation from linearity in the spreading rate for that profile is +5.5 and -26 percent. Taking the true age as 35 million years the deviation is around -10 percent.

Heirtzler and his colleagues have written a series of papers (4, 7, 11, 12) in which they speculate on the probable temporal history of spreading in the world's ocean basin based on the assumption that profile V-20 S.A. is the result of continuous and linear seafloor spreading. Our date generally upholds the proposed anomaly time scale of Heirtzler *et al.* (7) for the last 35 million years and the suggestion of other authors of significant time-variation in the spreading rate in various parts of the ocean basin (4; 11-13).

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Strontium-90 Concentration Factors of Lake Plankton, Macrophytes, and Substrates

Abstract. *The ratio of concentration of strontium-90 in living and inert lake components to that in lake water (concentration factors) was determined for plankton, macrophytes, and substrates in eutrophic, mesotrophic-eutrophic, and dystrophic Latvian lakes. Concentration factors of strontium-90 in aquatic organisms and substrates are higher in a dystrophic lake than in the other types.*

Among environmental factors caused by man, the effects of man-made radionuclides are unique (1). Despite previous work on radioecology of aquatic organisms (1, 2), accumulated knowledge is insufficient for solving hydrobiological problems resulting from the use of atomic energy. One such problem involves the role of living and inert lake components in the cycling of strontium-90. Concentration factors (CF), that is, the ratio of a radionuclide in a lake component to that in water, of ^{90}Sr have been studied in the laboratory in planktonic crustacea from Lake Bolshoe Miasovo (3). Accumulation of ^{90}Sr by unicellular and filamentous algae (4), by *Cladophora* sp. and *Myriophyllum* sp. in English lakes (5), and by some freshwater plants (6) has been studied. We have now

Table 1. Strontium-90 concentration factors from a eutrophic lake, 1967.

Sample size	Mean concentration factors		Density of zooplankton		Dominant zooplankters
	Ash weight	Wet weight	Count (10 ³ /m ³)	Weight (g/m ³)	
4	1,298 ± 618*	18 ± 10	May 470	3.4	<i>Bosmina coregoni gibbera</i> , <i>B. longirostris</i> , <i>Chydorus sphaericus</i>
9	705 ± 81	14 ± 5	June 326	3.7	<i>B. coregoni gibbera</i> , <i>C. sphaericus</i> , <i>Daphnia cucullata</i>
8	1,374 ± 450	20 ± 6	July 289	4.2	<i>B. crassicornis</i> , <i>B. coregoni gibbera</i> , <i>C. sphaericus</i>
10	385 ± 85	11 ± 1	August 186	3.4	<i>Sida crystallina</i> , <i>B. crassicornis</i> , <i>B. coregoni gibbera</i>
10	595 ± 152	11 ± 3	September 240	3.0	<i>B. coregoni gibbera</i> , <i>Chydorus</i> sp., <i>B. crassicornis</i>

* Ninety-five percent confidence limits

Table 2. Strontium-90 concentration factors of plankton from different sites of a dystrophic lake, 1967 (single samples).

Concentration factor		Zooplankton		Dominant zooplankters and other components
Ash weight	Wet weight	(10 ³ /m ³)	(g/m ³)	
			May	
10,300	226	272	4.5	<i>Asplanchna</i> sp., <i>Bosmina coregoni gibbera</i> , sapropel, peat
7,933	209	136	2.4	<i>B. coregoni gibbera</i> , <i>Asplanchna</i> sp., sapropel
7,033	88	179	7.6	<i>B. coregoni gibbera</i>
			June	
18,571	100	67	2.8	<i>B. coregoni gibbera</i> , <i>Sida crystallina</i> , sapropel
12,571	303	94	6.2	<i>S. crystallina</i> , <i>B. coregoni gibbera</i> , peat
			July	
7,000	133	125	2.5	<i>S. crystallina</i> , <i>Chydorus sphaericus</i> , much phytoplankton
4,640	25	130	13.4	<i>S. crystallina</i> , much phytoplankton
7,600	118	66	2.4	<i>S. crystallina</i> , <i>Leptodora kindtii</i> , much phytoplankton
14,000	157	45	0.7	<i>S. crystallina</i> , much phytoplankton and sapropel
4,560	21	115	10.0	<i>S. crystallina</i> , phytoplankton
			August	
12,929	67	158	4.4	<i>S. crystallina</i> , <i>Bosmina</i> sp., <i>Asplanchna</i> sp., much phytoplankton and sapropel
13,161	88	93	6.7	<i>S. crystallina</i> , sapropel, phytoplankton
12,285	59	59	2.7	<i>S. crystallina</i> , very much phytoplankton, sapropel
9,910	49	221	3.1	<i>Asplanchna</i> sp., <i>S. crystallina</i> , much phytoplankton, sapropel
10,268	38	141	3.1	<i>Bosmina</i> sp., phytoplankton
			September	
8,538	21	51	1.2	<i>B. coregoni gibbera</i> , phytoplankton
13,711	84	82	4.4	<i>S. crystallina</i> , much sapropel and peat
12,807	60	91	2.3	<i>B. coregoni gibbera</i> , much sapropel and peat
13,404	63	62	4.2	<i>S. crystallina</i> , <i>B. coregoni gibbera</i> , sapropel
10,615	44	70	1.2	<i>B. coregoni gibbera</i> , much phytoplankton

determined CF of ⁹⁰Sr of plankton (Tables 1 and 2), macrophytes (Table 3), and substrates (Table 4) in three different types of Latvian lake (eutrophic, mesotrophic-eutrophic, and dystrophic). These types are represented by Rušonu, Gusenu, and Pitelu, respectively. Rušonu and Gusenu contain calcium bicarbonate, and zooplankters predominate in the plankton (Table 1). Zooplankton and phytoplankton were present in about equal amounts in Pitelu (Table 2).

Water samples were collected once a month from five typical sites in each lake. At each site two water samples (100 liters each) were taken simultaneously (7). Plankton was collected at the same sites with a fry-neuston trawl (sieve size No. 61) designed by Zaitsev (8). For radiochemical analyses, 4 to 13 grams of ashed plankton were used. After the addition of carriers (100 mg of Sr, 30 mg of Ce, and 30 mg of Fe), the ash was dissolved with 12N HCl and distilled water at 200°C. Undissolved residue was removed, and ammonium oxalate was added to the filtrate. The solution was then warmed and adjusted to pH 4 with ammonium hydrate and complete precipitation was verified. The oxalate precipitate was filtered and again precipitated; it was then dried and ashed at 600°C for 1.5 hours. The carbonates obtained were dissolved in 6N HCl; hydroxides were precipitated at pH 7 to 8. The filtrate was adjusted to pH 4, and the solution allowed to establish an equilibrium between ⁹⁰Sr and ⁹⁰Y. Radiochemical analyses of the ash of freshwater plants and substrate were similarly performed. After equilibrium between ⁹⁰Sr and ⁹⁰Y occurred, carbonate precipitates (from water, plants, and substrates) were dissolved in 6N HNO₃ or HCl, stable yttrium was added to the solution, and the hydroxide of yttrium was precipitated by ammonia (pH 7 to 8), 25 percent carbon-free. The precipitate was filtered, precipitated again, and ashed; ionizing radiation was measured by a meter with a relative error of 10 percent. In the same way, ⁹⁰Y was isolated from planktonic samples after equilibrium between ⁹⁰Sr and ⁹⁰Y was established. The disintegration of isolated ⁹⁰Y was examined each time, and it always coincided with the theoretical disintegration curve for ⁹⁰Y.

Stable strontium was determined by flame photometry (9). The initial solutions were prepared by the method of addition and read in the flame of a

Table 3. Strontium-90 and stable strontium concentration factors (CF) of aquatic plants from eutrophic and mesotrophic-eutrophic lakes during September 1966 and 1967.

Plant	Mean concentration factors	
	Wet weight	Ash weight
<i>Chara</i> sp.	276 ± 20*	2,867 ± 604
<i>Equisetum</i> sp.	75 ± 33	2,053 ± 601
<i>Scirpus lacustris</i>	24 ± 6	1,350 ± 740
<i>Myriophyllum</i> sp.	63 ± 19	3,294 ± 1,185
<i>Stratiotes aloides</i>	96 ± 35	3,677 ± 1,005
<i>Elodea canadensis</i> †		3,225 ± 2,098
Ratio CF _{max} : CF _{min}	> 10	< 3

* Ninety-five percent confidence limits. † Eutrophic lake only.

Table 4. Strontium-90 concentration factors for different lake substrates during September 1966.

Substrate	Concentration factors	
	Ash weight	Dry weight
<i>Mesotrophic-eutrophic</i>		
Silt	33-51	31-50
Sand with salt	28	26
Sand	11-14	10-14
<i>Eutrophic</i>		
Silt	54-90	50-83
Silt with sand	38	29
<i>Dystrophic</i>		
Peat	1,097-6,386	274-1,250
Peat with sand	2,536-12,691	1,725-2,067
Sand with peat	441-528	412-493
Sand with silt and peat	956	825

mixture of acetylene with air at the wavelength of strontium. Ninety-five percent confidence intervals for means were calculated where sample numbers permitted.

Concentration factors of ⁹⁰Sr for plankton of eutrophic (Table 1) and mesotrophic-eutrophic (10) lakes are similar, but are greatly different from those for plankton of a dystrophic lake (Table 2). This difference may be explained (11) in the following way: concentrations of carriers in samples from the dystrophic lake (1966—Ca, 3.6 to 6.1 mg/liter; 1967—Ca, 4.7 to 5.9 mg/liter, and Sr, 13.6 to 43 μg/liter) are much less than those for samples of the eutrophic lake (1966—Ca, 35.3 to 40.6 mg/liter, and Sr, 71 μg/liter; 1967—Ca, 43.8 to 46.3 mg/liter, and Sr, 67.6 to 80.6 μg/liter) and the mesotrophic-eutrophic lake (1966—Ca, 36.1 to 38.9 mg/liter).

The ⁹⁰Sr CF for water plants are also higher in the dystrophic lake than in the other lake types (Table 3). The ⁹⁰Sr CF's for water plants are less in spring than in autumn (3 to 7 times,

calculating on the basis of wet weight). The ⁹⁰Sr CF are highest in the upper part of *Potamogeton lucens* (100 percent), average in the central part (50 percent), and least in the lower parts (including roots) (28 percent). These differences are noticed in autumn as well as in spring. The CF of stable Sr and ⁹⁰Sr are close—the mean ratio of Sr CF to ⁹⁰Sr CF in each sample of 9 species of plants equals to 1.1 ± 0.2. This means that complete exchange occurred between radioactive and stable Sr in lake plants.

Among lake substrates, sand substrates have the least ⁹⁰Sr CF (Table 4). The higher CF of sand substrates are a result of the admixture of silt and peat. The highest ⁹⁰Sr CF are of peat substrates from the dystrophic lake (Table 4). Concentration factors for ashed plankton in the eutrophic lake are significantly higher than those for ashed lake silt, but CF for ashed plankton and peat in the dystrophic lake are approximately equal.

Thus hydrobionts and substrates of a dystrophic lake are characterized by ⁹⁰Sr CF higher than those for mesotrophic-eutrophic and eutrophic lakes.

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Glomerular Sialoprotein

Abstract. *The high content of sialic acid in the glomerulus is associated with the cell membrane of epithelial cells lining the basement membrane. Whereas enzyme studies indicate that sialic acid is a determinant of the nephritogenic antigen, the physicochemical properties of this nephritogenic glycoprotein suggest that sialic acid may have an important role in the filtration mechanism.*

Although sialic acid is present in glomerular preparations (1), its exact localization has not been established and its significance has not been defined. We have noted that a high concentration of sialic acid is located in the cell membranes lining the basement membrane. This sialic acid can be neutralized by polycations and by antisera to kidney tissue, and it can be removed by neuraminidase and trypsin; these reduce or abolish the nephritogenic antigenicity of the glomerulus.

The presence of acidic mucopolysaccharide in the glomerulus was shown (2) by the colloidal iron reaction, but the acidic component was not identified. Spiro (1) has provided evidence that "preparations of basement membrane" obtained by ultrasonic treatment of glomeruli contain two distinct carbohydrate units in approximately equal proportions: (i) a disaccharide unit containing glucose and galactose and (ii) an oligosaccharide consisting of galactose, mannose, hexosamine, fucose, and sialic acid. In view of the similarity of this oligosaccharide to that of the antigenic blood group substances