carried off with this particulate matter. However, an insignificant amount of beryllium was found in the sample taken without fuel. When the lantern was lighted with the fuel turned on, most of the beryllium appeared on the sample paper in the first few minutes. In two of these tests (tests 3 and 4, Table 1) the initial samples were taken with the fuel turned on. In these tests the beryllium evolved at once. Sampling at varying intervals revealed that the beryllium emissions were immediately high and decreased rapidly. The total beryllium collected from each mantle was rather consistent at about 200 μg (Table 1). When the sampling period was shortened to 1-minute intervals, I observed that most of the beryllium was evolved in the first 2 minutes after lighting (Fig. 1). Actually the beryllium was released so fast that the quantities collected in the first minute of use equaled or exceeded the amount of beryllium subsequently emitted (Fig. 1).

Under these test conditions the sampler was exhausting air through the box at a rate of 25 cubic feet (0.70 m^3) per minute. This resulted in 12 changes of air per minute in the enclosure. These conditions do not occur in the normal use of the lantern. In normal use, less beryllium would be expected to evolve from the lantern with deposition being the greatest on the inner surface of the lantern cap. A gentle cleaning of the cap after 30 minutes of cumulative use over a period of 4 months produced 100 μg of beryllium.

The dual-mantle type of lantern emits about 50 percent more beryllium than the single-mantle type of lantern. When such a dual-mantle lantern was functioning properly so that it burned brightly at once, half of the beryllium that was emitted was given off in the first minute of a 10-minute test. In one experiment I had difficulty maintaining a brightly burning mantle because of a faulty fuel gasket. In this case the beryllium emissions were lower, but the mantle continued to evolve beryllium for a prolonged period. This resulted in a near equal total beryllium release over the 10-minute period (Fig. 1).

The inhalation of beryllium may produce two forms of beryllium disease. The chronic form can develop from exposure to low concentrations of beryllium over a long period of time, perhaps many years. To protect against this hazard industrial hygienists recommend that exposures not exceed 2 μg per cubic meter of air averaged over an 8-hour period (*1*). This level is set for the protection of those whose occupation requires that they work with beryllium. Nonoccupational limits, for people of varying susceptibility who may be exposed to this environment 24 hours a day, are much lower, 0.01 μg of beryllium per cubic meter of air averaged over a month.

The acute form could result from a single exposure to a high concentration of beryllium for a brief time. To protect against this form, it is recommended (*1*) that concentrations in excess of 25 μg of beryllium per cubic meter of air never be exceeded. A large camper has a volume of approximately 14 m^3. If the 260 μg of beryllium collected from a dual-lantern mantle (Fig. 1) were distributed uniformly throughout this volume, the average concentration would be 18 μg per cubic meter.

The process of lighting a new mantle can be particularly hazardous since it involves working the cleaning wire and slowly opening the fuel valve full as the mantle begins to burn brightly. This requires from about 1 to 2 minutes, the period during which the new mantle is emitting most of the beryllium. To carry out this operation the user usually places his face in close vicinity to the mantle and can inhale emissions from the mantle. Furthermore, when replacing and disposing of the old mantles, one should attempt to contain the light fluffy residue in order to limit contamination of the area. This is particularly important if the lantern is permanently installed in a camper or trailer.

The company which produces the brand of mantle tested manufactures 17×10^6 mantles each year. It is reasonable to assume that this number is sold and used each year. It is quite likely that many people are unnecessarily exposed to the dangers associated with beryllium inhalation simply because they are unaware of the hazard present during the first few minutes after the lighting of a new mantle.

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Mercury in the Greenland Ice Sheet: Further Data

Abstract. *New data support the contention that the mercury content of Greenland glacial ices has not increased dramatically in recent years but rather is distributed nonhomogeneously through the ice sheet.*

Weiss *et al.* have reported measurements of the mercury content of Greenland glacial ices by neutron activation techniques (*1*). On the basis of data obtained from two separate sites (Camp Century and a "virgin site"), they concluded that a doubling of the mercury content had occurred in recently deposited ice layers. Dickson has pointed out that the data from the two sites did not overlap in time, which prevented an intersite calibration (*2*).

We have analyzed ice core samples from Camp Century (77°10′N, 61°08′W) and site 2 (76°59′N, 56°04′W) by flameless atomic absorption spectrometry (*3*). Our data allow an intersite comparison because an overlap in time exists in the data. The "virgin site" is roughly midway between Camp Century and site 2 (*4*).

Table 1. Total mercury concentrations in four Greenland glacial ices.

Sample	Depth (m)	Date	Mercury (ng/liter)
Camp Century	56.94	1850	13 ± 10
Site 2	54.12	1870	169 ± 15
Site 2	21.59	1930	100 ± 12
Camp Century	13.75	1940	50 ± 10

A distinct difference can be seen between the mercury content of the two sites, a finding that lends support to Dickson's contention that the horizontal distribution of mercury through the ice cap is heterogeneous (*2*). Siegel *et al.* have reported a high mercury content in volcanic ash from Icelandic volcanic sources and indicated that winds do exist which could transport this mercury to Greenland (*5*). Correlations between the mercury content of ice and world volcanic activity are tenuous at best, although volcanic chronologies are available (*6*).

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Contemporary Phosphorites on the Continental Margin of Peru

Abstract. *Phosphorite nodules occurring along the biologically productive continental margin of Peru have been dated by uranium-series methods. The radiometric ages range from late Pleistocene to Recent, indicating that phosphorites are currently forming in this area.*

Ever since Kazakov (*1*) linked the origin of marine phosphorite to coastal upwelling in the ocean, the association between these two has generally been considered as one of cause and effect (*2*). Until recently, however, attempts to demonstrate a contemporary age for phosphorites of the sea floor in areas of present-day upwelling proved unsuccessful. Many of the phosphorites studied contained pre-Pleistocene fossils, or showed other evidence of being reworked "lag deposits" (*3*), while absolute age determinations by uranium-series methods invariably yielded ages in excess of 800,000 years (*4, 5*). These results have hampered attempts to investigate the origin of marine phosphorite in greater detail, since an analysis of the present oceanographic conditions in these areas would not necessarily be relevant to the depositional environment of pre-Recent phosphorites.

So far, the only evidence suggesting contemporary formation of marine phosphorite was the exposed portion of a wooden log dredged from a depth of 410 m in the Gulf of Tehuantepec (*6*); unfortunately, the age of phosphorization could not be verified at the time by absolute dating. Baturin and co-workers (*7*) presented morphological evidence for authigenic marine phosphorite in Recent diatomaceous muds on the shelves off southwest Africa and Chile; the phosphorite occurred as semiconsolidated nodules, with no sign of transport or reworking. Using radiometric dating (*8*), they confirmed the contemporary formation of several of these phosphatic nodules.

We report here another extensive marine phosphorite deposit (Fig. 1), for which a contemporary origin is demonstrated by uranium-series age determinations. This deposit was discovered incidentally during an investigation of laminated anaerobic sediments associated with coastal upwelling off Peru and Chile (*9*). In this area of high organic productivity, a seasonal eastern boundary current maintains a well-developed oxygen minimum which intensifies toward the coast (*10*). A zone of anoxic sediments occurs between 100 and 400 m where the oxygen-deficient waters impinge on the continental margin. The phosphorite nodules are confined to two narrow bands roughly coinciding with the upper and lower boundaries of the oxygen minimum layer, as defined by hydrographic station data taken either at or in the immediate vicinity seaward of the dredging sites (*9*).

Electron microprobe analyses and x-ray diffraction data indicate that apatite rich in fluorine (2 to 4 percent fluorine)—most likely carbonate fluorapatite or francolite—is the major component of the phosphorites. The concentration of phosphorus, as P_2O_5, ranges from 17 to 35 percent, reflecting varying degrees of dilution by detrital minerals and biogenic debris. A few nodules are essentially pure cryptocrystalline apatite, or collophane, but more commonly the phosphatic material occurs as a matrix, cementing silt-size detrital minerals and biogenic components. A more complete discussion of the geochemistry and mineralogy of the phosphorite nodules and associated sediments will be presented separately (*11*).

To determine the age of formation of this deposit a number of representative phosphorite samples were selected and dated by uranium-series methods (*5*). Our results are shown in Table 1. If it is assumed that (i) uranium was incorporated into the phosphorites during their formation, (ii) the uranium was derived primarily from seawater, (iii) the $^{234}U/^{238}U$ ratio in seawater during the last few hundred thousand years has not significantly differed from its present accepted value of 1.15, and (iv) the phosphorites have remained a closed system with respect to uranium since the time of their formation, then the ages corresponding to the $^{234}U/^{238}U$ ratios range from about

Table 1. Isotopic data for uranium and thorium in marine phosphorites. The concentrations are in parts per million (ppm); ratios are activity ratios.

Sample	Depth (m)	Uranium (ppm)	Thorium (ppm)	$^{234}U/^{238}U$	$^{230}Th/^{234}U$	Age (× 10^3 years)	
						^{234}U	^{230}Th
				Off Peru			
KK 71-161							
Surface	320	103	6.7	1.09 ± 0.01	0.46 ± 0.02	180 ± 60	≤ 66
Core	320	9.6	6.1	1.10 ± 0.01	0.62 ± 0.03	140 ± 50	≤ 102
KK 71-96	450	6.7		1.06 ± 0.03		300 ± 100	
A-183							
Surface	446	140	2.3	1.11 ± 0.01	0.61 ± 0.03	110 ± 50	≤ 100
Core	446	117	1.8	1.10 ± 0.01	0.70 ± 0.03	140 ± 50	≤ 125
PD-12-05	345	168	2.4	1.15 ± 0.01	0.021 ± 0.001	Recent	≤ 2
PD-15-13	120	102	3.2	1.14 ± 0.02	0.06 ± 0.01	30 ± 50	≤ 7
				Other areas			
Sea off California [15 samples; (*5*)]	150–1100	36–149	5.5–43	0.95–1.02	1.00–1.12	> 800	> 200
Chatham Rise [7 samples; (*5*)]	285–420	117–524	4.5–12	0.96–1.01	0.99–1.25	> 800	> 200