Selected uranium and uranium-thorium occurrences in New Hampshire

by

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ABSTRACT

Secondary uranium mineralization occurs in a northwest-trending fracture zone in the Devonian Concord Granite in recent rock cuts along Interstate Highway 89 near New London, New Hampshire. A detailed plane table map of this occurrence was prepared. Traverses using total gamma ray scintillometers throughout the pluton of Concord Granite identified two additional areas in which very small amounts of secondary mineralization occurs in the marginal zones of the body. All three areas lie along the same northwest trend.

A ground radiometry survey of a large part of the Jurassic White Mountain batholith was conducted. Emphasis was placed on those areas from which earlier sampling by Butler (1975) had been done. No unusual geological characteristics were apparent around sample localities from which anomalous U and Th had been reported. The results of this survey confirm previous conclusions that the red, coarse-grained, biotite granite phase of the Conway Granite is more radioactive than other phases of the Conway Granite or other rock types of the White Mountain Plutonic-Volcanic Series. Aplites associated with the Conway Granite were found generally to be as radioactive as the red Conway Granite.

INTRODUCTION

This report of uranium and uranium-thorium occurrences in New Hampshire consists of two parts. Part 1 deals with the uranium occurrence in road cuts of the Concord Granite on Interstate 89 near Lake Sunapee, N. H. A detailed plane table map of these road cuts was prepared. Scintillometer traverses here and the surrounding area in the Sunapee and Mt. Kearsarge quadrangles have led to the discovery of two additional small occurrences of secondary uranium mineralization along a linear trend including the I-89 occurrence. All occurrences lie in marginal zones of the Devonian Concord Granite.

Part 2 presents the results of a reexamination of the Mesozoic Conway Granite and related rocks of the White Mountain Plutonic-Volcanic Series within the main batholith and in immediately adjacent stocks in north-central New Hampshire. This work was conducted largely by ground radiometry in an attempt to define the geological features and possible extensions of known or suspected radioactivity anomalies (Butler, 1975). Unlike the Sunapee area, no secondary uranium mineralization has been reported, nor was found during this study.

Delayed neutron activation analyses for uranium and thorium were made by the U.S. Geological Survey on samples of the Concord Granite and selected aplites associated with the Conway Granite. The Concord Granite from the I-89 exposures averages 15.1 ppm U and 9.9 ppm Th. Values from the two analyzed aplites were 56.2 and 89.7 ppm Th and 19.7 and 20.2 ppm U, respectively. No analyses were made of the Conway Granite (Butler, 1975).

Instrumentation and data analysis

Four total gamma ray scintillometers were used in this study. Three were provided by the U.S. Geological Survey and one by the Department of Earth Sciences, University of New Hampshire. Three were Precision Radiation Instruments Models (PRI) 111, 111B, and 111C and the fourth was a LaRoe Instruments FV-65[1/]. With the range of sensitivities represented by these instruments and occasional malfunction of one or more meters, radiometry data can be considered qualitative at best.

The instruments were calibrated daily using a 0.2 mr/hr radium disc; no significant instrument drift was noted over a 4-8 hour period. Background readings were taken at each locality in the study area at a height of about one meter over covered areas with no nearby outcrops. Total gamma radiation in milliroentgens per hour (mr/hr) was recorded on rock surfaces and reduced as multiples of background. An average background value of 0.01 mr/hr was used for the reduction of raw data for the Sunapee region. For data obtained from the White Mountain batholith and vicinity, a higher background value of 0.015 mr/hr was used. In the Sunapee and White Mountain regions, background readings ranged from 0.007 to 0.012 and 0.012 to 0.018 mr/hr, respectively, depending largely on instrument types. No two of the four instruments gave consistent background reading, yet the maximum values obtained on outcrop were usually very similar, particularly for the two most similar instruments (PRI-111B and 111C). Thus a constant background value for each of the two general areas was considered necessary and adequate for reduction purposes.

[1/]Use of a specific brand name does not necessarily constitute endorsement by the U.S. Geological Survey.

Joint surfaces and traces, weathered (rottenstone) zones, and fracture zones were scanned. Areas where mass effect might be a significant contributing factor were noted (for example talus accumulations, quarry dumps, cavities, rottenstone pits). Numerous readings were made in each area (Appendix 1); average values for each major rock type in each area are listed in Table 1. Note that rock units common to both areas yield similar values.

Table 1.--Ground radiometry values as multiples of background

Rock type	Average	Range
Sunapee Region - average background 0.01 mr/hr		
Concord Granite		
I-89	2.5	1/ 1.6-23
Crockett Corner	2.0	1/ 30
Trow Hill	2.1	1/ 1.5-11
Powerline	1.9	1.5- 3.0
Lamprophyre dike		1.0- 1.2
Kinsman Quartz Monzonite	1.0	
Bethlehem Gneiss	1.0	
Littleton Formation		0.8- 1.0
White Mountain batholith - average background 0.015 mr/hr		
Conway Granite		
Ammonoosuc stock	3.5	2/ 2.0- 6.6
Profile stock	1.7	1.5- 1.8
Pemigewasset stock	2.6	2.0- 3.0
Mad River pluton	1.9	1.6- 2.5
White Mountain batholith (sw)	2.0	1.7- 2.7
North Conway area	2.3	3/ 1.7- 6.0
Aplites (total)	2.4	1.8- 3.7
Mount Osceola Granite	1.6	
Kinsman Quartz Monzonite	~1.0	
Littleton Formation	~1.0	

1/ Extremes of range are mineral shows.

2/ Middle Sugarloaf Mtn. is a weathered fracture zone.

3/ Fletchers quarry shows sporadic high values.

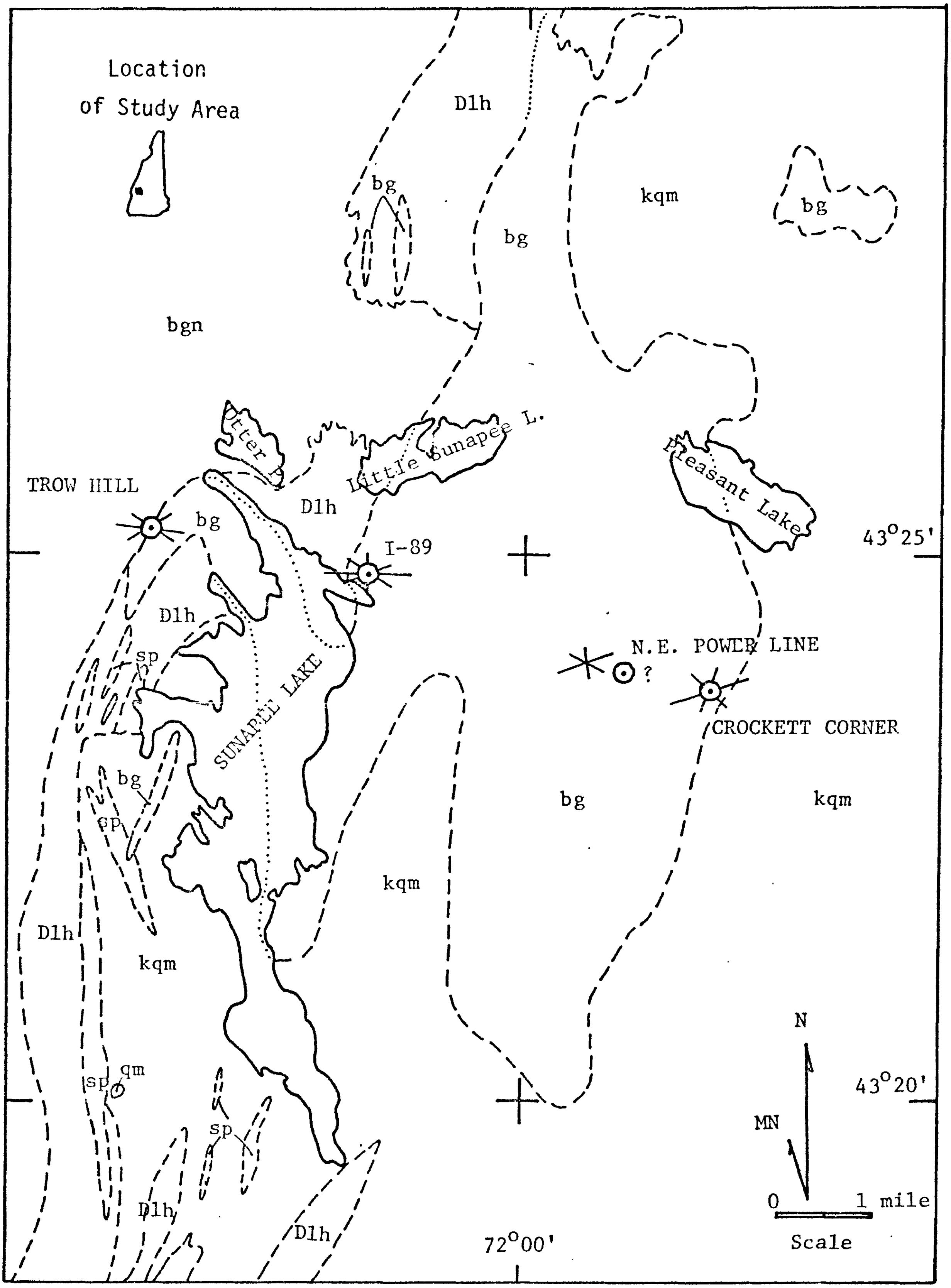


Figure 1.--Geological map of parts of the Sunapee (Chapman, 1952) and Mt. Kearsarge (lyons, unpub.) quadrangles, New Hampshire. Explanation: Devonian, New Hampshire Plutonic Series; bg, binary granite (Concord); qm, unnamed quartz monzonite; sp, Spaulding Quartz Diorite; kqm, Kinsman Quartz Monzonite; bgn, Bethlehem Gneiss; Dlh, Littleton Formation; ⊙, uranium mineralization, queried where uncertain; ✳, principle joint trends, longest is dominant.

PART 1--NEW LONDON, NEW HAMPSHIRE

The occurrence of the secondary uranium minerals, renardite and possibly metaautunite and torbenite, tentatively identified by R. Grauch of the U.S. Geological Survey, in the vicinity of New London, N. H. has been known for about 10 years. The find was made during excavation for Interstate Highway 89. The locality (fig. 1) has received some attention by geologists from the U.S. Geological Survey (Grauch and Zarinski, 1976; Boudette, 1977), Dartmouth College and others. With the recent effort to inventory the nation's energy resources, funding was made available from the U.S. Geological Survey to the Office of State Geologist and the New Hampshire Mineral and Energy Council.

A detailed geological map was prepared with plane table and telescopic alidade of portions of the road cuts in the Devonian Concord Granite exposed along I-89 about 1 km south of Exit 12. In addition the area within an approximately 10 km radius was examined for uranium mineralization. Two confirmed occurrences and one suspected occurrence were identified by mapping and scintillometer traverses within the area away from I-89 (fig. 1).

An airborne geophysical (aerorad) survey contracted by ERDA to Texas Instruments, Inc. (CJO-166-1, 1976) covers the west-central part of New Hampshire and was reviewed in the search for extensions of the known uranium occurrences. Raw data for the Lake Sunapee region were reduced to ppm U equivalent by R. A. Rich (written commun., 1976) and considered as anomalies if reduced values exceeded 8 ppm U. Several anomalous areas were defined in this manner; however, because of the approximately 7 km flight-line spacing only one corresponded to those identified in the Concord Granite in this study (Crockett Corner). The I-89 occurrence was apparently missed. Two other anomalous areas were identified within the area covered. Both were field checked and found to be areas underlain by Kinsman Quartz Monzonite; no ground radiometric anomalies were identified. Pegmatites in western New Hampshire are known to carry primary uranium minerals and may account for the anomalies noted by Rich.

General Geology

The geology of the Sunapee quadrangle is summarized by Chapman (1952). A preliminary geologic map of the Mt. Kearsarge quadrangle was made available by J. B. Lyons (unpub. mapping, 1976). The region encompassed by these two quadrangles is underlain by lower and middle Paleozoic igneous and metamorphic rocks. The eastern two-thirds of the Sunapee quadrangle contains a variety of exposed members of the Devonian New Hampshire Plutonic Series and the high grade Upper Silurian (?) and Lower Devonian Littleton Formation (Billings and Fowler-Billings, 1976). The Lower (?) Devonian Bethlehem Gneiss occupies a band about 10 km wide that trends northeasterly the length of the Sunapee quadrangle. Southeasterly the Littleton Formation is interrupted by successively younger, and less metamorphosed, members of the plutonic series. These include the Kinsman Quartz Monzonite, Spaulding Quartz Diorite, an unnamed quartz monzonite, and finally the Concord Granite. Details of these units are treated by Chapman (1952), by Nielson and others (1976), and most recently by Lyons and Livingston (1977).

The northeast quarter of the Sunapee and the northwest quarter of the Kearsarge quadrangles were examined in the course of this study (fig. 1). The principle study area lies along the western margin of the main pluton of Concord Granite near the northeastern corner of Lake Sunapee where secondary uranium mineralization was previously reported.

Site Geology

A geologic map of road cuts and median strip along I-89 at a scale of 1:240 was prepared by standard plane table and alidade methods (plate 1). The map covers the northern 500 feet of the road cuts where secondary uranium mineralization is most abundant. Several additional "hot spots" were identified in rottenstone south of the area covered by plate 1. Detailed geologic maps of the other three sites were not compiled.

Host Rock

Secondary uranium mineralization occurs entirely within the Devonian Concord Granite or its detritus. The host is a gray binary granite composed of microcline, oligoclase, quartz, biotite and muscovite as the dominant phases. Accessories include zircon, apatite, and sphene(?). The granite is medium grained and weakly to moderately foliated particularly near the western margin. Preferred orientation of biotite and locally abundant biotite schlieren define the foliation.

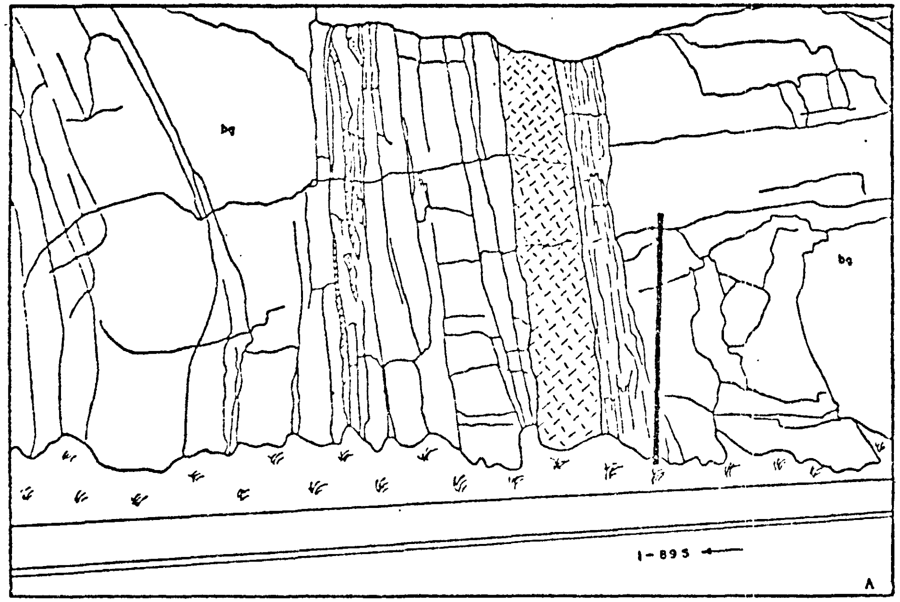
Jointing is well developed, particularly in the I-89 exposures. Three and often four principal sets are dominant. These vary locally but trend approximately E-W, NW-SE, NE-SW and N-S and are generally steeply dipping. In addition, curviplanar joints that merge with exfoliation sheeting are locally well developed along I-89.

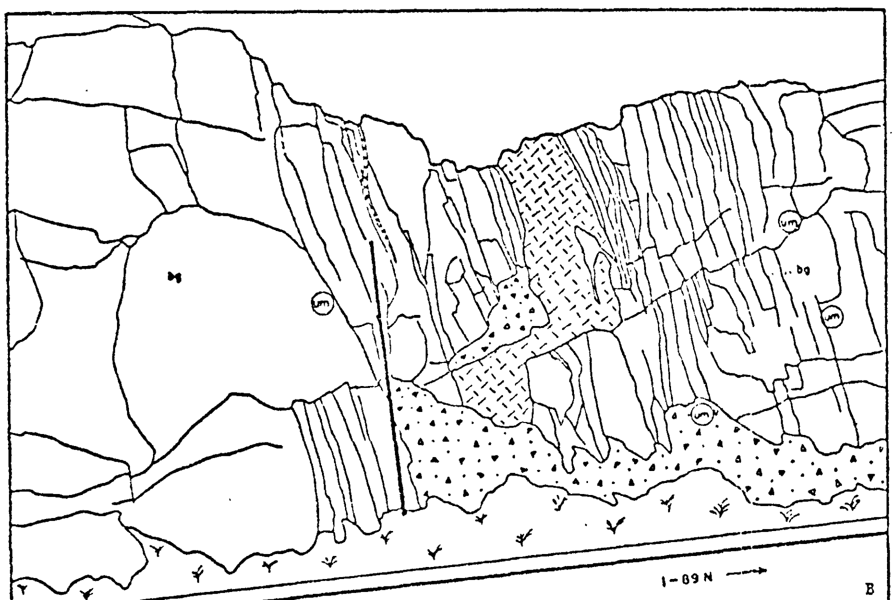
The E-W vertical joint set, best displayed in the exposures on I-89, occurs as several zones containing close-spaced joints, also called fracture zones. Joint spacings vary from a centimeter or less increasing away from the center of the zone to a meter or more. The major fracture zone (fig. 2A, B, C) is intruded by two lamprophyre dikes. This specific zone contains the most abundant secondary uranium mineralization. Minor mineral shows were identified by scintillometer traverses in the I-89 cut in the other fracture zones. The major fracture zone was not identified away from I-89.

Sampling and chemical analysis

Fresh 3-5 kg samples of the Concord Granite were obtained from the east side of the I-89 median strip. They are listed in table 1 as measured in feet north to south with respect to alidade shot points and plotted on plate 1. One sample (220S K-33) was taken from a well developed rottenstone (mechanically disintegrated bedrock) zone. Care was taken to avoid rock with observable secondary mineralization.

Results of delayed neutron analyses of 10 gram splits from large crushed samples indicate an average 15.1 ppm U and 9.9 ppm Th for the Concord Granite from the I-89 exposures (table 1). Page (1976) reports 13 ppm U from one sample from the I-89 exposures. A plot of the uranium-thorium contents (fig. 3) shows a more variable distribution for U than for Th.





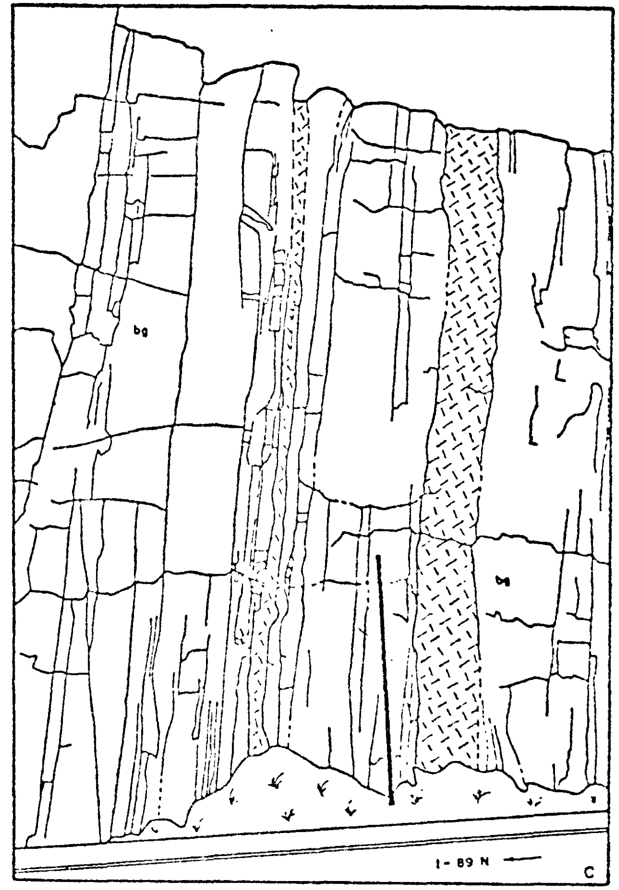


Figure 2. Line drawings from photographs illustrating the relationship between fracture zone, lamprophyre dike, and uranium mineralization. Black bar is 13-foot stadia rod for scale. A. View to west, southbound lane; B. View to west, Median strip, northbound; C. View to east, northbound.

EXPLANATION

Soil

Talus and rottenstone

Lamprophyre dike (TR ?)

bg Concord Granite (Devonian)

Joints

um Uranium mineralization

Table 2.--Uranium and Thorium analyses

[Analysts: H. T. Millard, Jr., C. M. Ellis, and V. C. Smith. *, rottenstone, fz, fracture zone, leaders (-----) indicates unreliable analyses].

Sample		ppm Th	ppm U	Th/U
Concord	2N K-13	----	31.84	----
Granite	2S K-21 (fz)	7.03	10.29	0.63
	10S K-21 (fz)	13.95	9.91	1.41
	K-23 (fz)	8.51	8.61	0.99
	24S K-29	----	20.93	----
	10S K-31	----	23.46	----
	52S K-33	8.40	14.91	0.56
	220S K-33*	9.92	13.57	0.73
	230S K-33	9.37	14.19	0.66
	495S K-33	12.14	7.63	1.53
	600S K-33	9.76	11.23	0.86
	$\overline{X}$	9.89	15.14	0.65
Aplite-	BC - 11	89.72	20.15	4.45
	L. Falls	56.17	19.74	2.85

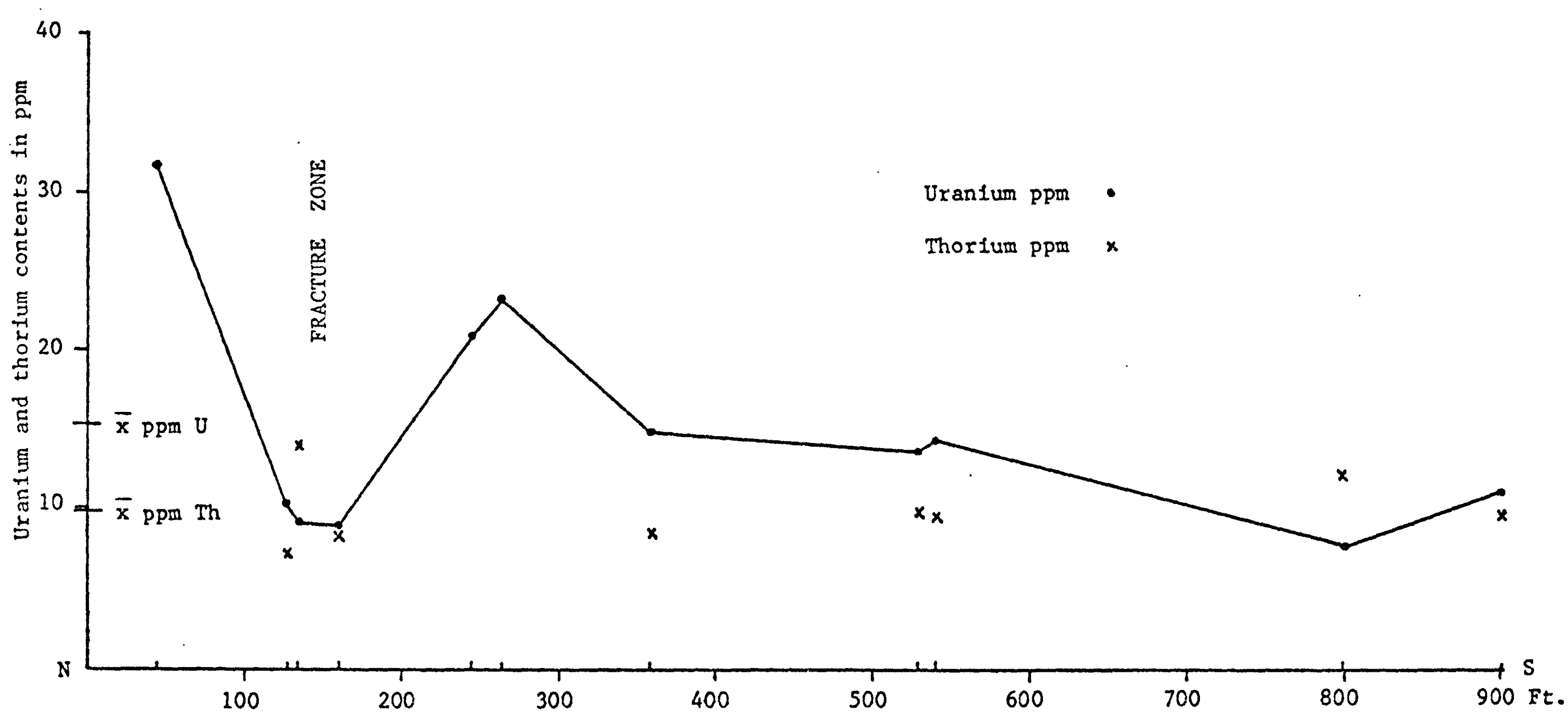


Figure 3.--Uranium and thorium distribution in the Concord Granite, along I-89 median strip New London, New Hampshire.

Uranium mineralization

Secondary uranium mineralization was identified in three localities in the vicinity of New London, N. H. A fourth area is thought to contain uranium mineralization but lacks outcrops. The principal occurrence is the I-89 road cuts south of Exit 12 (New London). A second locality was identified in recently exposed outcrops at Crockett Corner, the junction of N. H. Routes 11 and 114 south of New London. The third, with a very small show of secondary uranium minerals occurs along Rt. 11 one mile southwest of Georges Mills. All four areas are on an approximately linear trend (fig. 1).

I-89 occurrence

Secondary uranium minerals are found as fracture fillings and coatings primarily along E-W trending, near vertical joint surfaces. The same relationship is displayed on N and E dipping surfaces, usually in protected areas. Only in one location in the median strip was a coated top surface exposed and that surface appeared recently exposed. The coating could be traced along the subhorizontal fracture in the granite. The coatings are generally yellow, shiny, brittle, and thin (<5 mm) and have no megascopic crystalline form.

Since road construction 10 years ago, leaching from exposed surface coatings has occurred with redeposition of "fresh" fragile coatings on the protected undersides of joint slabs and occasionally on small loose talus accumulations. In the course of detailed scintillometer traverses of the entire road cuts (Appendix 1), a number of additional shows in near vertical fractures were identified. "Hot spots" were found with no mineral show along the base of the cuts in rottenstone talus accumulations below fracture zones and occasionally in soil. These occurrences with higher than background scintillation readings attest to the high solubility and apparently rapid removal of these secondary uranium minerals from joint surfaces and concentration in recent detritus.

Crockett Corner (Rt. 11/114)

Construction of an access road to I-89 south of New London recently created topographically low road cuts which exposed yellowish Concord Granite near the eastern margin of the main pluton (fig. 1). In this area the granite is fine grained. There are more numerous pegmatite dikes, and jointing is not as well expressed as the outcrops along I-89.

Secondary mineralization is localized in a N. 70 E. near vertical fracture along the contact between Concord Granite and a late pegmatite dike. Open fracture filling is indicated by euhedral quartz crystal encrustations on the fracture surface. Small metaautinite(?) crystals are well developed but were collapsed when dehydrated. The zone containing these minerals cannot be traced laterally along strike as exposures are limited.

New England power line between Route 11 and Knights Hill Road

A scintillometer traverse was completed between I-89 and the Rt. 11/114 occurrence. In the course of this traverse readings were made on bedrock (where exposed) and soil. One soil-covered area approximately 10 m^2 in a swale 50 m NW of Pole 181 registered over twice background level. No outcrops were exposed in the immediate region. The nearest Concord Granite outcrop located within 50 m showed normal readings.

This area is noted because it is approximately on strike between the I-89 and Rt. 11/114 occurrences.

Exposures along old Main Street approximately on line with the previously mentioned sites show no significant increase in radiation.

Route 11-Trow Hill, Georges Mills

Concord Granite is exposed intermittently along Rt. 11 southwest of Georges Mills at the approximate contact with the Littleton Formation. This body is inferred to be part of the main Concord pluton on the east side of the Lake Sunapee (fig. 1). Critical relations are submerged beneath Lake Sunapee. A very small mineral show was located in the northwestern contact zone between granite, pegmatite and schist by scintillometer traversing. The occurrence is in an area that is strongly sheared, with abundant slickensided surfaces. Mineralization in the form of minute crystals is restricted to the contact between schist and pegmatite and appears unrelated to the east-west to northeast zones where other mineralization has been identified.

Summary

Secondary uranium mineralization in the vicinity of New London, N.H., occurs in the Concord Granite. In all cases where actual minerals were observed, the occurrences were near contact margins, not in the central portions of the pluton. Two of the occurrences (Trow Hill and Crockett Corner) were located by scintillometer traverses.

The three occurrences and one suspect area lie approximately on strike. The four areas define a WNW trend across the Concord pluton. Most of the mineralization in the I-89 occurrence is within a close spaced fracture zone trending E-W, which may have controlled mineralization. The others are not within such a zone that is recognizable in the field or from examination of topographic maps. However, the arrangement does closely approximate suggestions of northwest-trending lineaments in west-central New Hampshire (Page, 1976) often defined by drainage patterns (G. W. Stewart, oral commun., 1975).

PART 2-THE CONWAY GRANITE

The Mesozoic Conway Granite in north-central New Hampshire (plate 2) is exposed as a composite batholith with adjacent satellitic stocks. It is the youngest intrusive member of central complexes in other areas of central New England. The north-central New Hampshire occurrences have a mean age of 180 m.y. (Foland and others, 1971; Foland and Faul, 1977). Since its recognition by Billings and Keevil (1946) as an abnormally radioactive granite, the Conway has received increasing attention as a low grade uranium-thorium resource and possible dry hole geothermal source. Surface sampling and analysis in the 1950's cover a wide area of the New Hampshire exposures of the Conway and related rocks of the White Mountain Plutonic-Volcanic Series (Butler, 1975). In addition three cores totaling some 900 m have been thoroughly analyzed for the uranium, thorium, and potassium distributions with depth (Adams and others, 1962; Rogers and Adams, 1963; Rogers and others, 1965; Brimhall and Adams, 1969). Recent studies include a 1 km core in the Redstone area (Hoag and Stewart, 1977) and geological-geophysical examinations of the Conway Granite in the eastern part of the batholith as a geothermal source (Osberg, oral commun., 1976; Rivers and Creasy, 1977; Wetteraurer and Bothner, 1977).

This study examines the localities from which Conway and related rock samples have been taken and U-Th analyses made (Butler, 1975). The field program was designed to obtain basic lithologic, structural, and ground radiometry data that might define extensions of areas considered from previous analyses as anomalous ("hot spots"). Scintillometer traverses radiated from most of Butler's sample localities in the batholith and extended throughout as much of the surrounding area as feasible.

Reconnaissance work extended into a number of areas not previously sampled. Scintillometer checks were made at and near contacts, the central portions of satellitic stocks, rottenstone occurrences, and rock units genetically related to the Conway Granite.

As an operational definition, the Conway Granite is here considered as the widespread medium- to coarse-grained, occasionally porphyritic, two-feldspar biotite granite with minor amphibole as an additional mafic phase. Average modal data are listed in table 3. Crosscutting aplites are also included in this group. Related granites containing alkali amphiboles and pyroxene-fayalite (Mount Osceola Granite) are separated from the type Conway because they normally generate less total radiation (fig. 4). Excellent summaries of the petrologic characteristics of the White Mountain Plutonic-Volcanic Series rocks are found in Billings (1956), Frye (1965), and others.

Table 3.--Modal data for the Conway granite

[Data from Gaudette and Bothner, 1971. Accessories listed as follows: a, apatite; z, zircon; f, fluorite; and al, allanite. Samples colums are numbered as follows: 1. Average Conway Granite (43 samples); Ammoosoosuc stock (1 samples a,z,f; 3. Profile stock (2 samples) al, z, a; 4. Plume (1 sample) a,z; 5. Mad River pluton (4 samples) a, al, z; 6. Southern batholith (6 samples) al, al, f, z; and 7. North Conway area (12 samples) a, al, z, f; tr., trace.]

Minerals	1	2	3	4	5	6	7
Perthite	45.0	34.4	49.0	29.5	43.4	53.6	46.2
Oligoclase	22.4	35.3	21.4	48.0	17.1	14.1	25.7
Quartz	27.4	22.8	21.7	19.8	35.5	28.1	29.6
Biotite	4.6	7.5	7.7	2.7	3.8	4.1	7.0
Hornblende	0-4.6	0	0-4.6	0	0-1.3	0-1.0	0-4.3
Opaque	0.6	tr.	tr.	tr.	0.1	tr.	0.5

Results

In general, ground radiometry confirms previous conclusions (Butler, 1975) that the biotite granites in the White Mountain batholith are more radioactive than those granites with multiple ferromagnesian phases. The mean value for biotite granite is 2.2 $\pm$ 0.7 compared with 1.5 + $\pm$ 0.2 for amphibole bearing granites (fig. 4). Anomalously high values (as much as 6.6) were recorded only in biotite granites. Similar high values were observed in one deeply weathered (rottenstone) biotite granite exposure, and several thick aplite bodies for which new analyses were made. No systematic relationship, however, is apparent within or between the several areas in which high radiation (3-6 times background) was recorded.

For ease of discussion the White Mountains batholith was divided into the following subareas (plate 2): (1) the Ammonoosuc "stock" and its southeast-trending connection to the main batholith through Crawford Notch; (2) the Profile stock, associated intrusive breccias in The Basin, rottenstone in Franconia Notch and the Pemigewasset (Flume) stock; (3) the Mad River pluton; (4) the southern part of the main batholith along the Kangamagus Highway includes the Hancock Branch and the Swift River drainages to Bear Notch; and (5) the eastern area including the North Conway area, Iron and Tin Mountains in Jackson, Redstone, and the rock and rottenstone quarries in Albany.

The Ammonoosuc "Stock"

The Ammonoosuc "Stock" is a teardrop-shaped body at the northern edge of the White Mountain batholith. It is connected to the main batholith by a thin neck through Crawford Notch. The Conway Granite

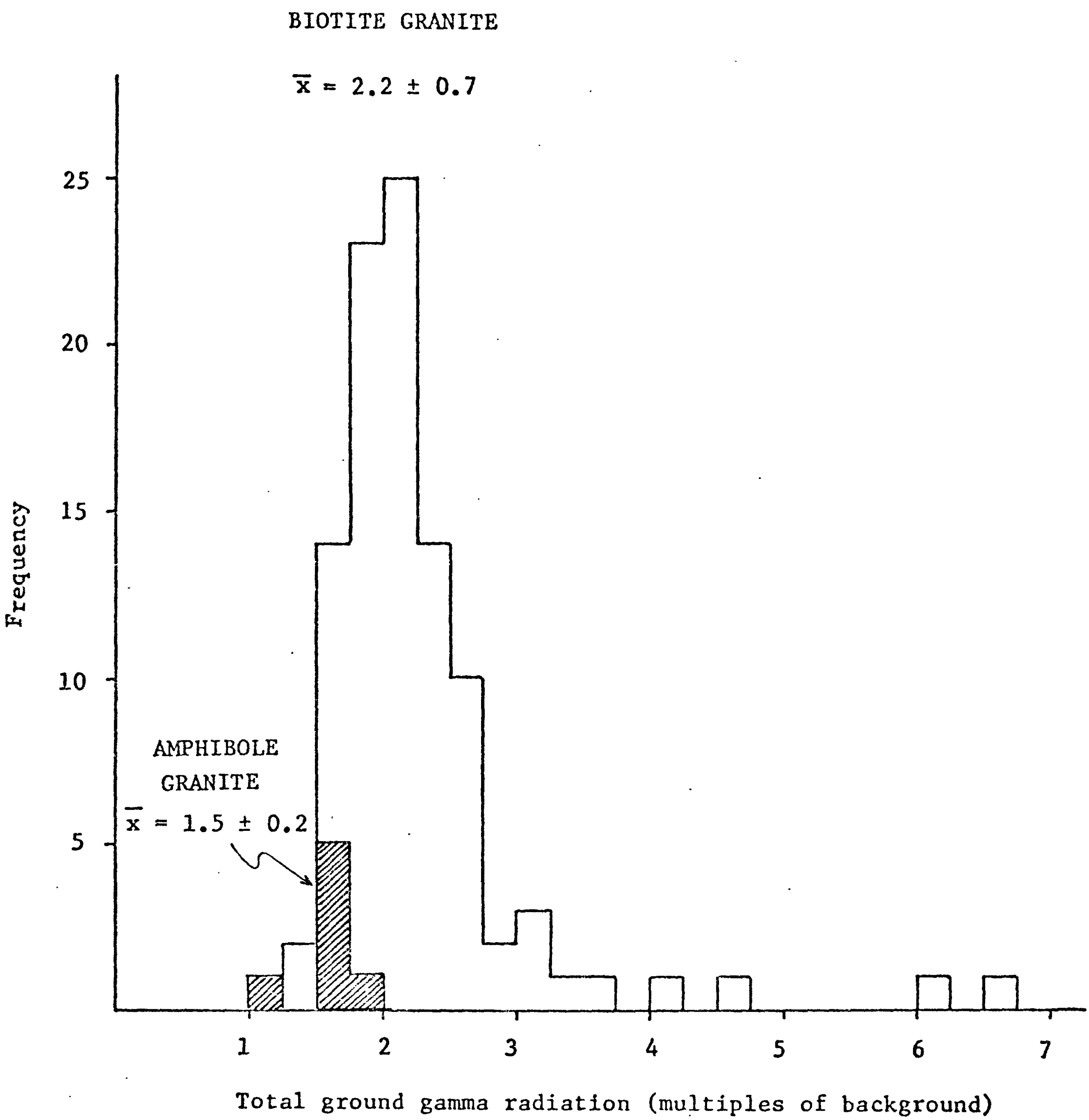


Figure 4.--Ground gamma radiation comparison between biotite (Conway-type) and amphibole (Mount Osceola-type) granites in the White Mountain batholith.

exposed in this stock is coarse grained and carries biotite as the only mafic phase. Butler (1975, p. 13) identifies the rock exposed at the Lower Falls of the Ammonoosuc River as topaz-bearing biotite quartz monzonite and notes an analysis of 25.5 ppm U and 69.0 ppm Th. Ground radiometry measurements range from 2 to 5 times background at this locality. In general, readings were higher on wet, nearly flat exfoliation surfaces. Dry surfaces, near vertical joint surfaces, pegmatitic stringers and aplite dikes averaged about 3 times background. No secondary mineralization was identified.

Excellent granite exposure is present on Middle and South Sugarloaf mountains west of the Zealand Falls Road. Outcrops on the tops of these hills are composed of coarse-grained occasionally vuggy and pegmatitic granite. With one exception radiation is about normal for Conway Granite (2-3 times background). On the southern side of Middle Sugarloaf deeply weathered granite with close-spaced fractures containing discontinuous vugs 10-50 cm in width is anomalously radioactive. Readings averaging 6 times background were recorded in the weathered fracture zone and associated talus. The north-trending fracture zone could be traced over the top of Middle Sugarloaf but readings were normal. Only on the vertical surface were high readings obtained.

In Crawford Notch granitic rocks exposed in contact with the Upper Silurian (?) and Devonian Littleton Formation averaged about twice background. Aplitic dikes cutting the Littleton were slightly higher, typical of several other aplitic masses noted elsewhere in the batholith.

The Profile Stock

The Profile stock is an oval-shaped mass separated from the western margin of the batholith by screen-like masses of Mount Osceola Granite, Mount Lafayette Granite Porphyry, slivers of Kinsman Quartz Monzonite and a ring dike of Mount Garfield Porphyritic (Albany-equivalent) Quartz Syenite. The Conway Granite is generally fine grained and often porphyritic. Biotite is the principal mafic phase with minor amounts of amphibole. Jointing is well expressed in outcrops at the top of the mountain with a close-spaced north-trending set commonly developed.

Radiometry measurements throughout the Profile stock were low in comparison to the Conway Granite elsewhere in the batholith; background values were average. Average values for the body were less than twice background. Butler (1975) notes U and Th analyses of 14.2 and 32.0 ppm respectively from samples from Canon Mountain.

Rottenstone is well developed at the base of the east side of Franconia Notch in biotite-amphibole granite of the Profile stock. Lower values (about 1-1/2 times background) were recorded in this locality. The few exposed aplitic dikes, less altered than the coarser Conway Granite, had similar low readings.

No "hot spots" were identified in the Profile stock nor in the associated intrusive breccias. Intrusive breccias at Eagle Cliff and The Basin exhibited background radioactivity. Normal twice background values were obtained from Conway Granite exposures of The Basin (13.1 ppm U; Butler, 1975).

The Pemigewasset (Flume) stock lies south of the Profile stock, is similar in size and shape but has a 1 km wide tail that extends to a point just east of Lincoln, N.H. It is composed of coarse-grained biotite granite with slightly higher than average readings for Conway Granite. Sporadic measurements on the Indian Head (14.2 ppm U; Butler, 1975), a local roche moutoneé, and in the Flume were three times background. No secondary mineralization was noted.

The Mad River Pluton

The Mad River pluton is the only adjacent satellite stock associated with the White River batholith examined in this study. The stock is oval in plan and is nearly bisected by the Mad River. Good exposures are present along the new access road to the Waterville resort area as well as the ridges surrounding the Mad River drainage. Low U values of 3.3 and 11.5 ppm are reported by Butler (1975) for this coarse and centrally porphyritic biotite granite; minor amphibole is sometimes present. Abundant aplites are exposed in the Dickey Mountain and Welch Mountain region. Where observed contacts with the schists of the Littleton Formation and Kinsman Quartz Monzonite are sharp, steep and cross-cut by numerous granitic dikes.

Radiation measurements over the stock averaged slightly less than twice background. No significant variation was observed in the granite at or near contacts. No "hot spots" or secondary mineralization was observed.

The Southern Batholith

The southern part of the White Mountain batholith is accessible by the Kangamagus Highway, numerous trails, and the East Branch of the Pemigewasset, Hancock Branch, and Swift River drainages. For this report, the area is separated from the North Conway (or eastern) area at approximately the Bear Notch Road. The Conway Granite here is a relatively uniform coarse-grained biotite granite with rare amphibole. Cross-cutting aplitic and diabase dikes are present. The Conway Granite is easily distinguished from several large bodies of Mount Osceola Granite mineralogically and radiometrically. Exposures are very good along the Kangamagus Highway above about 1,100 feet and are poorer away from the road except along the steeper slopes and ridge tops.

Scintillometer traverses radiated from most of Butler's seven sample localities throughout this region and for which an average of 14.2 ppm U (range 7.5-17.4) is reported (Butler, 1975). Radiation measurements averaged 2.3 times background, a bit higher than elsewhere recorded in the southern and western part of the batholith. Aplite dikes were only slightly higher than the average. The Mount Osceola Granite averaged 1.6 times background. Again no pattern away from earlier sample sites, no "hot spots," nor secondary mineralization was observed. Some well-jointed wet exposures near the head waters of small tributaries read nearly three times background.

The Eastern Batholith

The North Conway area includes roughly the eastern one-third of the White Mountain batholith and is the area that has received the most recent attention as a uranium and geothermal resource. It includes the largest and most numerous granite quarries (for example Redstone and B and M Ledge), rottenstone pits (the so-called Government Pits on the southeast flank of Moat Mountain), and varied mineralized areas (Iron and Tin Mountains in Jackson and the fluorite and smoke quartz veins and vugs near Moat Mountain) in the batholith.

Aside from the varied, genetically related, extrusive and intrusive phases of the White Mountain Plutonic-Volcanic Series, the Conway Granite appears more varied in this area than elsewhere in the batholith. The most common variety is the typical red to pink, coarse-grained, biotite granite. Recent remapping of parts of the North Conway quadrangle (Rivers and Creasy, 1977) has led to further subdivision of the Conway, hastingsite, and Black Cap granites of Billings (1928). The granitic rocks have been remapped in part on the basis of ferromagnesian content (biotite, biotite-amphibole, and alkali amphibole) and in part on grain size. Red and green varieties are also distinguished.

The red biotite granite is the most radioactive phase of the Conway Granite. The distinction is most obvious in the Redstone quarry where the red biotite granite is frequently three to four times background and the green is about two times background. Fracture zones within the red phase, some with associated fluorite, commonly have the higher values (G. W. Stewart, oral commun., 1976). Butler (1975) reports values of 10.8 to 14.2 ppm U and 77.0 ppm Th for fresh samples of the red phase from the Redstone quarry and 10.0 ppm U and 40.0 ppm Th for the green phase.

Between the Redstone quarry and Hurricane Mountain various biotite-amphibole and alkali amphibole granites are exposed. Scintillometer traverses in this area yielded values only slightly over twice background with lower values for those granites containing more amphibole. Black Cap Granite and associated aplites, some greater than 10 m thick, on the east side of the mountain, averaged 2.5 times background with values as much as 3.7 and U and Th values of 20.1 and

89.7 ppm, respectively (table 2). It is noteworthy that an aplite dike cutting the Albany Porphyritic Quartz Syenite at the Lower Falls of the Swift River (west side of Moat Mountain) also shows radiation values of nearly three times background and U and Th values of 19.7 and 56.2 ppm, respectively (table 1).

North of Hurricane Mountain and north and east of Mt. Pequawket, Conway Granite, exposed on North and South Twin Mountains and Robbins Ridge, showed radiation values averaging two times background. Similar values were obtained from Humphreys Ledge, Cathedral Ledge, and White Horse Ledge, the three more famous cliffs on the west side of the Saco River near North Conway.

In the southeastern margin of the batholith numerous "roche moutonees" provide excellent exposure of the biotitic Conway Granite. White Ledge, Whitton Ledge and B and M Ledge are most notable. Fletchers quarry is located on the northwest flank of B and M Ledge. Most localities here yielded values slightly over two times background, fairly typical of the Conway Granite. Slightly higher values, approaching three times background, were obtained from Nickerson and Birch hills, and one questionable value of 6 times background was obtained from the Fletcher quarry.

Rottenstone localities in Conway Granite in Albany and deeply weathered biotite granite in Bartlett were examined and low values (1.3 and 1.8 times background, respectively) were obtained in both areas. No secondary uranium mineralization was observed, though the Government Pits are well known to local mineral collectors for vein fillings of euhedral smoky quartz, amazonite, occasional phenacite and others.

Two mineralized areas (Iron Mountain and Tin Mountain) in Jackson in the contact regions of the batholith were also examined. Iron Mountain is located at the contact between the Conway Granite and the Littleton Formation and Tin Mountain is located at the contact between schists of the Littleton and the Black Cap Granite. Neither area showed evidence of uranium mineralization. Normal values of twice background were obtained.

Summary

The Conway Granite exposed throughout the White Mountain batholith and adjacent satellitic stocks exhibits rather uniform ground radiation (fig. 4). The coarse-grained biotite granite generally has slightly higher total radiation values than those varieties containing both biotite and minor amphibole. Granites carrying only amphibole are generally lower radiation generators. Late aplite dikes generate about the same radiation as the red biotite granite. Mineralized zones within the Conway Granite produced no radiometry evidence of uranium mineralization. Deep, mechanically weathered, rottenstone occurrences, with the single exception of Middle Sugarloaf Mountain, were not anomalous. No correlation between "hot spots" as defined by Butler's samples and the geological characteristics of the sample locality was apparent.

GENERAL SUMMARY

Based on the detailed and reconnaissance mapping and ground radiometry data obtained in this study, only general distributive characteristics of the radioactivities of the Concord Granite in the New London, N. H., area and the Conway Granite in the White Mountain batholith are possible. No conclusions regarding the origins of the secondary uranium mineralizaton in the Concord Granite or the occasional radioactive anomalies in the Conway Granite can be reached, nor were they intended. The following observations, however, may be worthy of further consideration and future work.

The Concord Granite:

1. The Concord Granite averages 9.9 ppm Th and 15.1 ppm U, which is probably contained in the accessory minerals.
2. Exposures in the New London area and a cursory thin section examination of the host binary granite provided no evidence of deuteric or hydrothermal alteration. Feldspars and accessory bearing biotite were fresh.
3. Secondary uranium mineralization was restricted to fracture zones and joint surfaces. In the decade of exposure in the I-89 rock cuts, the secondary minerals have been continually removed in solution with some evaporative concentration noted in more recent talus and soil accumulations.
4. The greatest concentration of secondary minerals is found in an I-89 fracture zone shared with a lamprophyre dike. Boudette (1976, oral commun., 1977) has suggested that the dike may have impeded mineralizing solutions sufficiently to permit deposition.
5. The three areas of mineralization in marginal zones of the Concord Granite pluton and a fourth area where higher than average radiation values were obtained, define a northwest trend across the pluton. No topographic or geologic extension of this trend, however, was apparent away from the pluton.

On the basis of present data it is not possible to distinguish whether (a) the uranium originated from the original Concord Granite magma and was later leached and concentrated in fracture zones or (b) was introduced into the fracture zones in the Concord Granite from some external source. Primary and secondary uranium minerals are known to occur in pegmatites of the same general age as the Concord Granite in west-central New Hampshire. Present work does not preclude exploratory drilling at the I-89 site to test the possible of concentrated secondary uranium at depth.

The Conway Granite:

1. The red, coarse-grained, biotite granite phase and some aplite dikes associated with it generate more total ground radiation than other phases of the Conway Granite and other rocks of the White Mountains Plutonic-Volcanic Series.
2. The biotite granite tends to contain more radioactive accessory minerals than other granites of the White Mountain Plutonic-Volcanic Series.
3. Alteration, while not readily apparent in outcrop, is known to occur in both the most recent 1 km core in the Conway granite at Redstone (Hoag and Stewart, 1977) and in earlier cores (Rogers and others, 1965; Brimhall and Adams, 1969).
4. Ground radiation, while generally uniform over the batholith as a whole, does vary from exposure to exposure probably as a function of weathering (Richardson, 1964) and (or) accessory mineral content.

5. No correlation between "hot spots" as defined by Butler's samples and the geologic characteristics of the sample locality was apparent in the course of this reexamination. If the "hot spots" do indeed represent areas where uranium and thorium are concentrated in the Conway Granite, exposures in the immediate vicinity were too scarce for complete definition.

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APPENDIX 1.--Raw total gamma radiation data

Location of geographic names can be found by reference to the appropriate USGS topographic maps.

New London, N. H. : Sunapee and Mt. Kearsarge 15-minute quadrangles

White Mountain batholith: North Conway, Crawford Notch, Ossipee Lake, Mt. Chocorua, Plymouth, Mt. Washington, and Whitehead 15-minute quadrangles and Franconia, South Twin Mtn., Lincoln, and Mt. Osceola 7 1/2-minute quadrangles. quadrangles.

Readings were made on the 0.05 scale and listed in MR/HR, with instrument type and background value or range noted.

A. New London area, Sunapee and Mt. Kearsarge 15-minute quadrangles

1. I-89 Occurrence. Ground radiometry data were collected facing the vertical rock cuts at a distance of 2′ from the rock surface and on rock, talus, or soil surface. Data are listed at approximately 10-foot intervals from north to south beginning at the northern-most exposure of each rock cut. Annotation: lamprophyre dike (d), fracture zone or joints (f), mineral show (u), talus (t), soil (s), rottenstone (r). Column A represents measurements taken approximately 2 feet from rock surfaces; column B, measurements taken on rock or soil surface.

Distance	W-cut, S-bound lane FV-65 (0.011 mr/hr)		Median Strip FV-65 (0.011 mr/hr)		E-cut, N-bound lane FV-65 (0.011 mr/hr)	
	A	B	A	B	A	B
0-10	.035	.05	.02-.025	.035	.035	.035
10-20	.035	.05	.02-.025	.035	.035	.035
20-30	.035	.05	.02-.025	.03	nd	nd
30-40	.035	.045	.02-.025	.03	nd	nd
40-50	.035	.045	.02-.025	.03	nd	nd
50-60	.035	.045	.02-.025	.025	nd	nd
70-80	nd	.045	.075	.23(u)	.05-.08	.32(u)
80-90	nd	.045	.025-.030	nd	.05	nd
90-100	.05-.06	.095	.025-.030	nd	.05	nd
100-110	.04-.05	.165(u)	.025-.030	nd	.04	nd
110-120	.04-.05	nd	.025-.030	nd	.04-.05	nd
120-130	nd	.02(d)	.025-.030	nd	.04-.05	nd
130-140	.03	.034	.025-.030	nd	.04-.05	nd
140-150	.03-.04	.055	.025-.030	nd	.04-.05	nd
150-150	.03-.04	.055	.025-.030	nd	.03-.04	nd
160-170	.03-.04	.055	.035-.04	.045-.065	.03-.04	nd
170-180	.05	.09	.035-.04	nd	.04	nd
180-190	.04-.06	nd	.034-.04	nd	.04	nd
190-200	.04	nd	.035-.04	nd	.04	nd
200-210	.03-.05	.055	.034-.04	nd	.04	nd
210-220	.05	nd	.035-.04	nd	.06	.065
220-230	.04	nd	.040-.05	nd	.05	nd
230-240	.04	nd	.040-.05	nd	.05	nd
240-250	.04	nd	.040-.05	.105	.05	nd
250-260	.04	nd	.040-.05	.105	.04-.05	.05
260-270	.04	nd	.05-.08(f)	.055-.135(f)	.04-.05	nd
270-280	.04	nd	.05-.08(f)	.2-.38(u)	.05(f)	.33-.55(u)
280-290	.04	nd	.02-.03(d)	nd	.04	.055
290-300	.04	nd	.04	nd	.04	nd
300-310	.04-.05	.09	.04	nd	.02(d)	.02
310-320	.04-.05	nd	.04	nd	.035(f)	nd
320-330	.04-.05	nd	.04	nd	.04	nd
330-340	.04-.05	nd	.04	nd	.05	.06
	PRI-111C (.077-.099 mr/hr)					
340-350	.017	.023	.04	nd	.05	.06
350-360	.021	.036(f)	.04	nd	.05	.06
360-370	.02	nd	.04	nd	.05	nd
370-380	.02	.025	.04	nd	.05	nd
380-390	.02	.025(t)	.04	nd	.05	nd
390-400	.02	nd	.04	nd	.05	nd
400-410	.02	nd	.04	nd	.05	nd
			LaRoe FV-65 (.012-.013 mr/hr)			
410-420	nd	nd	.020	.023	.021	.033
420-430	.025	.055(f,u)	.020	.023	.025	.031

Distance	W-cut, S-bound lane FV-65 (0.011 mr/hr)		Median Strip FV-65 (0.011 mr/hr)		E-cut, N-bound lane FV-65 (0.011 mr/hr)	
	A	B	A	B	A	B
430-440	.021	.028(r)	.020	.02	.022	.030
	.021	.028(f)	.020	.02	.022	.027
450-460	.018	.022	.020	.02	.022	.025(s)
460-470	.020	.030(r)	.020	.024	.022	.035(s)
470-480	.020	.030(r)	.021	.021	.020	.030(r)
480-490	.023	.030(f)	.020	nd	.024	.029(t)
490-500	.018	.033(s)	.019	.020	.025	.032(s)
500-510	.018	nd	.020	.022	.022	.024
510-520	.018	nd	.020	nd	.020	.033(t)
520-530	.018	nd	.018	nd	.020	.026
530-540	.020	nd	.020	.023	.018	.020
540-550	.020	.025(s)	.015	nd	.020	nd
550-560	.022	.025(s)	.018	nd	.020	.035(f)
560-570	.021	.023	.017	nd	.018	.032(f)
570-580	.020	.021	.016	.018	.020	.025(s)
580-590	.020	.025	.0220	.021(r)	.020	.022
590-600	.018	.019	.019	.021(r)	.020	.022
600-610	.016	.031	.020	.02	.022	.025(r)
610-620	.022	.023(s)	.028	.04(t)	.022	.030
620-630	.017	.035	.028	.036(t)	.42	.55(f,t)
630-640	.020	.037(t)	.020	nd	.032	.55(t)
640-650	.022	nd	.03	.10(f)	.025	.035
650-660	.022	.025(s)	.016	.018	.016	.020
660-670	.020	.024	.014	.018	.022	.60(f,s)
670-680	.022	.030	.018	.020	.015	nd
680-690	.020	.023(s)	.018	nd	.015	.017
690-700	.020	.030(f)	.018	.020	.017	.022
700-710	.017	.033	.022	.036(s)	.022	nd
710-720	.021	.032	.020	.025	.022	.028(s)
720-730	.022	.039	.022	.024	.021	nd
730-740	.015	.017(s)	.022	.022	.025	.035(f)
740-750	.018	.040	.020	.020	.024	.030
750-760	.021	.032	.020	nd	nd	nd
760-770	.020	.028	.018	.020	.023	.034(f)
770-780	.020	nd	.018	.020	.022	.026
780-790	.020	.022(s)	.018	.021	.021	.030(f)
790-800	.015	.021(s)	.020	.021(s)	.022	nd
800-810	.016	nd	.020	.022	.023	.024
810-820	.016	.028	.020	.023	.023	nd
820-830	.022	nd	.020	.020	.020	nd
830-840	.018	.022	.018	.021	.019	.020
840-850	.017	.020(t)	.017	.021	.019	.021
850-860	.017	.020(t)	.016	.021	.019	.021
860-870	.015	.018(s)	.015	.019	.020	
870-880	END OF W-CUT		.013	.016	.018	
880-890	S-BOUND		.014	.018(s)	.018	
890-900			.017	.020	.018	
900-910			.015	.017	.018	

Distance	W-cut, S-bound lane FV-65 (0.011 mr/hr)		Median Strip FV-65 (0.011 mr/hr)		E-cut, N-bound lane FV-65 (0.011 mr/hr)	
	A	B	A	B	A	B
910-920			END OF MEDIAN		.018	
920-930			STRIP		nd	.025(f)
930-940					.018	nd
940-950					.018	nd
950-960					.018	nd
960-970					.018	.028(f)
970-980					nd	nd
980-990					.022	nd
990-1000					.015	nd
1000-1010					.015	nd
1010-1020					.015	nd
1020-1030					.017	nd
1030-1040					.015	nd
1040-1050					.013	nd
1050-1060					.013	nd
1060-1070					.015	nd
1070-1080					.011	nd
1080-1090					.012	

nd

2. Trow Hill area, Sunapee quadrangle (PRI-111B, 0.01; LaRoe, 0.012 mr/hr)
   Mica Hill
   - Bethlehem Gneiss — 0.01
   - Massive pegmatite — 0.005-0.01

   Job Creek Road and Dunning Point
   - Littleton Formation — 0.008-0.016
   - Concord Granite — 0.020

   Rt. 11, area about 0.2 mi NE of Trow Hill Road, contact zone between Concord Granite and Littleton Formation
   - Littleton Formation — 0.008-0.010
   - Concord Granite — 0.012-0.11 (u)

   (highest values from very small mineral show at hill crest 0.4 mi NE of Trow Hill Road near BM 1323

3. Crockett Corner, Mt. Kearsarge quadrangle (PRI-111C, 0.01)
   Approximately 0.1 mi SE of intersection of Rts. 11 and 114 toward I-89
   - Concord Granite — 0.012-0.30 (u)
   - Pegmatites — 0.01-0.012

   (highest values obtained in open quartz encrusted fracture with observed secondary uranium mineralization)

4. N. E. Powerline, Mt. Kearsarge quadrangle (LaRoe, 0.012)
   Traverse along powerline from Bog Road SE to I-89 access road parallel to Old Main Street
   - Concord Granite — 0.012-0.03

   (highest values about 150-feet SE of Pole 181 in soil covered swale; ocassional similar values were obtained along Old Main

Street where Concord Granite is exposed)

5. Surrounding areas
   a. Pleasant Lake and Great Brook, Mt. Kearsarge quadrangle (LaRoe, 0.01)
      - Concord Granite — 0.015 (0.03-0.11 contact of Concord and pegmatite in stream exposure)
      - Kinsman Quartz Monzonite — 0.010
   b. Twin Lakes Village, Sunapee quadrangle (LaRoe, 0.012), N-side of Little Sunapee Lake
      - Concord Granite — 0.015-0.06 (high values in wet joints in Kidder Brook exposure
   c. Clark Pond Brook, Hominy Pot Road, Mt. Kearsarge quadrangle, (LaRoe, 0.012)
      - Concord Granite — 0.03
   d. Blueberry Mountain, Sunapee quadrangle (PRI-11C, 0.011-0.014)
      - Kinsman Quartz Monzonite — 0.014-0.025 (area identified by R. A. Rich as probable anomaly ($\geq$8 ppm U)
   e. Other units
      - Bethlehem Gneiss — 0.012
      - Spaulding Quartz Diorite — 0.012

B. White Mountain batholith and adjacent stocks

1. Ammonoosuc stock, Whitehead, Mt. Washington, and Crawford Notch quadrangles.
   a. Lower Falls of the Ammonoosuc River (PRI-111C, 0.014)
      - Conway Granite (red) — 0.036-0.070 (highest values associated with wet exfoliation surfaces)
      - Pegmatite veins — 0.044
   b. Zealand Falls Road (PRI-111C, 0.014)
      - Conway Granite (red) — 0.044
      - Conway Granite (green) — 0.033-0.036
      - Mount Garfield Porphyritic Quartz Syenite — 0.025-0.026
   c. North and Middle Sugarloaf Mountains (PRI-111B, 0.015)
      - Conway Granite (red) — 0.025-0.032
      - Rottenstone fracture zone — 0.09-0.10 (N. Sugarloaf, near summit)
   d. Crawford Notch (PRI-111B, 0.015)
      - Conway Granite — 0.025-0.037
      - Aplite dikes — 0.045
      - Littleton Formation — 0.015

2. Profile (Canon) stock, Franconia 7 1/2-minute quadrangle Conway Granite, free to medium grained, occasionally porphyritic
   a. Canon Mountain (PRI-111B, 0.015; PRI-111C, 0.012-0.015)
      - Kinsman Trail elev. 3895 — 0.026-0.029

Summit	4180	0.025
Profile clearing	4080	0.020-0.025
Mittersill, N side Canon Mtn. top to bottom		0.018-0.027
Canon Ball, SE side Canon Mtn.		0.020-0.030

b. Eagle Cliff, Greenleaf Trail, intrusive breccia — 0.020

c. Franconia rottenstone, Rt. 3 east side opposite LaFayette Campground — 0.023-0.028

d. The Basin, Franconia 7 1/2-minute quadrangle (PRI-111C, 0.017)

Intrusive breccia, matrix	0.018
Conway Granite	0.034

3. Pemigewasset stock, Lincoln 7 1/2-minute quadrangle (PRI-111C, 0.015-0.017)

a. The Flume, Conway Granite — 0.033-0.037
(values up to 0.048 in some wet vertical joints)

b. Whitehouse bridge, Conway Granite — 0.030-0.032

c. Mt. Pemigewasset (Indian Head) — 0.032-0.045

d. Kangamagus Highway, east of Lincoln, N.H., near entrance to Loon Mtn.

Mount Osceola granite	0.026
Talford (Littleton) schist of Billings and Williams (1935)	0.010
Conway Granite (river exposures)	0.022-0.025

4. Mad River pluton, Plymouth and Mt. Choconia quadrangles Conway Granite, coarse grained to strongly porphyritic

a. Mt. Tecumseh, Waterville Valley Ski area (PRI-11C, 0.015)

Ski trail traverse, main chair lift		
	elev. 2340	0.025
	elev. 2530	0.027-0.029
	elev. 2650	0.020-0.022
porphyritic	elev. 2870	0.023-0.026
Top, main chair lift	elev. 3300	0.030-0.032

b. Welch and Dickey Mountains (PRI-111C, 0.015)

Dickey Mountain traverse		0.023-0.025
aplites	elev. 2630	0.025
	elev. 2400	0.030-0.032
Welch Mountain	elev. 2100	0.040
	elev. 1910	0.032
Mad River	elev. 1280	0.033-0.037

c. Snows Mountain, Plymouth 15-minute quadrangle (PRI-111B, 0.015)

Top Snows Mountain Ski Area Area	elev. 2040	0.020-0.025
Snow Brook	elev. 1780	0.030-0.035
Fletchers Cascade, granite and aplite	elev. 2040	0.032-0.033
Kinsman Quartz Monzonite contact		0.015

d. Bald Knob and Smarts Brook, contact between coarse Conway Granite and Littleton Formation

Conway Granite		0.023-0.026
Aplite		0.030-0.033
Littleton Formation		0.011

e. Main road to town of Waterville Valley, rock cuts between BM 1170 and BM 1332 and stream exposures

Porphyritic Conway Granite	elev. 1320	0.025-0.028
High Brook near BM 1179	elev. 1680	0.034-0.037
SE tributary High Brook	elev. 1560	0.028-0.030
Drakes Brook	elev. 1740	0.028

5. Southern White Mountain batholith area, Pemigewasset River and Hancock drainages, Kangamagus Highway from Loon Mountain to Bear Notck Road. Lincoln 7 1/2, Mt. Osecola 7 1/2, and Crawford Notch 15-minute quadrangles.

a. East Branch Pemigewasset River (PRI-111B, 0.015)

Conway Granite	ranges	0.025-0.027
Mount Osceola Granite - Franconia Campground		0.024-0.025

b. Mt. Hitchcock, north and west flanks

Conway Granite in stream exposures	0.025-0.033
occasional wet surfaces	0.05
Diabase dikes	0.017

c. Sawyer River Trail to Greens Cliff (PRI-111B, 0.013)

Conway Granite	0.025-0.031
Mount Osceola Granite	0.016
Kinsman Quartz Monzonite	0.013-0.014

d. Kangamagus Highway - Hancock Overlook to Kangamagus Pass (PRI-111C, 0.015)

Conway Granite	0.030-0.038

e. Bear Notch Road - Kangamagus Highway northeast to Bartlett (PRI-111C, 0.015)

Conway Granite	0.034
Mount Osceola granite	0.020-0.022

6. Eastern White Mountain batholith, North Conway area. North Conway, Mt. Choconia, Ossipee Lake, and Crawford Notch 15-minute quadrangles

a. West side Saco River, North Conway quadrangle (PRI-111C, 0.018)

Diana's Bath, Conway Granite (red)	0.033
Moat Volcanics	0.028
Cathedral Ledge, cg (red)	0.035
Hummphrey's Ledge, cg (green)	0.029-0.031
aplite	0.035-0.036
White Horse Ledge, cg (red)	0.023-0.028
Thompson Falls Trail (PRI-111B, 0.015) cg (red)	0.035
Green Hill (PRI-111B, 0.015) cg (red)	0.028
Attatash Ski Area, Rt. 302 (PRI-111B,	

0.015)

Conway Granite (green) 0.030-0.035
Aplite 0.038
Mount Osceola Granite 0.025
Stoney Brook - Conway Granite (red) 0.027-0.030
Porphyritic quartz syenite contact 0.020
Bartlett, rottenstone in Rt. 302 exposures 0.026-0.027
Syen̮ites of Hart Ledge Complex (Henderson and others, 1977) Rt. 302 0.015-0.017

b. South of Moat Mtn. South of Moat Mtn.
Government (rottenstone) pits, Albany, N. H., Ossipee Lake quadrangle
Deeply weathered Conway Granite, southeast flank of Moat Mtn. (PRI-111B, 0.015) 0.027-0.035 (mass effect)
B & M Ledge, Fletchers granite quarry (PRI-11C, 0.015)
Coarse, massive Conway Granite (red) 0.032-0.035 (one value up to 0.09)
White Lake State Park, Whites Ledge (PRI-11B, 0.014)
Conway Granite 0.022-0.026
Lower Falls, Swift River, aplite cutting Albany Porphyritic Quartz Syenite (sample LFalls) 0.042-0.048

c. Redstone, North Conway, Jackson area, North Conway quadrangle
Redstone quarry, abundant exposure, quarry dumps-mass effect
Conway Granite (red) 0.042
Conway Granite (green) 0.028
Cranmore Mtn. cg (red) 0.028-0.038
Peaked Mtn. 0.025-0.030
Black Cap Mtn., summit 0.035-0.038
fracture zone 0.045-0.065
White Lot Brook (PRI-111B, 0.020)
cg (red) 0.03-0.035
Black Cap Granite 0.029
Aplite (BC-11) elev. 1400, S-branch 0.032-0.055
Hurricane Mtn. Rd., west side 0.020-034
Rottenstone pits at summit 0.020-0.022
Iron Mountain, mineralized contract between Littleton Formation and Conway Granite (PRI-111C, 0.013)
Conway Granite (red) elev. 1830-2120 0.027-0.032
Littleton Formation, Jerico Road 0.013
Tin Mountain (PRI-111C, 0.008)
Aplite 0.028
Porphyritic quartz syenite 0.027
Littleton Formation 0.015
Doublehead Mountain (PRI-111C, 0.013)
Hastingsite granite elev. 2240 0.024
North and South Turn Mountain (PRI-111B, 0.015)
Conway Granite 0.027-0.038
Robbins Ridge
Conway Granite (weathered) 0.019-0.021
Chatham (Sebago) Granite (binary) of Billings (1928) 0.015