GEOLOGICAL SURVEY RESEARCH 1969

Chapter B

GEOLOGICAL SURVEY PROFESSIONAL PAPER 650–B

Scientific notes and summaries of investigations in geology, hydrology, and related fields

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CONTENTS

GEOLOGIC STUDIES

Cartographic techniques

HYDROLOGIC STUDIES

Ground water

Surface water

Relation between surface water and ground water

Quality of water

Geochemistry of water

Coastal geohydrology

Soil moisture

INDEXES

GEOLOGICAL SURVEY RESEARCH 1969

This collection of 40 short papers is the first published chapter of "Geological Survey Research 1969." The papers report on scientific and economic results of current work by members of the Conservation, Geologic, and Water Resources Divisions of the U.S. Geological Survey.

Chapter A, to be published later in the year, will present a summary of significant results of work done during fiscal year 1969, together with lists of investigations in progress, reports published, cooperating agencies, and Geological Survey offices.

"Geological Survey Research 1969" is the tenth volume of the annual series Geological Survey Research. The nine volumes already published are listed below, with their series designations.

Geological Survey Research 1960—Prof. Paper 400
Geological Survey Research 1961—Prof. Paper 424
Geological Survey Research 1962—Prof. Paper 450
Geological Survey Research 1963—Prof. Paper 475
Geological Survey Research 1964—Prof. Paper 501
Geological Survey Research 1965—Prof. Paper 525
Geological Survey Research 1966—Prof. Paper 550
Geological Survey Research 1967—Prof. Paper 575
Geological Survey Research 1968—Prof. Paper 600

RADIOCARBON DATING OF ASH DEPOSITS ON AMCHITKA ISLAND, ALASKA

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Work done in cooperation with the Advanced Research Projects Agency, U.S. Department of Defense

Abstract.—Peat deposits on the tableland of Amchitka Island contain 3 layers of volcanic ash, each about 1–2 cm in thickness. Radiocarbon dates of discrete plant stems from these ash layers indicate that the age of the uppermost ash deposit is 725 ±250 years B.P. The two lower ash layers lie about 7 cm apart; the average of their dates is 1,845 years B.P. The amount of peat above the ash layers indicates that average rates of accumulation are approximately 0.2 cm/yr for fibrous to mucky peat, and 0.052 cm/yr for the more completely humified and compacted peat (muck). The total depth of peat at this location (2.8 m) indicates that about 3,400 years was required for the formation of this deposit. It is estimated, therefore, that this tableland has borne a vegetation mantle no longer than 4,000 years.

Amchitka Island, the largest in the Rat Island group (Aleutian Islands), has an area of 114.1 square miles (Coats, 1956, p. 86), one-half of which is tableland of several segments at different altitudes ranging from about 135 to 500 feet (Powers and others, 1960, p. 526). These segments are largely mantled with a mat of living heath and bog vegetation which overlies deposits of peat and muck that are as much as 3 meters thick. Three layers of ash, each about 1–2 centimeters thick, can be recognized in profiles of this organic deposit. The vertical distance between the ash layers is presumed to relate to the rate of peat deposition at a particular site. Perennially frozen ground (permafrost) has not been reported in the Aleutian Islands, and no effects of cryogenic processes were evident in these peat deposits on Amchitka Island.. There have been no volcanoes on this island since its emergence from the sea, which was inferred by Powers, Coats, and Nelson (1960, p. 550) to have been before late Pleistocene time.

The dating of these ash deposits allows one to determine the absolute and relative rates of peat deposition under different types of vegetation. From these rates the length of time that the present vegetation mantle has existed on this island may be estimated.

Recently combined carbon is continuously introduced into peat deposits through roots which grow downward in successive seasons; therefore, samples that represent the total material in the deposit are unsatisfactory for radiocarbon dating of the peat. In the peat profile that was studied, living roots were found 0.5 m above the bottom of the thick peat deposit. In addition, downward migration of humic substances probably distributes recently combined atmospheric carbon throughout the deposit. Carson (1968, p. 16) stated, "As is well known, peats are among the more difficult organic materials upon which to base C–14 interpretations. Annual dilution produces material of composite age, in both surface and buried mats." Dates of peat samples, therefore, ordinarily represent average ages of the organic matter in the samples, and are more recent than the age of the oldest material in the sample.

Acknowledgments.—This study was supported in part by Advanced Research Projects Agency, Department of Defense, under Order No. 938. James A. Erdman assisted in the collection and preparation of the samples.

MATERIALS AND METHODS

Trenching on Amchitka Island at an altitude of about 125 feet exposed the profile of a peat deposit 2.8 m thick which afforded an exceptionally good opportunity to obtain, from the ash layers within the deposit, samples of organic matter that were relatively free of

U.S. GEOL. SURVEY PROF. PAPER 650-B, PAGES B81–B83

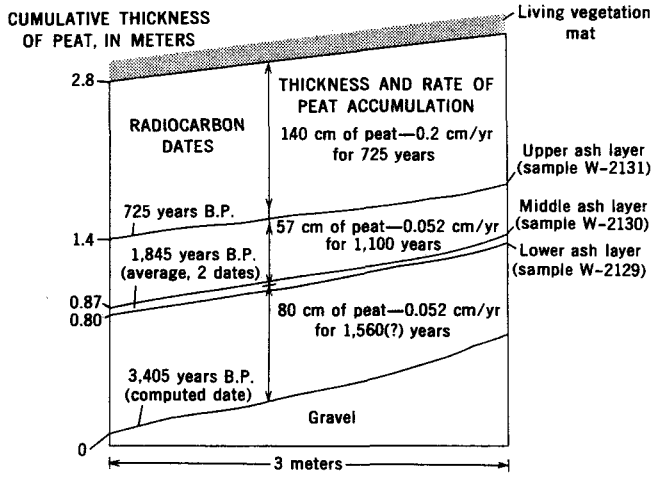

FIGURE 1.—Profile of a peat deposit on Amchitka Island, Alaska, showing the location and dates of the ash layers and the computed rates of peat deposition.

recent carbon contamination (fig. 1). This profile was of a peat composed principally of sedges (*Carex lyngbyaei*(?) and others), with some heath plants (mostly crowberry, *Empetrum nigrum*) also present. The sedge and crowberry stems were preserved as discrete plant organs that could be separated from the humified structureless mucky material and living plant roots that made up the greater part of the total deposit. These stems grow only on or just above the surface of the peat; for this reason it is known that the ash falls and the plant tissues imbedded in them are contemporaneous.

In February 1968, samples of these plant stems were removed by hand sorting from the 3 ash layers, washed to reduce gross contamination from humic materials, sealed in polyethylene bags, and in March 1968, sent to the U.S. Geological Survey's radiocarbon laboratory in Washington, D.C., for further processing and dating. Pretreatment of the stems was limited to a wash in a warm dilute HCl solution in order to remove carbonates. The usual rigorous treatment in boiling acid and alkali was eliminated because of the small size of the samples. The samples were then converted to acetylene gas and counted for 1 day in each of two proportional counters.

It should be noted that the two lower ash layers (lower and middle layers, fig. 1) were located very near each other, that the plant parts which were sampled did not lie entirely in one plane, and that at places it was impossible to determine to which ash layer a stem should be assigned. For these reasons it probably is best to consider the two lower samples as one, and to average the dates of the two samples. The time interval between the deposition of the upper and the two lower ash layers is, therefore, the only reliable measure of the rate of humified peat deposition that was obtained.

RESULTS

The age of the plant material in the upper ash layer (W-2131, fig. 1) was found to be 725±250 years B.P. (before present). The materials in the middle layer (W-2130) and in the lower layer (W-2129) were 1,950±250 and 1,740±250 years B.P., respectively. These two latter dates are averaged as 1,845 years B.P. in figure 1.

The top of the upper ash layer was 1.4 m below the ground surface, and the peat in the part of the profile above the ash layer was reddish brown and fibrous at upper levels, grading to dark-brown humified material (muck) just above the ash layer. This peat had accumulated at the approximate average rate of 0.2 centimeters/year. This rate of accumulation agrees well with that of peat in the vicinity of Fairbanks, Alaska, that was given by Heilman (1968, p. 336) as 0.25–0.38 cm/yr. Carson (1968, p. 17) reported radiocarbon ages of surface peats from the Barrow, Alaska, region to range from 4,280±160 years B.P. for the bottom layer of peat that was 10 inches thick to 395±150 years B.P. for peat 6 inches thick. An examination of the history of these peat deposits suggests that reliable rates of peat deposition in this region cannot be inferred from these data.

The more completely humified and compacted peat between the upper ash layer and the two lower ash layers accumulated in approximately 1,100 years, or at an average rate of about 0.052 cm/yr. The contrast between rates of accumulation of peat that is fibrous to mucky, and that of more completely humified muck, gives some concept of the degree of compaction and the loss of organic constituents by decomposition and leaching in lower layers of a peat deposit in the Aleutian Islands climate, if it is assumed that the deposition of organic matter on the ground surface occurred at a rather uniform rate.

About 80 cm of humified peat lay below the lower ash layer in the profile. If this layer of peat accumulated at the same rate as that described above (0.052 cm/yr), approximately 1,560 years was required for this layer to form. Thus, the estimated age of the lowermost peat in the profile is about 3,400 years. It seems likely, therefore, that the low plateaus of Amchitka Island have borne a vegetation mantle no longer than 4,000 years.

All profiles of the peat mantle that were examined on the low plateaus contained the three ash layers. The distance between the upper and the middle ash layers

in peat that was formed under the crowberry-moss-lichen heath indicates that this peat accumulates at about half the rate of that formed under sedge meadows. This difference in rate may be a measure of the difference in biomass productivity of the two plant communities, or it may only indicate that sedge-peat deposits, because of their wetter habitat, are less affected by erosion and oxidation processes.

The source of the ash that formed the three strata was not determined. These ash falls antedate the historical record of volcanic activity in the Aleutian Islands that was reported by Powers (1958, p. 64–67). Recorded activity of volcanoes on Semisopochnoi, Little Sitkin, and Kiska Islands, which are about 36, 40, and 75 miles distant, respectively, from the study site on Amchitka Island, suggests that any or all of these volcanic islands may have been the source of the ash layers in the peat profile that was studied.

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