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SHORT NOTES

MEASURED BETA ACTIVITY OF ALASKAN FIRN

By T. H. Wu

(Department of Civil Engineering and Institute of Polar Studies, Ohio State University, Columbus, Ohio 43210, U.S.A.)

Abstract. The measured β activities of firn samples from two sites on the Juneau Icefield are in good agreement with each other and with those of Greenland firn. A consistent pattern of β-activity variation can be identified for the firn layers from 1959 through 1962. The 1952–53 firn layer cannot be identified from the measured β activities.

Résumé. *Activité Bêta mesurée dans le névé d'Alaska.* Les activités Bêta mesurées d'échantillons de névé de deux stations du Juneau Icefield sont en bon accord entre eux et avec celles du névé du Groenland. Un certaine caractéristique de la variation de l'activité Bêta peut être indentifiée pour les couches de névé de 1959 jusqu'à 1962. La couche de névé de 1952–53 ne peut être indentifiée par les activités Bêta mesurées.

Zusammenfassung. *β-Aktivitätsmessungen im Firn von Alaska.* Die in Firnproben an zwei Stellen des Juneau Icefield gemessenen β-Aktivitäten stimmen miteinander und mit Messungen im Firn Grönlands gut überein. Eine einheitliche Struktur der β-Aktivitäts-Änderung kann in den Firnlagen von 1959 bis 1962 festgestellt werden. Die Firnlage von 1952–53 kann aus gemessenen β-Aktivitäten nicht bestimmt werden.

Introduction

The dating of firn profiles has been done by means of stratigraphic interpretation, stable isotope ratio and fall-out contamination from nuclear bomb tests. The use of radioactive fall-out has the advantage that reference levels which correspond to years of especially heavy or low fall-out may be established (Picciotto and Wilgain, 1963; Vickers, 1963; Woodward, 1964; Crozaz and others, 1966). The correlation, of course, must take into consideration the rate of fall-out and the global circulation pattern of the fission products. This topic has been well summarized by a number of authors (for example, Libby, 1959; Martell, 1959; Libby and Palmer, 1960) and it is not repeated here.

During the summer of 1963 and 1964 firn specimens were obtained from two sites on the Juneau Icefield in Alaska. The gross β activity of these specimens was determined in an effort to date the firn strata. This paper summarizes the results and compares them with those of Crozaz and others (1966) which indicated abrupt β-activity increases in the 1952–53 and 1961–62 firn layers in Greenland.

Firn Stratigraphy

The study was made at two sites designated as 8 and 10. Site 8 was located at an elevation of 5 700 ft (1 740 m) in a zone of heavy annual accumulation. Site 10 was located at an elevation of 3 500 ft (1 070 m) near the *névé* line.

Firn stratigraphy was observed in test pits and on crevasse walls. The major features recorded were ice layers, their thicknesses and dirt layers (Figs. 1 and 2).

Previous studies of firn profiles (Miller, 1963) have used firn densities and pollen counts in conjunction with stratigraphic features. In most cases the annual ablation surface is marked by a dirty layer or an ice layer. In addition, a continuous record of annual snow accumulation at these two sites obtained by the Juneau Icefield Research Program provides a check on the thicknesses of the firn layers. The very dirty layer at a depth of 50 ft (15.2 m) (Fig. 1) is rather pronounced on many crevasse walls and it has been considered as the reference surface that represents the 1951 ablation surface (Miller, 1963). Nevertheless, the estimated dates shown in Figures 1 and 2 contain a large personal element of interpretation.

Firn Samples

Firn samples were taken from the walls of test pits and from crevasse walls in 1963 and 1964. Before sampling from the crevasses, about 6 in (15.2 cm) was scraped off the walls to reduce contamination. The melted firn was concentrated by evaporation. Gross β activity was measured by proportional gas counter (Nuclear Chicago 447) with a calibrated efficiency of about 40 per cent.

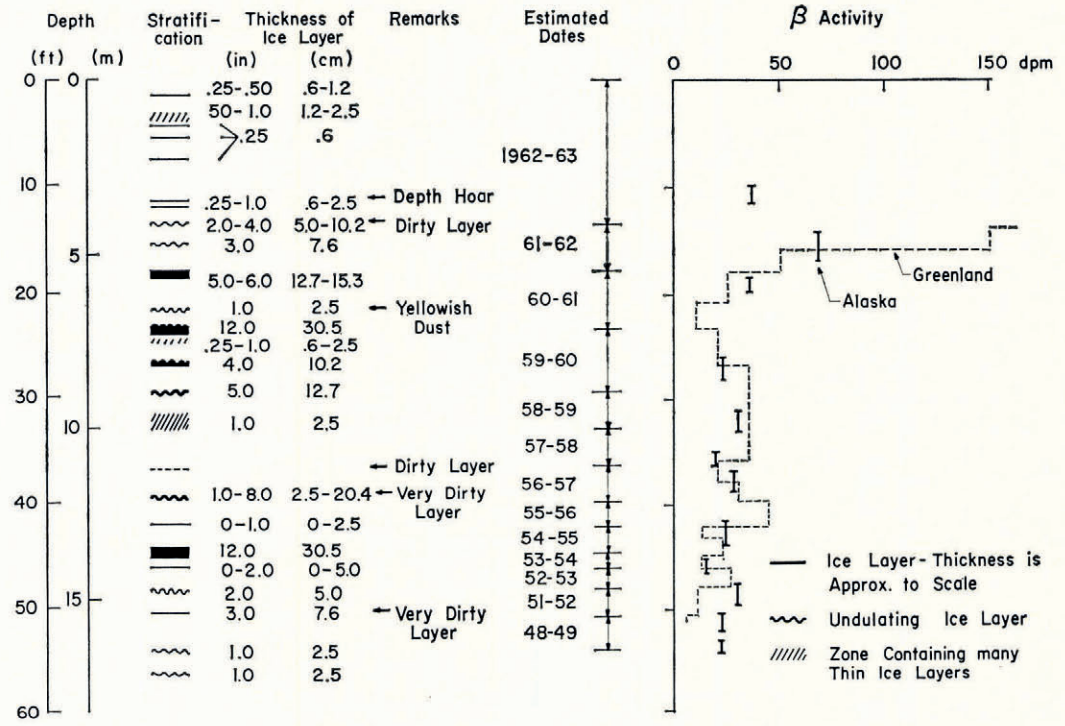

Fig. 1. Firn stratigraphy and β activity, site 10, Juneau Icefield

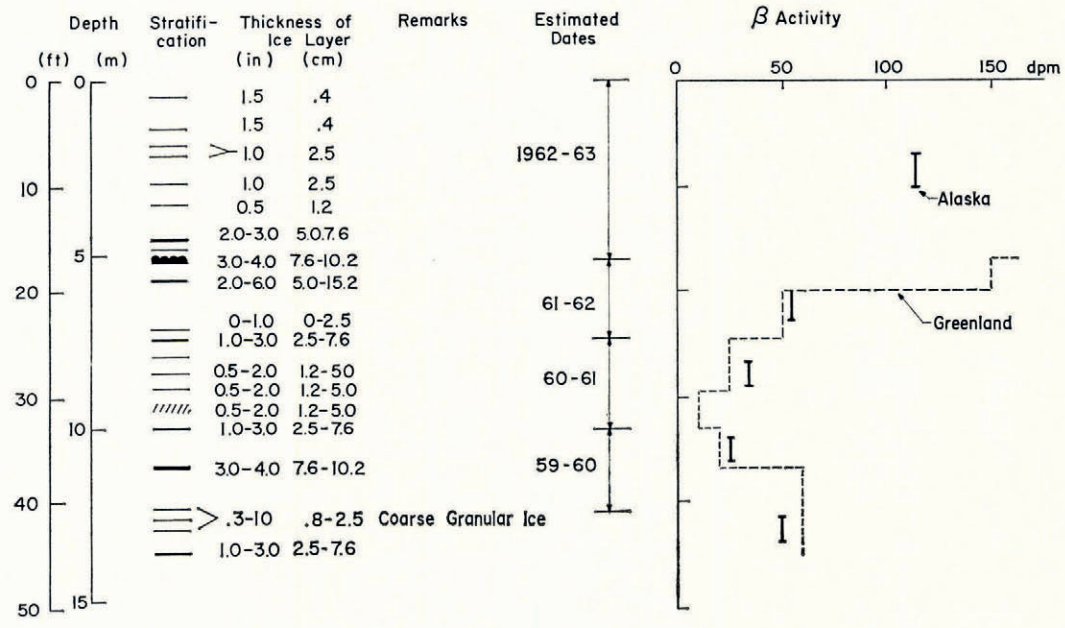

Fig. 2. Firn stratigraphy and β activity, site 8, Juneau Icefield

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Beta Activity

The measured β activities of the 1963 specimens are plotted as profiles in Figures 1 and 2. For comparison, the β activities of Greenland firn for the same years (Crozaz and others, 1966) are also shown.

The general agreement in β activity at the two locations is consistent. Both show a decrease in activity for the years 1959 and 1960 and a steady increase from 1961 on with the resumption of atmospheric nuclear bomb tests. In conjunction with this observation, it should be noted that the identification of the 1959 through 1962 firn layers is considered fairly reliable and involves much less uncertainty than the identification of the deeper layers. Hence the 1960–61 and 1961–62 layers may possibly serve as reference layers for this area.

The β activity of the 1962–63 firn at site 10 is substantially lower than those at site 8 and in Greenland. Four samples of the 1962–63 firn obtained at site 10 in 1964 had β activities between 34 and 44 dpm. At the same site seven specimens of 1963–64 firn had β activities between 20 and 44 dpm. The reason for the low activities is not known.

The relatively high β activities of the 1948–49 and 1951–52 firn layers at site 10 are not in agreement with known fall-out records. The first megaton size U.S. and Russian tests brought heavy ^{90}Sr fall-out in 1953, whereas earlier low-yield tests did not produce significant amounts of ^{90}Sr (Martell, 1959). If one attributes this discrepancy to mistakes in stratigraphic interpretations, the very dirty layer at 50 ft (15.2 m) must be assigned to a later year. On the other hand, questions may well be raised concerning the effect of ablation and run-off on contamination. Thus the 1952–53 firn layer at this site cannot be definitely established.

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