ELECTRICAL CONDUCTIVITY MEASUREMENT ON AN ICE CORE FROM THE ILLIMANI (6430 m, 16°39'S, 67°47'W), BOLIVIA

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For a first dating, the electrical conductivity was measured on an ice core from Illimani. By this fast method, a continuous signal over the whole ice core is received, from which maxima in conductivity can be assigned to volcanic events and annual layers can be counted. The preliminary dating obtained by annual layer counting and ice flow modelling agreed well, indicating that several hundred years of palaeoclimate information are preserved by this glacier.

INTRODUCTION

In June 1999, two ice cores were drilled down to bedrock at 138 and 136 m, respectively, on Illimani, Bolivia, by a joint PSI/IRD expedition [1]. To perform a first dating and to interrelate the two ice cores, the electrical conductivity was measured [see e.g. 2].

The non-destructive electrical conductivity method (ECM) gives an indication about acidity in the ice, and is applied before cutting the ice. It serves as a screening for a preliminary detection of seasonal layers as well as for a first dating by identifying volcanic events. This allows determining a suitable depth resolution for the subsequent analysis.

EXPERIMENTAL PART

The electrical conductivity measurements were performed at the Laboratoire de Glaciologie et Géophysique de l'Environnement (LGGE) in Grenoble, France.

The electrical conductivity was measured after cutting off a 8 mm section in longitudinal direction of the core. After polishing, two electrodes slide over the ice core and the current is measured in dependence of the depth.

RESULTS AND DISCUSSION

The raw ECM data were averaged over 1 cm and the averaged data versus depth are shown in Fig. 1. Seasonal layers were identified by their characteristic two minima, possibly corresponding to the dry seasons. Annual layer counting was performed down to a depth of 40 m waterequivalent (m weq.). From the accumulation of the first six years (confirmed by a maximum conductivity due to the Pinatubo eruption in 1992) an average accumulation rate of 0.67 m weq. y^{-1} was derived. This accumulation rate and an ice thickness of 111.2 m weq. was used to model the ice flow with a one-dimensional model [3].

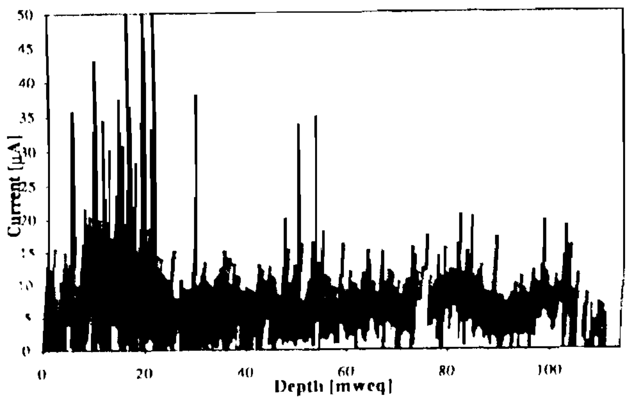

Fig. 1: 1-cm average ECM data versus depth.

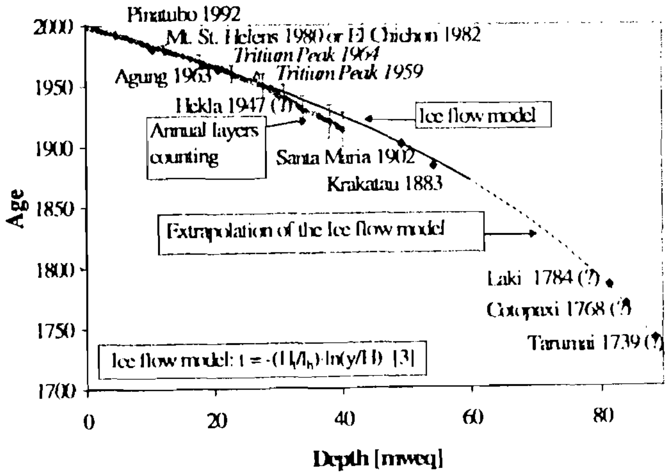

Fig. 2: Age-depth relationship for an Illimani ice core obtained by annual layer counting, ice flow modelling, and identification of volcanic events.

The obtained age-depth relationship is shown in Fig. 2, along with the result of annual layer counting, the location of the two maxima in tritium activity (attributed to the years 1959 and 1964), and ECM peaks assigned to volcanic events [4]. The different dating methods agree well and indicate that the ice core from Illimani covers a time period of several hundred years.

In future, ^{210}Pb activity will be measured and trace elements with stronger seasonal cycles will be analysed to confirm this first dating.

REFERENCES

[1] B. Zweifel et al., PSI Annual Report 1999, p.39.

[2] K. Taylor et al., J. Glaciology **38**, 325 (1992).

[3] J.F. Nye, J. of Glaciology **4** (36), 785-789 (1963).

[4] T. Simkin et al., Volcanoes of the world, Smithsonian Institution, 1983.

Knüsel S., Taupin Jean-Denis, Petit J.R., Schotterer U., Schwikowski M., Gäggeler H.W. (2001).

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In : Annual report 2000. Berne : Labor für Radio- und Umweltchemie der Universität Bern und des Paul Scherrer Instituts, p. 24.