Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19410

Applications of ^{39}Ar-ATTA in Alpine ice samples – surface ages and constraints on diffusion

DAVID WACHS[1,2], PASCAL BOHLEBER[3], ANDREA FISCHER[4], SUSANNE PREUNKERT[5], MARTIN STOCKER-WALDHUBER[6], BERTRAM GRAF VON REVENTLOW[7], YANNIS ARCK[8], JULIAN ROBERTZ[2], MARKUS OBERTHALER[8] AND WERNER AESCHBACH[8]

[1]Institute of Environmental Physics, Heidelberg University
[2]Kirchhoff-Institute for Physics, Heidelberg University
[3]Ca‘ Foscari University of Venice, Department of Environmental Sciences, Informatics and Statistics, Venice, Italy
[4]Institute for Interdisciplinary Mountain Research
[5]Université Grenoble Alpes, CNRS, Institut des Géosciences de l'Environnement (IGE)
[6]Institute for Interdisciplinary Mountain Research, Innsbruck
[7]Institute of Environmental Physics, Heidelberg
[8]Heidelberg University

Presenting Author: dwachs@iup.uni-heidelberg.de

Radiometric age constraints of Alpine ice cores are needed not only at the base but more frequently also at the surface, due to wide-spread negative surface mass balance. In this context, ^{39}Ar closes an important gap in radiometric ice dating between ^{3}H, ^{210}Pb and ^{14}C. The ^{39}Ar isotope with its half-life of 268 years enables dating between 50 and 1000 years. The very low isotopic abundance of about 10^{-16} of ^{39}Ar however sets high demands on the measurement method. The quantum technological Argon Trap Trace Analysis (ArTTA) method reduces the required amount of ice to a few kilograms, hence enabling the application to Alpine glaciers.

This work aims at fully developing the application of the ArTTA dating tool to glacier ice after pilot studies have successfully applied the method to ice blocks and cores[1][2]. Comprehensive sampling campaigns have been conducted at Jamtalferner, Austria in September 2021 and first measurement results were obtained. At this site, the open lying and well-preserved stratigraphy of the ice offers the opportunity to compare ice block samples from the surface to ice core samples for a time range of several centuries. Ages between 130 and 260 years were measured on surface samples, showing similar ages as moraine dating has provided for this glacier. Furthermore, faced with ever older surface ages of alpine glaciers, ^{39}Ar fills the gap left by the disappearance of bomb ^{3}H to provide reliable constraints on the youngest ages in an ice core. Surface sampling has been performed on several alpine glaciers such as Weißseespitze, Großvenediger, and Sonklarspitze.

The risk of atmospheric contamination due to diffusion of argon into ice has been an open question for ^{39}Ar dating of ice. In order to shed light on the effective diffusion of argon in glacier ice, we analysed samples from ice cores that are expected to be free of ^{39}Ar and that were stored for decades. Any ^{39}Ar in these samples is likely the result of accumulated atmospheric ^{39}Ar contamination. We find that diffusion of argon in ice is not a substantial problem for ^{39}Ar dating.

[1]Feng et al. 2019
[2]Ritterbusch et al. 2022