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PAIGE: Chronologies for Polar Paleoclimate Archives – Kickoff conference of a new Italian–German partnership project

Florian Adolphi[1], C. Barbante[2,3], P. Bohleber[3], G. Mollenhauer[1], T. Tesi[2] and F. Wilhelms[1]

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The new international collaborative project called PAIGE (Chronologies for Polar Paleoclimate Archives - Italian-German Partnership) is funded by the Helmholtz Association and aims to strengthen collaborative research between the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) and the Italian Institute of Polar Sciences of the National Research Council of Italy (ISP-CNR). The project's key theme revolves around the ambitious goal of linking chronologies for paleoclimate archives from ice cores and sediment cores.

At the beginning of the PAIGE project, an international workshop on chronology of high-latitude paleoclimate archives was held in Bologna and Venice, Italy, in October 2021. The aim of the conference was to identify the state of the art but also the main gaps of knowledge regarding chronologies and synchronization of polar paleoclimate archives. The conference was held in a hybrid format, allowing for in-person and online attendance. Participants included students and early-career researchers, as well as senior scientists. The plenary session featured 11 invited keynotes followed by discussion and a final wrap-up session each day.

During the conference, a common theme developed around the potential and limitations of linking chronologies from different archives as well as hemispheres. New approaches and techniques for achieving precise chronological control were presented. A special role in this context is played by identifying traces of volcanic eruptions through their chemical signature, as well as tephra deposits. On this topic, Michael Sigl (University of Bern, Switzerland) presented the potential of volcanic signals to improve ice-core dating during the Holocene, as well as to investigate the short-term climatic and societal impact of volcanic eruptions. His talk was complemented by Anders Svensson's (University of Copenhagen, Denmark) presentation on bi-polar ice-core synchronization by means of ice-core sulfate records over the last glacial period. Allessio Di Roberto (INGV, Pisa, Italy) then discussed how to bridge the gap to the marine sector by using tephra particles found in ice cores and sediments. Another powerful synchronization tool is cosmogenic radionuclides such as ^{10}Be; Raimund Muscheler (Lund University, Sweden) presented how ice-core ^{10}Be and ^{36}Cl records can be used to detect changes in the cosmic ray flux, while Martin Frank (GEOMAR, Germany) illustrated the potential and challenges of using ^{10}Be to date marine sediments.

Felix Ng (Sheffield University, UK) showed recent advances in the model treatment of impurity diffusion in ice cores, which is directly relevant to the interpretation not only of volcanic peaks, but also of cosmogenic radionuclides found at greater depths. In addition, Francesco Muschitiello (University of Cambridge, UK) elaborated how to use advanced probabilistic methods to synchronize environmental archives based on their proxy records. Besides synchronization, another focus was on the absolute dating of ice cores and sediments using radiometric methods. Florian Ritterbusch (University of Science and Technology of China) discussed recent advances in using radiogenic noble gas isotopes of Ar and Kr for absolute ice-core dating, with particular examples of how this novel dating technique by atom trace trap analysis can constrain existing chronologies. Walter Geibert (AWI, Germany) showed new approaches of using U-series isotopes to obtain high-resolution chronologies in marine sediments back to ~450 kyr ago. For younger sediments, radiocarbon is the most commonly employed dating method and Claire Waelbroeck (LSCE, France) and Jutta Wollenburg (AWI) discussed challenges related to the marine reservoir age and post-depositional alterations of carbonate shells, respectively.

Inspired by two days of presentations and discussions, the third day of the workshop was dedicated to ongoing work within PAIGE: in Bologna, early-career researchers working on permafrost dynamics presented and discussed their results and explored options for increased collaboration and exchange between the institutes. In Venice, a subgroup intensified the discussion on obtaining high-resolution impurity data from ice cores, specifically with laser ablation inductively-coupled plasma mass spectrometry (LA-ICPMS).

Ultimately, the outcome of the workshop highlighted not only the importance of linking chronologies from marine and ice archives, but also the ambitious nature of such an endeavor. No single dating method is likely to deliver this breakthrough, but the path forward lies in a multi-disciplinary combination of high-resolution stratigraphic dating methods in concert with absolute age constraints from radiometric techniques. Accordingly, it will be crucial to have marine and ice-core experts continue and intensify their inter-disciplinary dialogue. Facilitating this exchange will be a lasting added value of the PAIGE project to the two scientific communities. People interested in learning more about the project and upcoming activities are invited to contact Florian.Adolphi@awi.de or Pascal.Bohleber@unive.it.

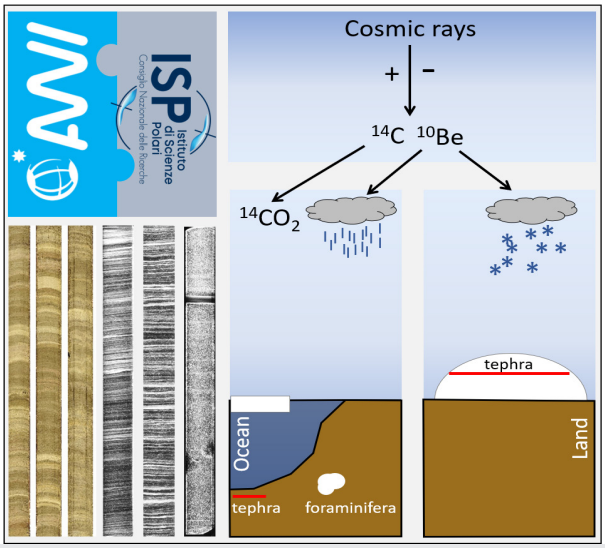

Figure 1: Schematic illustration of the PAIGE's goals to connect the chronologies of ice-cores and marine sediments as well as AWI and ISP-CNR in order to improve our understanding of past climate changes and enhance scientific exchange between communities.

AFFILIATIONS
[1]Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany
[2]Institute of Polar Sciences – National Research Council of Italy
[3]Ca'Foscari University of Venice, Italy

CONTACT
Florian Adolphi: florian.adolphi@awi.de