

ICE MEMORY

Sheltered by
UGA Foundation

Foundation

SVALBARD

Preserve today the ice memory
for future generations

2023

Press kit
April 2023

EXPEDITION LEADERS



ICE MEMORY FOUNDERS

Like most glaciers, the Svalbard ice fields are retreating due to climate change, constituting irretrievable loss. The impacts of global warming are being felt four times faster in the Arctic Region than in other regions of the world. Because they contain precious records on climatic and environmental history, glaciers represent a scientific heritage and cultural legacy of central importance to humanity.

Founders & donors

Ice Memory is the collective responsibility of our generation. This is why the international project receives support in equal parts from scientific institutions (founders and scientific partners of the foundation) and philanthropic donors.



EXPEDITION LEADERS



IN THE FRAMEWORK OF



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Università
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The expedition is funded by the **Italian Ministry of University and Research** through the PRA, the FISR programs and by the **Ice Memory Foundation**.

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Why preserve the ice of Svalbard?

Ice cores are exceptional climate archives, as they alone have recorded the direct parameters of the atmosphere's dynamics, physics, and chemical composition. They also contain a wealth of information on the evolution of the Earth's environment.

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Glaciers, true history books

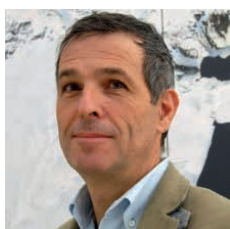
By trapping the different components of the atmosphere, ice represents an invaluable source of information for tracing our environmental past, for providing an account of past climate change, and especially for understanding our future.

Variations in temperature, atmospheric concentrations of greenhouse gases, natural aerosol emissions, pollutants produced by humans...The science of ice cores can study the dozens of chemical compounds that are trapped in the ice: gases, acids, heavy metals, radioactivity, and water isotopes form the memory of the climates and environments of the past.

One can predict that in coming decades, researchers will have new ideas and techniques to give voice to these archives. For instance, they may be able to isolate other information contained in the ice of which we are not aware today.

This scientific information trapped in the ice — synthesised and highlighted by the IPCC — is a useful element in the crucial decisions of how to shape international environmental and climate policy.

« The reason and beauty of the Ice Memory initiative is not to produce added value in terms of today's knowledge, but to create the conditions so that those who come after us can produce it. »



Carlo Barbante,
Vice Chairman of the Ice Memory Foundation,
Climate Scientist, Director of the Institute of Polar Sciences (CNR),
Professor Ca'Foscari University of Venice.

Protecting ice memory

The story of the Ice Memory Foundation

The Ice Memory initiative aims to collect, save, and manage ice cores from selected glaciers currently in danger of degradation or disappearance, with a view to preserving the information they contain for decades and centuries to come.

Over the last few decades, glaciologists have observed the effects of increased temperatures on high-mountain glaciers, and the subsequent loss of irreplaceable scientific data. The data from both polar and non-polar ice is essential to understanding the evolution of the climate and environment in the past, as well as to anticipating the changes ahead.

Faced with this alarming observation, the glaciologists Jérôme Chappellaz - CNRS and Patrick Ginot - IRD (IGE/UGA-CNRS-IRD-G-INP) from France and Carlo Barbante (CNR/Ca'Foscari Univ. of Venice) from Italy decided to take action by launching the Ice Memory initiative in 2015. Margit Schwikowski (PSI) and scientists from over 10 nations joined them in 2017.

UNESCO's executive committee recognised the importance of safeguarding this scientific legacy via two decisions in 2017 and 2018, and by encouraging nations to fully support the Ice Memory initiative. This important step served as a decisive chapter for our team.

In 2021, 7 major scientific institutions created the International Ice Memory Foundation, located at the University Grenoble Foundation: the CNRS, the IRD, University Grenoble Alpes, and the French Polar Institute (IPEV) in France; the National Research

Council (CNR) and Ca' Foscari University of Venice in Italy; and the Paul Scherrer Institute (PSI) in Switzerland.

The Ice Memory Foundation unites scientific and institutional communities in an effort to create an Antarctic sanctuary for heritage ice cores, managed under international governance. Thanks to this initiative, future generations of scientists will therefore have access to high-quality ice cores to pursue their research.

Dozens of ice cores sampled from around the world will be stored for several centuries in the Ice Memory Sanctuary in Antarctica. These heritage cores should enjoy the status of a common good of humanity, with sustainable international governance ensuring their preservation, as well as their exceptional and appropriate use in the future.

Safeguarding these ice cores will be key to fostering scientific advances and knowledge that will ultimately contribute to the well-being of humanity.

His Serene Highness Prince Albert II of Monaco, who is particularly committed to protecting and studying the poles and glaciers, has agreed to serve as the Honorary President of the Ice Memory Foundation.

The Foundation's governance is international, with members from France, Italy, Switzerland, China, and the United States, including two former Intergovernmental Panel on Climate Change (IPCC) Vice Presidents. The Foundation manages the overall worldwide strategy, relations with institutional and scientific partners, in addition to the philanthropy program.

« The Ice Memory Foundation is based on fundamental values that are shared between the international Ice Memory community: trust in science, disinterested cooperation, trust in future generations, and independence from political and economic power. »



Jérôme Chappellaz,
Co-founder & Chairman of the Ice Memory Foundation,
Senior Glaciologist,
Full Professor at EPFL, the Swiss Federal Institute of Technology in Lausanne
Senior scientist at CNRS.

A race against time to conserve high-quality data

The increased frequency of periods or events involving positive temperatures at high altitudes (summer heat waves in the Alps, powerful El Niño events in the Andes), will result, in coming years, in the systematic percolation of meltwater through the upper layers of snow on glacier surfaces. This phenomenon irremediably alters the chemical composition of deep layers of snow, forever destroying the potential of these archives to reconstruct the history of geochemical signals relating to the climate, human activity, and the biological evolution of our environment.

If climate change continues at its current pace, all of the world's glaciers will continue to be altered

and to disappear. According to IPCC simulations, the glaciers with peaks below 3,500 m in the Alps and 5,400 m in the Andes will be gone by 2100. These unique pages from the history of our environment will disappear forever, with no possibility for future generations to study them.

This is essential to promoting scientific advances and knowledge by future generations of researchers equipped with new technologies and research concepts. The knowledge obtained through the ice cores this initiative will continue to guide policy decisions that will ultimately contribute to the well-being of humanity.

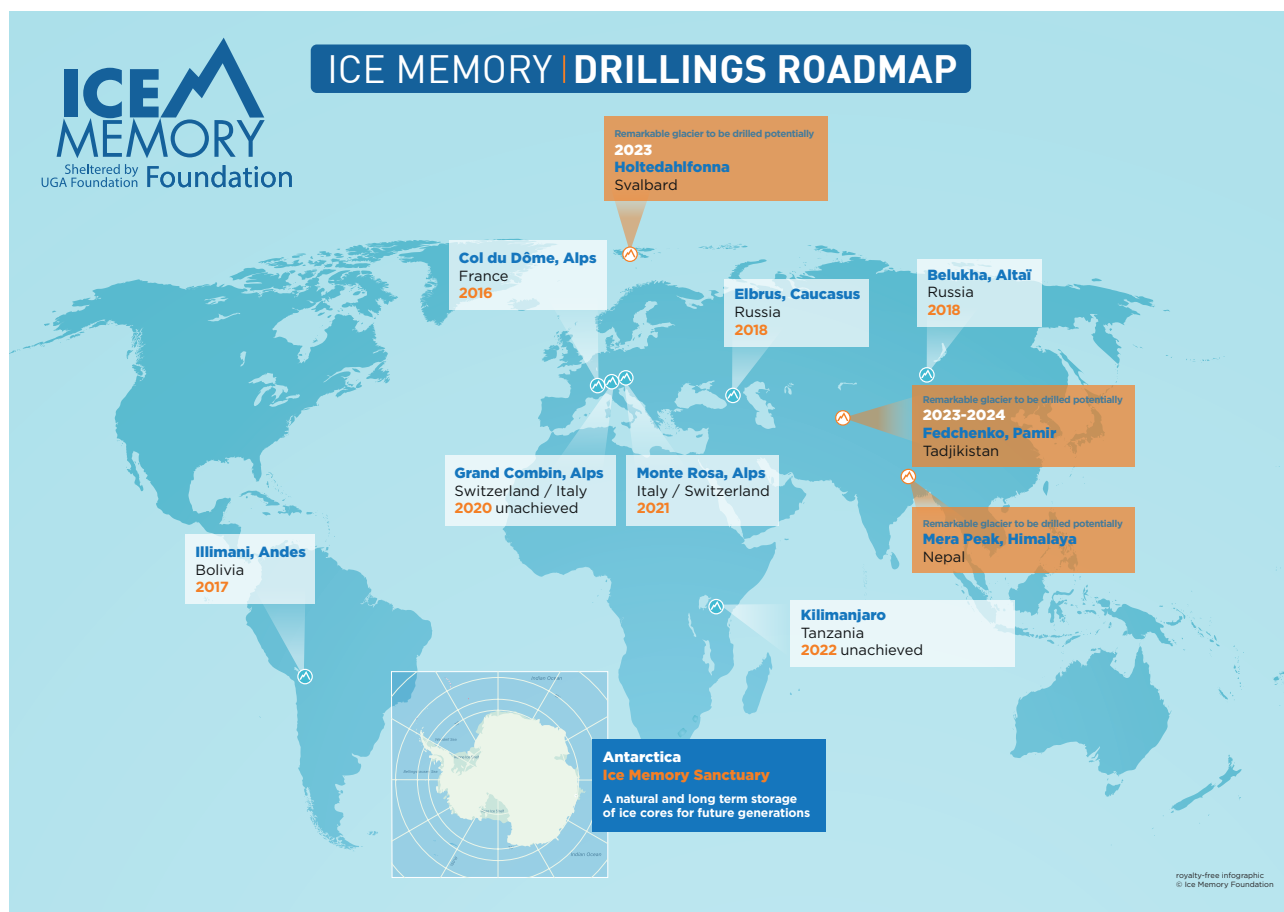
Sampling 20 glaciers in 20 years: the choice of the sites

The Ice Memory Foundation has brought the international community of glaciologists together in the effort to complete at least twenty core drillings in 20 years from the planet's glaciers. These glaciers should:

- **demonstrate an urgency of preservation while**

ensuring high-quality records,

- **provide significant and recognised scientific results on the atmospheric composition, environmental parameters,** and climate of the past, as well as ensure optimal geographical and temporal coverage for the region.



The Arctic Ice of Svalbard glaciers in 2023

An invaluable archive of one of the Northernmost area where the impacts of global warming are going 4 times faster

© ana-paula-grimaldi

The Holtedahlfonna site is recognized as able to provide significant and unique spatial information on a regional scale that reflects changes in the high north Atlantic. The Holtedahlfonna ice core site is also invaluable when investigating the variations in sea ice extent over the past three centuries.

The emblematic glaciers of Svalbard Archipelago can still provide the quality of ice that is essential for paleoclimatic and environmental studies of the Arctic Region. In other words, the history of the North, its climate and environmental activity is trapped

and preserved in the ice crystals of Svalbard: a frozen library containing 300 years of archives on the most important and fastest change on the Planet.

Arctic amplification: why is the Arctic warming faster?

This is a race against time. Since 1979, the Arctic has warmed nearly four times faster than the rest of the world (1). A large part of the explanation relates to sea ice. The sea ice is covered in a bright layer of snow which reflects around 85 percent of incoming solar radiation back out to space. When covered with sea ice, the Arctic Ocean acts like a large reflective blanket, reducing the absorption of solar radiation. As the sea ice melts, absorption rates increase, resulting in a positive feedback loop where the rapid pace of ocean warming further amplifies sea ice melt. This contributes to

even faster ocean warming, and affects the global area, even the ice fields.

This feedback loop is largely responsible for what is known as Arctic amplification, and is the explanation for why the Arctic is warming so much more than the rest of the planet.

Holtedahlfonna: a lab for monitoring the loss of mass balance

In Svalbard, several glaciers are monitored to detect the potential loss of mass. Mass balance is the difference between glacier growth in winter due to precipitation and glacier reduction in summer due to melting and runoff. All glaciers have had a reduction in mass through the monitoring period (since 1967).

The Ice Memory Svalbard Expedition

The goals of the expedition

The goals of the mission are to extract two ice cores covering the glacier's full depth down to the bedrock, **approximately 125 m**. The samples consist of cylinders, each measuring 105 mm in diameter and 1m in length to facilitate transportation. Scheduled in April 2023, the operation on the Holtedahlfonna icefield should last 4 to 5 weeks.

Destination of the two ice cores:

- **One is dedicated to contemporary analysis:** it will be used to carry out geochemical analyses of reference using current technology, to enable today's scientific community to highlight research in view of:

- 1) **Determining the role of sea ice in Arctic amplification** and its impact on the atmosphere, particularly on the chemical processes of bromine and mercury.
- 2) **Comparing** the data obtained with satellite data on sea ice extent and snow accumulation measurements.

- 3) Establishing the **possible provenance areas of the chemical species** through atmospheric transport models
- 4) **Investigating the degradation (or not) of the climate signal** compared to a previous ice core drilled in 2005
- 5) **Reconstructing the history of microbial colonization and evolution in relation to past climate.**

- **The second is dedicated to long term conservation:** the second ice core will be preserved for future centuries at the Ice Memory Sanctuary sheltered at the French-Italian Concordia Station in Antarctica (see page 11).

These two ice cores will allow scientists to study 300 years of climate and environmental History in the North and Arctic Region (the last deep ice core drilled in 2005 offered old data from 1694).

Mission logistics

Ny-Ålesund Station: the expedition headquarters

The headquarter for this expedition is situated at the "Dirigibile Italia", the research station, one of the multidisciplinary research stations managed by the CNR, providing support to numerous national and international research projects. The station, inaugurated in 1997, is located in the village of Ny-Ålesund (78°55' N, 11°56' E). It is named after the General Umberto Nobile who set off from the station in 1928, for a polar expedition. Since July 2020, the station has been managed by the Institute of Polar Sciences.

The base will physically house part of the team dedicated to activities before, during, and after drilling. It will provide support to the entire team for meeting preparations for field activities and equipment preparation. It will also provide the scientists with snowmobile and polar equipment support.



© Martin Fuchs Pixabay

A month in the deep North: the challenges of the ice cores extraction

Holtedahlfonna's Ice Field

300 km² | largest ice field on north-western Spitsbergen
-11 °C | average annual air temperature (1992-2020)
+4/5 °C | temperature increase during the last 40-50 years
2005 | previous ice core drilling

Drilling site

1100m altitude
 -25°C to -5°C range of temperature on the site
 4 hours by snowmobile
 12h of drilling per day

8 researchers
 1 driller
 1 mountain guide

Ice Cores

2 expected
 125m length expected
 300 years of climate and environmental history
 105mm diameter

1 month: expected duration of the operation from drilling to storage

Headquarters in Ny-Ålesund station
 Storage of the ice cores
 in a refrigerated container
 until transport to Europe

Journey of the ice cores

- Ny-Ålesund to Longyearbyen - Norway
- Longyearbyen to Brest - Norway to France
- Brest to Grenoble - France
- Grenoble to Venice - France to Italy
- Shipping to Antarctica in 2024-2025

Drilling technique

In order to sample ice formed by the compression of successive layers of snow year after year, drilling operations make a vertical cut using a core drill, a steel tube attached to a power cable shaped like a screw and equipped with cutting blades. The steel tube, which is approximately 1.50 cm long, is driven into the ice by its rotational functionality.

Once it is completely driven in – and thus filled with ice – glaciologists extract the tube, which now contains an ice cylinder known as an ice core, measuring approximately 0.5 meter in length and 10cm in diameter. They then repeat the process in the borehole.

Each core is placed in a protective cover that is numbered and marked with its location and depth of extraction, as well as its top and bottom end.

They are then carefully stored in isothermal storage boxes while awaiting transport in a refrigerated container. The cold chain that must be maintained from the drilling site to storage is particularly sensitive, and represents a crucial element in such an ice core drilling operation.

The journey towards the Ice Memory Sanctuary in Antarctica A challenge in cold chain logistics

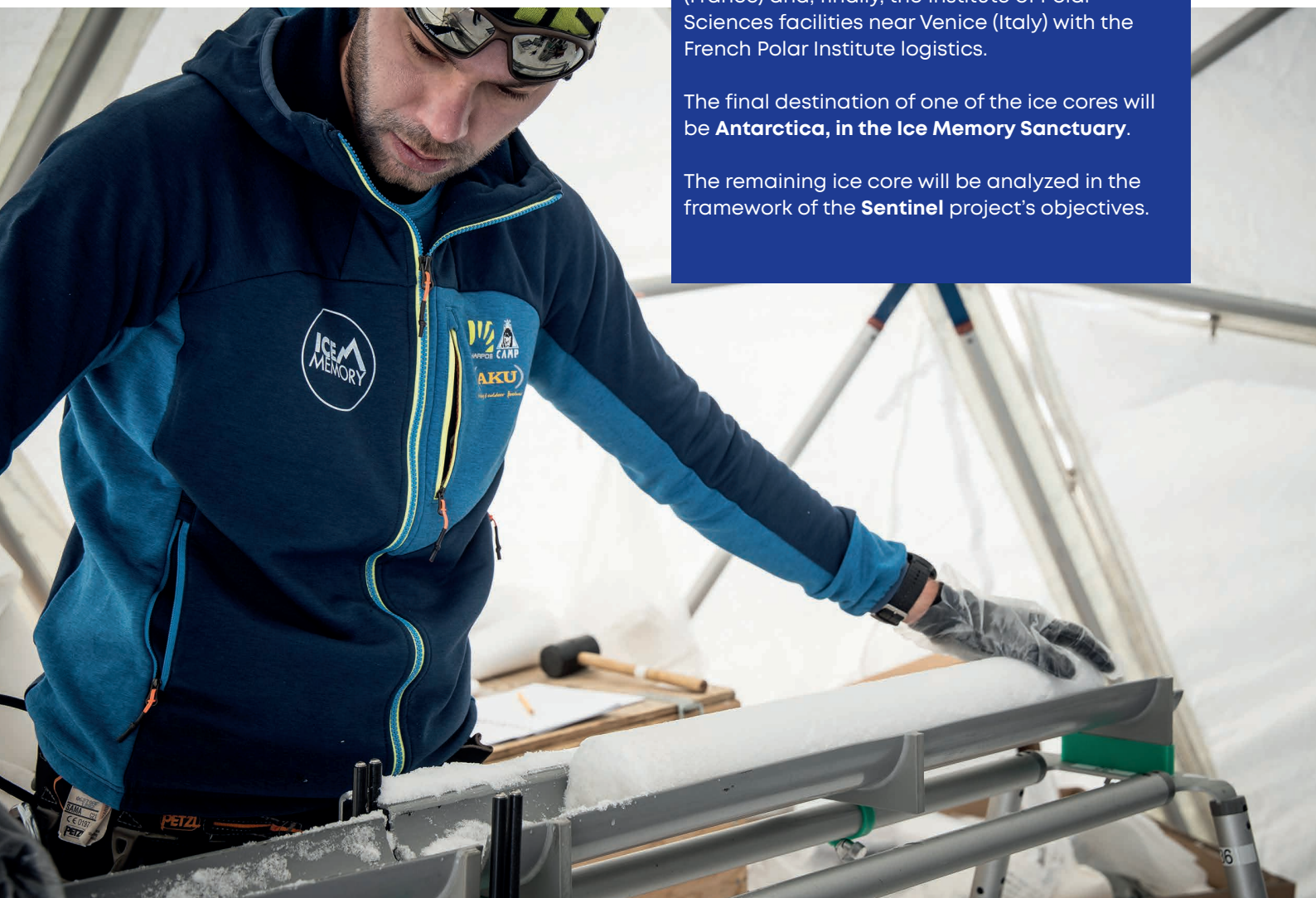
After each drilling operation, it is crucial for the ice samples to remain frozen while being transported and shipped in containers. At first, they will be transported in dedicated tubes by snowmobiles from the icefield to the headquarters at the Ny-Ålesund station.

Then, the 2 ice cores will then be placed in isothermal boxes and transported in refrigerated containers (-20°) equipped with an independent generator for maritime shipping from Svalbard to Europe.

A few months after the expedition ends, the cores will be shipped by boat to Brest (France), then the journey will continue towards Grenoble (France) and, finally, the Institute of Polar Sciences facilities near Venice (Italy) with the French Polar Institute logistics.

The final destination of one of the ice cores will be **Antarctica, in the Ice Memory Sanctuary**.

The remaining ice core will be analyzed in the framework of the **Sentinel** project's objectives.



Risk and safety

Even though Svalbard is easy to reach nowadays and the icefield is quite accessible, the expedition team will face a number of dangers, risks and rough conditions.

Working conditions in the Arctic environment

The Svalbard region, located at 79°N latitude, is characterized by minimum winter temperatures between -20° and -25°C. During the drilling operation, the temperatures may fluctuate between -25°C and -5°C. Even with these important variations, most of the areas in which the Team will be moving have a very low avalanche risk.

Reaching the drilling site

Crevasses and water channels are dangers to be reckoned with for anyone traveling on glaciers tracks or routes. At the end of the melt season, Norwegian Polar Institute scientists examined the condition of the glaciers from a helicopter. In addition, they acquired several satellite and aerial images of the areas. The photos show that the crevasses in the Holtedahlfonna glacier are full of snow in the winter season and open in the summer. Generally, in April the snow layer is thick and strong enough to allow snowmobiles to cross snow bridges. Most of the water channels are well known. Therefore, they can be avoided

taking safe routes by using GPS navigation systems to take safe routes.

Encountering the King of the Arctic

The remote camp will be set up in uninhabited areas of the Svalbard archipelago. So, the Team will actively monitor the possible presence of **polar bears**. Normally, the highest probability of encountering the King of the Arctic is in the coastal area, while the probability decreases moving towards the interior of the archipelago and in elevated areas.

For the Team, the most likely situation is to spot a bear while traveling to or from work. Surveillance is planned also during the night hours to ensure safety. In the unlikely event that a bear is sighted at a safe distance from the remote field work area, all Team members are informed, and activity is immediately stopped until the situation is clarified.

If the bear moves towards the Team, scientists will leave the area as soon as possible using snowmobiles. The use of a rocket launcher may be considered to keep the bear at a safe distance while preparing to evacuate the camp.

Composition and organisation of the team

- A logistical team consisting of:
8 researchers, 1 driller, 1 video maker. See below.

expedition leader



Andrea Spolaor
Paleoclimatologist & Snow chemist
CNR - Italy



Jacopo GABRIELI
Glaciologist
CNR - Italy



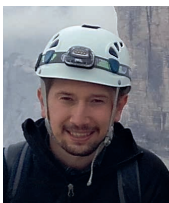
Catherine Larose
Genomics expert
CNRS - France



Jean-Charles Gallet
Snow physicist
NPI - Norway



David Cappelletti
Chemist
University of PERUGIA - Italy



Daniele Zannoni
Research technologist
Ca' Foscari University
of Venice - Italy



Victor Zagorodnov
Ice cores driller
Cryosphere Research
Solutions LLC - USA



Federico Scoto
Climatologist
CNR/Ca' Foscari U. - Italy



Fabrizio de Blasi
Glaciologist
Polar Institute -CNR - Italy



Paolo Conz
Mountain guide
Italy



Riccardo Selvatico
Photographer & video maker
Italy

All biographies
and scientific
institutions and
partners -
see pages 15-16
in appendices.

Antarctica, the sanctuary of Ice Memory's heritage for centuries to come

Under current conditions, there is no cold room that can ensure 100% conservation, in other words conservation that is free from the risk of technical or economic failure over very long periods of time. The French Polar Institute (IPEV) and the Programma Nazionale di Ricerche in Antartide (PNRA) of Italy, which jointly manage the Concordia Station on the Antarctic Plateau, will provide transport and storage for the ice cores drilled for Ice Memory.

The Ice Memory Sanctuary: 300m² of storage at Concordia Station in 2024-2025

A dedicated snow cave will be built at the French-Italian Concordia Station, the only international research station on the Antarctic Plateau. The station is operated by the French Polar Institute and PNRA, and allows natural storage at -50°C.

Located close to the Concordia Station, the storage site will cover a surface area equivalent to approximately twenty 20-foot containers, or approximately 300 m². Jointly managed by IPEV and PNRA, the first cave should be available for the first Ice Memory cores in 2024-2025.

The Ice Memory Sanctuary offers solutions to major challenges

Despite the added complexity of transporting the heritage cores to Antarctica, this strategic choice is essential for several fundamental reasons:

- **Guaranteed long-term preservation of the samples** using 100% "natural" storage with no energy consumption required for refrigeration, thereby protecting the precious samples from any risk of disrupted refrigeration (technical problems, economic crisis, conflict, acts of terrorism, etc.).
- **Structured management of these unique samples**, combined with restrictive Antarctic logistics that prevent easy access to the cores.
- **Storage in a polar region managed via the Antarctic Treaty** - signed by the world's major nations, and for which territorial claims are frozen.



© Thibaut VERGOZ

Photos de la cave
© Rocco Ascione / PNRA /
French Polar Institute

The Ice Memory sanctuary at Concordia Station will rely on an innovative solution combining the rigidity of existing infrastructure with the environmental friendliness of natural snow arches. Design studies conducted by French and Italian polar logistical agencies, with additional support from scientists at IGE (Grenoble, France), yielded a design proposal combining natural snow with strengthened infrastructure, in order to provide the longest possible lifetime for the repository, all while limiting the impact of construction in the Antarctic environment in accordance with the Madrid Protocol.

A sanctuary open to all international teams under Antarctic Treaty governance

The long-term governance of the Ice Memory Sanctuary, spanning decades and centuries, should ideally be placed under the auspices of international institutions to ensure that this legacy can be passed down through the generations, with no damage and with optimum governance. The heritage ice cores must be stored under common ethical governance and Ice Memory technical protocols.

An Ice Memory Sanctuary in Antarctica will therefore be available for all Ice Memory labelled ice cores, for an indefinite period. They are destined to become the common heritage of humanity, and will be preserved under international governance according to the rules adopted by the Antarctic Treaty System. They will be managed in accordance with the Madrid Protocol. A specific protocol applicable to operators in Antarctica, which will be adopted by the Ice Memory Foundation, is currently being developed.

The 41st Antarctic Treaty Consultative Meeting (ATCM), held in July 2018 in Buenos Aires, recognised the importance of the Ice Memory project, and will ensure that the programme adheres to the Madrid Protocol on Environmental Protection to the Antarctic Treaty. The 42nd ATCM, held in Prague in July 2019, included a discussion surrounding an Ice Memory Information Paper presented by the French and Italian delegations.

Universal governance by 54 nations via the Antarctic Treaty ensures that this continent is a land exclusively dedicated to Peace and Science - an ideal location to keep and preserve Ice Memory ice cores for decades and centuries to come.



Appendices



Budget and philanthropy



« Ice Memory is the collective responsibility of our generation, which is why we call on civil society to participate through philanthropy. »

Anne-Catherine Ohlmann,
Ice Memory Foundation Director

The operation's total budget is estimated at **xxx M€**. The majority part is provided by the Italian Ministry of University and Research through the PRA and the FISIR programs. The scientific institutions participating in the operation provide logistics and human resources. The Ice Memory Foundation completes the budget to cover the costs related to Ice Memory heritage core.

SVALBARD EXPEDITION
SPONSORS



Major philanthropic partners

The Ice Memory Foundation is supported in equal parts by the founding scientific institutions and philanthropic donors. We would like to thank all of the donors who have helped make the initiative a reality since 2015.



The Prince Albert II of Monaco

Foundation is committed to protecting and advancing the health of the planet for present and future generations by promoting a new relation to nature, as well as through innovation that can accelerate this change. The foundation's objective is to promote effective solutions for our planet's biodiversity, climate, oceans, and water resources. It has supported Ice Memory since its launch in 2015.



The Didier and Martine Primat Foundation

raises awareness among the general public and public authorities about planetary issues related to human activities, and works towards a more responsible world by supporting concrete actions fostering the emergence of more environmentally conscious and sustainable lifestyles. Faced with the disastrous situation of disappearing glaciers, the Foundation has supported Ice Memory since 2017, especially the 2022 Kilimanjaro operation.



Thermo Fisher Scientific is a world

leader in serving science through cutting-edge technologies and services that enable researchers, organizations, and companies to make the world healthier, cleaner, and safer.

Thermo Fisher Scientific has supported Ice Memory since 2017 by donating state-of-the-art analytical equipment, and therefore helping the PANDA analytical platform (IGE) reach the Top 3 ice core science research institutes in Europe.



KÄSSBOHRER E.S.E.

The Ice Memory Foundation would like to thank all of the donors who have helped make the initiative a reality since 2015: the Air Liquide Foundation, the BNP-Paribas Foundation, Kassbohrer, AKU, Karpos, Findus, Elcom, Alizent, GMM, Pressario, and Lexinnov, with special thanks to Claude Lorius as well as the Italian Ministry of University and Research.

The Svalbard team members

Andrea Spolaor



Expedition leader. Andrea Spolaor is a paleoclimate and snow chemistry expert at CNR. He participated in several field expeditions in Arctic, Antarctic and Alpine regions. He studies elements and compounds

post-depositional and photochemical processes in surface snow and snow-atmosphere interactions. His main topic is trace elements measurements in ice cores with particular focusing on iron for its role in the ocean fertilization, and halogens measurements for their connections with sea ice changes. He also studies the impact caused by the ancient civilization on atmospheric composition. He is involved in aerosol measurements in the polar environment to understand the natural cycle of trace elements, biogenic compounds and black carbon and their possible changes in the recent decades.

Jacopo Gabrieli



Jacopo Gabrieli studied chemistry at the University of Padua, and earned a doctorate in Environmental Science from the Universities of Venice and Grenoble. He is a researcher at the Institute of Polar Science at

the CNR, where he has spent years studying the climate archives contained in ice cores. Mountaineer for both his work and as a passion, Jacopo has taken part in major research projects involving Alpine glaciers, as well as in Greenland, Antarctica, and Svalbard.

Catherine Larose



Catherine Larose has been employed by CNRS and working in the Environmental Microbial Genomics group (EMG), Ampere laboratory at Ecole Centrale de Lyon, UoL, since 2013. She combines molecular

and biogeochemical approaches to understand oligotrophic ecosystem function. She applies cutting edge metatranscriptomics and metagenomics to understand community function, evolution and activity. Her role in the Sentinel project is to study the evolution of microbial communities over time and link them to environmental changes.

Jean-Charles Gallet



Jean-Charles Gallet, snow physicist at the Norwegian Polar Institute since 2010 and since 2020 a permanent resident in Longyearbyen, Svalbard. His focus is on snow physical and optical properties

as well as the impurity content in snow (dust, black carbon), as well as the link between physical properties of snow and its chemical and biological content. Part of his work also focuses on the link between snow and ecosystems on Svalbard (i.e., rain on snow event).

David Cappelletti



David Cappelletti is full Professor of Chemistry at the University of Perugia and associate researcher to ISP-CNR. Member of Comitato Glaciologico Italiano. The recent scientific activity is

mainly focused on atmospheric aerosols, vertical profile measurements in the boundary layer by tethered balloon, and atmosphere-cryosphere exchanges with particular emphasis on black carbon and mineral dust. He participated in 10 Arctic expedition campaigns since 2011.

Daniele Zannoni



Daniele Zannoni is a research technologist at Ca' Foscari University of Venice. After receiving his PhD in Environmental Sciences in 2018, Daniele has been involved in research on environmental radioactivity at CNR-ICMATE and in stable water isotopes and ice core research at CNR-ISP. Afterwards, at the Geophysical Institute – University of Bergen, he contributed to the development of custom airborne measurement systems of the isotope composition of atmospheric water vapor.

Victor Zagorodnov



Victor Zagorodnov has 50 years of expertise in glaciers research practically in all glaciated Earth Regions: Antarctica, Greenland, Central Asia, Tibet, South America, Alaska, Africa, New Guinea,

and others. I have been increasingly engaged since 1972 in assessing climate change impacts on natural resources and society, acting chiefly in the capacity of a project leader (15 expeditions of a total 33). In all expeditions, I use the ice drilling technique for paleoclimate analysis.

Federico Scoto



Federico Scoto is currently a Postdoc the Institute of Atmospheric Sciences and Climate (ISAC-CNR). During his PhD in Science and Management of Climate Change earned in 2020 at Ca'

Foscari University (Venice, Italy), he studied past abrupt climate variability, making use of ice core-based proxies to reconstruct past sea ice fluctuations in the Arctic region. Over the past years, he has also developed practical and theoretical skills by participating in several field campaigns, including Svalbard, Alaska, and the Alps. Since late 2020, he has been coordinating the snow monitoring program at Ny-Alesund, which aims to better understand the chemical and physical evolution of the seasonal snowpack.

Fabrizio de Blasi



Fabrizio de Blasi has a master's degree in Forest and Environmental Science and PhD in Land Environment Resources and health. Since 2010, his research activities

have been on the mountain and environmental science with a focus on the relationship between climate change and snow and ice dominated high altitude environments. He is a researcher at the Institute of Polar Sciences-CNR in Venice and his research topic is the analysis of climate evolution during the last 2000 years through the study of Alpine and Apennine ice cores. Since 2017, he has been part of the Italian team of Ice Memory.

Paolo Conz



Paolo Conz born and lives in Feltre, in the southern part of the Dolomites. He went on his first climbing trips as a teenager, and eventually became a Mountain Guide, a Regional Instructor in

Mountain Rescue, the Deputy Station Manager in Ravine Rescue in the Veneto region, and a Helicopter Rescuer. He has participated in the Ice Memory missions on Grand Combin, Monte Rosa, and Gran Sasso.

Riccardo Selvatico



Riccardo Selvatico is a photographer and videomaker who has made the passion for images his work. Born in Venice in 1974, he approached photography after graduating in Tourism Economics at

Ca' Foscari. Besides photography, he is also dedicated to video making. His area of action is the whole Outdoor world with a particular focus on high mountains. During the winter, now since 2013, he has been following the television production of the Ski Mountaineering World Cup.

Institutions leading the Svalbard expedition

ISP-CNR



The mission of the ISP is to contribute to increasing the quality of Italian scientific and technological research in the polar regions, and to provide knowledge on global changes in support of Italian and European environmental policies by the development of new technologies and survey methodologies.

Founded in 2019, our mission will allow us to improve our understanding of the climatic changes taking place in the Arctic and Antarctic environments and possible future developments at both polar and global levels. Our studies address research issues related to both the chemical/geochemical and physical aspects of the poles using a multidisciplinary approach to protect these vulnerable extreme environments. The repercussions of climate change on these dynamics are still largely unknown and will require integrated research using long term multidisciplinary methods to understand them fully.

ISAC-CNR



The Institute of Atmospheric Sciences and Climate (CNR-ISAC) aims at an integrated scientific understanding of the atmosphere, the ocean and their processes, by means of a multidisciplinary approach which combines scientific and technological skills in meteorology, climate, atmospheric dynamics and composition, Earth observations; it develops basic research, theoretical, experimental and numerical, and modeling work together with impact evaluation.

ISAC is the largest CNR Institute on atmospheric sciences, structured in 7 Units over the country, 7 permanent observatories, including 1 Global station and 3 Regional Stations of the Global Atmosphere Watch (GAW) program of the World Meteorological Organization (WMO) and 2 atmospheric research Supersites.

ISAC is recognised internationally through its collaboration with a large number of European laboratories, and research centers worldwide.

Università degli Studi di Perugia



The University of Perugia was founded in 1308. In that year, Pope Clement V issued a bull entitled Super specula, which granted the Studium of the city the authority to engage in higher education. Today, research, education and consulting activities in the various disciplines are organized in 14 Departments, with about 25,000 students, 1,100 professors and researchers and 1,100 staff members. The University also offers study programs in some other Umbrian towns: Assisi, Foligno, Narni and Terni.

In recent years, the University has undertaken a broad renewal of its degree programs and curricula, which prepare students to meet the demands of the labor market and to satisfy the needs for innovation expressed by employers in private and public sectors. On the international level, the University remains firmly committed to developing collaborative relationships with European and non-European Universities, to facilitate and improve international advanced study opportunities for its students.

The Norwegian Polar Institute



The NPI is a directorate under the Ministry of the Climate and Environment. We are Norway's central governmental institution for environmental monitoring, mapping and scientific research in the Arctic and the Antarctic regions. NPI provides Norwegian authorities with research based strategic advice on issues relating to the polar regions.

NPI has had a year-round presence in Ny-Ålesund since 1968, it acts as the official Norwegian host in Ny-Ålesund and as the point of contact for scientific research and associated activities, and it has the overall on-site responsibility for ensuring coordination.

The founders of the Ice Memory Foundation

CNRS cnrs.fr

The French National Center for Scientific Research is one of the most recognised and renowned public research institutions in the world. For more than 80 years, it has continued to attract talent at the highest level and to nurture multi-disciplinary and interdisciplinary research projects at the national, European and international levels. Geared towards the public interest, it contributes to the scientific, economic, social and cultural progress of France. The CNRS is above all 33,000 women and men, more than 1,000 laboratories in partnership with universities and other higher education institutions bringing together more than 120,000 employees and 200 professions that advance knowledge by exploring the living world, matter, the Universe, and the functioning of human societies. The CNRS ensures that this mission is carried out in compliance with ethical rules and with a commitment to professional equality. The close relationship it establishes between its research missions and the transfer of acquired knowledge to the public makes it today a key player in innovation in France and around the world. Partnerships with companies are at the heart of its technology transfer policy, and the start-ups that have emerged from CNRS laboratories bear witness to the economic potential of its research. The CNRS also provides access to research findings and data, and this sharing of knowledge targets many audiences: scientific communities, the media, decision-makers, economic actors and the general public.

Université Grenoble Alpes univ-grenoble-alpes.fr

UGA, which is among the world's top 150 universities in the Shanghai ranking, is rooted in its territory, and emphasises interdisciplinary and international openness. It is one of 8 French universities recognised by the French Initiative of Excellence (IDEX) label. Since 2020, UGA has included the three constituent institutions of Grenoble INP – l'Institut d'ingénierie et de management-UGA, Science Po Grenoble-UGA, and Ecole nationale supérieure d'architecture de Grenoble ENSAG-UGA – along with 3 additional academic components in the form of the Faculté des sciences-UGA, Ecole universitaire de technologie-UGA, and the Faculté Humanités, santé, sport, sociétés-UGA. A series of campuses located chiefly in Grenoble and Valence are home to 59,000 students, including 10,000 international students and 2,900 doctoral students, and over 7,700 staff members. National research organisations such as the CEA, CNRS, Inria, and Inserm have closely associated with l'Université Grenoble Alpes to develop a joint international research and technology transfer policy. Relations with INRAE, the IRD, and CHU Grenoble Alpes have also been promoted. UGA has supervisory authority over l'Institut des géosciences de l'environnement, which manages the project and supports the Foundation behind Ice Memory.

Ca' Foscari University of Venice unive.it

Originally established as Italy's first business school in 1868, Ca' Foscari University of Venice is a multidisciplinary institution offering a wide range of study programmes in economics, management, modern languages, the humanities, and the sciences. Today the university is also exploring new areas of research by focusing on climate change, digital humanities, digital transformation, social innovation, and nanoscience. Ca' Foscari University is currently fifth in Europe in terms of the number of European Marie Curie fellows recruited, and has been in the top ten for the last five years. It has risen in the QSWorld University Rankings by Subject, one of the most influential university rankings worldwide, thanks to its excellent results in Modern Languages (61st worldwide), History (among the best 150 universities worldwide), Linguistics, Economics & Econometrics, and Geography (among the best 200).

Institut de recherche pour le développement ird.fr

The French National Research Institute for Sustainable Development (IRD) is a French public multidisciplinary research organisation, and a committed actor in international development. Its original model favours equitable scientific partnerships with developing countries. The IRD's research priorities are to further the achievement of the Sustainable Development Goals (SDGs) by supporting development policies and by helping design appropriate solutions for the environmental, economic, social, and cultural challenges faced by humans and our planet.

At the initiative of the observation of Andean glaciers along with its partners, the IRD is one of the creators of the Ice Memory initiative launched in 2015. The IRD pursues a science of durable solutions that directly address the major challenges facing our societies, notably by relying on interdisciplinary approaches and the co-construction of knowledge. It mobilises multiple teams and research instruments around glaciers – indicators of climate variability that are central to the environmental, societal, and economic issues of both the present and future.

CNR - National Research Council of Italy cnr.it

The National Research Council of Italy is represented by the Institute for the Dynamics of Environmental Processes (IDPA). The latter is devoted to advancing our knowledge regarding the processes of the Earth system and its interactions with humanity through applied research and training, with a focus on the monitoring and management of anthropogenic effects. It promotes approaches for solving problems in Earth science and for developing decision-making processes with respect to sustainable development. It communicates its results in order to foster understanding and awareness for the benefit of society.

The primary research area of CNR-IDPA is the study of contamination on a global scale, the transport and transfer mechanisms for chemical substances between different environments, the transformation processes and cycles for chemical substances in the environment, and the development of analytical methods for studying specific pollutants in snow, ice, water, and on land.

IDPA-CNR has broad experience in studying past climate change, as well as contamination on both a local and global scale, especially in remote mountainous areas. The institute also focuses on densely populated areas to measure the impact of human activities on the environment, in an effort to understand the diffusion mechanisms of contamination, and to propose relevant actions for environmental restoration.

French Polar Institute institut-polaire.fr

The French Polar Institute provides human, logistical, technical and financial resources and also the legal framework necessary for developing French scientific research in the polar and subpolar regions.

These regions' isolation and extreme climates make it imperative for operators to have highly specific technical knowledge and skills. The Institute brings together specialist professionals in polar logistics, turning to good use its knowledge of harsh environments and special range of skills to coordinate, support and run an annual 60 to 80 science and technology projects in the higher latitudes of the globe, both North and South. At the Institute's headquarters in Brest, permanent teams about 50 strong, two-thirds of whom are made available on secondment by the CNRS, manage the resources necessary for organizing scientific expeditions.

In the Antarctic and the Subantarctic islands, around 200 seasonal or winter staff are deployed over the various bases. They provide the support for over 200 research scientists in their fieldwork operations. For the Arctic, 100 or so scientists leave each year with the support of the French Polar Institute.

Paul Scherrer Institute psi.ch

The Paul Scherrer Institute (PSI) is the largest research institute for natural and engineering sciences in Switzerland, conducting cutting-edge research in three main fields: matter and materials, energy and the environment, and human health. PSI develops, builds, and operates large, complex research facilities. Each year, over 2,500 scientists from Switzerland and around the world come to PSI to use our unique facilities for experiments that cannot be carried out anywhere else. PSI is committed to training future generations, and therefore approximately one quarter of our staff are apprentices, post-graduates, or post-doctoral fellows. It also offers the iLab school laboratory for younger students.

University Grenoble Alpes Foundation fondation.univ-grenoble-alpes.fr

The UGA Foundation supports scientific research, pedagogical innovation, and student initiatives with the academic partners of Grenoble Alpes University – a leading French university – and host scientific foundations, in an effort to accelerate the transitions of the 21st century, and to contribute to a sustainable and resilient society. The UGA Foundation has been involved in the Ice Memory initiative from the beginning in 2015, and has been home to the international Ice Memory Foundation since 2021.



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