CASE STUDY

Unlocking the secrets of the Antarctic with the aid of ultrapure water

CNR Institute, University of Venice, Italy

Scientists involved in the Italian National Antarctic Research Program have been analyzing ice, snow, sediment, atmospheric and oceanic samples from Antarctica for over 30 years to study the concentrations and distribution of chemicals in the region, identifying natural background levels and investigating changes over time. These measurements are often made at ultra-trace levels requiring the most sensitive analytical techniques and the purest water for sample preparation and analysis. Ultrapure water provided by ELGA LabWater has played a key role in this work.

Background

Antarctica is one of the few pristine environments remaining on the planet. Studies in Antarctica and the Southern Ocean are critically important to our understanding of global climate and environmental variability. Regional properties and processes have important global consequences, from atmospheric composition to ocean circulation. In addition, the region is also susceptible to change in our global environment, potentially giving rise to strong feedbacks which could accelerate climatic change.

The analysis of polar ice cores allows investigators to study atmospheric constituents over a long time scale; the properties of most aerosol compounds remain unaltered in the ice. The chemical information obtained from the ice allows scientists to establish the climatic and environmental conditions and biomass burning events on Earth over many thousands of years. More recent changes are studied via ocean and aerosol sampling.

Our client's mission

The CNR Institute for the Dynamics of Environmental Processes (CNR-IDPA), and the Department of Environmental Sciences, Informatics and Statistics, Università Ca' Foscari in Venice, Italy, specialize in the analysis of ultra-trace levels of substances in environmental matrices. Due to their expertise, the CNR-IDPA has provided critical support in many ship-borne expeditions to the Antarctic for the recovery and analysis of ice cores and to take marine, snow and atmospheric aerosol samples. The frozen samples are subsequently analyzed under tightly controlled conditions in Venice.

Importance of Ultrapure Water in sample preparation

All sample bottles used for environmental analysis go through a stringent cleaning protocol over a period of several weeks to ensure that they are contaminant free.

The use of ultrapure water is vital for this application, and since 2002 the Venice laboratory has been relying on ELGA's expertise for the production of Type I water.

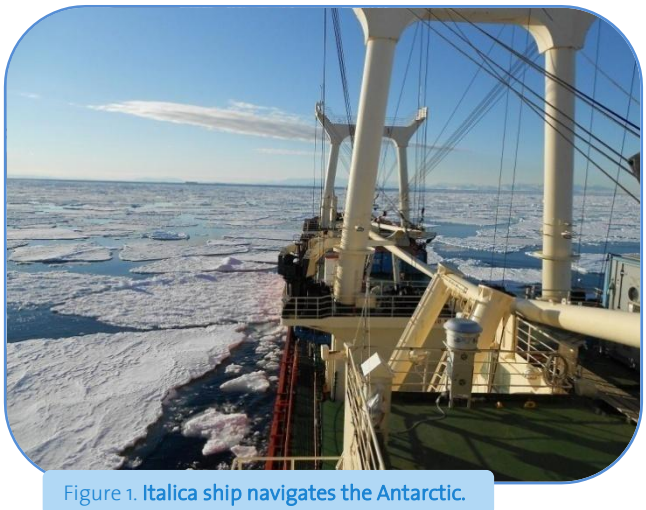

Figure 1. **Italica ship navigates the Antarctic.**

The polyethylene and Teflon bottles used for the samples sent to the Antarctic were pre-cleaned extensively in the University of Venice, rinsed repeatedly with pure water from an **ELGA PURELAB® Ultra** (Figure 4) and finally stored filled with 0.1% hydrochloric acid prepared from high purity acid and water from the same PURELAB Ultra.

Dr. Warren Cairns, an analytical chemist at CNR-IDPA, explained: "When monitoring baseline levels in a pure environment such as Antarctica, it is vital to avoid introducing any contaminants during the sampling procedure. We have an **ELGA PURELAB Option-Q** coupled to a **PURELAB Ultra Analytic** water purifier in a Class 1000 clean room, which provides the Type I ultrapure water needed for our bottle cleaning procedures. We use vast quantities of ultrapure water to wash and rinse our LDPE (Low Density Polyethylene) sampling bottles before we send them to Antarctica, and must be absolutely certain that we do not introduce any contaminants; we need to be certain that whatever we are analyzing is coming from our samples and nowhere else. Once clean, the bottles are triple bagged and heat sealed, ready to be opened and used on site."

The expedition to Antarctica

The ship left Italy for the 27th expedition in November 2011; the 14 scientists involved in the project joined the ship in New Zealand in January 2012, and spent the next two months collecting samples in the Antarctic. The mission concluded in April 2012, when the ship returned to Italy with over 300 frozen samples ready for analysis.

Figure 2. **Detail of Italica ship (2012).**

The expedition focused on air, water and snow sampling. Analytes of interest included the pollutants of particular concern (POPs) and, in water samples, rare earth elements (REEs).

The ship was equipped with a laboratory with a clean room in a container. Air monitoring equipment was set up on the upper deck, while various systems were used to take water samples from different locations at a range of depths.

Figure 3. **Dr. Warren Cairns**
Analytical Chemist at CNR-IDPA

"We must be sure that what we are analyzing has come from the sample and is not due to contaminants introduced into the bottle, and our ELGA water purification systems ensure that we have ultrapure water constantly available.".

ELGA's contribution to the mission

Confidence in the cleanliness of all the sampling equipment is vital, and a reliable source of ultrapure water is essential to minimize contamination during the collection and handling of samples.

For this reason, ELGA LabWater provided the PURELAB Ultra used for initial sample equipment preparation and for standards and blanks during sample analyses.

Moreover, the laboratory on the ship was equipped with a PURELAB flex 3 (Figure 5), which constantly provided reliable ultrapure water during the expeditions.

Figure 4. **ELGA PURELAB Ultra.**

Figure 5. **ELGA PURELAB flex 3.**

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The PURELAB flex 3 was fed from a large tank of desalinated water on the ship and was used to clean the laboratory, to rinse bottles, and to rinse sampling equipment prior to use and between samples.

PURELAB flex 3 reliably produced ultrapure water under very demanding conditions.

Dr. Elena Barbaro (Figure 6), from The Institute for the Dynamics of Environmental Processes – CNR in Venice, who was responsible for the on-ship laboratory, was delighted with the performance of the PURELAB flex 3 unit: **"The PURELAB flex 3 system had permitted to ensure a good decontamination of sampling materials in order to analyze trace concentrations of inorganic compounds. The system was very versatile, very stable as MΩ, and water was quickly purified by assuring a continuous work."**.

Figure 6. **Dr. Elena Barbaro**
Scientific Researcher at CNR-IDPA

References:

- **Trace element determination in seawater by ICP-SFMS coupled with a microflow nebulisation/desolvation system** Toretta C., Cozzi G., Barbante C., Capodaglio G. And Cescon P. Anal. Bioanal. Chem., 2004, 380: 258-68
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- **Direct determination of levoglucosan at the picogram per millilitre level in Antarctic ice by high performance liquid chromatography/electrospray ionization triple quadrupole mass spectrometry** Gambaro A., Zangrando R., Gabrielli P., Barbante C. And Cesco P. Anal. Chem., 2008, 80(5), 1649-1655
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To find out more about ELGA LabWater's water treatment technologies and solutions for analytical applications, **visit www.elgalabwater.com**

About ELGA LabWater

ELGA LabWater manufactures supplies and services water purification systems for use in laboratories, and which meet the water requirement specifications for general laboratory, healthcare and clinical grades of water. ELGA offices and distributors are located in more than 60 countries worldwide. ELGA is the global laboratory water brand name of Veolia Water Solutions & Technologies.

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