

Methods for ^7Be analysis

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Sampling

Surface sea ice, water beneath sea ice at 1m depth and surface water were collected during the ice-stations. In order to avoid any alteration related to the presence of the vessel, sea ice and seawater at 1 m beneath ice samples were collected at distances of about 200 m away from the ship. Sea-ice thickness was measured by drilling and also by using an electromagnetic field system with a ground based EM [Schauer, 2008]. ^7Be present in sea ice was collected assuming that it was concentrated within the upper 10 cm of sea ice, as previous tests carried out by some of us (unpublished) showed. Approximately 100 L of sea ice from the upper 10 cm were collected using stainless steel shovels after removal of the overlying snow. Previously, snow thickness was estimated using a calibrated pole. Once on board, sea ice was melted at room temperature and was not filtered. Unfiltered water was collected using a peristaltic pump at 1 m beneath the ice through a hole in the ice floe. Surface seawater samples were obtained from the water intake line of the RV Polarstern, placed at 8 m depth.

When sea-ice sediments (SIS) were visually detected, approximately 10 to 200 g of dried sediments (SIS) were collected from the upper surface of the ice floes, usually from ridges or cryoconite holes (small holes produced by aggregation of particles in the surface ice by absorption of solar energy). Sediment sampling was carried out by scraping with a stainless steel shovel or an ice-hammer to obtain blocs of turbid sea ice. Once onboard, sea ice samples were thawed and SIS were isolated from the supernatant liquid by careful decantation. Afterwards, SIS samples were kept frozen and stored in plastic bags until their analysis in the laboratory. Before radionuclides analysis, all samples were dried to constant mass in an oven at 60 °C for 48-72 hours and thereafter were subsequently ground to a powder.

Samples representative of integrated wet (single events) and total (wet+dry) atmospheric deposition were collected on board the ship using plastic funnels with an effective surface area of 0.19 m² connected to a polyethylene container placed beneath the funnels. At the end of each rain-snow event, the funnels' surfaces and interior walls of the collection bottles were washed with a known volume of 1M HCl.

^7Be analysis

Water and melt-water from sea ice samples were immediately acidified with 37% HCl to pH ~1-2 and spiked with 10 mg of stable Be as an internal tracer. 300 mg of Fe³⁺ were added as a carrier and then samples were left for 12-24 hours for equilibration after vigorous stirring. pH was adjusted to 8.5 with NaOH in order to allow the precipitation of Fe-hydroxide (Fe(OH)₃) that scavenges ^7Be from solution. The sample supernatant was carefully removed via siphoning and the precipitate was stored until analysis in the laboratory.

^7Be measurements were conducted at the Universitat Autònoma de Barcelona (UAB) within two months after collection to minimize ^7Be decay using gamma spectrometry. The iron precipitates from water samples (sea ice, deposition, water beneath ice and surface water) were dried and placed in plastic vials for gamma measurements. In the case of aerosols, filters were digested with aqua-regia (1HCl: 3HNO₃), after addition of stable Be as a yield tracer, and the resulting solutions were evaporated to adequate volumes for measurement by gamma spectrometry. Chemical recoveries of Be were determined through measurement of stable Be in small aliquots by optic absorption spectrometry. Aliquots of about 0.47 - 11 g of each dried, ground sea-ice sediment sample were placed into plastic vials for gamma spectrometry.

Gamma spectrometry was carried out using well-type, low-background, high-resolution gamma spectrometers (HPGe). ^7Be has an energy peak at 478 keV, and the detectors were calibrated for several cylindrical geometries by using certified materials (i.e. MCR 2009-018). Counting efficiencies depending on the used geometries ranged from 0.135 to 0.152. All ^7Be activities were decay-corrected to the date of collection. For samples with ^7Be activities below the detection limit, we also corrected the minimum detectable activity (MDA) for decay to the date of collection.

Schauer U. (2008). The expedition ARKTIS-XXII/2 of the research vessel "Polarstern" in 2007, Reports on polar and marine research, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, 579, pp. 271, hdl:10013/epic.30947.d001.