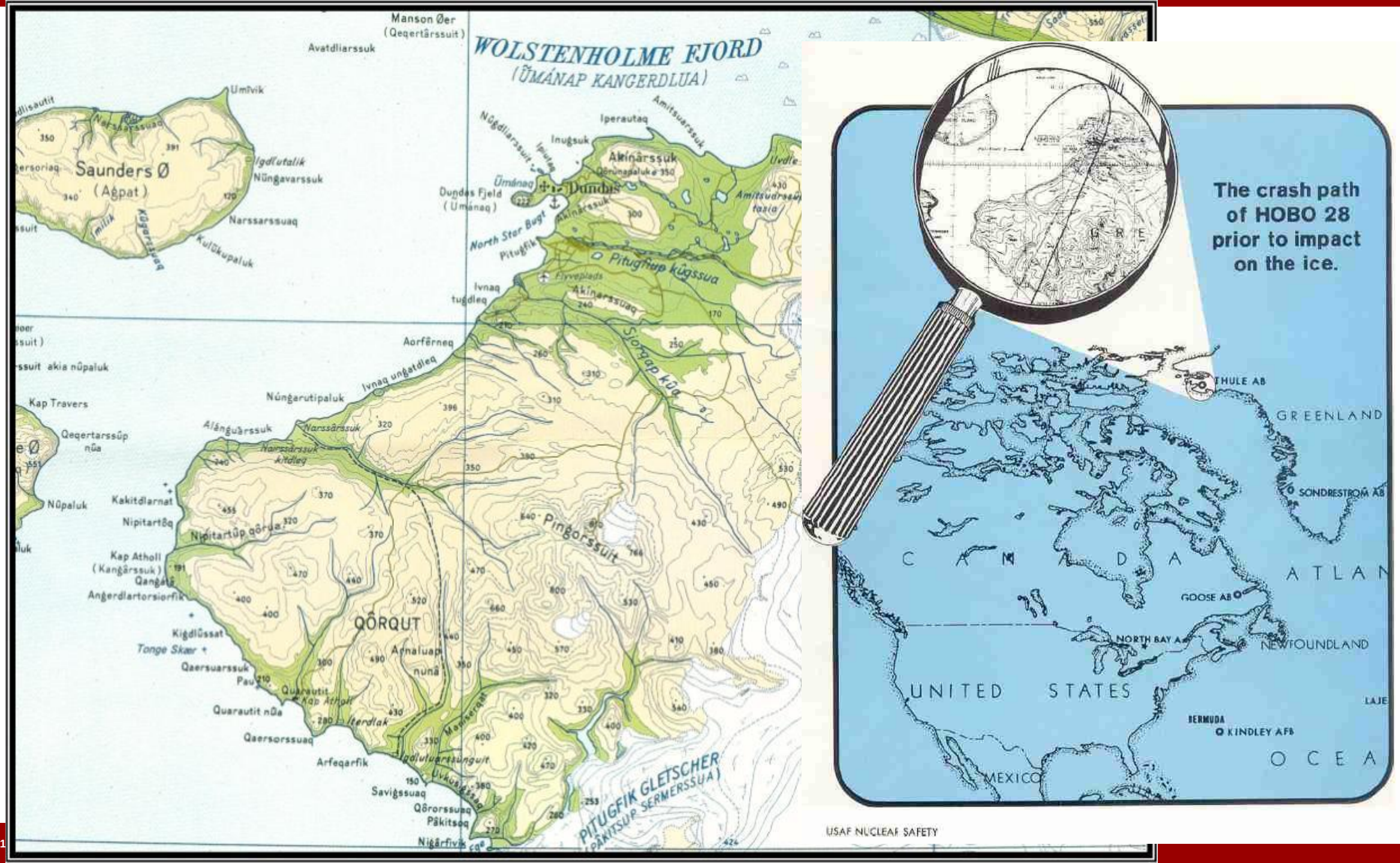
Thule accident

Sven Nielsen

On January 21, 1968, a B-52 bomber (HOBO 28) carrying four nuclear weapons crashed on the sea ice off the shore of Thule, Greenland. Both the aircraft and the weapons disintegrated on impact. There was no nuclear explosion since the design of the weapons precluded any nuclear reaction. Nevertheless, limited contamination resulting from the dispersed radioactive material from the weapons had to be controlled and removed, as did the aircraft debris.

HOBO 28 Accident details

- Following take-off, the flight proceeded uneventfully. The first aerial refueling, accomplished approximately 4 hours into the mission, was routine. One hour later the aircraft commander instructed the copilot to begin crew rest. At this moment started a series of events that led to the destruction of HOBO 28. The cabin temperature became too cool for comfort at the flight-planned altitude. In accordance with approved procedures, the copilot set the temperature control to maximum heat. This action provided a source of very hot air for cabin temperature control. After making the initial setting, the copilot began decreasing the control setting as crew members reported they were getting too hot. Then, a few miles south of Thule Air Base, one crew member reported the odor of burning rubber. With fumes growing stronger in the cabin, the aircraft commander instructed the crew to go on oxygen and locate the source of danger.
- The navigator searched the crew compartment once without finding where the smoke and fumes were coming from. Ordered to make a second search of the same area, he moved a metal box, and located the fire. Hurriedly he alerted the crew and started using a fire extinguisher on the flames. The pilot notified the ground station of a fire in the cabin and requested authority for an immediate descent and for emergency landing at Thule Air Base. Two minutes later he began the descent. Downstairs, the navigator was having little success in containing the fire even though he had now used both available fire extinguishers. Shortly after descent began, all aircraft electrical power was lost, and the bailout order was given and executed. The aircraft continued on down, struck the ice in a steep left bank and disintegrated from impact, explosion, and fire.
- Seven persons were aboard the aircraft. Six survived.


WOLSTENHOLME FJORD
(ÛMÁNAP KANGERDLUA)
Manson Øer
(Qeqertârssuit)
Avatdliarssuk
Saunders Ø
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Umîvik
Igdlutalik
Nûngavarssuk
Narssarssuaq
Kulûkupaluk
Iperautaq
Inugsuk
Akinârssuk
Dundas
Dundas Fjeld
(Umânaq)
North Star Bugt
Pitugfik
Pitughûp kûgssua
Ivnaq tugdleq
Aorfêrneq
Ivnaq ungatdleq
Sjorqap kûa
Núngarutipaluk
Alânguârssuk
Narssârssuk
Kap Travers
Qeqertarssûp nûa
Nûpaluk
Kakitdlarnat
Nipitartôq
Nipitartûp qôrda
Kap Atholl
(Kangârssuk)
Qangâlâ
Angerdlartorsiorfik
Kigdlûssat
Tonge Skær
Qaersuarssuk
Quarautit
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Arfeqarfik
Savigssuaq
Qôrorssuaq
Pâkitsoq
Nigârfivik
QÔRQUT
Arnaluap nunâ
Pingorssuit
PITUGFIK GLETSCHER
(UPÂNITSUP SERMERSSUA)
The crash path of HOBO 28 prior to impact on the ice.
THULE AB
GREENLAND
SONDRESTROM AB
GOOSE AB
NORTH BAY A
NEWFOUNDLAND
UNITED STATES
BERMUDA
KINDLEY AFB
MEXICO
USAF NUCLEAR SAFETY


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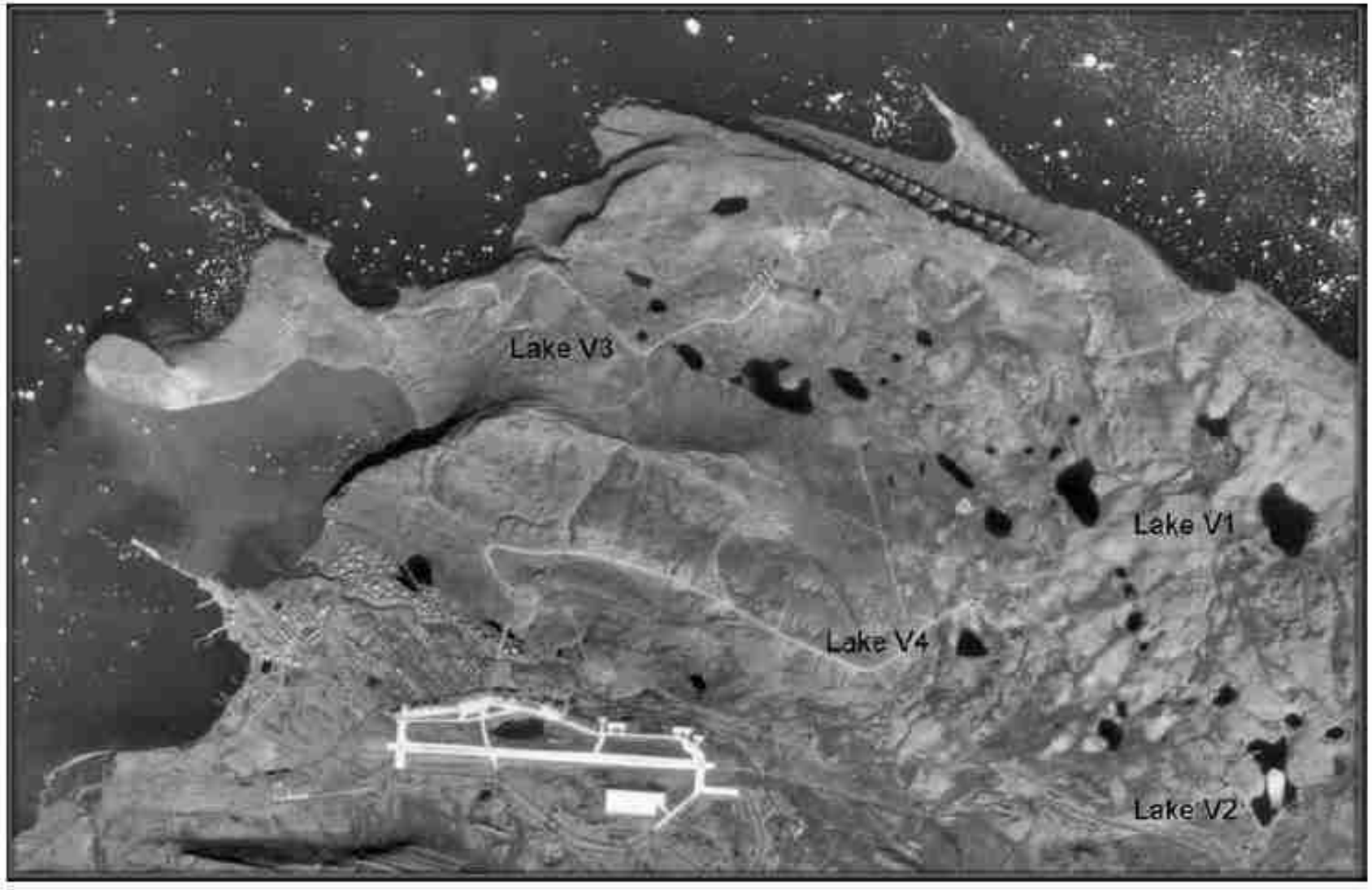
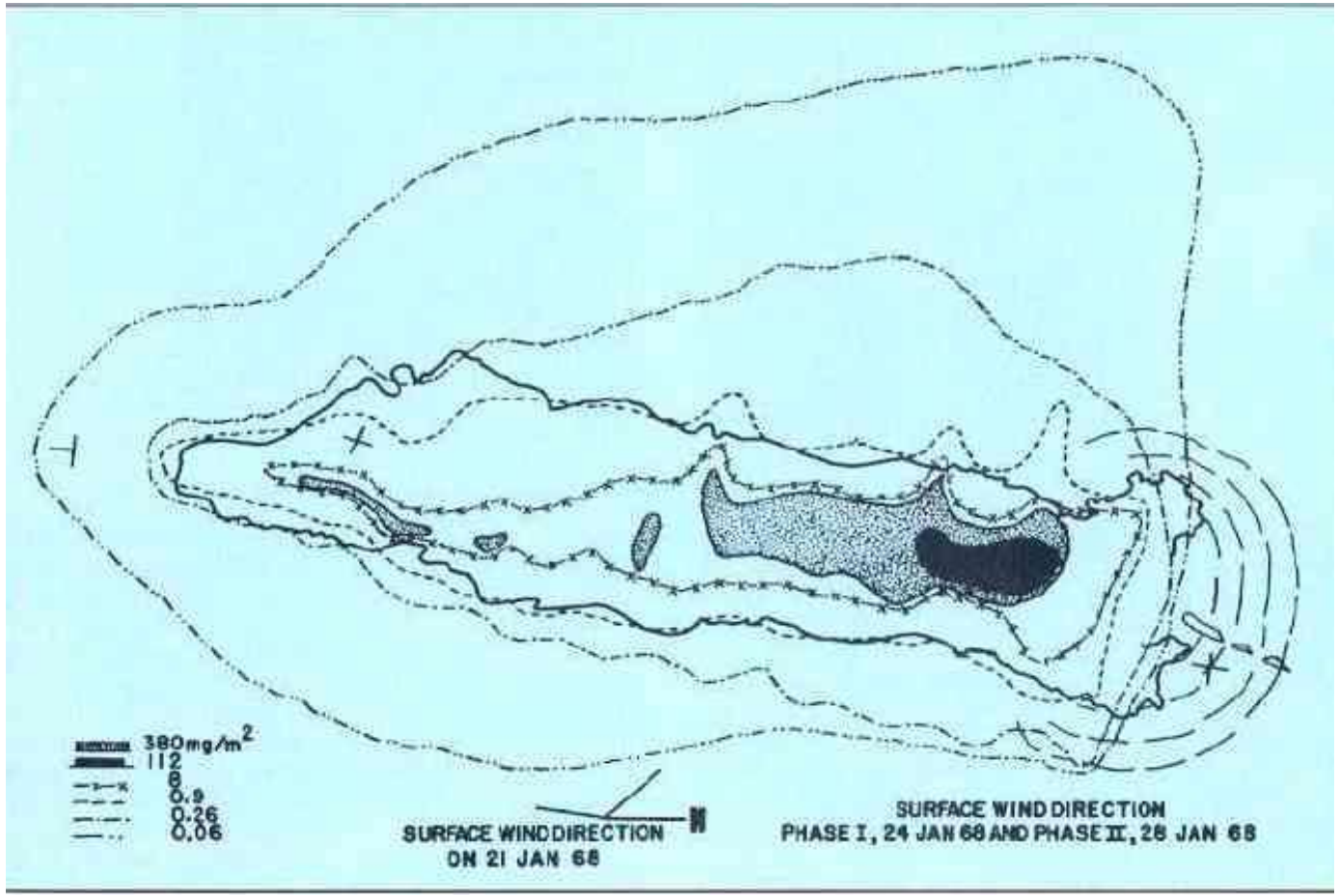
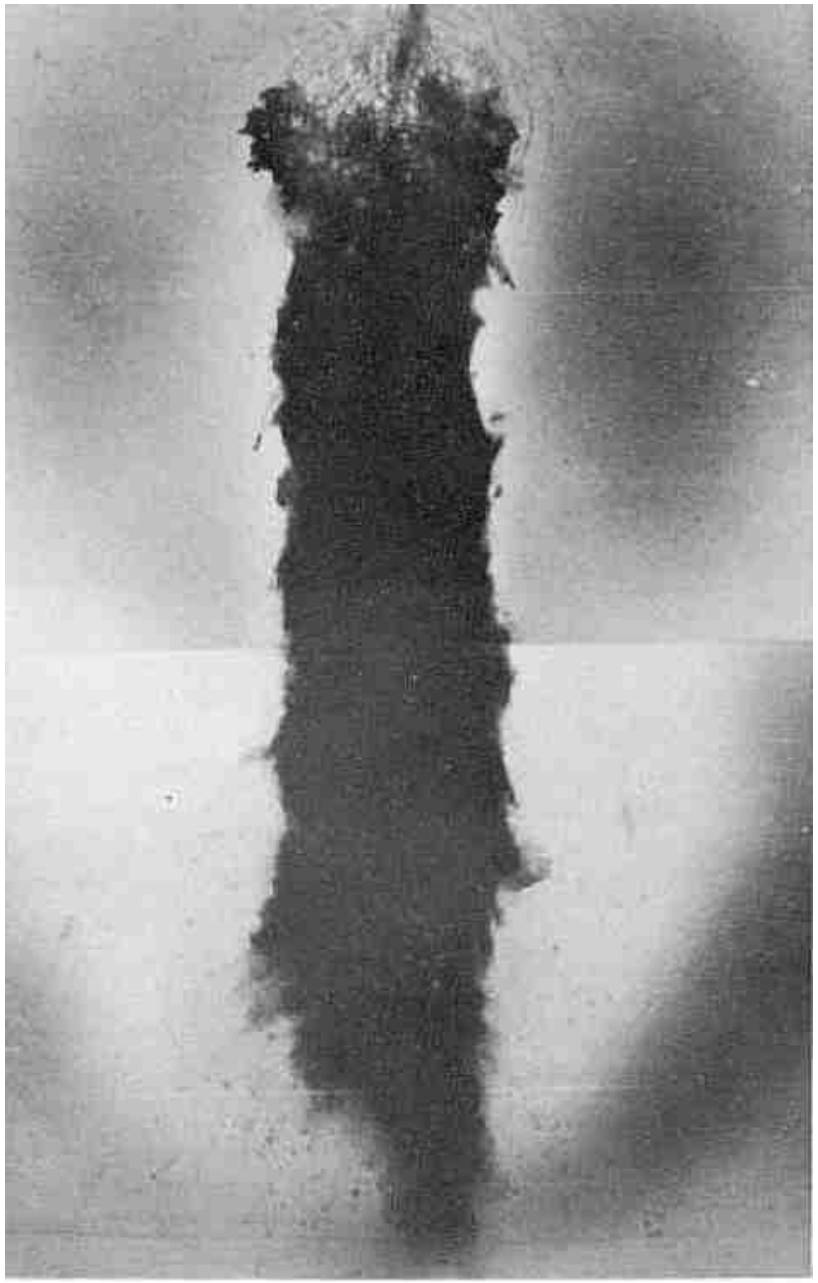

Lake V3
Lake V1
Lake V4
Lake V2





Aerial photograph of the crash site.

Capt William K McRaney scanning the ice core.

FIDLER

Loading aircraft debris into engine containers

Workers scraping contaminated snow from the ice be...

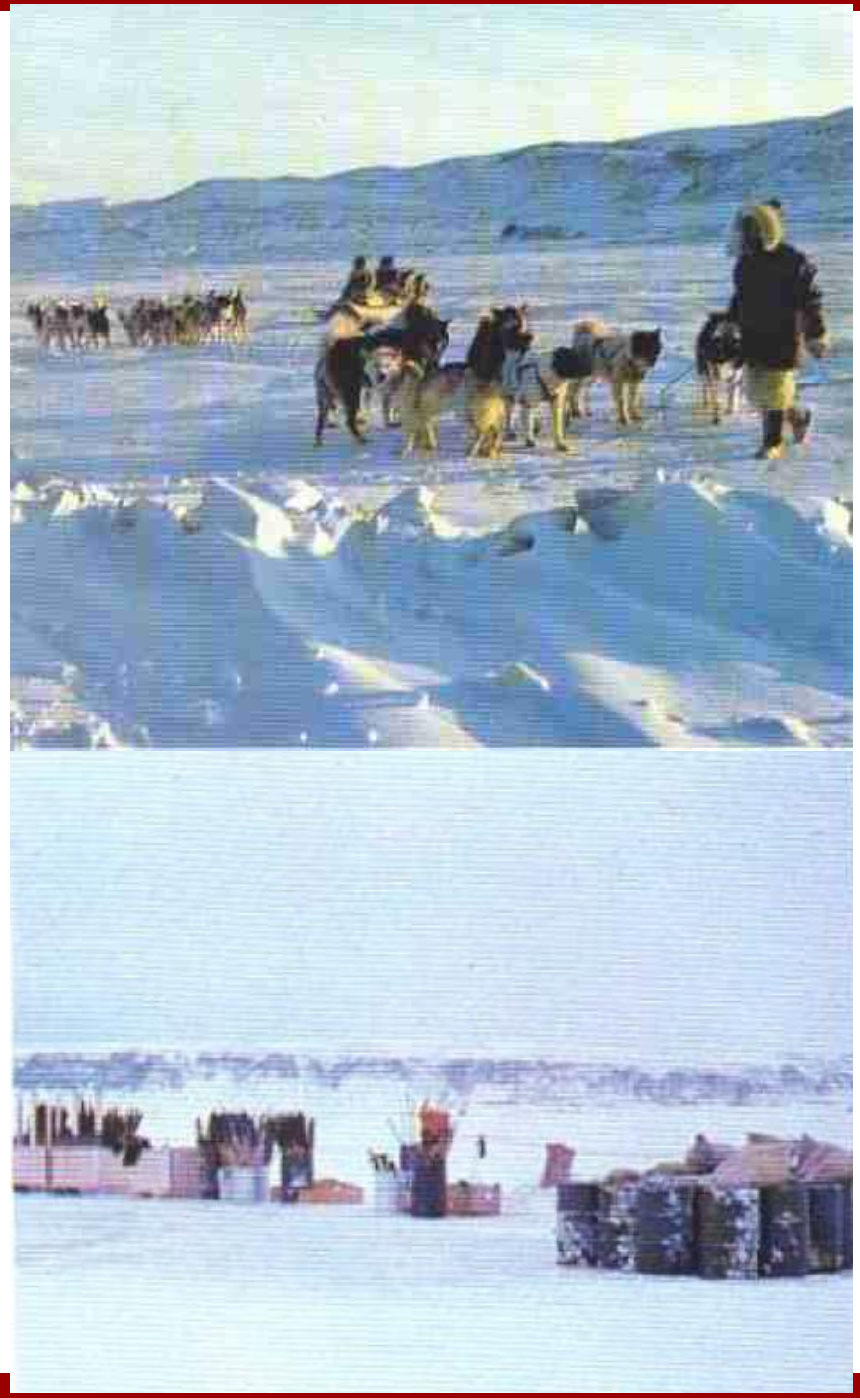
Sealing a tank containing aircraft debris

Air force reaction to this kind of emergency. Have known contract around-the-clock pre-planning, flexibility, adequate support, and priorities in handling requirements. There is always a conflict of interest between immediate accomplishment and appropriate documentation. Dye Created by Project emphasized the value of a carefully prepared program and adequate documentation to indicate progress as well as areas which required reconsideration. In the long run, comprehensive documentation is the key both to the saving of time and money.

Crane lowering a drum onto 33,000-gallon fuel preparatory to loading it with contaminated snow and ice.

Hopefully, there will be no more Crested Ice or comparable problems. However, the project demonstrated one thing, it was the almost limitless adaptability of well-trained, disciplined and motivated people. Their intelligence, ingenuity, and determination in solving a problem without precedent—in the most inhospitable of environments—was a source of great pride to me. In men like these, nothing is impossible. Their saga will be a continuing inspiration to all of us.

JAN/FEB/MAR 1970



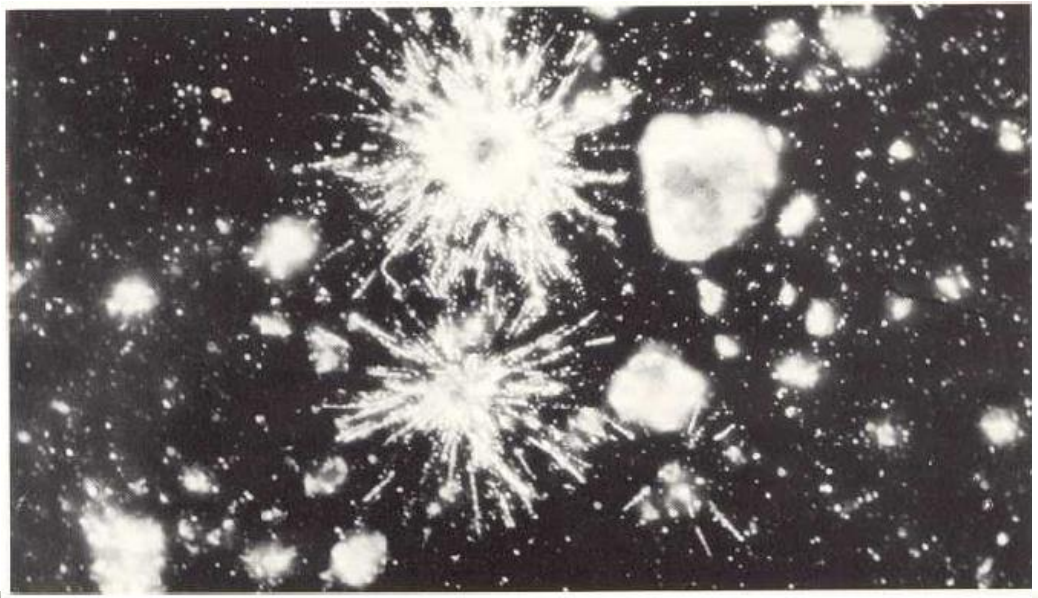


Figure 5. Microphotograph showing alpha tracks from plutonium particles in a sample from the crushed ice.

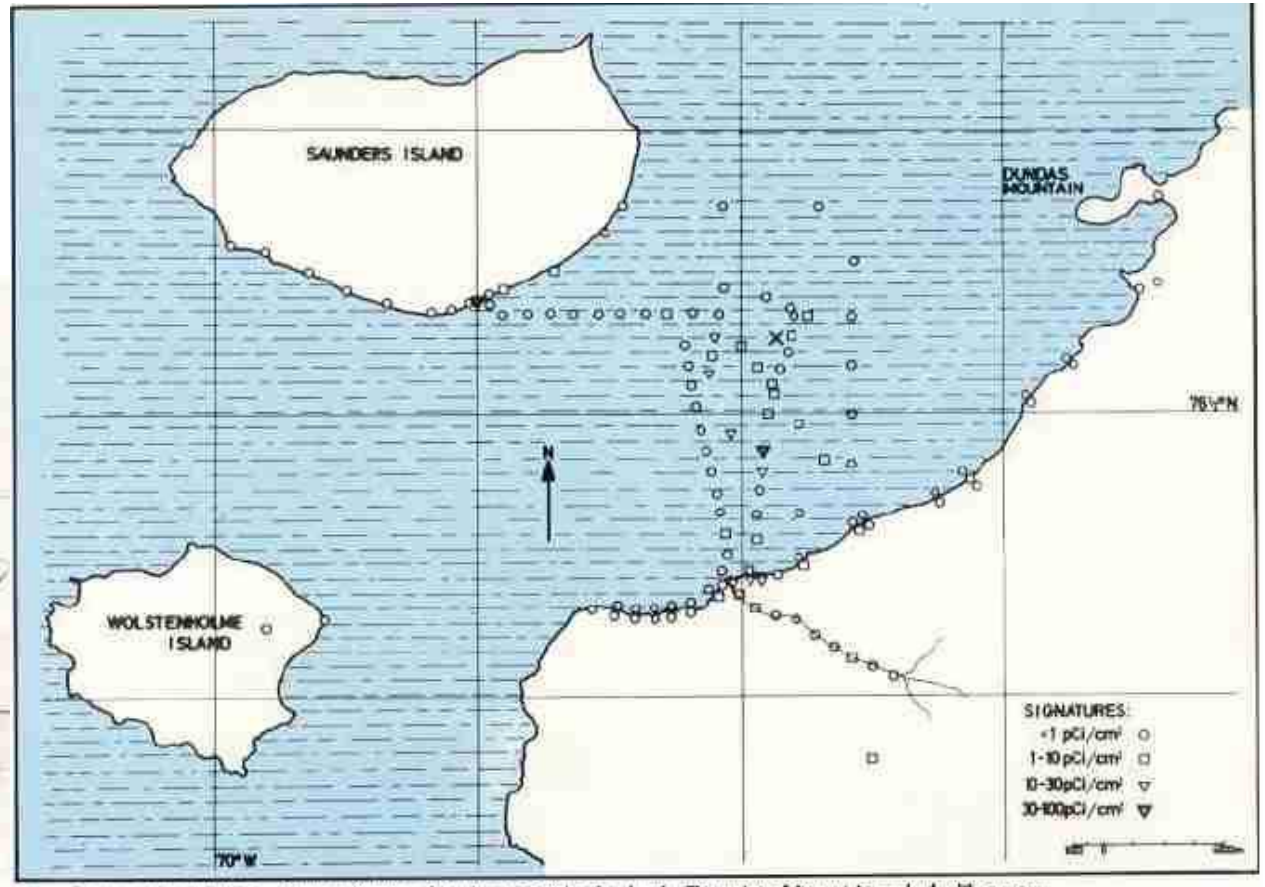
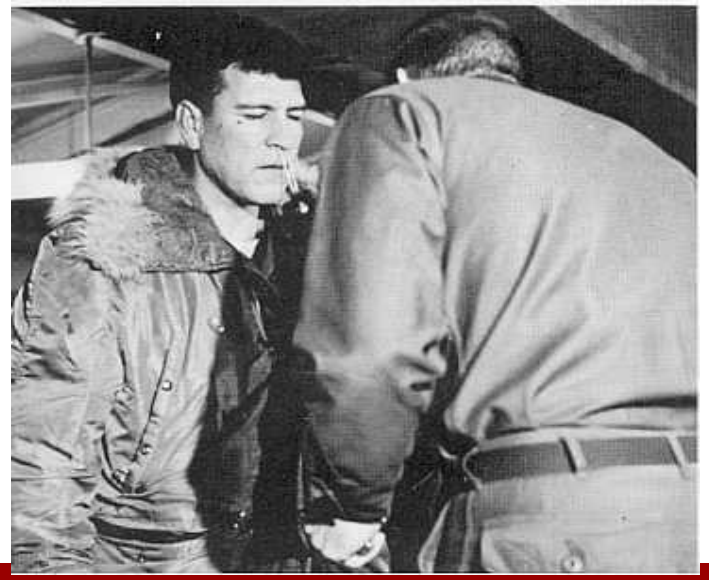


Figure 3. Map of the Bylot Sound area showing plutonium contamination levels. The point of impact is marked with a cross.

Cleaning up

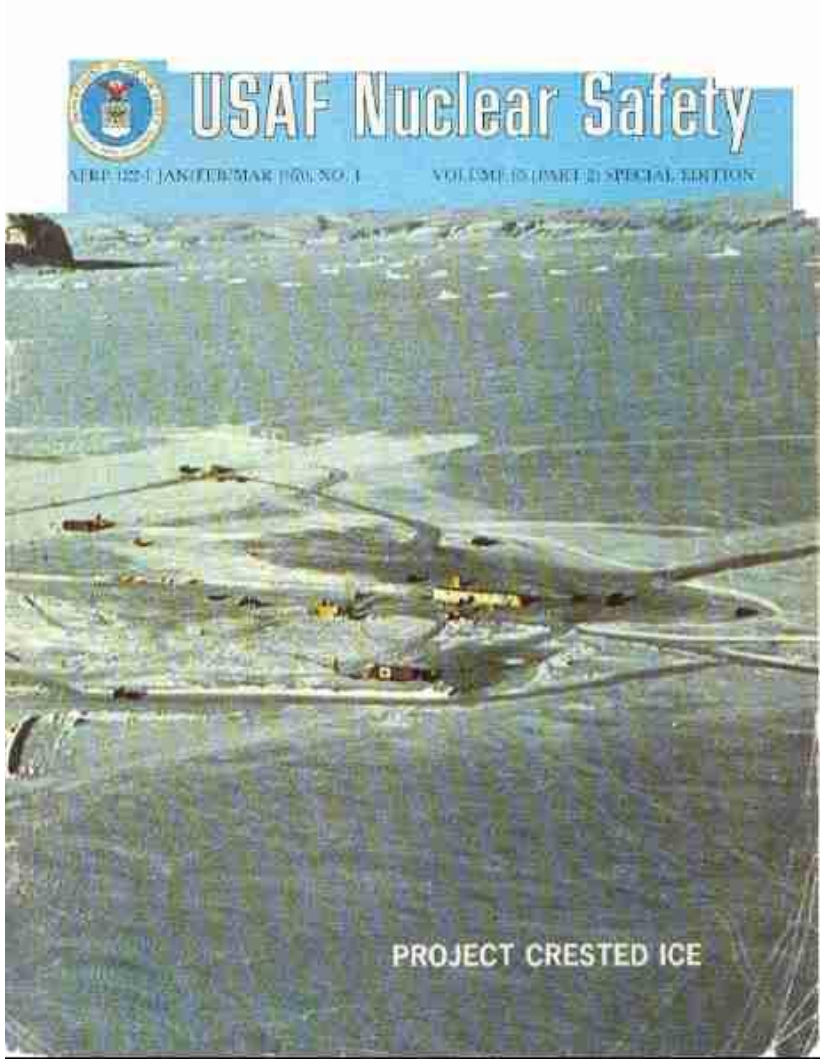
Personnel monitoring at decontamination station.

Nasal swabs were included in the personnel monitoring routine.



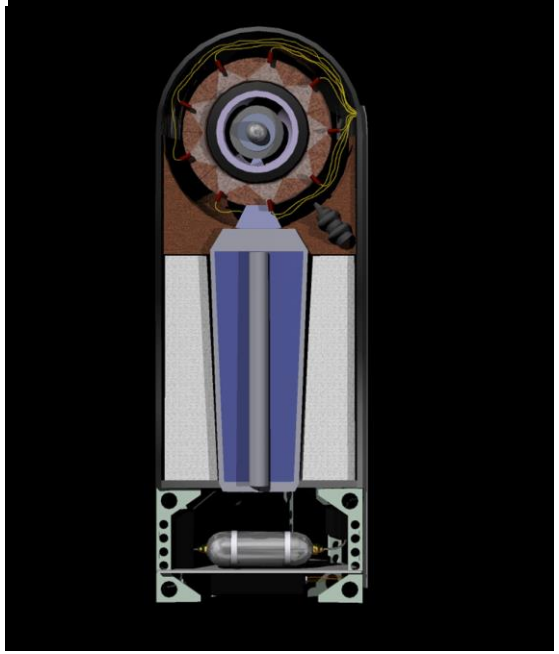
Col C. S. Dresser, (right), base commander at Thule AB, and Commander Jorgen Malgard, Danish liaison Officer, make a clean sweep of Project Crested Ice.

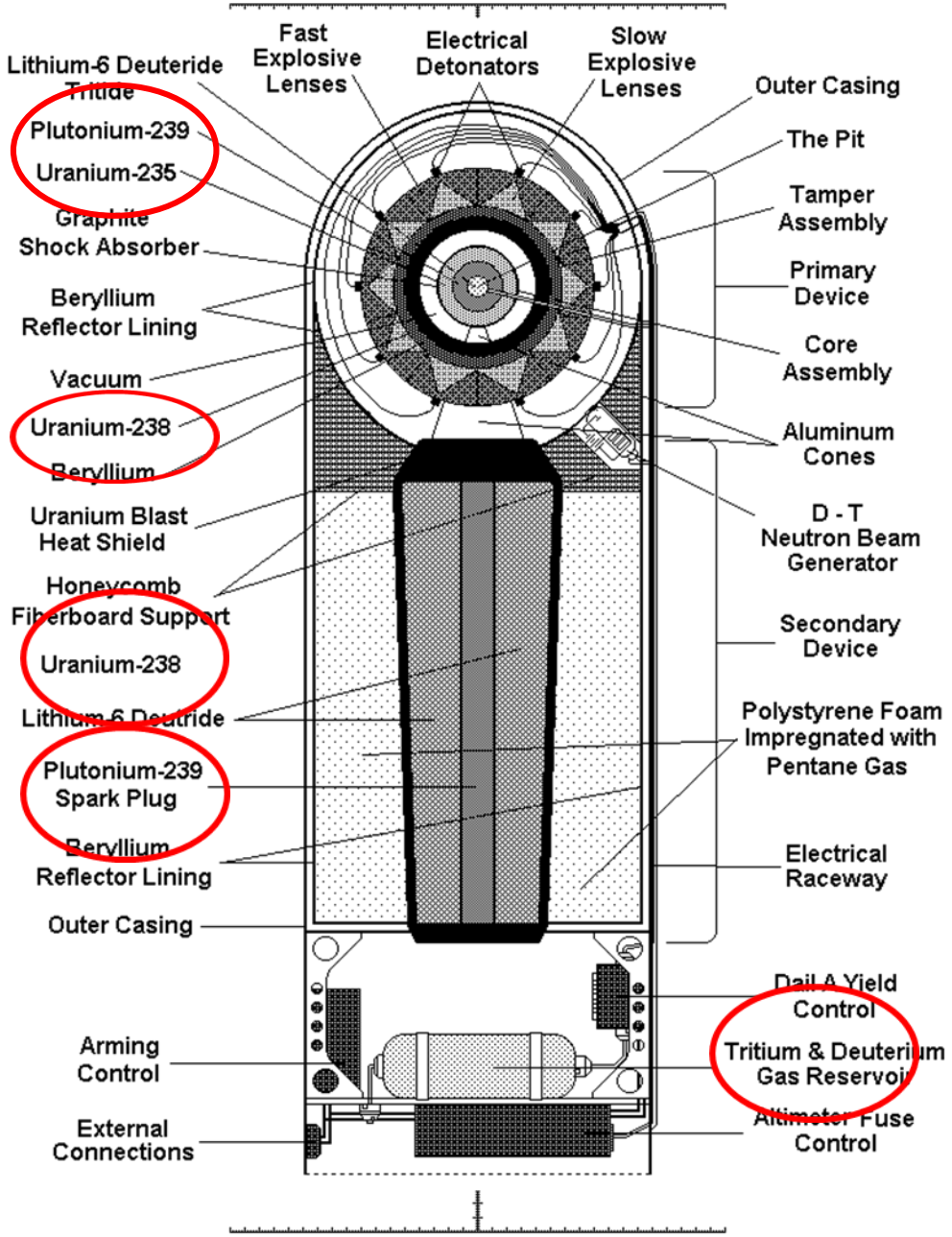
Project Crested Ice



- Plane wreckage and weapons components shipped to US
- Contaminated ice/snow stored in 25000 Gallon tanks at Tank Farm before sending to US
- Radioecological follow-up

B-52 - US Strategic Air Force




Fast Explosive Lenses
Electrical Detonators
Slow Explosive Lenses
Lithium-6 Deuteride
Tritide
Plutonium-239
Uranium-235
Graphite
Shock Absorber
Beryllium Reflector Lining
Vacuum
Uranium-238
Beryllium
Uranium Blast Heat Shield
Honeycomb
Fiberboard Support
Uranium-238
Lithium-6 Deutride
Plutonium-239
Spark Plug
Beryllium Reflector Lining
Outer Casing
Arming Control
External Connections
Outer Casing
The Pit
Tamper Assembly
Primary Device
Core Assembly
Aluminum Cones
D - T Neutron Beam Generator
Secondary Device
Polystyrene Foam Impregnated with Pentane Gas
Electrical Raceway
Dail A Yield Control
Tritium & Deuterium Gas Reservoir
Fuse Control

Previous Thule investigations

•Marine expeditions: 1968, 1970, 1974, 1979, 1984, 1991, 1997, 2003

•Terrestrial sampling (Including lakes):

- 1968 (Crested Ice). Pu on snow at Narssarssuk, Saunders Island and Wolstenholme identified.
- 1968 (WC Hanson). Investigations around Kap Atholl. Weapons Pu identified.
- 1997 (Eriksson & Holm). Soil & lake sediments north & east of TAB. No signs of weapons Pu.
- 2003 (Thule-2003 expedition). Soil sampling at Narssarssuk
- 2006 Sampling at Nassarssuk and south of Green Valley.

US EML air sampling at Thule Air Base

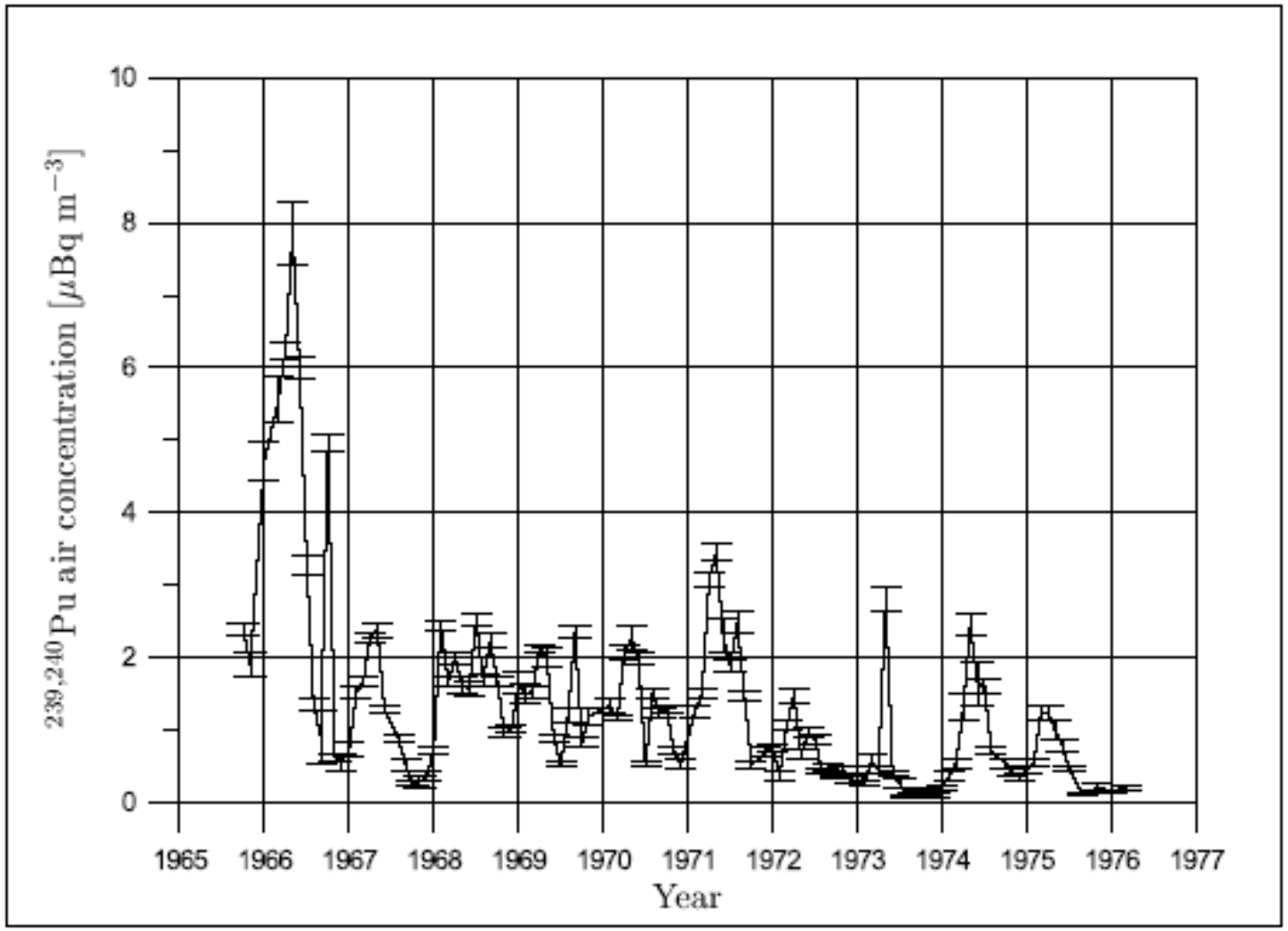
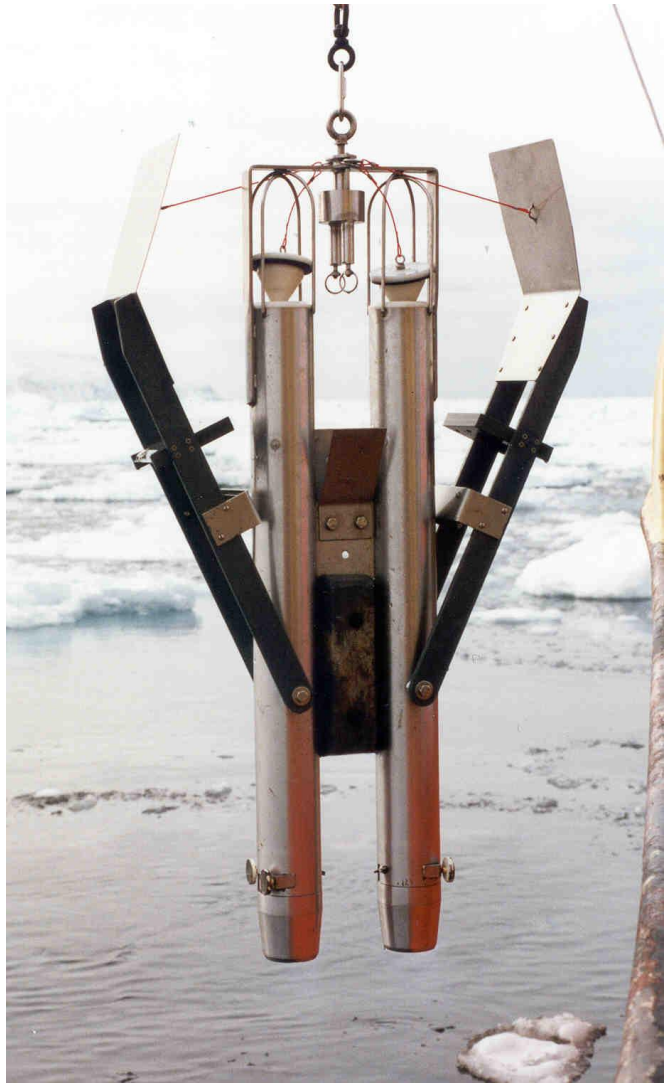


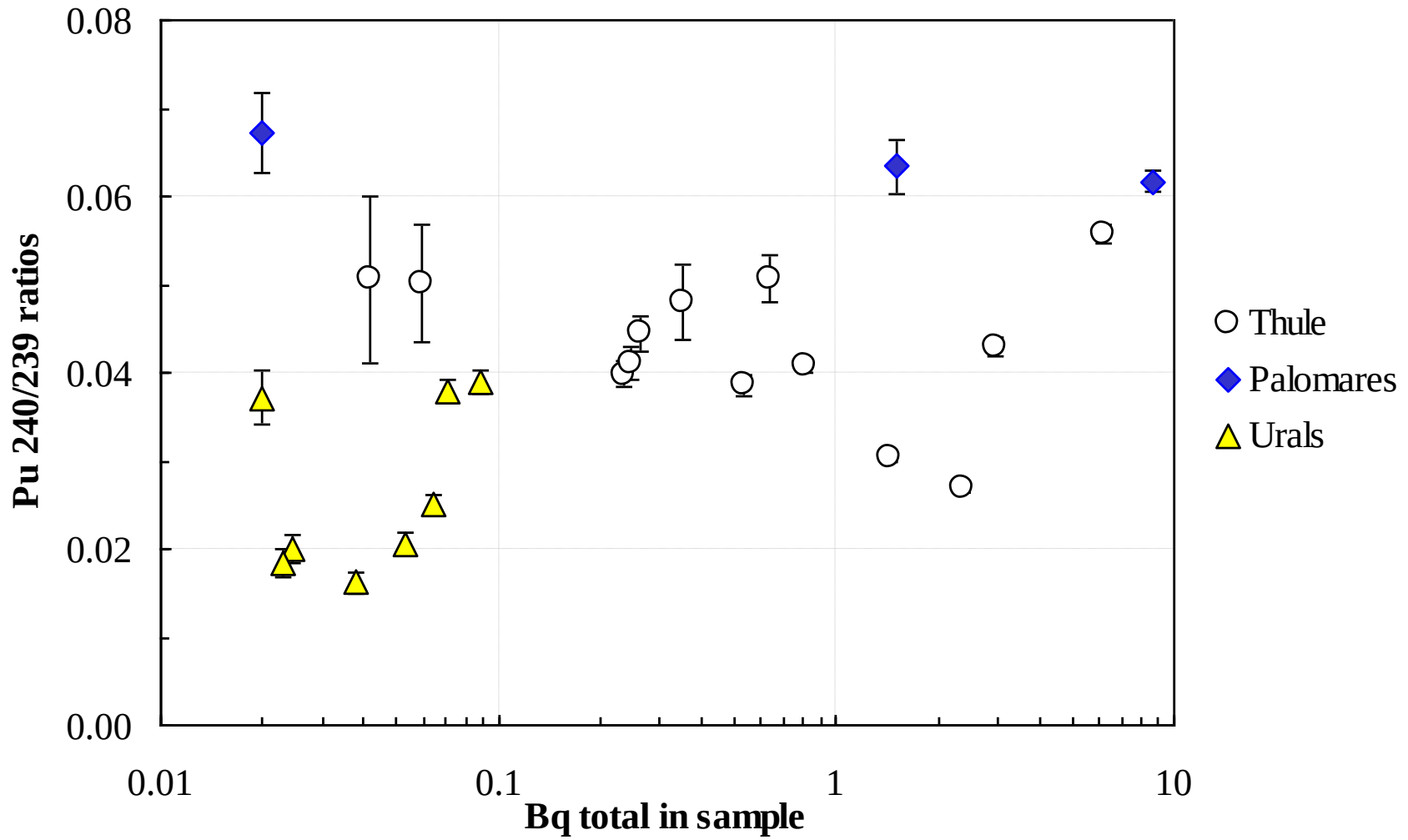
Fig. 5. EML measurements of the air concentration of ^{239,240}Pu at the Thule air base (EML, 1999).

Thule-97: Erkki Ilus, STUK, Mats Eriksson, LU & Risø



Gemini sediment sampler

Biota fishing equipment: Crabnets (below) and Sigsbee trawl (right)



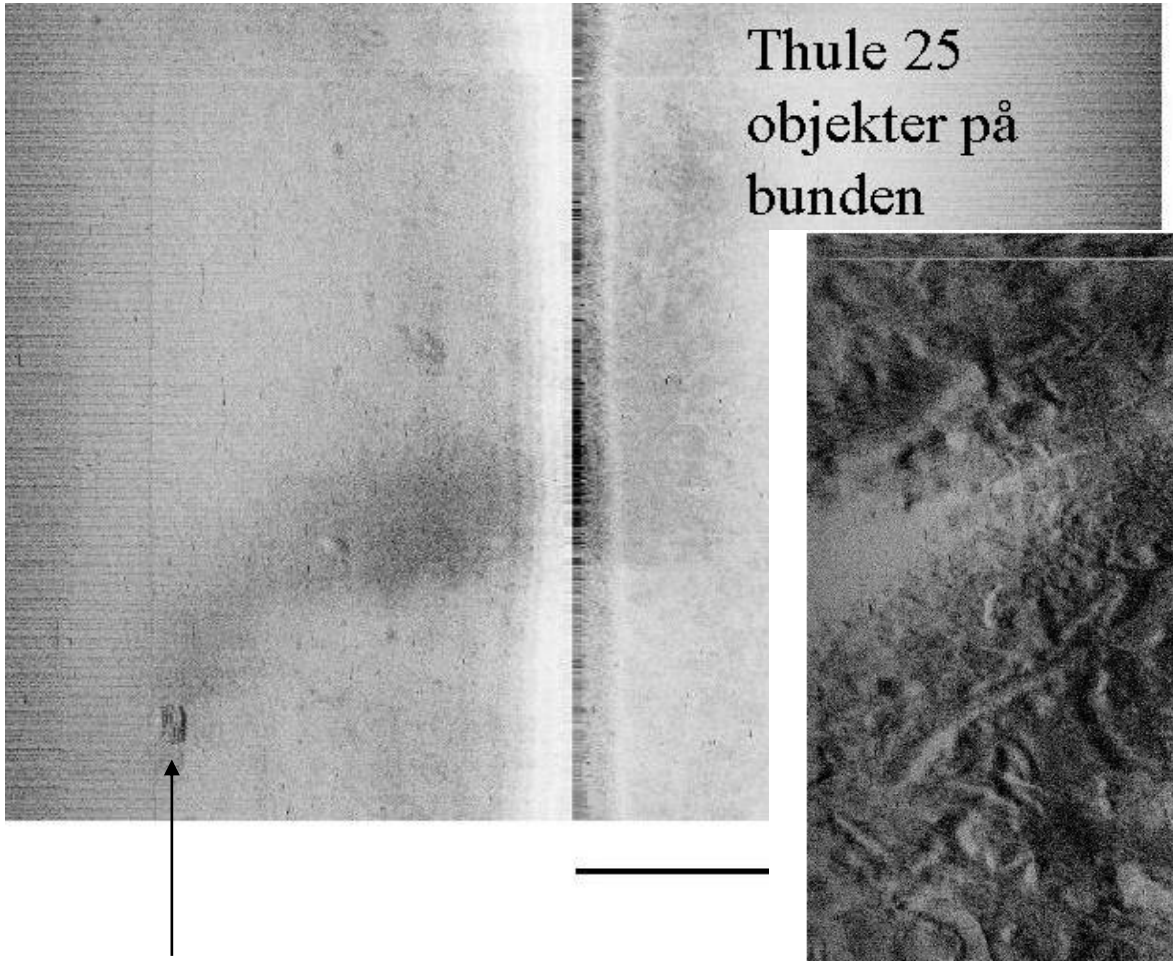
^{240}Pu / ^{239}Pu atom ratios, Thule (1968), Palomares (1966) and Urals

Sampling campaign 14-27 August 2003

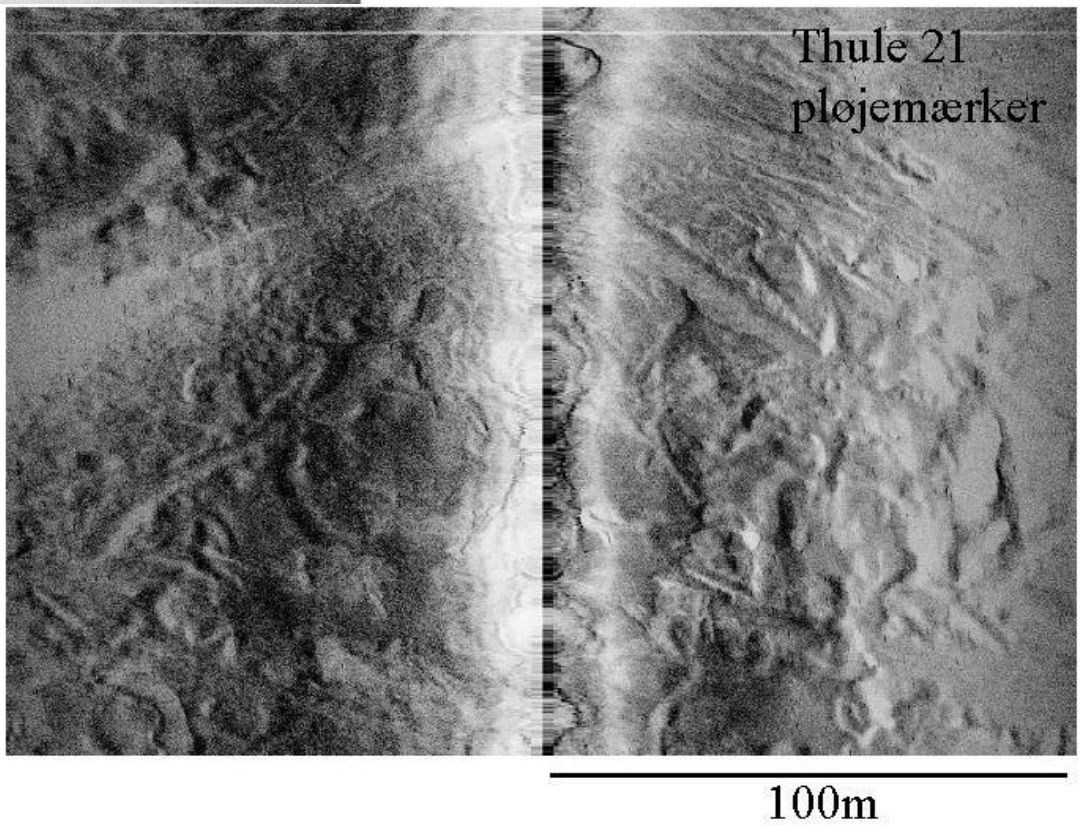
- Sediment mapping
- Sampling of
  - Sediment, particles
  - Seawater
  - Seaweed
  - Other biota
  - Soil

Research Vessel Adolf Jensen, 165 BRT (1967)

Seabed characteristics from side-scan sonar

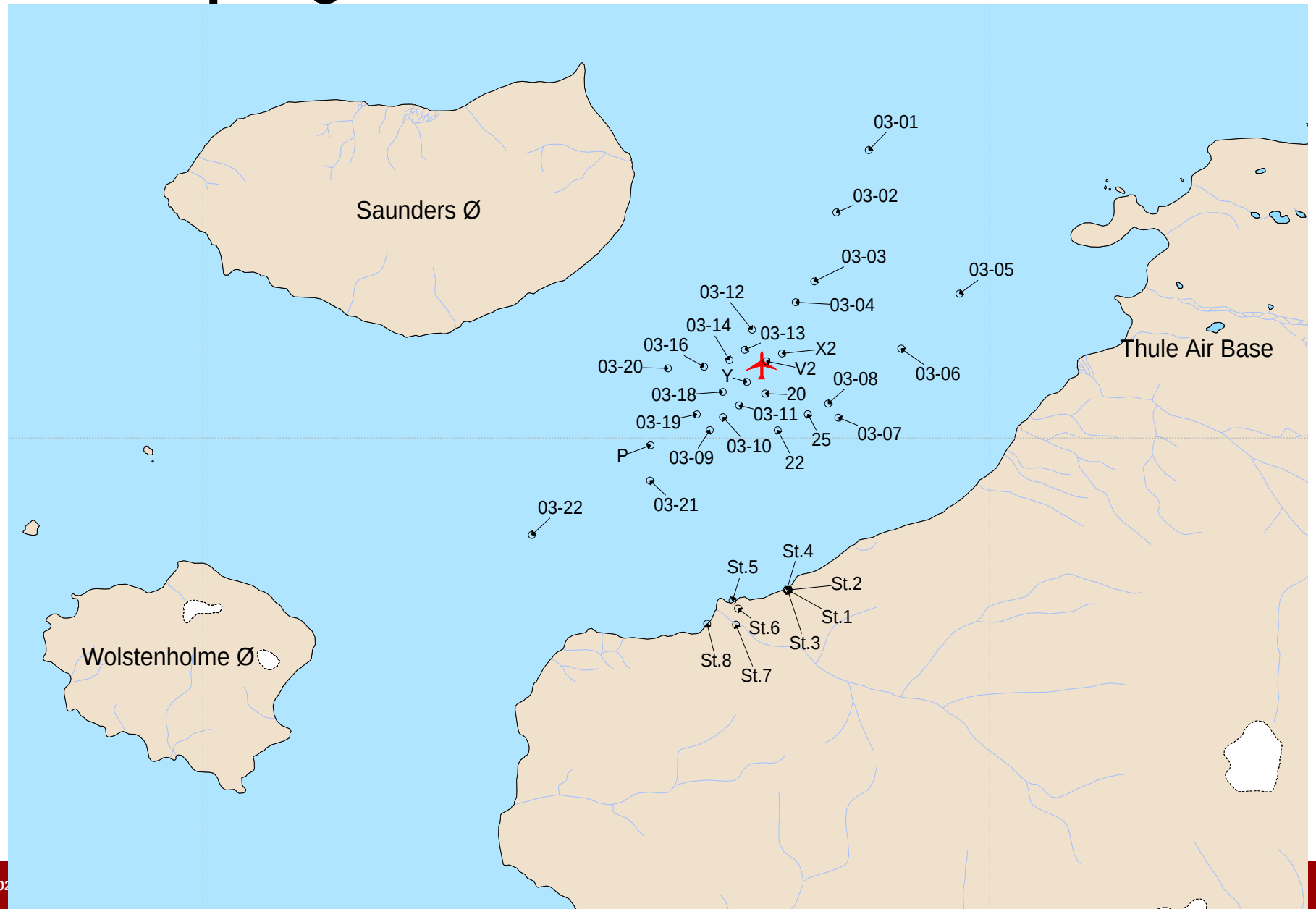


Rectangular object of ca. 5x5 m found at about 180 m depth

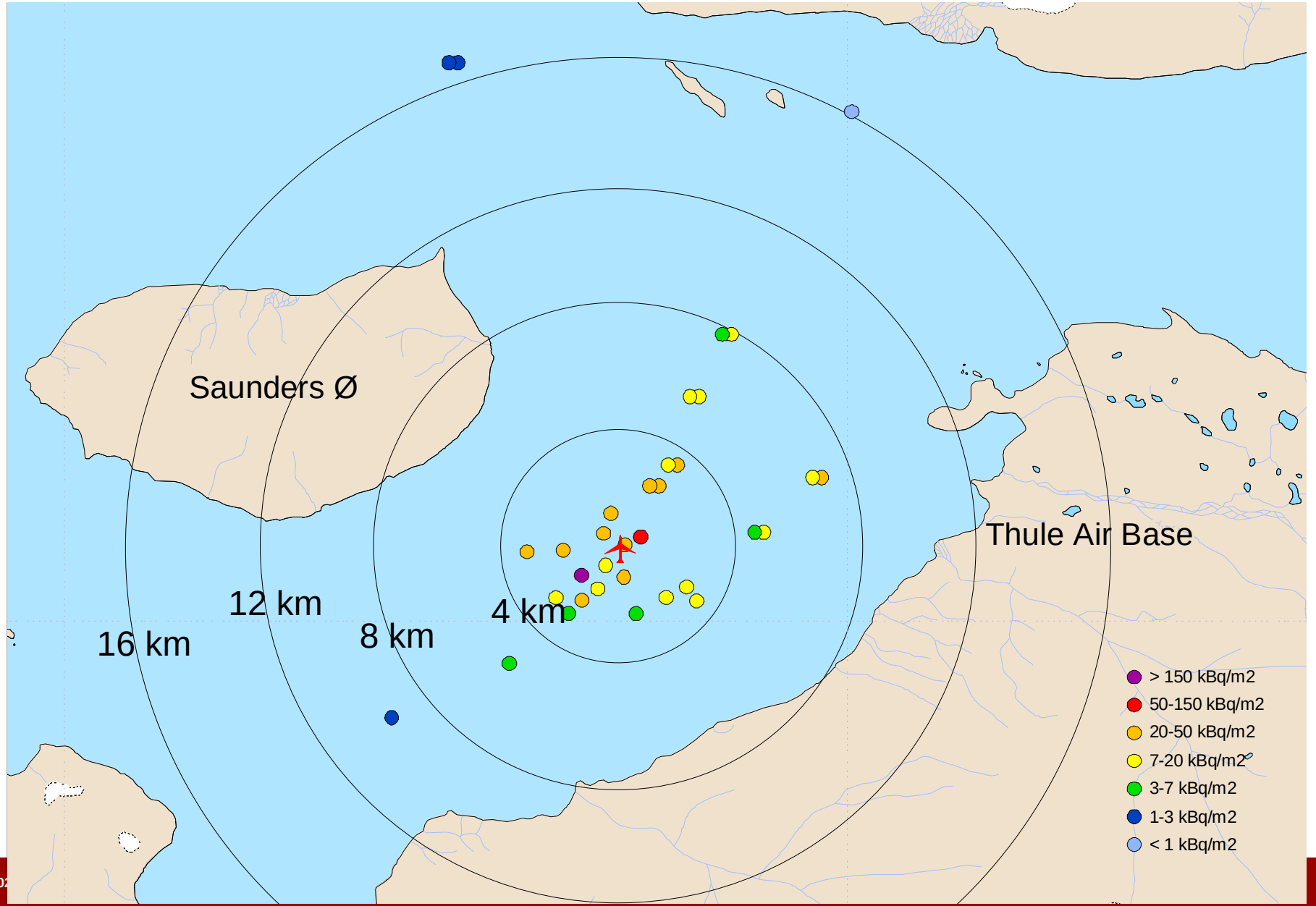


Iceberg scour marks on seabed at 100-150 m

Sampling locations for sediment and soil in 2003



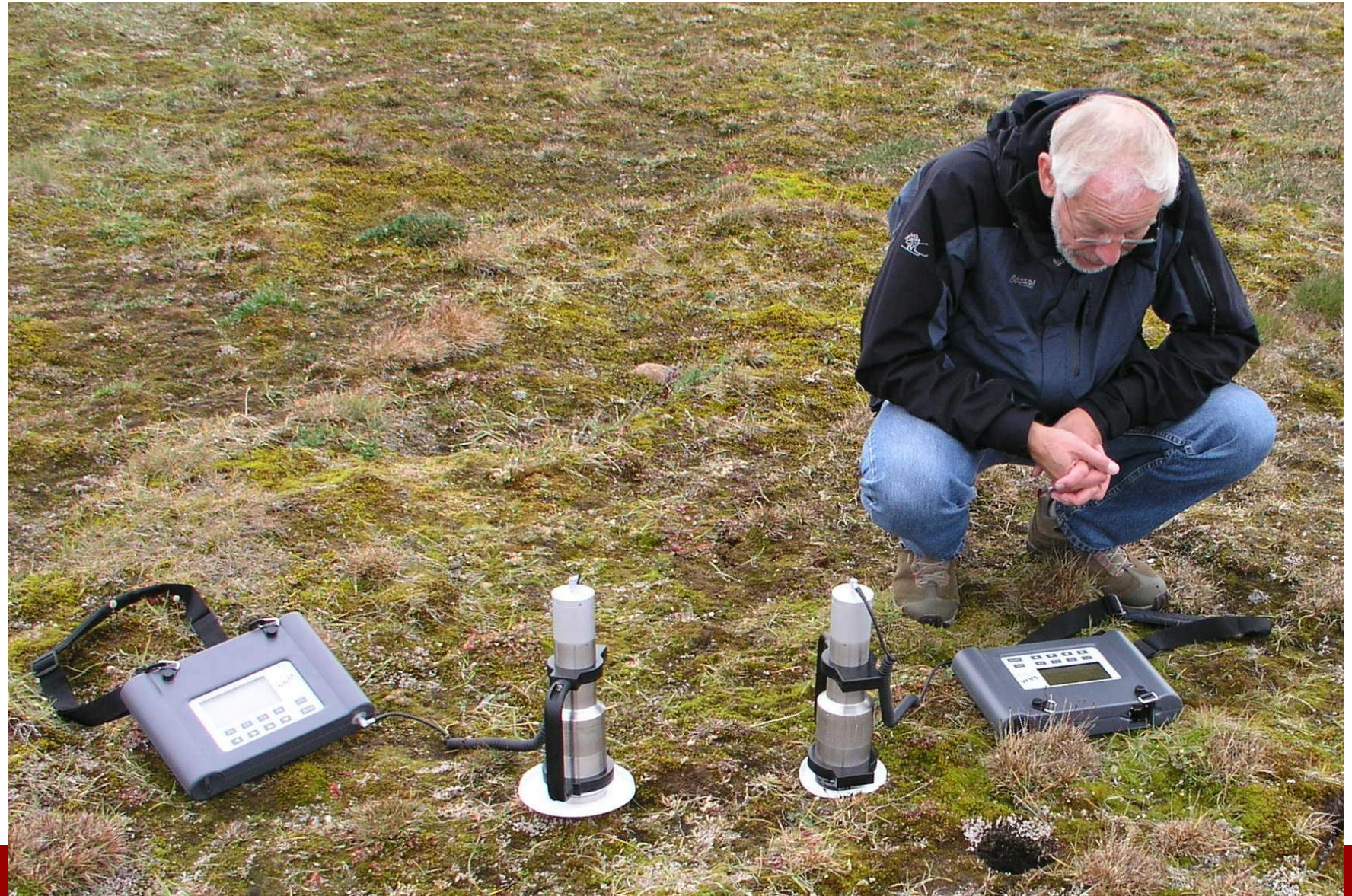
Total ^{239,240}Pu in sediments



Results from 2003 survey

- Pu inventory in sediments estimated with systematic account of hot particles at 3 TBq (about 1 kg), which is higher than earlier estimates
- Pu in seawater, sediments and biota illustrate remobilisation from the seabed and transport to surface waters and further away
- Insignificant risk of exceeding dose limit from marine exposure pathways
- Small potential risk on land from inhaling resuspended radioactive particles

Gamma measurements 2006



Vacuuming for hot particles at Narssarsuk, 2007

Passive sampling of aerosols using sticky surfaces

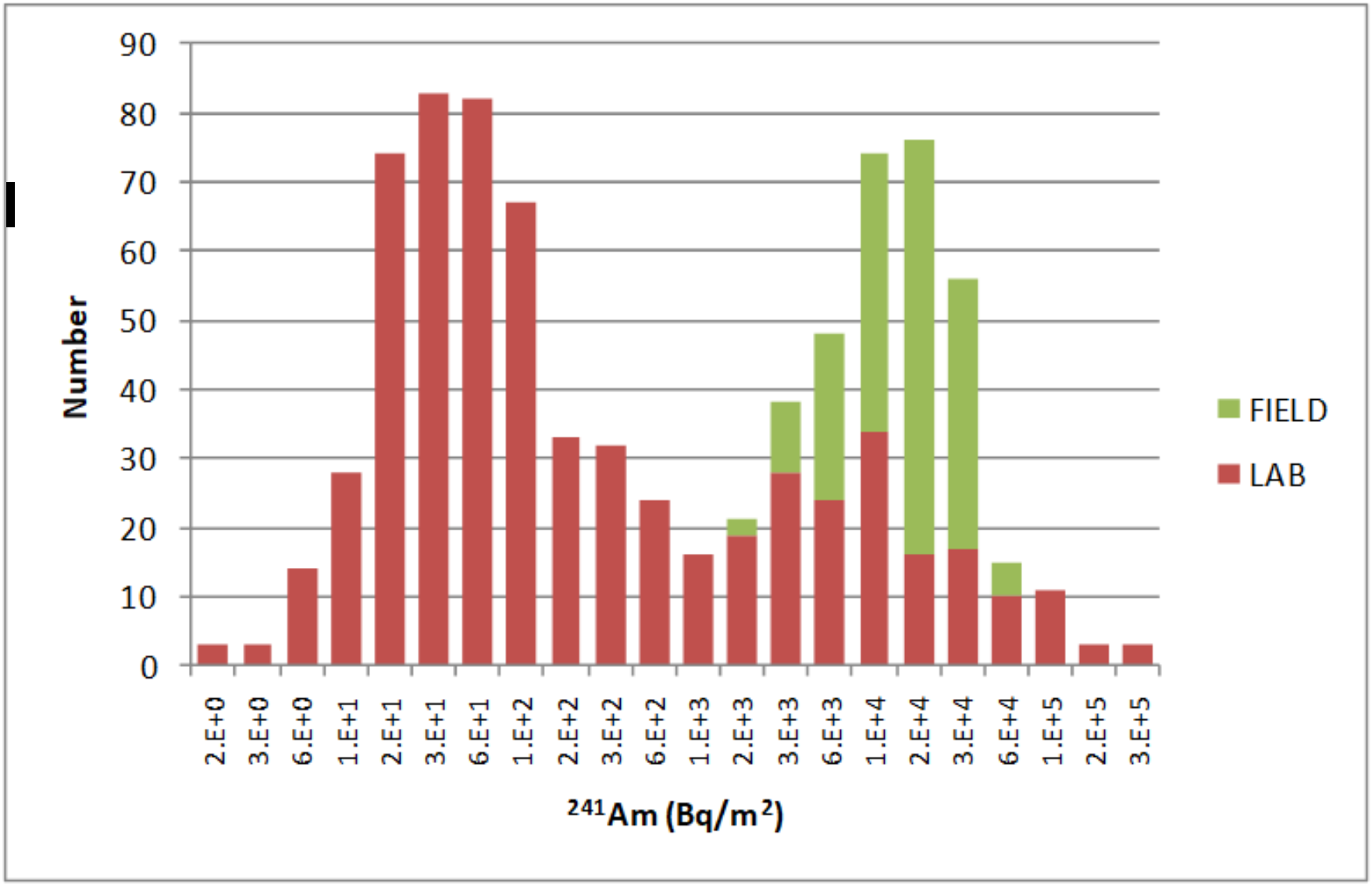
Active air sampling

Soil sampling

Am-241 in soil

Portable gamma spectrometer used for field measurement of ^{241}Am at Narssarsuk with detector at 1 m above ground

Am-241 in soil



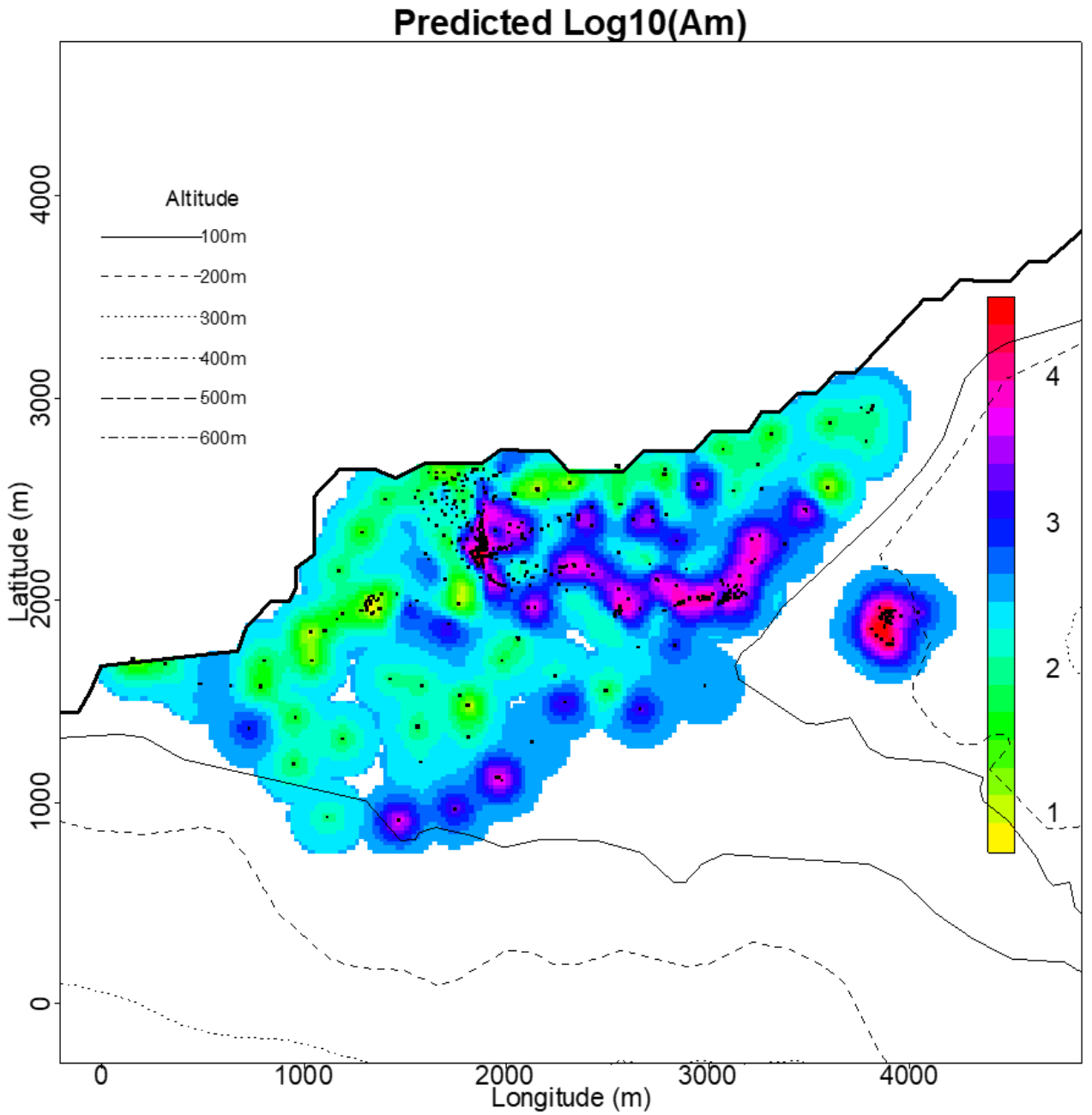
Am-241 in soil determined from laboratory analyses of soil samples and field measurements.

Pu/Am concentrations on land

Estimates based on geostatistical analysis of data from lab analyses of soil samples and field measurements.

Spatial prediction of the $\log_{10}$(Am) concentrations in the Narsaarsuk area overlaid with height curves. Black dots indicate measurement locations.

Total Pu inventory on land estimated at 100 g with 95% confidence interval from 50 g to 200 g



Dose assessment at Thule, 2011

- External dose – negligible contribution from Pu/Am contamination compared to natural background
- Inhalation – extremely low concentrations of Pu in air and doses correspondingly low
- Ingestion of meat from musk oxen – no analytical data available on Pu/Am in meat from musk oxen, but experience from UK/USA on transfer to cattle and sheep indicates that the dose will be insignificant
- Wound contamination – conservative estimates of a wound contamination of 0.1 g contaminated soil or a hot particle cause doses well below 1 mSv/y
- Total doses to individuals in the Thule area are estimated to be smaller than 1 mSv/y and have no significance to health


The End