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Radioactivity Exploration from the Arctic to the Antarctic

Part 1. Introduction

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This book is dedicated to professor emeritus Bengt Forkman (Nuclear Physics, Lund University) who in 1979 took the initiative to arrange an environmental radioactivity research program for the Ymer-80 expedition. He engaged his old friend Bertil Persson whom he during the 1960th inspired to university studies in Lund who just been promoted to professor of Radioecology at the Swedish University of Agricultural Sciences in Uppsala. Bertil Persson was tutor for Elis Holm at Lund University, who for his thesis was engaged in radiochemical analysis of plutonium isotopes in the environment. Elis Holm became deeply involved in management of Ymer-80 and all the following expeditions as well. We found a superior talent for the logistics in Kjell-Åke Carlsson (who was mechanical engineer at the department of radiation physics at Lund University). Without him, we would not have been able to solve all the thousands of practical issues and contacts with authorities and sponsors. He also contributed with the diaries extensive photographic and video documentation of all the expeditions. We have together compiled this book although several others were partly engaged in the various expeditions to whom we are deeply thankful for their contributions. They will appear as contributors in the separate parts of this book:

1. Ymer-80 (Bengt Forkman, Boel Forkman, Lars Ahlgren (diseased))
2. Swedarp 1988-1989 (Per Roos, Birgitta Roos)
3. Arctic Ocean 1991
4. Tundra Expedition
5. Arctic Ocean 1996 (Dan Josefsson, Mats Ericsson)

Our first Arctic expedition “Ymer-80” was conducted during the period June 23 - October 6 1980, to commemorate the discovery of the Northeast Passage by Adolf Erik Nordenskiöld in 1878-1880. The vessel used for the expedition was the Swedish icebreaker, M/S Ymer. The use of such a heavy icebreaker made areas permanently covered with ice accessible to extensive scientific activity by various research teams. The aim of our radio-ecological research was to investigate

present levels and sources of both natural and man-made radioactivity in the Arctic air and marine environment, and to study the pathways and distribution of these radionuclides in different compartments. Apart from caesium and plutonium isotopes, we also investigated natural radioactive elements, such as uranium and thorium in water, as well as radon and radon daughters in the air (Holm et al., 1983, Samuelsson et al., 1986). In the Arctic water samples were collected between 57°N to 82.8 °E, and enhanced levels of ¹³⁷Cs was found along the Norwegian coast caused by ¹³⁷Cs released from European nuclear fuel reprocessing facilities spread by the Gulf Stream along the Norwegian coast. We also found hot spot of plutonium in the Arctic Ocean. During the expedition, far out in the ice. Far out in the Arctic ice Bertil Persson received a call on short wave radio from the Chancellor of Lund University, Håkan Westling, who asked if he would accept promotion as professor in Medical radiation Physics and Head of Radiation Physics at Lund University Hospital. The answer was “Yes”, and so the exploration of environmental radioactivity proceeded.

The second expedition “Swedarp” took place during Nov 1988 to Feb 1989. The research platform was the ship, M/S Stena Arctica, with air-sampling device installed on board. We started from Gothenburg (67.4°N; 12°E) with the first destination Montevideo (34.8°S; 56.2°W). From Montevideo, we continued to the Swedish permanent base “Svea” at the North shelf of Antarctica. After unloading supply and equipment for the continental research group, the ship continued to the Argentinean base “Marambio”. The expedition members were allowed to visit “Paulet Island” with the remains of the stone-hut, built by the Swedish captain Carl Anton Larsen and his crew during 1903-04, after that their vessel "Antarctic" was shattered by the ice masses in the Weddell Sea and sank.

The third expedition in 1991 was to the Arctic Ocean with the Swedish icebreaker M/S Oden. The research program was focused on oceanography and geology in the western parts of the Eurasian Basin, the north west Markov Basin and parts of the Barents sea (Josefsson, 1998 , Roos et al., 1998). By using pumps of the ship, samples of surface-water, were collected and processed in 200 l vessels in our laboratory accommodated in a container on board.

The forth expedition was the joint Swedish-Russian “Tundra Ecology-94” expedition during 1994 with the Russian ice-breaking research vessel R/V Akademik Fedorov a platform, along a coastline of 3500 km-from the Kola Peninsula 10°E to Kolyuchinskaya Bay 173°E. Air sampling was performed during the route along the Norwegian and North Siberian coastlines and water samples were collected from the vessels cooling water system. Continuous sampling of caesium took place with a separate pump and a pipe hanging from the rail.

Finally, in 1996 we returned to the Arctic Ocean with the Swedish icebreaker M/S Oden. This expedition focused on studying the distribution of radionuclides in different water masses of the central Arctic Ocean. The expedition crossed the Barents Sea, entered the Nansen Basin at the St. Anna Trough, and continued north across the Amundsen Basin. The main part of the expedition was concentrated on the north Lomonosov Ridge and the return route passed the North Pole and went south along 10 °E towards Svalbard. Water samples from the surface and subsurface layers,

as well as bottom sediments, were collected for analysis of fission products and transuranic elements in seawater and sediment.

Acknowledgement

The expeditions were organized by the Swedish Polar Research Secretariat, which is a government agency that promotes and coordinates Swedish polar research to the Arctic and Antarctic regions. We greatly acknowledge the support from the organizers and the leaders of the expeditions. Financial support by the Natural Research Council (NFR), Magnus Bergvalls Foundation, Carl Jönssons understödsfond and all others is greatly acknowledged.

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