

Expedition Report

An Expedition to Antarctica (1999-2000)

OF all the continents, Antarctica is an isolated, glaciated continent embracing an area of about 14 million sq km. More than 98% of its surface is covered with 2000 m of thick ice sheet. It is the coldest, windiest and driest continent containing more than 70% of the world's fresh water. The close relation between this Titanic glacier, the atmosphere, the ocean and the continental thrust, and the existence of large mineral wealth made Antarctica an area of great future hope.

The Indian Antarctic Research Station "Maitri" is situated (70°45'39.4"S : 11°44'48.6"E) in Schirmacher Oasis, Queen Maud Land area in East Antarctica. The Schirmacher Oasis is one of the small snow and ice free polar rock desert near the shore of the east Antarctica with a maximum width of 3.5 km and a length of about 20 km with east-west orientation. Its size is approximately 35 sq km of solid bedrock, fern and ice fields accounts for 27 square kilometres and 3 square kilometres respectively. The lakes, ponds and pools in the Lake District cover a total area of about 3 square kilometre representing the essential part of the surface water. The elevation of the oasis ranges between 0-228 m with an average of about 100 m. The gentle slopes and plain areas are covered with a mostly thin blanket of moraine debris. The northern end is characterised by steep slopes and has a large number of bays due to block patterns caused by disturbances.

The proglacial lake namely Zub lake (Priyadarshini) adjacent to "Maitri" is the only source of water for survival. The climatic conditions are similar to other East Antarctic ice free regions with annual temperature of -10°C. January is the warmest month (-0.5°C to -0.9°C) and August is the coldest (-22°C to -65°C). The mean wind velocity is about 15 to 20 knots in summer and it reaches up to 150 to 180 knots in winter and most prevalent wind direction is east to south. The average precipitation is between 250-300 mm. The relative air humidity is about 50%.

The continent's hostile climate precludes most terrestrial life: mosses and lichens are the most widespread vegetation wherever the ground is exposed and moisture available. In the Schirmacher Oasis the Precambrian Crystalline Basement of the East Antarctica platform is exposed over an area of about 30 sq km. The polymetamorphic rock sequence consisting dominantly of biotite-garnet gneisses and pyroxene bearing granulites with minor intercalation of marbles and calc-silicate rocks, ultramafics, amphibolites and other metabasites is traversed by a number of distinctly younger basalt (dolerite) dykes. The rocks have undergone multiple episodes of metamorphism, migmatization and deformation.

Indian Antarctic Research Programme started in 1981 with an objective to foster and promote scientific studies in the thrust areas of atmospheric sciences, geology, geophysics, meteorology, biology, oceanography and geomagnetism. In this endeavour, a number of scientific research expeditions were successfully launched by the Govt. of India wherein scientists from various research organisations like Survey of India (SOI), Geological Survey of India (GSI), National Aerospace Laboratory (NAL), Physical Research Laboratory (PRL), National Geophysical Research Institute (NGRI), Hyderabad; National Environmental Engineering Research Institute (NEERI), Nagpur; Indian Institute of Geomagnetism (IIG), Mumbai; India Meteorological Department (IMD), Defence Institute of Physiology & Allied Sciences (DIPAS), All India Institute of Medical Sciences (AIIMS), New Delhi and others participated and conducted substantial scientific research in Antarctica over the years. Some of the noteworthy research works done earlier by various organizations are geological mapping of Schirmacher Hills and neighbouring mountain chains (Wohlthat, Orvin and Petermann etc.); airborne magnetic study over an area of more than 12000 sq km; ground magnetic survey of various mountain chains in and around Queen Maud land; investigation of ozone hole phenomenon in Antarctica by measuring various components of UV radiation; studies in changes in physiological characteristics of human being under different degrees of extreme stress of environmental conditions in Antarctica; isotopic studies of ice cores and marine as well as land biology of Antarctic flora and fauna. Hitherto no palaeoclimatic work on the lake sediments of Antarctica has been carried out by the Indian researchers. Whereas, a few workers (Serena P. Fulford - *Smith et al.*, 1996; Donna Roberts *et al.*, 1999) worked on the evolution of Ace Lake, Vest fold Hills, East Antarctica by using diatoms and other microbiota.

To increase the camping duration Government of India extended the air connectivity between Mumbai to Cape Town enroute to Antarctica during XIXth Indian Scientific Expedition and subsequent journey by a German ship "Magdalena Oldendorff" to Antarctica, 3800 km from South Africa. XIXth Indian Scientific expedition to Antarctica in 1999-2000 included for the first time a member (S.K. Bera) from the Birbal Sahni Institute of Palaeobotany (BSIP) for palaeoclimatic research. The duration of the stay in Antarctica mainland was 62 days for collection of samples as well as preliminary study in summer camp laboratory. BSIP having vast experience in palaeoclimatic studies has drawn an ambitious plan to undertake Antarctic research studies.

Pollen/spores, diatoms, dinoflagellates, microforams etc. are good markers of the changes in climate. These elements retrieved from lake sediments provide sequential changes in

past vegetation and corresponding environments to infer climatic events of the region. Climatic interpretations through these deposits of microbiota are attributed to the change in climate and vegetation composition in the region. Glacier and precipitation in the form of snow provide melted water for shallow lakes along the coastal region and a unique environment for ecological studies of plants and animals.

The main objectives of the research of BSIP are as follows:

i) to investigate surface samples (moss cushion, Antarctic desert soil, dry algal mat and moraines etc.) and air catches in and around Schirmacher Oasis so as to study the interplay of pollen and spores and their deposition.

ii) to study glacial lake sediments in order to calibrate the events and episodes leading to palaeoclimatic interpretation.

During the expedition a large number of palynological samples in and around Schirmacher Oasis, Queen Maud Land area as well as from nunataks and high mountain areas of Wohlthat and Orvin Range were collected. Moss cushions, soil, moraines etc. were collected in a transect at an interval of 100 to 200 m. Ice and snow samples were collected from higher reaches for elemental analysis. Lake bottom sediments were collected in Zub lake by using a HYDROBIOS gravity corer with a one meter long core tube and total core recovery finally was 60 cm. Besides, daily air sampling (using Burkard air sampler) on voyage from Capetown (35°S) to Antarctica mainland and return voyage from Antarctica to Capetown was done for about two and half months for the first time in Indian expedition. Air samples were also taken over shelf area in Indian Bay (300 to 350 m above) by Helicopter. Different rock samples were also collected (biotite garnet gneiss, calc - silicate rocks, amphibolites, dolerites, etc.) for the museum of BSIP.

The palynological study of the various samples will be helpful to understand the pattern of pollen and spores dispersal and deposition in and around Schirmacher Oasis which

could in turn help to interpret the palaeoenvironment through the study of proglacial lake sediments. Few moss and soil samples examined from Schirmacher Oasis reveals the occurrence of grasses, herbs, and even exotic arboreals along with algal and fungal spores proves the potentiality of the study.

Still a number of localities like nunataks, other neighbouring mountain ranges having frozen lake (varved clay) and many unnamed fresh water lakes in the Schirmacher Oasis are palynologically unexplored. The Institute will continue palynological research by participating in the Indian Scientific Expedition Programme for Antarctica in future.

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Legend of Photographs

1. Indian Scientific Research Station, Maitri, East Antarctica.
2. The view of ice shelf in Eastern Antarctica, also showing the end of Schirmacher oasis.
3. Part of Zub Lake showing pipe line supplying water to Maitri Station.



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