GEOCHEMICAL ATLAS OF NORTHERN FENNOSCANDIA. Published by the support of Nordic Council of Ministers under the Project Leadership of G. Kautsky, Geological Survey of Sweden; 155 maps and 19 pp. of explanatory text; Printed in Finland, 1986.

The Geochemical Atlas of Northern Fennoscandia is the result of a joint endeavour of the Geological Surveys of Finland (GTK), Norway (NGU) and Sweden (SGU) in cooperation with the Swedish Geological Co (SGAB) and the Geological Survey of Greenland (GGU). The Atlas includes 155 maps on 1 : 4,000,000 scale encompassing the region north of the 66° latitude in Finland, Norway and Sweden. The Atlas has emerged from the 'Nordkallot Project' initiated in 1980 with the prime objective of defining potential economic ore-bearing structures/formations and to gather in the process, valuable information relating to environment, public health and agriculture.

The data presented in the Atlas is derived from a multi-sample-type/multi-element low density geochemical reconnaissance survey carried out during the period 1980–83 covering an area of 250,000 km^2. Till, stream sediments, stream organic matter and stream moss, constituted the four sample types collected during the survey as dictated by the geological peculiarities of N. Fennoscandia. Geologically, the area covered comprises of the northern part of the Precambrian Baltic Shield bordered by the Caledonian fold belt towards the north and west.

In view of the pioneering effort involved in a work of such magnitude and the possible relevance to us (as we are yet to undertake such surveys), it is perhaps appropriate to go into some of the details of sampling, analysis and data presentation adopted by the Scandanavian colleagues.

Methods of sampling and analysis: A drainage area of approximately 10 km^2 in size was selected within each 30 km^2 of the survey region, with the sampling station at the downstream apex of each drainage domain. Each sample representing a sample station is composited from several subsamples drawn at various points within the sample station. Thus a total number of 22,469 samples of till, stream sediment, stream organic matter and stream moss, forms the basic material for the multi-element analysis. The till samples were drawn from the c-horizon of the soil at 50-60 cm depth and separated into two size fractions of minus 0.062 mm and 0.062-0.500 mm. Stream organic matter consisting of admixed humic material, plant roots, leaves etc., with varying amounts of mineral matter was sampled from the stream banks at five to ten sites within a 50 m section of the stream. The minus 0.1 mm fraction of the ashed sample is used for the analysis. Stream moss consisting of admixed species of aquatic bryophytes growing in the stream bed was also collected along 50 m sections of the stream. Ashed minus 0.1 mm fraction is once again used for the analysis. Heavy mineral fraction (>2.96 g/cm^3) was obtained from the 0.062-0.500 mm fraction of stream sediment using a heavy liquid continuous overflow centrifuge.

The geochemical samples (different fractions) were analysed for their contents of total and/or acid soluble elements as the case may be for the following elements :

a. *Tills* – Co, Cr, Cu, K, Mg, Mn, Ni, Pb, Ti, V, Zn, As, Au, Ba, Br, Cs, Fe, La, Na, Rb, Sc, Sm, Ta, Th, U, W, Al, Ca, Cl, Mo, P, Si and Zr.

b. *Stream sediments* – Ag, Al, Ba, Ca, Ce, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Cl, Na, Nb, P, Si, Sn, Sr, Ti, V, W, Y and Zn.

Stream organic matter – Al, Ba, Ca, Cl, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Rb, Si, Sr, Th, Ti, U, V, Y and Zn.

d. Stream moss – As, Au, Ba, Br, Co, Fe, Lu, Mo, Sb, Sc, Sn, Th and U.

The samples were analysed by a combination of analytical methods of x-ray fluorescence spectrometry (XRF), inductively coupled argon plasma spectroscopy (ICP), neutron activation analysis (NAA) and optical emission spectroscopy (OES). All the analyses of a certain type were done in one and the same laboratory regardless of the origin of the samples. Duplicate samples were used to check possible sampling and analytical errors.

The results of the above exercise are presented in well-produced multi-coloured geochemical maps (143 in number) on 1 : 4,000,000 scale prepared by digitising the coordinates of the sample stations using the Universal Transversal Mercator (UTM) grid and Lambert's projections by automatic plotters. On the single element maps each sample is indicated by a dot, the diameter of which increases logarithmically with the log.-increase of concentration. The size-fraction analysed, the method of analysis, the laboratory where the analysis was carried out and the number of samples plotted are prominently displayed on the map. In addition, frequency distribution diagrams for the element contents of the whole survey region are plotted on Gaussian probability paper on each single-element map. In addition to the above 143 geochemical maps, the Atlas includes another twelve maps of immediate interest like the Lithology Map, the Gravity Anomaly Map, uninterpreted and interpreted aeromagnetic maps, ice-flow direction map and mine and ore prospect maps of the northern Fennoscandia.

Based primarily on the geochemistry of heavy mineral fractions and principal component maps, eighteen geochemical provinces have been delineated in the region surveyed and mapped. Understandably, the geochemical distribution patterns to a large extent coincide with well-known geological units though a refinement of geochemical characteristics of different greenstone belts by different geochemical signatures has been made possible and is of Interest to us as far as our own greenstone belts are concerned.

The explanatory text to the Atlas in a succinct way dwells upon the geochemical provinces delineated, geochemical anomalies noted, the geochemical patterns in relation to glaciation (the analogy of the geochemical patterns in relation to ubiquitous lateritisation in the Indian context comes to mind), reproducibility of geochemical patterns and last but not the least the utilisation of the geochemical maps in mineral exploration and environmental pollution. Geochemical maps of selected trace-elements thought to be essential for plants and animals are also presented in the Atlas indicating their relevance in the newly emerging field of Geomedicine. 55 selected papers of recent years on the subject are listed in the references for the more interested reader.

Thus, the Geochemical Atlas of the Northern Fennoscandia is a monumental work in line with the excellent traditions in Geochemistry in the Scandinavian countries. The Atlas is neatly printed with high quality map reproduction and is recommended for perusal by the Indian Geoscience Community, policy makers and planners with the hope that it would stimulate us on to a similar project of bringing out a Geochemical Atlas of the Indian Subcontinent that would undoubtedly serve in the fields of mineral exploration, environmental pollution, health and agriculture.

Geol. Surv. of India, AMSE Wing
Bangalore

M. S. RAO