Geochemistry is the science that studies the chemistry of the Earth as a whole. Our quality of life and the potential for sustainable development depend on the geochemistry of the near-surface environment – the distribution of chemical elements in minerals, rocks, soils, sediments, water, plants and the atmosphere.

To understand on-going natural environmental processes, it is essential to have a basic understanding of the circulation of elements in earth systems. We must understand how elements such as carbon, nitrogen, phosphorus and sulphur react during the rock cycle. Their distribution in the biosphere is controlled by processes of soil development from bedrock weathering, processes of erosion, transport and the deposition of sediments synchronous to on-going biochemical processes and changing conditions of chemical equilibria in the near-surface environment.

The geochemistry of food quality is a frequently neglected aspect of a healthy lifestyle. It is important to understand that our body, in order to function properly, in addition to organic nutrients also needs ‘minerals’ or ‘chemical elements’ such as iron in our blood, calcium in our bones and fluorine to strengthen our teeth. These nutrients are derived from the plant and animal proteins we ingest. Plants derive their mineral contents from the soil in which they grow. The chemical deficiencies or excesses in any particular soil are passed on through the food chain into plants, animals feeding on these plants and thence into the human diet. The optimum balance of chemical elements in soil is narrow: both severe deficiency and excess of essential elements can cause problems, such as crop failure or livestock mortality. Even less severe chemical deficiency or excess reduces crop and livestock yield.

Within Europe, we now understand that ‘mineral’ or ‘element’ deficiencies of soil result in health related problems and negatively affect agricultural production and economics. Several case histories of health concerns based on environmental geochemistry include the following:

In England, excess molybdenum in soil, and thence in pastures and fodder, caused a similar molybdenum excess in grazing cattle; due to the excess of this element, these cattle acquired a deficiency in another element, copper. Copper deficiency in these cattle exhibited as stunted growth, late maturity and decreased production. Supplementing the molybdenum rich pastures with copper corrected the problem.

In France, magnesium deficiency in certain types of soil has been associated with specific kinds of cancer.

A high occurrence of leukaemia in some areas of Poland was linked to soil deficient in iron, copper, and magnesium with excessive concentrations of silicon and potassium: the carcinogenic agent proved to be toxins produced by the micro-organism Aspergillus flavus, a fungus that thrives in soil of this particular chemistry. Soil fertilisation with certain trace elements and the mineral dolomite controlled the fungus, and the incidence of leukaemia dropped.

A lack of iodine in soil causes goitre, a disease producing enlargement of the human thyroid gland: common table salt is iodised to ensure adequate dietary levels.

Low levels of manganese and chromium in soil apparently increase the incidence of heart disease and atherosclerosis in the local population.

In addition to hazards within the natural environment, human activity changes the geochemistry of the near-surface environment in ways that often adversely affect human health. Pollution is one obvious source of geochemical change. The industrialisation of Europe from the 18th century onward, and the development of intensive farming methods, have changed and are changing the geochemistry of the near-surface environment in such a way as to degrade our habitat and threaten our health.

A prime example of human-industrial induced geochemical toxicity is that of lead. We are all aware that ingestion of lead can cause a variety of illnesses: lead poisoning affects the nervous system, the gastrointestinal tract, and blood-forming tissues with symptoms ranging from abdominal pain, headache, dizziness, confusion, visual disturbances to serious conditions such as mental retardation, blindness, deafness, and paralysis. In the home environment, a former
source of lead poisoning was found to be lead-based paints and lead water pipes. Children, especially vulnerable as their bodies grow and nervous systems develop, chewed on painted toys, furnishings and peeling wall paint. In the workplace, industrial labourers were exposed to lead-bearing dusts and fumes in mining and smelting operations, within the petroleum industry, in printing plants, during the manufacture of plumbing and gas fittings, paints and pigments, batteries, ceramics, glass, ammunition and a host of other essential items. Lead-based insecticides used in agriculture, and the exposure to tetraethyl lead used as an additive to petrol, comprised potentially serious sources of lead poisoning. Less well-known, but no less serious, are the health hazards that can be caused by exposure to arsenic, antimony, cadmium, nickel and other metallic elements introduced by industrial activity.

It is important to realise that everything in and on the earth, whether mineral, plant or animal, is made from some combination of the almost ninety naturally occurring elements. Everything we grow or make depends on the availability of the appropriate elements. Our existence, the quality of our lives and our very survival depends on the appropriate proportions and combinations of these elements in the geochemical environment. Both natural processes and human activity continuously modify our living environment. The European Geological Surveys consider it important to quantify the present abundance and spatial distribution of chemical elements across the surface of Europe. Such a systematic study on so great a scale has never before been attempted. The results are presented in a two volume publication entitled the ‘Geochemical Atlas of Europe’.

Multi-element maps based on soil sampling alone would be very instructive, but Europe is both geologically complex and pedologically heterogeneous. Such a study in short term or medium term is impractical and costly. Employing their extensive knowledge-base in sampling techniques, the European Geological Surveys initiated the present low-density sampling programme by collecting a variety of analytical specimens (residual soil, humus, stream sediment, stream water, floodplain sediment), thus producing complementary data sets, each illustrating a different part of the near-surface environment.

It is the responsibility of the European Geological Surveys to provide decision-makers, researchers, and citizens with high-quality geochemical data concerning the environment in which they live. In the present volume, we assess the geology and mineralisation of Europe and its affect on our environment, and we attempt an elementary understanding of geochemistry in climate and human impact. Scientists from other disciplines may view and interpret the data from their own perspectives.

The ‘Geochemical Atlas of Europe’ represents a significant collaboration among the geoscientists of the twenty-six National Geological Surveys. Each survey has contributed considerable time and effort to produce this unique work. On behalf of the Directors and Presidents of the European Geological Surveys I would like to thank all who participated in this project – geoscientists, field teams, laboratories, and data processing specialists. We express our special gratitude to Professor Reijo Salminen, Chairperson of the “Geochemistry” Working Group, for managing this “Herculean” task for nearly ten years, and for bringing this phase to a successful conclusion. Finally, we appreciate the contribution of all supporting services of computer processing, editing, print and electronic publishing provided by the Geological Survey of Finland, without which these two volumes would not exist.