

Preface

The soil layer and the subsurface region below it are two interrelated natural bodies that comprise the earth's upper layer from land surface to aquifers. In general, it is considered that the structure and properties of the soil–subsurface system are the result of natural processes occurring over geological timescales, formed as a result of rock weathering under various climatic and biotic regimes. Despite the fact that the soil–subsurface has in many cases been affected by human impact, anthropogenic factors in defining the actual matrix and properties of the soil–subsurface system have been largely neglected.

More specifically, in modern society, the natural soil–subsurface system has been exposed to considerable amounts of chemical contaminants, added both intentionally and by accident. The fate of chemical contaminants in the soil–subsurface system has been the subject of an enormous number of experimental studies, designed to quantify their retention, transport, and persistence. The reversibility of chemical interactions between contaminants and the soil–subsurface system has been studied frequently, and in a variety of cases, irreversible pollutant retention has been reported. However, the effect of chemical pollutants on the soil–subsurface matrix and properties has been essentially neglected.

In this book, we draw attention to a new perspective, namely irreversible changes in the pristine soil–subsurface system following chemical pollution. By integrating the results available in the literature, reporting on various cases of interactions between chemical pollutants and soil, we observe that contaminants may lead to the formation of a new soil–subsurface regime characterized by a matrix and properties different than those of the pristine regime. In contrast to the geological timescales controlling natural changes of the matrix and properties of the soil–subsurface system, the timescale associated with chemical pollutant induced changes is far shorter and extends over a “human lifetime scale”. The many examples resembled in the present book confirm that chemical contamination should be considered as an additional factor in the formation of a contemporary soil–subsurface regime with a different matrix and properties than those of the pristine system.

After an introductory part (Chaps. 1–4), we describe irreversible contaminant induced changes in the matrix of isolated mineral and organic constituents that form the soil–subsurface system. For this purpose, we group the examples selected from the literature according to contaminant induced changes resulting from exchange (Chap. 5) and binding (Chap. 6) processes. However, contaminant effects on soil–subsurface properties are a result of changes occurring in natural bodies, where the various constituents are not isolated but appear together as organo-mineral complexes. Chapter 7 discusses contaminant induced changes occurring in chemical and physical characteristics of the soil–subsurface system, as well as in the fluid transmission properties of this system.

In support of our analysis, we relied on research findings presented in a large number of papers, selected from the vast number of available publications. Many other research results of equal value could have been used to illustrate contaminant induced changes to the soil–subsurface matrix and properties, showing that anthropogenic chemicals may become a factor in contemporary soil–subsurface metagenesis.

We hope that the present book, written for the use of soil scientists, hydrologists, and geochemists, will be helpful in shaping their approach to chemical induced changes in the soil–subsurface system. Our thesis on irreversible changes, and formation of a new, contemporary soil–subsurface regime following chemical disposal, should be considered in preventing, controlling, and developing new technologies for a sustainable soil–subsurface system exploitation and management.

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Soil-Subsurface Change

Chemical Pollutant Impacts

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