Contaminant Geochemistry

Interactions and Transport in the Subsurface Environment

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Part III
Contaminant Partitioning in the Subsurface

Contaminants may reach the subsurface in a gaseous phase, dissolved in water, as an immiscible liquid, or as suspended particles. Contaminant partitioning in the subsurface is controlled by the physicochemical properties and the porosity of the earth materials, the composition of the subsurface water, as well as the properties of the contaminants themselves. While the physicochemical and mineralogical characteristics of the subsurface solid phase define the retention capacity of contaminants, the porosity and aggregation status determine the potential volume of liquid and air that are accessible for contaminant redistribution among the subsurface phases. Environmental factors, such as temperature and water content in the subsurface prior to contamination, also affect the pollution pattern.

Under natural conditions, subsurface contaminants can be composed of single organic or inorganic compounds or mixtures thereof. These compounds have different properties, so they react differently, even if they reach the subsurface simultaneously. Therefore, knowledge of subsurface partitioning among individual components in a contaminant mixture is of major importance.

Chapter 5 discusses contaminant adsorption on geosorbents and includes a short description of the surface properties of adsorbents and the methodology for quantifying adsorption. The chapter continues with a presentation of adsorption of various types of toxic chemicals on the subsurface solid phase. In addition to physicochemical adsorption, contaminants can be retained in the subsurface by precipitation, deposition, and trapping. These topics, as well as hysteresis phenomena and formation of bound residues, are discussed.

Contaminant partitioning is described in the following chapters. Chapter 6 examines aqueous solubility equilibria as affected by environmental factors and the apparent solubility of toxic chemicals in the presence of natural and industrial ligands, cosolvents, and electrolytes. Volatilization of contaminants from the water phase is discussed in Chapter 7. A significant portion of Part III is devoted to the presentation of numerous examples, selected from literature, that illustrate contaminant partitioning among the subsurface solid, aqueous, and gaseous phases. Chapter 8 reports experimental results on the partitioning of toxic chemicals under various environmental conditions, as individual compounds or contaminant mixtures, when adsorbed or retained on mineral or organic solid phases, dissolved in subsurface water, or volatilized into the surface or subsurface atmosphere.