

Preface

Global environment consists of a variety of ecosystems of different sizes and compositions. Within each of them, and between them, of particular interest are zones characterized by gradients of properties. This concerns both transfers between phases (solid–gaseous, solid–liquid, and liquid–gaseous) and gradients of properties within a phase (redox, density, temperature, chemical composition). Many of the features are characteristic of areas where land meets ocean. Seawater properties and processes are largely different from those appearing in freshwater. Thus, the land–sea interface is interesting by itself. Moreover, land and coastal zones are areas of intensive anthropogenic activity. The unwanted results of the activity are contamination of freshwater and degradation of coastal areas. Therefore, zones where freshwater meets seawater are of particular interest due to both natural phenomena and transfer of contaminants to the marine environment.

Discharges of freshwater to the sea are well characterized as long as river runoff is considered. This, without doubt, is in relation to the importance of the discharges and relative ease of collecting representative samples of river runoff. Another way of discharge from land to the sea is direct discharge of groundwater. Groundwater flows under the seafloor and seeps through porous sediments to the overlaying seawater. The phenomenon is called submarine groundwater discharge (SGD). Numerous problems occur regarding identifying SGD sites, quantification of SGD fluxes, and collecting the SGD representative samples. Thus, studies on SGD are difficult and require specific methods.

Appreciation of SGD has a long history. For example, both Romans and middle-aged Europeans used SGD as a source of freshwater. However, it was only recently that the importance of SGD for coastal ecosystems was recognized. The appreciation has come with the discovery of the SGD role as a source of nutrients and other chemical substances in the coastal zone. This was followed by studies on the role of SGD as a factor influencing benthic biota in the discharge zone. Recently, the importance of carbon species loads, both organic and inorganic, delivered to the marine environment with seeping groundwater was documented. Interest in the SGD-derived carbon species is due to the common appreciation that

carbon dioxide concentration in the atmosphere is a primary driving force of climate warming.

Decades of research on the qualitative and quantitative composition of groundwater seeping to the coastal zone led to the conclusion that SGD plays important role in developing equilibria in the coastal zone environment. Both enrichment of seawater with inorganic ions and dilution of ions occurring in seawater have been documented. The range of seawater–groundwater interactions depends on many factors such as individual characteristics of aquifers, including rock type, groundwater flow velocity, and anthropogenic contribution. New studies are undertaken in order to increase the amount of data characterizing SGD so that appropriate generalization and scaling up could be carried out.

This volume summarizes recent achievements in the field of SGD studies performed in the Baltic Sea, a European landlocked brackish water body in the temperate climate. For a number of years, SGDs in the area had been investigated with respect to the groundwater flow rate. Within the last 5 years, new findings regarding chemical composition of seeping groundwater have been presented. In the book, concentrations, in groundwater seeping through sandy bottom sediments to the coastal zone along the southern coast of the sea, are presented and discussed. Research on speciation changes of chemical constituents on mixing of groundwater and seawater has also been carried out, and the results are presented in the book. Studies on chemical composition were accompanied with detailed studies of the discharge rates. These have made possible estimation of the chemical loads delivered to the study area and scaling up the loads to the entire Baltic Sea using the literature-derived discharge rates. Some of the loads have been scaled up to the World Ocean. Although both the former and the latter results should be regarded as indicative, they underline the worldwide importance of SGD.

The authors hope that the readers will find the data themselves, the discussion, and conclusions of interest, and that the book will strengthen the appreciation of the SGD's importance to the coastal marine environment.

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