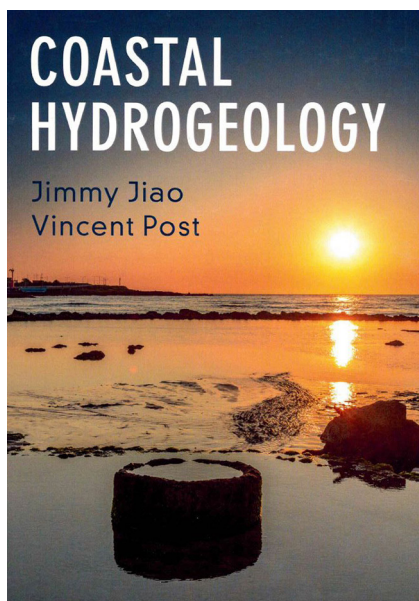


Coastal hydrogeology, by Jiao Jimmy and Vincent Post, 2019. Cambridge University Press, Cambridge, UK. 403 pages. Hardback: price £49.99, ISBN: 9781107030596.



A significant percentage of present-day human populations live on the coasts of oceans and seas, depending increasingly on groundwater. In coastal areas fresh groundwater of inland origin interacts with saline sea water, creating a dynamic equilibrium that is highly vulnerable to external forces, such as increased pumping rates, land reclamation or sea level rise. Intrusion of sea water threatens coastal aquifers on a global scale; it has been a central theme at Salt Water Intrusion Meetings (SWIMs), scientific conferences held regularly since over 50 years. More recently, another process has been receiving increased attention – submarine groundwater discharge (SGD), or the flow of groundwater to the sea, which is considered to be an important source of nutrients and contaminants in coastal marine waters. Coastal hydrogeology has many aspects and certainly deserves to be covered by a dedicated textbook. Such a volume has now been written by Jimmy Jiao and Vincent Post, both of whom are highly esteemed researchers who work on coastal groundwater systems. They have done

an excellent job of synthesising the vast amount of current knowledge on this topic into 12 highly readable chapters, with many high-quality figures.

Chapter 1 introduces the basic concepts related to groundwater occurrence in coastal areas, including salinity and its influence on groundwater head. In the second chapter the authors derive governing equations for water flow and solute transport in variable-density groundwater systems, starting from the basic principles of mass conservation. All derivations are presented in a clear and easy-to-follow manner. Fundamentals of numerical solution are also briefly discussed. The third chapter is devoted to a mathematical description of coastal groundwater processes based on the assumption that freshwater and salt water are two immiscible liquids divided by a sharp interface. While this is a simplification of reality, it can be used to derive analytical solutions of significant practical importance. Historically, the first of these was the well-known Ghyben-Herzberg formula. The present authors provide an excellent summary of its origin and subsequent development. Several other analytical solutions are also discussed. Chapter 4 deals with the influence of tides on groundwater. The authors provide useful analytical solutions which describe the propagation of tidal forcing into aquifers under various hydrogeological conditions. In chapter 5 hydrogeochemical topics are covered, from the evolution of chemical composition and application of isotope analysis to trace water origin and determine age, to some lesser-known aspects, including natural osmotic processes or the influence of land reclamation on groundwater chemistry.

Chapters 6 presents an overview of sea water intrusion processes. The authors distinguish between different modes and conditions under which intrusion occurs and present case studies from different parts of the world. Chapter 7 focuses on submarine groundwater discharge. A very good summary of the topic is given, while the authors attempt to disentangle the confusion related to the use of the

same terms, albeit meaning different things, in the fields of hydrogeology and oceanology.

The next four chapters are devoted to some more specific aspects of coastal hydrogeology. In chapter 8 the reader finds a discussion of changes in coastal groundwater systems over geological time scales. Such changes often lead to the presence of relic inland saline groundwater, which is not related to contemporary sea water intrusion. In contrast, significant fresh or brackish groundwater bodies are found offshore. Chapter 9 focuses on the influence of land reclamation of groundwater in coastal areas. Analytical solutions provided in this chapter can be used as a screening tool to assess how land reclamation changes the position of the groundwater table and the freshwater/saltwater interface. Chapter 10 can be seen as more or less complementary to the previous one, as it discusses the influence of sea level rise on coastal aquifers. Here again, theory is illustrated by analytical solutions. Chapter 11 is devoted to air flow in the coastal vadose zone, induced by the action of waves and tides. This factor is often overlooked, but may be important, as seen in the case of air pressure buildup that leads to damaged pavements at Hongkong airport.

The final chapter concerns the monitoring and management of coastal aquifers. The authors discuss groundwater head and salinity measurements (including geophysical methods), the assessment of coastal aquifer vulnerability and various technical and non-technical measures that can be taken to mitigate sea water intrusion. This has been the only part of the book where I felt that more information could have been included. For instance, I would have been happy to see more details on geophysical investigations or on vulnerability assessment methods.

This aside, the present tome is a very informative piece of scholarship, highly recommended to the whole scientific community working on coastal environments, from either perspective, land or sea. It will also be very useful to engineers and water managers tasked with solving practical problems of groundwater use and protection along coastlines.

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