Coastal Groundwater Salinization: A Looming Threat to Water Security in the Era of Climate Change

Eya Ben Saad

LMU, National Institute of Research and Physical-Chemical Analysis (INRAP), Technopole, 2020 Sidi Thabet, Ariana, Tunisia

Tunis-El Manar University, 1060 Tunis, Tunisia

eya.bensaad@inrap.mesrs.tn

1. Introduction

Groundwater resources form important reservoirs widely exploited for domestic, agricultural, industrial and tourist needs (Villholth, 2006; Custodio, 2010). However, coastal aquifers remain exceptionally vulnerable to salinization due to a variety of natural and anthropogenic factors (Mastrocicco and Colombani, 2021). As a hydrogeologist and Ph.D. candidate in Geology, my research focuses on the assessment of hydrogeochemical processes inducing groundwater salinization in coastal regions under climate change. My experiences in this area have enabled me to understand the complexity of the processes involved in the salinization of coastal groundwater and the challenges involved in developing sustainable management strategies to mitigate its impacts. In this paper, I will outline the sources and mechanisms of groundwater salinization in coastal regions, and the implications of these processes for water resource management.

2. The Sources, Mechanisms, and Implications of Coastal Groundwater Salinization

The salinization of coastal groundwater is a complex process that is influenced by various factors such as seawater intrusion, anthropogenic activities, and climate change. Seawater intrusion is the primary cause of salinization, resulting from the movement of seawater into the coastal aquifer due to over-pumping, excessive groundwater abstraction, and sea-level rise caused by climate change (Santos et al., 2014). Anthropogenic activities such as agricultural practices, urbanization, and industrial activities can also contribute to salinization by introducing pollutants and contaminants into the coastal groundwater system. Furthermore, groundwater salinization arises from complex hydrogeochemical processes, namely cation exchange, mineral dissolution, and redox reactions. Cation exchange occurs when saltwater infiltrates the aquifer, displacing the existing freshwater cations with salt cations. This exchange of cations leads to an overall increase in the salinity of the groundwater. Mineral

dissolution is another key process in groundwater salinization. When saltwater comes into contact with minerals such as gypsum and halite, it dissolves them, releasing their constituent ions into the water. Additionally, redox reactions, like the oxidation of organic matter, can also contribute to the increased salinity of groundwater.

The salinization of coastal aquifers has significant consequences for water security and human well-being. It leads to the degradation of freshwater resources, making them unsuitable for human consumption and agricultural use. This, in turn, can have negative impacts on food security and livelihoods, particularly for coastal communities that depend on groundwater for their daily needs.

Mitigating the salinization of coastal groundwater requires sustainable water management strategies that take into account the complex hydrological, hydrogeological, and geochemical processes involved in coastal aquifer systems. These strategies should be based on a thorough understanding of the aquifer's physical and chemical characteristics, as well as its response to climate change.

3. Conclusion

The salinization origin of coastal groundwater under climate change and anthropogenic activities is a looming threat to water security in the era of climate change. Addressing this challenge requires a holistic approach that considers the complex interactions between natural and human systems. Addressing the issue requires a coordinated effort by governments, local communities, and scientists to understand the origins of salinization and develop appropriate mitigation strategies. By pushing the boundaries of what is possible and rallying the collective will to drive change, we can forge a new path towards water security, one that inspires and captivates the world.

References

Custodio E (2010). Coastal aquifers of Europe: an overview. Hydrogeology Journal, 18, 269-280.

MastrocicoM, Colombani N (2021) The issue of groundwater salinization in coastal areas of the Mediterranean region: a review. Water, 13(1), 90.

Santos FD, Stigter TY, Faysse N, Lourenc TC (2014) Impacts and adaptation to climate change in the Mediterranean coastal areas: the CIRCLE-MED initiative. Regional Environmental Change, 14, 1-3.

Villholth K G (2006) Groundwater assessment and management: Implications and opportunities of globalization. Hydrogeology Journal, 14, 330-339.

Author Responsibility Disclaimer

The author is responsible for referencing the figures, tables, and the information shared in this article.