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## Preface

Groundwater is used for drinking water, irrigation lands, or general industrial processes. The quality of groundwater determines if it is suitable for consumption. At present (2014), arsenic and fluoride contamination of groundwater resources has been identified in many parts of the world, although recognition of the widespread nature of the problem has been advanced only relatively recently. Despite localized inputs of As from human activities, much of the contamination of groundwater with As is shown to arise from geogenic sources and affected groundwater has been found in countries on nearly every continent or major land mass. To date, little is known about arsenic and fluoride and its health effects in Pakistan.

*Arsenic and fluoride Pollution: A Pakistan Perspective* aims to provide a comprehensive background for students and researchers interested in simultaneous presence of arsenic and fluoride in groundwater, its consequences on human health, and to find the protection and sustainable management of the groundwater for the future use. This book gives an overview of the arsenic and fluoride contamination of groundwater in Pakistan and focuses on a case study from Lahore, Punjab, distribution of arsenic and fluoride, its mechanism, possible contaminant sources, and health risk assessment.

Chapter 1 of the book is devoted to general aspects of arsenic and fluoride in groundwater and soil, its worldwide distribution, documented cases of As contamination in groundwater and the environment, health effects, and revisiting the mechanisms of arsenic and fluoride. Status of arsenic and fluoride groundwater pollution is discussed in Chap. 2. Population exposed and sources and causes of arsenic and fluoride in different provinces of Pakistan are presented here. This chapter shows the severity of the problem in Pakistan as this problem is less focused in Pakistan compared to other arsenic and fluoride effected countries in South Asia.

From Chap. 3 the focus is on the case study of arsenic and fluoride groundwater pollution from Lahore, Punjab. This chapter is from the author's Ph.D. thesis. This chapter is divided into two parts; Part A is concerned with study background, sampling methods, and analysis, while Part B describes the isotope analysis which was used as tracer of pollution sources in the area.

Results of the case study are extended in Chap. 4 while Chap. 5 is about the sources of pollution which could be anthropogenic or natural. Sources of nitrogen and sulfur are discussed with reference to isotopes used in this study. Factors affecting the arsenic and fluoride mobility and the natural mechanism of arsenic in case study is discussed in this chapter. Chapter 6 is about the health risk assessment of arsenic in the area. Carcinogenic and non-carcinogenic risk is discussed in the chapter. Chapter 7 is about the remedies used in the arsenic affected areas of Pakistan and the environmental legislations regarding arsenic and fluoride in the area. This book can serve as a good reference for the student and researcher populations exposed to arsenic and its level of risk.

*This book is written* to give an overview of the arsenic and fluoride pollution in Pakistan and it will serve as a reference book for students and researchers in the field of Geochemistry and dealing with arsenic contamination and its remediation. This book also provides beginning graduate students in environmental geochemistry sciences with an overview of contaminant behavior of arsenic in groundwater; on the basis of these studies further research can be framed. I hope that I have succeeded in presenting the reader with a comprehensive—but not exhaustive—overview of the current knowledge of arsenic and fluoride pollution in Pakistan.

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A Pakistan Perspective

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