
Contents

FOREWORD	ix
CHAPTER 1. CONTINENT–SEA INTERFACE: A HYDROGEOLOGICAL CONTINUUM.	1
Nathalie DÖRFLIGER, Bertrand AUNAY and Perrine FLEURY	
1.1. Introduction	2
1.2. Land–sea interface: from geology to the hydrogeological continuum.	3
1.2.1. The continent–ocean continuum.	4
1.2.2. The land–sea continuum: islands	16
1.3. Problems with the management of water resources of coastal aquifers	18
1.3.1. Coastal aquifers of sedimentary basins.	22
1.3.2. Karstic coastal aquifers	26
1.3.3. Coastal insular volcanic aquifers	30
1.4. Conclusion and perspectives	30
1.5. Bibliography.	31
CHAPTER 2. CHEMICAL ELEMENTS AND ISOTOPES, TRACERS OF LAND–SEA EXCHANGES	39
Catherine JEANDEL, Pieter VAN BEEK and François LACAN	
2.1. Introduction	39
2.1.1. Marine geochemistry and the concept of a tracer.	40
2.2. Groundwater discharge into the sea and estimate of “the age of coastal waters”: Ra isotopes	42
2.2.1. Ra isotopes, how do they work?.	42

2.2.2. Submarine groundwater discharge	44
2.2.3. Age of water bodies and horizontal transport	47
2.3. Boundary exchange: what do isotopes of neodymium and thorium bring?	48
2.3.1. Isotopes of neodymium, how does this work?	48
2.3.2. Input of Nd isotopes	50
2.3.3. Isotopes of Th: how does this work?	56
2.3.4. Thorium: indicator for wide coastal exchanges, e.g. the Mediterranean	57
2.3.5. Contribution of experimental methods: initial particle/ dissolute reaction kinetics	58
2.4. Which processes release Fe from ocean margins: the Fe isotope approach?	59
2.4.1. Besides being a tracer, what is the role of iron in the ocean?	59
2.4.2. Isotopes of iron	60
2.4.3. Clues about the processes that release iron	63
2.5. Conclusion	65
2.6. Bibliography	66
CHAPTER 3. EUTROPHICATION OF THE MARINE ENVIRONMENT	71
Alain MÉNESGUEN	
3.1. Manifestations of marine eutrophication	71
3.1.1. Macroalgal proliferations and anoxic “malaigue”.	72
3.1.2. Phytoplanktonic proliferations and hypoxia.	86
3.1.3. Toxic phytoplanktonic proliferations	94
3.1.4. Definition of marine eutrophication.	109
3.2. Mechanisms of marine eutrophication	113
3.2.1. Hydrodynamic confinement	113
3.2.2. Nutrient enrichment	118
3.3. Regulatory monitoring of marine eutrophication and restoration efforts in eutrophicated zones	133
3.3.1. International assessment charts	133
3.3.2. Eutrophication indicators and their threshold values	142

3.3.3. Modeling: a tool for the understanding and remediation of eutrophication	150
3.4. Bibliography.	163
CHAPTER 4. POLLUTION BY MARINE DEBRIS	193
François GALGANI	
4.1. Introduction	193
4.2. Cycle of ocean litter	195
4.2.1. Methods for evaluating debris at sea	195
4.2.2. Nature and quantity of debris flowing into the sea	198
4.2.3. Importance of plastic waste	200
4.2.4. Sources	202
4.2.5. Lifecycle and distribution	205
4.3. Degradation of litter at sea	210
4.4. Effects of marine litter on the environment.	213
4.4.1. Ecological effects	213
4.5. Socioeconomic aspects	222
4.5.1. Legislative aspects (laws, conventions and directives)	222
4.5.2. Initiatives	226
4.5.3. Understanding and educating	230
4.6. Conclusion.	232
4.7. Acknowledgments	234
4.8. Bibliography.	234
4.8.1. Websites.	236
CHAPTER 5. RADIOACTIVITY OF ANTHROPIC ORIGIN IN THE MARINE ENVIRONMENT.	237
Sabine CHARMASSON, Pascal BAILLY DU BOIS, Hervé THÉBAULT, Dominique BOUST and Bruno FIÉVET	
5.1. Introduction	237
5.2. Sources of radionuclides in the marine environment.	238
5.2.1. Atmospheric weapons testing	238
5.2.2. Major accidents	240
5.2.3. Liquid releases from nuclear facilities operating normally	243
5.2.4. Waste	244
5.3. Worldwide oceanic distribution	245
5.3.1. In surface waters	245
5.3.2. In the water column	247

5.4. Behavior and fate in ecosystems	249
5.4.1. Water compartment	251
5.4.2. Behavior of radionuclides related to sediments and material in suspension	258
5.4.3. Transfers of radionuclides to marine species	267
5.5. Vulnerability of coastal areas	274
5.5.1. Dispersal in the sea of contaminants – hydrosedimentary modeling	275
5.5.2. Sensitivity of coastal areas	276
5.6. Conclusion	279
5.7. Bibliography	280
LIST OF AUTHORS	283
INDEX	285