

Contents

Preface	ix
Gwenn PERON-PINVIDIC	
Part 1. Rifting and Rifted Margins: Definitions	1
Chapter 1. What is Rifting? Introduction and Basic Definitions	3
Gwenn PERON-PINVIDIC	
1.1. Introduction	3
1.2. Rift classifications	6
1.2.1. Rift mechanism classification: active versus passive rifting	7
1.2.2. Plate tectonic setting classification	8
1.3. Structural features associated with continental rifting	20
1.3.1. Extensional mechanisms	20
1.3.2. Main structural geometries	21
1.3.3. Main basin types	37
1.4. Subsidence	41
1.5. Rift-related materials	44
1.5.1. Sediments	44
1.5.2. Salt	49
1.5.3. Magma	53
1.6. References	58
Chapter 2. What is a Rifted Margin? From the Early Models to Modern Views and Future Challenges	71
Gwenn PERON-PINVIDIC	
2.1. What is interesting about studying rifted margins?	72
2.2. Morphological definition	75
2.3. Classification schemes for rifted margins	77

2.3.1. Classifications based on the extensional context: the divergent, sheared and transtensional rifted margins	77
2.3.2. Classifications based on the amount of magma involved: the volcanic and non-volcanic rifted margins	80
2.3.3. Classifications based on sediment volume: sediment-rich and sediment-starved rifted margins	85
2.4. Historical review of how our understanding of rifted margins evolved	91
2.4.1. The pioneering models	91
2.4.2. The evolution of knowledge	95
2.5. Continental rifted margins	118
2.5.1. Structural domains	119
2.5.2. The 3D perspective	138
2.5.3. The parameters influencing rift evolution.	139
2.6. Future research.	142
2.6.1. Question 1: What is early rifting?	144
2.6.2. Question 2: What is final rifting?	149
2.6.3. Question 3: What is breakup?	150
2.6.4. Question 4: What is the COB?	153
2.6.5. Question 5: Why are rifted margins segmented?	157
2.7. References	159
Part 2. How Do We Study Rifted Margins?	177
Summary of Contributions	179
Chapter 3. How Can We Identify and Study Remnants of Rifted Margins in Orogens?	181
Geoffroy MOHN, Julie TUGEND, Benoît PETRI, Anders MCCARTHY and Dominique FRIZON DE LAMOTTE	
3.1. Introduction	182
3.2. Brief considerations on orogens	186
3.2.1. Structure of an orogen	186
3.2.2. The significance of Ophiolitic assemblages	187
3.2.3. Classification and types of orogens	188
3.3. Identifying fossil-rifted margins in orogenic systems: principles and criteria	189
3.3.1. Identification of coherent tectonic units.	190
3.3.2. Sedimentary/stratigraphic record and depositional environments	191
3.3.3. Basement lithology and evolution	194
3.3.4. Rift-related deformation style: classical rift geometries versus supra-detachment basins.	196
3.4. Application to case studies	199

3.4.1. Recognition of a proximal domain: the case study of the Dauphinois Unit in the Western Alps	199
3.4.2. Recognition of necking zones: the case studies of the Campo-Grosina Units (Alps) and Southern part of Mauléon Basin (Pyrenees)	200
3.4.3. Recognition of hyper-extended domains: the case studies of the Senadhja Nappe (Rif belt)	204
3.5. Conclusion	207
3.6. Acknowledgments	208
3.7. References	208
Chapter 4. What Can We Learn from Marine Geophysics to Study Rifted Margins?	223
Julia AUTIN and Louise WATREMEZ	
4.1. Geophysical methods	223
4.1.1. Seismic imaging.	224
4.1.2. Potential field methods	239
4.2. Understanding continental rifted margins using geophysics	245
4.2.1. Geological objects interpretation	245
4.2.2. Data complementarity	254
4.3. Conclusion	258
4.4. Acknowledgment	258
4.5. References	258
Chapter 5. Numerical Modeling of Rifting: An Overview	265
Marta PÉREZ-GUSSINÉ and Zhonglan LIU	
5.1. Introduction	265
5.2. A brief historical introduction to numerical modeling of rifting.	267
5.3. Dynamic modeling: description and formulation	273
5.3.1. Eulerian and Lagrangian frameworks	273
5.3.2. Governing equations	274
5.3.3. Rheological models.	276
5.3.4. Strain softening	278
5.3.5. Initial and boundary conditions	278
5.3.6. Initial weaknesses.	281
5.4. Dynamic modeling: applications	282
5.4.1 Margin width and extension mode	282
5.4.2. Normal fault geometry	287
5.4.3. Symmetric and asymmetric margins	289
5.4.4. Melting and serpentinization.	292
5.4.5. Surface processes	295

5.5. Summary and future perspectives	297
5.6. References	299
Chapter 6. Analogue Modeling of Continental Rifting: An Overview	309
Frank ZWAAN and Guido SCHREURS	
6.1. Introduction	309
6.2. Methodology	310
6.2.1. Scaling principles	311
6.2.2. Materials	311
6.2.3. General experimental setups and boundary conditions	312
6.2.4. Model analysis techniques	315
6.3. Model application	319
6.3.1. A 2D perspective on rifting	319
6.3.2. Exploring 3D rift processes	325
6.4. Summary, challenges and future opportunities	329
6.5. Acknowledgments	333
6.6. References	333
List of Authors	345
Index	347
Summary of Volume 2	351