
Uncertainty Underground

Yucca Mountain and the Nation's High-Level Nuclear Waste

edited by Allison M. Macfarlane and Rodney C. Ewing

The MIT Press
Cambridge, Massachusetts
London, England

Contents

Preface ix

Acknowledgments xv

Contributors xix

1 Introduction 1

Allison M. Macfarlane and Rodney C. Ewing

Part I Policy 27

2 Nuclear Waste Story: Setting the Stage 29

Thomas A. Cotton

3 Regulating the Geologic Disposal of High-Level Nuclear Waste at Yucca Mountain 45

William M. Murphy

4 Performance Assessment: What Is It and Why Is It Done? 57

Chris Whipple

5 Performance Assessments: Are They *Necessary* or *Sufficient*? 71

Rodney C. Ewing

6 Technical Policy Decision Making in Siting a High-Level Nuclear Waste Repository 85

Allison M. Macfarlane

Part II Science and Technology 101

I Earth Science 103

7 The Mountain Matters 105

David Applegate

- 8 **Volcanism: The Continuing Saga** 131
Bruce M. Crowe, Greg A. Valentine, Frank V. Perry, and Paul K. Black
- 9 **Climate Change at Yucca Mountain: Lessons from Earth History** 149
MaryLynn Musgrove and Daniel P. Schrag
- II **Hydrology** 163
- 10 **Hot Upwelling Water: Did It Really Invade Yucca Mountain?** 165
Nicholas S. F. Wilson and Jean S. Cline
- 11 **Water and Radionuclide Transport in the Unsaturated Zone** 179
June Fabryka-Martin, Alan Flint, Arend Meijer, and Gilles Bussod
- 12 **Colloidal Transport of Radionuclides** 199
Annie B. Kersting
- 13 **The Importance of Mineralogy at Yucca Mountain** 217
David L. Bish, J. William Carey, Steve J. Chipera, and David T. Vaniman
- 14 **Contaminant Transport in the Saturated Zone at Yucca Mountain** 237
Lynn W. Gelhar
- III **Thermohydrology** 255
- 15 **Thermohydrologic Effects and Interactions** 257
G. S. Bodvarsson
- 16 **The Near Field at Yucca Mountain: Effects of Coupled Processes on Nuclear Waste Isolation** 271
William M. Murphy
- IV **Waste Package Behavior** 285
- 17 **Waste Package Corrosion** 287
David W. Shoesmith
- 18 **Drip Shield and Backfill** 301
David Stahl
- V **Waste Forms** 315
- 19 **Zircaloy Cladding** 317
Eric R. Siegmann

20 Spent Fuel	331
Jordi Bruno and Esther Cera	
21 Glass	353
Werner Lutze	
22 Storing Waste in Ceramic	365
William L. Bourcier and Kurt Sickafus	
Part III Coping with Uncertainty	379
23 The Path to Yucca Mountain and Beyond	381
Luther J. Carter	
24 Uncertainty, Models, and the Way Forward in Nuclear Waste Disposal	393
Allison M. Macfarlane	
Index	411