



## CONTENTS

|                        |     |
|------------------------|-----|
| CONTRIBUTORS . . . . . | vii |
|------------------------|-----|

### Crust and Upper Mantle Structure in Northern Eurasia from Seismic Data

NINA I. PAVLENKOVA

|                                                                                                  |     |
|--------------------------------------------------------------------------------------------------|-----|
| 1. Introduction . . . . .                                                                        | 1   |
| 2. Crustal Structure of the Main Tectonic Units of Northern Eurasia . . . . .                    | 14  |
| 2.1 East European Platform . . . . .                                                             | 17  |
| 2.2 East Siberian Platform (Siberian Craton) . . . . .                                           | 27  |
| 2.3 Young Platforms and Massifs . . . . .                                                        | 31  |
| 2.4 Orogenes and Tectonic Active Regions . . . . .                                               | 41  |
| 3. Crustal Types, Their Relation to Geological Structure, and Rheology of<br>the Crust . . . . . | 56  |
| 3.1 Maps of Crustal Parameters . . . . .                                                         | 56  |
| 3.2 Generalized Petrological Model of the Crust . . . . .                                        | 61  |
| 3.3 Crustal Types . . . . .                                                                      | 68  |
| 3.4 Mechanical Properties of the Crust and the Nature of<br>Seismic Layering . . . . .           | 78  |
| 3.5 Generalized Rheological Model of the Crust . . . . .                                         | 85  |
| 4. Structure of the Upper Mantle . . . . .                                                       | 90  |
| 4.1 Generalized Upper Mantle Model of the East Siberian Platform . . .                           | 91  |
| 4.2 Two-Dimensional Mantle Models for Siberia Platforms . . . . .                                | 98  |
| 4.3 The Upper Mantle of Europe . . . . .                                                         | 103 |
| 4.4 General Properties of the Upper Mantle . . . . .                                             | 109 |
| 5. Summary . . . . .                                                                             | 115 |
| References . . . . .                                                                             | 121 |

### Poroelastic Techniques in the Study of Earthquake-Related Hydrologic Phenomena

EVELYN ROELOFFS

|                                                                     |     |
|---------------------------------------------------------------------|-----|
| 1. Introduction . . . . .                                           | 135 |
| 2. Examples of Earthquake-Related Hydrologic Phenomena . . . . .    | 136 |
| 3. Stress, Strain, Fluid Pressure, and Fluid Mass Content . . . . . | 140 |
| 3.1 Poroelastic Constitutive Relations . . . . .                    | 140 |

|     |                                                                        |     |
|-----|------------------------------------------------------------------------|-----|
| 3.2 | Pore Pressure Buildup in Undrained Compression . . . . .               | 145 |
| 3.3 | Calculating and Measuring the Poroelastic Constants . . . . .          | 147 |
| 3.4 | Barometric Response of Confined Aquifers . . . . .                     | 148 |
| 3.5 | Volumetric Strain Response . . . . .                                   | 150 |
| 3.6 | Tidal Analysis . . . . .                                               | 150 |
| 3.7 | Steplike Coseismic Water Level Changes . . . . .                       | 155 |
| 4.  | Well-Aquifer Systems . . . . .                                         | 156 |
| 4.1 | Wellbore Storage . . . . .                                             | 157 |
| 4.2 | Oscillations (“Hydroseismograms”) . . . . .                            | 159 |
| 5.  | Coupled Flow and Deformation . . . . .                                 | 163 |
| 5.1 | Governing Equations . . . . .                                          | 163 |
| 5.2 | Pore Pressure Changes Due to Strain or Fluid Influx . . . . .          | 164 |
| 5.3 | Water Table Aquifers and Confined Aquifers . . . . .                   | 165 |
| 6.  | Dissipation of Undrained Pressure by Flow to the Water Table . . . . . | 166 |
| 6.1 | Water Table Drainage as a Function of Frequency . . . . .              | 166 |
| 6.2 | Hydraulic Diffusivity . . . . .                                        | 168 |
| 6.3 | Effect on Well Tides of Flow to the Water Table . . . . .              | 170 |
| 6.4 | Effect on Barometric Response of Flow to the Water Table . . . . .     | 170 |
| 6.5 | Water Table Drainage as a Function of Time . . . . .                   | 175 |
| 7.  | Flow Accompanying Fault Movement . . . . .                             | 177 |
| 7.1 | Water Level Changes Associated with Fault Creep . . . . .              | 177 |
| 7.2 | Fluid Flow Following Earthquakes . . . . .                             | 182 |
| 7.3 | Unexplained Observations . . . . .                                     | 183 |
| 8.  | Hydrologic Earthquake Precursors . . . . .                             | 184 |
| 9.  | Summary . . . . .                                                      | 188 |
|     | References . . . . .                                                   | 189 |
|     | INDEX . . . . .                                                        | 195 |

