

# Contents

Series Preface .....	v
<i>Arnold H. Bouma</i>	
Preface .....	vii
<i>Richard H. Bennett</i>	
Acknowledgments .....	ix
Contributors .....	xvii
<b>Part I Basic Clay Microstructure</b>	
<b>A. Microstructure: Signatures</b>	
1 The Signatures of Clay Microstructure—Overview .....	3
<i>Richard W. Faas and Neal R. O'Brien</i>	
2 Determinants of Clay and Shale Microfabric Signatures: Processes and Mechanisms .....	5
<i>Richard H. Bennett, Neal R. O'Brien, and Matthew H. Hulbert</i>	
3 Millimeter-Scale Sedimentary Structure of Fine-Grained Sediments: Examples from Continental Margin Environments .....	33
<i>S.A. Kuehl, T.M. Hariu, M.W. Sanford, C.A. Nittrouer, and D.J. DeMaster</i>	
4 Problems of Particle Delamination and of Stepwise Aggregation in Clay Swelling .....	47
<i>E.T. Stepkowska</i>	
5 The Nature and Significance of Gas-Generated Microvoids as “Secondary” Microfabric Features in Modern and Pleistocene Marine and Estuarine Sediments .....	55
<i>Stanislas Wartel, Sethi Parvinger Singh, and Richard W. Faas</i>	

6	Clay Fabric of Fine-Grained Turbidite Sequences from the Southern Nares Abyssal Plain . . . . .	61
	<i>L.E. Shephard and A.K. Rutledge</i>	
7	Microfabric and Physical Properties Characteristics of a Consolidated Clay Section: ODP Site 697, Weddell Sea . . . . .	73
	<i>William R. Bryant, Richard H. Bennett, Patti J. Burkett, and F.R. Rack</i>	
8	Physical Property Changes Accompanying Deep Burial of Clay-Rich Sediments, Barbados Convergent Margin . . . . .	93
	<i>Jane Schoonmaker Tribble, Fred T. Mackenzie, and Jozsef Urmos</i>	
9	Sedimentary Structures: Textures and Depositional Settings of Shales from the Lower Belt Supergroup, Mid-Proterozoic, Montana, U.S.A. . . . .	101
	<i>Jürgen Schieber</i>	
10	Porosities, Permeabilities, and Microfabrics of Devonian Shales . . . . .	109
	<i>David K. Davies, William R. Bryant, Richard K. Vessell, and Patti J. Burkett</i>	

## **Part I Basic Clay Microstructure**

### **B. Environmental Processes: A Continuum**

11	Environmental Processes: A Continuum—Overview . . . . .	123
	<i>William R. Bryant</i>	
12	Interparticle Grain Size Relationships Resulting from Flocculation . . . . .	125
	<i>Kate Kranck</i>	
13	The Changing Microfabric of Suspended Particulate Matter—The Fluvial to Marine Transition: Flocculation, Agglomeration, and Pelletization . . . . .	131
	<i>J.P.M. Syvitski</i>	
14	Microstructure of Suspensates: From Stream to Shelf . . . . .	139
	<i>J.W. Pierce</i>	
15	The Influence of Organic Carbon Flux on the Deposition of Clays in the Marine Environment: Implications with Respect to Microstructure . . . . .	147
	<i>Kathleen M. Fischer</i>	
16	Mass Arrival Mechanisms and Clay Deposition at the Seafloor . . . . .	161
	<i>W.B. Dade, A.R.M. Nowell, and P.A. Jumars</i>	
17	Distinguishing Features of Layered Muds Deposited from Shallow Water High Concentration Suspensions . . . . .	167
	<i>R. Kirby</i>	
18	Effect of Bed Shear Stresses on the Deposition and Strength of Deposited Cohesive Muds . . . . .	175
	<i>Emmanuel Partheniades</i>	
19	Fluidization of Soft Estuarine Mud by Waves . . . . .	185
	<i>Mark A. Ross and Ashish J. Mehta</i>	

20	The Significance of Sediment-Flow Dynamics on Clay Microstructure Development: Riverine and Continental Shelf Environments . . . . .	193
	<i>Huon Li and Richard H. Bennett</i>	
21	Silt Microfabric of Detrital, Deep Sea Mud(stone)s (California Continental Borderland) as Shown by Backscattered Electron Microscopy . . . . .	203
	<i>Suzanne Reynolds and Donn S. Gorsline</i>	
22	Physical Properties and Microstructural Response of Sediments to Accretion-Subduction: Barbados Forearc . . . . .	213
	<i>Elliott Taylor, Patti J. Burkett, Jerri D. Wackler, and John N. Leonard</i>	
23	Anomalous Stress History of Sediments of the Northwest Pacific: The Role of Microstructure . . . . .	229
	<i>Kathleen A. Dadey, Margaret Leinen, and Armand J. Silva</i>	

## **Part II Applied Clay Microstructure**

### **A. Modeling—Past and Present: New Directions**

24	Modeling—Past and Present: New Directions—Overview . . . . .	239
	<i>Sibel Pamukcu</i>	
25	Influence of Some Physicochemical Activities on Mechanical Behavior of Clays . . . . .	241
	<i>Sibel Pamukcu and Mustafa Tuncan</i>	
26	Organization of Clay Particles in Aqueous Suspension as Inferred from Spectroscopy of Organic Dyes . . . . .	255
	<i>Jos Cenens, Robert A. Schoonheydt, and Frans C. De Schryver</i>	
27	Some Effects of Vicinal Water on the Sedimentation Process, Compaction, and Ultimate Properties of Sediments . . . . .	259
	<i>W. Drost-Hansen</i>	
28	Rheology and Microstructure of Concentrated Illite Suspensions . . . . .	267
	<i>D.J.A. Williams and P.R. Williams</i>	
29	A Coupled Fluid Expulsion/Deformation Model of Dewatering Sediments . . . . .	273
	<i>F. Tom Chang, G.P. Lennon, Sibel Pamukcu, and B. Carson</i>	
30	The Flocc Camera: A Three-Dimensional Imaging System of Suspended Particulate Matter . . . . .	281
	<i>J.P.M. Syvitski, K.W. Asprey, and D.E. Heffler</i>	
31	Characterization of Clay Fabric . . . . .	291
	<i>A.G. Altschaeffl and S. Thevanayagam</i>	
32	Microtexture and Microchemistry of Clay-Rich Sediments . . . . .	297
	<i>R.E. Ferrell, Jr. and P.K. Carpenter</i>	
33	Quantitative Rock Mineral Analysis . . . . .	303
	<i>George D. Brunton</i>	

**Part II Applied Clay Microstructure**  
**B. Measurements/Techniques/Sampling Strategy**

34	Applied Clay Microstructure: Measurements, Techniques, and Sampling Strategies for Clay Fabric Research—Overview .....	307
	<i>Peter Smart and Wen-An Chiou</i>	
35	Techniques for the Preparation of Submarine Sediments for Electron Microscopy .....	309
	<i>Roy J. Baerwald, Patti J. Burkett, and Richard H. Bennett</i>	
36	Observation Technique for Wet Clay Minerals Using Film-Sealed Environmental Cell Equipment Attached to High-Resolution Electron Microscope .....	321
	<i>Akira Fukami, Kurio Fukushima, and Norihiko Kohyama</i>	
37	Clay Fabric of Gassy Submarine Sediments .....	333
	<i>W.A. Chiou, William R. Bryant, and Richard H. Bennett</i>	
38	Objective Measurement and Classification of Microfabrics and Their Relationship to Physical Properties .....	353
	<i>Cynthia M. Ross and Robert Ehrlich</i>	
39	Automatic Analysis of Microstructure of Cohesive Sediments .....	359
	<i>Peter Smart, N.K. Tovey, X. Leng, M.W. Hounslow, and I. McConnochie</i>	
40	The Application of Image Analysis Techniques to Microstructure Studies in Geotechnical Engineering .....	367
	<i>Shobha K. Bhatia and Aly Soliman</i>	
41	Quantification of Clay Fabric: A Simple Technique .....	379
	<i>W.A. Chiou, William R. Bryant, and Richard H. Bennett</i>	
42	Measurements of Bond Energy of Clays and Ocean Wave Attenuation .....	389
	<i>Kolchi Ando and T. Yamamoto</i>	
43	Geoacoustic Properties of a Marine Silt .....	395
	<i>R.D. Stoll</i>	
44	Sediment Shear Waves: A Comparison of <i>In Situ</i> and Laboratory Measurements .....	403
	<i>Michael D. Richardson, Enrico Muzi, Luigi Troiano, and Bruno Miaschi</i>	
45	Geoacoustic Properties in the Near-Surface Sediment in Response to Periodic Deposition .....	417
	<i>Charles Libicki and Keith W. Bedford</i>	
46	Elasticity of Fine-Grained Abyssal Sediments, Brazil Basin, South Atlantic Ocean .....	431
	<i>Thomas H. Orsi and Dean A. Dunn</i>	

**Part II Applied Clay Microstructure****C. Applications: Present Requirements**

47	Applications: Present Requirements, Waste Disposal, Containment, and Packing Material . . . . .	449
	<i>Thomas F. Lomenick and J.D. Kasprovicz</i>	
48	Disposal of Radioactive and Hazardous Wastes into Clay-Rich Rocks . . . . .	451
	<i>Thomas F. Lomenick and J.D. Kasprovicz</i>	
49	Preliminary Geotechnical Considerations of Borehole Facilities as Waste Repositories in Clay Deposits . . . . .	465
	<i>Mysore S. Nataraj</i>	
50	Hydrocarbon Liquids and Clay Microstructure . . . . .	469
	<i>Robert M. Quigley and Federico Fernandez</i>	
51	Effects of Hydrothermal Treatment on the Engineering Properties, Microstructure, and Composition of Oilwell Cements . . . . .	475
	<i>Eliza Grabowski and J.E. Gillott</i>	
52	The Role of the Microstructure of Pacific Red Clays in Radioactive Waste Disposal . . . . .	489
	<i>Patti J. Burkett, Richard H. Bennett, and William R. Bryant</i>	
53	Influences on the Rheology of Marine Sediments Composed of Low-Activity Minerals . . . . .	509
	<i>J. Kenneth Torrance</i>	
54	The Geotechnical Importance of Clay Flexibility . . . . .	515
	<i>N.B. Aughenbaugh</i>	
55	The Microfabric of Some Hong Kong Marine Soils . . . . .	519
	<i>N.K. Tovey</i>	
56	Application of Microstructure Classification of Marine Sediment to Engineering Geological Evaluation . . . . .	531
	<i>Gao Guorui</i>	
57	Preliminary Geotechnical Evaluation of Deep Borehole Facilities for Nuclear Waste Disposal in Shales . . . . .	539
	<i>Mysore S. Nataraj</i>	
58	Microstructural and Mineralogical Characterization of Selected Shales in Support of Nuclear Waste Repository Studies . . . . .	545
	<i>S.Y. Lee, L.K. Hyder, and P.D. Alley</i>	

**Part III Future Research Directions and Recommendations: Basic and Applied**

59	Research Recommendations of the Clay Microstructure Workshop . . . . .	563
	<i>Matthew H. Hulbert</i>	
	Index . . . . .	567