
Contents

Introduction	1
List of Figures	7
1 Previous Work	9
1.1 From the Beginnings to 1962	9
1.2 From 1962 to the Present Time	10
1.3 Obsolete Stage Names in Modern Geological Maps of the Jura Mountains	22
2 What Can Be Measured, Calculated, or Quantified by Comparison	25
2.1 Sediment Thickness	25
2.2 Direct Time Calibration of Sediments	26
2.2.1 Radiometric Ages	26
2.2.2 Geomagnetic Polarity Scale	26
2.3 Relative Time Calibration of Sediments	26
2.3.1 Biochronology of Ammonites and Ammonite Zones	26
2.3.2 The Three Principal Marl-Limestone Successions in the Swiss Oxfordian	26
2.3.3 Elementary Marl-Limestone Cycles	27
2.3.4 Comparison of Marl-Limestone Cycles with MILANKOVITCH-Type Periodicity	29
2.4 Rates of Sedimentation	30
2.5 Provenance and Quantity of Calcareous Mud	30
2.6 Water Depth and Sea Floor Topography	31
2.7 Subsidence	31
2.8 Syndimentary Tectonics	31
2.9 Sea Level Variations	32
2.10 Oxygen Content and Salinity of Bottom Water	32
2.11 Paleoclimate	33
3 Paleogeography and Paleoclimate	35
4 Sedimentation	41
4.1 Minerals, Fossils, and Sediments Diagnostic of Climate and of Water Temperature, Oxygenation, and Depth	41
4.1.1 Minerals	41
4.1.2 Fossils	47
4.1.3 Sediments	47
4.2 Water Depth and Sea Floor Topography in the Deep Subtidal Zone	51
4.2.1 Water Depth	51
4.2.2 Sea Floor Topography	53
4.3 How the Composition of the Macrofossil Assemblage in a Sediment Varied with Increasing Depth of Deposition	56

4.3.1	Variation in Main Macrofossil Assemblages	56
4.3.2	Spherical Calcareous Oncoids Growing at Widely Varying Water Depth	58
4.4	Oxygen Content of Bottom Water	63
4.5	The Influence of Bottom Water Oxygenation on the Composition and Preservation of Fossil Assemblages	64
4.6	Hermatypic Corals and Their Greater Tolerance of Clay Mineral Sedimentation Compared to that of Ammonites	68
4.7	Sediment Transport from Land to Sea	70
4.8	The Mode of Formation of Thin and Widespread Iron Oolites in Relatively Deep Water on the Level Basin Floor	70
4.8.1	Macrofossil Assemblages in Iron Oolites	70
4.8.2	How Iron Ooids did <i>not</i> Become Embedded into Thin, Widespread Beds of Argillaceous or of Calcareous Mud on the Basin Floor	71
4.8.3	How Iron Ooids Dispersed at the Surface of Mud-Grade Sediment Could be <i>Accreted</i> and Become Embedded at a Water Depth of up to 100 m	76
4.8.4	Accretion of Brown Iron Ooids of Goethite and Green Iron Ooids of Berthierine Side by Side in Well-Oxygenated Bottom Water of the Deep Subtidal Zone	78
4.9	Aggradation, Progradation, and Backstepping	79
4.10	Depositional Slopes with Truncation Surfaces, Debris Flows, and Turbidites	81
4.11	Lateral Shift of Belts with Maximal Sedimentation Rate	84
4.12	Carbonate Platforms Versus Ramps	87
4.13	Lateral Shift of Carbonate Platform Margins	91
4.14	Origin of Calcareous Mud	92
4.14.1	Different Sources of Calcareous Mud	92
4.14.2	Export of Calcareous Mud from Carbonate Platforms	94
4.14.3	Whittings, their Localization and Quantitative Relevance	96
4.15	Deepening-Upward and Shallowing-Upward Successions	97
4.15.1	Deepening-Upward Successions	97
4.15.2	Shallowing-Upward Successions and Walther's "Law"	104
5	Sea Level Variations	107
5.1	Rapid Relative Sea Level Rises: Timing and Quantification	107
5.2	Evidence that <i>Rapid</i> Relative Sea Level Rises Were Eustatically Driven	118
5.3	Falls of Sea Level in the Late Jurassic	119
5.4	Why Stillstand, Progradation, and Backstepping of Basinward Rims of the Shallow-Water Sedimentary Units Investigated Are Diagnostic of Eustasy	124
5.5	The Pattern of Global Sea Level Variation in the Late Jurassic	125
5.5.1	Long-Term Variations	125
5.5.2	Short-Term Variations	125
6	Hermatypic Coral Assemblages: Growth Form, Spatial Distribution, and Paleobathymetry	127
7	Age and Time Correlation of Sediments	131
7.1	Direct Measurement of Age Using Nuclear Decay	131
7.2	Relative Time Calibration According to Ammonite Biochronology	132
7.3	The Ammonite Zones of the Oxfordian and Kimmeridgian Stages in Northern Switzerland	133
7.4	Time Correlation	146

8	Rates of Sedimentation Varying Between Positive (Net), Zero, and Negative (Erosion)	151
8.1	Net Sedimentation at a Normal Rate	151
8.2	Stratigraphic Condensation	152
8.3	Omission (Nondeposition)	153
8.4	Subaqueous Erosion of Unlithified Sediment by Bottom Currents	153
8.5	Subsolution: Subaqueous Corrosion of Early Lithified Limestone	155
8.6	Subaerial Erosion of Limestone Interrupting Shallow-Marine Sedimentation	159
9	Subsidence	161
9.1	Endogenic Subsidence	161
9.2	Exogenic Subsidence Under Load: Isostatic Equilibration of the Lithosphere	162
10	Synsedimentary Tectonics	165
11	Discussion and Conclusions	169
11.1	Generalities	169
11.2	Endogenically Driven, Vertical Movements of the Basement	169
11.3	Rates of Sedimentation compared with Rates of Exogenic Subsidence	172
11.4	Interpretation of Sediments	172
11.4.1	Time Calibration and Correlation	172
11.4.2	Great Thickness Variation in Coeval Sediments	173
11.4.3	Paleobathymetry	173
11.4.4	Sea Floor Topography	175
11.5	Paleoclimate and Sediment Supply	179
11.5.1	Subtropical Climate Alternating Between Humid and Semiarid	179
11.5.2	Long-Term Climatic Change Throughout the Oxfordian Age	179
11.5.3	Sediment Supply and Mode of Transport	181
11.5.4	Storms and Storm Wave Base	183
11.5.5	Kaolinite as a Means in Time Correlation	184
11.6	Sea Level Variation	185
11.6.1	Eustasy in the Quaternary	185
11.6.2	Eustasy in the Late Jurassic	185
11.7	The Potential of Ammonites in Sedimentary Geology	187
12	Main Conclusions	191
	Acknowledgements	203
	References	205
	Index	213