

# CONTENTS

<b>CHAPTER 1 Introduction</b>	<b>1</b>
1.1 Well logs – a definition and some history	1
1.2 Well logs – the necessity	1
1.3 Wireline logs – the making	2
1.4 LWD logs – the making (MWD and definitions)	3
1.5 Log runs	6
1.6 Log grid presentations	6
1.7 Digital log data formats	9
1.8 Log acronyms (mnemonics)	10
1.9 The logging companies	10
1.10 Well log interpretation and uses	11
1.11 This book – content and aims	11
<b>CHAPTER 2 The logging environment</b>	<b>13</b>
2.1 Introduction	13
2.2 Invasion and the pressure environment of boreholes	13
2.3 Temperature environment of boreholes	16
2.4 Damage around the borehole	17
2.5 Logging tool capabilities: beds	17
2.6 Logging tool capabilities: spatial considerations	23
2.7 Depth measurement in boreholes	26
2.8 Logging tool conveyancing methods	30
2.9 Conclusion	30
<b>CHAPTER 3 Subsurface pressure measurement</b>	<b>31</b>
3.1 Introduction	31
3.2 Subsurface fluid pressures	32
3.3 Subsurface pressure tools	35
3.4 Sampling	43
3.5 Comment	45
<b>CHAPTER 4 Temperature logging</b>	<b>47</b>
4.1 Generalities	47
4.2 Subsurface temperatures and geothermal gradients	47
4.3 Borehole temperature measurement	49
4.4 True formation temperatures and borehole corrections	50
4.5 Temperature log uses	51
<b>CHAPTER 5 Caliper logs</b>	<b>55</b>
5.1 Generalities	55
5.2 Caliper tools	56
5.3 Log presentations	58
5.4 Simple, two-arm, wireline caliper interpretation	58
5.5 Four-arm caliper interpretation	62
<b>CHAPTER 6 Self potential or SP logs</b>	<b>65</b>
6.1 Generalities	65
6.2 Principles of measurement	66
6.3 The SP tool	67
6.4 Log characteristics	68
6.5 Quantitative uses	69
6.6 Qualitative uses	72

<b>CHAPTER 7 Resistivity logs</b>	<b>75</b>
7.1 Generalities	75
7.2 Theoretical considerations	76
7.3 Zones of invasion: resistivity variations	81
7.4 Resistivity tools	87
7.5 The different types of resistivity tools	88
7.6 Modern resistivity tools: some examples	93
7.7 Log characteristics	100
7.8 Quantitative uses of the resistivity logs	104
7.9 Qualitative uses	106
<b>CHAPTER 8 The gamma ray and spectral gamma ray</b>	<b>117</b>
8.1 Generalities	117
8.2 Natural gamma radiation	118
8.3 Tools	120
8.4 Log characteristics	122
8.5 Geochemical behavior of potassium, thorium and uranium and natural radioactivity	128
8.6 Radioactivity of shales and clays	131
8.7 Quantitative use of the simple gamma ray	132
8.8 Qualitative use of the simple gamma ray	133
8.9 Quantitative use of the spectral gamma ray	142
8.10 Qualitative and semi-quantitative uses of the spectral gamma ray log	142
<b>CHAPTER 9 Sonic or acoustic logs</b>	<b>147</b>
9.1 Generalities	147
9.2 Older, compressional wave, wireline sonic tools (pre-1985)	151
9.3 Full waveform array, dipole, wireline sonic tools	156
9.4 LWD sonic tools	162
9.5 Porosity determination from the sonic log	164
9.6 Qualitative and semi-quantitative uses of sonic logs (non-seismic)	167
9.7 Quantitative uses of sonic logs (non-seismic)	176
9.8 Seismic applications of sonic logs	182
<b>CHAPTER 10 The density and photoelectric factor logs</b>	<b>187</b>
10.1 Generalities	187
10.2 Principles of measurement	188
10.3 Tools	189
10.4 Log characteristics	194
10.5 Quantitative uses	195
10.6 Qualitative uses	196
THE PHOTOELECTRIC FACTOR LOG (or Litho-Density)	205
10.7 Generalities	205
10.8 Principles of measurement	206
10.9 Log characteristics	207
10.10 Quantitative uses	209
10.11 Qualitative uses	209
<b>CHAPTER 11 The neutron log</b>	<b>211</b>
11.1 Generalities	211
11.2 Principles of neutron measurement	212
11.3 Tools	215
11.4 Log characteristics	220
11.5 Quantitative uses	222
11.6 Qualitative uses	225
11.7 Neutron-density combination: lithology identification	232
11.8 Gamma-neutron tools	236
<b>CHAPTER 12 Lithology reconstruction from logs</b>	<b>239</b>
12.1 Introduction	239
12.2 Subsurface lithology	239

12.3	Lithology from drill data – the mud log	240
12.4	Lithology from cores – direct physical sampling	242
12.5	Manual lithology interpretation from logs (qualitative)	245
12.6	Computer aids to manual lithology interpretation (semi-quantitative)	250
12.7	Software derived lithology from logs (quantitative)	257
12.8	Conclusion	261
<b>CHAPTER 13 Nuclear magnetic resonance</b>		<b>263</b>
13.1	Generalities	263
13.2	Principles of measurement	264
13.3	Tools	271
13.4	Log characteristics	274
13.5	Petrophysical uses	276
13.6	Geological uses	282
<b>CHAPTER 14 The dipmeter</b>		<b>285</b>
14.1	Generalities	285
14.2	Dipmeter tools	286
14.2	Dipmeter processing	289
14.4	Processed log presentations	291
14.5	Dipmeter quality assessment	295
14.6	Dipmeter interpretation: the basics	296
14.7	Sedimentary dipmeter interpretation	297
14.8	Structural dipmeter interpretation	316
14.9	Conclusion	
<b>CHAPTER 15 Image logs</b>		<b>317</b>
15.1	Generalities	317
15.2	Wireline imaging tools	320
15.3	LWD imaging tools	325
15.4	Image processing: electrical and acoustic	328
15.5	Some basic practicalities for interpretation	334
15.6	Sedimentary interpretation of images, some concepts and examples	340
15.7	Structural interpretation of images, some examples	344
15.8	Quantitative uses of electrical images: thin beds, permeability, fractures and facies	352
15.9	What next?	357
<b>CHAPTER 16 Facies, sequences and depositional environments from logs</b>		<b>357</b>
16.1	Introduction	357
16.2	Facies	357
16.3	Log-based sequence (electrosequence) analysis: a tool for sedimentological and stratigraphic interpretation	361
16.4	Carbonate sediments	369
16.5	Conclusion	370
<b>CHAPTER 17 Sequence stratigraphy and stratigraphy</b>		<b>371</b>
17.1	Introduction	371
17.2	High resolution siliciclastic sequence stratigraphy using well logs	371
17.3	Log examples of sequence stratigraphic surfaces	377
17.4	Sequence stratigraphy: the building blocks	387
17.5	Carbonate sequence stratigraphy	394
17.6	Lithostratigraphy	401
17.7	Correlation methods	401
17.8	Conclusion	408
<b>CHAPTER 18 Conclusions</b>		<b>409</b>
<b>References</b>		<b>413</b>
<b>Index</b>		<b>428</b>