

Contents

1	Geothermal Energy	1
1.1	Geothermal Systems	1
1.2	Geothermal Resources	2
1.3	Geothermal Processes	3
1.4	OpenGeoSys (OGS)	7
1.5	Tutorial and Course Structure	8
2	Theory	9
2.1	Continuum Mechanics of Porous Media	9
2.2	Governing Equations of Heat Transport in Porous Media	14
3	Numerical Methods	19
3.1	Approximation Methods	19
3.2	Solution Procedure	19
3.3	Theory of Discrete Approximation	21
3.4	Solution Process	24
3.5	Finite Element Method	30
3.6	Exercises	37
4	Heat Transport Exercises	39
4.1	Exercises Schedule	39
4.2	OGS File Concept	39
4.3	Heat Conduction in a Semi-Infinite Domain	40
4.4	Heat Flow Through a Layered Porous Medium	51
4.5	Heat Transport in a Porous Medium	59
4.6	Heat Transport in a Porous-Fractured medium	70
4.7	Heat Convection in a Porous Medium: The Elder problem	80
5	Introduction to Geothermal Case Studies	91
5.1	Bavarian Molasse	91
5.2	Urach Spa	92
5.3	Gross Schönebeck	93

A Symbols	95
B Keywords	99
B.1 GLI—Geometry	99
B.2 MSH—Finite Element Mesh	99
B.3 PCS—Process Definition	100
B.4 NUM—Numerical Properties	100
B.5 TIM—Time Discretization	101
B.6 IC—Initial Conditions	102
B.7 BC—Boundary Conditions	102
B.8 ST—Source/Sink Terms	102
B.9 MFP—Fluid Properties	103
B.10 MSP—Solid Properties	103
B.11 MMP—Porous Medium Properties	104
B.12 OUT—Output Parameters	104
References.....	105

Geoenergy Modeling I

Geothermal Processes in Fractured Porous Media

Böttcher, N.; Watanabe, N.; Görke, U.-J.; Kolditz, O.

2016, XII, 107 p. 56 illus., Softcover

ISBN: 978-3-319-31333-7