Preface

In the past decade, development of unconventional oil and gas resources has been perhaps the biggest new trend in the energy sector. It has become possible to produce huge new resources that were previously considered uneconomic. Key enabling technologies have been long horizontal wells and multiple fracturing stages (King 2010).

Hydraulic fracturing in geothermal energy is typically referred to as Enhanced Geothermal Systems, or EGS (Tester 2007). EGS researchers hope that improvements in stimulation design will enable geothermal to one day experience the same growth in production that is now being seen in unconventional oil and gas.

Despite years of research and field experience, fundamental questions remain unanswered. What is the relative importance of new and preexisting fractures in stimulation? Why do the fracture networks generated in unconventional oil and gas frequently appear to be so complex? What does a stimulated, unconventional reservoir "look like?"

Computational modeling has the potential to be very useful for stimulation design, helping engineers make routine design decisions, test novel ideas, perform formation evaluation, and make decisions about data collection. A remarkable diversity of models and modeling approaches exists. Unfortunately, progress is hampered by the nonuniqueness caused by limited and incomplete data, resulting in difficulty in confirming model assumptions. Therefore, while stimulation modeling holds tremendous promise, it remains a work in progress. A tremendous amount of work is being done in this area, and progress is expected in the years ahead.

This book summarizes a hydraulic stimulation model developed especially for unconventional applications in oil, natural gas, and geothermal. The model described in this book remains incomplete. Several important physical processes remain neglected or incompletely described. However, the strength of this model is that it fully, efficiently, couples fluid flow and the stresses caused by deformation in large, complex discrete fracture networks. We believe that realistically capturing induced stresses will lead to better insight into stimulation processes. Furthermore, we believe that the complexities of the reservoir—spatially variable fracture density, orientation, stresses, and so on—have profound effects on the stimulation process that cannot easily be simplified out of a numerical model without obscuring important details.

Several novel techniques were developed for this work, and existing methods were combined in novel ways. We hope that this work provides a useful contribution to the field of stimulation modeling and lays the groundwork for future research.

References

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