Fluid Flow in Sedimentary Basins and Aquifers

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Fluid Flow in Sedimentary Basins and Aquifers

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Contents

Preface

This Special Publication of the Geological Society is the proceedings of a meeting on 'Fluid Flow in Sedimentary Basins and Aquifers' held at the Geological Society in London in June 1985. The meeting was organized by the Petroleum and Hydrogeological Specialist Groups of the Society and attended by 200 earth scientists. The aim of the meeting was to bring together geologists concerned with different aspects of fluid flow in sedimentary basins, to present case histories of flow in different types of basin, and to emphasize economically important aspects of fluid flow. It is hoped that this volume which includes thirteen of the papers presented at the meeting will be a useful reference on this complex and evolving subject in geology.

Further advances in our understanding of fluid flow will require accurate description and prediction of rock types, aquifer and seal geometry, and permeability in basins, and advances in modelling flow—particularly over long periods of geological time. The convenors, Jeremy Goff of the Petroleum Group and Brian Williams of the Hydrogeological Group, hope that this volume will stimulate further interest in this topic and encourage further research in this economically important aspect of geology. The convenors wish to express their sincere thanks to the Geological Society for their help and support in the organization of this meeting.

Introduction

Knowledge of fluid flow in sedimentary basins is of vital economic importance for understanding water resources, aquifer behaviour, petroleum migration, accumulation and production, geothermal resources and toxic waste disposal. The meeting on 'Fluid Flow in Sedimentary Basins and Aquifers' allowed workers in different fields of geology to compare and contrast their approaches to the study of fluid flow. Advances in the study of fluid flow by hydrogeologists, for example, may be significant for flow studies by petroleum geologists and engineers, and vice versa.

The papers in this volume discuss principles of fluid flow, and geologically important aspects of flow at all scales ranging from large scale basinal flow systems to flow in small aquifers and fracture systems. The volume is divided into four sections covering the following topics: fluid flow in compacting basins, fluid flow in the Western Canadian Sedimentary Basin, fluid flow in the United Kingdom Sedimentary Basin, and fluid flow in low permeability and fractured media.

In the first section, Chapman discusses the large-scale geological controls on fluid flow in compacting basins, the physical principles controlling fluid flow, and the rock properties which affect flow. He emphasizes how the stratigraphy (distribution of lithologies) in a basin controls the directions and pattern of fluid flow. He also comments on the development of abnormal pressures, and on the role of faults in vertical flow in basins. Magara attempts to quantify horizontal, compaction driven, fluid flow caused by sediment loading. He applies his theory to the sourcing of the oil fields in the Arabian Gulf region. He combines his fluid flow study with work on the maturation of the source rock and concludes that major horizontal oil migration has occurred.

The Western Canadian Basin has become an important area for studies of fluid flow and the second section of the volume includes four papers which cover this topic. Hitchon describes the recent research work being carried out at the Basin Analysis Group of the Alberta Geological Survey. Using hydrogeological studies of oil sand and of a deep waste disposal site as examples, he describes how fluid flow can be modelled in areas with extensive geological and hydrogeological data bases. He emphasizes the importance of identifying individual 'hydrostratigraphic units' (aquifers, aquitards and aquicludes), and of modelling the fluid flow within and between the identified aquifers. Corbett and Tóth discuss the evolution of fluid flow systems through geological time in part of the Western Canadian Basin. They recognize flow systems controlled by the present land surface, erosional rebound effects, and an ancient cross formational flow system which is not adjusted to the present land relief.

Jones and Majorowicz, using a large bottom hole temperature data base, show that redistribution of heat due to groundwater motion occurs in the Western Canadian Basin. Bradbury and Woodwell describe ancient fluid flow in the thrust belt flanking the Western Canadian Basin. They show how isotopic data can be used to help identify ancient flow systems. In Western Canada they identify ancient flow systems resulting from dewatering of thrust sheets with major flow in basal aquifer systems. In another example from the Southern Pyrenees they show that aquifer flow was largely confined to the crystalline basement of the foreland, with shear zones acting as important conduits for fluid flow.

The third part of the volume covers fluid flow in United Kingdom groundwater basins. Downing, Edmunds and Gale define seven groundwater provinces in the United Kingdom. They use geological, hydrochemical and heat flow data to interpret the patterns of regional