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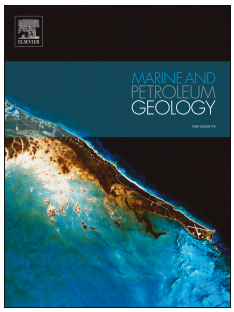

An efficient approach for characterizing basin-scale hydrodynamics

Amandeep Singh, Dan Palombi, Nevenka Nakevska, Gavin Jensen, Ben Rostron

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An efficient approach for characterizing basin-scale hydrodynamics

Amandeep Singh[a,*], Dan Palombi[a], Nevenka Nakevska[a], Gavin Jensen[b], Ben Rostron[c]

[a]*Alberta Energy Regulator/Alberta Geological Survey,4999 98 Avenue Edmonton, Alberta*
[b]*Saskatchewan Geological Survey, Saskatchewan Ministry of the Economy, Regina,Saskatchewan*
[c]*Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta*

Abstract

As the upstream oil and gas sector continues to use more groundwater resources for their operations, a comprehensive understanding of formation fluids at the sedimentary basin scale is required to inventory and manage available groundwater resources. Basin-scale fluid flow is often simplified to only assess pre-development groundwater conditions without understanding how large-scale hydrocarbon development might be changing regional flow patterns. This study focuses on two aspects of hydrogeological mapping for characterizing basin-scale hydrodynamics: (1) assessing the influence of hydrocarbon production and injection on pressure measurements used to map hydraulic heads and infer groundwater conditions; and (2) determining the effects of variable density groundwater on understanding the magnitude and direction of flow primarily in saline formation water aquifers. Drillstem Tests (DST's) are transient pressure tests that are used to infer regional groundwater flow, but they can be strongly affected when the sample location is located within the vicinity of a hydrocarbon production or injection well. To identify production and injection influences this study implements a Cumulative Interference Index (CII) methodology. This implementation can be used to map pre-development groundwater flow conditions and evaluate regional changes or effects due to historical oil and gas activity. Density effects are often neglected and can have considerable effect on groundwater flow in cases where aquifers contain dense brines, are inclined and sloping, or possess weaker hydraulic gradients than the buoyancy force potential. This study implements a vectorial analysis to identify flow directions in regions where density driven flow is important and can change the inferred magnitude and direction of flow. Two case studies are presented to demonstrate the effectiveness of these methodologies at evaluating basin-scale hydrodynamics.

Keywords: Groundwater Mapping, Production Induced Drawdown, Production and Injection Influences, Drillstem Tests, Variable Density, Hydrodynamics

1. Introduction

The importance of groundwater resources in many sedimentary basins is ever increasing with the onset and expansion of water-intensive hydrocarbon production technologies e.g. Steam Assisted Gravity Drainage, hydraulic

*Corresponding author
Email address: amandeep.singh@aer.ca (Amandeep Singh)