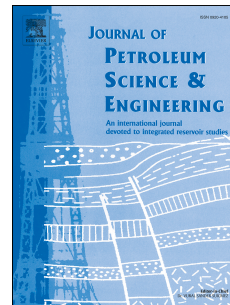


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An innovative nitrogen injection assisted in-situ conversion process for oil shale recovery: Mechanism and reservoir simulation study

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1 **An innovative nitrogen injection assisted in-situ conversion process for oil shale**
2 **recovery: mechanism and reservoir simulation study**

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7 **Abstract:** In-situ conversion process (ICP) can be an effective technique for the
8 development of oil shale and ultra heavy oils, in which kerogen or heavy components
9 will be cracked into light oils and gases via underground heating and pyrolysis, and
10 the retorted oil can be recovered via conventional extraction techniques. Heating of
11 targeted formation can be conducted using electrical heaters installed in vertical or
12 horizontal wells, while a slow heating rate and lack of driving energy for oil
13 production are the main issues of the conventional in-situ conversion process. In this
14 study, an innovative nitrogen injection assisted in-situ conversion process (NAICP)
15 was proposed to increase formation heating rate and improve oil production from oil
16 shale. Reaction models of kerogen pyrolysis at elevated temperature were established,
17 along with models for the evolution of porosity and permeability of oil shale
18 formation during the pyrolysis process. The performance of nitrogen injection on the
19 effectiveness of the ICP was then investigated through reservoir numerical simulation.
20 The simulation results show that additional nitrogen injection can improve the heating
21 rate of the oil shale formation, enhance oil production and energy efficiency in
22 comparison with the conventional ICPs, which can be attributed to enhanced heat
23 convection, pressurization effect and gas driving mechanism. Nitrogen injection
24 assisted in-situ conversion process can be a promising technique for the exploitation
25 of oil shale.

26 **Keywords:** In-situ conversion process; Nitrogen injection; Oil shale; Reservoir
27 numerical simulation; Kerogen pyrolysis

28 **1 Introduction**

29 Oil shale has been considered as a promising substitute to conventional oils due
30 to its large reserves and wide distribution (Lee et al., 2015; Kang, 2008; Wang, 2014).

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