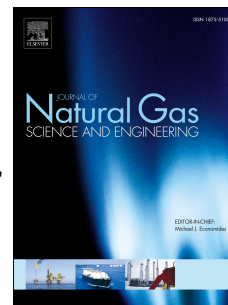


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Analyzing wellbore stability in chemically-active anisotropic formations under thermal, hydraulic, mechanical and chemical loadings

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1 **Title:** Analyzing Wellbore Stability in Chemically-Active Anisotropic Formations under
2 Thermal, Hydraulic, Mechanical and Chemical Loadings

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6 **Keywords:** anisotropy; porochemothermoelasticity; THMC; thermo-chemo-hydro-
7 mechanical; wellbore stability; shale

8 **Abstract**

9 Several factors influence the stress state in subsurface rocks. In addition to pore pressure
10 and far-field in-situ stresses, thermal and chemical gradients have substantial bearings on the
11 in-situ stress state during and after drilling operations. Drilling inclined boreholes through
12 laminated formations such as shaley sands presents several challenges. Due to their laminated
13 nature, shales demonstrate high degree of elastic anisotropy, and are often chemically-
14 reactive to drilling fluid. The majority of models utilized in the industry assume a
15 homogeneous isotropic elastic static model that fails to give an accurate depiction of the
16 observed borehole failure. In this work, governing equations for anisotropic
17 porochemothermoelasticity are developed to simulate the drilling of an inclined borehole
18 problem in a transversely isotropic rock. Using the developed constitutive and transport
19 equations, a finite element method based numerical model is constructed to estimate the pore
20 pressure, temperature, solute concentration and stress distribution. Nonlinear conductive-
21 convective heat transfer and diffusive-advective solute transfer models are considered in this
22 work to address both high and low permeability formations. Finally, the model is used to
23 assess time-dependent wellbore stability during and after drilling. The novel pseudo-3D
24 analysis developed in this work is advantageous for real-time operations due to its
25 computational speed and stability.

26

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