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Mudcake growth: Model and implications

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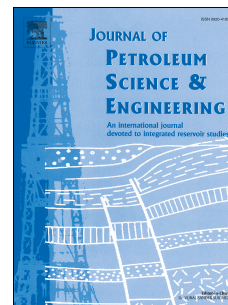
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1 **MUDCAKE GROWTH: MODEL AND IMPLICATIONS**2 Q. Liu<sup>1</sup> and J.C. Santamarina<sup>2</sup>3 **Affiliations**4 (1) Qi Liu (communicating author)  
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14 **Abstract:** Oil and gas account for 60% of the world's energy consumption. Drilling muds that  
15 are used to advance oil and gas wells must be engineered to avoid wellbore integrity problems  
16 associated with mud cake formation, to favor cake erosion during cementing, and to prevent  
17 partial differential sticking. We developed a robust mud cake growth model for water-based mud  
18 based on wide stress-range constitutive equations within a Lagrangian reference system to avoid  
19 non-natural moving boundary solutions. The comprehensive mud cake growth model readily  
20 accommodates environmental factors (e.g., temperature, pH, and ionic concentration) and  
21 defines the yield stress distribution for displacement-erosion analyses. Results show that the mud  
22 cake thickness is more sensitive to time than to filtration pressure, therefore, time controls the  
23 non-uniform distribution of mudcake thickness during drilling. Long filtration time, high  
24 permeability, high salinity, high in-situ temperature and low viscosity exacerbate fluid loss and  
25 give rise to thick filter cakes. The analysis of residual cake thickness during cement displacement  
26 must take into account the effective stress dependent mudcake formation and the time-dependent  
27 mud thixotropy. Thixotropy dominates the mud yield stress at high void ratios, e.g.  $e > 20$ . The  
28 offsetting force that causes differential pressure sticking increases sub-linearly as a power  
29 function of the still-time.

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