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A further evaluation of mud cooling technology for gas hydrate exploration

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Mud cooling is a key technology applied in gas hydrate drilling operation to keep the hydrate-bearing sediments below hydrate equilibrium temperature. GHMCS [1] (Gas Hydrate Mud Cooling System), which is a set of special equipment to cool mud, has been designed, constructed and operated in Qinghai-Tibet Plateau and Mohe Basin in China for the exploration of gas hydrate. The gas hydrate bearing cores were obtained with its application in permafrost regions in China and then a steam mining system [2] for natural gas hydrates (SMSGH) was used for the exploitation of natural gas hydrates in the regions. Field test showed the temperature of the mud in the well could be kept lower than that of the hydrate equilibrium while drilling.

Our further study shows that the hydrate dissociation in wellbore can also be induced by gas diffusion from pore water to drilling fluid even if the temperature (and the pressure if necessary) of the drilling fluid is well controlled to keep the conditions of hydrate-bearing sediments along the hydrate equilibrium boundary. The dissociation of gas hydrate was modelled based on Fick's first law. It was found that the dissociation rate was mainly dependent on the temperature of the sediments. The locations of dissociation front of CH₄ hydrate in well wall were calculated as a function of time. It was found that hydrate dissociation induced by gas diffusion does not pose a significant wellbore stability risk in a cold drilling through hydrate-bearing sediments. Temperature-controlled technologies like GHMCS can work well in keeping wellbore stable during drilling through hydrate-bearing sediments.

References:

[1] Zhao J (2010) Energy Explor Exploit 28(5): 351-364

[2] Sun Y (2012) Energy Fuels 26(12): 7280-7287

