PRODUCTION STRATEGY FOR MARINE HYDRATE RESERVOIRS

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Abstract
Large deposits of gas hydrates have been found in shallow marine sediments along the coastlines of many countries. A recent discovery was made of a hydrate reservoir with an underlying aquifer in block AC 818 of the Gulf of Mexico. In the present work, we assess the production of natural gas from a model of block AC 818 (an unconfined reservoir with limited aquifer) using a thermal, compositional, 3-D simulator. Three components (water, methane, and hydrate) and four phases (gas, aqueous-phase, hydrate and ice) are considered. For horizontal reservoirs, if the aquifer attached is large and at the under-burden, then depressurization is ineffective. Warm water injection with horizontal wells is better than vertical wells as they increase the area of warm water reach. If the aquifer is connected to just one side of the reservoir then the reservoir can be depressurized, but the warm water injection is necessary for significant production. Aquifer helps to mobilize the hot water injected. The distance between the injection and production well should be increased so that water channels that bypass the hydrate bearing sediments does not form. For dipping reservoirs, the production well should be at the top and the injection well should be on the contact of hydrate and water zones for optimum production.

Keywords: methane hydrates, warm water flooding

INTRODUCTION
Milkov and Sassen (2001) have documented the presence of natural gas hydrate systems in the Gulf of Mexico. Boswell et al. (2009) have reported a recent discovery of a class 2 unconfined hydrate reservoir in the Gulf of Mexico block AC 818. The hydrate is found at a high saturation pore-filling state in the Frio sand (containing fine grained volcanoclastic sand), about 460m below the seafloor. The hydrate zone is confined by impermeable layers at the top and bottom, but it is considered to be connected to an aquifer on one side. In the present work, we study different production strategies for this reservoir to optimize natural gas production. The fluid permeability is low in such reservoirs at the beginning due to the presence of hydrates; thus horizontal wells are considered along with warm water injection. The next section summarizes the reservoir description. The results are discussed in the following section.

RESERVOIR DESCRIPTION
The block AC 818 is modeled as a 1200m long and 500m wide reservoir, as shown in Figure 1.

Figure 1: Hydrate reservoir description
It is assumed to have an 18m thick hydrate layer which is exposed to an infinite aquifer at one side. In the hydrate zone, the hydrate saturation is assumed to be 0.75 and the water saturation is 0.25. At the bottom of the reservoir, the initial pressure is 31.4MPa and the initial temperature is 294.9K. Both initial pressure and temperature vary with the depth in the reservoir according to