ABSTRACT

A model of potential distribution and thickness of gas hydrates in deep-water areas of the northern Gulf of Mexico was developed using data from public sources and the literature. First, stability curves for Structure Type I and Type II hydrates were generated using commercial software and their reliability was checked with reported experimental data and gas compositions and gravities. Next, mudline and subsurface temperatures and pressures in 111 fields and 44 wells in the deep-water Gulf were calculated, to establish the minimum and maximum conditions at which hydrates would be stable. Intersecting the pressure-temperature trend lines from the field calculations with the Type I and Type II stability curves and using the geothermal and pressure gradients allowed an estimate of subsurface pressures and depths at which the two types of hydrates could exist in each field or well. Using the modeling results the potential extent and thickness of each type of hydrate were mapped. The resulting maps together with geophysical data can be of practical use for assessing the hydrate resource and for evaluating possible geohazards to drilling and production operations.

INTRODUCTION

Deep-water areas of the northern Gulf of Mexico (GOM) are a prime location for formation of gas hydrates of Structure Type I, in which gas is formed by bacteriological decomposition of organic matter, and Structure Type II, in which gas is formed thermogenically in deeper horizons and migrates up through faults or gas chimneys (Brooks et al., 1986). A third type of hydrate, called Structure Type H (Sloan, 1998), also thermogenic and with a more complex structure accommodating molecules of isopentane, is found less commonly on the slope of the GOM (Sassen et al., 1999b). The Gulf’s favorable setting for gas hydrate formation is due in large part to deltaic sedimentation, which supplies abundant organic material, to the presence of salt with its associated diapirism and faulting, which provide migration pathways, and to subsurface pressures, which contribute to the generation of shale diapirs, mud volcanoes and gas chimneys.

A satisfactory assessment of the resource potential of gas hydrates in the northern GOM, as well as the delineation and avoidance of hazards to drilling and production activities caused by possible dissociation of near-surface hydrates and consequent mass movement of sediments, relies heavily on determination of areal distribution and thickness of the gas hydrate stability zone (GHSZ), defined as the range of depths in which hydrates are stable.

The complexity of defining the GHSZ in the GOM is compounded by the fact that Type I hydrates are composed principally of methane (Kvenvolden, 1995) while Type II hydrates contain appreciable amounts of heavier hydrocarbons such as ethane and propane, and minor quantities of butane and pentane (Milkov and Sassen, 2001). Phase stability conditions, which mark the transition from water and gas to hydrates, are different therefore for Types I and II, as are their GHSZ’s. Presence of higher molecular weight hydrocarbons in Type II hy-