ABSTRACT

Exploration activity on the Arctic continental shelves areas is expected to gain momentum in the next decade as oil companies resume exploration activities in the US and Canadian Beaufort Seas and move into new areas in the nearshore Russian Arctic. These areas are often underlain by relict, degrading permafrost and in situ hydrates. Hydrate degradation results in an increase in pore pressure due to the “Self Preservation” effect. This paper presents a tool for predicting upper bound pore pressure gradients arising from melting hydrates. The model was successfully tested against measured pore pressures at the Nerlerk M-98 well (Weaver and Stewart, 1981) in the Canadian Beaufort Sea.

KEY WORDS: Permafrost; in situ hydrate; Arctic; pore pressure.

INTRODUCTION

The oil industry has drilled many exploration wells on the Arctic continental shelves, particularly in the Beaufort Sea. There are plans to drill many more wells in similar environments in the Pechora, Kara Laptev, East Siberian and Chukchi Seas. These continental shelves were subaerially exposed during the one or more of the Pleistocene glaciations of the last 100k years. As a result, permafrost formed in the upper sediments (see Fig. 1) and to a lesser degree, depending on availability of local pore gases, in situ hydrate also developed on the continental shelves in association with the permafrost (Vigdorchik, 1980; Weaver and Stewart, 1981; Judge, 1986). During the Holocene these areas were submerged by seawater and today the permafrost that remains is relict in nature and undergoing gradual melting, progressing from the base upwards in response to the earth’s geothermal gradient. The geothermal gradient is also responsible for slow degradation of the in situ hydrates on the shelves.

Degradation of permafrost and hydrate occurs at both upper and lower permafrost and hydrate boundaries as well as in fine grained soils (silts and clays) within the permafrost and hydrate zone.