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GAS HYDRATE STABILITY ZONE ASSOCIATED WITH SUBSEA PERMAFROST THAWING IN THE CANADIAN BEAUFORT SEA INFERRED FROM MARINE HEAT FLOW MEASUREMENTS

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Marine heat flow measurements using a 5 m-long Ewing-type heat probe was made at the Canadian Beaufort Sea margin during the 2013 and 2014 R/V Araon Arctic cruises as the Korea-Canada-U.S. cooperative research project. Beaufort Sea margin is one of the most appropriate location to study associative geological processes of permafrost degradation and gas hydrate dissociation because the region has experienced long-term warming since the Last Glacial Maximum. Three different thermal regimes were selected to delineate spatial distribution of the current gas hydrate stability zone: a transect line in the Eastern slope of Mackenzie Trough across permafrost limit where seems to locate along 100 meter water depth based on observation deep boreholes in the permafrost region, shallow-water mud volcanos outside of the permafrost region, and deep-water reference sites also outside of the permafrost region. At all stations, geothermal gradients were estimated from a near-linear trend of temperature readings at depths, indicating that subsurficial fluid circulation is negligible for at least topmost sediment interval. With respect to geothermal gradients from reference sites, much higher geothermal gradients were observed from mud volcanos where intermittent expulsion of warm methane-rich fluids were seen and/or gas hydrate was recovered by a gravity core. On the contrary, lower and even negative gradients are coincident with the permafrost region. Findings where both linear geothermal gradients from all stations and correlatable heat flow results between from the reference sites and from the deep boreholes may support to assume steady-state heat flow through the deep to shallow sedimentary column over the sea margin. Still we need more surficial marine heat flow measurements over the sea margin to draw firm conclusions but at this stage there is possibility that the previous estimate of the gas hydrate stability zone based only on deep borehole heat flow results is also applicable to non-permafrost region off the shelf except for mud volcanos where the gas hydrate stability zone significantly shoals due to high geothermal gradient.