Integrated Analysis of Permafrost Features, Gas Seeps, Gas Hydrate and Geologic Structures in Prudhoe Bay, Alaska

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Methane hydrate (crystalline solid in which water molecules form an ice-like framework that trap gas molecules) is an attractive energy resource because of its high energy density of any other naturally occurring form of methane, as well as its relatively close proximity to the Earth's surface and seafloor (Pellenbarg 2000). Hydrate distribution on the Alaska North Slope (ANS), Prudhoe Bay region, is thought to be controlled by the availability of migrated thermogenic hydrocarbon gas from depth, via the Eileen and other fault zones. Migration along the Eileen Fault Zone (8,000 ft below the surface) intersects the pressure/temperature stability field of gas hydrates which would allow excess gases (mainly methane) from gas hydrate formation continue migrating toward the surface. A gas charged pingo, with comparable gas composition to gas hydrates found at depth, is evidence that some of the trace methane gases at depth continue migrating to the surface (Collett pers. comm.). Using GIS techniques, geologic structures, geophysical data and geochemical samples of shallow permafrost have been integrated with processed remote sensing images of pingos. Initial results show slight pingo alignment to the underlying faults. Analysis of seismic data by USGS in Milne Point, northwest of Prudhoe, show a gas chimney correlating well with a lake and shallow faults in the area. Milne data is a base for understanding the interaction of faults, gas hydrates and the additional geochemical data of the Prudhoe area which will be used for additional analysis. If such an association exists, the migrating gases may be an indicator for subsurface gas hydrate formation, suggesting that permafrost features would become a possible indicator for gas hydrates.