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Cryopegs as destabilization factor of intra-permafrost gas hydrates

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A characteristic feature of permafrost soils in the Arctic is widespread intra-permafrost unfrozen brine lenses - cryopegs. They are often found in permafrost horizons in the north part of Western Siberia, in particular, on the Yamal Peninsula. Cryopegs depths in permafrost zone can be tens and hundreds of meters from the top of frozen strata. The chemical composition of natural cryopegs is close to sea waters, but is characterized by high mineralization. They have a sodium-chloride primary composition with a minor amount of sulphate. Mineralization of cryopegs brine is often hundreds of grams per liter, and the temperature is around -6…-8 °C. The formation of cryopegs in permafrost is associated with processes of long-term freezing of sediments and cryogenic concentration of salts and salt solutions in local areas. The cryopegs' formation can take place in the course of permafrost evolution at the sea transgressions and regressions during freezing of saline sea sediments. Very important feature of cryopegs in permafrost is their transformation in the process of changing temperature and pressure conditions. As a result, the salinity and chemical composition are changed and in addition the cryopegs' location can be changed during their migration.

The cryopegs migration violates the thermodynamic conditions of existence intra-permafrost gas hydrate formations, especially the relic gas hydrates deposits, which are situated in the shallow permafrost up to 100 meters depth in a metastable state [1]. The interaction cryopegs with gas hydrates accumulations can cause decomposition of intra-permafrost hydrates. Moreover, the increasing of salt and unfrozen water content in sedimentary rocks sharply reduce the efficiency of gas hydrates self-preservation in frozen soils. It is confirmed by experimental investigations of interaction of frozen gas hydrate bearing sediments with salt solutions [2]. So, horizons with elevated pressure can appear, as a result of gas hydrate decomposition in the permafrost deposits during cryopegs' migration. From these horizons will be active methane emissions, including gas explosion in coastal areas and on the Arctic shelf. This mechanism of methane emissions is a significant geological hazard during the development of oil and gas fields in the Arctic.

References.

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