GC31B-1181: Seasonal Variations of Stable Isotope Composition of River Flow in Permafrost Regions of Yenisei and Kolyma Rivers (Russia)

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Permafrost plays an important role in the hydrology of the northern regions. To investigate the role of climate change on permafrost degradation and hydrology, extensive field work was conducted in a series of small watersheds located in the discontinuous permafrost zone of the lower Yenisei River near Igarka, and in the continuous permafrost zone of the Kolyma River near Cherskii. Climatic, hydrologic and permafrost characteristics were monitored at both locations over a three year period and extended using historical data. Stable isotope composition of rain, snow, water from lakes and rivers, and various types of ground ice was used to determine various inputs and runoff pathways to a river flow in several watersheds.

The study found that water flow of smaller creeks follows precipitation closely, while flow of larger rivers is affected by evaporation effects related to water storage in thermokarst lakes. Ground ice of the epigenetic permafrost near Igarka has a similar isotopic composition as that of Holocene permafrost and contemporary late summer precipitation. Ground ice of the syngenetic Pleistocene permafrost (Ice Complex) near Cherskii has a significantly lighter isotopic composition than pore water of the active and transient layers.

Increases in air temperature resulted in thickening of the active-layer and melting of ice that reach the transient layer in continuous permafrost. In areas where the transient layer severely reduced as a result of intense forest fires and other landscape disturbances, ground ice from permafrost is also involved in hydrological processes. Progressive decrease in the seasonal freezing layer thickness and a lower permafrost table promoted more groundwater storage and redistribution of summer precipitation towards winter baseflow in discontinuous permafrost region. The major contribution of permafrost at both locations is not through the melting of ground ice, but through changes in soil properties affecting the water flow.