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Application of Cl-36/Cl ratio for ground ice chronometry

Alexander Blinov (1), Juerg Beer (2), David Gilichinsky (3), and Lutz Schirrmeister (4)

(1) Saint Petersburg State Polytechnic University, Saint Petersburg 195251, Russia, blinov@phtf.stu.neva.ru, (2) Swiss Federal Institute of Aquatic Science and Technology, CH-8600 Duebendorf, Switzerland, beer@eawag.ch, (3) Institute of Physicochemical and Biological Problems in Soil Science, Russian Academy of Sciences, Pushchino 142290, Russia, gilichin@online.stack.net, (4) Alfred Wegener Institute for Polar and Marine Research, Telegrafenberg A43, D-14473 Potsdam, Germany, Lutz.Schirrmeister@awi.de

Permafrost is a unique natural system that contains several proxy records such as fossil faunal, floral, and microbial communities and greenhouse gases. Its potential as a palaeoenvironmental archive makes the development of an accurate permafrost chronology an essential objective of the data interpreting. This problem has not been solved yet, especially for early Pleistocene to late Pleistocene deposits. Recently we have examined the ratio of the cosmogenic nuclide chlorine-36 (^{36}Cl) to chloride (Cl^-) in ground ice (ice wedges and segregation ice) as a measure of the formation age of ground ice. The ^{36}Cl/Cl was measured in 32 ground ice samples of Pleistocene permafrost horizons of the northeastern Arctic. Though the experimental results showed two orders of magnitude variability, we have developed several local permafrost chronometry scales. General concordance of the modeled ages with geological expectations and other chronological estimates supports the potential power of the proposed dating method. However, the large observed change in ^{36}Cl/Cl ratios from higher to lower values during the transition from Last Glacial Maximum to Holocene climatic conditions remains unexplained. The interpretation of the measurements is made more complex by individual differences in chemical composition, geographical location and geological history of the samples. Further ^{36}Cl/Cl serial measurements that are needed to refine this dating method into a practical tool with a clear protocol will be discussed.