Seasonal variations in the sources and formation of Fe-bearing particles in the Lena River basin; evidence from iron isotopes.

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Large rivers are important suppliers of Fe-bearing particles to the Arctic Ocean. These particles are the net result of chemical and physical weathering in the catchment, but their formation remains poorly understood. This study reports the Fe isotope composition of particles (>0.22 μm, P[Fe]) in the Lena River, NE Russia, sampled during different flow regimes: winter-base flow (October 2012 to March 2013), spring-flood (May 2015), post-spring flood period (June 2013) and summer baseflow (July 2012, September 2012).

The P[Fe] concentrations are lowest (0.3 mg/L) during winter baseflow, when the river is ice-covered and the ground is frozen. $\delta^{56}Fe_P$ values, lower than crustal values, indicate redox processing and particle formation on the poorly oxygenated river bed. During ice breakup and spring discharge in early May, the P[Fe] increases to 5 mg/L and the particles are dominated by poorly reactive clays. The $\delta^{56}Fe_P$ values, similar to continental crust, result from the physical weathering of the upper soil surface. The shift in $\delta^{56}Fe_P$, from negative values during winter to crustal values in the spring, marks a switch between ice-dominated and fluvially dominated systems. After the spring-flood in late May-June, the P[Fe] decreases to 0.5 mg/L. The $\delta^{56}Fe_P$ values are lower than crustal composition and the particles are dominated by nanoparticulate ferrihydrite, resulting from renewed chemical weathering and the oxidation of reduced Fe^{2+} in the active layer.

Fe-bearing particles in the Lena River show seasonal variations in Fe isotope compositions attributed to chemical weathering in the winter (ice-dominated system), physical weathering during spring (ice break-up) and renewed chemical weathering in the summer (fluvially-dominated system).