Weathering signals in Lake Baikal and its tributaries

Tim Jesper Suhrhoff¹, Jörg Rickli¹, Marcus Christl², Elena G. Vologina³, Eugene V. Sklyarov³, and Derek Vance¹

¹Institute of Geochemistry and Petrology, ETH Zurich, Zurich, Switzerland (jesper.suhrhoff@erdw.ethz.ch)
²Laboratory of Ion Beam Physics, ETH Zurich, Zurich, Switzerland
³Institute of the Earth's Crust, Siberian Branch of the RAS, Irkutsk, Russia

Lake Baikal is the world’s largest (by volume), deepest, and oldest (30-40 Ma) lake. In the catchment, climate varies from arid to semi-arid to arctic-boreal with extreme seasonal and spatial differences in temperature and precipitation¹. Elevation ranges from 450-3000m, resulting in a large range of geomorphic settings. The catchment has also been affected by periodic Quaternary glaciations². Although the geology of the catchment is diverse and contains igneous, metamorphic and sedimentary rocks of Archean to Cenozoic ages, the most prominent lithologies are granitoids and gneisses with only minor carbonate contributions¹. Continuous lake sediment cores are available recording the Quaternary glacial cycles, and even dating back into the Miocene. Lake Baikal is therefore a promising site to study variation of silicate rock weathering in both space and time.

In preparation for paleo-studies, we constrain the present-day budget of the lake with respect to radiogenic weathering tracers (Nd, Pb, and Sr) and meteoric ¹⁰Be/⁹Be isotope ratios. Nd, Sr, Pb, and their radiogenic isotope systems show different behaviors in Lake Baikal. Sr concentrations in the lake are similar to riverine inputs, reflecting conservative behavior of Sr and resulting in a uniform isotopic composition that is slightly higher than the average of riverine inputs (possibly due to loess inputs³). Pb concentrations are higher in the lake than in the major tributaries. The isotopic composition of both lake and rivers point to anthropogenic sources of Pb. In contrast, Nd concentrations in the lake are much lower than in the rivers. Nd isotopic compositions are similar in the central and southern basin but less radiogenic in the northern basin. Both ¹⁰Be and ⁹Be concentrations are much lower in Lake Baikal than in its tributaries, possibly indicating removal due to pH induced changes in dissolved-particulate partitioning⁴. This may also explain the contrast in Nd concentrations between rivers and the lake. ¹⁰Be/⁹Be ratios in the lake are slightly elevated compared to riverine inputs, suggesting a potential role for dust and/or precipitation as a source for ¹⁰Be⁵. We will also compare silicate weathering fluxes derived from meteoric Be isotope ratios with those derived from major element concentrations and riverine discharges.

Taken together, these results highlight the importance of assessing modern processes at sediment core locations prior to interpreting variation in the past, and the benefits of using a suite of weathering proxies rather than relying on one: while Sr isotopes at any core location record changes to the chemistry of the whole lake (and the processes in its catchment), Be and Nd
isotopes are likely biased to the inputs of the nearest rivers.