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Investigating paleo-silicate weathering at Lake Baikal using radiogenic Sr, Nd, Pb, and meteoric Be isotopes

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Lake Baikal, the world's oldest and largest lake, has extensive and continuous sedimentary records dating back to the Miocene epoch[1]. Weathering fluxes in the catchment are representative of global processes in terms of the relative contribution of silicate weathering to dissolved fluxes[2]. The isotope composition of lake water is recorded in sediments through the precipitation of authigenic FeMn-(oxy)hydroxide phases[2]. Hence, Lake Baikal is a promising site to study paleo-weathering conditions. Focusing on the last 30 kyr, we apply radiogenic Sr, Nd, Pb, and meteoric Be isotopes to the sediment record of Lake Baikal to constrain past changes in in weathering sources, processes, and rates in the continental interior of Asia.

All studied isotope systems indicate secular variability in detrital silicate fractions and paleo-water compositions. Authigenic Nd (~14.5 ε_{Nd} units) and $^{208}Pb/^{204}Pb$ (by ~1.3 $^{208}Pb/^{204}Pb$) show large secular variability, with more radiogenic Nd and less radiogenic $^{208}Pb/^{204}Pb$ during warm periods. Variability in authigenic Sr is smaller (~0.015 $^{87}Sr/^{86}Sr$). Changes in weathering sources, weathering congruency, and weathering rates all potentially contribute to the observed variation. Some of the variability requires distinct weathering sources between cold and warm periods. Isotope mixing models indicate a lower contribution of the Selenga River, the major tributary to the lake today, to the dissolved budgets of Pb and Nd in the Southern and Central Basins during the last glacial period, concomitant with weathering rates that are ~40% lower than today. Coupled Be and Nd isotope systematics reveal that the post-glacial increase in weathering rates was caused by increased weathering throughout the catchment of the Southern and Central Basins, and cannot only be attributed to changes in weathering source. This is different at a second more northerly sediment site, where the observed variation in meteoric Be (between previous glacial and interglacial maxima) is dominated by changes in solute source region, highlighting the impact of changes in weathering sources on Be-based estimates of weathering rates in lake settings.

1. Kashiwaya *et al.* (2001), *Nature* 410, 71–74.
2. Suhrhoff *et al*. (2022), *GCA* 321, 133–154.