Intense soil erosion and enhanced chemical weathering in the aftermath of Snowball earth

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Cap carbonates above the Neoproterozoic glacial deposits contain geochemical information ascribed to extreme environmental conditions in the snowball Earth aftermath. It was suggested that post-snowball climate dominated by extremely high CO_2 partial pressures, resulting in extreme temperatures and associated high continental weathering rates. Lithium is almost exclusive hosted by silicates, and its isotopic fractionation in rivers is controlled by the intensity of silicate weathering, making Li isotopic compositions of river, or ocean, are promising tracer of silicate weathering and atmospheric CO_2 consumptions. Determination of Li isotopic compositions for two well-characterized sections of the Doushantuo Group, namely Chenjiayuanzi and Jiulongwan, from Southern China, indicates dynamic perturbations for marine chemistry and Li inventory. The Chenjiayuanzi section starts with a ~2m-thick cap dolostones directly overlying the Nantuo glacial diamictite, followed by a 7m-thick black shale intercalated with thin muddy dolostones and a 50m-thick dolostone. The Jiulongwan sections are two parallel profiles consist of only cap dolostones, with height of 1.7m and 3.2m, respectively. Lithium isotopic compositions of cap dolostones increasing sharply by ~10-20‰ from bottom to top in all the analyzed sections, and then decreasing also rapidly by ~10‰ in the immediately followed dolostones in Chenjiayuanzi section. The bottom of the cap carbonates recorded very low δ^7Li values of ~ -6‰ and 0‰ for the two sections. The non-actualistic low δ^7Li values of the bottom cap dolostones suggest a rapid decline of seawater δ^7Li values response to the fast melting down of continental ice sheet and consequent flood soil erosions. The sharply increased δ^7Li values in the cap dolostones suggests significant increase in the intensity of silicate weathering after the soil erosion and a rapid change in seawater Li inventory during the deglaciation. The drawdown of δ^7Li values in the afterward dolostones either reflects a fast mixing of melted freshwater with deep salty seawater, or a dynamic balancing of the overshoot riverine Li input of the seawater Li inventory. In any event, the Li isotopic data suggest a dynamic evolution and gradual stabilization of seawater chemistry after deglaciation.