Flow path dependent weathering rate calculation methods for streams and watersheds.

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Abstract. The calculation of weathering rates in watersheds is important to characterizing geochemical contribution to stream solute loads. Weathering rate and stream solute flux data aid inter-basin comparisons. There are generally three types of weathering rate calculations made: 1) land surface normalized weathered solute flux (LWF), 2) constant rate weathering contribution (CRC), and 3) dynamic hydrologic exchange weathering rate modeling (DHE), which takes into account hyporheic exchange processes. LWF rate values are normalized to watershed land surface areas, but CRC and DHE rates are normalized to weathering mineral surface area. These three calculation methods were applied to increasing dissolved Si data collected from Von Guerard Stream in the Dry Valleys of Antarctica. The glacial meltwater streams of the Dry Valleys flow for 6 to 10 weeks per year during the height of the austral summer. None of the Dry Valley streams are connected to a groundwater system, but most of the streams have streambeds composed of very porous alluvium, allowing for rapid hyporheic exchange. LWF calculations from three contrasting flow seasons (annual flows of 160×10^3 m^3, 140×10^3 m^3, and 7.2×10^3 m^3) suggest that during high flow austral summer seasons, there is a greater transport of dissolved Si from the stream (130×10^3 mol Si km^{-2} yr^{-1}, 112×10^3 mol Si km^{-2} yr^{-1}, and 24×10^3 mol Si km^{-2} yr^{-1} respectively). Results also suggest that although CRC and DHE values are similar in magnitude (10^{-15} to 10^{-14} mol Si m^{-2} s^{-1}), DHE calculations are more representative of weathering reactions occurring in streambeds. This work was carried out in a nearly ideal field setting, but similar processes may be occurring in other (temperate) streams and watersheds.

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