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Congruent vs. incongruent silicate weathering as a function of climate hydrochemistry in two subduction-related granitoids.

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The Hakai Critical Zone Observatory is located on the Calvert Islands in the Pacific Coastal Temperate Rain Forest zone with ca. 3400 mm MAP. Local bedrock is granodioritic with organic-rich podzols and histols. The site has been characterized as a "DOC hotspot"[1]. We studied the hydrochemical response for two hydrologic events over > 30 fold variation in Q. C-Q relations for Na, K, Mg, Ca and Si were chemostatic (power law slopes 0±0.08). Si/Al is near 3, and sea salt corrected Na/Si and Ca/Si are near 0.27 and 0.48. $^{87}Sr/^{86}Sr$ data from mineral separates define an isochron with an age of 114.1 ± 2.9 Ma with plagioclase from 0.7038 to 0.7047. Amphiboles are 0.775-0.794; ≥ 96% of dissolved Sr ($^{87}Sr/^{86}Sr \approx 0.70630\pm15$) is derived from plagioclase. Mineral $d^{30}Si$ was near -0.4‰ for amphiboles, -0.2 for plagioclase, -0.05 for quartz. Dissolved $d^{30}Si$ was also chemostatic at 0.47±0.10 (1 s.d.)[2], while Ge/Si was 1.63±0.37 µmol/mol. Major element ratios (Si/Al, Na/Si, Ca/Si) and Ge/Si are consistent with near-congruent weathering of Na, Ca felspar. The water chemistry is consistent with soil chemistry that indicates low CIA and limited clay mineral formation[3]. We propose that high rainfall, short residence time and complexation of Al with DOC contribute to high Si export efficiency and near-congruent dissolution. This is in marked contrast to data from a lithologically but climatically different Southern Sierra CZO that shows strongly incongruent silicate weathering; the difference may in part reflect longer transit times and low DOC influence in the SSCZO. The activity of aluminum appears to play a critical role in the degree of congruency in these granitoid systems and their ability to retain Si in secondary mineral phases.

1. Oliver et al. *Biogeoscience* 2017; 2. Fernandez et al. *JGR Biogeosciences* 2022 ; 3. Nelson et al. *J. Soil Sci*. 2021.