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δ30Si – discharge relationships in small catchments spanning different climates and lithologies

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Chemical weathering of silicate rocks sustains long term solute cycling through water-rock interactions in the terrestrial subsurface that transforms pristine bedrock into the diverse landscapes that characterize the Earth's surface (i.e. the Critical Zone). The drawdown of CO_2 via these weathering reactions serves as a major component in the long term cycling of carbon and is thought to play a key role in the regulation of Earth's climate over geologic timescales. Thus, understanding the silicate weathering feedback is critical for assessing regional and global scale responses to a rapidly changing climate. However, to accurately quantify silicate weathering rates, a better understanding of solute generation and transport in the subsurface is required. Stream solute concentrations and discharge are highly coupled, integrating various reaction pathways and fluid residence times and thus can provide key insight into the hydrogeochemical controls within the critical zone. Strong responses of solute export with "storm" (flood) events characterized by large variations in discharge over a short time, suggests that transient hydrologic processes could exert a predominant control on weathering reactions in the critical zone. To address this, we utilize stable isotopes of Si (designated δ30Si), a highly sensitive silicate weathering tracer, to gain insight into the hydrogeochemical processes taking place under transient hydrological conditions.

Our study focuses on Si isotope analyzes performed on storm events from several small catchments spanning a range of different climates and lithologies as part of an international collaboration between U.S and French Critical Zone Observatory networks to better understand concentration-discharge relationships (SAVI). Our preliminary findings suggest that δ30Si – discharge relationships could provide unique insight into the balance between primary mineral dissolution and secondary mineral precipitation in the weathering zone and, thus, be a powerful complementary tool to frequently used C-Q relationships.