Quantifying weathering rind formation rates by *in situ* measurements of U-series disequilibria with laser ablation (LA) MC-ICPMS

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In order to quantify the important chemical weathering processes for volcanic regions, it is essential to develop and utilize new geochemical tools that can directly measure chemical weathering rates. U-series isotopes have emerged as a useful chronometer to directly constrain the rates of chemical weathering. However, the conventional solution-based MC-ICPMS method involves a long and expensive sample processing procedure that is unable to provide fast sample throughput with large numbers of measurements of U-series analysis. Here, we report in situ measurements of U-series disequilibria with laser ablation (LA)-MC-ICPMS on weathering rinds collected from the tropical volcanic Basse-Terre Island of French Guadeloupe. This study is among the first few studies that aim to directly date chemical weathering processes using in situ measurements of U-series disequilibria in weathering products. We characterized two weathering rinds for U-series isotope compositions and elemental distributions with LA-MC-ICPMS and LA-Q-ICPMS. The in situ measurements of U-series disequilibria were consistent with the previous bulk measurements with the conventional solution MC-ICPMS, but with a larger number of measurements and higher spatial resolution. The new rind formation ages, rates, and parameters for U-series mobility modeled in this study reveal new insights on rind formation such as the impact of micro-fractures on U-series mobility and the comparison of linear vs. power law rind thickness-age relationships. Our study demonstrates a new way to determine weathering rates rapidly and accurately in a large number of rinds collected from multiple watersheds on Basse-Terre.