



The relationship between riverine U-series disequilibria and erosion rates in a basaltic terrain

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U-series isotopes have been measured in the dissolved phase, suspended load and bedload of the main rivers draining basaltic catchments in Iceland. For the dissolved phase, ($^{234}\text{U}/^{238}\text{U}$) and ($^{238}\text{U}/^{230}\text{Th}$) range between 1.08 and 2.2, and 7.4 and 516, respectively. For the suspended load and bedload, ($^{234}\text{U}/^{238}\text{U}$) and ($^{238}\text{U}/^{230}\text{Th}$) range from 0.97 to 1.09 and from 0.93 to 1.05, respectively. Chemical erosion rates, calculated from dissolved major elements, range between 13 and 333 t/km²/yr. Physical erosion rates have also been estimated, from existing data, and range between 21 and 4864 t/km²/yr, with an average of 519 t/km²/yr. U-series disequilibria indicate that weathering in Iceland operates at close to steady-state conditions. A model of continuous weathering indicates a maximum sediment residence time of 10ka, with an average rate of U release into water of $1.6 \cdot 10^{-4} \text{ yr}^{-1}$, which is significant when compared to granitic terrains located at similar latitudes, and to tropical basaltic terrains.

All river waters display ($^{234}\text{U}/^{238}\text{U}$) greater than secular equilibrium, consistent with the effects of alpha-recoil. The same dissolved phase ($^{234}\text{U}/^{238}\text{U}$) exhibit a negative trend with physical erosion rates, explained by the dominant effect of close-to-congruent chemical weathering of hyaloclastite glass in the younger basaltic terrains. Therefore, chemical erosion rate and mineral weathering susceptibility play a major role in determining ^{234}U - ^{238}U disequilibria in basaltic river waters. Comparison of global data for river basins in which weathering was recently strongly limited indicates a negative correlation between silicate weathering rates estimated with major elements and the age of weathering estimated with U-series disequilibria. This strongly suggests a key role of time and soil thickness on the chemical erosion of silicates.