Erosion monitored by riverine sediment Ti-in-quartz, Southern Alps, New Zealand

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Quartz is an abundant mineral in the surface environment, and can have as its source a variety of primary and recycled sources. Recent developments have shown that Ti incorporation into quartz is proportional to crystallization temperature, pressure, and *a* (TiO_2) [1, 2]. We have explored the use of Ti and other trace elements as a fingerprint of the source of quartz sediment in rivers draining the actively uplifting and eroding Southern Alps of New Zealand.

The Haast River drains the western side of the Southern Alps and experiences very high rainfall and erosion rates. The bedrock schist within the catchment exhibits a metamorphic field gradient from chlorite through garnet-oligoclase zone. Quartz in these rocks have Ti concentrations that reflect prograde re-equilibration of detrital grains and crystallization of new quartz in the presence of ilmenite or titanite at appropriate pressures [3].

Sediment was collected along the length of the river system and sieved to obtain grain size fractions. Quartz grains from each size fraction were mounted in epoxy, polished and analyzed by LA-ICP-MS. Raw intensity data were normalized via analyses of the NIST 610 standard to obtain trace element concentrations. Ti-in-quartz temperatures [1, 2] were calculated using estimated pressure and *a* (TiO_2) for the schist bedrock.

Quartz sediment shows changes in trace element concentrations and Ti-temperature with location that reflect the metamorphic grade of the upstream bedrock. Several samples exhibit smooth variations with grain size. Bulk chemistry and mineralogy of bedload sediment have previously shown that physical erosion dominates over chemical weathering processes in the Haast River catchment but were unable to discriminate the bedrock sources [4]. Our results for the Haast River indicate that Ti-in-quartz can be a sensitive provenance tracer for sand; we are currently analyzing quartz sediment from other active river systems and sedimentary basins on the South Island in order to assess the robustness of the method.

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Contribution of groundwater to chemical weathering fluxes in the Pingtung Plain, Taiwan

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The concentration of dissolved cations in flowing groundwaters of the Pingtung Plain gravel, sand and clay aquifer systems in southwest Taiwan demonstrates that underground circulation is a significant source of major and trace ions to the ocean for Taiwan, comparable in magnitude to the weathering flux measured in the surface runoff of the Pingtung Plain in the Kaoping River. The waters from 33 wells at varying depths through a 280 m window in the plain were analysed for cations: Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Sr^{2+}, Fe^{2+} and Ba^{2+}, and anions: Cl^{-}, SO_4^{2-} and NO_3^{-}, and compared with a 5-year bi-weekly time series from the Kaoping River. Multi-year hydrological head data gives the direction of groundwater flow through the drilled depth of the basin, and indicates that pumping of the aquifer for irrigation and fish farming has had a limited effect on the hydrological stability of the system. Hydraulic conductivities for each well location show that hydrological connectivity exists throughout the drilled depth of the basin whereas chemical gradients suggest that stratified flow is in operation. At the proximal position of the groundwater flow paths, the concentration of dissolved species in the groundwater ranges from 1.1 to 3.3 times that of the Kaoping River; increasing to 2.3 to 8.5 times the Kaoping River values at the coastal region of the aquifer, indicating that net chemical weathering occurs along subsurface flow pathways. When compared to the 5-year time series for the Kaoping River, the relative contribution of subsurface fluxes is between 40 to 50% for Na, K, Sr, Ca and around 30% for Mg and SO_4. The results suggest submarine groundwater discharges in the Taiwan strait and that the impacts of groundwater from active margins on global ocean geochemcial budgets need to be much better constrained.