CO_2 evasion in relation to system metabolism and rock weathering on multi-annual time scales. A mass balance approach in rivers of the Australian Victorian Alps

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We examined the CO_2 system, mainly the dissolved inorganic carbon (DIC), partial pressure of CO_2 (pCO_2) and $\delta^{13}C$ values of DIC, DOC and POC in Victorian rivers and estuaries sampled during high discharge (winter 2006) and low discharge (summer 2007) conditions. Together with historical (1978-1990) data, this study provides, for the first time, a full multi-annual coverage of the linkage between CO_2 release via wetland evasion and CO_2 consumption via combined carbonate and aluminosilicate weathering. $\delta^{13}C$ values imply that DIC in the freshwater reaches is mainly derived from baseflow/interflow flushing of respired C3 plant detritus (39% in winter; 66% in summer), carbonate weathering (42% in winter, 12% in summer) and evaporation of atmospheric precipitation (25% in winter; 20% in summer). DIC concentrations in Victorian estuaries are higher than the oceanic value and generally decreased with increasing salinity as a result of tidal freshwater and seawater mixing. In each river the fraction of excess CO_2 that was not accounted for by oxygen depletion was negatively correlated with the runoff and positively correlated with total organic carbon content and temperature. This suggests that long water-soil contact times coupled with high baseflow/interflow flushing of organic carbon and warm water temperatures favor high excess CO_2 concentrations. Victorian rivers evade ~14.6 x 10^6 mol/km^2/yr CO_2 to the atmosphere which is about half the global average and probably due to an arid climate, low wind speed and low heterotrophic activity. Respired CO_2 efflux in Victorian soils is not balanced by combined *in river* photosynthesis, CO_2 evasion, CO_2 advection and rock weathering with ~49% to 94% of CO_2 left unaccounted for. This discrepancy implies that chemical weathering does not significantly neutralize respiration derived H_2CO_3. On a global scale tropical river systems with high water temperatures, thick vegetated soils and therefore high respiration derived H_2CO_3 concentrations should not be directly connected to high carbonate and silicate weathering rates.

Integrating lunar sample data with Lunar Prospector thorium data: Insights into the thermal and magmatic evolution of the Moon

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Much can be learned about the thermal and magmatic evolution of the Moon by integrating two separate, but complementary data sets: 1) thorium (Th) data derived from analyses of lunar samples; and 2) Th data derived from the Lunar Prospector Gamma Ray Spectrometer (LP-GRS). The integration of the LP-GRS geochemical data with sample data provides ground-truth for remotely sensed observations and allows us to extend sample data to regional and global scales.

Specifically, we use Th data to investigate the composition, structure, and thermal budget of the lunar crust and mantle by determining the abundance of Th (and other heat-producing elements) in volcanic lunar lithologies. We have compared Th data from lunar pyroclastic glasses, mare basalts, and compositionally evolved lithologies from the lunar sample suite with Th data derived from large expanses of similar lithologies on the lunar surface. These comparisons have led to the following results: new compositional information about unsampled features on the lunar surface, new information about the heterogeneity of the lunar mantle, development of a new model for silicic volcanism, new estimates for the distribution of heat-producing elements in the lunar mantle, revised Th paritition coefficients for the Moon, and new estimates of the heat-production potential within the lunar mantle.

In summary, our work has shown that the Moon contains a larger abundance of heat-producing elements than previously thought and that heat-producing elements were once globally distributed within the lunar interior (as opposed to concentrated on the nearside of the Moon). In total, the results derived from the integration of sample and remote sensing data have allowed us to place additional constraints on models for the formation and evolution of the Moon.