Modelling the biospheric influence on the weathering rate of silicate rocks in an EMIC

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On geological time scales the main agent for removal of CO_2 from the atmosphere is the formation of carbonate rocks in the oceans. The rate of formation is dependent on the input of products of weathering of silicate rocks from river runoff [1]. Weathering rates depend on climatic conditions such as the strength of the hydrological cycle but also on biospheric processes such as soil genesis, which in turn depend on the climate [2]. These fluxes of the global carbon cycle are usually modelled with global geochemical box models on geological time scales. In order to get spatial scale resolutions of weathering rates a geochemical model can be combined with an Earth System Models of Intermediate Complexity (EMIC) as previously done in [3], by using the EMIC's climatic output as input to the geochemical model. The study clearly illustrates the importance of spatial detail, which is not resolved in box models. In order to model weathering fluxes in a more direct way and quantify the importance of other spatially variable drivers, we develop a soil weathering module in connection with the SIMBA (SIMulation for Biospheric Aspects) vegetation model [4] for implementation into an EMIC. SIMBA simulates spatially explicit vegetation productivity and biomass as a function of temperature and soil moisture. With the soil module we simulate a) biospheric influence on soil water pH values through heterotrophic and root respiration of CO_2 [5] and b) potential soil water cation concentration by dissolution towards chemical equilibrium between soil water and generic silicate rock fragments corresponding to feldspars such as anorthite. The weathering or dissolution of cations from silicate rocks becomes a direct function of rainfall, runoff and soil water pH values and thus both directly and indirectly of biospheric productivity. In this talk we will present model results of spatial variability of pH and cation fluxes within the scope of long term climate variability.

References

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Detecting core-mantle interactions with W

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Whether or not chemical interactions occur between the core and lowermost mantle has been a controversial issue. The unambiguous identification of core-mantle exchange yields major implications for constraining mantle circulation patterns, the timing of inner-core crystallization, conditions at the core-mantle boundary, and the existence of an early enriched reservoir at the base of the mantle. Recently, core-mantle interactions have been inferred on the basis of coupled ^{186}Os-^{187}Os enrichments and elevated Fe/Mn ratios in Hawaiian lavas (Brandon *et al*., *EPSL* 1999; Humayun *et al*., *Sci* 2004). Tungsten (W), however, provides a powerful, dual approach to the detection of core-mantle interactions through the use of both W isotopic signatures and concentration ratios.

We have analyzed a global suite of 86 mantle-derived lavas via LA-ICP-MS. The samples, which are primarily basaltic glasses representative of MORB, arc, and intraplate sources, show little variation in W/Ba (0.00136 ± 83, 2σ). This value, which is concordant with previously published data for continental crust (Newsom *et al*., *GCA* 1996), is taken to represent the ratio of the silicate Earth. Assuming 6600 ± 1320 ng/g Ba in the silicate Earth, the abundance of W in this reservoir is 9.0 ± 5.8 ng/g. Accounting for the 1000 ± 300 ng/g W in the continental crust, the mean W concentration in the modern mantle is 4.1 ± 2.9 ng/g, with MORB and OIB representing more depleted and enriched source regions, respectively. Following mass balance, the core contains 516 ± 116 ng/g W. The relative abundance of W in the core and silicate Earth, coupled with the unique W isotopic signatures of these reservoirs (silicate Earth $\varepsilon W \equiv 0$; core $\varepsilon W \sim -2.1$), demonstrate that no core-mantle interaction is recorded in previously analyzed Hawaiian picrites (Schersten *et al*., *Nat* 2004), assuming a source of undifferentiated mantle.

As the W/Ba ratio of the core exceeds 10^3, minor enrichments in W/Ba in plume-derived magmas provide a sensitive tracer of outer core additions to a deep mantle source. The restricted range of W/Ba in modern-mantle sources indicates that 1 wt% addition of outer core material to a model Hawaiian plume source (with ~9 ng/g W) would result in a detectable increase in W/Ba by > 50%, as compared to an ~ 10% change in Fe/Mn.