Long-term turnover of plant derived sugars in soils below natural forest and plantation in Ethiopia

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Background

Carbohydrates are an important pool in the terrestrial carbon cycle. In order to predict future concentrations of CO_2 in the atmosphere, it is crucial to quantify mean residence times (MRT) of carbon species in soils. Furthermore, it is important to investigate which types of land use are suitable for long-term carbon-storage in soils.

Materials and Methods

In our study, we investigated the MRT of plant derived sugars in tropical soils by compound specific isotope analysis (CSIA). Samples were collected in a natural forest dominated by *Podocarpus falcatus* and in an adjacent 40 year old *Eucalyptus saligna* plantation in southern Ethiopia. Contents of Xylose and Arabinose were analyzed via GC-C-IRMS simultaneously with $\delta^{13}C$ values to one meter depth. [1] The ^{14}C age of Black Carbon was used for the calculation of MRT in a model, implying advection, diffusion and decay. [2] Calibration of the model was conducted by using a shift in $\delta^{13}C$ values as a consequence of a change from C_4 to C_3 vegetation in the study area about 600 years ago.

Results and Discussion

MRT of Xylose and Arabinose were the same in the natural forest and the plantation. MRT was exponentially dependent on depth. 70 percent of the sugars had MRT of less than 20 years. Only 1.3 to 2.0 percent of the Xylose and 5.0 to 5.7 percent of Arabinose reached MRT of more than 1500 years. Nonetheless, the *Eucalyptus* plantation contained 33 to 44 percent less sugars down to one meter depth ($p<0.01$).

Conclusion

The fewer amounts of sugars below *Eucalyptus* should be due to accelerated mineralisation while clear-cutting of the natural forest and reduced litter input after the conversion. Because MRT do not differ between the natural forest and the plantation, the land use with the highest carbon input in the soil should be preferred for carbon-sequestration.

References

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New method (HR-SF-ICP-MS) to measure biosilica production and dissolution in ocean surface waters

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A new method is described for a accurate and simultaneous determinations of the rate of production and dissolution of biosilica in marine surface waters, using isotopic dilution technique. This technique consists to label diatoms sampled from the euphotic layer with ^{30}Si spike in the form of $Si(OH)_4$. The samples are then incubated under *in situ* conditions during a given time (usually 24h). The isotopic dilution of the enriched seawater is used to estimate the dissolution of biosilica and the change in the isotopic composition of silica itself is used to estimate its production. Such sampling method and the calculation model associated are described in Corvaisier *et al.* [2005](1).

In this study we propose to measure the silicon isotopic abundances by a HR-SF-ICP-MS (Element 2) in wet plasma mode instead of TIMS (Finnigan THQ) (1).

In this purpose we apply first an alkaline digestion on biosilica or a preconcentration/subsequent-dissolution using the adapted MAGIC method for the dissolved silicon.

The sample is introduced through a glass concentric nebulizer (100µl/min) and a glass jacketed tracey cyclonic spray chamber. Instrumental mass bias is measured with the standard-sample bracketing technique using standards with the same matrix as the sample to avoid the matrix effects. We correct the blank contribution by subtraction of the average of two blanks bracketing the sample. A complete analyse (including standards and blanks) is performed in only 20 minutes. The repeatability and the internal precision on the silicon isotopic abundances of a 100ppb Si solution of a diluted alkaline digestion and diluted preconcentration are better than 1%, similar to the TIMS [1].

This new method is much faster and easier than when using TIMS(1). Moreover because HR-SF-ICP-MS are now widepsread instruments it will help to expand biosilica production-dissolution data which are currently very scarce (up to 2003, only 56 published profiles). In fine a better constrain of the silicon budget (production vs. dissolution) in the surface ocean will be gained.

Reference

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