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Silicon isotope fractionation between plant parts in banana: In situ vs. in vitro

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Abstract

We recently showed that silicon isotopic fractionation in banana (*Musa acuminata* Colla, cv Grande Naine) was related to phytolith production, and therefore to silica content in plant. The present study focuses on isotopic fractionation between the different plant parts. Silicon isotopic compositions were measured using a Nu plasma multicollector plasma source mass spectrometer (MC–ICP–MS) operating in dry plasma mode. The results are expressed as δ^{29}Si relatively to the NBS28 standard, with an average precision and accuracy of $\pm 0.08‰$ ($\pm 2\sigma$). On mature banana (*Musa acuminata* Colla, cv Grande Naine) from Cameroon, δ^{29}Si ranged from +0.13‰ in the petiole to +0.49‰ in the lamina, yielding to a 0.36‰ change towards heavier isotopic composition in the upper parts of the plant. This strongly accords with results obtained on in vitro banana plantlets cultivated in hydroponics, where the δ^{29}Si increase from pseudostems to lamina is 0.26‰. These preliminary results on in situ banana show a trend of intra-plant fractionation comparable with that of in vitro hydroponics banana plantlets and with previous data obtained on bamboo.

Keywords: Banana; Cameroon; δ^{29}Si; Silicon; Isotopic fractionation; Phytoliths

1. Introduction

Silicon is absorbed by plants as aqueous H_4SiO_4, and precipitates in aerial parts of the plant as biogenic opaline phytoliths. Phytoliths are restored to soils by decomposition of organic debris from plant material. By taking up huge quantities of silica, plants induce a strong biological imprint on silica cycle (Conley, 2002; Derry et al., 2005). The role of higher plants in the biogeochemical cycle of silicon is therefore major (Alexandre et al., 1997), but only a few studies have yet been carried out on silicon isotopic tools to investigate the actual contribution of plants to the silicon continental reservoir (Douthitt, 1982; Ziegler et al., 2000; Ding et al., 2003).

Biomineralization processes are known to fractionate the three stable silicon isotopes (^{28}Si, ^{29}Si, ^{30}Si) with a preferential uptake of light isotopes (De La Rocha et al., 1997; De La Rocha, 2003).

Just like many other monocotyledons, banana is a Si-accumulator plant (Lahav, 1995). This study concerns *Musa acuminata* Colla, cv Grande Naine. As shown in other crops, silica may enhance plant growth, mineral nutrition, mechanical strength, tolerance to water stress, and resistance to some fungal diseases (Matsuo et al., 1995). We suspect similar effects for banana (unpublished data), an important economical and nutritive re-

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