

Accumulation of germanium (Ge) in plant tissues of grasses is not solely driven by its incorporation in phytoliths

- until recently it has been generally assumed that Ge taken up by plants is stored in phytoliths together with Si
- this assumption is mostly based on the geochemical similarities between Ge and Si, while a scientific proof was lacking
- knowledge about chemical forms of Ge in plants is an important prerequisite for phytomining purposes and biogeochemical studies.

The aim of the present study is to:

- i) compare the uptake of Si and Ge in three grass species,
- ii) localize Ge and Si stored in above-ground plant parts and
- iii) evaluate the amounts of Ge and Si sequestered in phytoliths and plant tissues



Methods:

- mays (*Zea mays*), oat (*Avena sativa*) and reed canary grass (*Phalaris arundinacea*) were cultivated in the greenhouse on soil and sand to control element supply.
- leaf phytoliths were extracted by dry ashing
- total elemental composition of leaves, phytoliths, stems and roots were measured by **ICP-MS**
- for the localization of phytoliths and the determination of Ge and Si within leaf tissues and phytoliths scanning electron microscopy (**SEM**), energy dispersive x-ray spectroscopy (EDX) and laser ablation ICP-MS (**LA-ICP-MS**) was used



Results:

- the amounts of Si and Ge taken up by the species corresponded with biomass formation and decreased in the order ***Z. mays*** > ***P. arundinacea***, ***A. sativa***
- results from LA-ICP-MS revealed that Si was mostly localized in phytoliths, while Ge was disorderly distributed within the leaf tissue

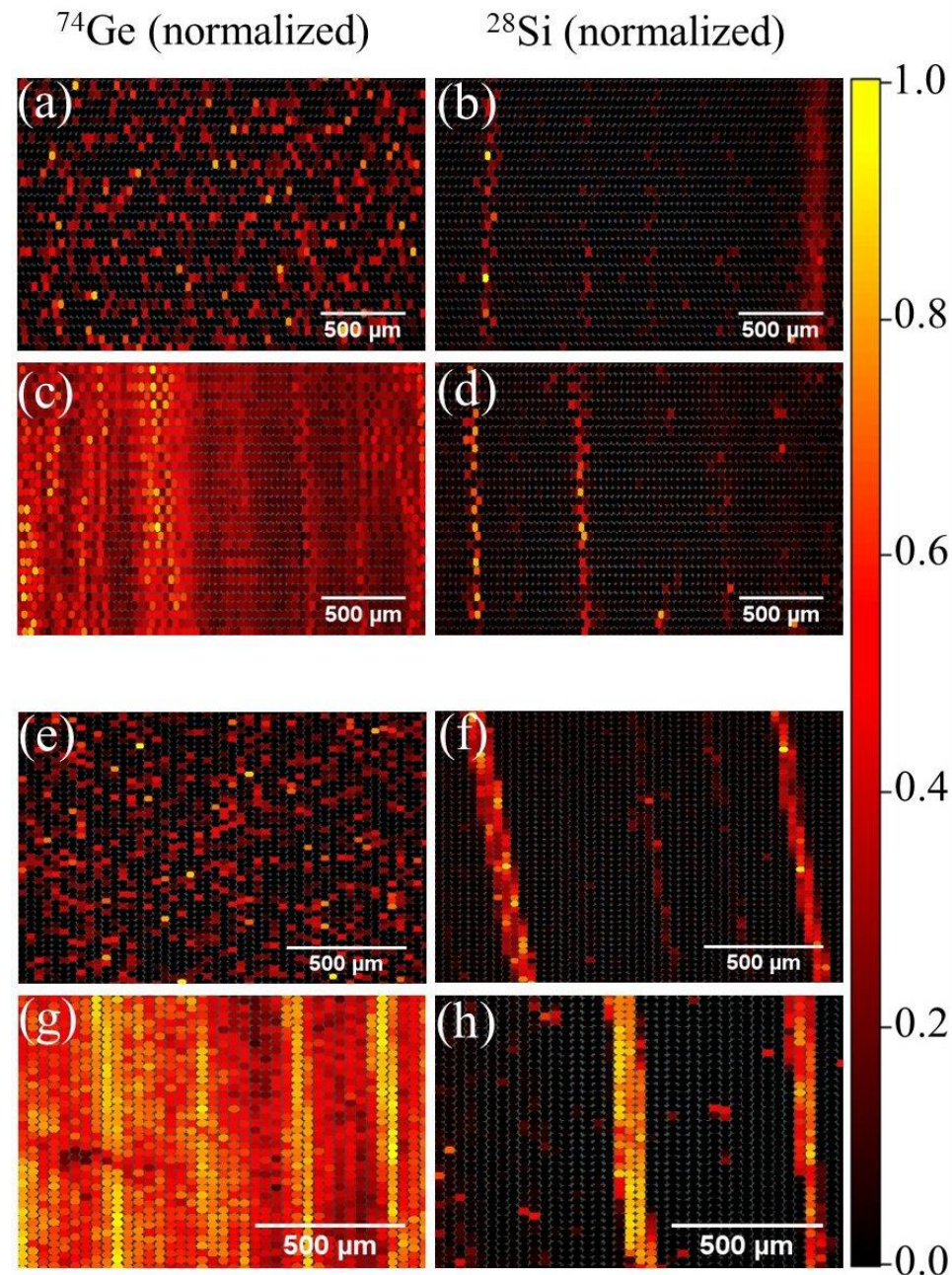
2D-maps a-d: *Zea mays*

e-h: *Avena sativa*

Relative intensity data of ^{74}Ge (left) and ^{28}Si (right) from same measured position are given:

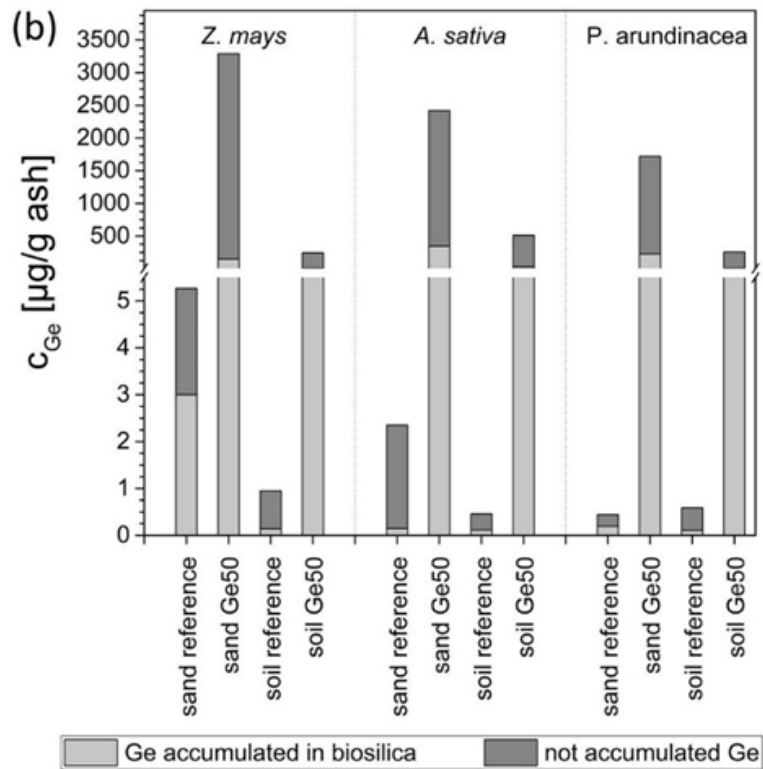
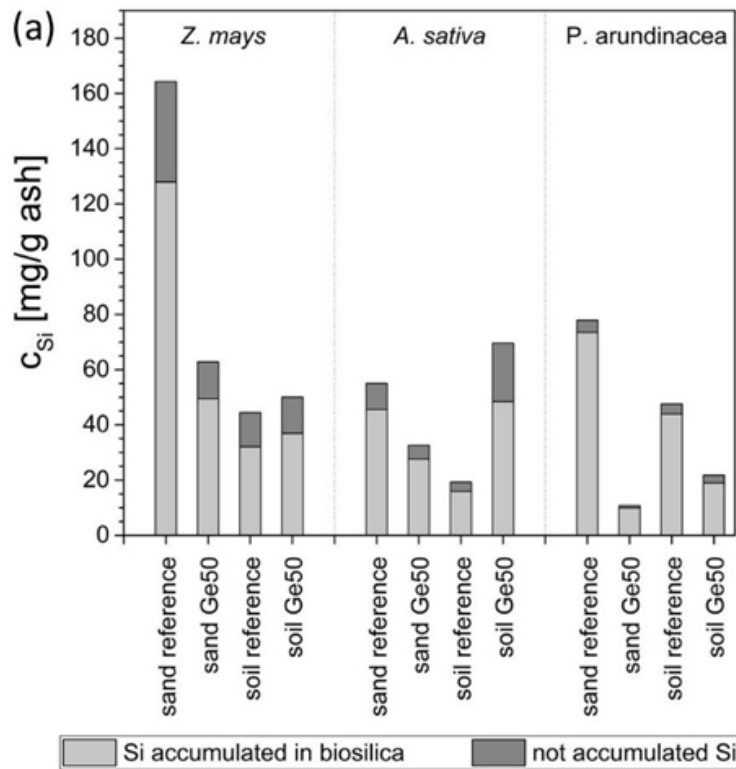
(a, b, e, f) reference plants without artificial Ge treatment

(c, d, g, h) plants treated with $50 \mu\text{mol l}^{-1}$ Ge



Kaiser S, Wagner S, Moschner C, Funke C, Wiche O (2020) Accumulation of germanium (Ge) in plant tissues of grasses is not solely driven by its incorporation in phytoliths. Biogeochemistry 148, 49-68.





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From the total amounts of Ge accumulated in leaves only 10% was present in phytoliths!

Conclusion:

- Most of the Ge accumulated in plants is bound to organic cell constituents
- The results highlight the necessity for using bulk Ge/Si instead of Ge/Si in phytoliths to trace biogeochemical cycling of Si

