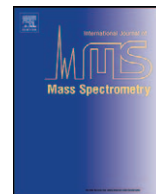




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# International Journal of Mass Spectrometry

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### Foreword

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#### Foreword

J. Sabine Becker

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#### In honour of Hans-Joachim Dietze on his 75th birthday

J. Sabine Becker

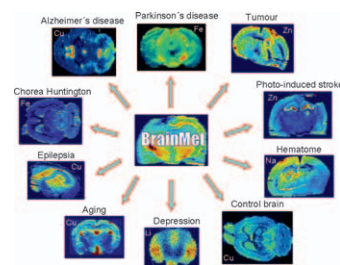
### Regular articles

3–15

#### Mass spectrometric imaging (MSI) of metals using advanced BrainMet techniques for biomedical research

Johanna Sabine Becker, Andreas Matusch, Julia Susanne Becker, Bei Wu, Christoph Palm, Albert Johann Becker, Dagmar Salber

► State of the art and new applications of the developed BrainMet bioimaging techniques (BrainMet—Bioimaging of Metals in Brain and Metallomics). ► Quantitative imaging of trace metals in biological tissues for biomedical research (neurodegenerative diseases) and met-allomics. ► Metalloprotein microscopy using a laser microdissection (LMD) apparatus for specific sample introduction into an inductively coupled plasma mass spectrometer (LMD-ICP-MS). ► Nano-BrainMet by application of near field effect in LA-ICP-MS (NF-LA-ICP-MS).

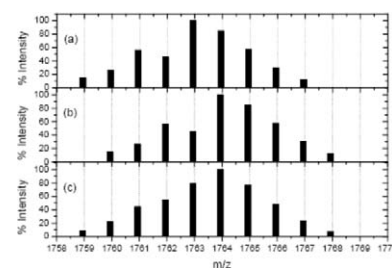


## 16–27

**Investigation of Se-containing proteins in *Bertholletia excelsa* H.B.K. (Brazil nuts) by ICPMS, MALDI-MS and LC–ESI-MS methods**

Sarath B. Jayasinghe, Joseph A. Caruso

► Importance of ICPMS as an “on-line assay” in selenoproteomics research. ► Distribution of Se-containing proteins in water-soluble protein fraction of Brazil nuts. ► Slightly modified Se-isotope pattern owing to the occurrences of partial deamidation. ► Identified proteins S14946, CAA00789, A25802, BAA96554, Q9LRC2, S14947, Q84ND2 BEREK.

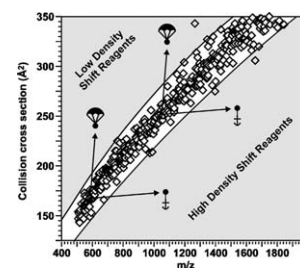


## 28–32

**Multiplexed analysis of peptide functionality using lanthanide-based structural shift reagents**

Thomas J. Kerr, Randi L. Gant-Branum, John A. McLean

► Functionally selective lanthanide-based ion mobility shift reagents are presented as a method to elucidate protein or peptide structural information as well as relative quantitation of protein expression profiles. ► Sequence information and site localization of primary amines (n-terminus and lysine), phosphorylation sites, and cysteine residues can be obtained in a data dependent manner using ion mobility-mass spectrometry (IM-MS). ► The high mass of the incorporated lanthanide ensures a significant shift of where the signal occurs in IM-MS conformation space. ► Peptide sequence information provided by the use of IM-MS shift reagents allows for both a more confident identification of peptides from complex mixtures and site localization following tandem MS experiments. ► Stable isotopes of the lanthanide series may also be used as relative quantitation labels since several lanthanides can be utilized in differential sample analyses.

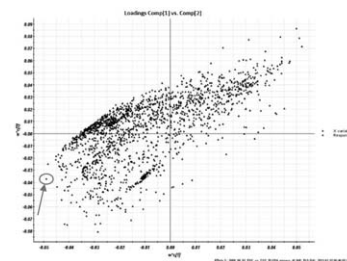


## 33–38

**Metabolomics and preterm birth: What biomarkers in cervicovaginal secretions are predictive of high-risk pregnant women?**

Christiane Auray-Blais, Evelyne Raiche, René Gagnon, Maryse Berthiaume, Jean-Charles Pasquier

► QT of mass spectrometry allows the evaluation of vaginal secretions in pregnant women. ► Vaginal secretion collections are non-invasive biological fluids for metabolomic studies. ► A cascade of biochemical events leads to perturbations in the metabolome of pregnant women. ► Predictive biomarkers may result in improved management of high-risk pregnant women. ► Metabolomic studies may lead to reliable predictors of preterm births.

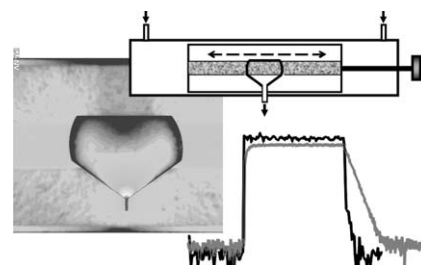


## 39–45

**High spatial resolution trace element analysis by LA-ICP-MS using a novel ablation cell for multiple or large samples**

Mattias B. Fricker, Daniel Kutscher, Beat Aeschlimann, Jakob Frommer, Rolf Dietiker, Jörg Bettmer, Detlef Günther

► Ablation cell design for fast wash out of laser generated aerosol. ► High spatial resolution LA-ICP-MS for analysis of large heterogeneous samples. ► Detection of Hg-derivatised ovalbumin in electrophoresis gel with LA-ICP-MS.

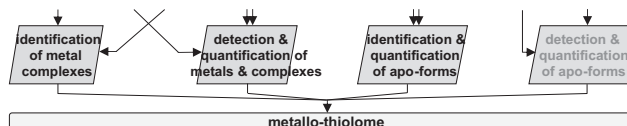


## 46–54

### Metallo-thiolomics: Investigation of thiol peptide regulated metal homeostasis in plants and fungi by liquid chromatography-mass spectrometry

Dirk Wesenberg, Gerd-Joachim Krauss, Dirk Schaumlöffel

► Molecular characterization of thiol peptide regulated metal homeostasis in plants and fungi. ► Modern LC-MS techniques for identification and quantification of thiol peptides. ► Metallo-thiolome and metallo-thiolomics.

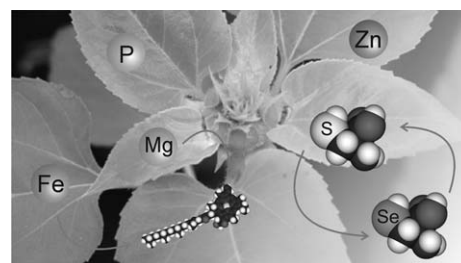


## 55–60

### Evaluation of sunflower metabolism from zinc and selenium addition to the culture: A comparative metallomic study

Marcelo Anselmo Oseas da Silva, Sara Adrián López de Andrade, Paulo Mazzafera, Marco Aurélio Zezzi Arruda

► Sun flowers treated with selenium translocate most of this element to the leaves. ► The absorption of selenium changes the concentration of sulfur in leaves. ► Selenium may participate randomly in cysteine biosynthesis pathway. ► The levels of Fe, Mg and P are unchanged in Se-treated plants. ► Zn-treated sunflowers did not present growth problems even in sterilized soil.

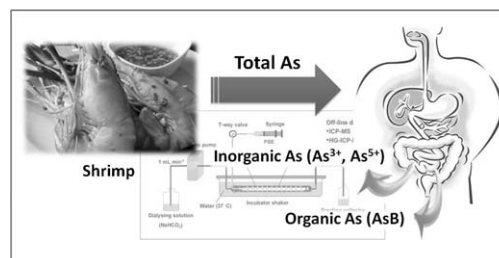


## 61–65

### Inductively coupled plasma mass spectrometry with a continuous-flow dialysis simulated gastrointestinal digestion for study of arsenic bioaccessibility in shrimp

Chayayos Arkasuwan, Atitaya Siripinyanond, Juwadee Shiwatana

► Arsenic bioaccessibility in shrimp was found to be approximately 55%. ► Most bioaccessible arsenic were the inorganic form. ► Only 1% or 2% of bioaccessible arsenic were the inorganic form. ► Ascorbic acid and fruit juices did not cause any significant changes in bioaccessibility of arsenic in shrimp.



## 66–69

### Detection of Zn-containing proteins in slug (Genus Arion) tissue using laser ablation ICP-MS after separation by gel electrophoresis

J. Susanne Becker, Dirce Pozebon, Andreas Matusch, Valderi L. Dressler, J. Sabine Becker

► The distribution of total Zn in a section of a slug is mapped by LA-ICP-MS. ► Zn-containing proteins are separated by one-dimensional gel electrophoresis. ► Zn-containing proteins are detected by MALDI-TOF-MS. ► This paper demonstrate the potential of LA-ICP-MS in metallomics.

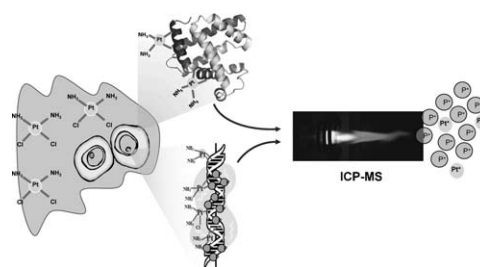


## 70–78

### Determination of Pt–DNA adducts and the sub-cellular distribution of Pt in human cancer cell lines and the leukocytes of cancer patients, following mono- or combination treatments, by inductively-coupled plasma mass spectrometry

Aref Zayed, Tamer Shoeib, Sarah E. Taylor, George D.D. Jones, Anne L. Thomas, Joanna P. Wood, Helen J. Reid, Barry L. Sharp

► Partitioning of Pt-based drugs in cells of patients undergoing Pt-based chemotherapy. ► New data on Pt-DNA adduct formation and persistence over extended treatment cycles. ► Variability inpatient response and evidence of adduct repair. ► The effect of combination therapy, such as the FOLFOX regimen. ► Effect of Se supplementation, and cell partitioning of drug.

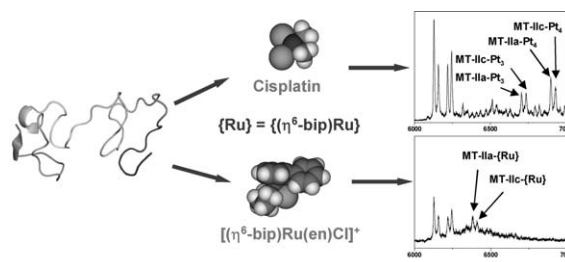


## 79–84

### A comparative study on interactions of cisplatin and ruthenium arene anticancer complexes with metallothionein using MALDI-TOF-MS

Guangxue Zhang, Wenbing Hu, Zhifeng Du, Shuang Lv, Wei Zheng, Qun Luo, Xianchan Li, Kui Wu, Yumiao Han, Fuyi Wang

► MALDI-TOF-MS studies reactivity of metal-based anticancer complexes to MTs. ► Ruthenium arene complexes bind to MTs at a much lower level than cisplatin. ► The low reactivity to MTs may account for less toxicity and non-resistance.

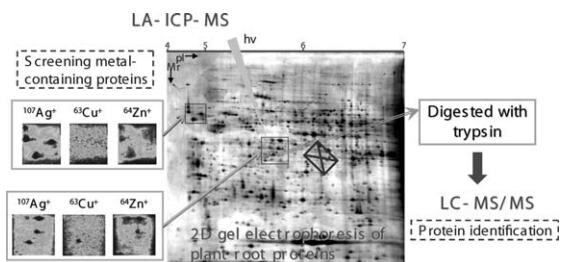


## 85–91

### Study of metal-containing proteins in the roots of *Elsholtzia splendens* using LA-ICP-MS and LC–tandem mass spectrometry

Bei Wu, Iuliana Susnea, Yingxu Chen, Michael Przybylski, J. Sabine Becker

► For the first time we combined LA-ICP-MS and LC–tandem MS to investigate metal-containing proteins in the roots of Cu-tolerant plant *Elsholtzia splendens*. ► The mechanisms for Cu tolerance and accumulation in the plant were thus illustrated with respect to Cu-binding ligands present in the roots. ► Different from other metal-tolerant plants, *E. splendens* may not utilize metal-containing proteins as Cu chelators, while free histidine could play an important role in Cu accumulation in the plants. MASPEC



## 92–98

### Analysis of gold nanoparticles using ICP-MS-based hyphenated and complementary ESI-MS techniques

Andreas Helfrich, Jörg Bettmer

► Hyphenated ICP-MS techniques for the characterisation of gold nanoparticles. ► Monitoring the nucleation process of synthesised nanoparticles. ► Characterisation of nanoparticles through their elemental ratios by ICP-MS. ► ESI-MS as complementary technique for molecular nanoparticle characterisation.

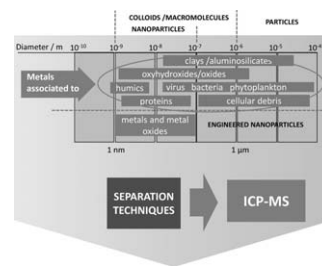


## 99–104

## An approach to the natural and engineered nanoparticles analysis in the environment by inductively coupled plasma mass spectrometry

M.S. Jiménez, M.T. Gómez, E. Bolea, F. Laborda, J. Castillo

- Different approaches to recent studies of ICP-MS applied to the analysis of nanoparticles in the environment are described.
- Usually several separation methods are used prior to the mass spectrometric measurements.
- The capabilities of the single particle detection by ICP-MS (SD-ICP-MS) are also discussed.

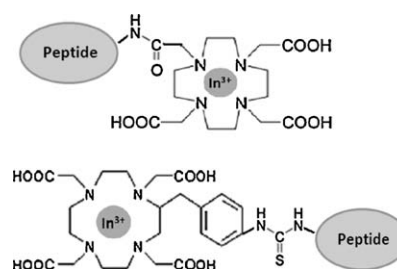


## 105–111

## High-throughput flow injection analysis of labeled peptides in cellular samples—ICP-MS analysis versus fluorescence based detection

Daniela Kretschy, Marion Gröger, Daniela Zinkl, Peter Petzelbauer, Gunda Koellensperger, Stephan Hann

- First comparison of fluorescence versus elemental labeling combined with flow injection analysis
- Ultimate sensitivity, negligible matrix effects, high throughput and reduced sample preparation of cellular samples is documented for FIA-ICP-MS
- Application of different ICP-MS quantification strategies with the benefit of superior short and long term precision.

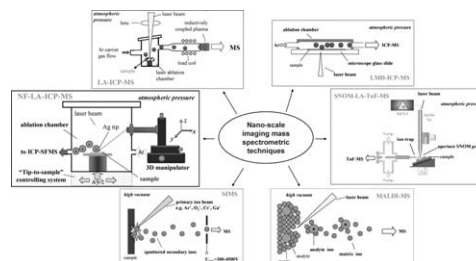


## 112–122

## Imaging of elements and molecules in biological tissues and cells in the low-micrometer and nanometer range

Bei Wu, J. Sabine Becker

- State of the art of advanced mass spectrometric imaging of biological tissues and cells with lateral resolution down to low-micrometer and nanometer scales was discussed.
- The promising future of imaging mass spectrometric techniques, especially nano-scale LA-ICP-MS, for application in biochemical studies with high spatial resolution down to the nanometer range was also discussed.
- Non-mass spectrometric techniques were reviewed as well for comparison with mass spectrometric imaging techniques.

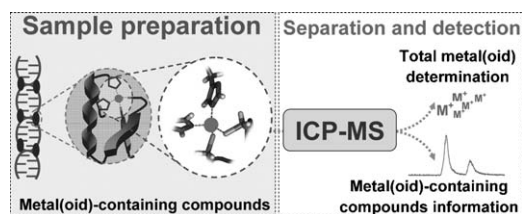


## 123–136

## Sample preparation strategies for bioinorganic analysis by inductively coupled plasma mass spectrometry

Márcia F. Mesko, Carla A. Hartwig, Cezar A. Bizzi, Juliana S.F. Pereira, Paola A. Mello, Erico M.M. Flores

- The main procedures for sample treatment in bioinorganic analysis are presented.
- Conventional and non conventional procedures for sample treatment are discussed.
- Metal (oid) or metal (oid)-containing compounds determination by inductively coupled plasma mass spectrometry (ICP-MS) are described.

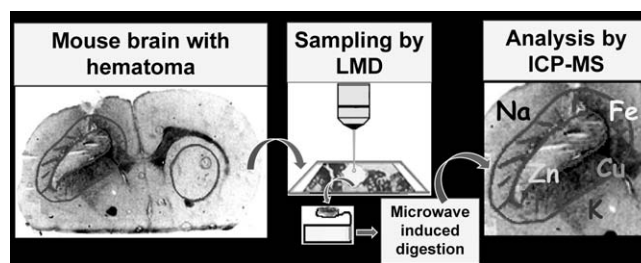


## 137–141

### Evaluation of metal distributions in small samples of mouse brain lesions (hematoma) by inductively coupled plasma mass spectrometry after sampling by laser microdissection (LMD)

Marcia F. Mesko, Dagmar Salber, Dirce Pozebon, Valderi L. Dressler, J. Sabine Becker

- Metal distributions were evaluated in mouse brain lesion (hematoma).
- ICP-MS was employed for quantitative K, Na, Cu, Fe and Zn determination after micro-sampling of biological tissues by laser microdissection (LMD) and digestion.

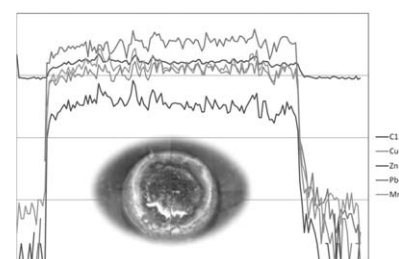


## 142–148

### Preparation of stable standards of biological tissues for laser ablation analysis

H. Sela, Z. Karpas, H. Cohen, Y. Zakon, Y. Zeiri

- A novel method, for preparing sol-gel based standards for laser-ablation analysis.
- The method is suitable for biological matrices, like rat brain tissue.
- Homogeneous distribution of elements in the standard has been demonstrated.
- Carbon-13 serves as a built-in internal standard.
- Long shelf life of standards at room temperature.

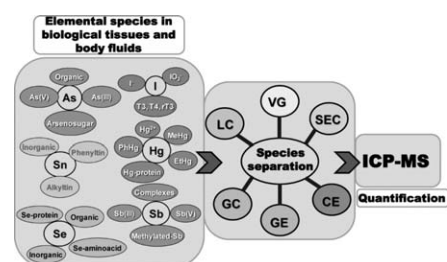


## 149–162

### As, Hg, I, Sb, Se and Sn speciation in body fluids and biological tissues using hyphenated-ICP-MS techniques: A review

Valderi L. Dressler, Fabiane Goldschmidt Antes, Clarissa Marques Moreira, Dirce Pozebon, Fabio Andrei Duarte

- Speciation analysis of As, I, Hg, Sb, Se, and Sn in biological materials is reviewed.
- Hyphenation of separation techniques with ICP-MS is discussed.
- New developments involving micro and nanoflow separation techniques are highlighted.
- Relevant applications are cited.

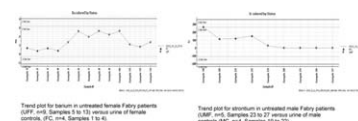


## 163–173

### Mass spectrometry analysis of metals, other elements and lipids in urine samples of Fabry disease patients

Christiane Auray-Blais, René Gagnon, Usarat Kumtabtim, Aimé Ntwari, J. Sabine Becker

- ICP-MS method allows metal/other elements quantification in urine of Fabry patients.
- Correlations were established for metals/other elements versus lipids in Fabry disease.
- Urinary strontium values were lower in all male Fabry patients understudy.
- Urinary barium levels were lower in all controls.
- Mass spec allows quantitative analysis of urinary isotopes versus Fabry disease biomarkers.

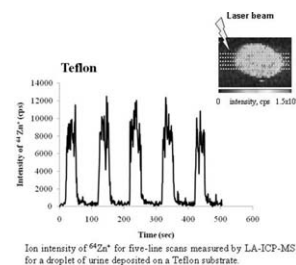


## 174–181

### Analysis of trace metals in single droplet of urine by laser ablation inductively coupled plasma mass spectrometry

Usarat Kumtabtim, Atitaya Siripinyanond, Christiane Auray-Blais, Aimé Ntwari, J. Sabine Becker

► LA-ICP-MS methodology allows a rapid trace metal analysis in urine droplets. ► Sample processing for LA-ICP-MS is simple, rapid and reduces possible contamination. No differences between LA-ICP-MS and ICP-MS trace metal analysis in urine droplets. LA-ICP-MS method is convenient for high sample throughput put trace metal analysis. ► LA-ICP-MS may be applicable to forensic medicine and clinical research.



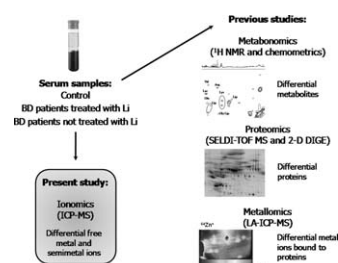
Ion intensity of  $^{44}\text{Zn}$  for five-line scans measured by LA-ICP-MS for a droplet of urine deposited on a Teflon substrate.

## 182–184

### Exploratory analysis of the serum ionic profile for bipolar disorder and lithium treatment

Alessandra Sussulini, Claudio E.M. Banzato, Marco A.Z. Arruda

► Exploratory analysis of serum ionic profiles by ICP-MS. ► Differentiation in serum ionic profile: controls vs. bipolar disorder patients. ► Distinct ionic profile for bipolar disorder patients treated with lithium or not. ► Hints for further biomarker discovery studies of bipolar disorder/lithium treatment.

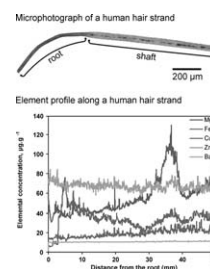


## 185–191

### Biomonitoring for arsenic, toxic and essential metals in single hair strands by laser ablation inductively coupled plasma mass spectrometry

Usarat Kumtabtim, Andreas Matusch, Sergio Ulhoa Dani, Atitaya Siripinyanond, J. Sabine Becker

► LA-ICP-MS techniques for the time-resolved assessment of exposition to elements were developed. ► Matrix matched multielement hair standards and hair phantoms with segmentally differential load of As were prepared. ► Characteristic peaks with steep increase and exponential decrease corresponding to intermittent high dose Mg treatment could be detected suggesting an elimination half live of Mg of about 10 days.

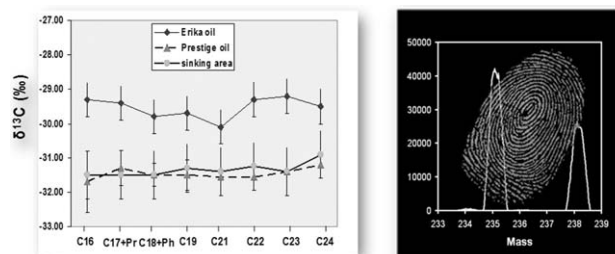


## 192–199

### Isotope analysis for marine environmental studies

M. Betti, F. Boisson, M. Eriksson, I. Tolosa, E. Vasileva

► Isotope analysis to fingerprint pollutants. ► Identification of the source of pollutants. ► Historical evolution of pollutants.

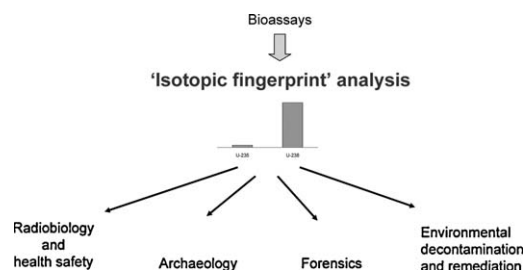


## 200–210

**Mass spectrometric analysis of long-lived radionuclides in bio-assays**

Sergei F. Boulyga

► Specific features of major radioactive contaminations of the biosphere. ► Merits of modern mass spectrometric techniques for determination of long-lived radionuclides. Analysis of long-lived isotopes of actinides and fission products in biological samples.

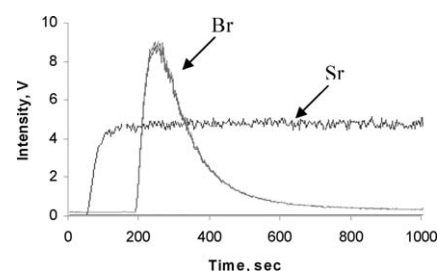


## 211–213

**High-precision isotope ratio analysis of inorganic bromide by continuous flow MC-ICPMS**

Faina Gelman, Ludwik Halicz

► The work represents a high-precision method for the isotope analysis of inorganic bromide in natural samples by continuous flow MC-ICPMS.

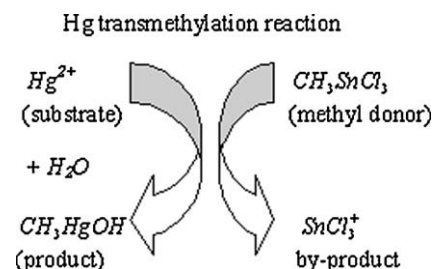


## 214–224

**Mercury isotope fractionation during abiotic transmethylation reactions**

D. Malinovsky, F. Vanhaecke

► Abiotic methylation of mercury in aqueous solution are concomitant with Hg isotope fractionation. ► Methyl radical substitution reactions facilitate formation of methylmercury. ► Hg isotope fractionation can be mass-independent under irradiation with UV light. ► Magnetic isotope effect appears to be the cause of mass-independent Hg isotope fractionation.

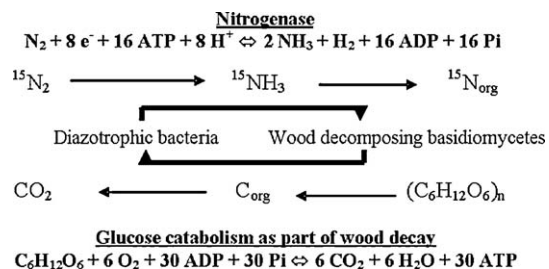


## 225–231

**Nitrogen metabolism of wood decomposing basidiomycetes and their interaction with diazotrophs as revealed by IRMS**

Petra Weißhaupt, Wolfgang Pritzkow, Matthias Noll

► IRMS as a precise method in microbial ecology. ► Tracing experiments with  $^{15}\text{N}_2$ . ► Investigation of the nitrogen metabolism of basidiomycetes and diazotrophs. ► Characterisation of a microbial interaction.

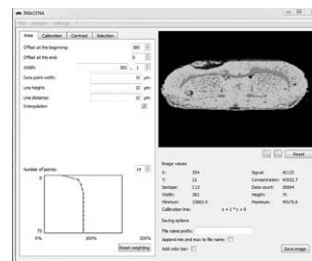




**232–239****IMAGENA: Image Generation and Analysis – An interactive software tool handling LA-ICP-MS data**

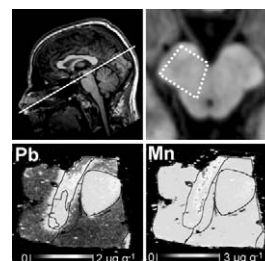
Tobias Osterholt, Dagmar Salber, Andreas Matusch, J. Sabine Becker, Christoph Palm

► IMAGENA generates images from the continuous stream of LA-ICP-MS rawdata. ► IMAGENA images show the spatial distribution of elements. ► IMAGENA visualises, corrects, calibrates and converts data to TIFF-images. ► IMAGENA proved its suitability and usefulness in more than two years of routine use. ► IMAGENA closes a significant bottleneck in the LA-ICP-MS image generation process.

**240–244****Element imaging in formalin fixed slices of human mesencephalon**

Andreas Matusch, Andreas Bauer, J. Sabine Becker

► LA-ICP-MS imaging of formalin fixed tissue yielded specific element distributions of Fe, Mn, Pb, Ni and Ca while Cu and Zn were washed out. ► Concentrations of Fe, Mn, were similar to those reported for fresh tissue. ► Fe and Pb follow a matrix-nigrosome distribution while Mn and Ca colocalize with clusters of melanised cell bodies.

**245–252****Automatic segmentation of tissue sections using the multielement information provided by LA-ICP-MS imaging and *k*-means cluster analysis**

A.M. Oros-Peusquens, A. Matusch, J. Sabine Becker, N.J. Shah

► A *k*-means clustering analysis on LA-ICP-MS data enabled an automatic determination of an atomical regions. ► Clustering on ischemic lesions induced by photothrombosis identified concentric zones of differential metal enrichment. ► Ischemic lesions display a very characteristic fingerprint of element distribution in the rim of the lesion. ► The fingerprint is preserved despite changes in Cu and Zn concentrations induced by formalin fixation and paraffin embedding. ► The behaviour of the images' tensor of inertia provides a way to determine the optimum image reconstruction parameters.

