Supplementary Information

# Prediction of Radiogenic Sr and Pb Isotope Signatures in Plants using Diffusive Gradients in Thin Films

Stefan Wagner[a,*], Jakob Santner[b], Markus Puschenreiter[c], Johanna Irrgeher[a], Thomas Prohaska[a]

[a] Montanuniversität Leoben, Department General, Analytical and Physical Chemistry, Chair of General and Analytical Chemistry, Franz-Josef-Straße 18, 8700, Leoben, Austria

[b] Justus Liebig University Giessen, Institute of Plant Nutrition, Heinrich-Buff-Ring 26-32, 35392, Giessen, Germany

[c] BOKU University, Department of Forest and Soil Sciences, Institute of Soil Research, Konrad-Lorenz-Straße 24, 3430, Tulln, Austria

[*]Corresponding author: stefan.wagner@unileoben.ac.at

**Contents** | **Page**


| Contents | Page |
|---|---|
| Text S1. Laboratory procedures, solutions, and materials | S-3 |
| Text S2. Total soil and extract digestion procedures | S-4 |
| Text S3. Plant sample preparation and digestion | S-5 |
| Text S4. Matrix separation | S-6 |
| Text S5. Daily optimization of MC-ICP-MS measurements | S-7 |
| Table S1. Characteristics of soils | S-8 |
| Table S2. Background equivalent concentrations (BECs), limits of detection ($x_L$), and limits of quantification ($x_Q$) of the TK100 DGT and Chelex DGT for Sr and Pb | S-9 |
| Table S3. Elution parameters of the automated matrix separation | S-10 |
| Table S4. Instrumental parameters of MC-ICP-MS measurements | S-11 |
| Table S5. Elemental analysis results for CRMs | S-12 |
| Table S6. Isotope ratio analysis results for CRMs | S-13 |
| Table S7. Sr and Pb mass fractions (mg kg$^{-1}$ dry weight) in lettuce, wheat, and radish tissues grown in soils | S-14 |
| Table S8. Relationship between Sr plant uptake and soil bioavailability indices (TK100 DGT, $NH_4NO_3$, $NH_4OAc$) of the five experimental soils | S-15 |
| Table S9. Mass fraction ($w$) ratios of Ca/Sr, Rb/Sr × 1000, and Ca/Pb in DGT eluates and soil extracts | S-16 |
| Table S10. Relative Sr and Pb isotope ratios, expressed as $\delta$-values, in DGT-labile, extractable, and total soil fractions | S-17 |
| Table S11. Absolute Sr and Pb isotope ratios in DGT-labile, extractable, and total soil fractions | S-18 |
| Table S12. Relative Sr and Pb isotope ratios, expressed as $\delta$-values, in lettuce, wheat, and radish tissues grown in soils | S-19 |
| Table S13. Absolute Sr and Pb isotope ratios in lettuce, wheat, and radish tissues grown in soils | S-20 |
| Table S14. Isotopic differences, expressed as $\Delta$-values, between DGT-labile (TK100 or Chelex) soil fractions and plant tissues | S-21 |
| References | S-22 |

## Text S1. Laboratory procedures, solutions, and materials

Soil and plant experiments, as well as matrix separation of Sr and Pb were performed at BOKU University (Institute of Soil Research, UFT Campus Tulln an der Donau), Austria. Mass spectrometric measurements were performed in cleanrooms (ISO class 8 according to ISO 14644-1) at both BOKU University and Montanuniversität Leoben (Chair of General and Analytical Chemistry), Austria.

Ultrapure water ($\sigma$ = 0.055 µS $cm^{-1}$; MilliQ IQ 7000, Merck-Millipore, Darmstadt, Germany) was used in all experimental work. Ultrapure water and analytical reagent-grade $HNO_3$ ($w$ = 65 %, Merck, Darmstadt, DE) used for sample preparation were additionally cleaned by single and double subboiling, respectively, in separate perfluoroalkoxy-polymer (PFA) distillation systems (DST-1000, Savillex, Eden Prairie, MN, USA). Trace metals basis HCl ($w$ = 37 %, PanReac AppliChem, DE) was subboiled in a quartz distillation system (AHF Analysentechnik, Tübingen, DE). Polyethene (PE) and glass materials, as well as piston-type acrylonitrile butadiene styrene (ABS) DGT moldings (R-SDU; DGT Research Ltd., Lancaster, UK) were cleaned in two steps using $HNO_3$ ($w$ = 10 % and $w$ = 1 %, respectively). PFA vials used for matrix evaporation were cleaned using hot $HNO_3$ ($w$ = 65 %) vapor in a PTFE cleaning system (Analab, Elemental Scientific, Omaha, USA). Following acid cleaning, all materials were rinsed with ultrapure water and dried in a metal-free class 100 laminar flow cabinet prior to use. If not stated otherwise, handling of DGT components and samples was carried out following clean trace analysis procedures as reported previously [1].

Subboiled $HNO_3$ and HCl, as well as $H_2O_2$ ($w$ = 30 %, suprapur, Merck), HF ($w$ = 40 %, for analysis, Merck), and $H_3BO_3$ ($w$ = 4 %, suprapur, Merck) were used for digestion. Soil extraction solutions were prepared by dissolving ammonium nitrate ($NH_4NO_3$; ≥99 %, Sigma-Aldrich, DE), ammonium acetate ($NH_4OAC$; IUPAC name: ammonium ethanoate, $NH_4CH_3CO_2$; for analysis, ≥98.0 %, Merck), and ethylenediaminetetraacetic acid (EDTA; $C_{10}H_{14}N_2Na_2O_8 \times 2H_2O$; 99.0-101 %, Merck) in ultrapure water.

Single-element standards ($c$ = 1 g $L^{-1}$) of Ca, Rb, Sr, In, and Pb were obtained from Inorganic Ventures (Christiansburg, USA). Multi-element standards for external calibration in ICP-MS measurements were prepared gravimetrically from a multi-element stock solution (ICP multielement standard Merck VI, Merck). For instrumental isotopic fractionation (IIF) correction, certified reference materials (CRMs) for Sr (SRM 987, high purity $SrCO_3$) and Pb (SRM 981, high purity Pb wire) with certified isotopic abundance ratios of $^{87}Sr/^{86}Sr$ = 0.71034 ± 0.00026 and $^{207}Pb/^{206}Pb$ = 0.91464 ± 0.00033, $^{208}Pb/^{206}Pb$ = 2.1681 ± 0.0008, and $^{206}Pb/^{204}Pb$ = 16.937 ± 0.011 ($U$, $k$ = 2), respectively, were obtained from the National Institute of Standards and Technology (NIST, Gaithersburg, USA) [2, 3]. Preparation and handling of the unbranched DGA resin (particle size 50-100 µm; TrisKem International, Bruz, FR) used for matrix separation was performed as detailed in Retzmann et al. [4], except for soaking the resin in diluted ethanol ($w$ = 30 %, absolute, Merck) instead of $HNO_3$ ($w$ = 2 %) before column packing.

## Text S2. Total soil and extract digestion procedures

Total soil digestion was performed using a method adapted from Prohaska et al. [5]. Briefly, ground soil samples ($m$ = ~100 mg) were digested in a mixture of 5 mL $HNO_3$ ($w$ = 65 %), 2 mL HCl ($w$ = 37 %), and 1 mL HF ($w$ = 40 %) for 30 min at 200 °C and $5.5 \times 10^6$ Pa in a microwave system (MARS 6, CEM, Charlotte, NC, USA). Subsequently, residual HF was neutralized by addition of 6 mL $H_3BO_3$, followed by 30 min at 170 °C and $5.5 \times 10^6$ Pa in the microwave. The total soil digests were diluted to obtain a total volume of ~50 mL using ultrapure water. For digestion of soil extracts, $NH_4OAc$ and EDTA extract solutions ($m$ = ~5 g) were weighed into 75 mL PTFE vessels and digested in a mixture of 5 mL $HNO_3$ ($w$ = 65 %) and 1 mL $H_2O_2$ ($w$ = 30 %) for 20 min at 200 °C and $5.5 \times 10^6$ Pa using the same microwave system as for total soil digestion. The extract digests were diluted to obtain a total volume of ~30 mL using ultrapure water.

**Text S3. Plant sample preparation and digestion**

Upon harvest, plant samples were rinsed with ultrapure water, blotted dry, and freeze-dried for seven days at -88 °C and 0.63 mbar (Alpha 2-4 LSCbasic, Christ, DE). Dried plant tissues were ground and homogenized using an analytical mill (A 11 basic, IKA, DE). Subsamples ($m$ = ~150 mg) of the ground plant tissues were digested in a mixture of 3 mL $HNO_3$ ($w$ = 65 %) and 0.76 mL $H_2O_2$ ($w$ = 30 %) using the same microwave settings as for soil extract digestion (**Text S2**). Prior to the addition of $H_2O_2$, the samples were left overnight in $HNO_3$ to allow for extended reaction time. Digests were diluted to ~20 mL with ultrapure water and passed through a 0.45 µm pore-size PES syringe filter (Sartorius, DE) to remove non-dissolved silicates.

## Text S4. Matrix separation

To obtain purified Sr and Pb fractions for isotope ratio analysis, soil extracts, total soil digests, and plant digests were processed by ion chromatography using an simultaneous Sr and Pb matrix separation procedure [6]. The method is based on an automated chromatographic system (prepFAST MC, Elemental Scientific, Omaha, USA) equipped with a self-packed 3 mL bed-volume column containing DGA resin (TrisKem International, Bruz, FR) with high affinity for Sr and Pb in $HNO_3$ ($c$ = 2 mol $L^{-1}$). The method allows for simultaneous separation of Sr and Pb from Ca-rich matrices with quantitative analyte recovery and separate collection of the purified Sr and Pb fractions. Details of the prepFAST MC system and column packing are provided in Retzmann et al. [4] and Zimmermann et al. [6]. Separation performance of newly packed columns was verified in calibration mode of the prepFAST MC loading 3 mL of an in-house reference solution containing Sr ($c$ = 0.25 mg $L^{-1}$), Pb ($c$ = 0.05 mg $L^{-1}$), Ca ($c$ = 100 mg $L^{-1}$), and Rb ($c$ = 1 mg $L^{-1}$). Prior to sample loading, the matrix of sample solutions was adjusted to a constant $HNO_3$ concentration ($c$ = 2 mol $L^{-1}$) using either $HNO_3$ ($w$ = 65%) or ultrapure water. All $NH_4NO_3$ extracts were diluted by a factor of 20 to reduce the on-column salt load for interference-free ion extraction. The $NH_4OAc$ and EDTA soil extract digests, total soil digests, and plant digests were diluted by varying factors aiming at Sr and Pb levels in separated eluate fractions >20 µg $L^{-1}$ and >2 µg $L^{-1}$, respectively, at a total sample load volume between 0.5-10 mL. To avoid any Sr and Pb overlap during elution, the total on-column Ca load was kept <500 µg [6]. If Sr or Pb concentrations in the respective eluate fractions were <20 µg $L^{-1}$ or <2 µg $L^{-1}$, respectively, matrix evaporation was performed in PFA vials at 90 °C on a hotplate. The eluates were evaporated until a remaining volume of approximately 50 µL and then redissolved in $HNO_3$ ($c$ = 2 %). Elution parameters are shown in **Table S3**.

**Text S5. Daily optimization of MC-ICP-MS measurements**

The preamplifier gains on Faraday cups were calibrated daily and the detector baselines were accounted for via repeated on-peak zero measurements in each analytical batch. Before each measurement sequence, the operating conditions were optimized for maximum analyte sensitivity, signal stability, and peak shape using solutions of SRM 987 for Sr and SRM 981 for Pb at the target sample concentrations. Typical optimizations included adjustment of torch position, desolvator and nebulizer Ar gas flows, ion lens voltages, and zoom optics to achieve stable beam intensities and consistent isotope ratios across all analytical runs.

**Table S1.** Characteristics of soils [a]

| Parameter | Unit | TU | SL | ST | AS | MZ | PR |
|---|---|---|---|---|---|---|---|
| Site | - | Tulln | Siebenlinden | Stetting | Arnoldstein | Mežica | Příbram |
| Country | - | AT | AT | DE | AT | SI | CZ |
| Latitude | - | 48.318889° N | 48.675222° N | 48.635778° N | 46.553639° N | 46.545944° N | 49.719417° N |
| Longitude | - | 16.069333° E | 14.998889° E | 13.264167° E | 13.690000° E | 14.937472° E | 14.013111° E |
| Soil type [b] | - | Calcic chernozem | Acidic cambisol | Acidic cambisol | Acidic cambisol | Calcic cambisol | Acidic fluvisol |
| $pH_{CaCl2}$ | - | 7.3 ± <0.1 | 4.5 ± <0.1 | 4.8 ± <0.1 | 4.8 ± <0.1 | 7.0 ± <0.1 | 5.0 ± <0.1 |
| $w(CaCO_3)$ | g kg$^{-1}$ | 83 ± 3 | 13 ± 5 | 17 ± 6 | $<x_L$ | 115 ± 26 | $<x_L$ |
| $w(C)_{organic}$ | g kg$^{-1}$ | 26.8 ± 0.4 | 20.0 ± 1.6 | 9.85 ± 0.16 | 25.3 ± 0.1 | 67.1 ± 0.4 | 21.5 ± 0.1 |
| Sand | g kg$^{-1}$ | 295 ± 7 | 532 ± 8 | 331 ± 6 | 409 ± 2 | 486 ± 17 | 598 ± 11 |
| Silt | g kg$^{-1}$ | 438 ± 3 | 333 ± 8 | 421 ± 1 | 466 ± 8 | 432 ± 17 | 320 ± 11 |
| Clay | g kg$^{-1}$ | 268 ± 4 | 136 ± <1 | 248 ± 5 | 126 ± 7 | 82 ± <1 | 82 ± <1 |
| CEC | mmol$_c$ kg$^{-1}$ | 340 ± 11 | 65 ± 2 | 91 ± 1 | 67 ± 7 | 247 ± 6 | 51 ± 1 |
| WHC | g kg$^{-1}$ | 454 ± 16 | 447 ± 1 | 467 ± 10 | 446 ± 12 | 460 ± 3 | 418 ± 2 |
| $w(Sr)_{total}$ | mg kg$^{-1}$ | 130 ± 2 | 163 ± 10 | 79.2 ± 0.4 | 87.5 ± 2.0 | 149 ± 3 | 52.0 ± 0.7 |
| $w(Pb)_{total}$ | mg kg$^{-1}$ | 28.0 ± 2.8 | 45.9 ± 1.4 | 27.6 ± 0.2 | 1049 ± 19 | 2232 ± 45 | 5009 ± 113 |
| $w(Sr)_{NH4NO3}$ | mg kg$^{-1}$ | 7.83 ± 0.46 | 2.45 ± 0.06 | 2.14 ± 0.03 | 2.42 ± 0.11 | 5.00 ± 0.12 | 2.20 ± 0.03 |
| $w(Sr)_{NH4OAc}$ | mg kg$^{-1}$ | 8.85 ± 0.07 | 2.66 ± 0.05 | 2.47 ± 0.03 | 2.52 ± 0.05 | 5.38 ± 0.05 | 1.87 ± 0.03 |
| $w(Pb)_{NH4NO3}$ | mg kg$^{-1}$ | $<x_L$ | 0.06 ± <0.01 | 0.02 ± <0.01 | 10.4 ± 0.4 | 0.50 ± 0.01 | 12.8 ± 0.3 |
| $w(Pb)_{EDTA}$ | mg kg$^{-1}$ | 10.4 ± 0.6 | 6.25 ± 0.19 | 4.04 ± 0.21 | 693 ± 17 | 1419 ± 28 | 2810 ± 73 |
| $w(Rb)_{total}$/ $w(Sr)_{total}$ | - | 0.79 ± 0.01 | 1.06 ± 0.04 | 2.20 ± 0.02 | 1.18 ± 0.01 | 0.57 ± 0.02 | 0.90 ± 0.01 |
| Lithological background | - | Clastic sediment | Muscovite-biotite granite | Paragneiss, migmatite | Glacial sediment | Undifferentiated sediment | Shale, mudstone |
| Geological age | - | Quaternary | Carboniferous | Neoproterozoic | Paleozoic | Neoproterozoic | Paleozoic |

[a] Values are means ± $s$ with $n$ = 3, except for clay content and WHC where $n$ = 2 (physical replicates). [b] According to World Reference Base for Soil Resources (WRB) [7].

**Table S2.** Background equivalent concentrations (BECs), limits of detection ($x_L$), and limits of quantification ($x_Q$) of the TK100 DGT and Chelex DGT for Sr and Pb

| **DGT** | **Sr** | | | | | | **Pb** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Disc loading / (ng disc$^{-1}$)** | | | **$c_{DGT}$ / (µg L$^{-1}$)** | | | **Disc loading / (ng disc$^{-1}$)** | | | **$c_{DGT}$ / (µg L$^{-1}$)** | | |
| | BEC | $x_L$ | $x_Q$ | BEC | $x_L$ | $x_Q$ | BEC | $x_L$ | $x_Q$ | BEC | $x_L$ | $x_Q$ |
| TK100 | 4.37 | 3.59 | 12.0 | 0.25 | 0.20 | 0.68 | 13.6 | 10.8 | 35.9 | 0.59 | 0.47 | 1.57 |
| Chelex | 3.76 | 1.18 | 3.92 | 0.21 | 0.07 | 0.22 | 1.09 | 1.49 | 4.95 | 0.05 | 0.06 | 0.22 |

**Table S3.** Elution parameters of the automated matrix separation using the prepFAST MC

| Step | Volume / mL | Flow rate / (mL $min^{-1}$) | Reagent | Reagent concentration / (mol $L^{-1}$) |
|---|---|---|---|---|
| Condition column | 10 | 2 | $HNO_3$ | 2 |
| Load sample | 0.5-10 | 1 | $HNO_3$ | 2 |
| Elute matrix | 8 | 2 | $HNO_3$ | 2 |
| Elute Sr | 7 | 1 | $HNO_3$ | 0.2 |
| Elute Pb | 5-7 | 1 | $HNO_3$ | 5 |
| Elute Ca/wash column | 15 | 2 | HCl | 0.1 |

**Table S4.** Instrumental parameters of MC-ICP-MS measurements

| Parameter | Sr | Pb |
|---|---|---|
| | Nu Sapphire (SP017, Nu Instruments) [a] | |
| RF power / W | 1300 | |
| Coolant flow / L $min^{-1}$ | 13 | |
| Auxiliary flow / L $min^{-1}$ | 0.9 | |
| Nebulizer pressure / psi | 29-32 | |
| Interface cones | Ni, dry | |
| Resolution mode ($m/\Delta m$) | Low (~300) | |
| Sample introduction system | Apex Omega (ESI) or Aridus 3 (Teledyne CETAC) with PFA nebulizer (ESI) | |
| Scan mode | Static batch analysis | |
| Integration time / s | 10 | |
| Number of cycles per block | 10 | |
| Number of blocks | 6 | |
| Blank acquisition mode | Measure zero (on-peak) | |
| Blank integration time / s | 300 | |
| Cup configuration (cup: $m/z$) | L5: 82, L4: 83, L2: 84, Ax: 85, H2: 86, H4: 87, H6: 88, H7: 89, H8: 90, H9: 91, H10: 92 | L3: 202, L2: 203, L1: 204, Ax: 205, H1: 206, H2: 207, H3: 208 |
| Preamplifier feedback resistor | $10^{11}$ Ω | $10^{11}$ Ω |
| Average sensitivity / V/(µg $g^{-1}$) | 900 | 1500 |
| **Parameter** | **Nu Plasma HR (NP048, Nu Instruments) [b]** | |
| RF power / W | 1300 | |
| Coolant flow / L $min^{-1}$ | 13 | |
| Auxiliary flow / L $min^{-1}$ | 0.9 | |
| Nebulizer pressure / psi | 26-31 | |
| Interface cones | Ni, dry | |
| Resolution mode ($m/\Delta m$) | Low (~300) | |
| Sample introduction system | Aridus II (Teledyne CETAC) with PFA nebulizer (ESI) | |
| Scan mode | Static batch analysis | |
| Integration time / s | 10 | |
| Number of cycles per block | 10 | |
| Number of blocks | 6 | |
| Blank acquisition mode | Measure zero (on-peak) | |
| Blank integration time / s | 300 | |
| Cup configuration (cup: $m/z$) | L5: 83, L4: 84, L3: 85, L2: 86, Ax: 87, H2: 88, H4: 89, H5: 90, H6: 91 | L2: 202, L1: 203, Ax: 204, H1: 205, H2: 206, H3: 207, H4: 208 |
| Preamplifier feedback resistor | $10^{11}$ Ω | $10^{11}$ Ω |
| Average sensitivity / V/(µg $g^{-1}$) | 160 | 500 |

[a] Used for the following isotope ratio measurements: Sr: TK100 DGT eluates; Pb: TK100 DGT eluates, wheat digests (soils TU, SL, ST), radish shoot digests, radish bulb digests (soils TU, SL, ST).

[b] Used for the following isotope ratio measurements: Sr: $NH_4NO_3$ extracts, $NH_4OAc$ extracts, total digests, lettuce digests, wheat digests, radish shoot digests, radish bulb digests; Pb: Chelex DGT eluates, $NH_4NO_3$ extracts, EDTA extracts, total soil digests, lettuce digests, wheat digests (soils AS and MZ), radish bulb digests (soils AS and MZ).

**Table S5.** Elemental analysis results for certified reference materials (CRMs) [a]

| CRM | Matrix | Sr | | | Pb | | |
|---|---|---|---|---|---|---|---|
| | | Experimental $w$(Sr) / (mg kg$^{-1}$) | Certified $w$(Sr) / (mg kg$^{-1}$) | Recovery / % | Experimental $w$(Pb) / (mg kg$^{-1}$) | Certified $w$(Pb) / (mg kg$^{-1}$) | Recovery / % |
| ISE 885 | Soil | 72.3 ± 2.2 | 66.3 ± 7.8 | 109 ± 3 | 20.7 ± 0.8 | 20.2 ± 4.6 | 102 ± 4 |
| SRM 1547 | Peach leaves | 62.7 ± 5.8 | 53.0 ± 5.0 | 118 ± 11 | 0.84 ± 0.09 | 0.869 ± 0.018 | 97.1 ± 9.8 |
| IPE 200 | Maize shoots | 14.5 ± 1.9 | 13.5 ± 1.6 | 107 ± 14 | 0.30 ± 0.07 | 0.292 ± 0.155 | 104 ± 25 |

[a] Experimental values are means ± 2*s* (*n* = 3 for ISE 885; *n* = 15 for SRM 1547; *n* = 12 for IPE 200). Certified values were taken from the CRM certificates [8-10], with errors showing 2*s* for ISE 885 and IPE 200 and expanded uncertainties (*U*, *k* = 2) for SRM 1547.

**Table S6.** Isotope ratio analysis results for certified reference materials (CRMs) and quality controls (QCs) [a]

| **Isotope ratio** | **Unit** | **SRM 987 (*n* = 60)** | **SRM 981 (*n* = 59)** | **QC-SRM 987 (*n* = 52)** | **QC-SRM 981 (*n* = 57)** | **ISE 885 (*n* = 3)** | **SRM 1547 (*n* = 15)** | **IPE 200 (*n* = 14)** |
|---|---|---|---|---|---|---|---|---|
| $\delta(^{87}Sr/^{86}Sr)$ | ‰ | 0.00 ± 0.04 | n.a. | 0.06 ± 0.22 | n.a. | 11.6 ± 0.2 | 4.55 ± 0.04 | -0.90 ± 0.08 |
| $n(^{87}Sr)/n(^{86}Sr)$ | - | 0.71035 ± 0.00008 | n.a. | 0.71043 ± 0.00020 | n.a. | 0.71855 ± 0.00018 | 0.71356 ± 0.00005 | 0.70967 ± 0.00008 |
| $\delta(^{207}Pb/^{206}Pb)$ | ‰ | n.a. | 0.00 ± 0.21 | n.a. | -0.19 ± 0.41 | -87.6 ± 0.8 | -98.5 ± 0.6 | -63.8 ± 3.6 |
| $n(^{207}Pb)/n(^{206}Pb)$ | - | n.a. | 0.91464 ± 0.00020 | n.a. | 0.91447 ± 0.00037 | 0.83449 ± 0.00072 | 0.82456 ± 0.00054 | 0.85629 ± 0.00325 |
| $\delta(^{208}Pb/^{206}Pb)$ | ‰ | n.a. | -0.01 ± 0.46 | n.a. | -0.15 ± 0.59 | -46.5 ± 1.0 | -55.3 ± 0.5 | -34.8 ± 3.0 |
| $n(^{208}Pb)/n(^{206}Pb)$ | - | n.a. | 2.16808 ± 0.00100 | n.a. | 2.16778 ± 0.00128 | 2.06731 ± 0.00219 | 2.04812 ± 0.00100 | 2.09275 ± 0.00648 |
| $\delta(^{206}Pb/^{204}Pb)$ | ‰ | n.a. | 0.00 ± 0.45 | n.a. | 0.14 ± 1.05 | 108 ± 1 | 121 ± 3 | 77.0 ± 4.7 |
| $n(^{206}Pb)/n(^{204}Pb)$ | - | n.a. | 16.93635 ± 0.01158 | n.a. | 16.93850 ± 0.01996 | 18.76860 ± 0.00642 | 19.00246 ± 0.04027 | 18.24420 ± 0.08172 |

[a] Values are means ± 2*s*. n.a. = not analyzed.

**Table S7.** Sr and Pb mass fractions ($w$, in mg kg$^{-1}$ dry weight) in lettuce, wheat, and radish tissues grown in soils [a]

| Soil | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) | *p* | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) | *p* |
|---|---|---|---|---|---|---|---|---|---|---|
| | $w$(Sr) / (mg kg$^{-1}$) | | | | | $w$(Pb) / (mg kg$^{-1}$) | | | | |
| TU | 25.2 ± 2.8 | 9.69 ± 1.03 | 88.6 ± 11.6 | 20.9 ± 2.9 | *** | 0.09 ± 0.04 | 0.05 ± 0.01 | 0.10 ± 0.03 | 0.19 ± 0.16 | ns |
| | a,w | a,x | y | a,w | | a | a | a | | |
| SL | 37.2 ± 3.8 | 24.0 ± 1.6 | 74.6 ± 15.2 | 28.1 ± 5.4 | ** | 0.57 ± 0.20 | 0.13 ± 0.04 | 0.12 ± 0.01 | 0.20 ± 0.14 | * |
| | b,w | b,x | y | a,wx | | a | a | a | | |
| ST | 21.4 ± 2.5 | 7.11 ± 0.56 | 70.9 ± 8.4 | 12.7 ± 1.8 | *** | 0.10 ± 0.03 | 0.06 ± 0.01 | 0.10 ± 0.03 | 0.09 ± 0.03 | ns |
| | a,w | c,x | y | b,z | | a | a | a | | |
| AS | 27.8 ± 2.5 | 32.6 ± 4.3 | 90.1 ± 23.5 | 40.3 ± 16.3 | ** | 38.9 ± 17.0 | 26.2 ± 4.8 | 26.6 ± 14.0 | 434 ± 272 | ns |
| | a,w | bd,w | x | ab,wx | | ab | b | ab | | |
| MZ | 37.4 ± 2.2 | 30.0 ± 2.0 | 86.7 ± 5.0 | 24.1 ± 11.1 | *** | 8.37 ± 2.71 | 5.64 ± 2.67 | 10.2 ± 3.4 | 37.0 ± 17.4 | ns |
| | b,w | d,x | y | ab,wx | | b | a | b | | |
| *p* | *** | *** | ns | ** | | ** | *** | ** | ** | |

[a] Values are means ± $s$ ($n$ = 4). Asterisks denote significance: * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$. ns = not significant ($p > 0.05$). a, b, c, d = different letters along columns denote significant differences ($p < 0.05$) between soils within the same plant group; w, x, y, z = different letters along rows denote significant differences ($p < 0.05$) between plants within the same soil group.

**Table S8.** Relationships between Sr plant uptake and soil bioavailability indices (TK100 DGT, $NH_4NO_3$, $NH_4OAc$) of the five experimental soils [a]

| Index | | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) |
|---|---|---|---|---|---|
| TK100 DGT | *r* | 0.296 | -0.082 | 0.346 | -0.288 |
| | *p* | 0.284 | 0.771 | 0.207 | 0.298 |
| $NH_4NO_3$ | *r* | 0.033 | -0.297 | 0.350 | -0.225 |
| | *p* | 0.907 | 0.283 | 0.201 | 0.421 |
| $NH_4OAc$ | *r* | -0.007 | -0.339 | 0.331 | -0.260 |
| | *p* | 0.980 | 0.216 | 0.229 | 0.349 |

[a] *r* = correlation coefficient; *p* = level of significance (Pearson correlation)

**Table S9.** Mass fraction ($w$) ratios of Ca/Sr, Rb/Sr × 1000, and Ca/Pb in DGT eluates and soil extracts [a]

| Soil | $TK100_{DGT}$ | $NH_4NO_3$ | $NH_4OAc$ | *p* | $TK100_{DGT}$ | $NH_4NO_3$ | $NH_4OAc$ | *p* | $TK100_{DGT}$ | $Chelex_{DGT}$ | $NH_4NO_3$ | EDTA | *p* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $w(Ca)/w(Sr)$ | | | | $w(Rb)/w(Sr) \times 1000$ | | | | $w(Ca)/w(Pb)$ | | | | |
| TU | 71.9 ± 23.1 | 361 ± 9 | 367 ± 3 | *** | 0.06 ± 0.04 | 20.0 ± <0.1 | 17.1 ± 0.2 | *** | n.a. | n.a. | n.a. | 2255 ± 185 | n.a. |
| SL | 49.3 ± 6.3 | 245 ± 3 | 224 ± 1 | *** | 4.91 ± 0.57 | 509 ± 4 | 516 ± 2 | *** | n.a. | n.a. | n.a. | 147 ± 6 | n.a. |
| ST | 64.7 ± 7.3 | 360 ± 1 | 318 ± 3 | *** | 9.69 ± 1.57 | 735 ± 1 | 681 ± 2 | *** | n.a. | n.a. | n.a. | 287 ± 10 | n.a. |
| AS | 54.1 ± 6.3 | 246 ± <1 | 233 ± 2 | *** | 7.03 ± 1.05 | 308 ± 1 | 314 ± 1 | *** | 12.7 ± 13.8 | 27.4 ± 1.0 | 57.7 ± 0.7 | 1.29 ± 0.04 | *** |
| MZ | 51.1 ± 12.7 | 450 ± 2 | 494 ± 6 | *** | 0.33 ± 0.09 | 84.0 ± 0.6 | 82.9 ± 1.0 | *** | 176 ± 196 | 217 ± 44 | 4532 ± 12 | 14.5 ± 0.3 | *** |
| PR | 35.7 ± 5.2 | 259 ± 1 | 250 ± 1 | *** | 2.70 ± 0.59 | 168 ± 1 | 188 ± 1 | *** | 3.79 ± 4.19 | 36.3 ± 2.5 | 44.5 ± 0.4 | 0.06 ± <0.01 | *** |

[a] Values are means ± $s$ ($n$ = 3). Asterisks denote significance: *** = $p < 0.001$. n.a. = not analyzed.

**Table S10.** Relative Sr and Pb isotope ratios, expressed as $\delta$-values, in DGT-labile, extractable, and total soil fractions [a]

| Soil | $TK100_{DGT}$ | $NH_4NO_3$ | $NH_4OAc$ | Total | $TK100_{DGT}$ | $Chelex_{DGT}$ | $NH_4NO_3$ | EDTA | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $\delta(^{87}Sr/^{86}Sr)$ / ‰ | | | | $\delta(^{207}Pb/^{206}Pb)$ / ‰ | | | | |
| TU | -1.29 ± 0.23 | -1.12 ± 0.23 | -1.07 ± 0.26 | 9.24 ± 0.42 | n.a. | n.a. | n.a. | -79.6 ± 3.4 | -85.0 ± 1.8 |
| | a,w | a,w | a,w | a,x | | | | a,w | a,x |
| SL | 12.7 ± 0.3 | 12.9 ± 0.2 | 12.9 ± 0.3 | 10.6 ± 0.5 | n.a. | n.a. | n.a. | -73.2 ± 1.2 | -76.9 ± 2.1 |
| | b,w | b,w | b,w | b,x | | | | b,w | b,x |
| ST | 2.66 ± 0.23 | 2.73 ± 0.23 | 2.87 ± 0.27 | 18.6 ± 0.4 | n.a. | n.a. | n.a. | -81.4 ± 0.3 | -92.0 ± 1.4 |
| | c,w | c,w | c,w | c,x | | | | a,w | c,x |
| AS | 0.41 ± 0.23 | 0.44 ± 0.23 | 0.55 ± 0.26 | 19.6 ± 0.2 | -67.0 ± 0.3 | -67.2 ± 0.2 | -67.2 ± 0.4 | -67.1 ± 0.3 | -67.4 ± 0.2 |
| | d,w | d,w | d,w | d,x | a | a | a | c | d |
| MZ | -1.30 ± 0.22 | -1.18 ± 0.23 | -1.12 ± 0.27 | 5.31 ± 0.47 | -67.3 ± 0.4 | -67.7 ± 0.3 | -67.4 ± 0.3 | -67.4 ± 0.3 | -67.6 ± 0.2 |
| | a,w | a,w | a,w | e,x | a | b | a | c | d |
| PR | 2.11 ± 0.35 | 2.04 ± 0.23 | 2.19 ± 0.29 | 12.7 ± 0.4 | -58.2 ± 0.3 | -58.3 ± 0.3 | -58.2 ± 0.5 | -58.1 ± 0.3 | -58.3 ± 0.2 |
| | e,w | e,w | e,w | f,x | b | c | b | d | e |
| | - | | | | $\delta(^{208}Pb/^{206}Pb)$ / ‰ | | | | |
| TU | - | - | - | - | n.a. | n.a. | n.a. | -43.4 ± 2.1 | -45.0 ± 1.5 |
| | | | | | | | | a | a |
| SL | - | - | - | - | n.a. | n.a. | n.a. | -37.8 ± 0.9 | -29.3 ± 1.3 |
| | | | | | | | | b,w | b,x |
| ST | - | - | - | - | n.a. | n.a. | n.a. | -46.0 ± 0.3 | -46.9 ± 1.6 |
| | | | | | | | | c | a |
| AS | - | - | - | - | -32.4 ± 0.3 | -32.6 ± 0.2 | -32.6 ± 0.6 | -32.4 ± 0.3 | -32.5 ± 0.2 |
| | | | | | a | a | a | d | c |
| MZ | - | - | - | - | -32.4 ± 0.3 | -32.9 ± 0.3 | -32.5 ± 0.3 | -32.4 ± 0.3 | -32.5 ± 0.2 |
| | | | | | a,w | a,x | a,wx | d,w | c,w |
| PR | - | - | - | - | -27.6 ± 0.4 | -27.7 ± 0.3 | -27.4 ± 0.8 | -27.3 ± 0.3 | -27.5 ± 0.3 |
| | | | | | b | b | b | e | d |
| | - | | | | $\delta(^{206}Pb/^{204}Pb)$ / ‰ | | | | |
| TU | - | - | - | - | n.a. | n.a. | n.a. | 97.5 ± 4.5 | 105 ± 2 |
| | | | | | | | | a,w | a,x |
| SL | - | - | - | - | n.a. | n.a. | n.a. | 88.4 ± 1.4 | 93.4 ± 2.5 |
| | | | | | | | | b,w | b,x |
| ST | - | - | - | - | n.a. | n.a. | n.a. | 101 ± <1 | 115 ± 2 |
| | | | | | | | | a,w | c,x |
| AS | - | - | - | - | 83.4 ± 0.3 | 83.7 ± 0.3 | 83.5 ± 0.5 | 83.8 ± 0.3 | 84.2 ± 0.3 |
| | | | | | a,w | a,w | a,w | c,w | d,x |
| MZ | - | - | - | - | 83.5 ± 0.8 | 84.0 ± 0.2 | 84.1 ± 0.3 | 84.4 ± 0.3 | 84.6 ± 0.3 |
| | | | | | a,w | a,w | a,wx | d,xy | e,y |
| PR | - | - | - | - | 68.4 ± 0.4 | 68.4 ± 0.3 | 68.6 ± 0.9 | 68.6 ± 0.3 | 68.5 ± 0.4 |
| | | | | | b | b | b | e | f |

[a] Values are means ($n$ = 3) ± $U$ ($k$ = 2). TK100 DGT and $NH_4NO_3$ data for soils SL, AS, and MZ was re-evaluated from Wagner et al. [1] using isotopic fractionation correction via $^{88}Sr/^{86}Sr$. n.a. = not analyzed. a, b, c, d, e, f = different letters along columns denote significant differences between soils within the same soil assessment method group; w, x, y = different letters along rows denote significant differences between soil assessment methods within the same soil group. Statistical differences between two mean values were assessed considering their expanded uncertainties ($U$, $k$ = 2) [11].

**Table S11.** Absolute Sr and Pb isotope ratios in DGT-labile, extractable, and total soil fractions [a]

| Soil | $TK100_{DGT}$ | $NH_4NO_3$ | $NH_4OAc$ | Total | $TK100_{DGT}$ | $Chelex_{DGT}$ | $NH_4NO_3$ | EDTA | Total |
|---|---|---|---|---|---|---|---|---|---|
| | $n(^{87}Sr)/n(^{86}Sr)$ | | | | $n(^{207}Pb)/n(^{206}Pb)$ | | | | |
| TU | 0.70963 ± 0.00022 | 0.70955 ± 0.00013 | 0.70953 ± 0.00016 | 0.71690 ± 0.00028 | n.a. | n.a. | n.a. | 0.84188 ± 0.00307 | 0.83689 ± 0.00163 |
| SL | 0.71958 ± 0.00038 | 0.71953 ± 0.00013 | 0.71960 ± 0.00016 | 0.71782 ± 0.00031 | n.a. | n.a. | n.a. | 0.84773 ± 0.00108 | 0.84429 ± 0.00190 |
| ST | 0.71192 ± 0.00086 | 0.71229 ± 0.00014 | 0.71241 ± 0.00017 | 0.72353 ± 0.00025 | n.a. | n.a. | n.a. | 0.84023 ± 0.00031 | 0.83048 ± 0.00128 |
| AS | 0.71086 ± 0.00026 | 0.71065 ± 0.00013 | 0.71073 ± 0.00016 | 0.72427 ± 0.00015 | 0.85334 ± 0.00033 | 0.85316 ± 0.00021 | 0.85316 ± 0.00052 | 0.85327 ± 0.00025 | 0.85300 ± 0.00041 |
| MZ | 0.70964 ± 0.00022 | 0.70950 ± 0.00013 | 0.70951 ± 0.00016 | 0.71408 ± 0.00032 | 0.85313 ± 0.00033 | 0.85273 ± 0.00029 | 0.85298 ± 0.00048 | 0.85295 ± 0.00025 | 0.85278 ± 0.00041 |
| PR | 0.71195 ± 0.00036 | 0.71177 ± 0.00013 | 0.71186 ± 0.00018 | 0.71930 ± 0.00029 | 0.86140 ± 0.00033 | 0.86129 ± 0.00025 | 0.86142 ± 0.00058 | 0.86150 ± 0.00025 | 0.86134 ± 0.00041 |
| | - | | | | $n(^{208}Pb)/n(^{206}Pb)$ | | | | |
| TU | - | - | - | - | n.a. | n.a. | n.a. | 2.07397 ± 0.00446 | 2.07048 ± 0.00331 |
| SL | - | - | - | - | n.a. | n.a. | n.a. | 2.08622 ± 0.00182 | 2.10456 ± 0.00280 |
| ST | - | - | - | - | n.a. | n.a. | n.a. | 2.06838 ± 0.00046 | 2.06646 ± 0.00351 |
| AS | - | - | - | - | 2.09792 ± 0.00035 | 2.09748 ± 0.00025 | 2.09731 ± 0.00115 | 2.09785 ± 0.00037 | 2.09759 ± 0.00029 |
| MZ | - | - | - | - | 2.09793 ± 0.00064 | 2.09667 ± 0.00058 | 2.09765 ± 0.00053 | 2.09784 ± 0.00036 | 2.09757 ± 0.00021 |
| PR | - | - | - | - | 2.10832 ± 0.00043 | 2.10796 ± 0.00048 | 2.10872 ± 0.00170 | 2.10884 ± 0.00028 | 2.10837 ± 0.00042 |
| | - | | | | $n(^{206}Pb)/n(^{204}Pb)$ | | | | |
| TU | - | - | - | - | n.a. | n.a. | n.a. | 18.58793 ± 0.07785 | 18.71407 ± 0.03173 |
| SL | - | - | - | - | n.a. | n.a. | n.a. | 18.43141 ± 0.03373 | 18.51719 ± 0.03337 |
| ST | - | - | - | - | n.a. | n.a. | n.a. | 18.64132 ± 0.00303 | 18.88559 ± 0.02039 |
| AS | - | - | - | - | 18.34875 ± 0.00850 | 18.35671 ± 0.00649 | 18.35426 ± 0.00300 | 18.35645 ± 0.00119 | 18.36612 ± 0.01126 |
| MZ | - | - | - | - | 18.35968 ± 0.00699 | 18.36292 ± 0.01178 | 18.36289 ± 0.00590 | 18.36650 ± 0.00150 | 18.37138 ± 0.00533 |
| PR | - | - | - | - | 18.09458 ± 0.00198 | 18.09463 ± 0.00036 | 18.09883 ± 0.01477 | 18.09996 ± 0.00123 | 18.09979 ± 0.00536 |

[a] Values are means ($n$ = 3) ± $U$ ($k$ = 2). TK100 DGT and $NH_4NO_3$ data for soils SL, AS, and MZ was re-evaluated from Wagner et al. [1] using isotopic fractionation correction via $^{88}Sr/^{86}Sr$. n.a. = not analyzed.

**Table S12.** Relative Sr and Pb isotope ratios, expressed as $\delta$-values, in lettuce, wheat, and radish tissues grown in soils [a]

| Soil | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) |
|---|---|---|---|---|---|---|---|---|
| | $\delta(^{87}Sr/^{86}Sr)$ / ‰ | | | | $\delta(^{207}Pb/^{206}Pb)$ / ‰ | | | |
| TU | -1.12 ± 0.26 a | -1.08 ± 0.25 a | -1.12 ± 0.17 a | -1.05 ± 0.20 a | -60.8 ± 6.1 a,w | -59.2 ± 8.9 a,w | n.a. | -75.5 ± 13.3 abc,x |
| SL | 12.5 ± 0.4 b,w | 13.0 ± 0.3 b,x | 13.2 ± 0.2 b,x | 13.4 ± 0.3 b,x | -71.3 ± 21.3 ab,wx | -66.4 ± 3.4 abc,x | n.a. | -74.2 ± 2.1 a,y |
| ST | 2.78 ± 0.31 c | 2.98 ± 0.26 c | 2.94 ± 0.18 c | 3.23 ± 0.39 c | -68.0 ± 8.5 ab | -67.9 ± 3.9 abc | n.a. | -77.5 ± 9.8 a |
| AS | 0.54 ± 0.53 d | 0.57 ± 0.25 d | 0.57 ± 0.18 d | 0.72 ± 0.34 d | -67.2 ± 0.4 b | -67.2 ± 0.2 b | -67.1 ± 0.4 | -67.3 ± 0.2 b |
| MZ | -1.01 ± 0.27 a | -0.96 ± 0.25 a | -1.07 ± 0.18 a | -0.94 ± 0.30 a | -67.5 ± 0.5 b | -67.5 ± 0.2 c | -67.3 ± 0.4 | -67.6 ± 0.2 c |
| | - | | | | $\delta(^{208}Pb/^{206}Pb)$ / ‰ | | | |
| TU | - | - | - | - | -31.6 ± 4.4 abc,w | -31.3 ± 4.6 a,w | n.a. | -40.6 ± 7.3 a,x |
| SL | - | - | - | - | -32.8 ± 8.9 abc,wx | -34.1 ± 2.7 ab,w | n.a. | -38.0 ± 1.2 a,x |
| ST | - | - | - | - | -35.6 ± 2.4 ab,w | -36.3 ± 1.1 b,w | n.a. | -43.1 ± 5.3 a,x |
| AS | - | - | - | - | -32.6 ± 0.7 c | -32.7 ± 0.2 a | -32.7 ± 0.5 | -32.8 ± 0.3 b |
| MZ | - | - | - | - | -32.5 ± 1.0 c | -32.6 ± 0.3 a | -32.5 ± 0.5 | -32.7 ± 0.2 b |
| | - | | | | $\delta(^{206}Pb/^{204}Pb)$ / ‰ | | | |
| TU | - | - | - | - | 72.6 ± 7.5 a,w | 71.1 ± 11.7 a,wx | n.a. | 92.1 ± 17.8 ab,x |
| SL | - | - | - | - | 86.0 ± 27.0 ab,wx | 80.1 ± 4.4 ab,w | n.a. | 89.3 ± 3.2 a,x |
| ST | - | - | - | - | 82.3 ± 10.1 ab | 82.16 ± 5.3 ab | n.a. | 94.6 ± 12.6 ab |
| AS | - | - | - | - | 83.5 ± 1.1 b | 83.5 ± 0.6 b | 83.3 ± 0.7 | 83.5 ± 0.6 b |
| MZ | - | - | - | - | 84.2 ± 1.4 b | 84.0 ± 0.7 b | 83.7 ± 0.8 | 84.1 ± 0.6 b |

[a] Values are means ($n$ = 4) ± $U$ ($k$ = 2). n.a. = not analyzed. a, b, c, d = different letters along columns denote significant differences between soils within the same plant group; w, x, y = different letters along rows denote significant differences between plants within the same soil group. Statistical differences between two mean values were assessed considering their expanded uncertainties ($U$, $k$ = 2) [11].

**Table S13.** Absolute Sr and Pb isotope ratios in lettuce, wheat, and radish tissues grown in soils [a]

| Soil | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) | Lettuce (shoot) | Wheat (shoot) | Radish (shoot) | Radish (bulb) |
|---|---|---|---|---|---|---|---|---|
| | $n(^{87}Sr)/n(^{86}Sr)$ | | | | $n(^{207}Pb)/n(^{206}Pb)$ | | | |
| TU | 0.70955 ± 0.00016 | 0.70958 ± 0.00014 | 0.70958 ± 0.00009 | 0.70959 ± 0.00011 | 0.85907 ± 0.00557 | 0.86047 ± 0.00406 | n.a. | 0.84561 ± 0.01220 |
| SL | 0.71919 ± 0.00025 | 0.71962 ± 0.00016 | 0.71975 ± 0.00010 | 0.71983 ± 0.00021 | 0.84947 ± 0.01951 | 0.85396 ± 0.00309 | n.a. | 0.84676 ± 0.00196 |
| ST | 0.71233 ± 0.00019 | 0.71247 ± 0.00015 | 0.71244 ± 0.00010 | 0.71263 ± 0.00026 | 0.85245 ± 0.00775 | 0.85257 ± 0.00359 | n.a. | 0.84378 ± 0.00897 |
| AS | 0.71071 ± 0.00036 | 0.71073 ± 0.00014 | 0.71075 ± 0.00010 | 0.71086 ± 0.00021 | 0.85322 ± 0.00034 | 0.85317 ± 0.00015 | 0.85362 ± 0.00175 | 0.85307 ± 0.00014 |
| MZ | 0.70958 ± 0.00016 | 0.70964 ± 0.00014 | 0.70958 ± 0.00010 | 0.70967 ± 0.00018 | 0.85295 ± 0.00044 | 0.85291 ± 0.00016 | 0.85236 ± 0.00296 | 0.85281 ± 0.00014 |
| | - | | | | $n(^{208}Pb)/n(^{206}Pb)$ | | | |
| TU | - | - | - | - | 2.09951 ± 0.00950 | 2.10032 ± 0.00989 | n.a. | 2.08014 ± 0.01587 |
| SL | - | - | - | - | 2.09705 ± 0.01936 | 2.09427 ± 0.00589 | n.a. | 2.08579 ± 0.00262 |
| ST | - | - | - | - | 2.09093 ± 0.00512 | 2.08949 ± 0.00238 | n.a. | 2.07474 ± 0.01158 |
| AS | - | - | - | - | 2.09747 ± 0.00154 | 2.09728 ± 0.00050 | 2.09783 ± 0.00233 | 2.09709 ± 0.00054 |
| MZ | - | - | - | - | 2.09760 ± 0.00217 | 2.09734 ± 0.00060 | 2.09633 ± 0.00506 | 2.09726 ± 0.00050 |
| | - | | | | $n(^{206}Pb)/n(^{204}Pb)$ | | | |
| TU | - | - | - | - | 18.17979 ± 0.12681 | 18.15000 ± 0.18556 | n.a. | 18.50479 ± 0.28502 |
| SL | - | - | - | - | 18.39129 ± 0.47056 | 18.29869 ± 0.07738 | n.a. | 18.45277 ± 0.05457 |
| ST | - | - | - | - | 18.32777 ± 0.17258 | 18.33453 ± 0.08766 | n.a. | 18.54388 ± 0.22006 |
| AS | - | - | - | - | 18.35154 ± 0.01907 | 18.35113 ± 0.01036 | 18.33976 ± 0.03529 | 18.35068 ± 0.01089 |
| MZ | - | - | - | - | 18.36855 ± 0.02719 | 18.36228 ± 0.01854 | 18.37052 ± 0.06262 | 18.36029 ± 0.01139 |

[a] Values are means ($n$ = 4) ± $U$ ($k$ = 2). n.a. = not analyzed.

**Table S14.** Isotopic differences, expressed as Δ-values, of Sr and Pb between TK100 and/or Chelex DGT-labile soil fractions and plant tissues [a]

| Soil | TK100 DGT | | | | Chelex DGT | | | |
|---|---|---|---|---|---|---|---|---|
| | **Lettuce (shoot)** | **Wheat (shoot)** | **Radish (shoot)** | **Radish (bulb)** | **Lettuce (shoot)** | **Wheat (shoot)** | **Radish (shoot)** | **Radish (bulb)** |
| | **$\Delta(^{87}Sr/^{86}Sr)_{DGT\text{-}plant}$ / ‰** | | | | **$\Delta(^{87}Sr/^{86}Sr)_{DGT\text{-}plant}$ / ‰** | | | |
| TU | -0.17 ± 0.35 | -0.21 ± 0.34 | -0.17 ± 0.29 | -0.24 ± 0.30 | n.a. | n.a. | n.a. | n.a. |
| SL | 0.24 ± 0.47 | -0.31 ± 0.39 | -0.51 ± 0.33 | -0.67 ± 0.42 | n.a. | n.a. | n.a. | n.a. |
| ST | -0.12 ± 0.39 | -0.32 ± 0.35 | -0.27 ± 0.30 | -0.57 ± 0.45 | n.a. | n.a. | n.a. | n.a. |
| AS | -0.13 ± 0.58 | -0.16 ± 0.34 | -0.16 ± 0.29 | -0.31 ± 0.41 | n.a. | n.a. | n.a. | n.a. |
| MZ | -0.28 ± 0.35 | -0.34 ± 0.33 | -0.23 ± 0.28 | -0.36 ± 0.37 | n.a. | n.a. | n.a. | n.a. |
| | **$\Delta(^{207}Pb/^{206}Pb)_{DGT\text{-}plant}$ / ‰** | | | | **$\Delta(^{207}Pb/^{206}Pb)_{DGT\text{-}plant}$ / ‰** | | | |
| AS | 0.14 ± 0.50 | 0.19 ± 0.38 | 0.12 ± 0.49 | 0.29 ± 0.38 | -0.01 ± 0.28 | -0.01 ± 0.28 | -0.07 ± 0.42 | 0.10 ± 0.28 |
| MZ | 0.20 ± 0.59 | 0.24 ± 0.39 | 0.06 ± 0.53 | 0.35 ± 0.38 | -0.20 ± 0.36 | -0.20 ± 0.36 | -0.38 ± 0.50 | -0.09 ± 0.35 |
| | **$\Delta(^{208}Pb/^{206}Pb)_{DGT\text{-}plant}$ / ‰** | | | | **$\Delta(^{208}Pb/^{206}Pb)_{DGT\text{-}plant}$ / ‰** | | | |
| AS | 0.21 ± 0.79 | 0.30 ± 0.41 | 0.28 ± 0.64 | 0.38 ± 0.43 | 0.09 ± 0.33 | 0.09 ± 0.33 | 0.08 ± 0.59 | 0.18 ± 0.34 |
| MZ | 0.15 ± 1.09 | 0.27 ± 0.51 | 0.17 ± 0.69 | 0.31 ± 0.49 | -0.31 ± 0.44 | -0.31 ± 0.44 | -0.41 ± 0.64 | -0.27 ± 0.41 |
| | **$\Delta(^{206}Pb/^{204}Pb)_{DGT\text{-}plant}$ / ‰** | | | | **$\Delta(^{206}Pb/^{204}Pb)_{DGT\text{-}plant}$ / ‰** | | | |
| AS | -0.12 ± 1.17 | -0.13 ± 0.69 | 0.06 ± 0.76 | -0.14 ± 0.69 | 0.22 ± 0.67 | 0.22 ± 0.67 | 0.41 ± 0.74 | 0.21 ± 0.66 |
| MZ | -0.72 ± 1.56 | -0.57 ± 1.04 | -0.24 ± 1.08 | -0.62 ± 0.98 | -0.04 ± 0.73 | -0.04 ± 0.73 | 0.29 ± 0.79 | -0.09 ± 0.65 |

[a] Values are means ± $U$ ($k$ = 2). n.a. = not analyzed.

## References


1. Wagner S, Santner J, Irrgeher J, Puschenreiter M, Happel S, Prohaska T. Selective Diffusive Gradients in Thin Films (DGT) for the Simultaneous Assessment of Labile Sr and Pb Concentrations and Isotope Ratios in Soils. Analytical Chemistry. 2022;94(16):6338-46. 10.1021/acs.analchem.2c00546.
2. National Institute of Standards and Technology (NIST). Certificate of Analysis Standard Reference Material® 987 Strontium Carbonate (Isotopic Standard) 2007. Available from: https://tsapps.nist.gov/srmext/certificates/987.pdf. Accessed on: 30.09.2025.
3. National Institute of Standards and Technology (NIST). Certificate of Analysis Standard Reference Material 981 Common Lead Isotopic Standard. 1991.
4. Retzmann A, Zimmermann T, Pröfrock D, Prohaska T, Irrgeher J. A fully automated simultaneous single-stage separation of Sr, Pb, and Nd using DGA Resin for the isotopic analysis of marine sediments. Analytical and Bioanalytical Chemistry. 2017;409(23):5463-80. 10.1007/s00216-017-0468-6.
5. Prohaska T, Watkins M, Latkoczy C, Wenzel WW, Stingeder G. Lead isotope ratio analysis by inductively coupled plasma sector field mass spectrometry (ICP-SMS) in soil digests of a depth profile. Journal of Analytical Atomic Spectrometry. 2000;15(4):365-9. 10.1039/A907203I.
6. Zimmermann T, Retzmann A, Schober M, Pröfrock D, Prohaska T, Irrgeher J. Matrix separation of Sr and Pb for isotopic ratio analysis of Ca-rich samples via an automated simultaneous separation procedure. Spectrochimica Acta Part B: Atomic Spectroscopy. 2019;151:54-64. https://doi.org/10.1016/j.sab.2018.11.009.
7. IUSS Working Group WRB. World Reference Base for Soil Resources 2014, update 2015: International soil classification system for naming soils and creating legends for soil maps. Rome: FAO; 2015. Available from: http://www.fao.org/3/a-i3794e.pdf. Accessed on: 19 January 2017.
8. Wageningen Evaluating Programs for Analytical Laboratories (WEPAL). Certificate of Analysis International Soil-Analytical Exchange REFERENCE MATERIAL ISE sample 885. 2020. Available from: https://participants.wepal.nl/webshop/quotation.php?action=download_certificate&ptprogram=Soil&file=/WEPAL/ISE-885.pdf. Accessed on: 29.09.2025.
9. National Institute of Standards and Technology (NIST). Standard Reference Material® 1547 Peach Leaves CERTIFICATE OF ANALYSIS. 2022. Available from: https://tsapps.nist.gov/srmext/certificates/archives/1547.pdf. Accessed on: 29.09.2025.
10. Wageningen Evaluating Programs for Analytical Laboratories (WEPAL). Certificate of Analysis International Plant-Analytical Exchange REFERENCE MATERIAL IPE sample 200. 2020. Available from: https://participants.wepal.nl/webshop/order.php?action=download_certificate&ptprogram=Plants&file=/WEPAL/IPE-200.pdf. Accessed on: 29.09.2025.
11. Linsinger T. Application Note 1 - Comparison of a measurement result with the certified value. Geel: European Commission - Joint Research Centre Institute for Reference Materials and Measurements (IRMM); 2010. Available from: https://ec.europa.eu/jrc/sites/default/files/erm_application_note_1_en.pdf. Accessed on: 08.10.2021.