Supplementary material

to

Cadmium associates with oxalate in calcium oxalate crystals and competes with calcium for translocation to stems in the cadmium bioindicator *Gomphrena claussenii*

Paula PONGRAC, Tânia S. SERRA, Hiram CASTILLO-MICHEL, Katarina VOGEL-MIKUŠ, Iztok ARČON, Mitja KELEMEN, Boštjan JENČIČ, Anja KAVČIČ, Mina T. VILLAFORT CARVALHO, Mark G.M AARTS

The following supporting information is available:

Figure S1 The Cd L_3 edge μ-XANES spectra measured in selected Ca oxalate crystals (in stems and leaves) and in the Cd-enriched pixel in a root of *Gomphrena claussenii* grown in hydroponics, exposed to 1 mM (1Ca) or 10 mM (10Ca) $CaSO_4$ + 0.1 mM $CdSO_4$, and Cd L_3 edge μ-XANES spectra of the reference compounds. eV, electron volts.

Figure S2 Concentrations of magnesium (Mg), phosphorus (P), sulphur (S), manganese (Mn), iron (Fe) and zinc (Zn) in *Gomphrena claussenii* grown in hydroponics, exposed to different $CaSO_4$ (*Low Ca*, 0.1 mM; *Sufficient Ca*, 1 mM or *High Ca*, 10 mM) and cadmium (Cd) concentrations.

Figure S3 Backscattered electron image of a leaf and a stem cross sections of *Gomphrena claussenii* grown in hydroponics, exposed to 1 mM $CaSO_4$ + 0.1 mM $CdSO_4$.

Figure S4 Phosphorus (P), sulphur (S) and potassium (K) distribution maps in a root of *Gomphrena claussenii* grown in hydroponics, exposed to 10 mM $CaSO_4$ + 0.1 mM $CdSO_4$.

Figure S5 Phosphorus (P), sulphur (S) and potassium (K) distribution maps in an oxalate crystal in a stem and a leaf cross-section of *Gomphrena claussenii* grown in hydroponics, exposed to 1 mM $CaSO_4$ + 0.1 mM $CdSO_4$.

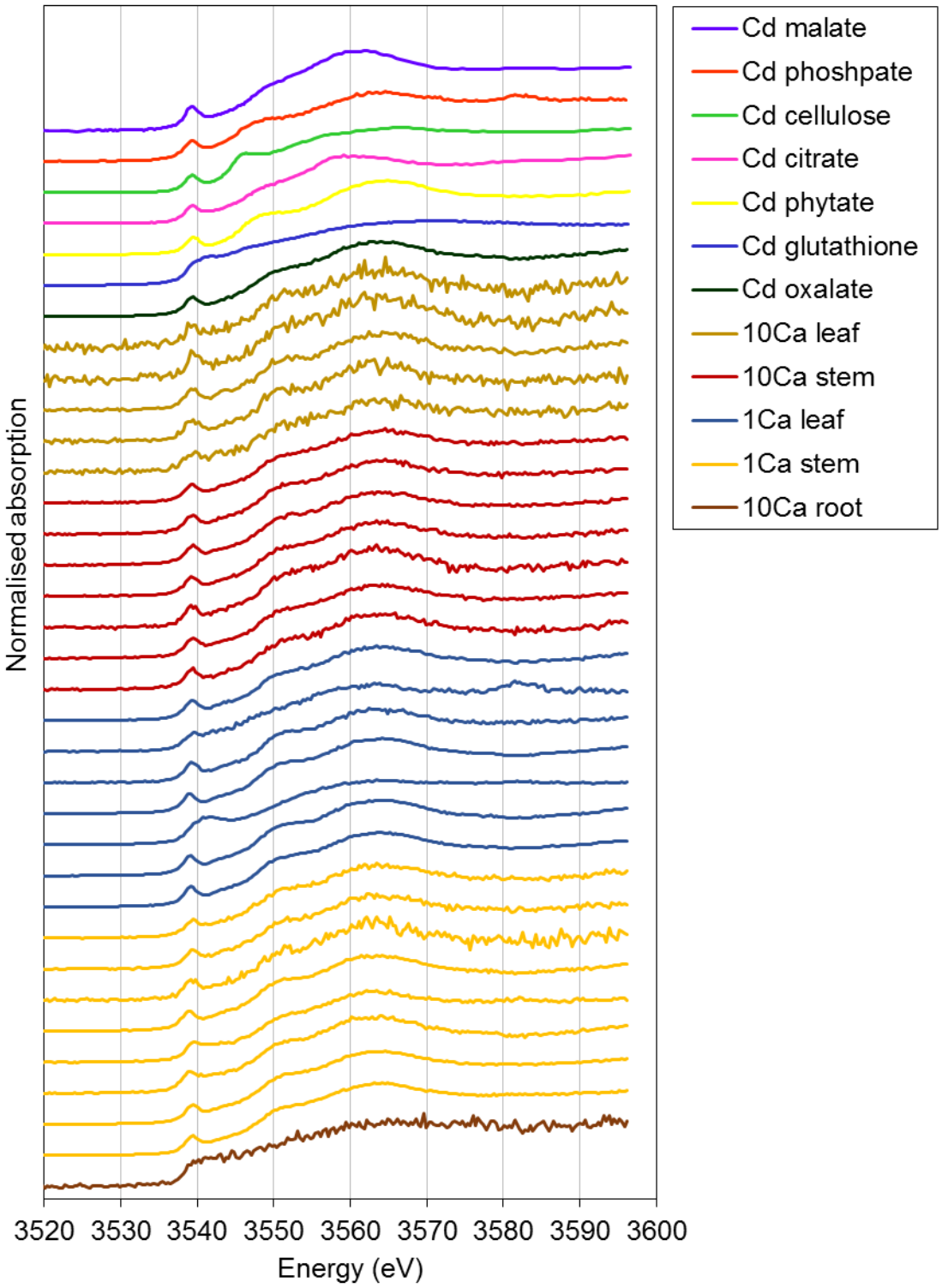

Figure S1 The Cd L_3 edge µ-XANES spectra measured in selected Ca oxalate crystals (in stems and leaves) and in the Cd-enriched pixel in a root of *Gomphrena claussenii* grown in hydroponics, exposed to 1 mM (1Ca) or 10 mM (10Ca) $CaSO_4$ + 0.1 mM $CdSO_4$, and Cd L_3 edge µ-XANES spectra of the reference compounds. Spectra are shifted vertically for clarity. eV, electron volts.

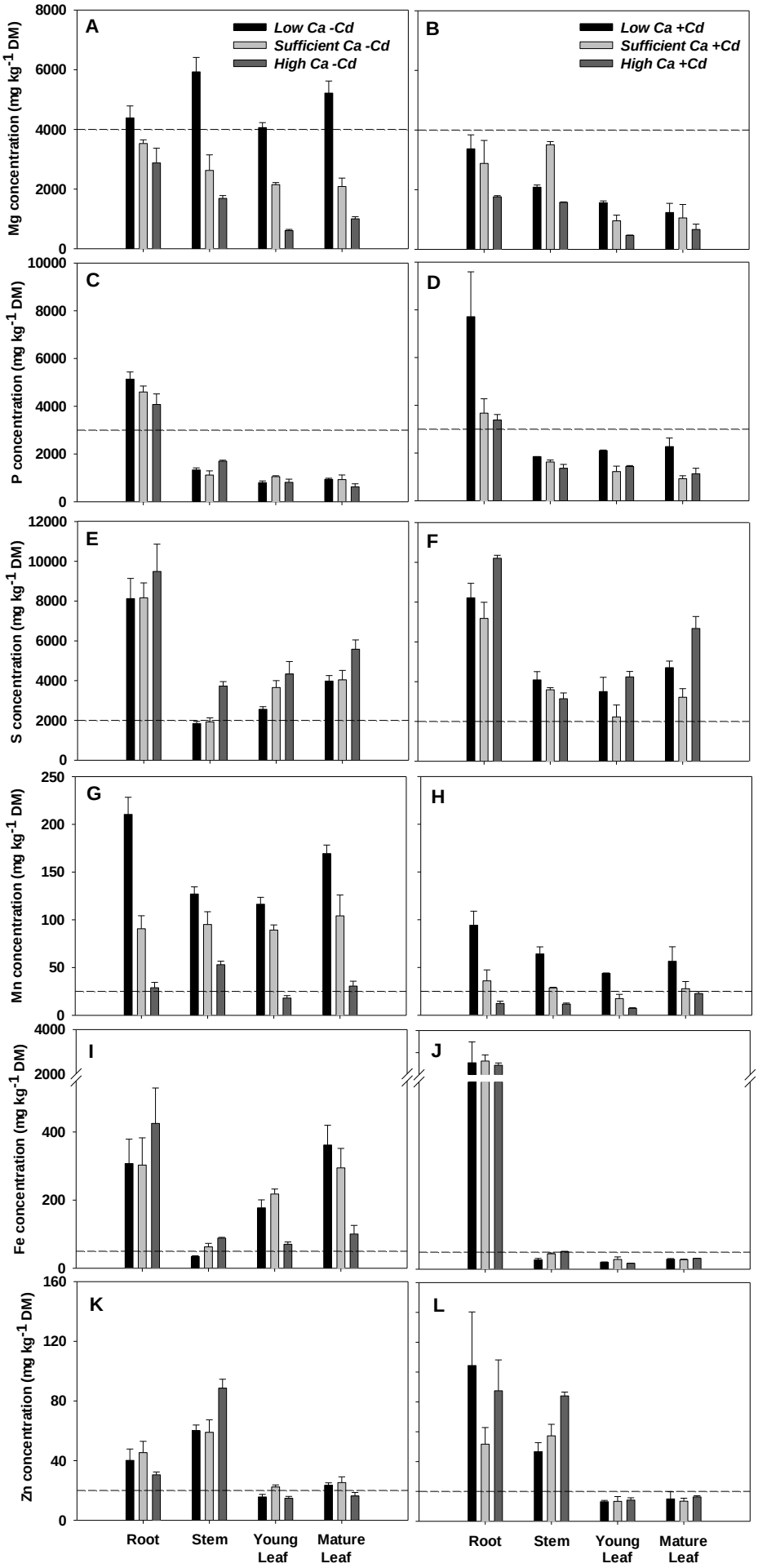
A
Low Ca -Cd
Sufficient Ca -Cd
High Ca -Cd
B
Low Ca +Cd
Sufficient Ca +Cd
High Ca +Cd
Mg concentration (mg kg-1 DM)
C
D
P concentration (mg kg-1 DM)
E
F
S concentration (mg kg-1 DM)
G
H
Mn concentration (mg kg-1 DM)
I
J
Fe concentration (mg kg-1 DM)
K
L
Zn concentration (mg kg-1 DM)
Root
Stem
Young Leaf
Mature Leaf

Figure S2 Concentrations of magnesium (Mg), phosphorus (P), sulphur (S), manganese (Mn), iron (Fe) and zinc (Zn) in *Gomphrena claussenii* grown in hydroponics, exposed to different $CaSO_4$ (*Low Ca*, 0.1 mM; *Sufficient Ca*, 1 mM or *High Ca*, 10 mM) and cadmium (Cd) concentrations; no $CdSO_4$ added: *-Cd* (**A, C, E, G, I and K**), or 0.1 mM $CdSO_4$ added: *+Cd*, (**B, D**, **F, H, J and L**). Dashed line indicates the adequate nutrient concentration for mature spinach leaves (*Spinacia oleracea*, Amaranthaceae; [1]). Shown are means and standard errors; DM, dry matter.

Reference

1 C. R. Campbell, 2000, 1040, 122.

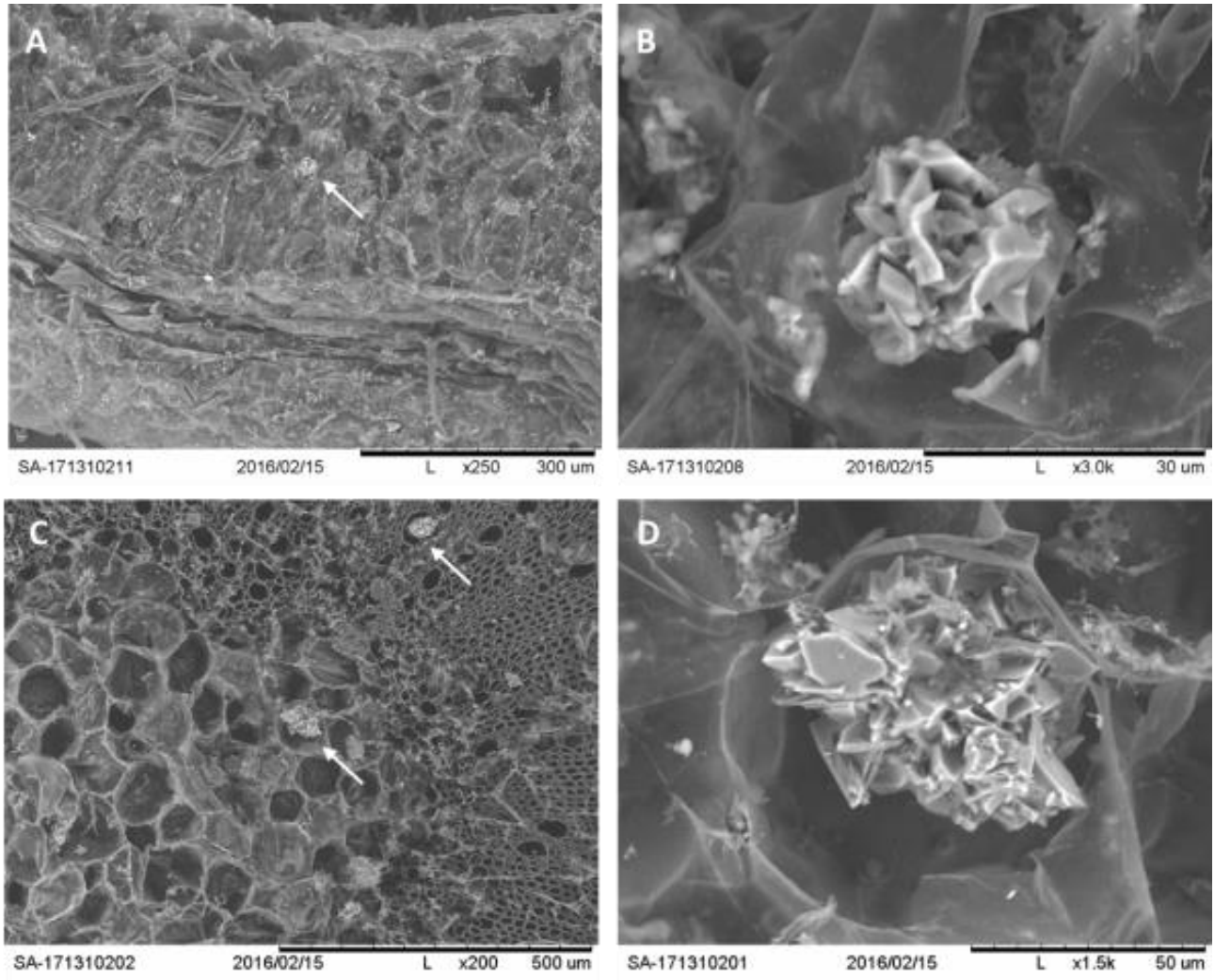

Figure S3 Backscattered electron image of a leaf (**A** and **B**) and a stem (**C** and **D**) cross sections (with oxalate crystals in A and C indicated by arrows; B and D are zooms on these crystals) of *Gomphrena claussenii* grown in hydroponics, exposed to 1 mM $CaSO_4$ + 0.1 mM $CdSO_4$.

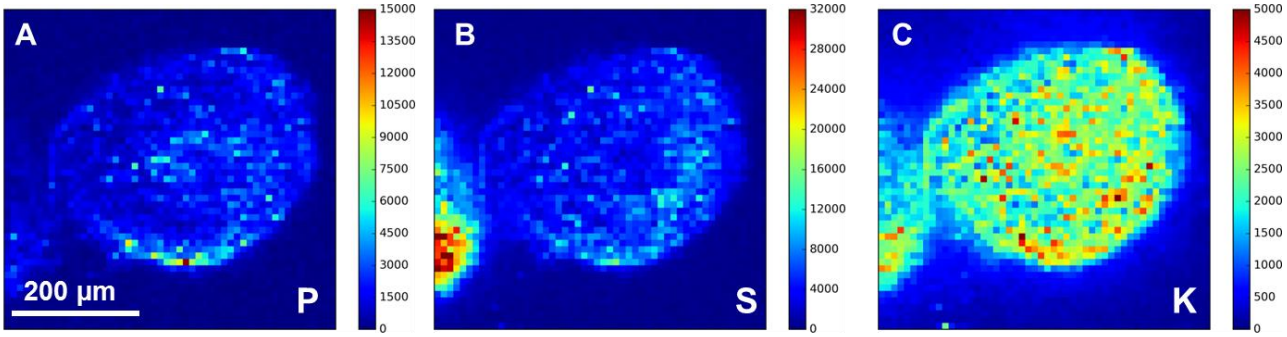

Figure S4 Phosphorus (P; **A**), sulphur (S; **B**) and potassium (K; **C**) distribution maps in a root of *Gomphrena claussenii* grown in hydroponics, exposed to 10 mM $CaSO_4$ + 0.1 mM $CdSO_4$. Colour legends to the distribution maps are in counts per second. Step size: 10 µm.

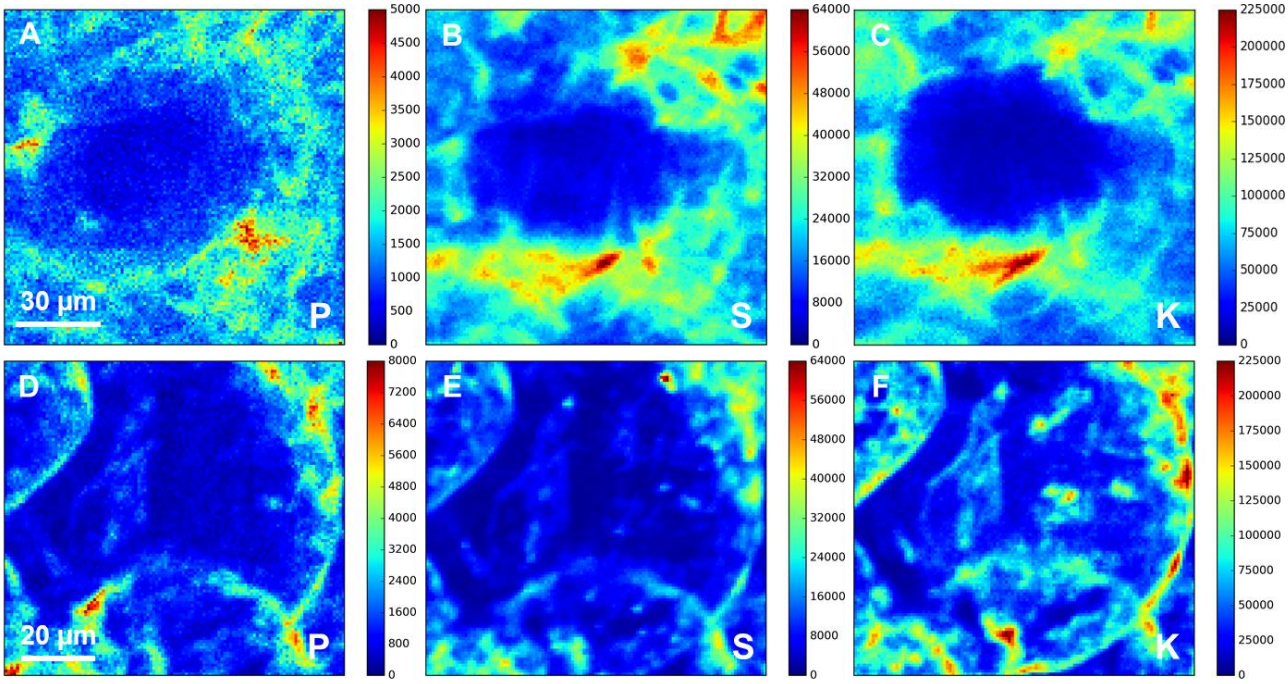

Figure S5 Phosphorus (P; **A** and **D**), sulphur (S; **B** and **E**) and potassium (K; **C** and **F**) distribution maps in an oxalate crystal in a stem (**A-C**) and a leaf (**D-F**) cross-section of *Gomphrena claussenii* grown in hydroponics, exposed to 1 mM $CaSO_4$ + 0.1 mM $CdSO_4$. Colour legends to distribution maps are in counts per second. Step size: 1 µm (A-B) and 0.8 µm (D-E).