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Microanalyse à haute résolution du bois et dendrochronologie des arbres tropicaux

Wood SXRF microanalysis and dendrochronology of tropical trees

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D. Thiaudière, C. Mocuta (SOLEIL, DIFFABS)



Context

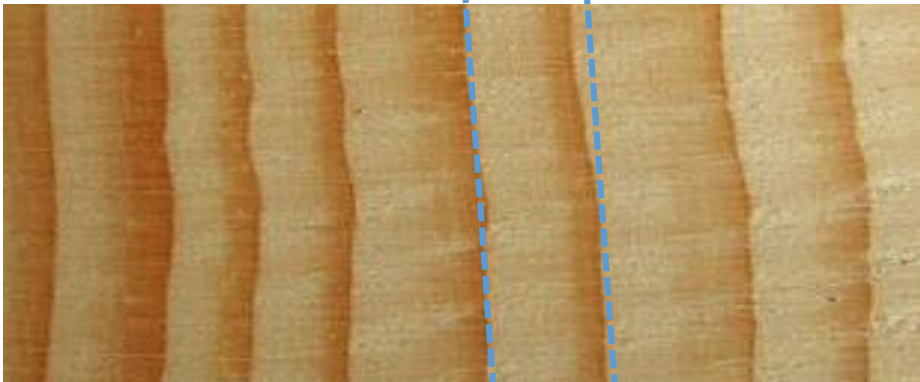
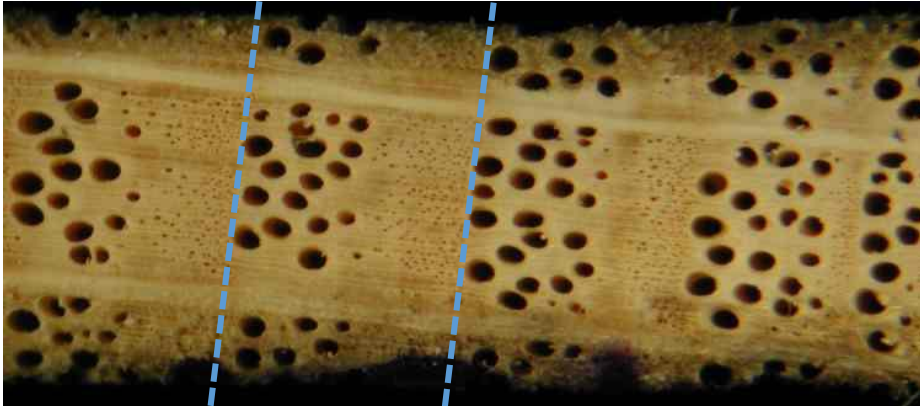


Paracou, Guyane française, 140 tree species /ha

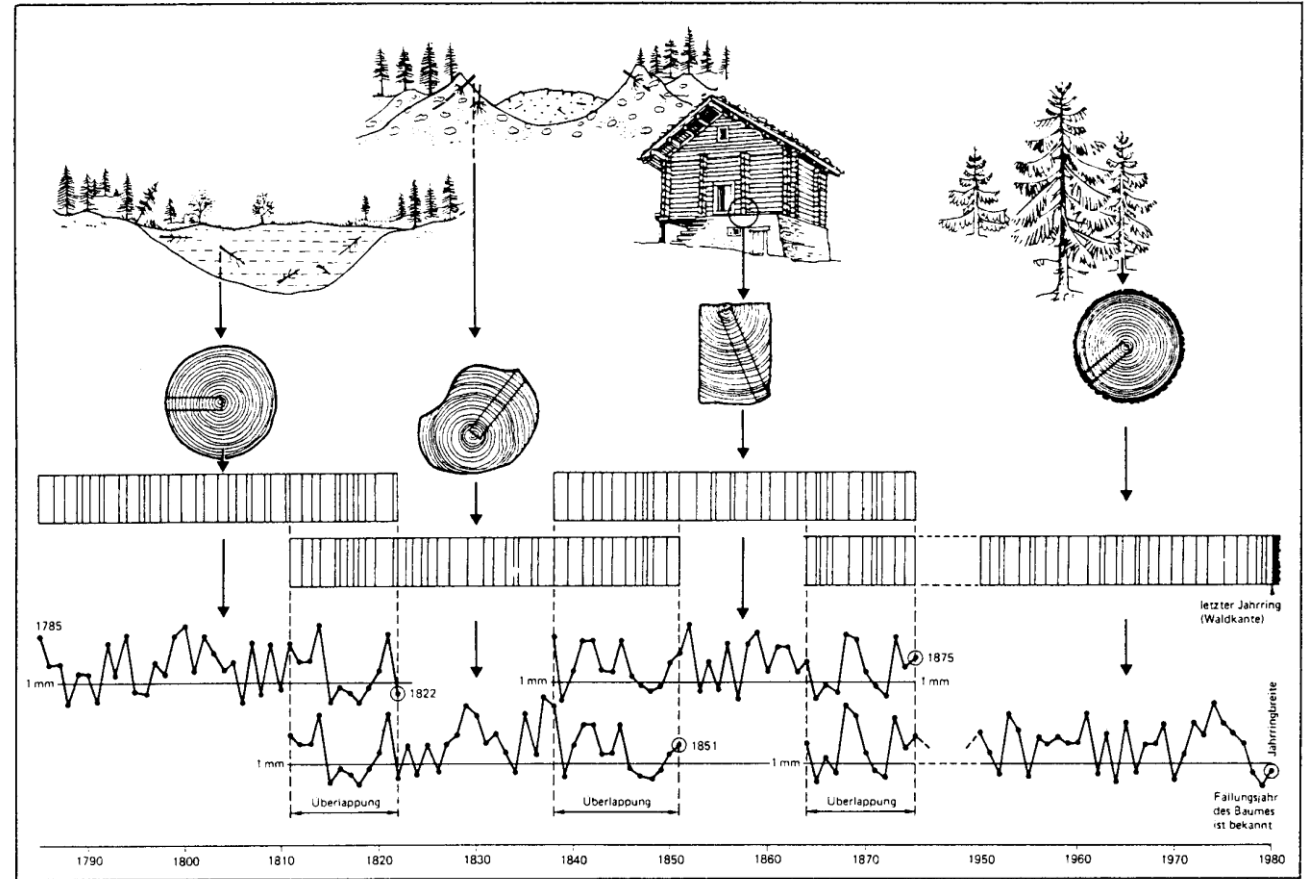
- Effect of environmental global changes on forest (temperature, precipitation pattern, $[\text{CO}_2]_{\text{atm}}$, atmosp. deposition,...)
- Sustainable management of forest resources
- Wet tropical forests:
 - lack of knowledge on growth dynamics (and determinants).
 - Harvest policies

Dendrochronology

Quercus robur



Abies alba

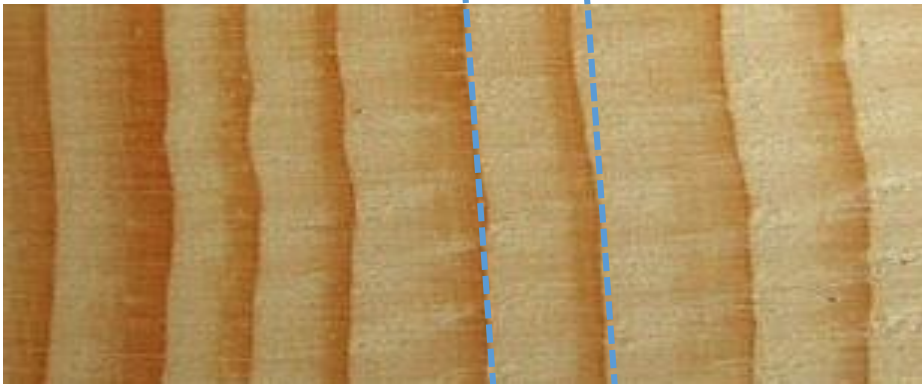
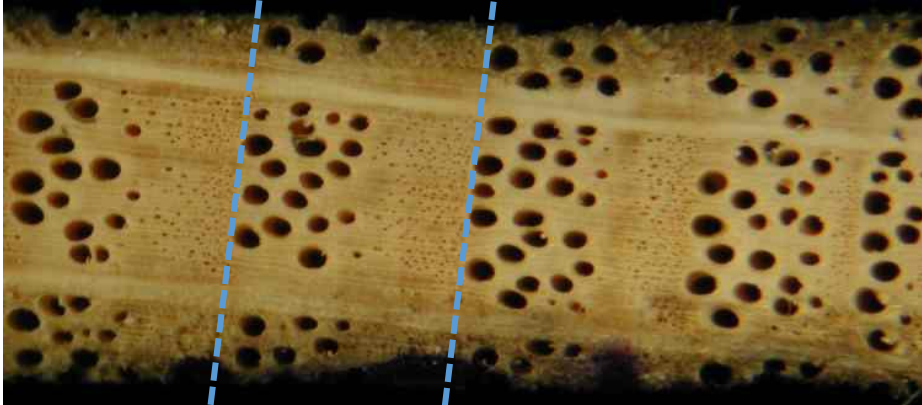


Schweingruber, 1983

→ Retrospective growth analysis

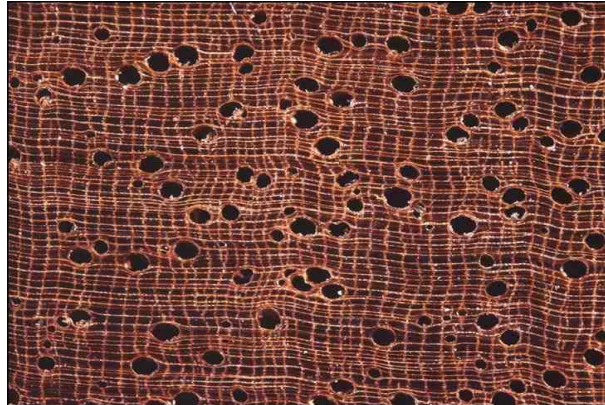
Dendrochronology

Quercus robur



Abies alba

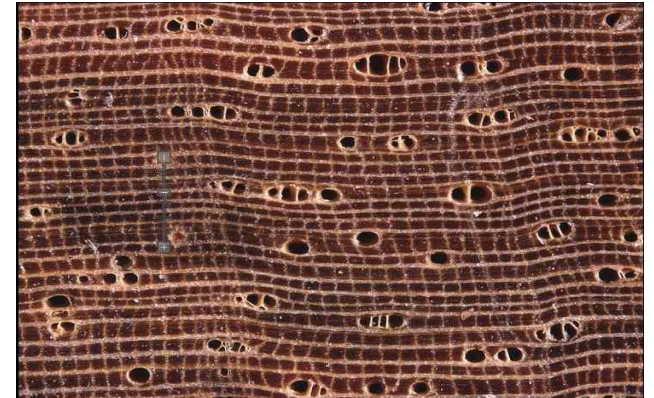
Licania micrantha



Goupia glabra



Vouacapoua americana



Couratari multiflora

→ Retrospective growth analysis

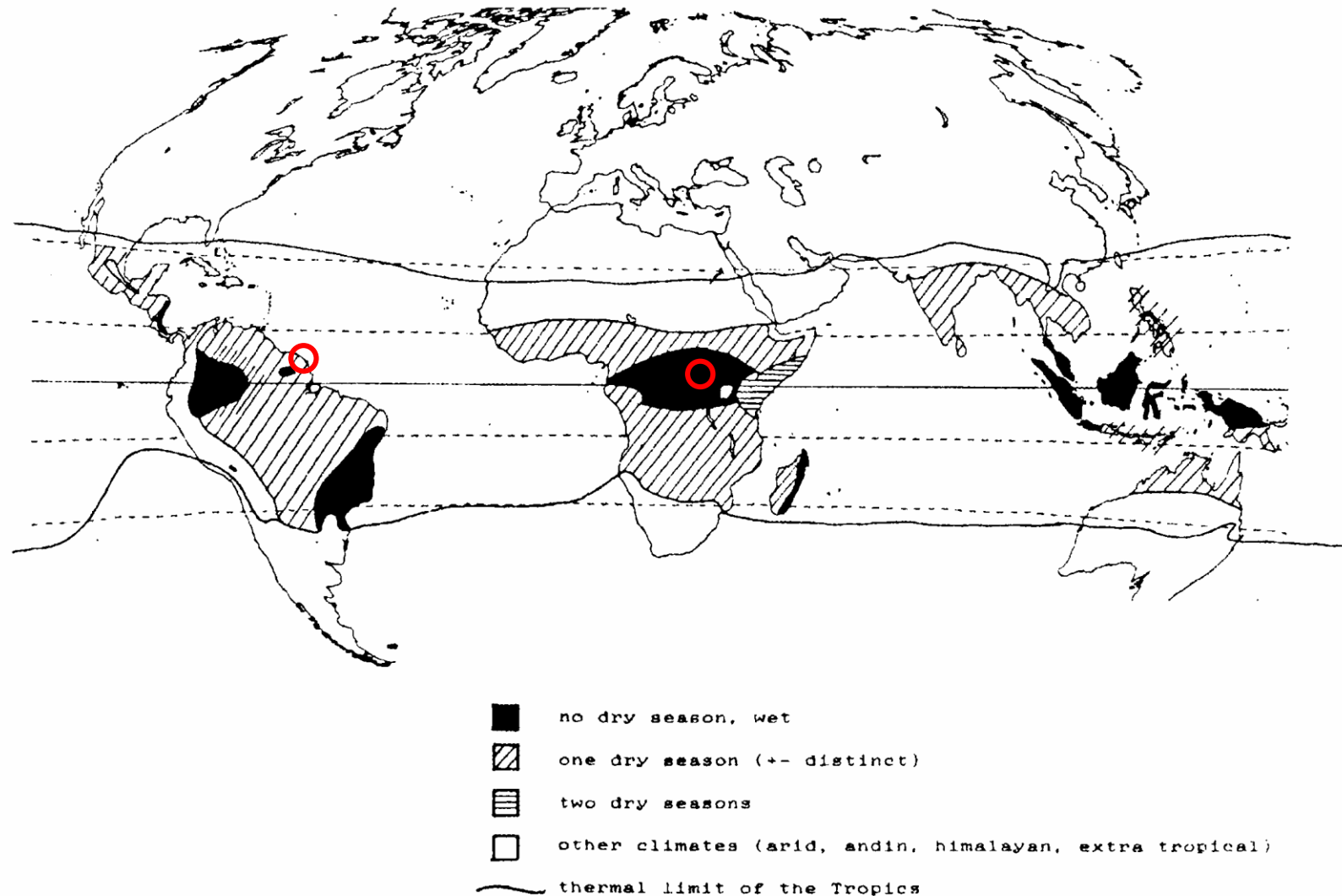


Tropical forest trees

Objectives

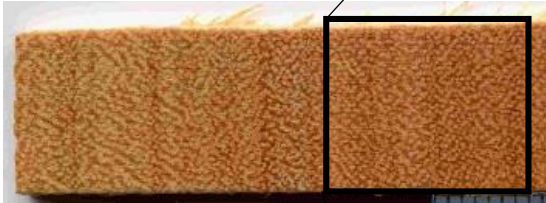
- **Find (reliable) chemical markers of radial growth in the wood for *a posteriori* reconstruction of tree growth (and dating)**
- Synchrotron XRF: (i) non-destructive (repetitions, further measurements), (ii) relatively rapide, (iii) high spatial resolution... as compared to stable isotopes approaches (*e.g.* $\delta^{13}\text{C}$, $\delta^{18}\text{O}$)
- Dendrochemical variations : endogenous and/or environmental determinism

Climate seasonal variations in tropical forests



Wood samples & sampling design

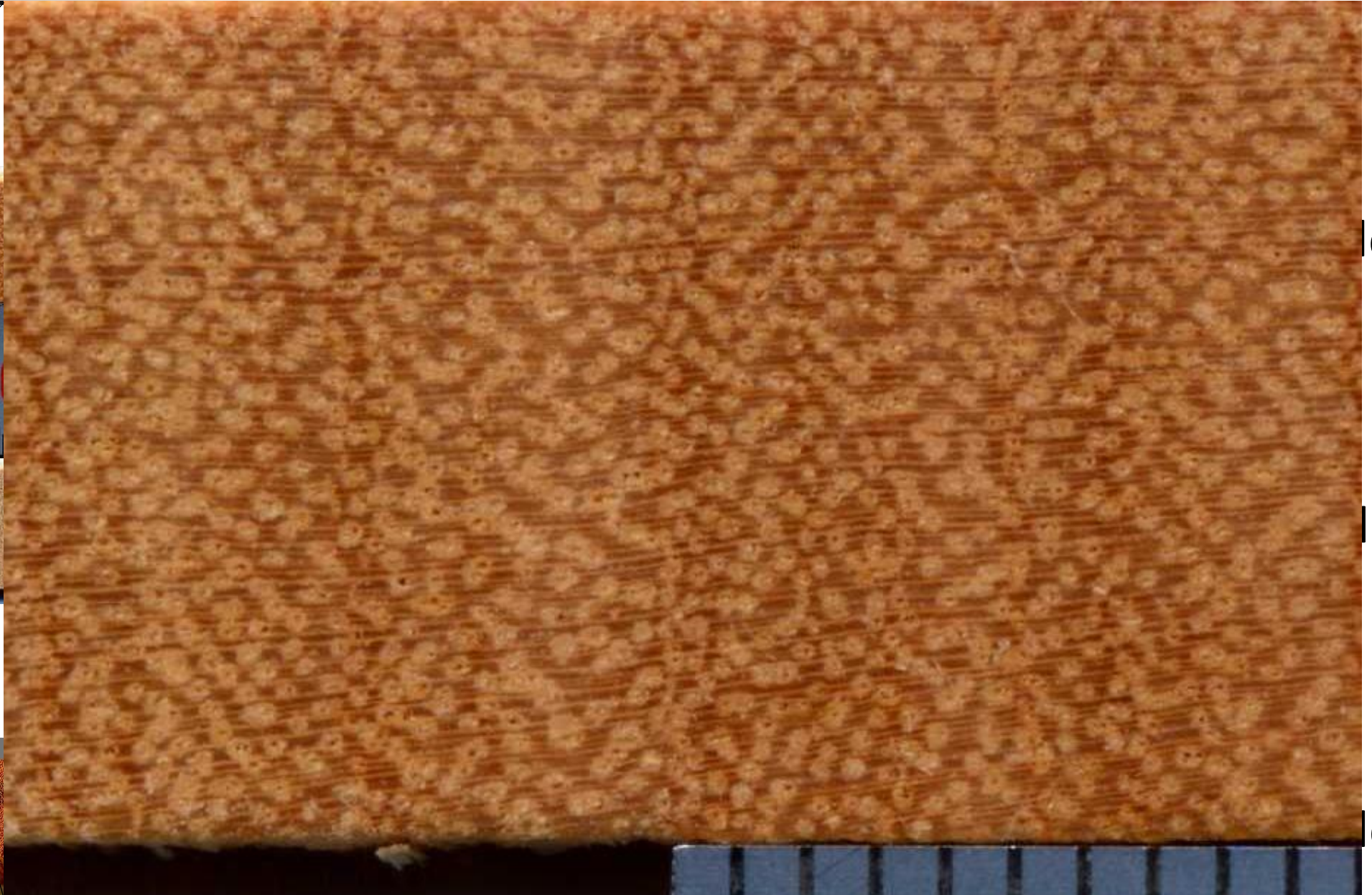
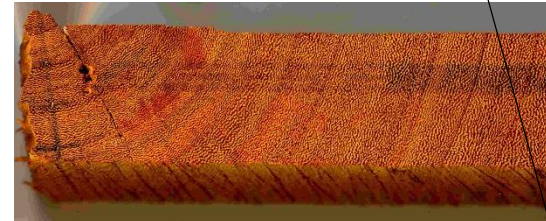
Sextonia rubra



Dicorynia guianensis



Pericopsis elata



ld)

ld)

ld)

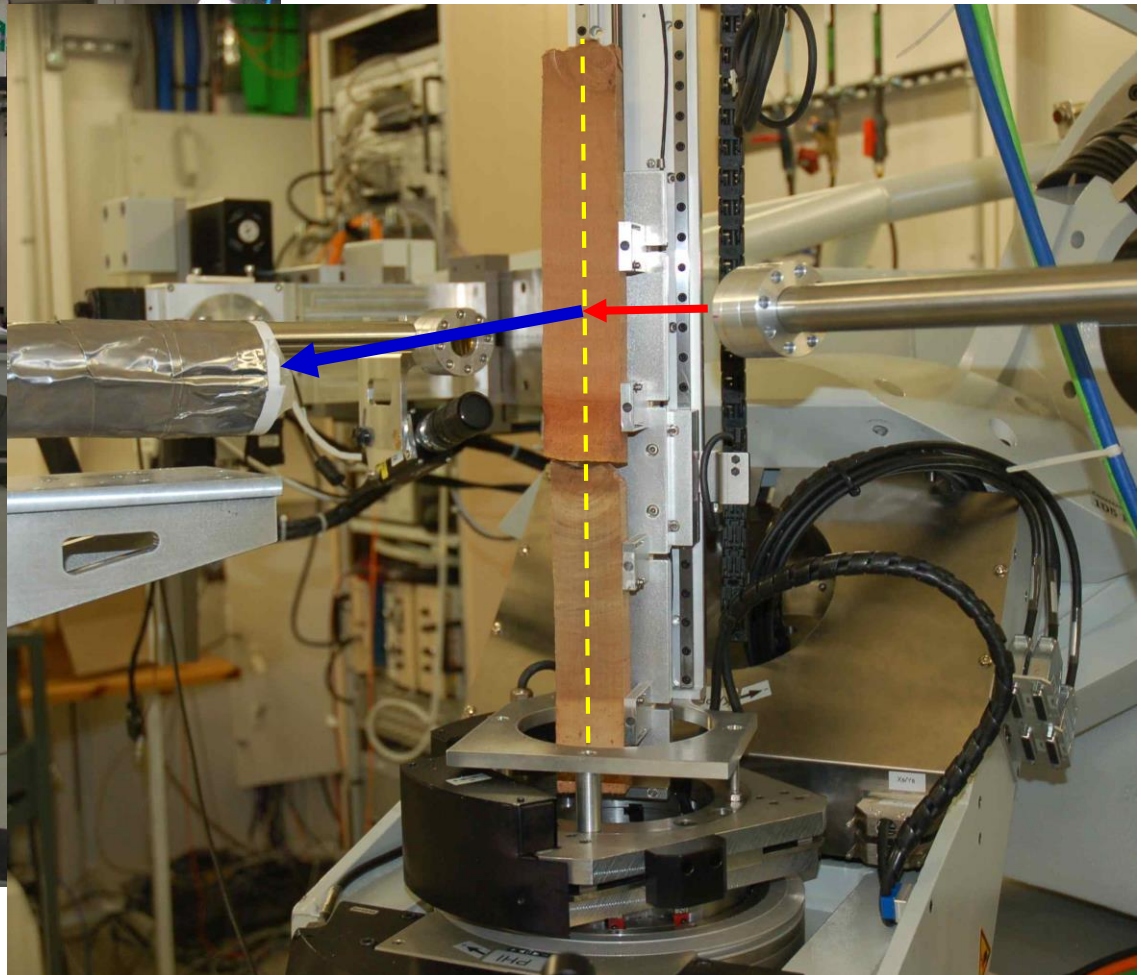
DIFFABS



SDD Röntec

10.7 keV / 18.1 keV

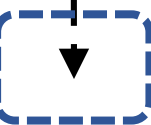
Spot 300×424μm



pith



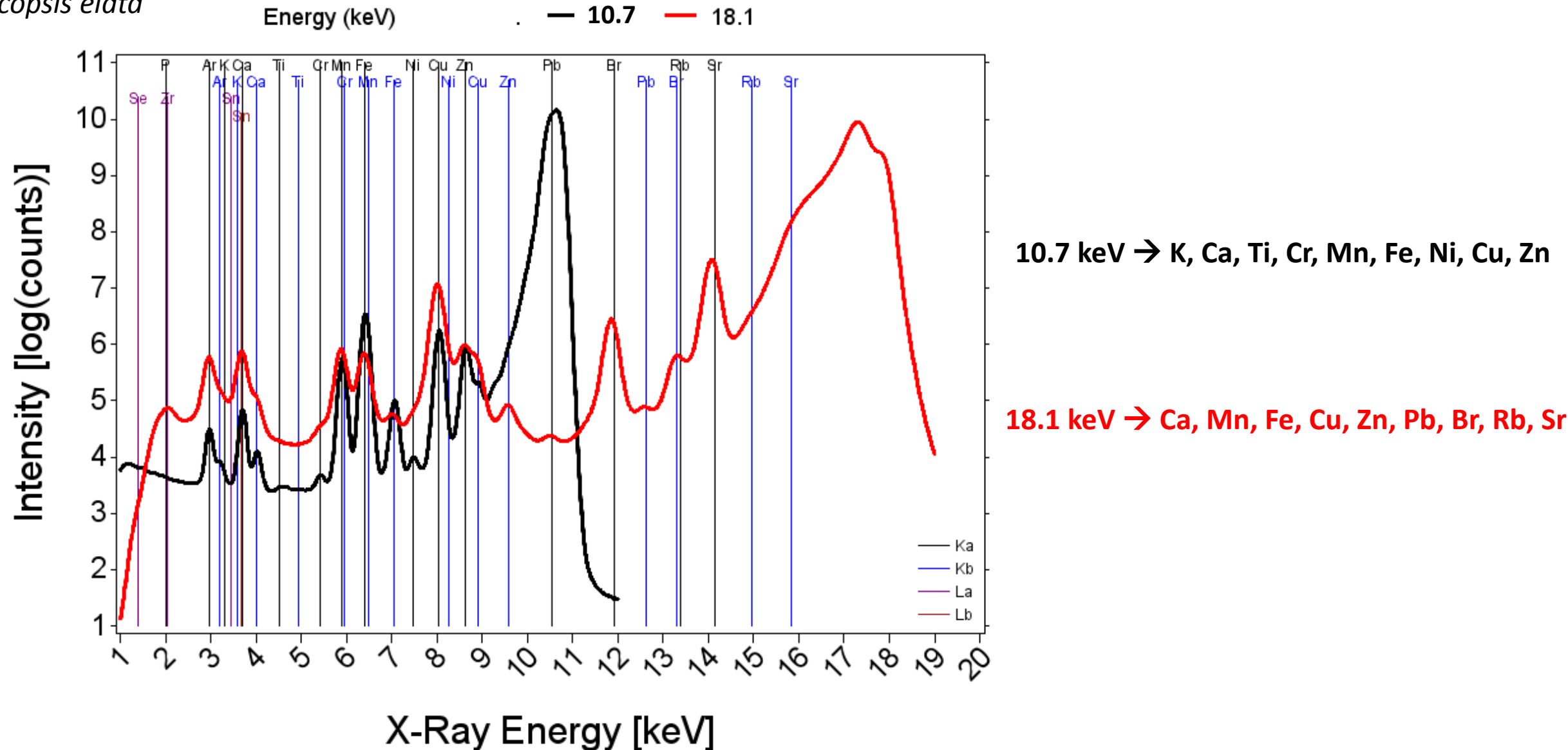
200 μm
step



bark

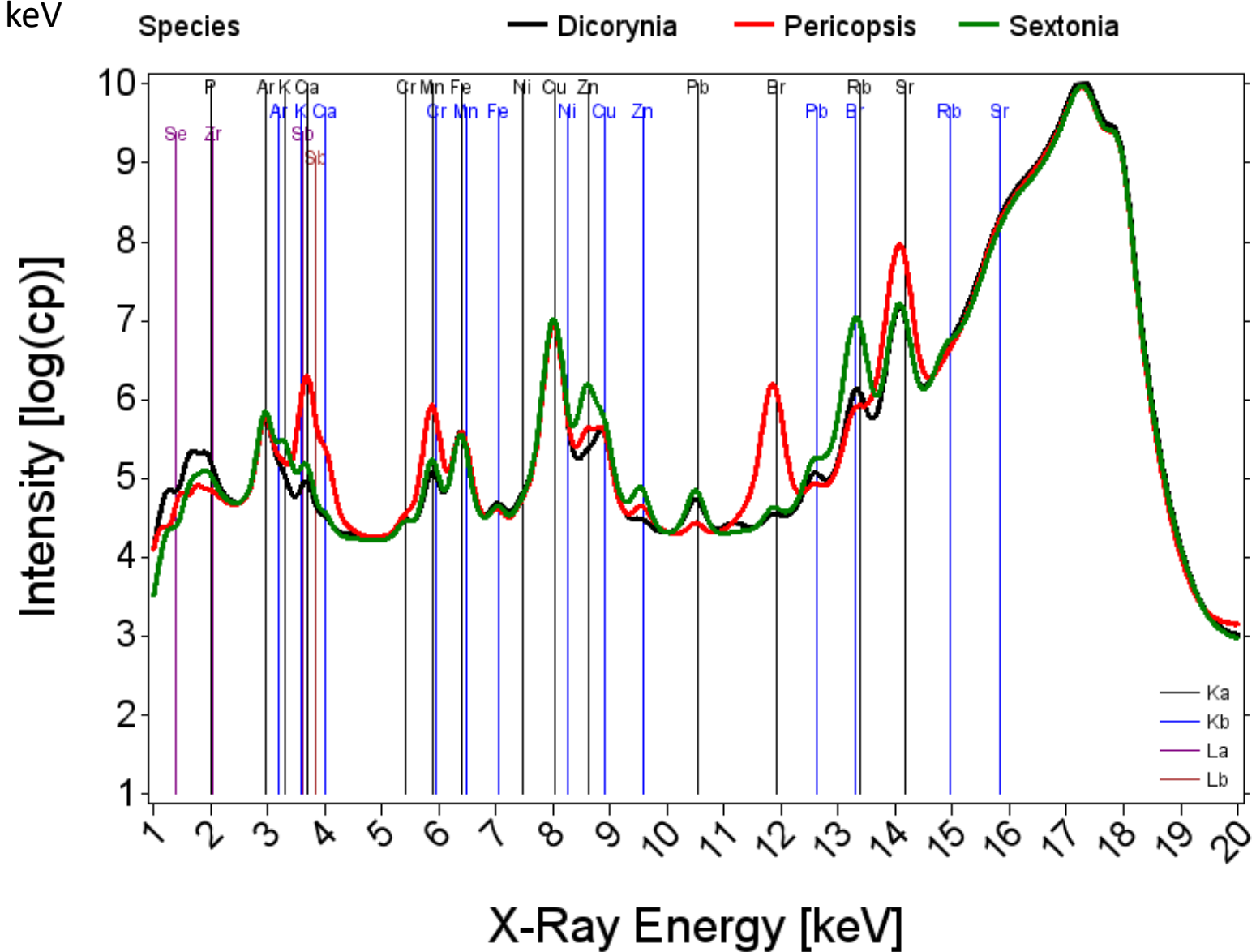
Results: wood elemental composition

Pericopsis elata



Results: wood elemental composition

18.1 keV



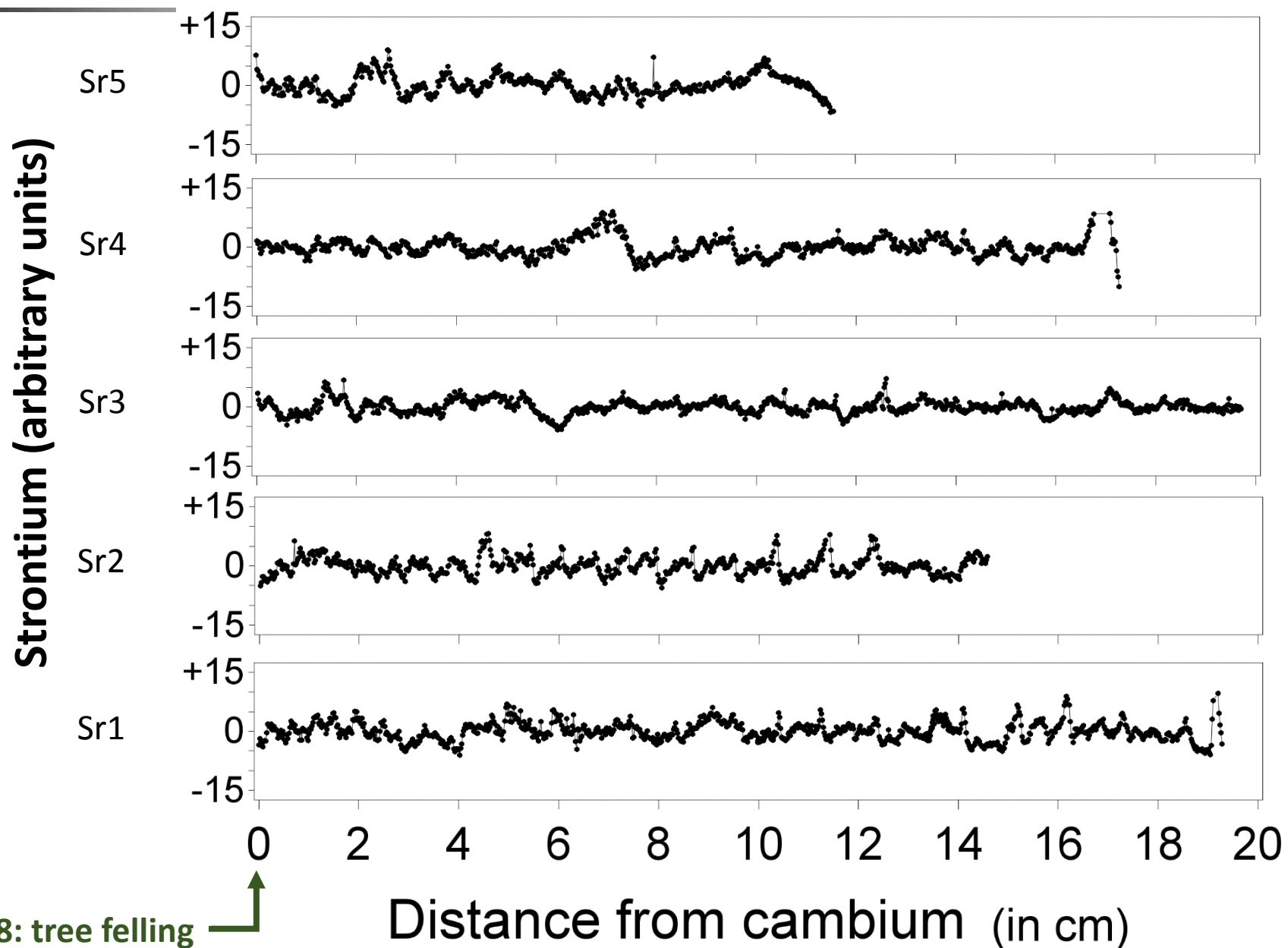
ICP-AES

(ppm)	Dg	Sr
K	400	1400
Ca	530	350
Ti	0.8	0.4
Cr	8.2	7.4
Mn	8.1	10.3
Fe	87.4	49.8
Ni	2.3	1.3
Cu	1.8	2.2
Zn	6.3	6.5
Pb	1.3	1.2
Br	-	-
Rb	1.6	5.7
Sr	7.5	7.1

Results: radial variations

18.1 keV

Sextonia rubra

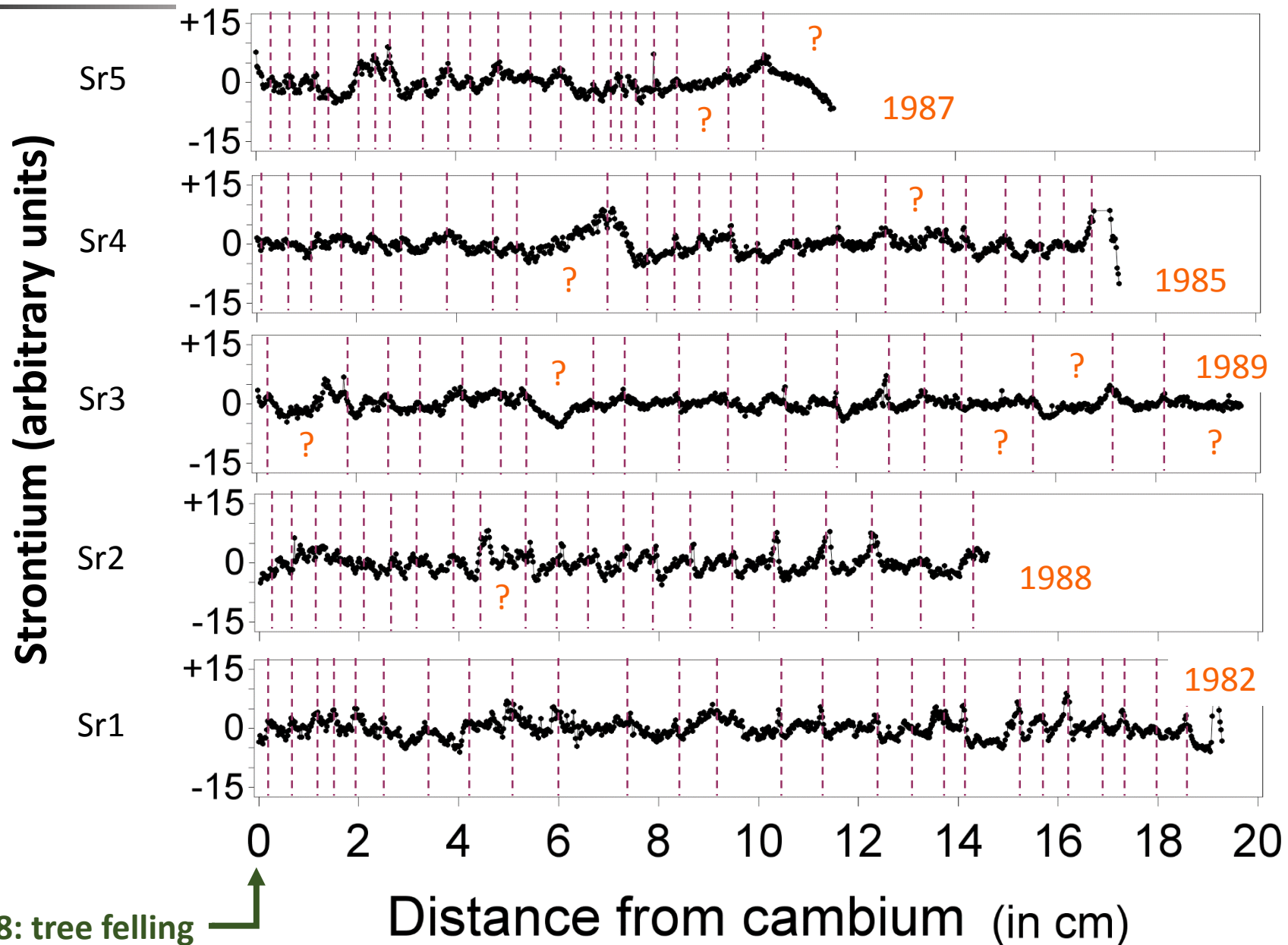


Results: peak detection

18.1 keV

Sextonia rubra

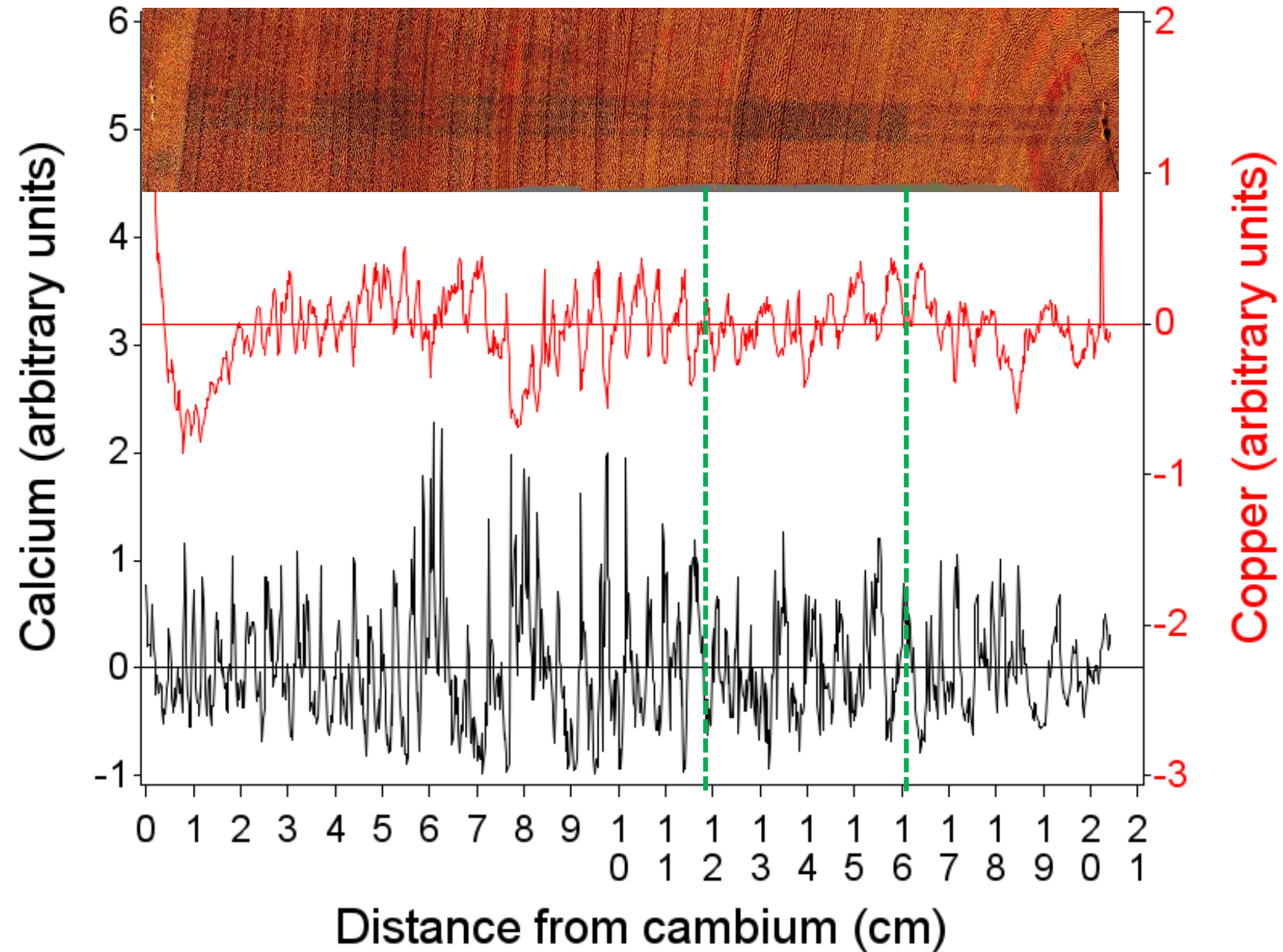
First expected year
of growth: 1982



Results: covariations

10.7 keV

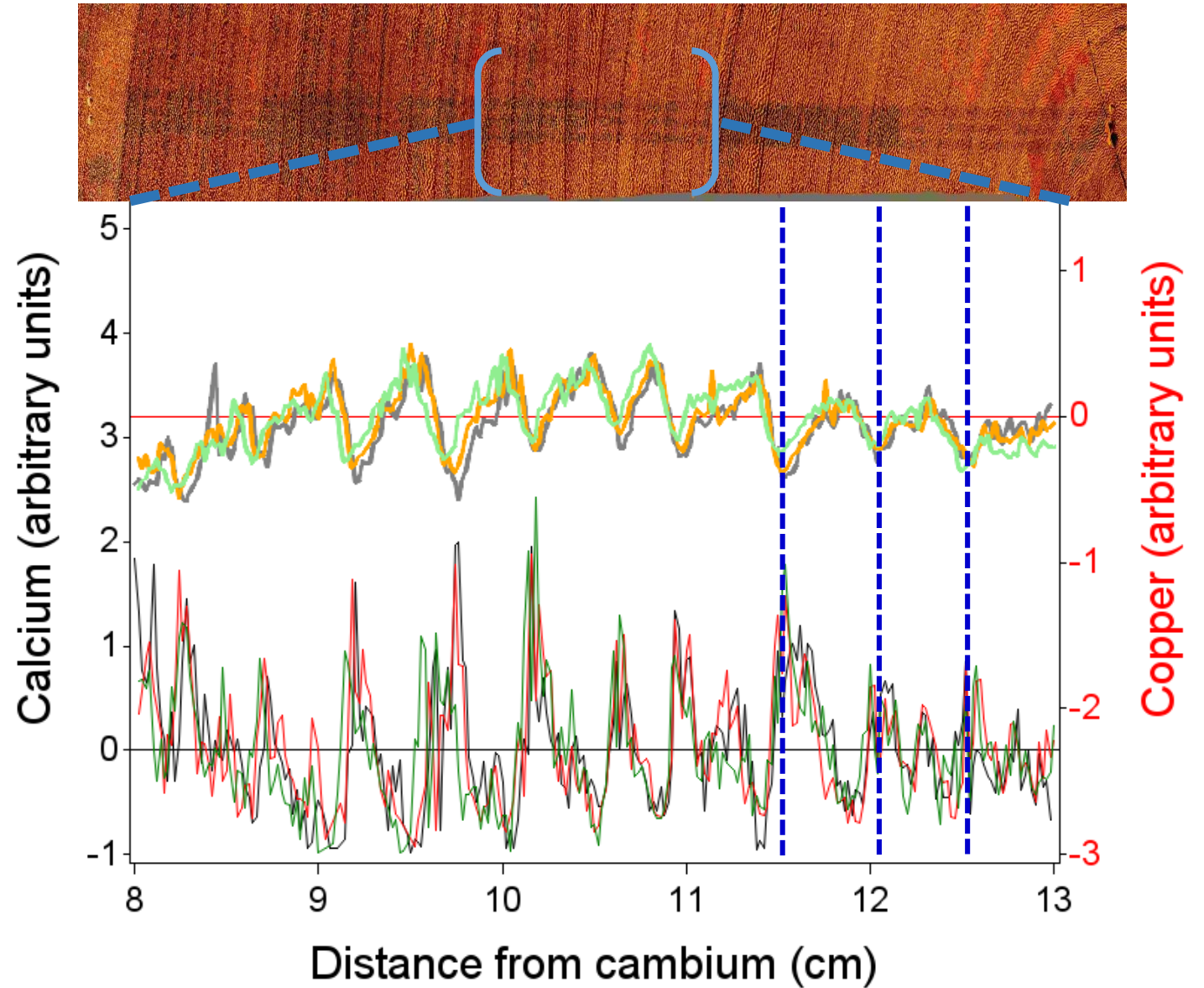
Pericopsis elata



Results: covariations

10.7 keV

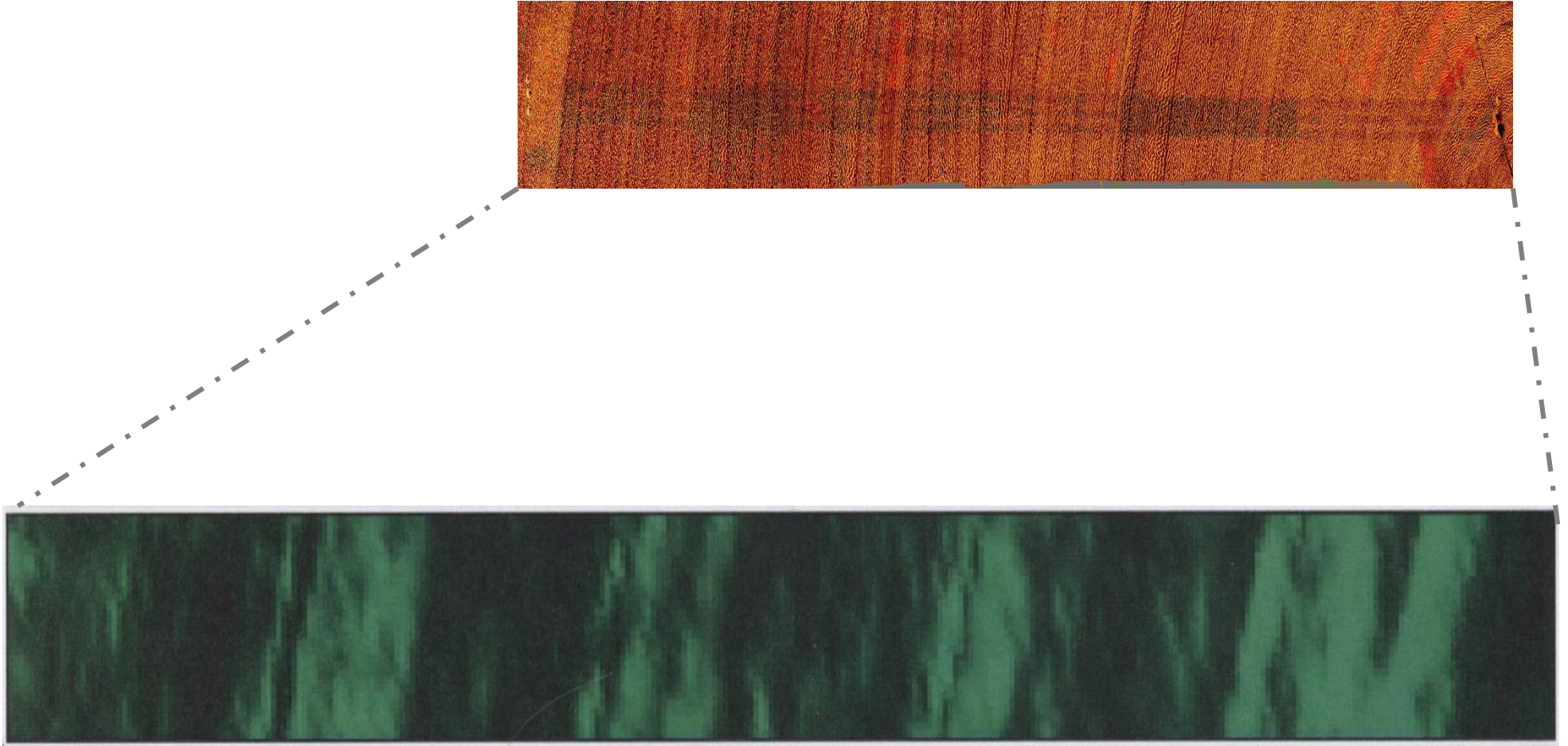
Pericopsis elata



Results: mapping

10.7 keV

Pericopsis elata



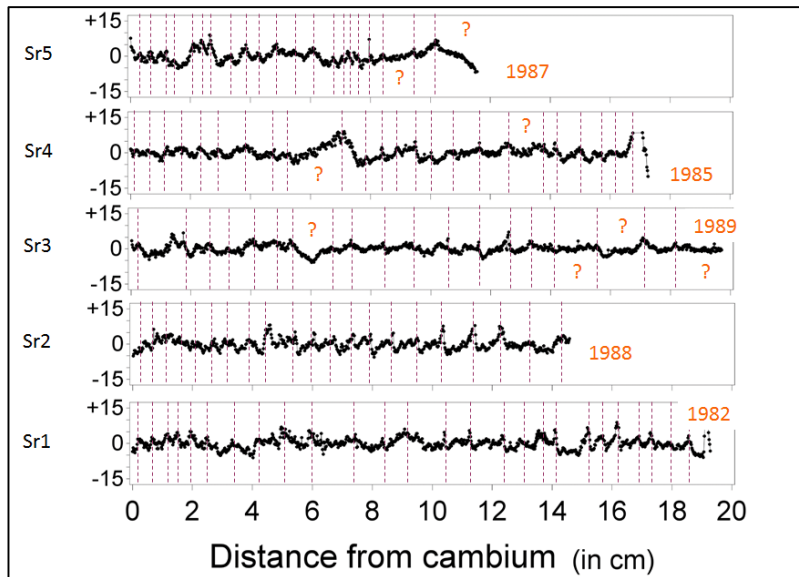
Mapping of spatial variations in calcium

Results: back calculated radial growth

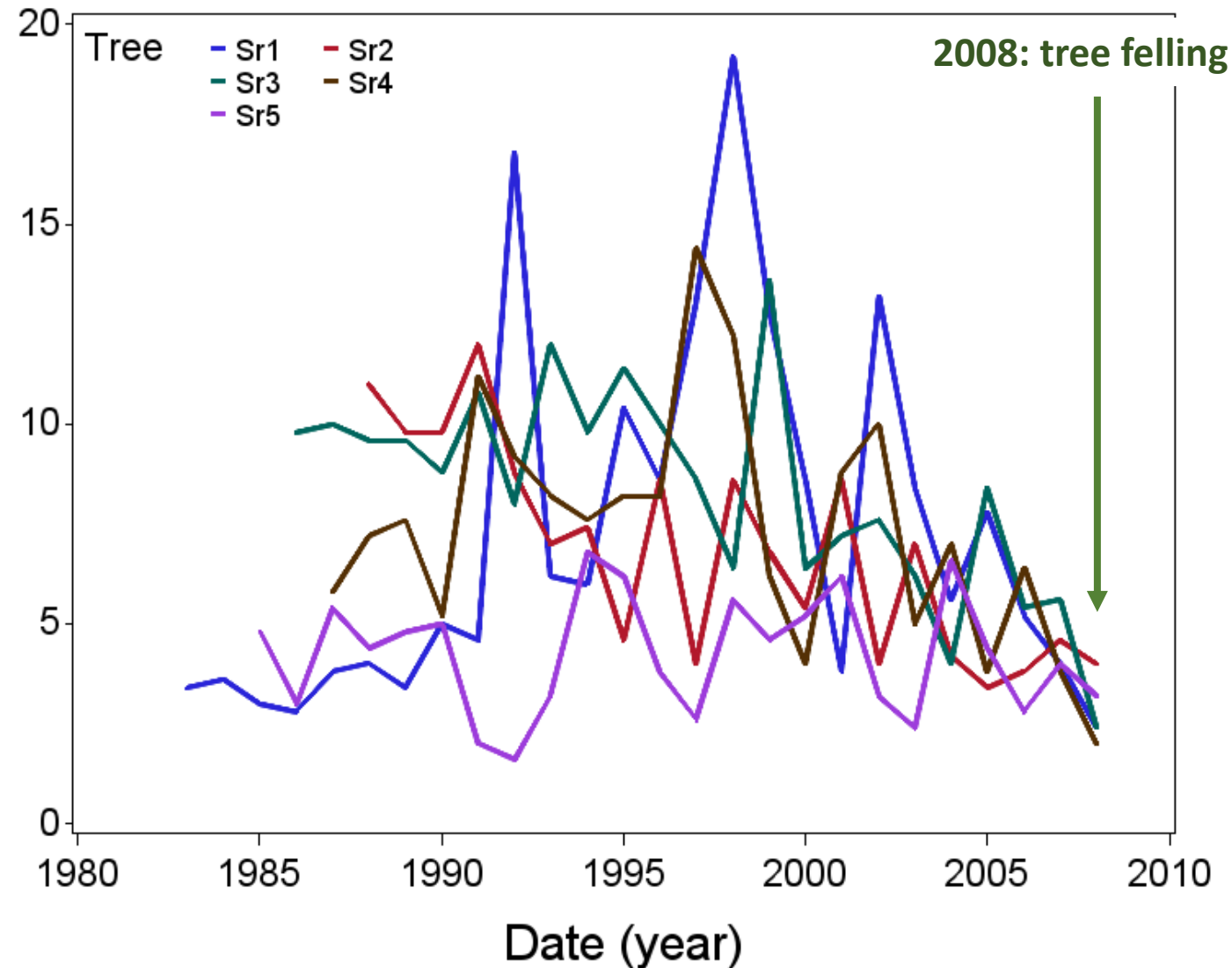
18.1 keV

Sextonia rubra

Strontium chronologies



Radial growth (mm/year)



Perspectives

- « Technological transfer » to lab XRF (*e.g.* SEM/EDS) for large samplings → growth chronologies
- Growth dynamics (*e.g.* response to perturbation), relationship with climate (*e.g.* precipitation patterns), effect of (global) environmental changes (*e.g.* N deposition)