Microanalyse à haute résolution du bois et dendrochronologie des arbres tropicaux

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Wood SXRF microanalysis and dendrochronology of tropical trees

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arbre

Advanced Research on the Biology of Tree and Forest Ecosystems

INRA SCIENCE & IMPACT

UNIVERSITÉ DE LORRAINE

ceba

Context

Paracou, Guyane française, 140 tree species /ha

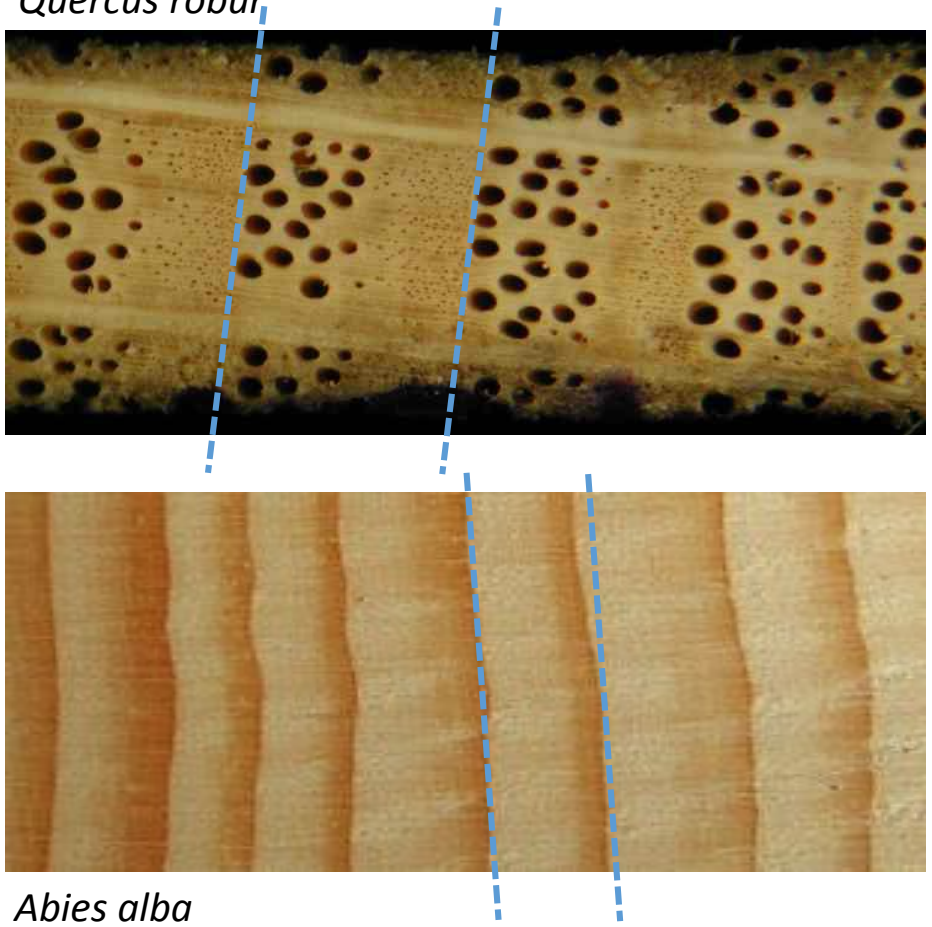
- Effect of environmental global changes on forest (temperature, precipitation pattern, $[CO_2]_{atm}$, atmosp. deposition,…)

- Sustainable management of forest ressources

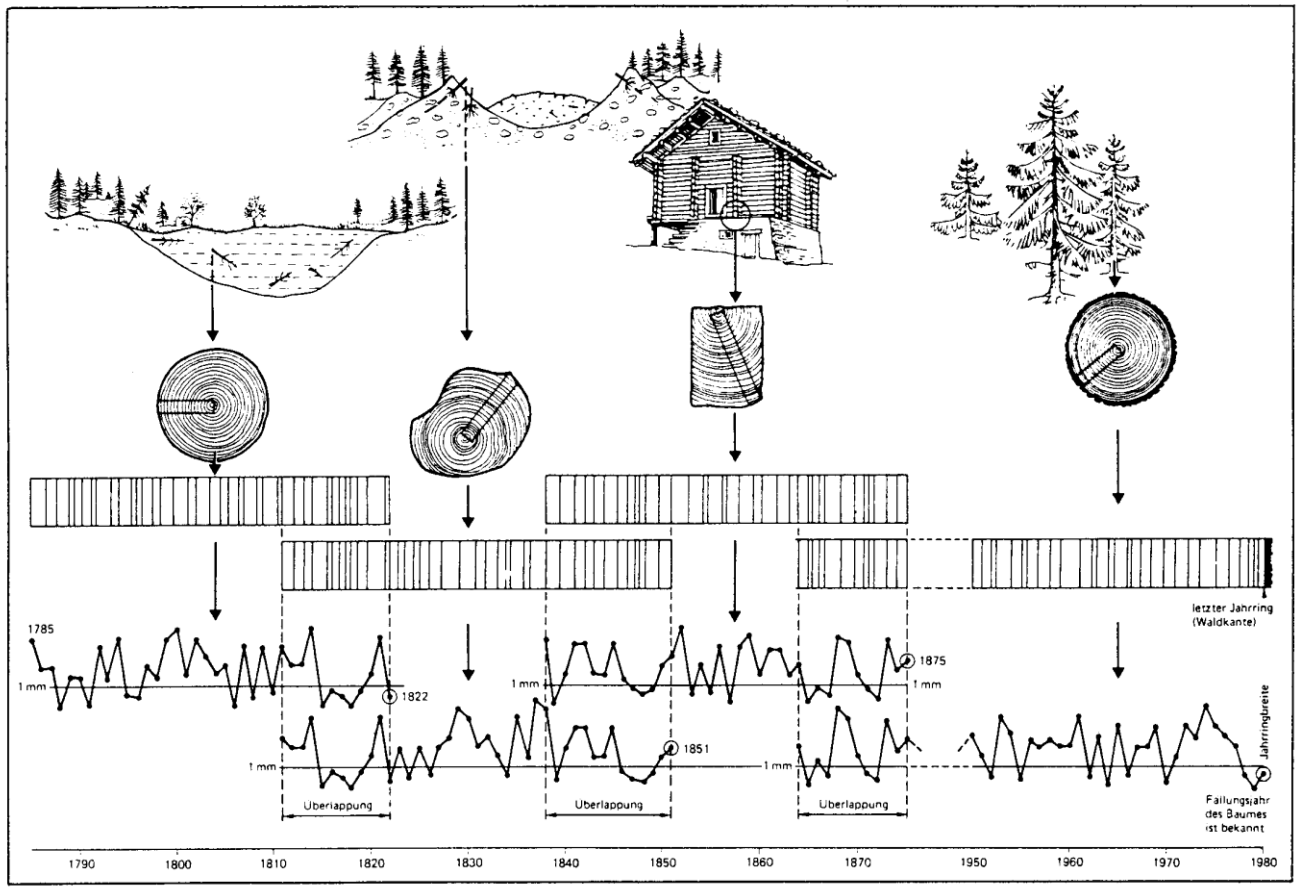
- Wet tropical forests:
  - lack of knowledge on growth dynamics (and determinants).
  - Harvest policies

Dendrochronology

Quercus robur



Abies alba

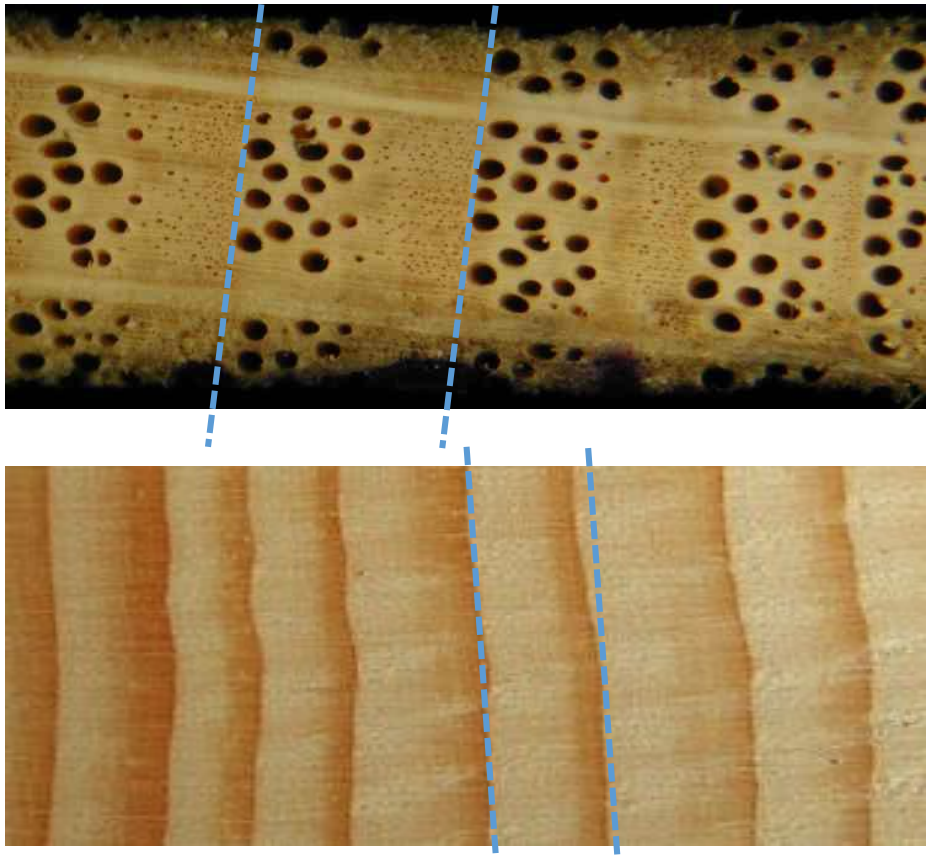


Schweingruber, 1983

→Retrospective growth analysis

Dendrochronology

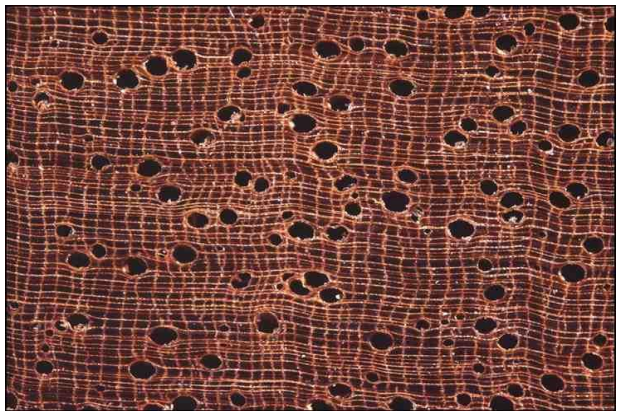
Quercus robur



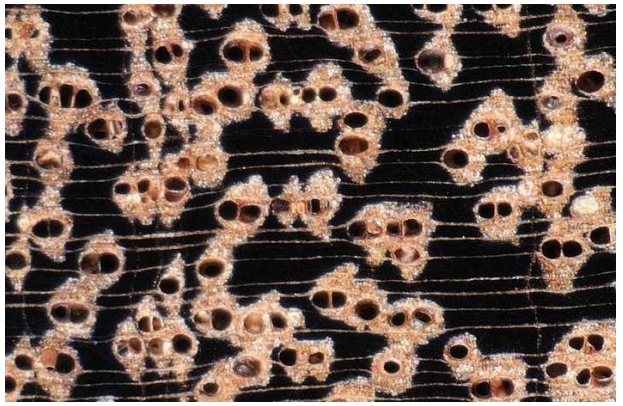
Abies alba

→Retrospective growth analysis

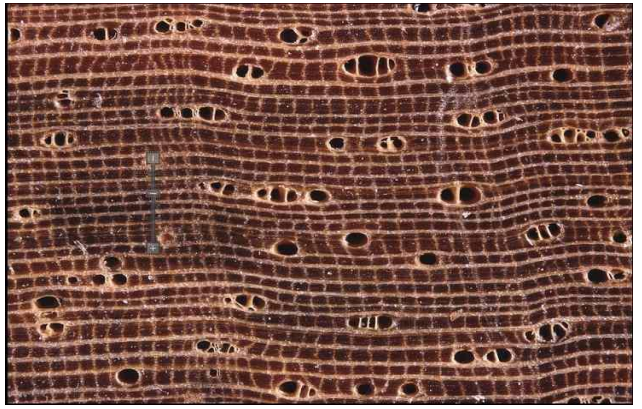
Licania micrantha



Goupia glabra



Vouacapoua americana



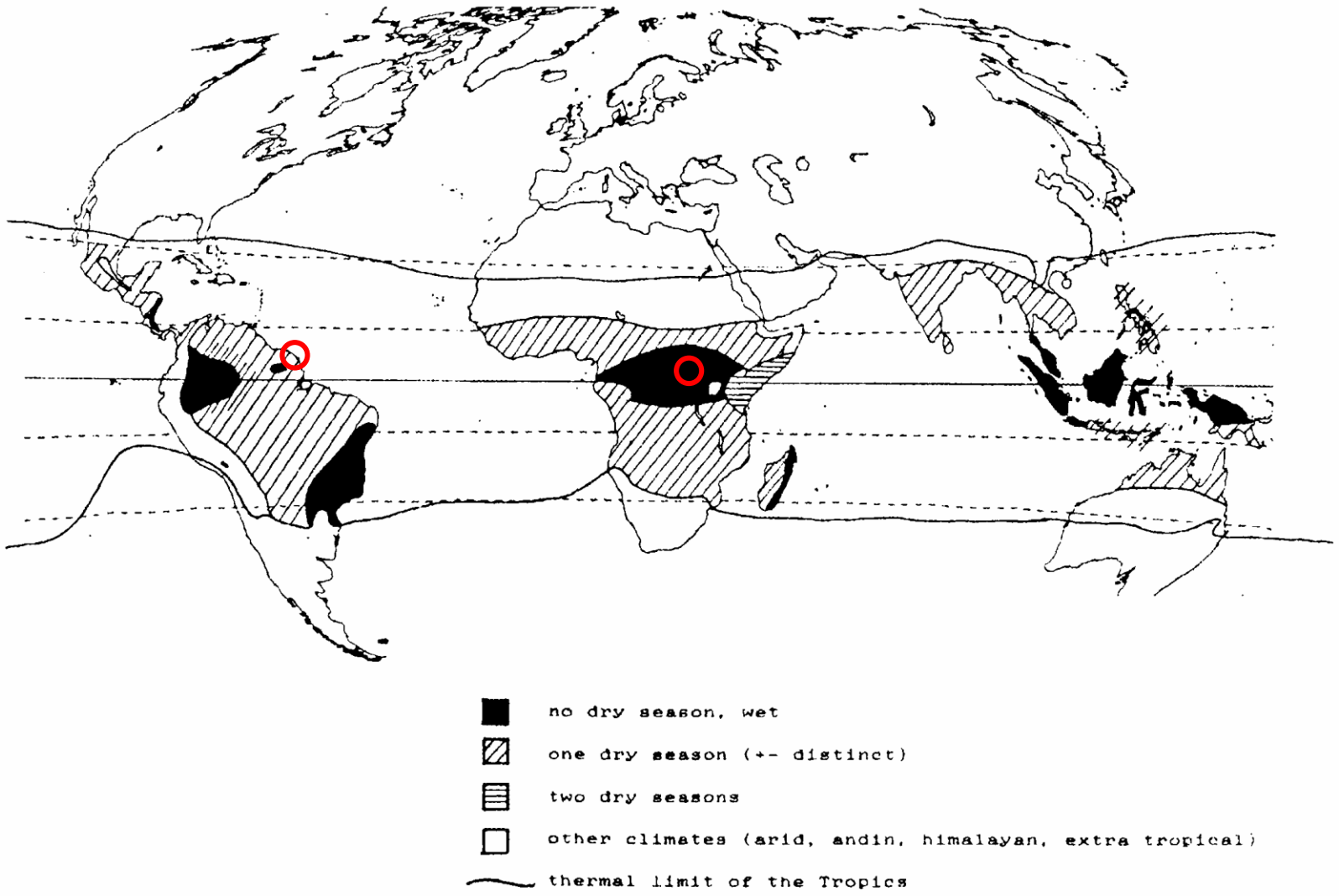
Couratari multiflora

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.* $\delta^{13}C$, $\delta^{18}O$)
- Dendrochemical variations : endogenous and/or environnemental determinism

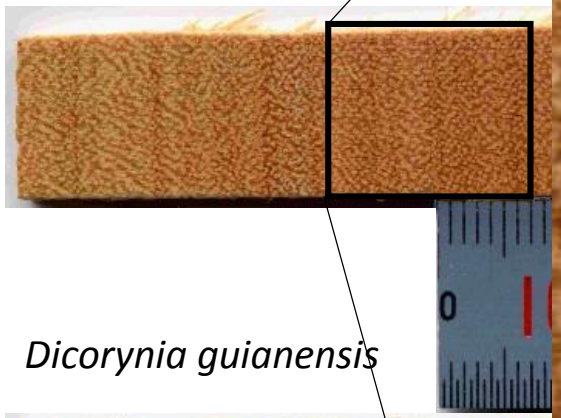
Climate seasonal variations in tropical forests



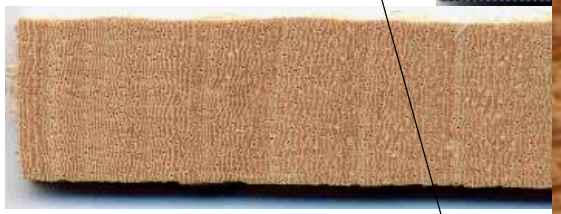
Worbes, 1995

Wood samples & sampling design

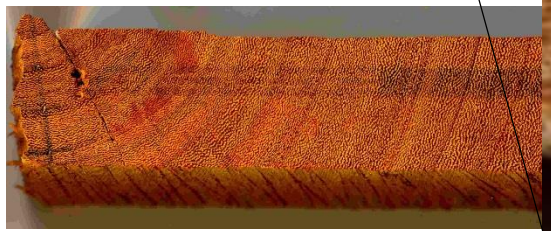
Sextonia rubra

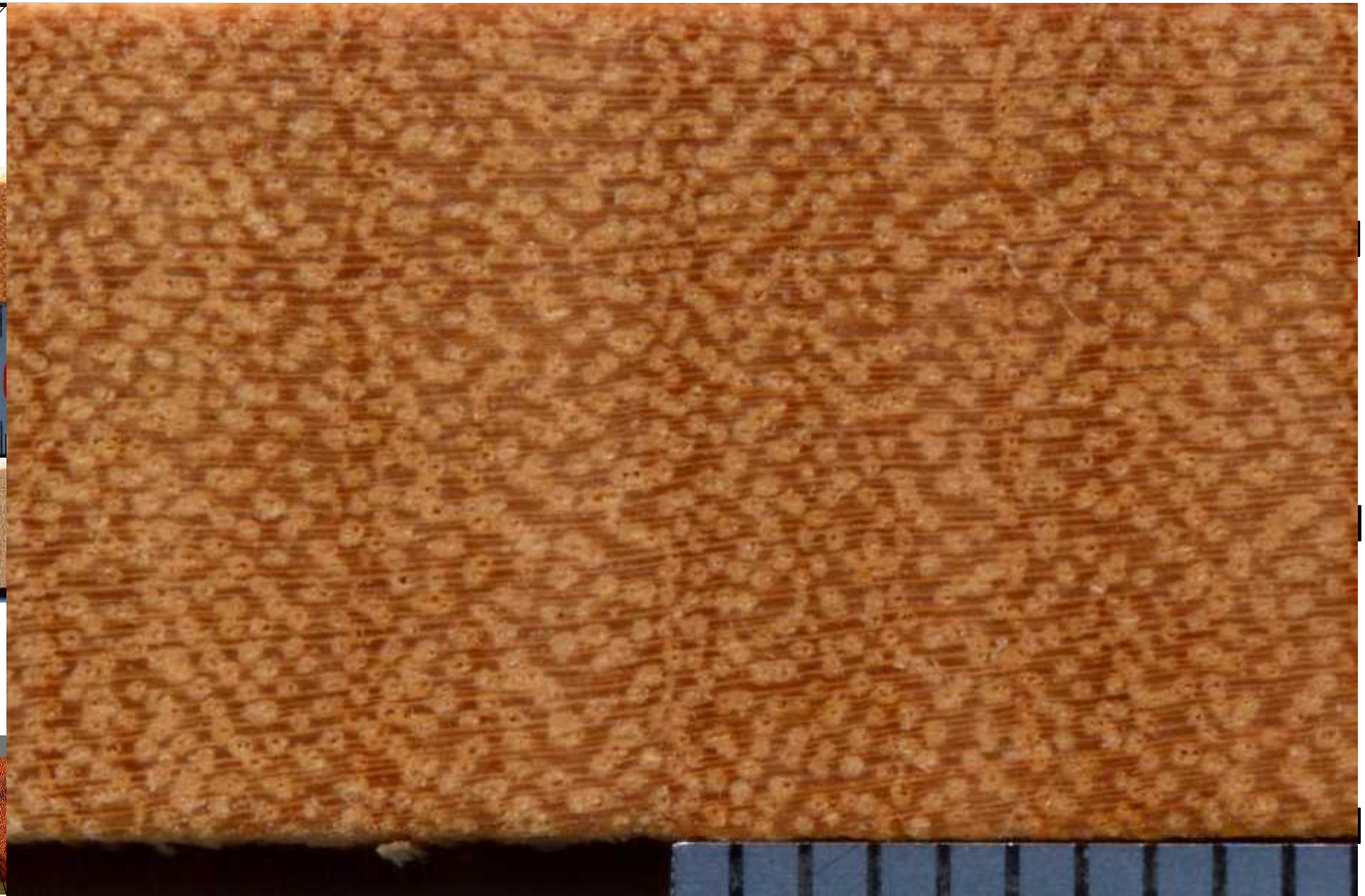


Dicorynia guianensis



Pericopsis elata



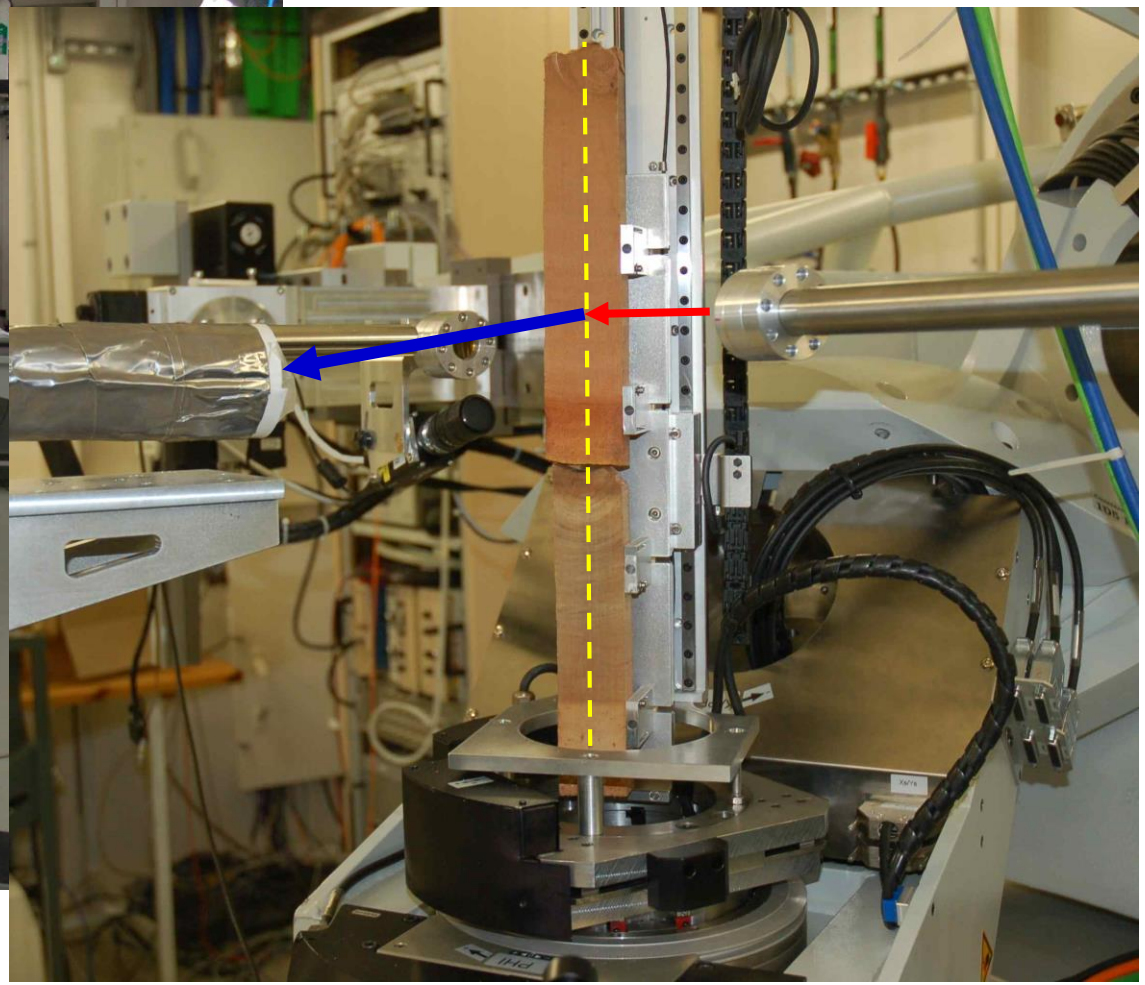


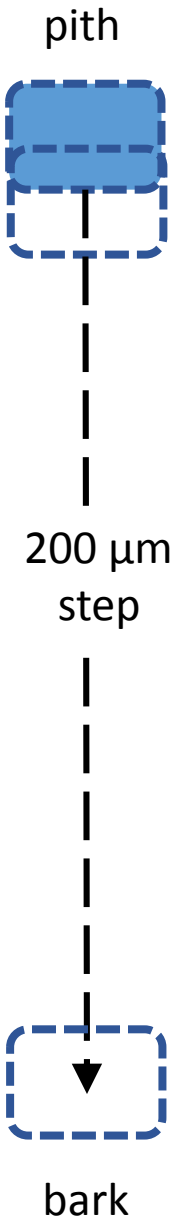
DIFFABS

SDD Röntec

10.7 keV / 18.1 keV

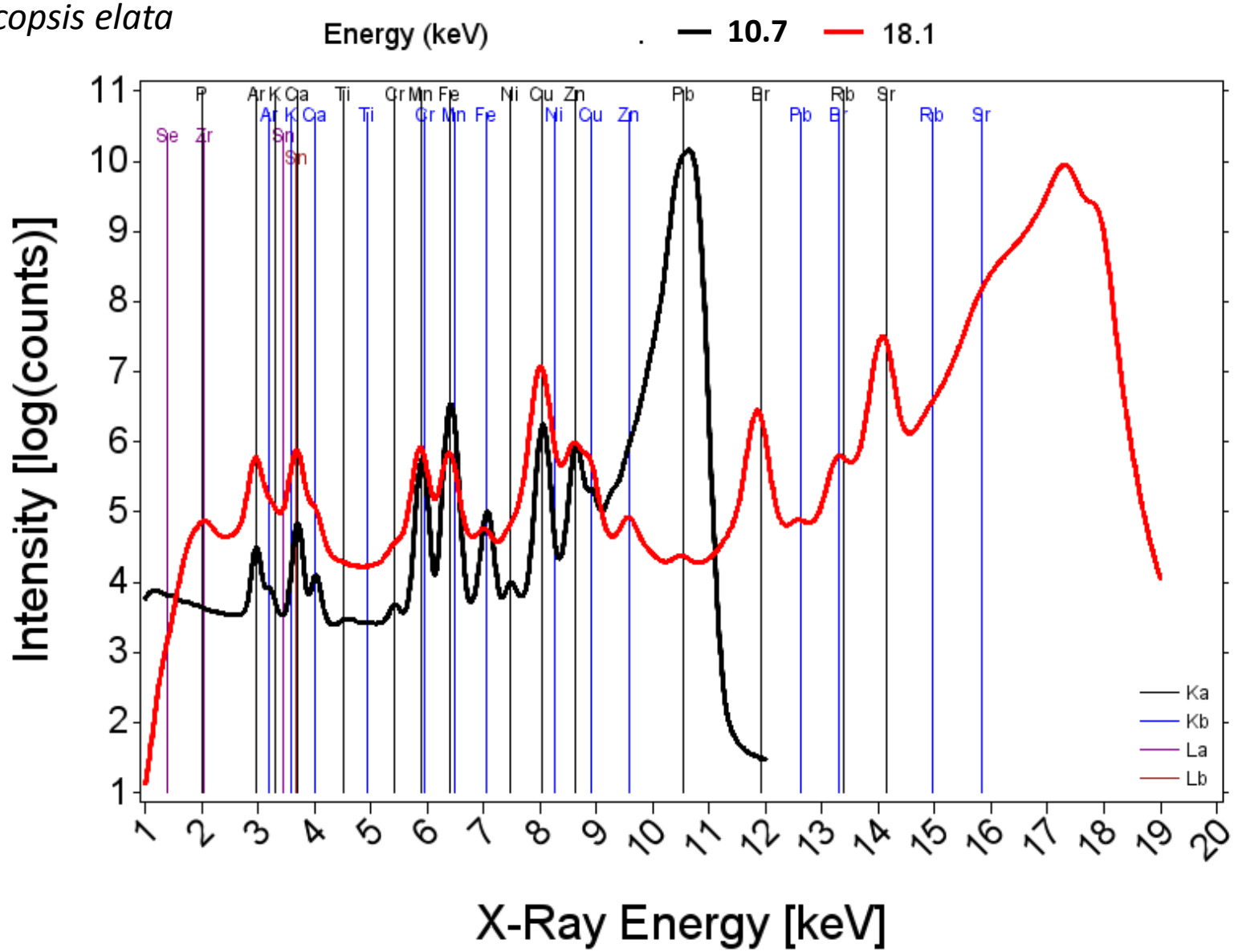
Spot 300×424µm





Results: wood elemental composition

Pericopsis elata

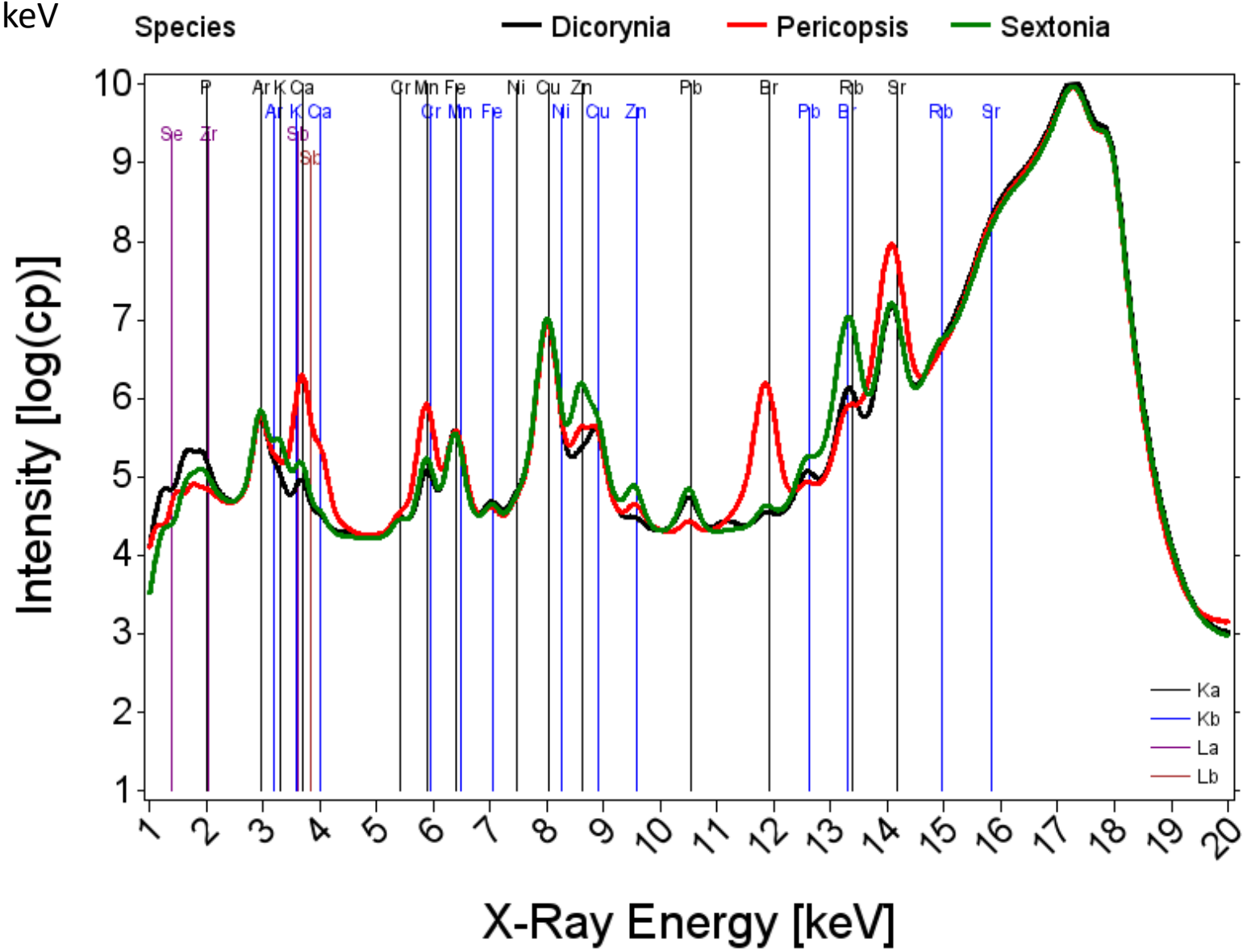


10.7 keV → K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn

18.1 keV → Ca, Mn, Fe, Cu, Zn, Pb, Br, Rb, Sr

Results: wood elemental composition

18.1 keV



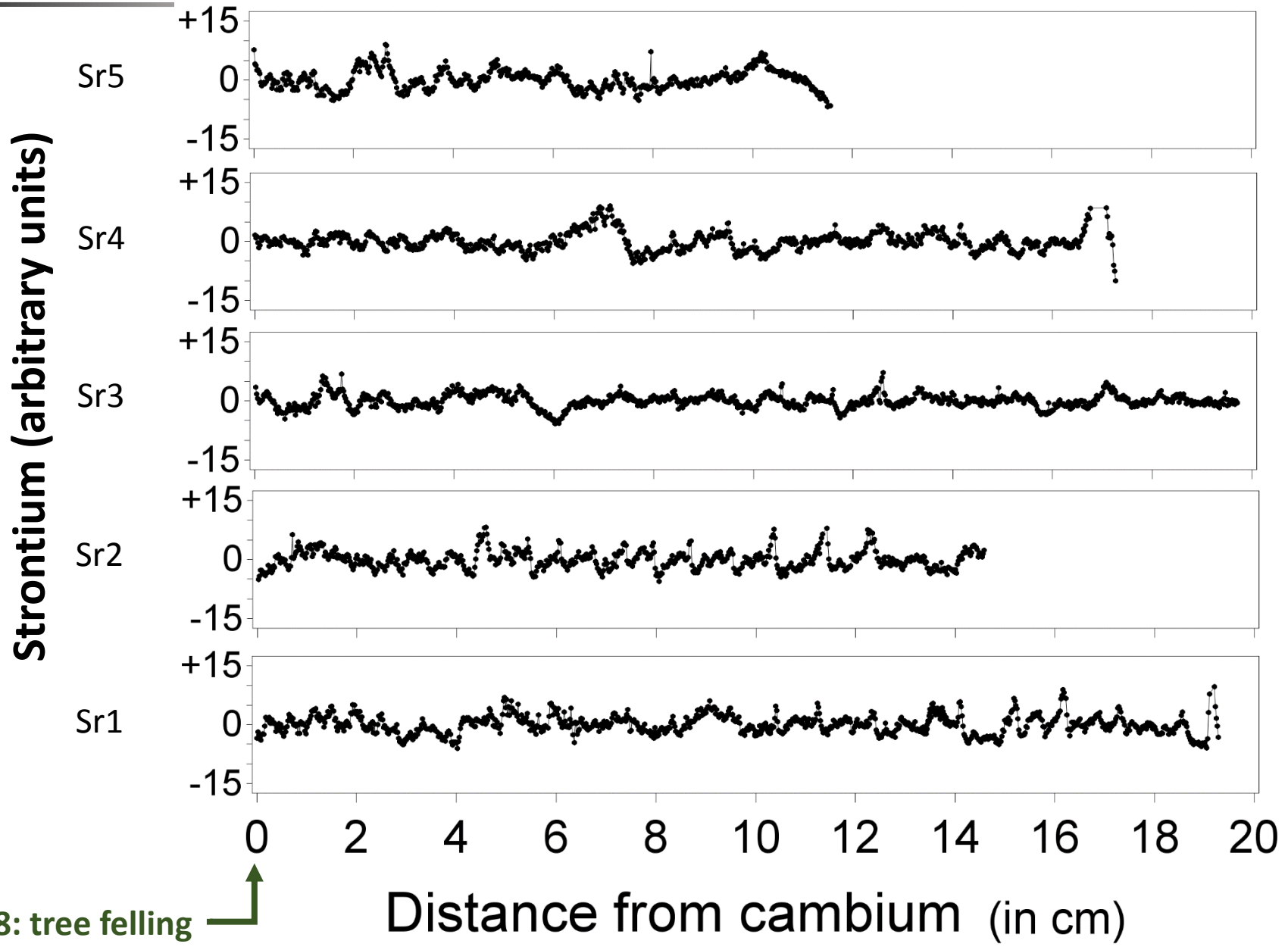
ICP-AES

(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

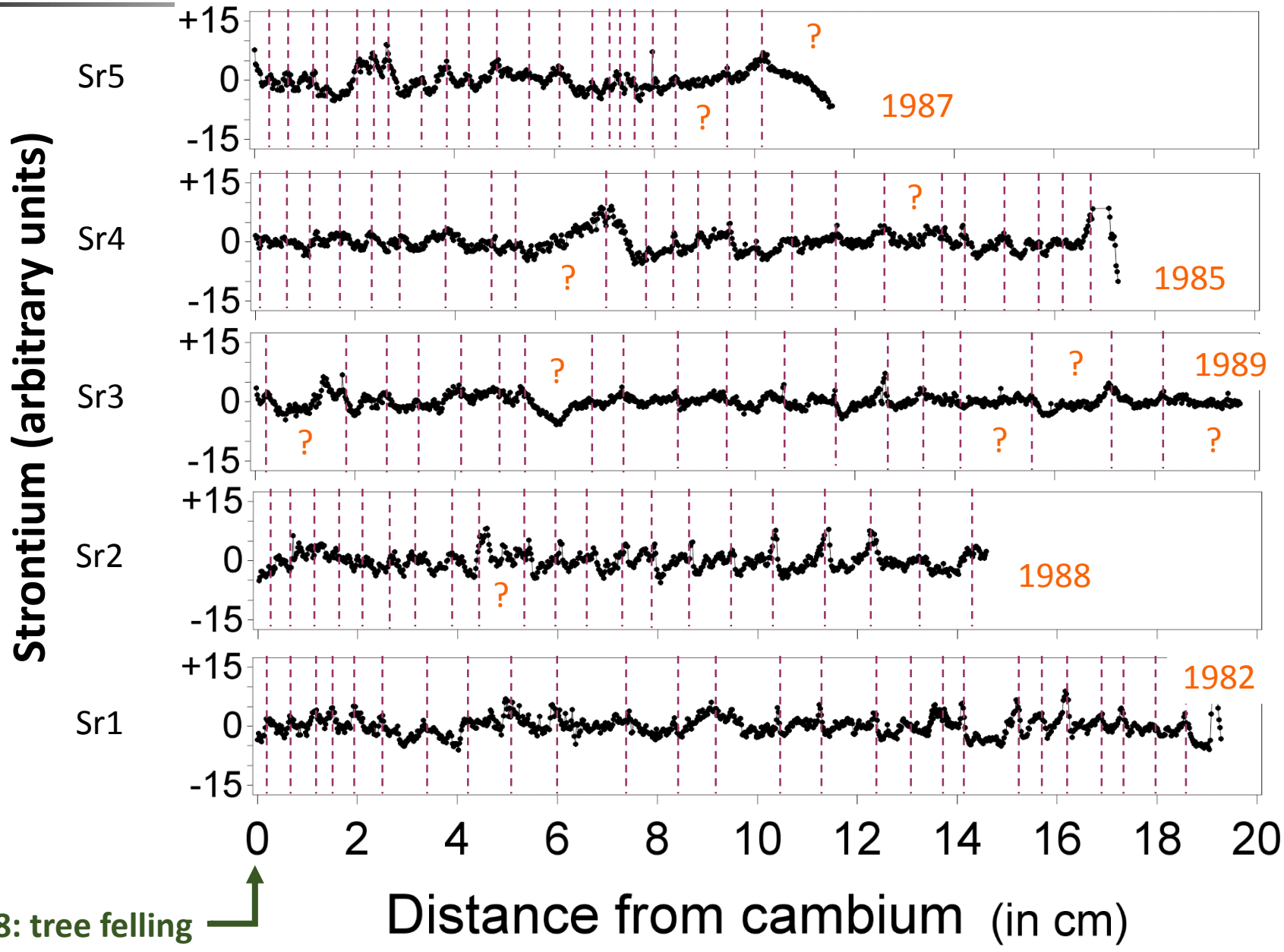


Results: peak detection

18.1 keV

Sextonia rubra

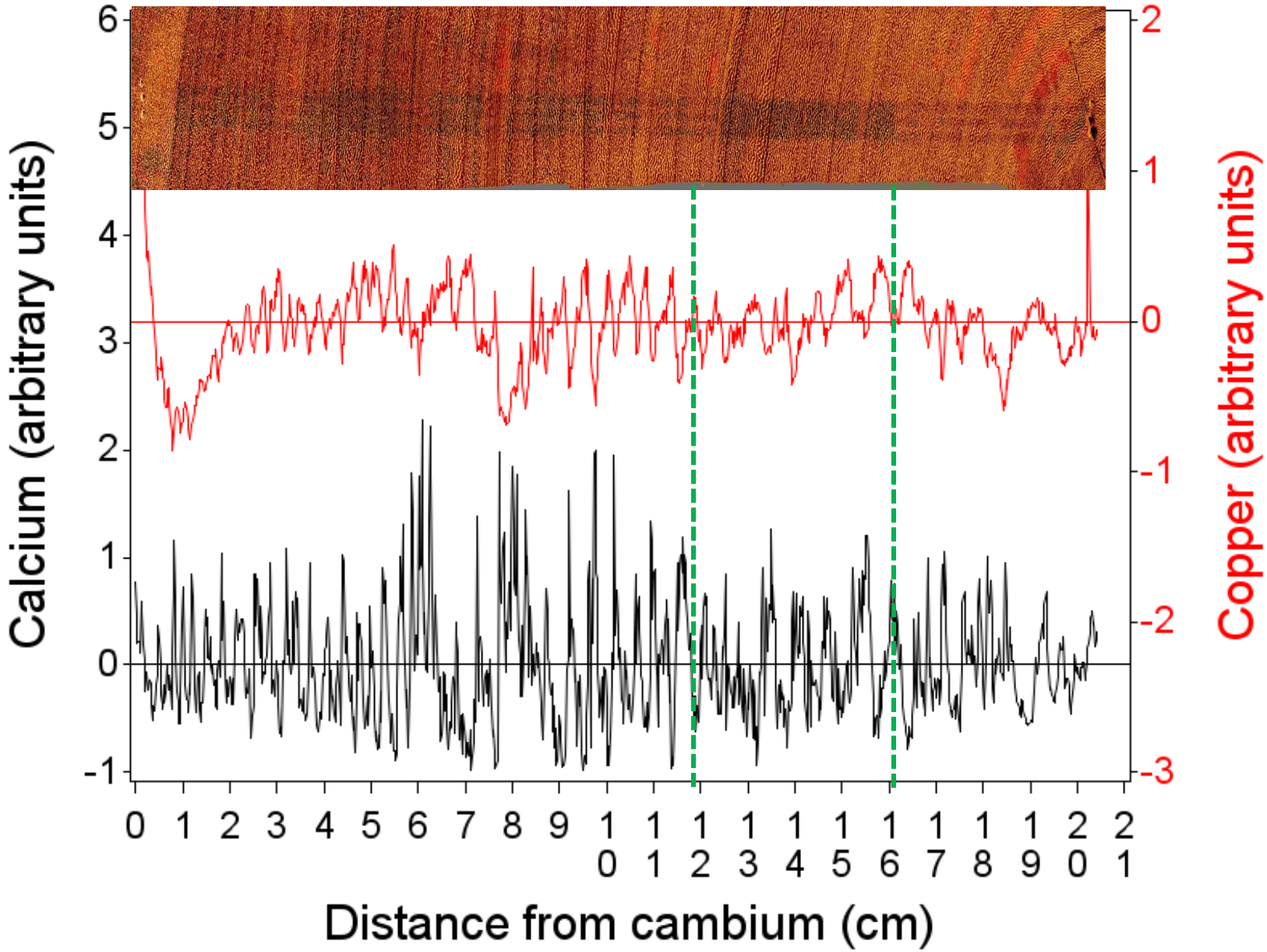
First expected year of growth: 1982



Results: covariations

10.7 keV

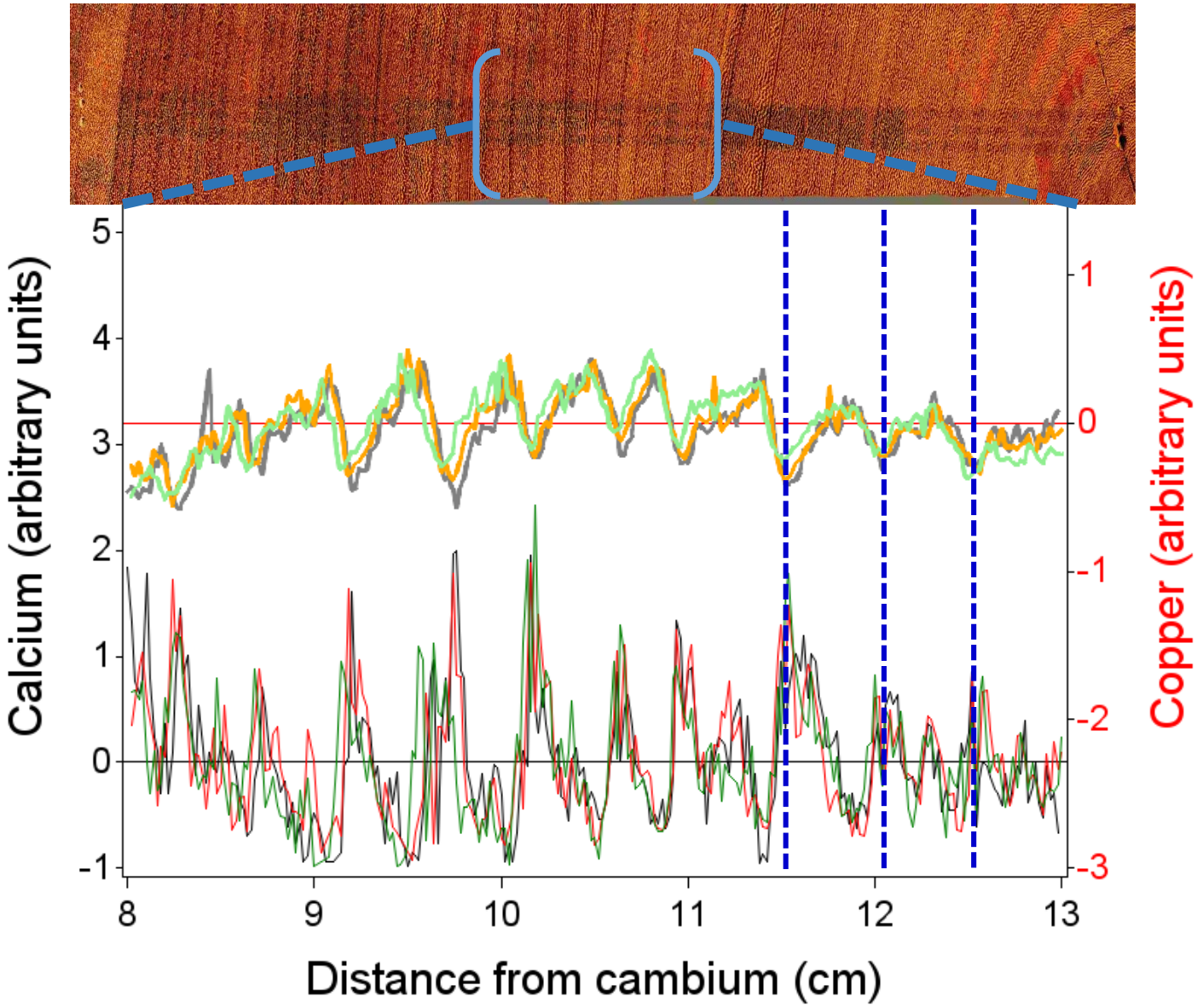
Pericopsis elata



Results: covariations

10.7 keV

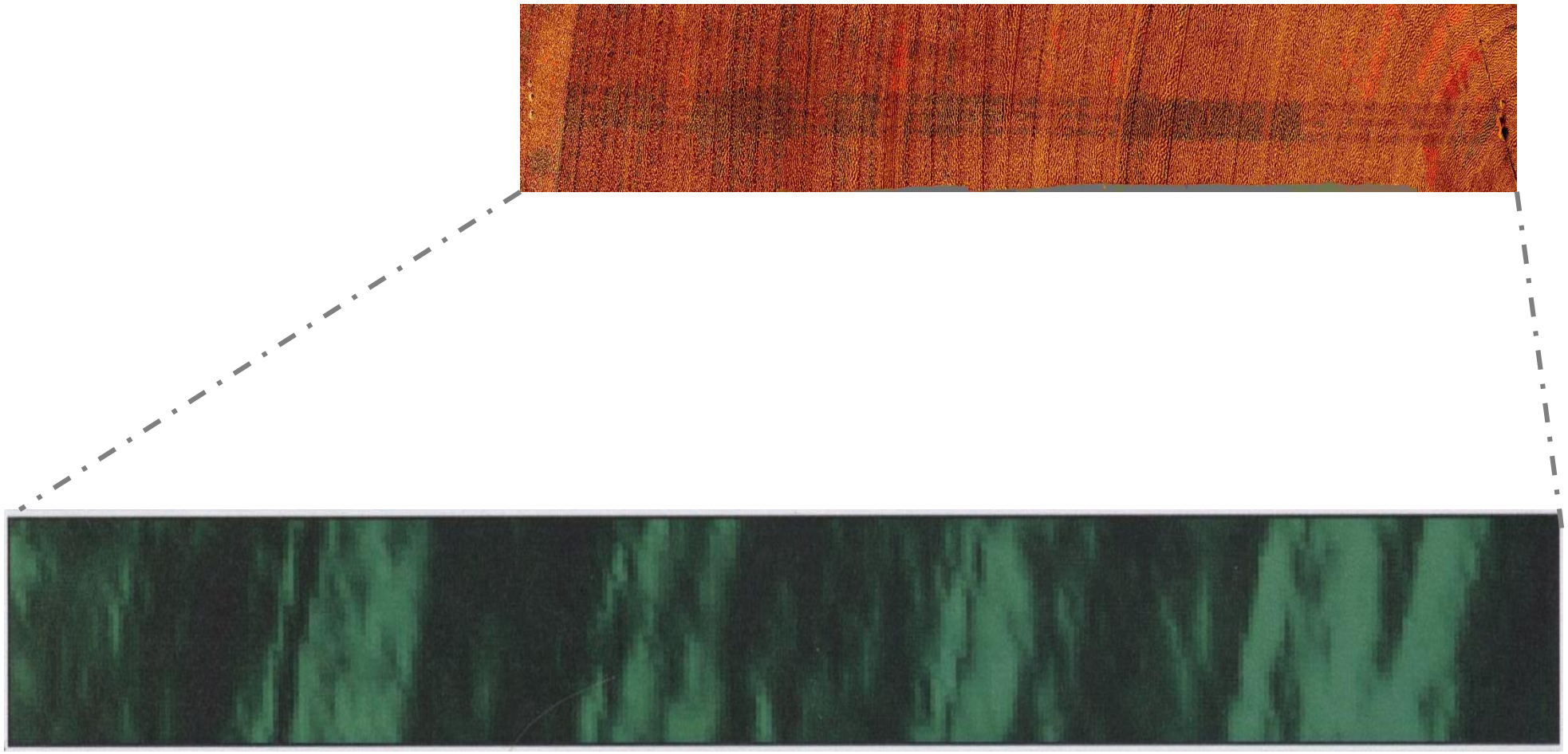
Pericopsis elata



Results: mapping

10.7 keV

Pericopsis elata



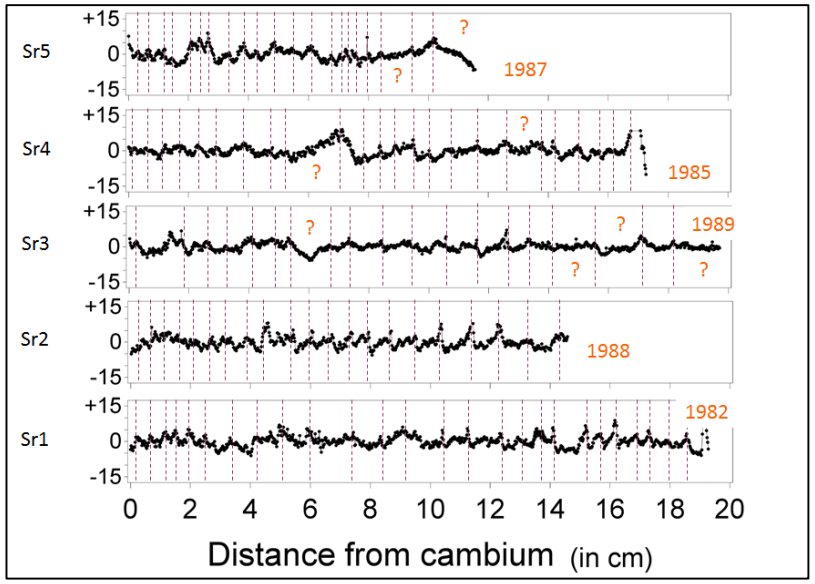
Mapping of spatial variations in calcium

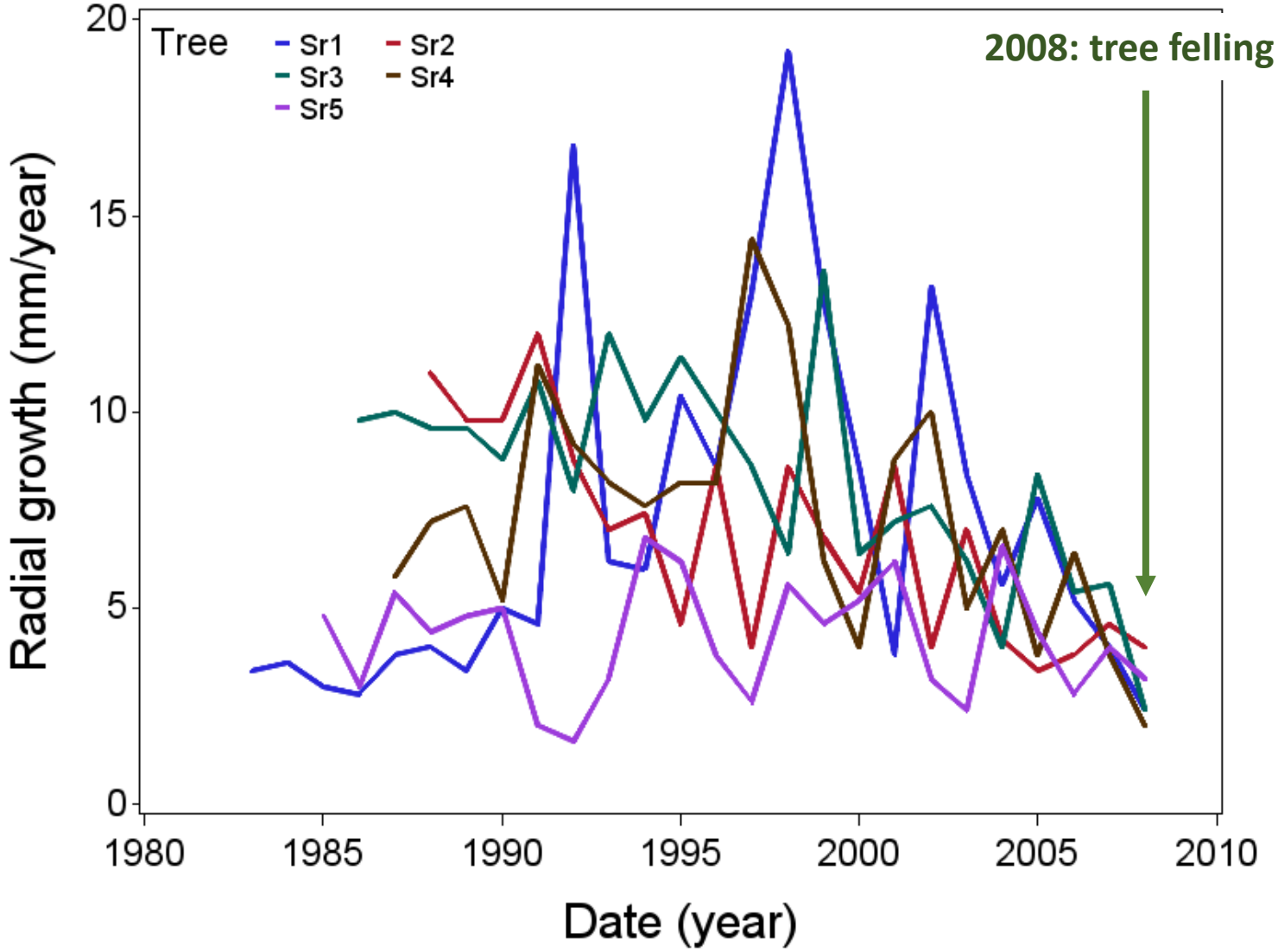
Results: back calculated radial growth

18.1 keV

Sextonia rubra

Strontium chronologies





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)