



Influence of the Chemical Association Form of Alkali Compounds on the Release Behavior from Solid Biomass



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Motivation

Chemical Composition important in many steps in the life cycle:

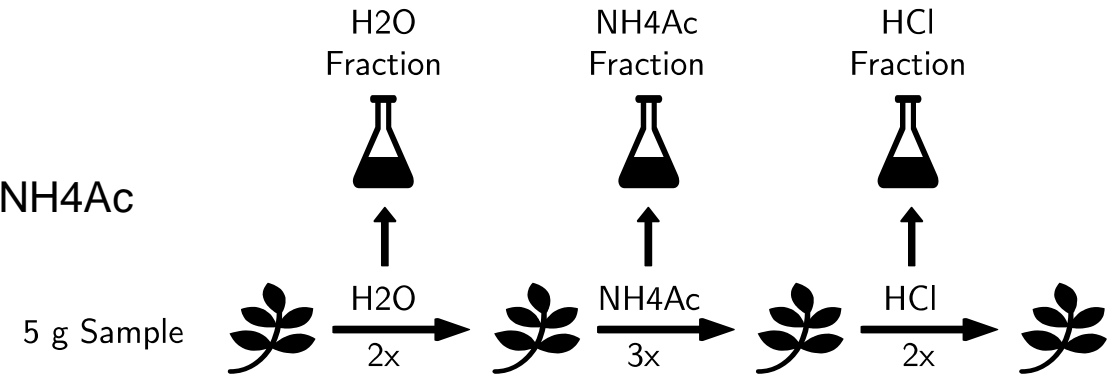
- Growth and Harvesting
- Combustion
- Fine Particle- and Deposition Formation
- Ash Utilization (Phosphorous Recycling)

Which method of analysis should be used?

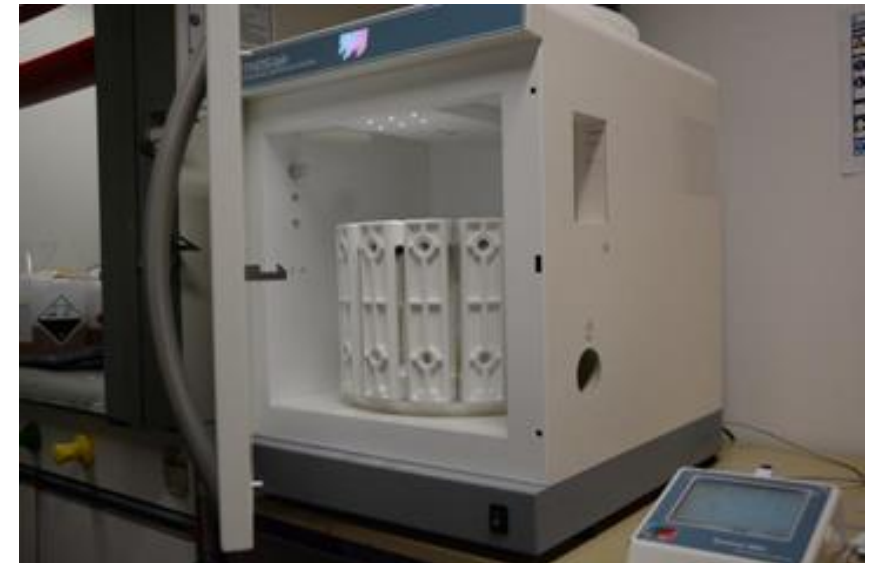


Liquid Sampling Methods

- Chemical Fractionation: Subsequent Leaching
 - Soluble salts are solved in the water fraction
 - Organically associated species are ion exchanged in the NH₄Ac fraction
 - Acid-soluble minerals are solved in the HCl fraction

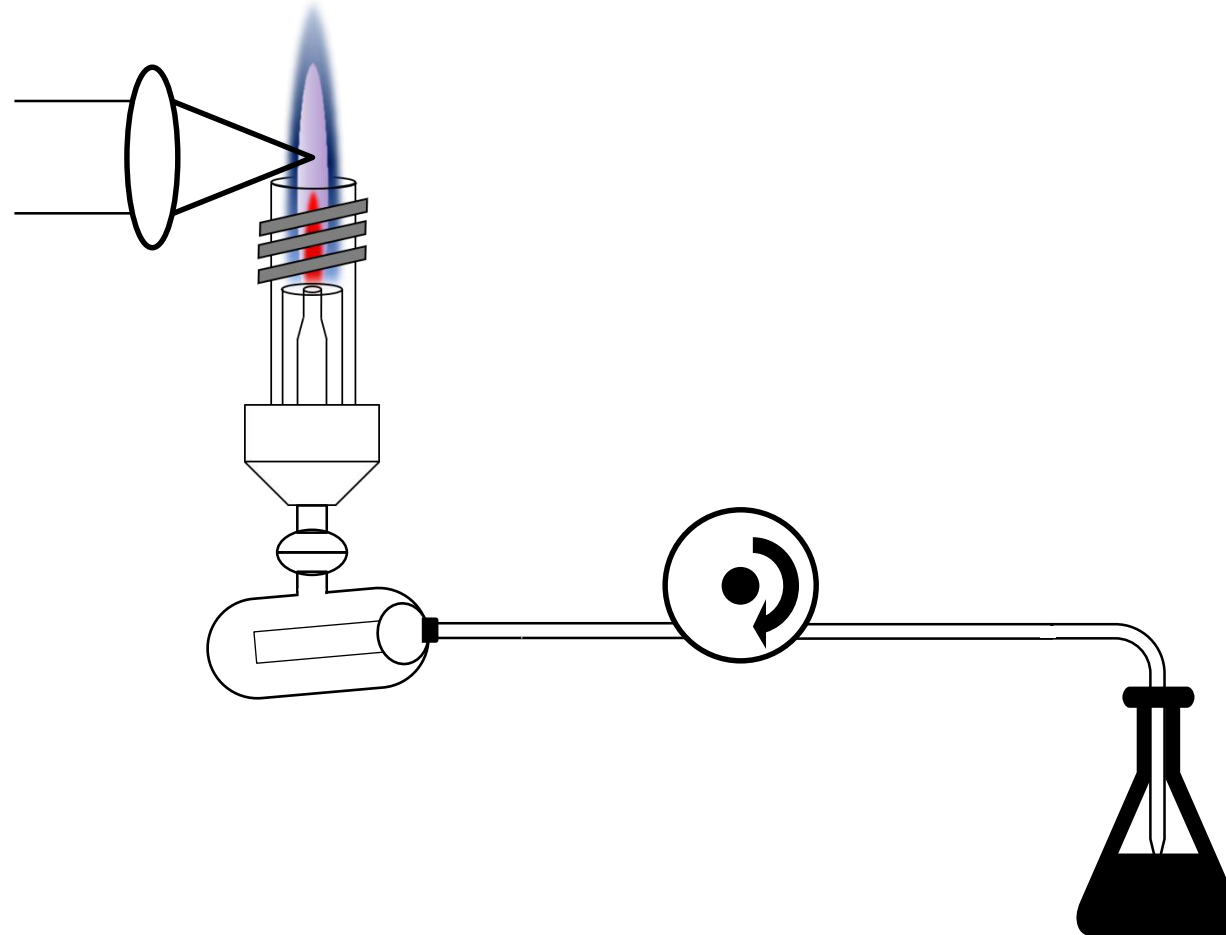


- Microwave Pressure Digestion in 10 ml **HNO₃** (65%)
- Microwave Pressure Digestion in 7 ml HNO₃ (65%), 3 ml HCl (37 %), 2 ml **HBF₄** (50%)



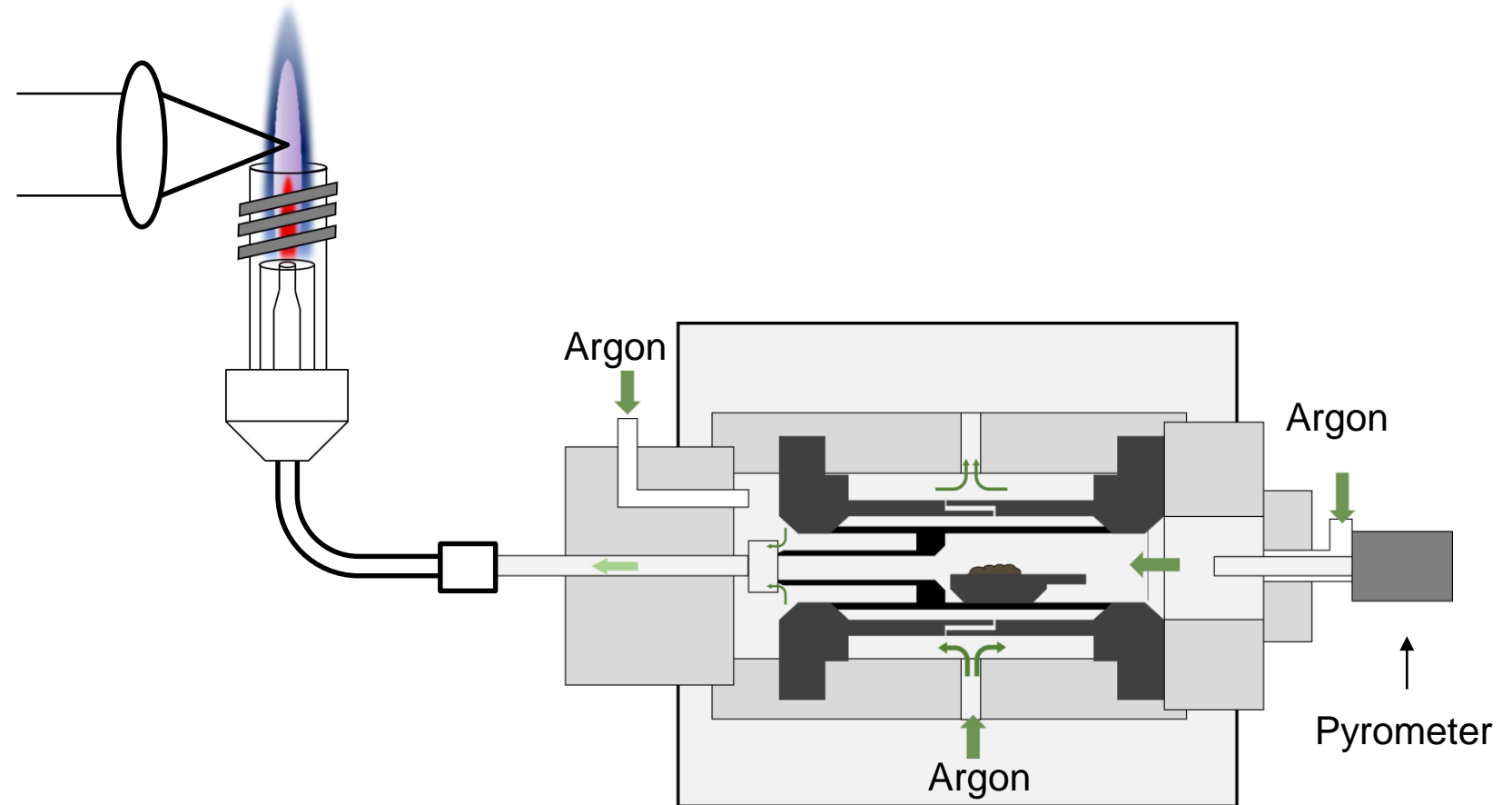
Inductive Coupled Plasma- Optical Emission Spectroscopy

- Liquid sample introduction
- Nebulizer creates an Aerosol
- Liquid Multi-Element Standard for Calibration
- Averaged over 3 Measurements



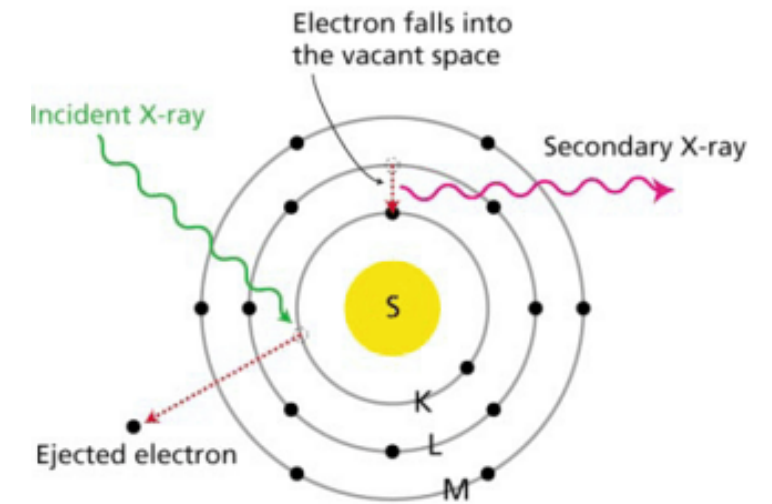
Electrothermal Vaporization: ETV

- Solid Sample Introduction
- Vaporization creates an Aerosol
- Reference Material used for calibration
- Averaged over 20 + Samples

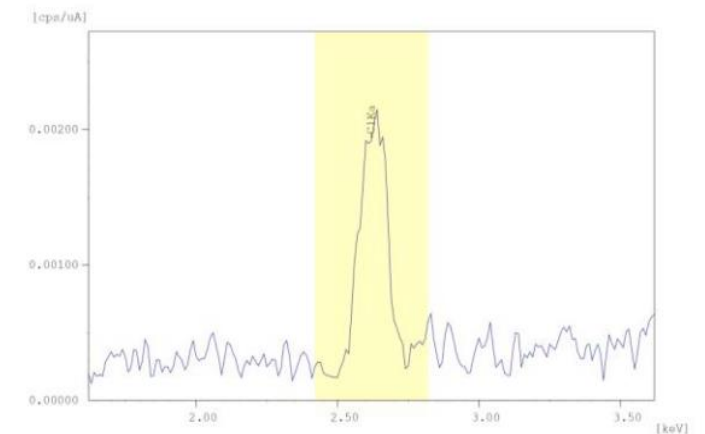


X-ray fluorescence analysis (XRF)

- Production of an ash sample according to DIN EN ISO 18122 (550 °C)
- Measurement of the ash sample
- Averaged over two samples

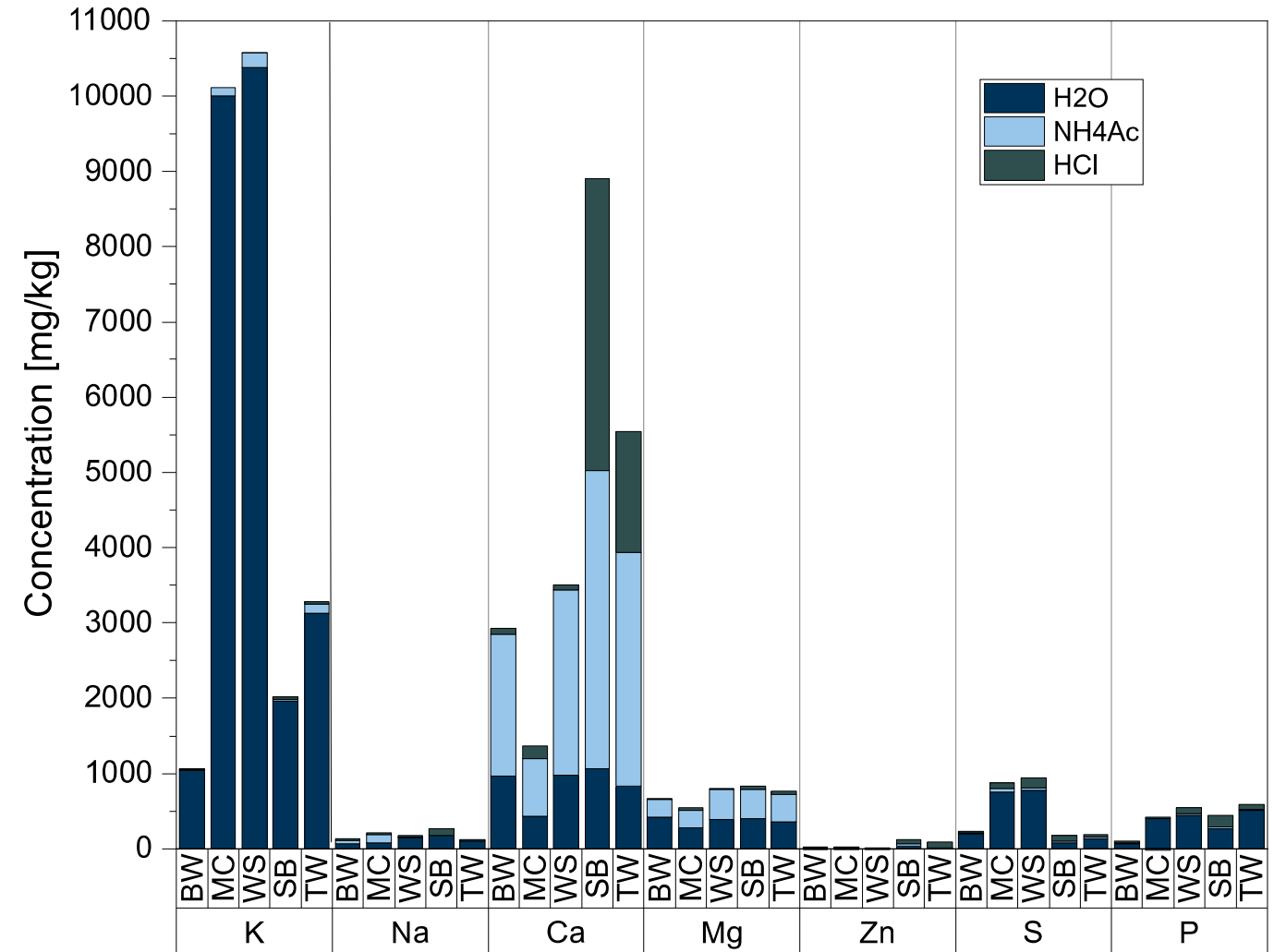


Working principle of X-ray fluorescence spectroscopy



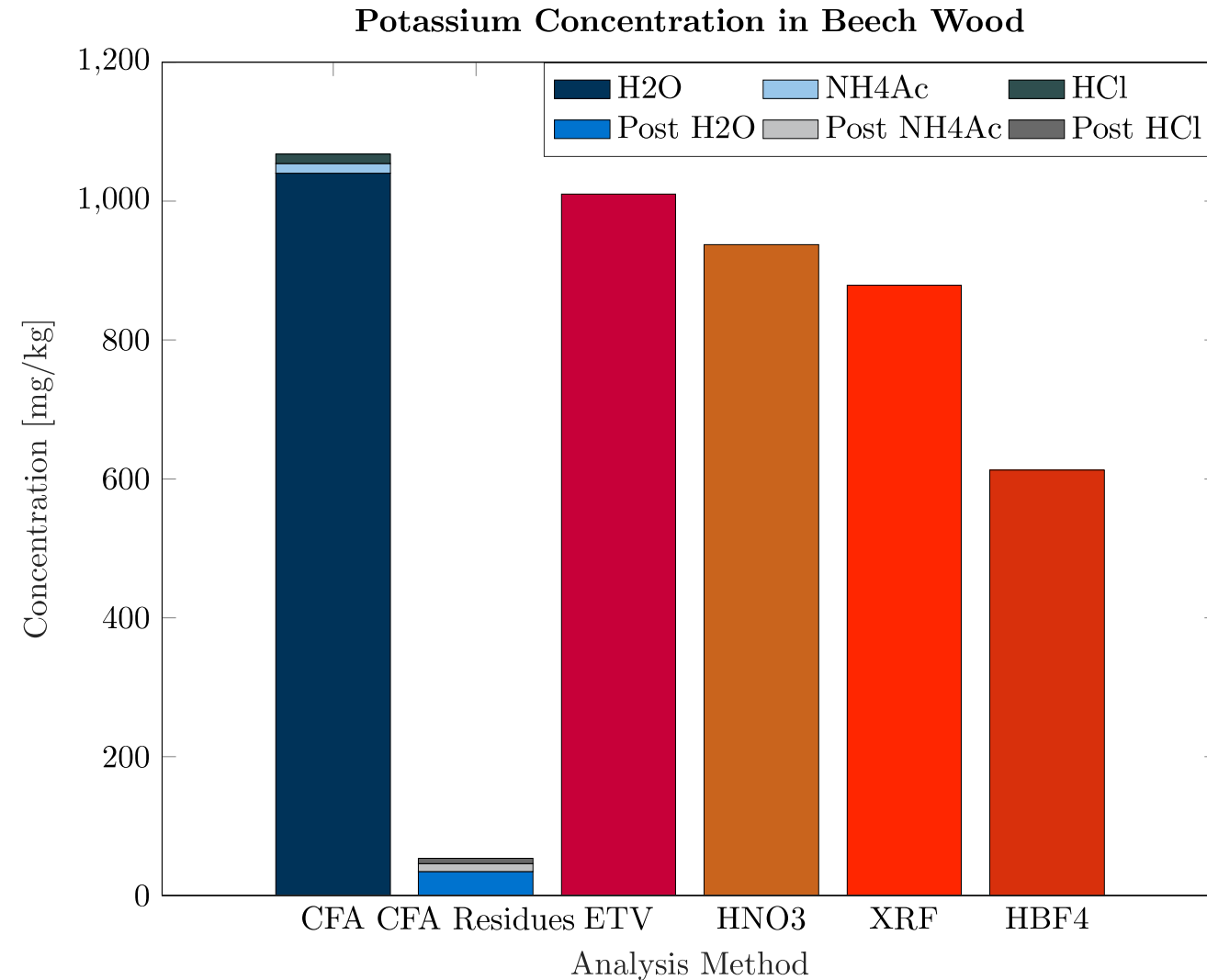
Results: Chemical Fractionation

- BW: Beech Wood
- MC: Miscanthus
- WS: Wheat Straw
- SB: Spruce Bark
- TW: Torrefied Wood



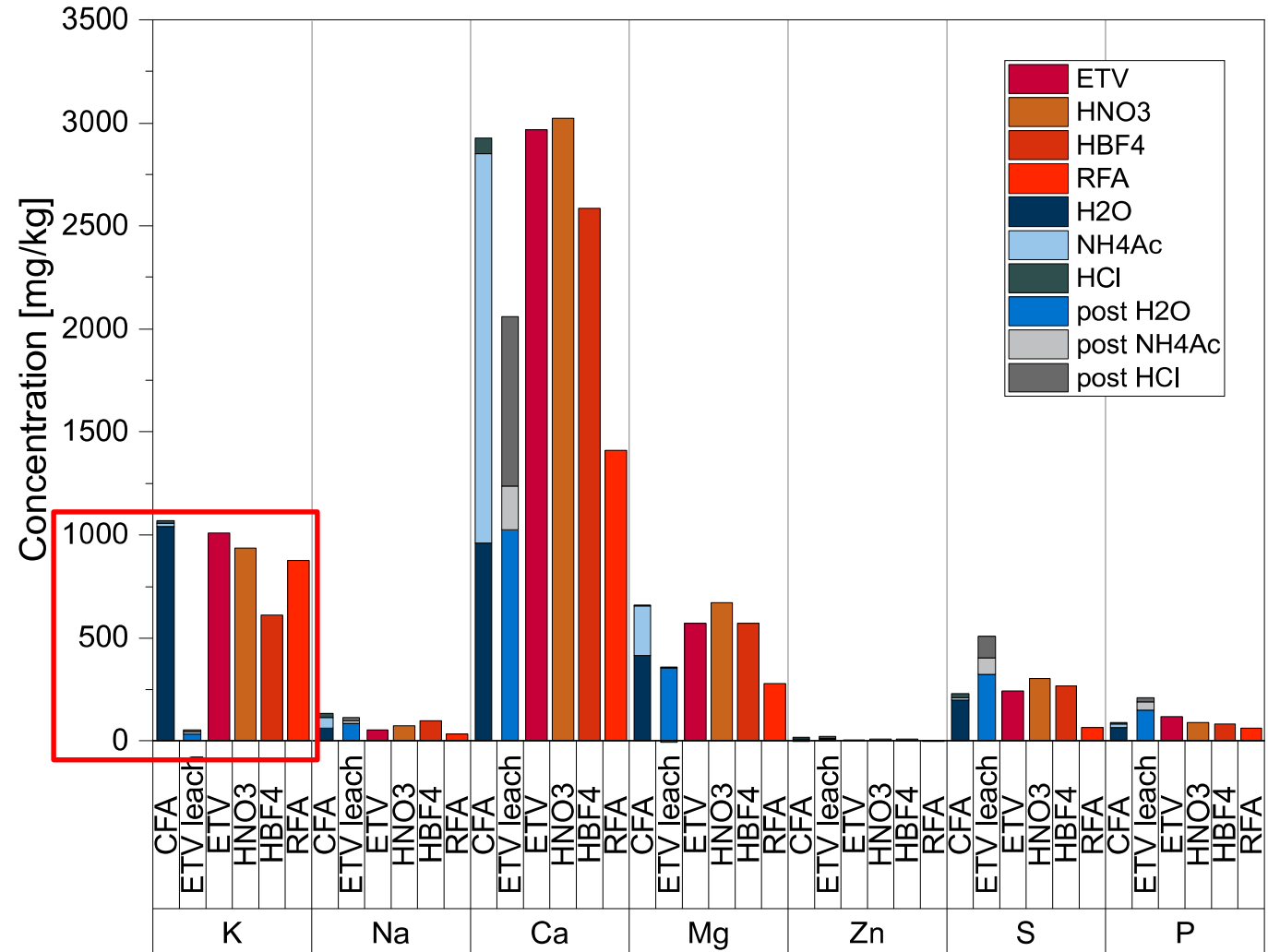
Results: Potassium Concentration in Beech Wood

- CFA Residues are analyzed in the ETV-System
- Challenge: Small and inhomogeneous samples



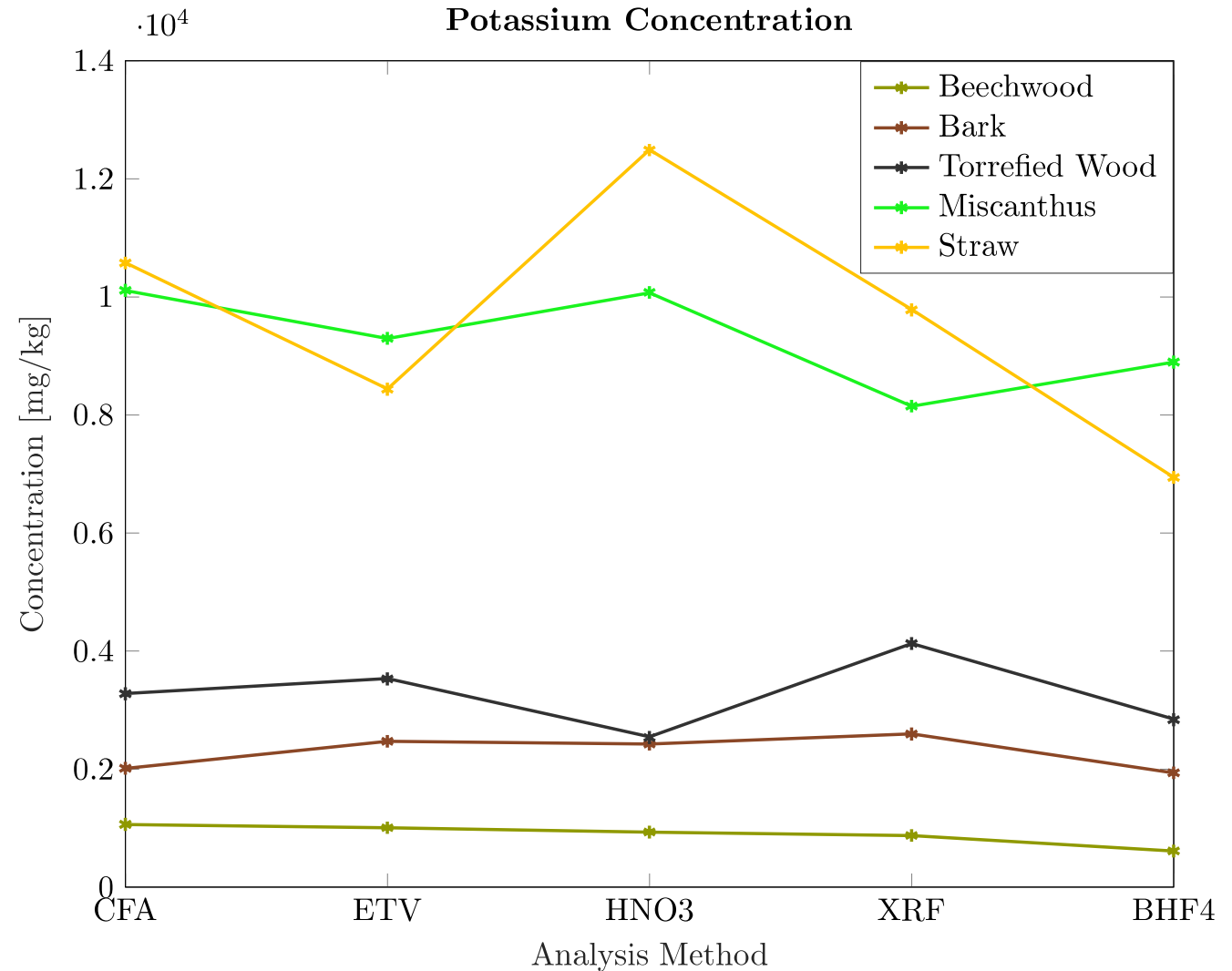
Results: Beech Wood Composition

- Wide range of concentrations
- Same order of magnitude for all methods



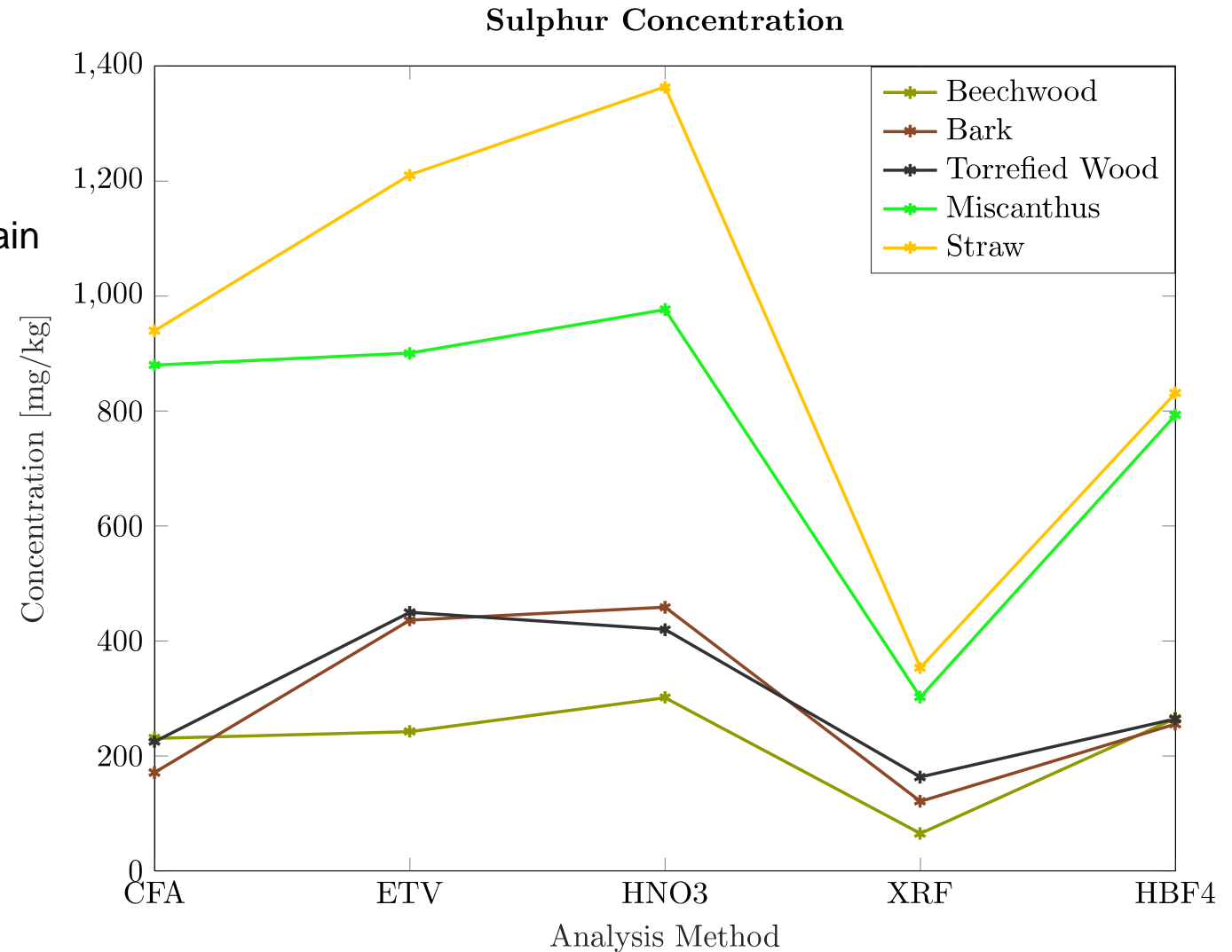
Results: Potassium in different elements

- Potassium concentration highly elevated in Miscanthus and Straw
- Wide range of concentrations is a challenge for a ETV-ICP-OES Method



Results: Sulphur in different elements

- XRF insufficient for Sulphur analysis
- Tradeoff between high elemental concentrations in ash and volatility of certain elements



Summary and Outlook

- 5 Different Biomass Samples
- 5 Different Analysis Methods
- 7 + 9 Elements Analyzed

Next Step: Temperature Resolved Measurements

Thank You for Your Attention!



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