

Penn
UNIVERSITY of PENNSYLVANIA



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& the BIOCOMBUST Team (DE, FR, CH)

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🌿 **Combustion Engineering**

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🌿 **Atmospheric Chemistry, Meteorology and Modeling**

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🌿 **Cement Chemistry, Mineralogy and Microscopy**

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🌿 **Project Management and Outreach**

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PARTNER



MAX-PLANCK-INSTITUT
FÜR CHEMIE

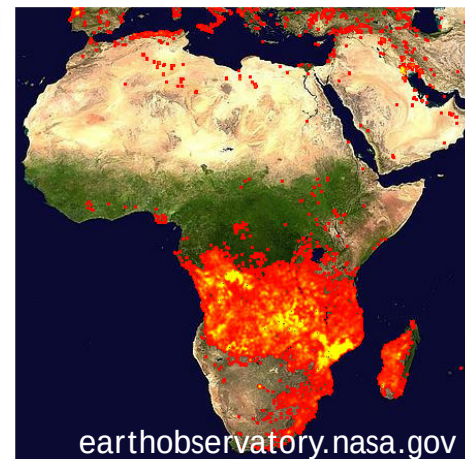
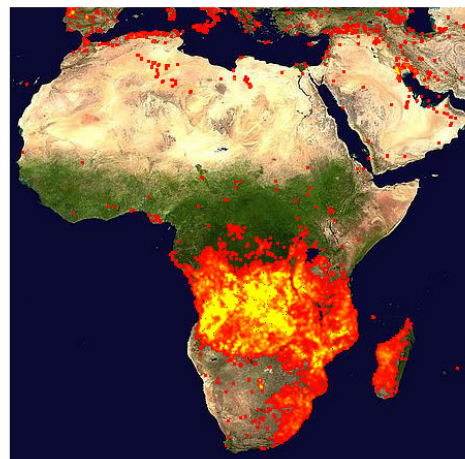
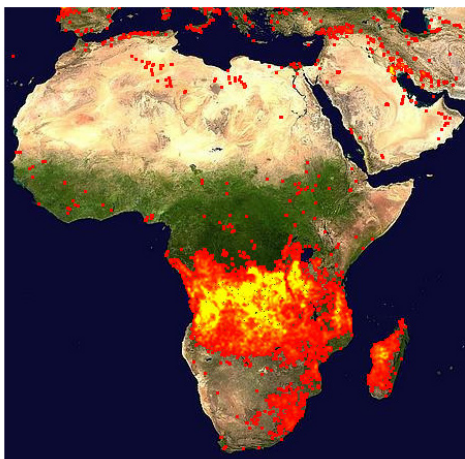
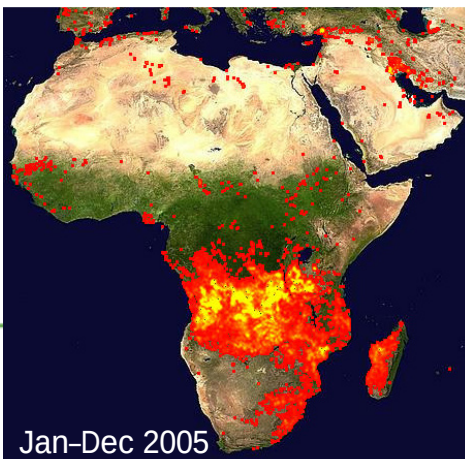
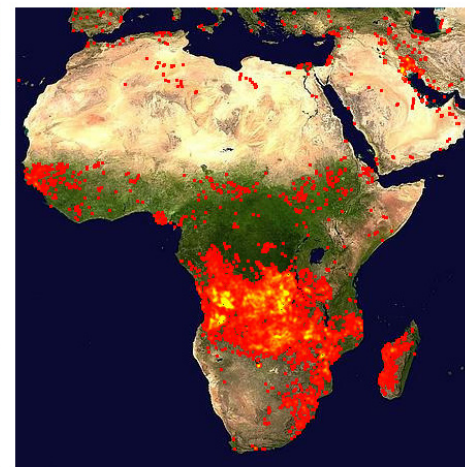
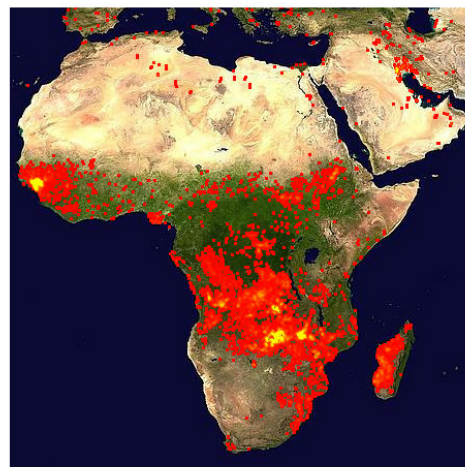
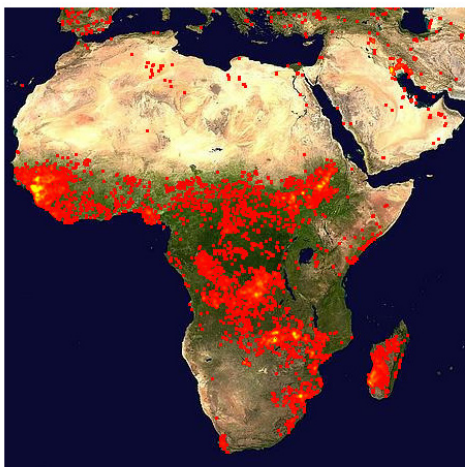
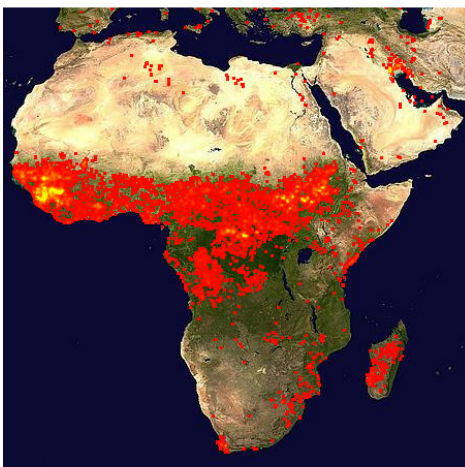
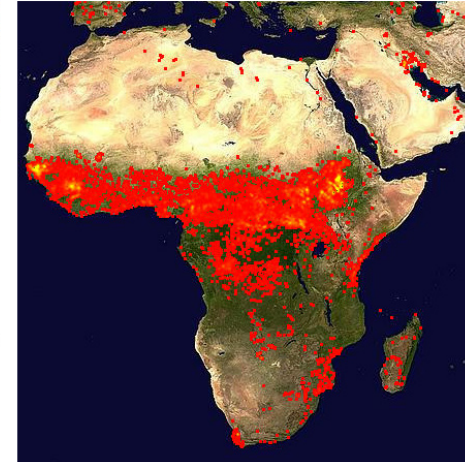
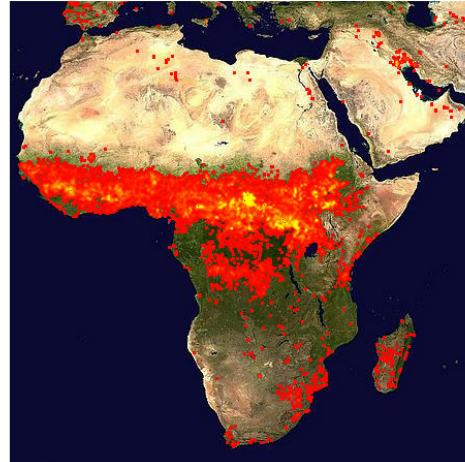
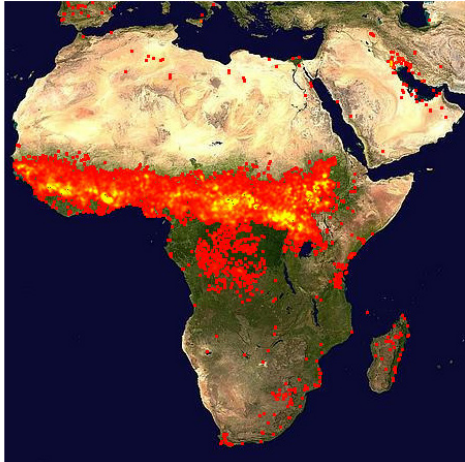
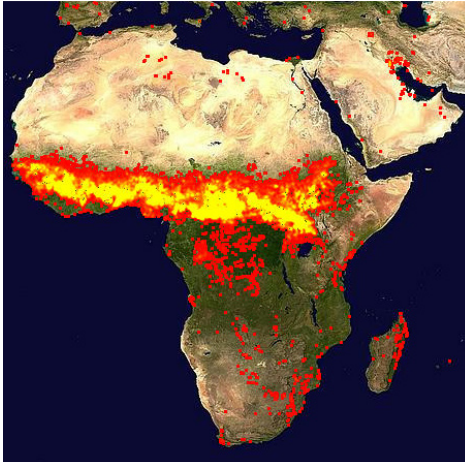


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Jan-Dec 2005

earthobservatory.nasa.gov

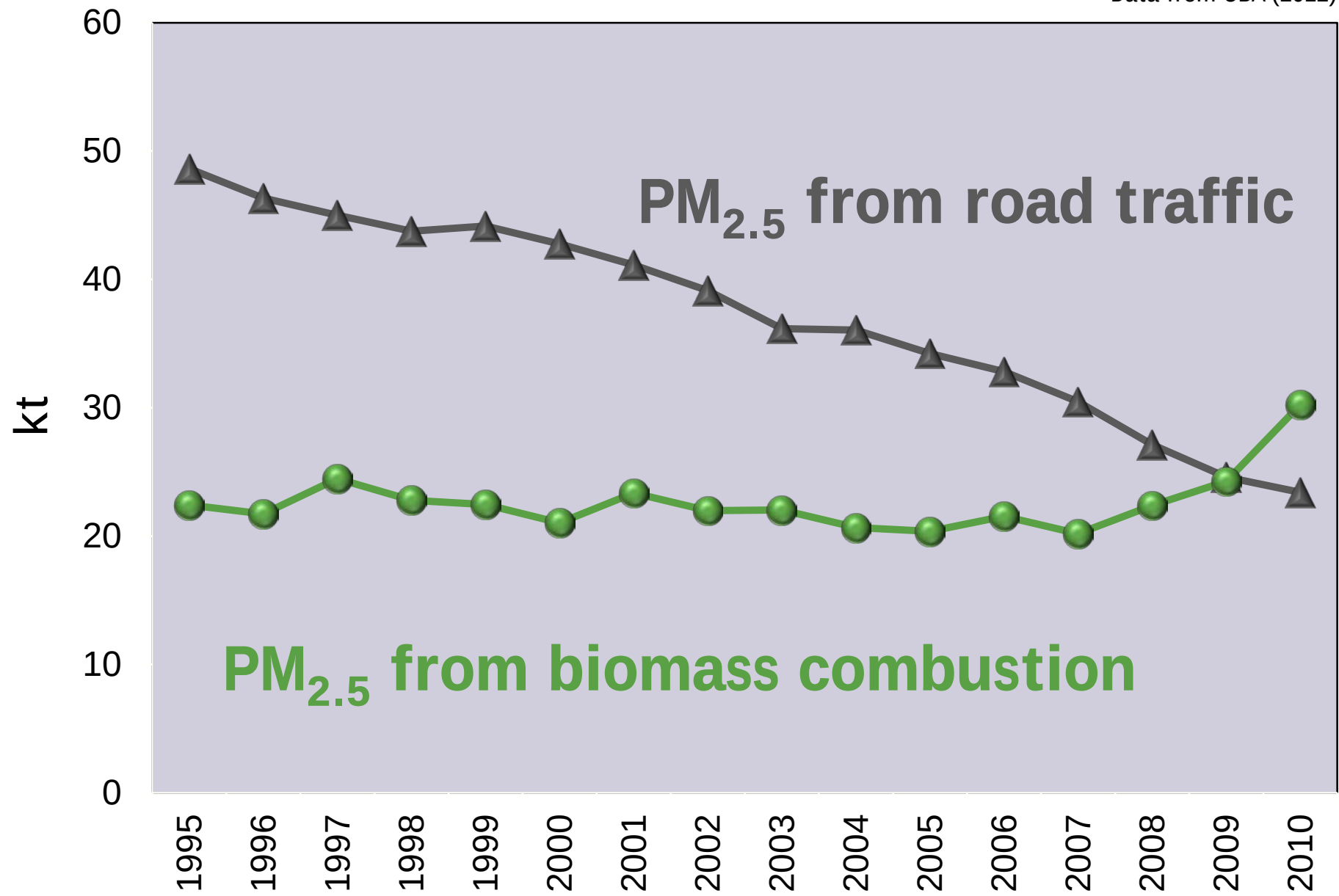
December 4, 2001

Visible Earth (NASA)











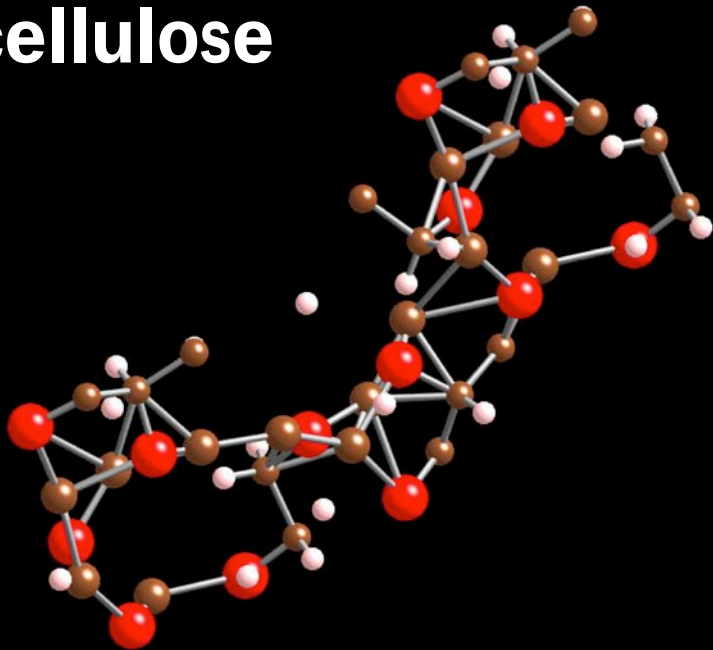
FUEL CHARACTERIZATION



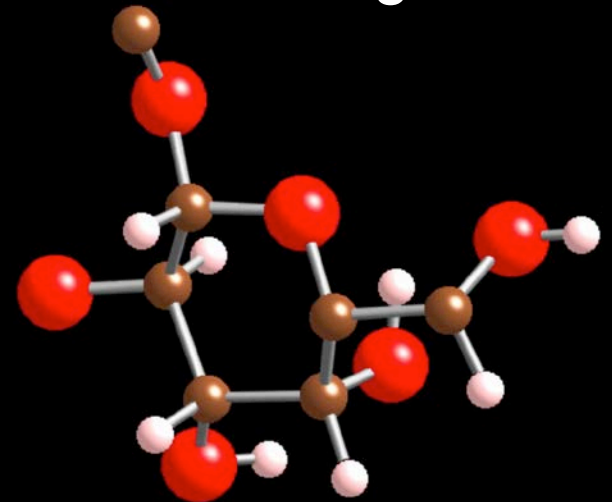


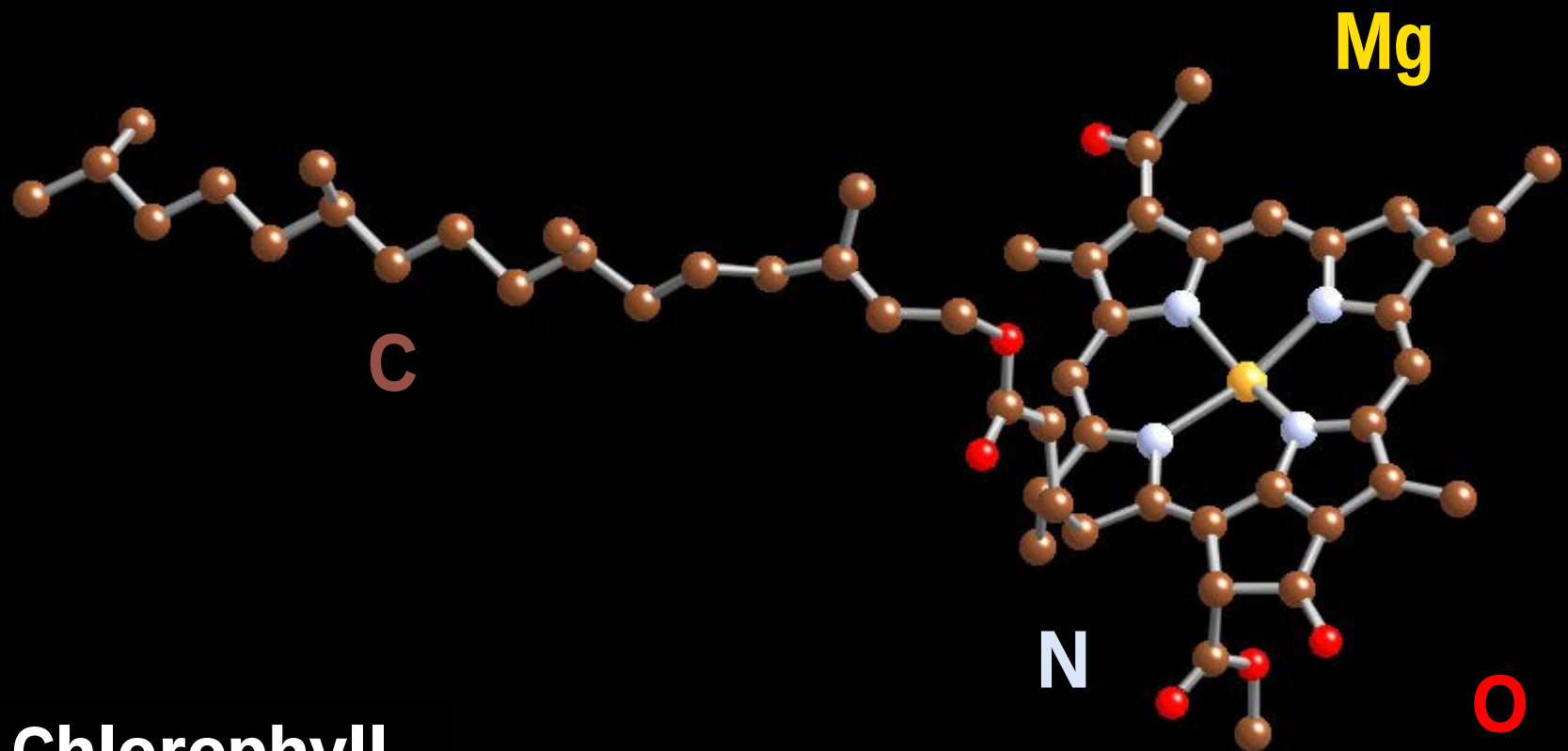


cellulose



glucose





Chlorophyll



Arundo



Sugarcane



Wheat

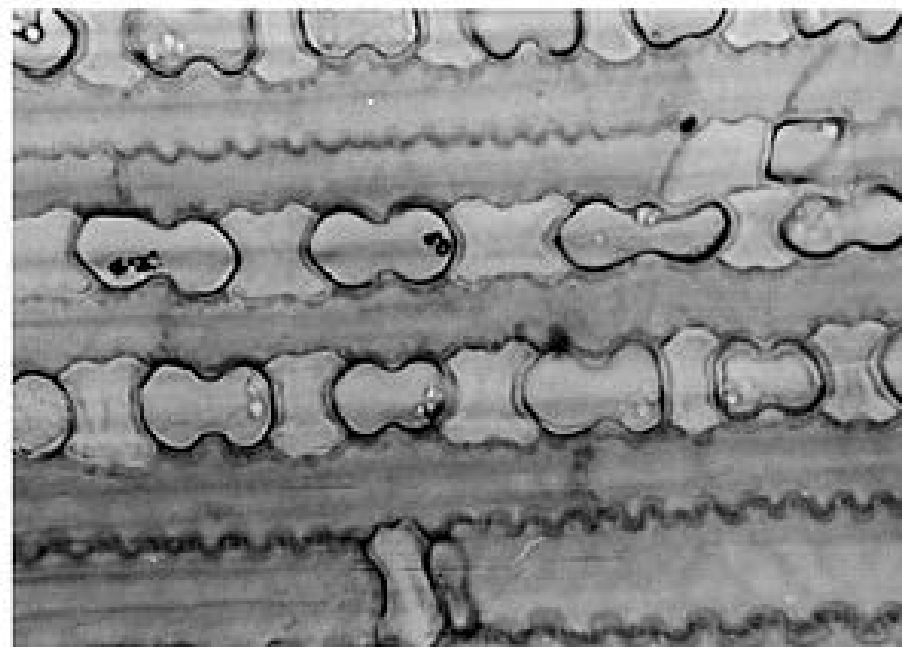
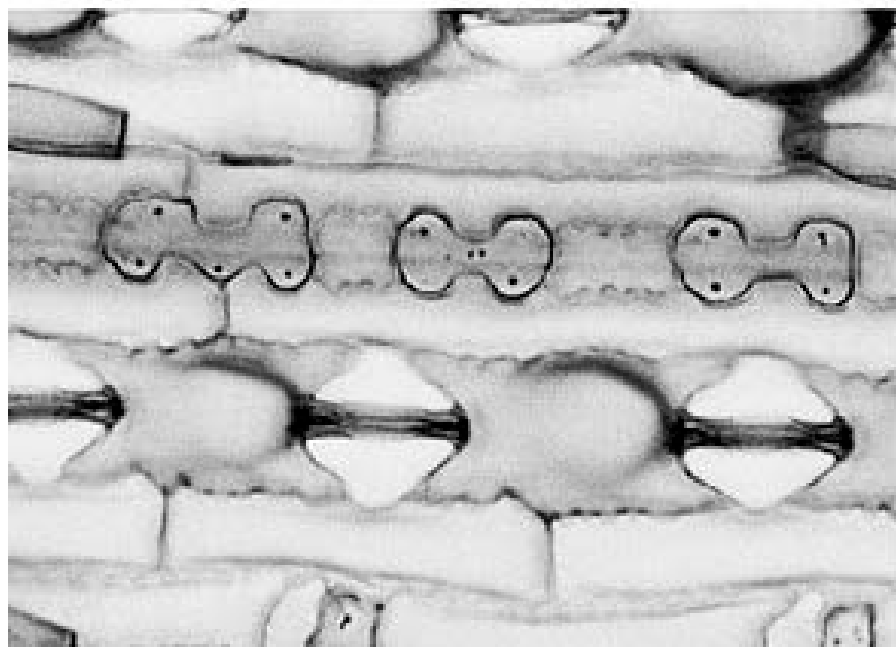
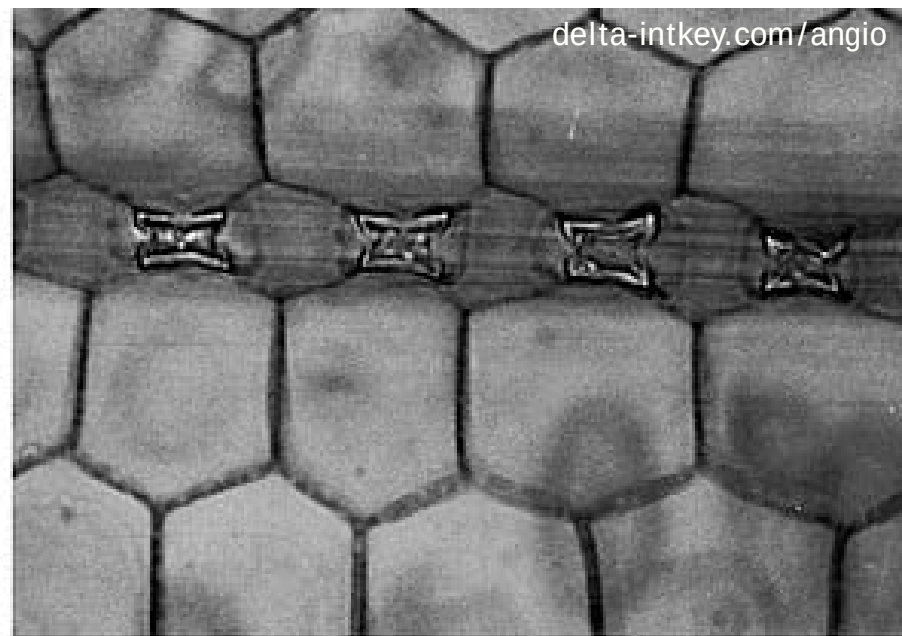
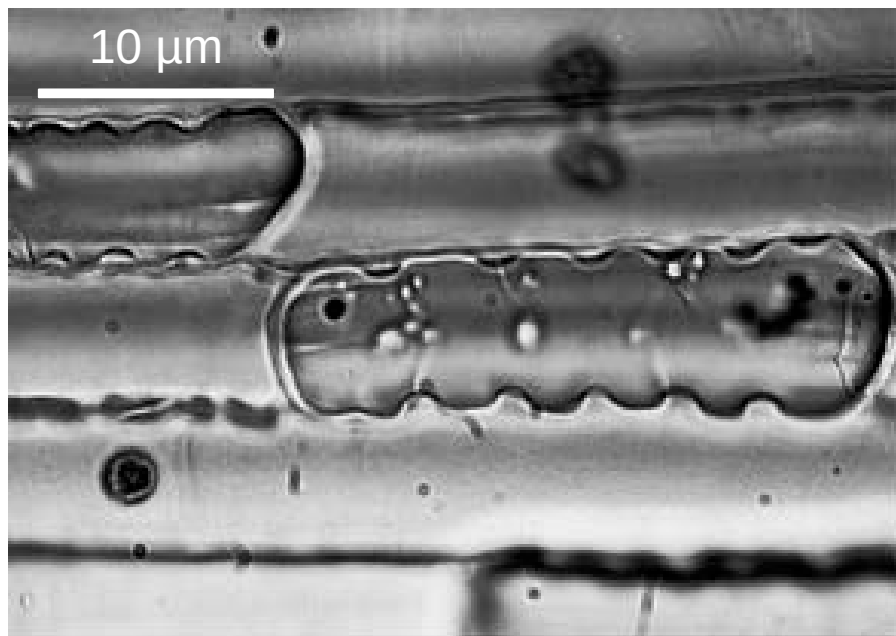
Poacea Family



Miscanthus



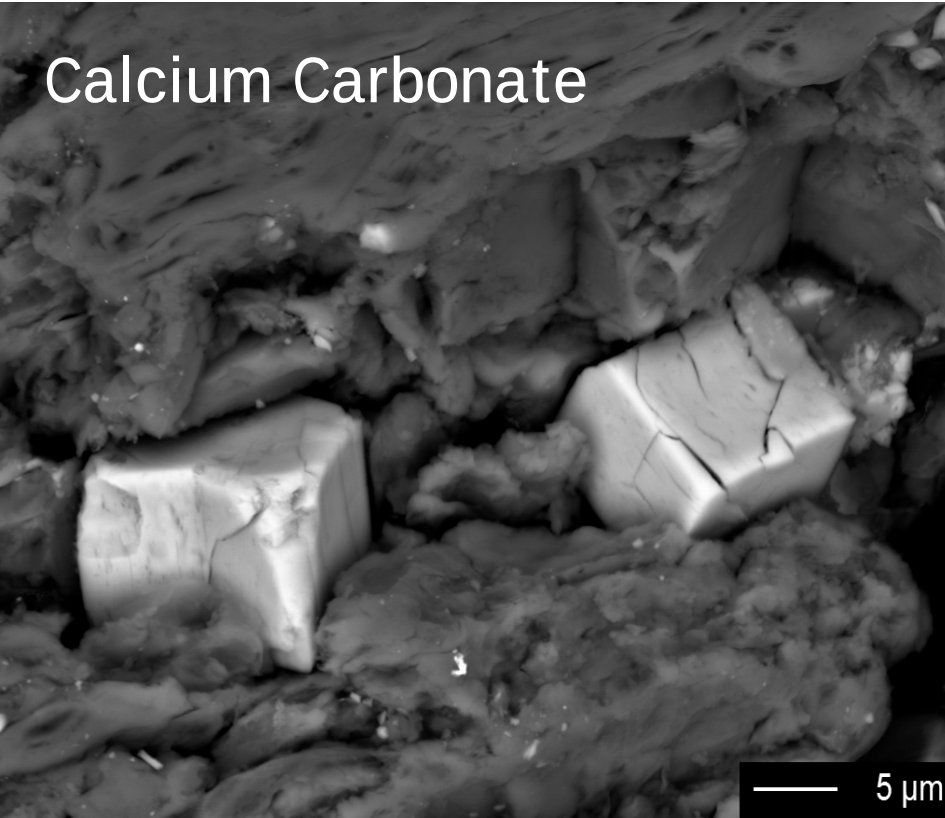
Rice



Inorganic Components

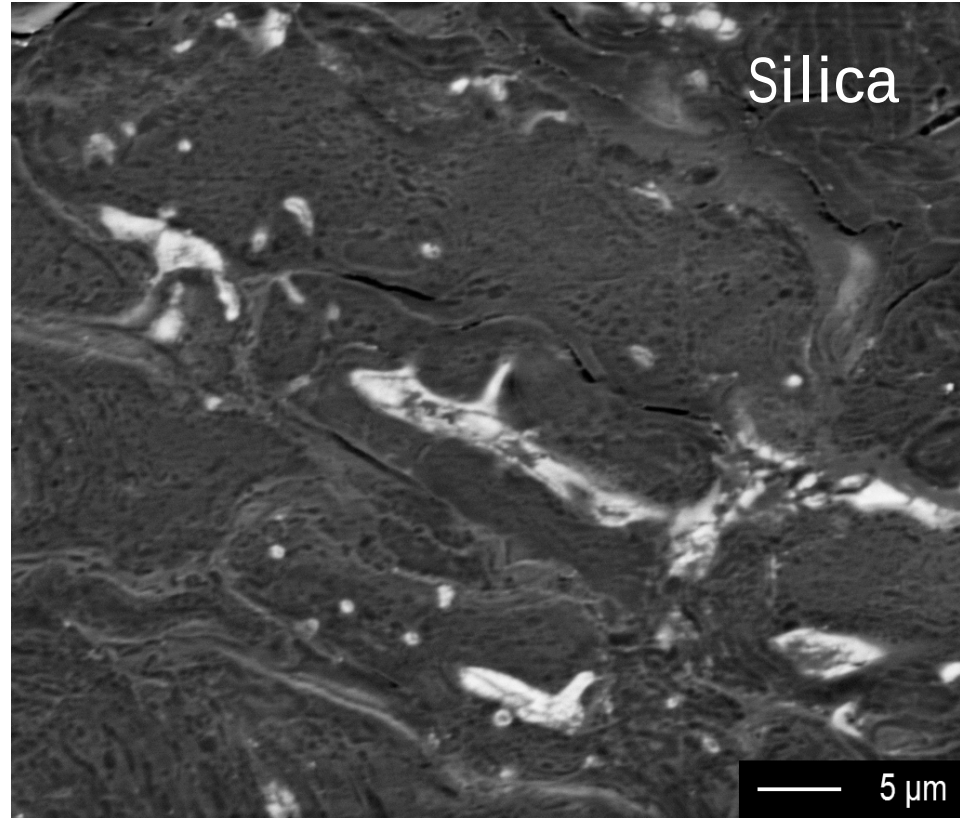
Wood

Calcium Carbonate

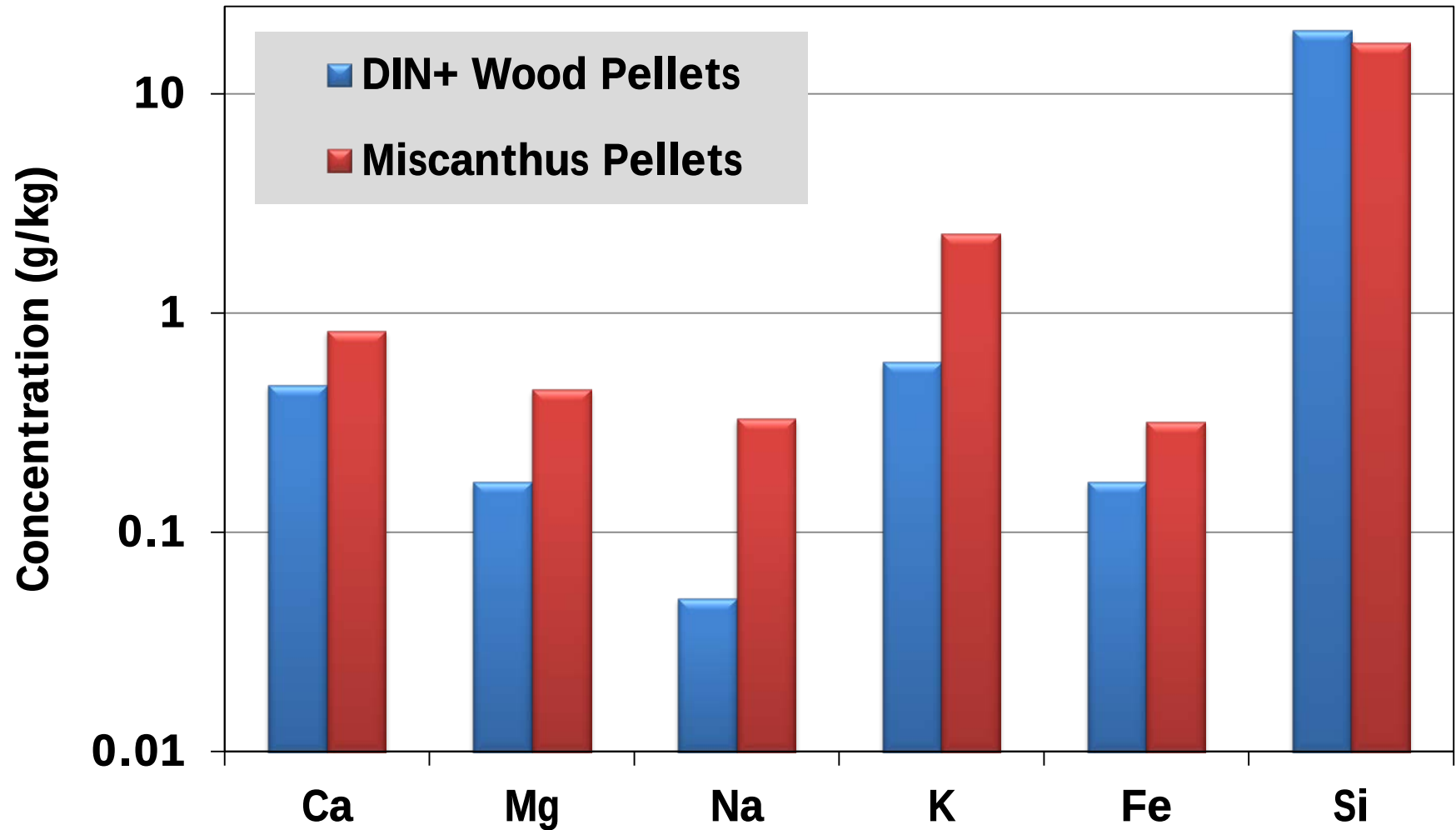


Miscanthus

Silica



Biomass Composition

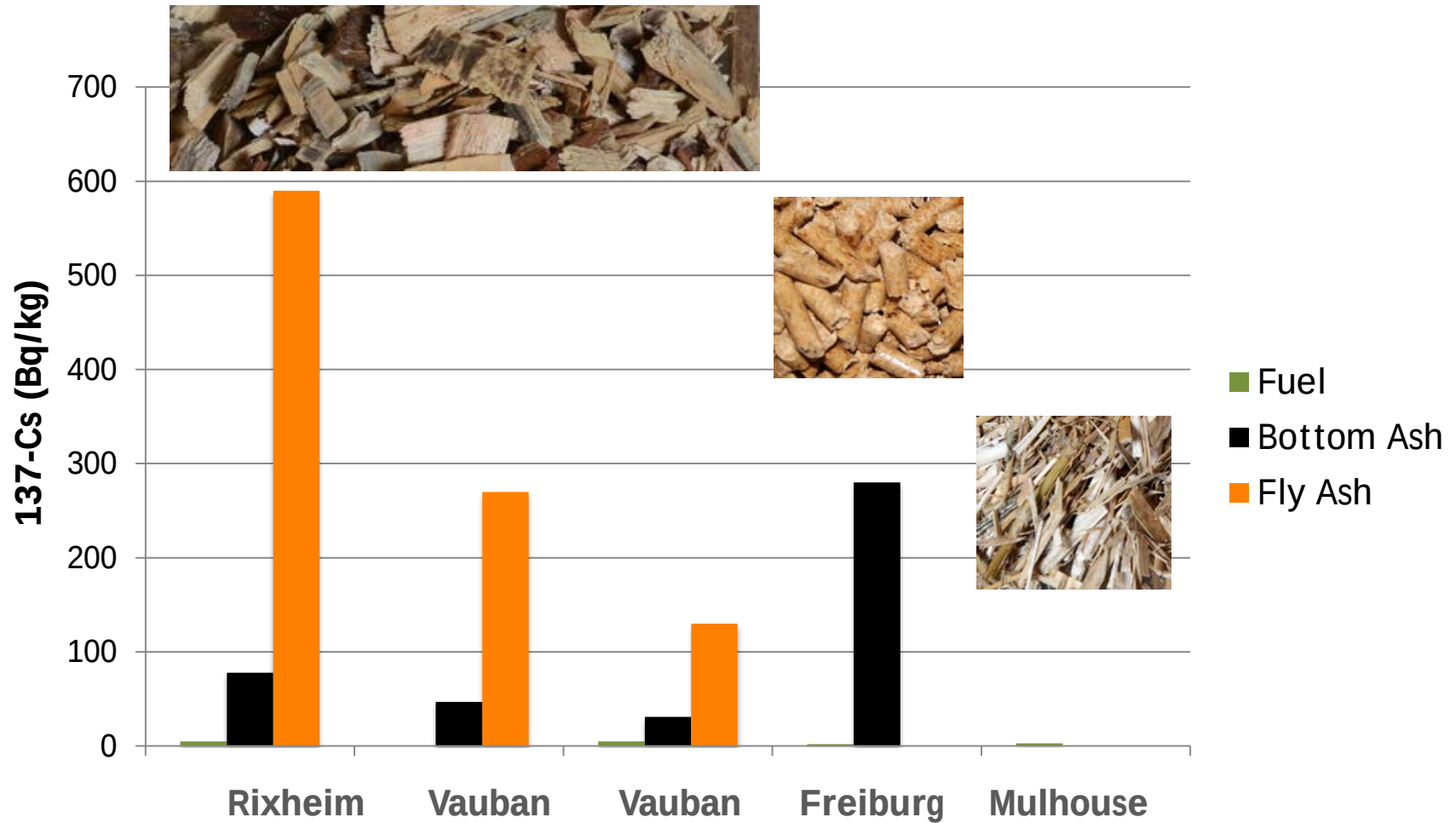


Combustion

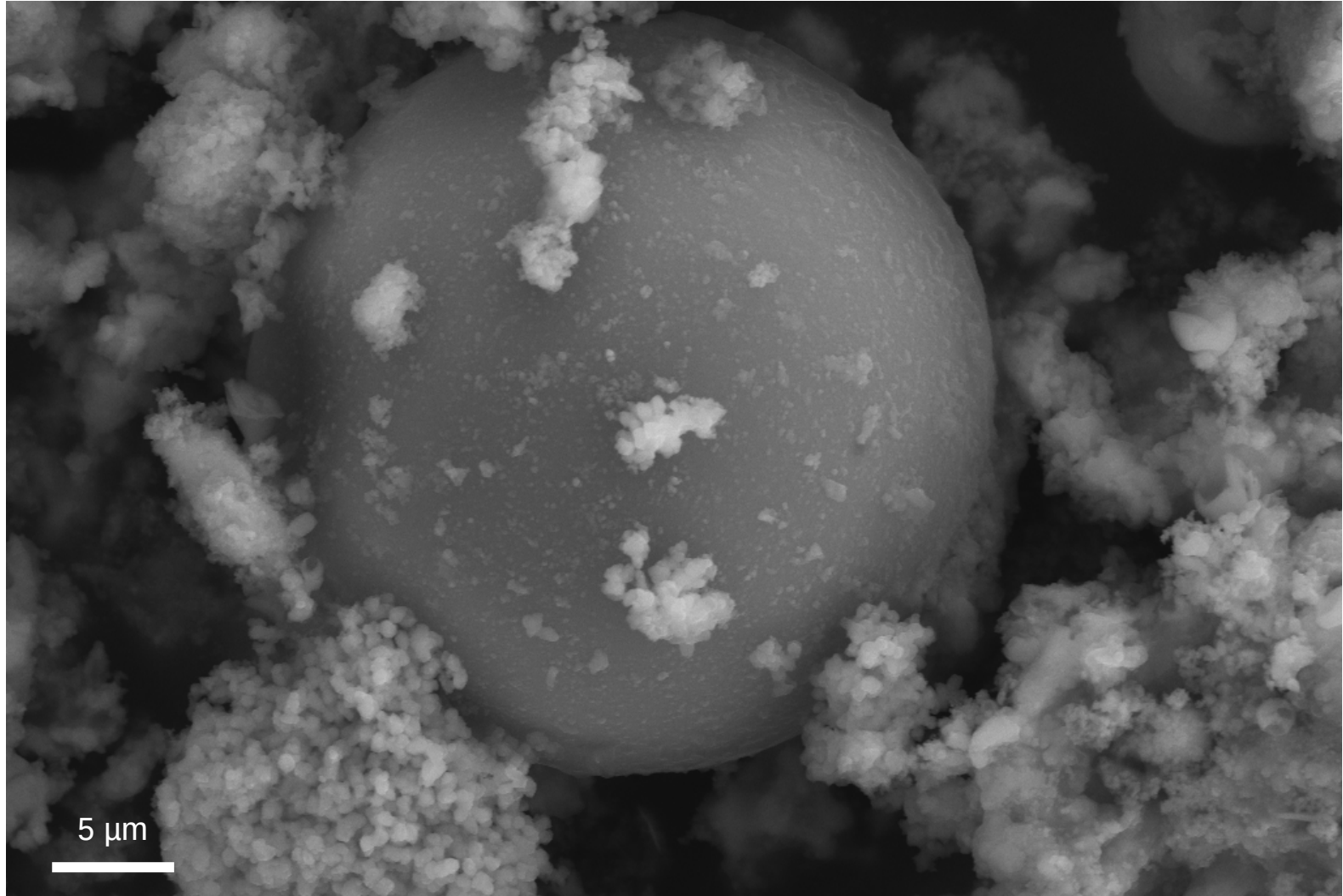




Activity concentration ^{137}Cs



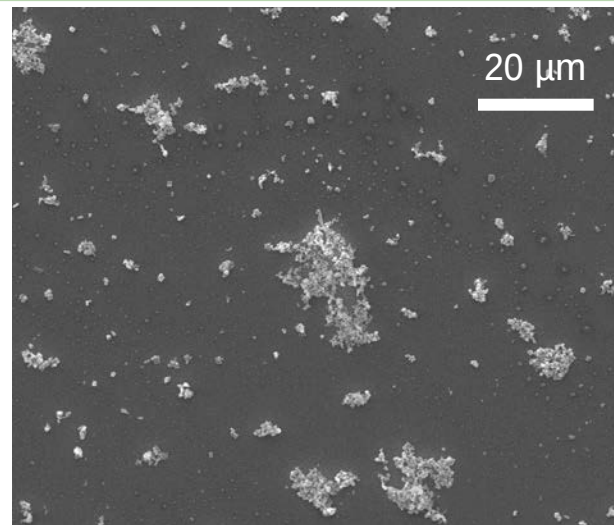
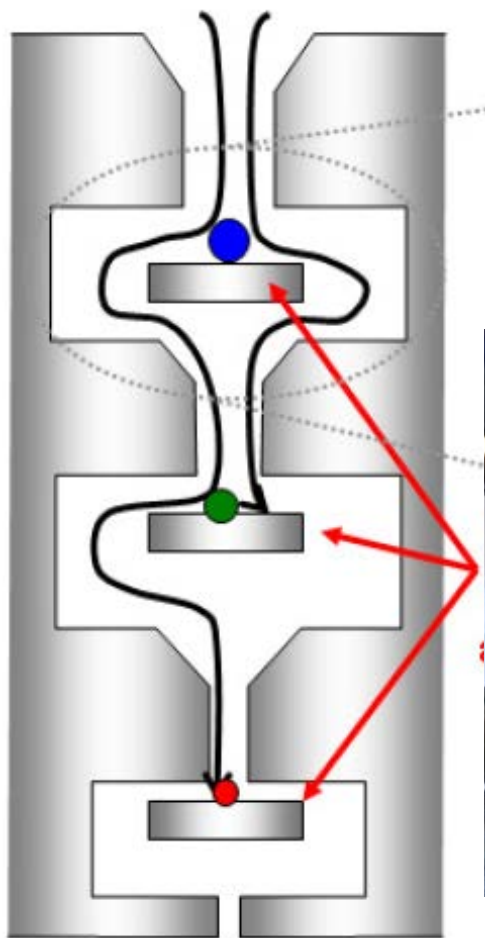
Fly Ash Particles



Particle Sampling



DGI Impactor





Air Quality Measurements



MoLa

Air Quality Measurements

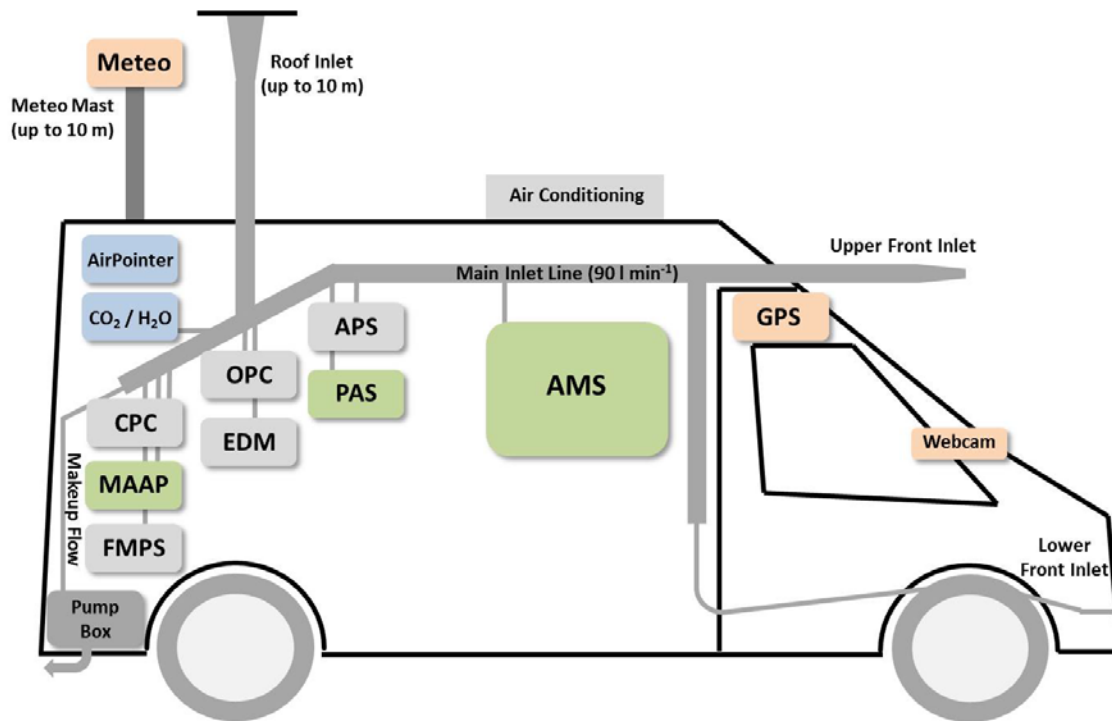
Trace gases

(CO, CO₂, NO_x, SO₂, O₃)

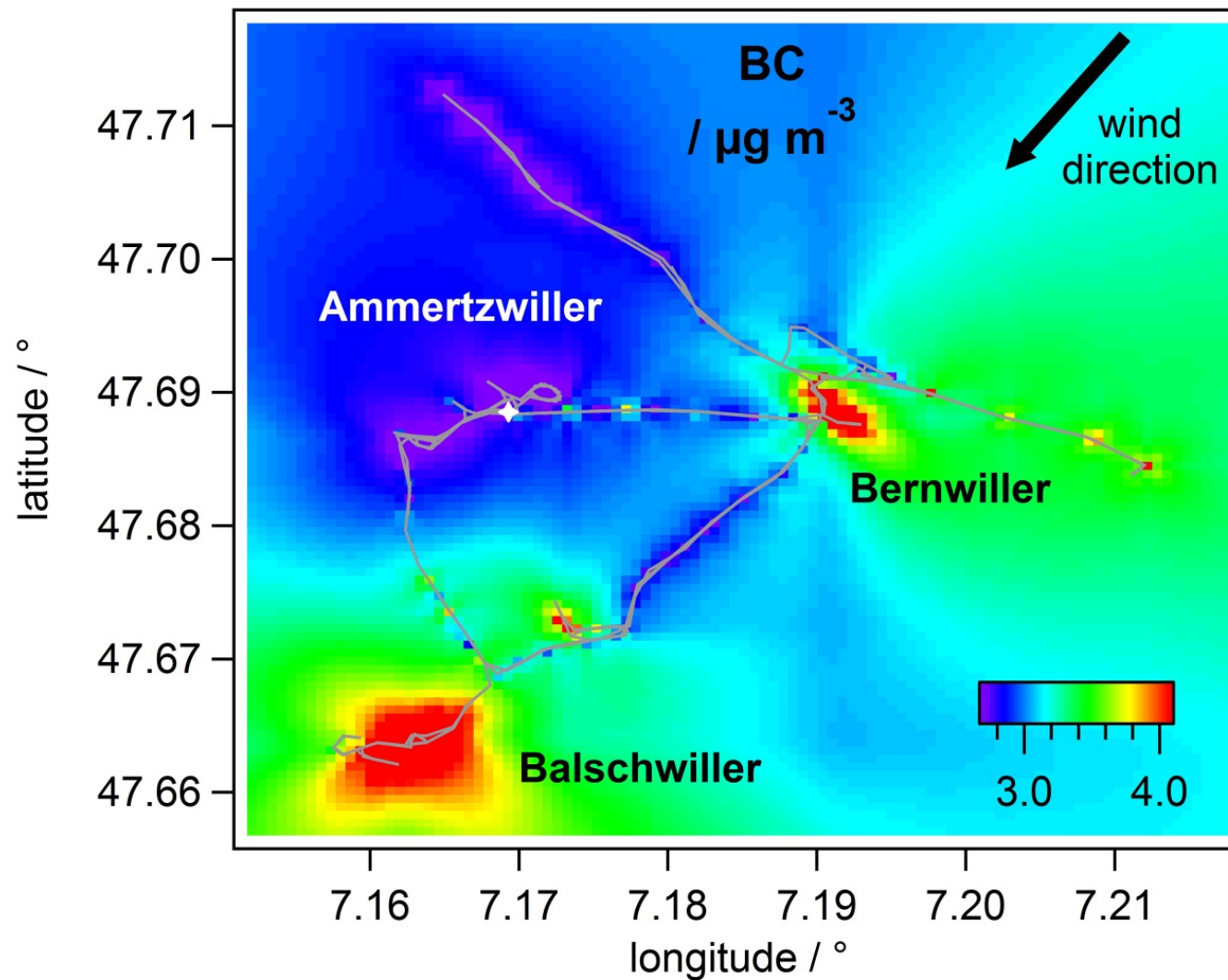
Meteorology, GPS position

Chemical composition of PM₁
(sulfate, nitrate, organics, soot, PAH)

Physical particle properties (number and mass concentration, size distribution)



Air Quality Measurements



Ambient Particle Sampling

Mini-Volume
Sampler



$<2.5 \mu\text{m}$



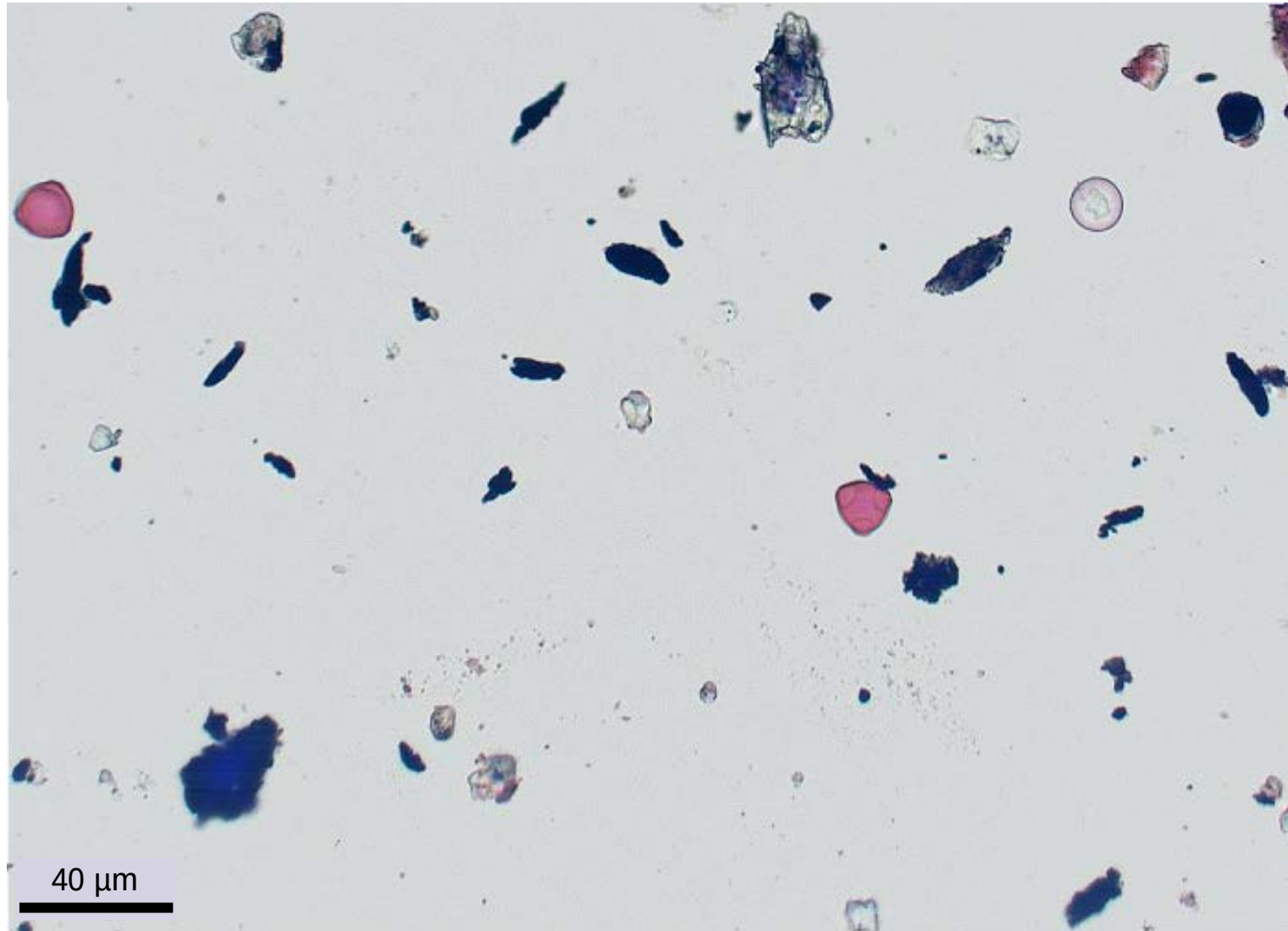
Passive
Sampler

$2.5-10 \mu\text{m}$

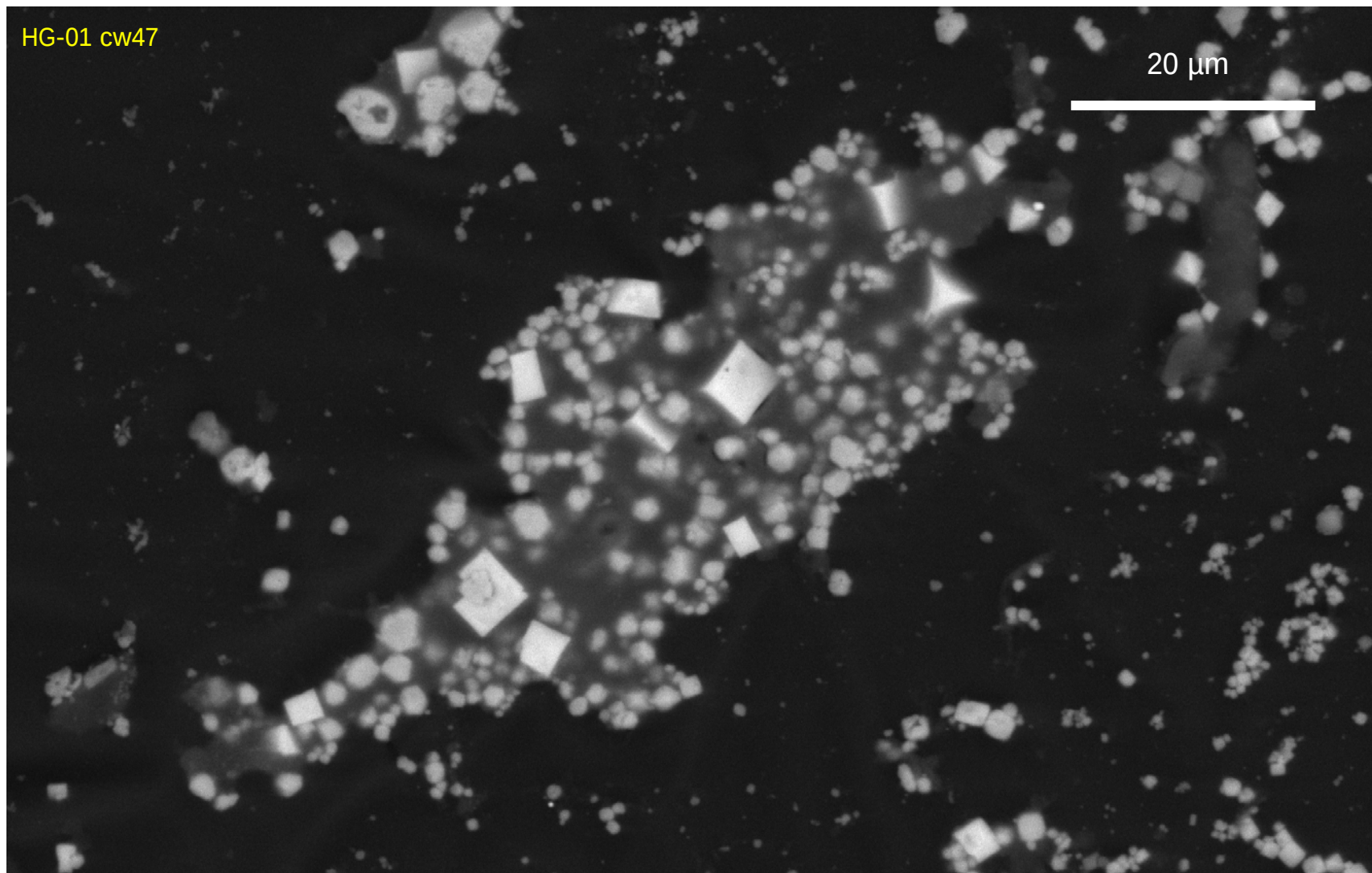
Single-Particle Characterization



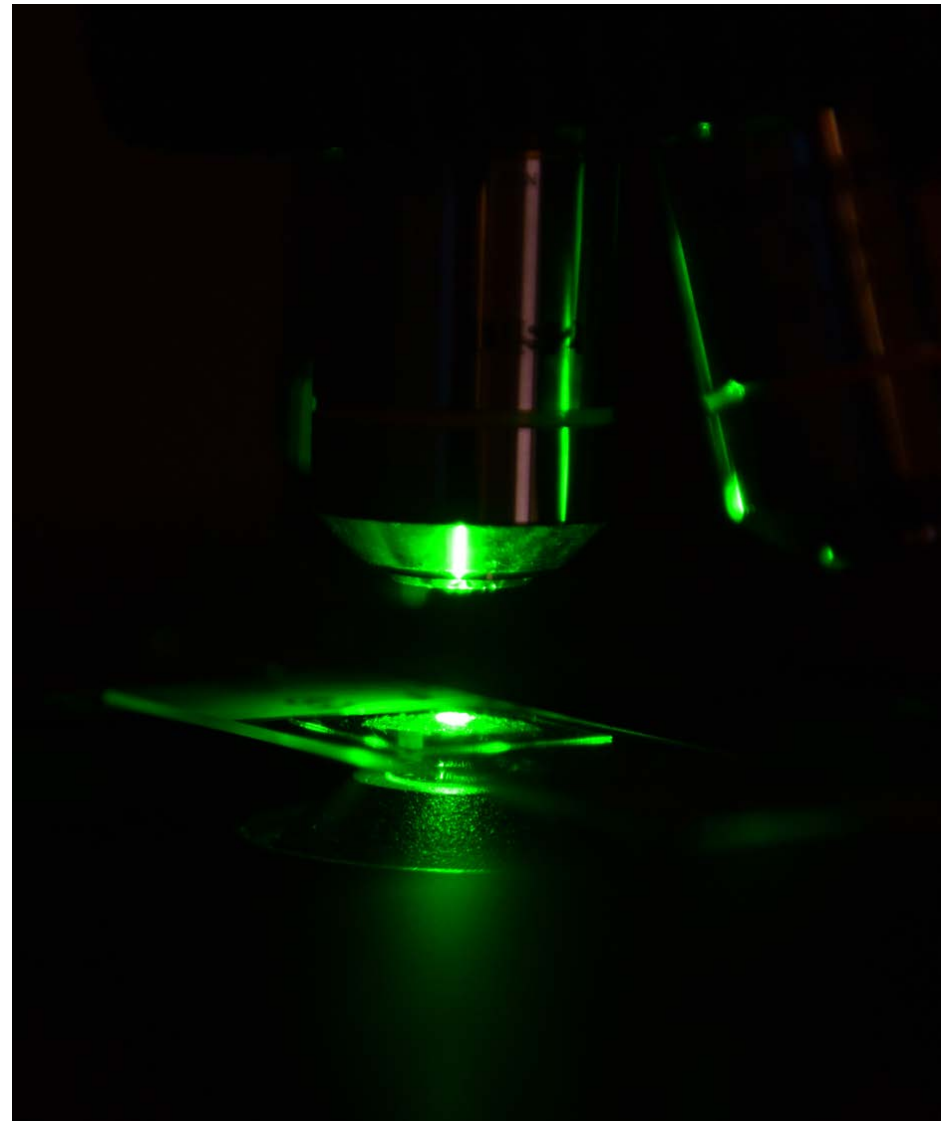
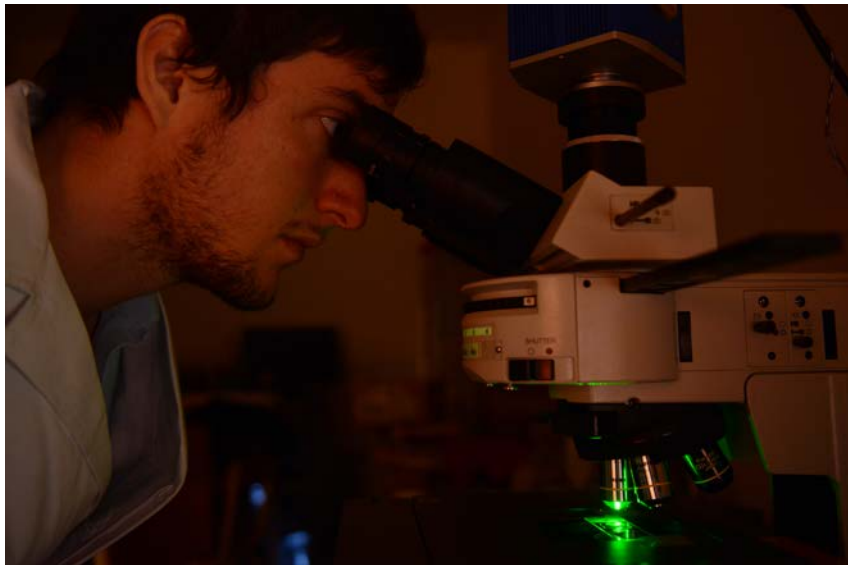
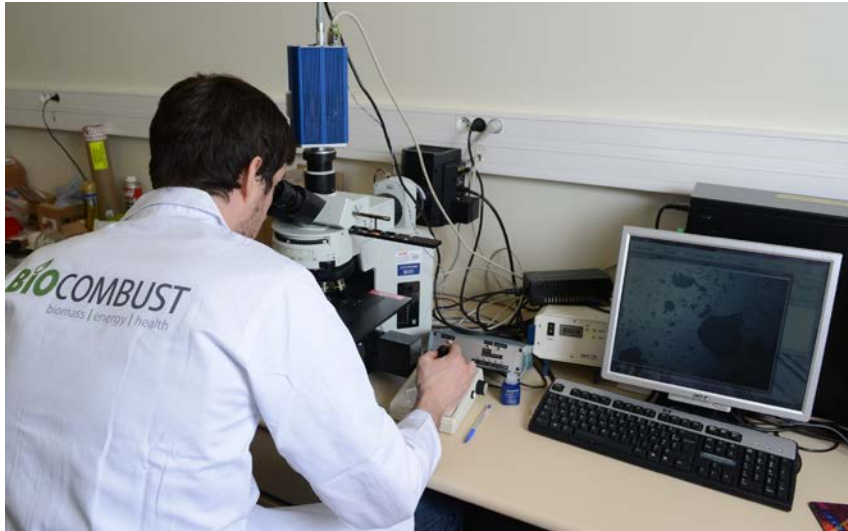
Single-Particle Characterization



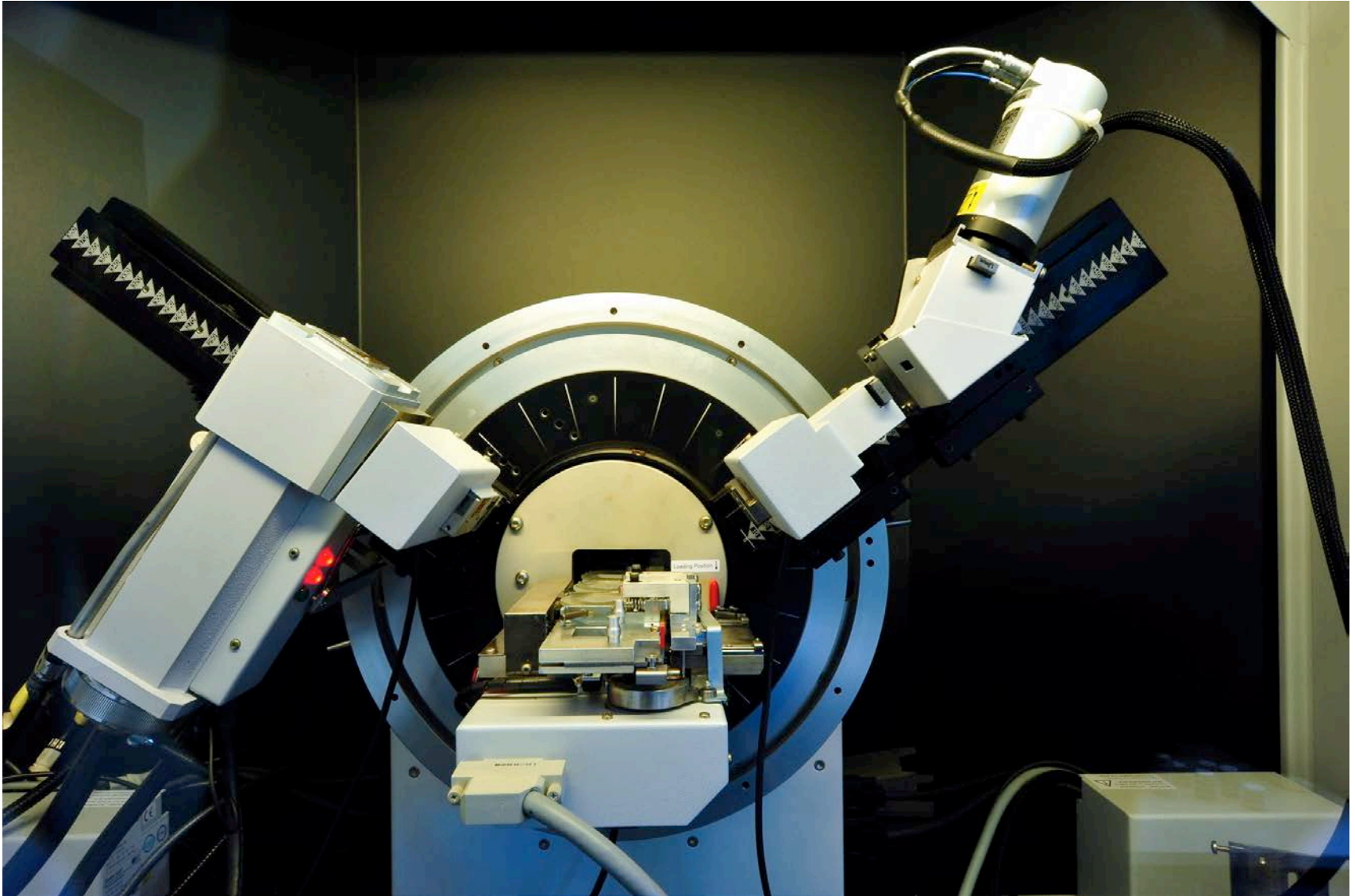
KCl and NaCl



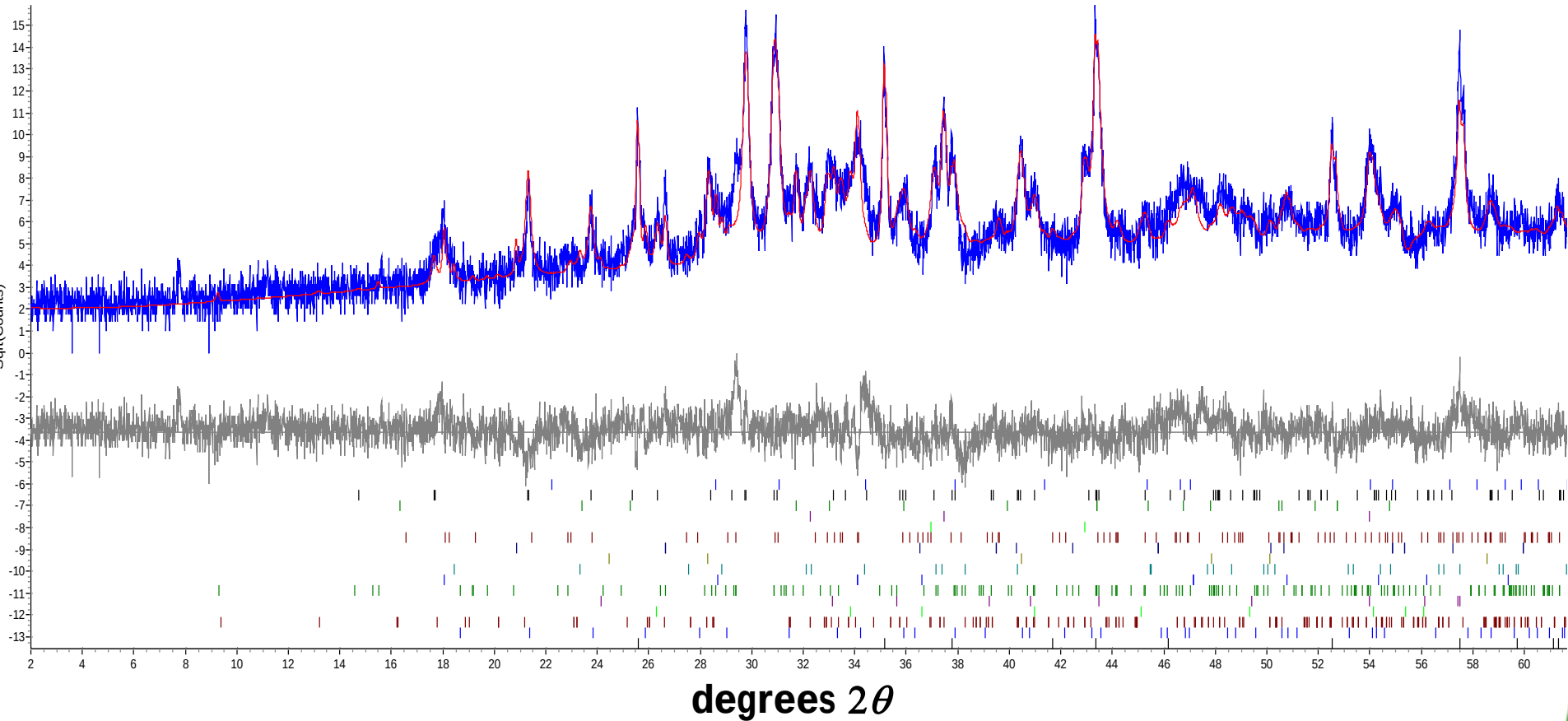
Fluorescence Microscopy



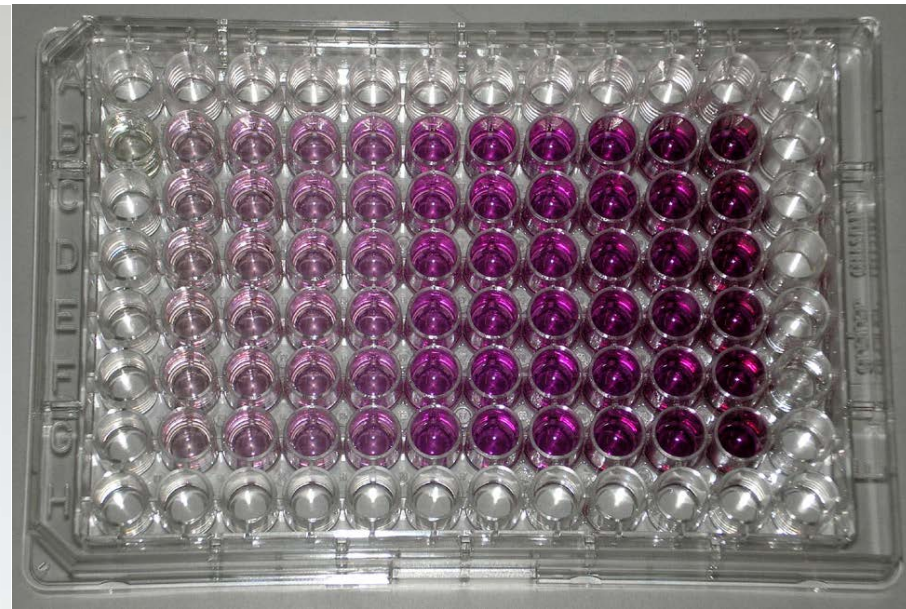
Phase Identification



XRD - Rietveld

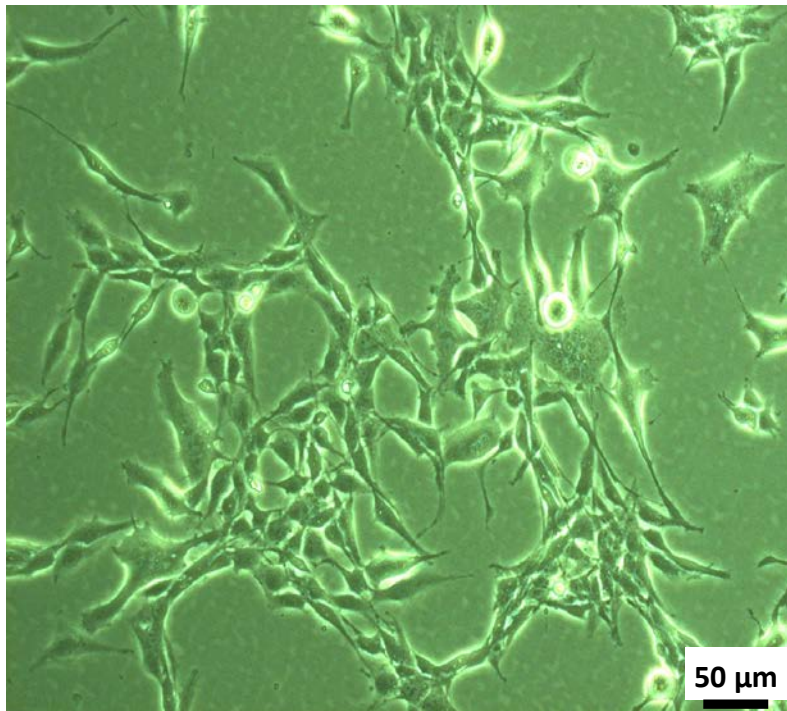


BIOLOGICAL EFFECTS

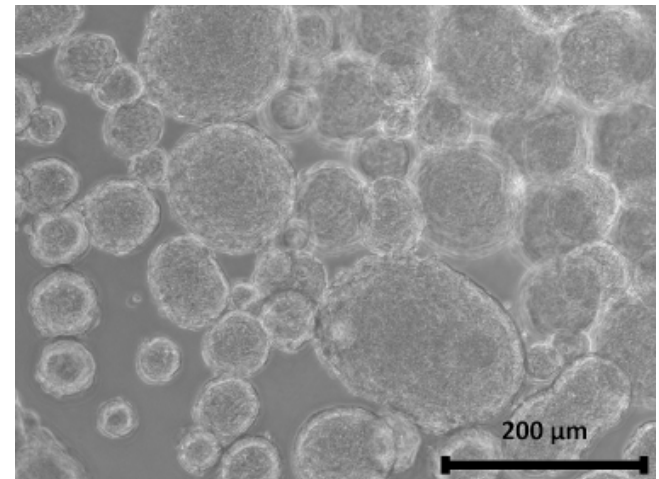
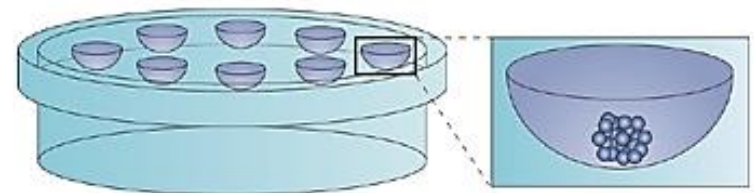


2D vs. 3D Lung Cell Models

BEAS-2B (2D cell culture)



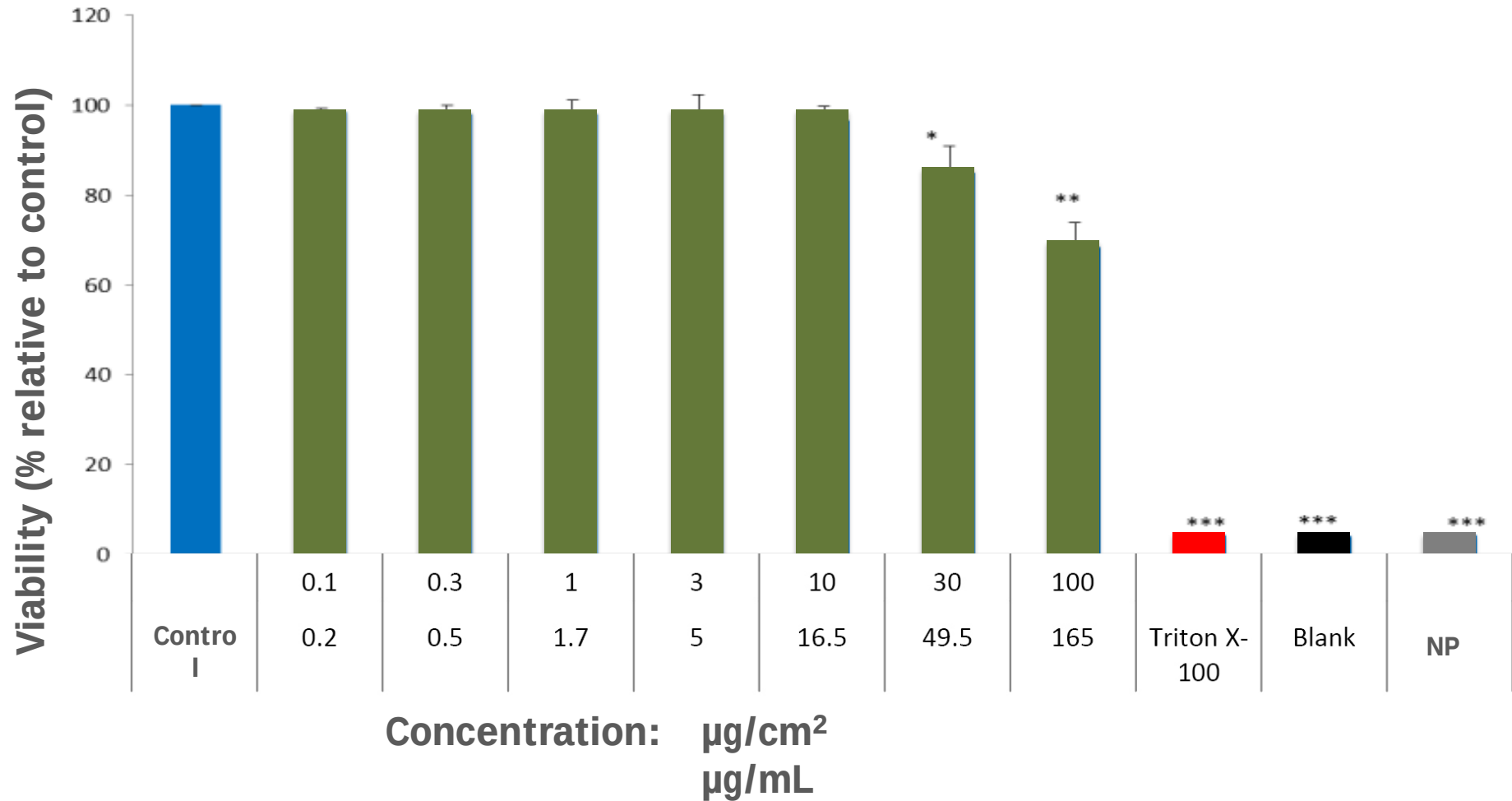
FBEC spheroid (3D cell culture)



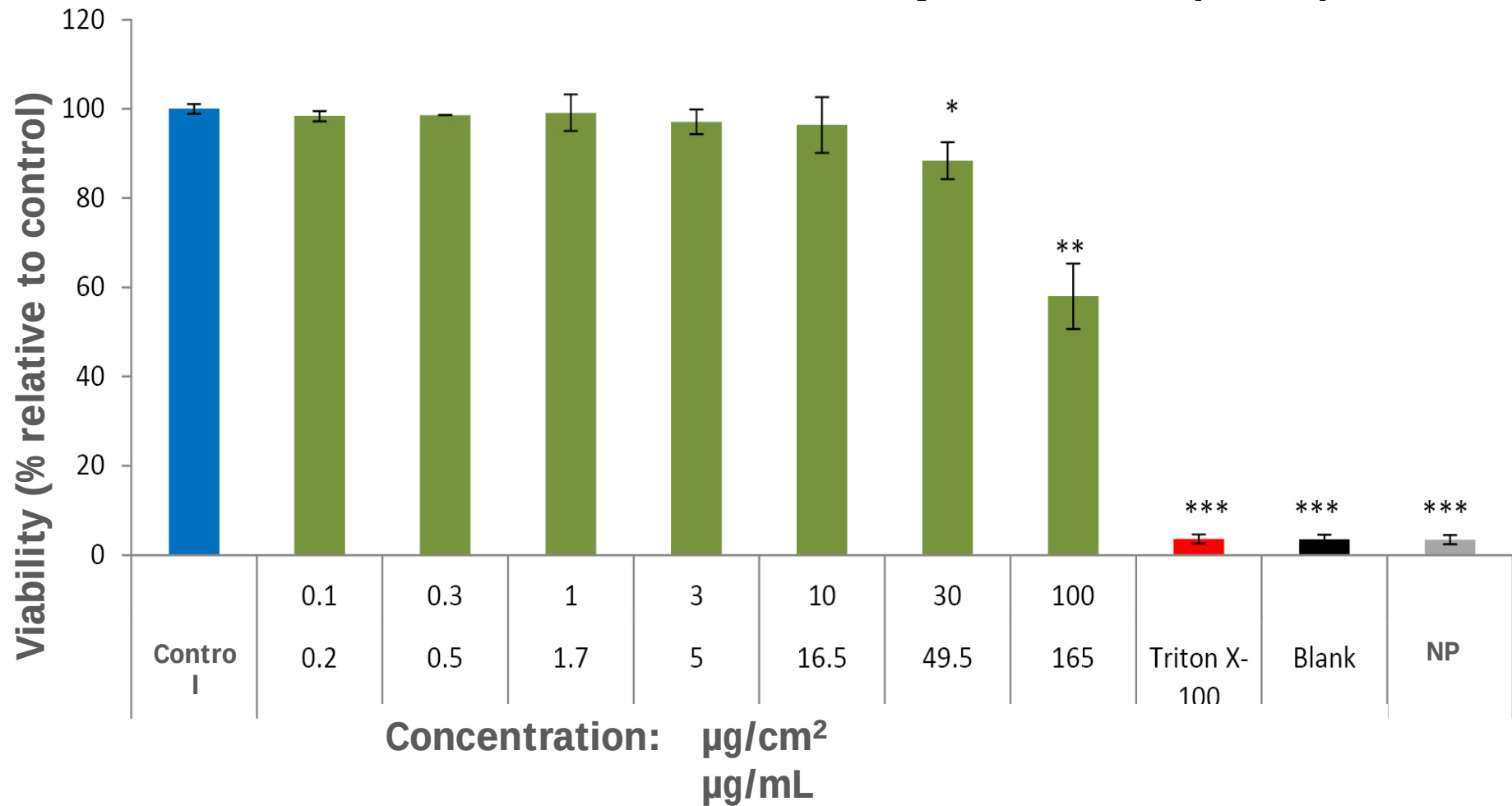
Submersed Lung Cell Exposure



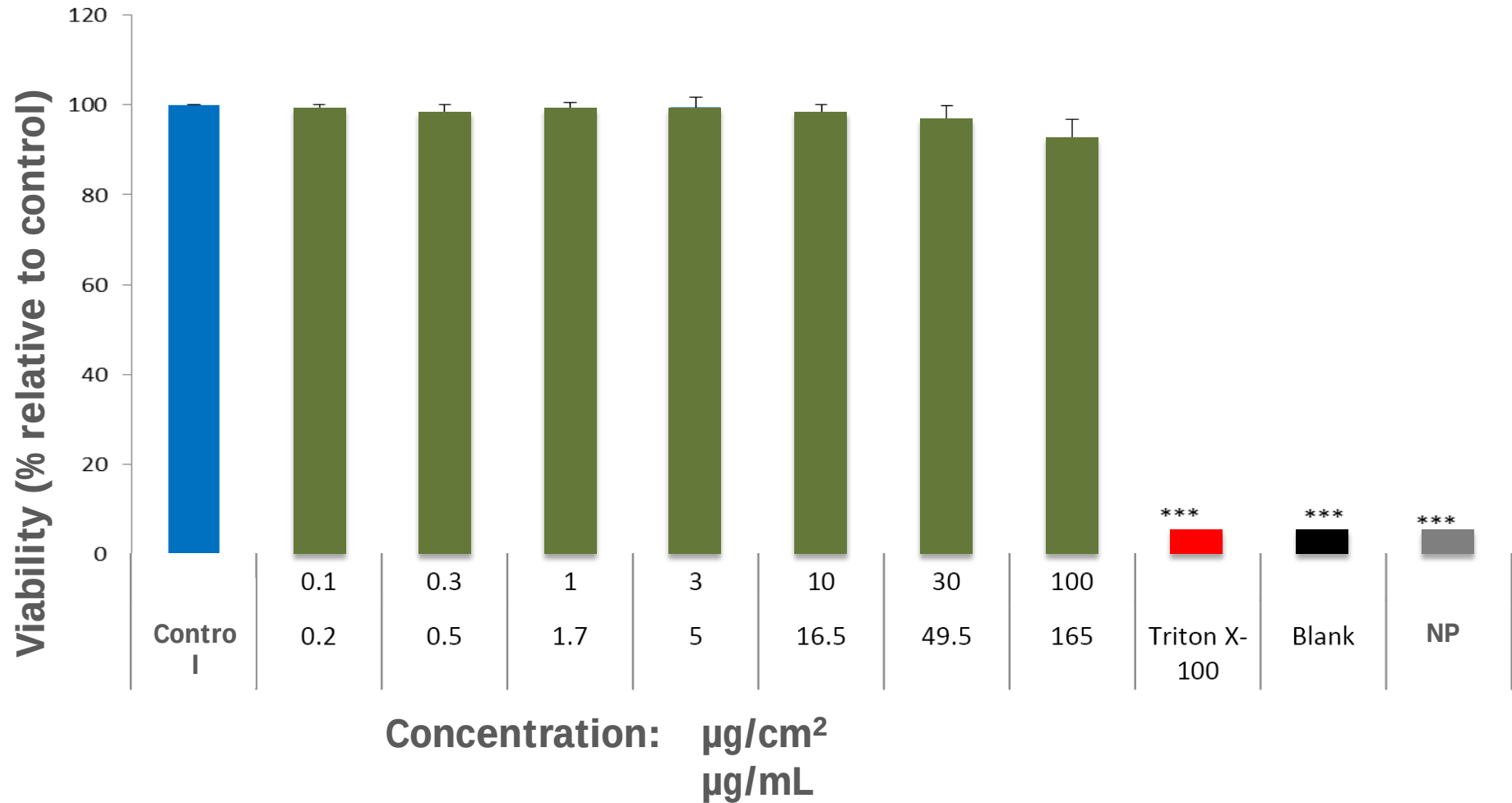
Diesel emission particles (24 h)



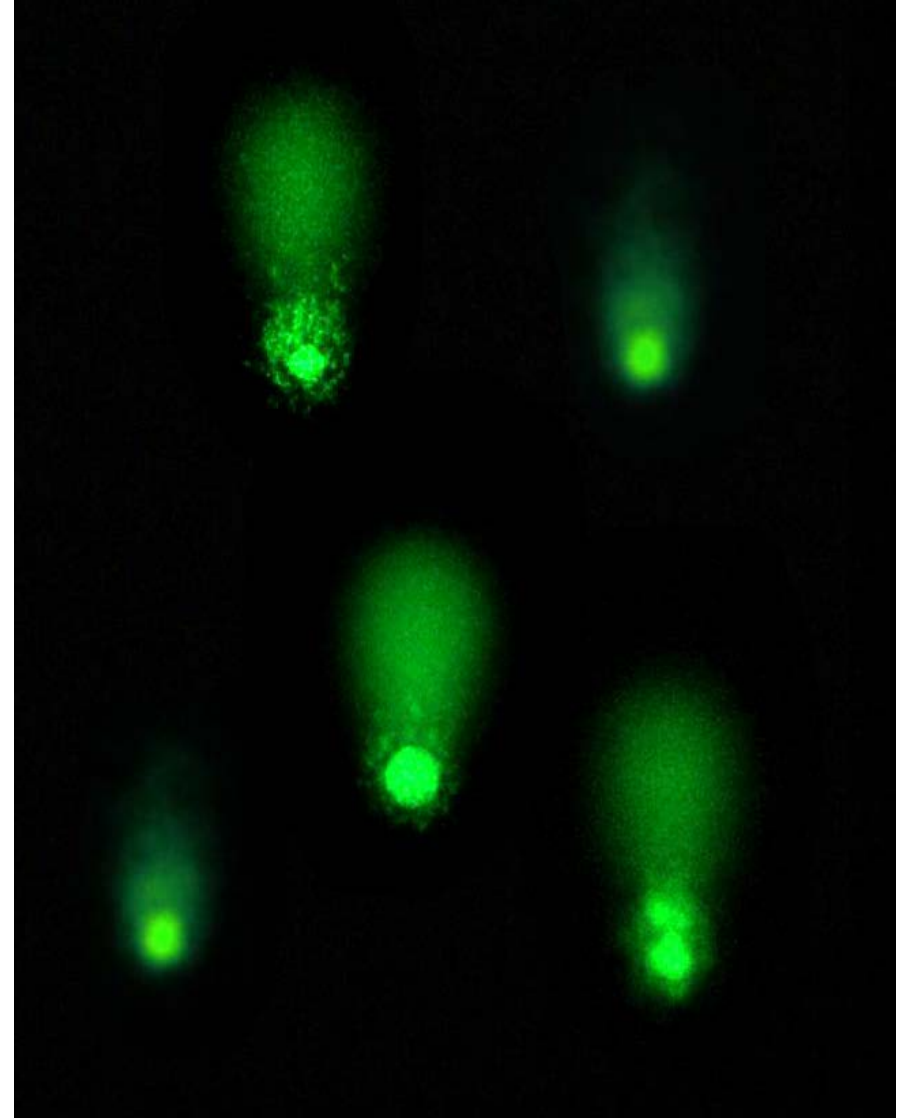
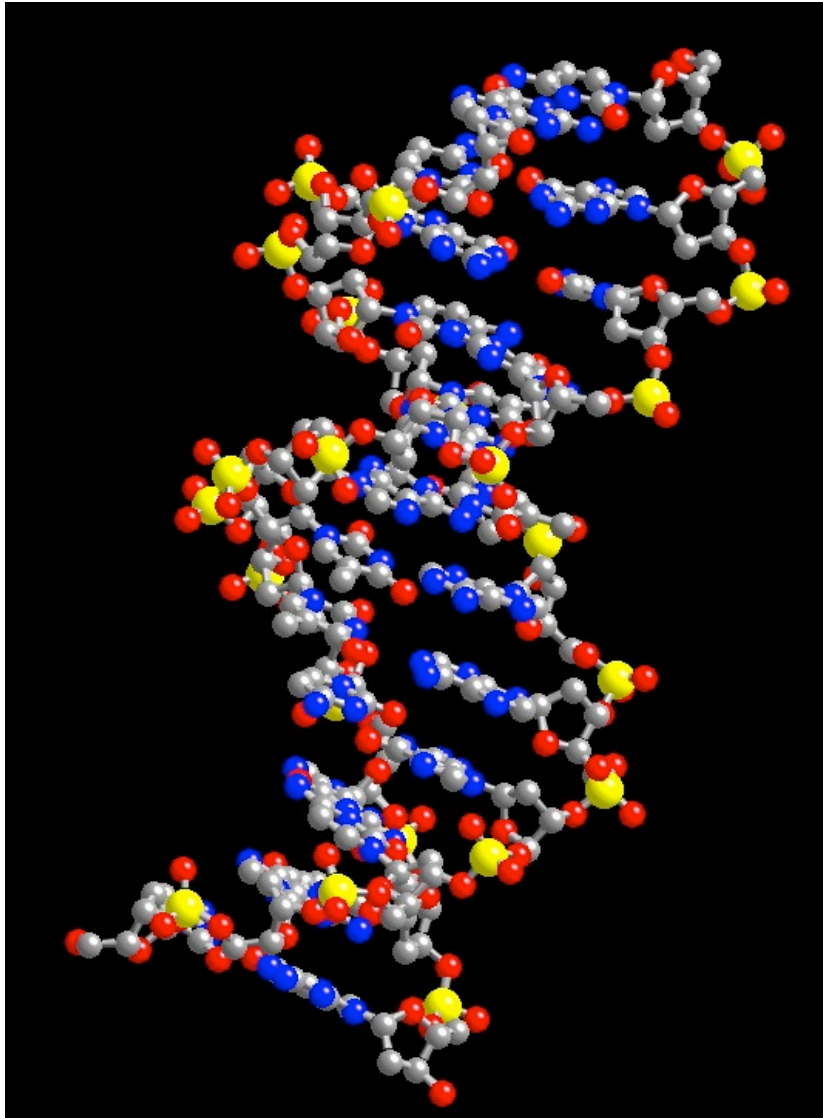
Beech wood combustion particles (24 h)



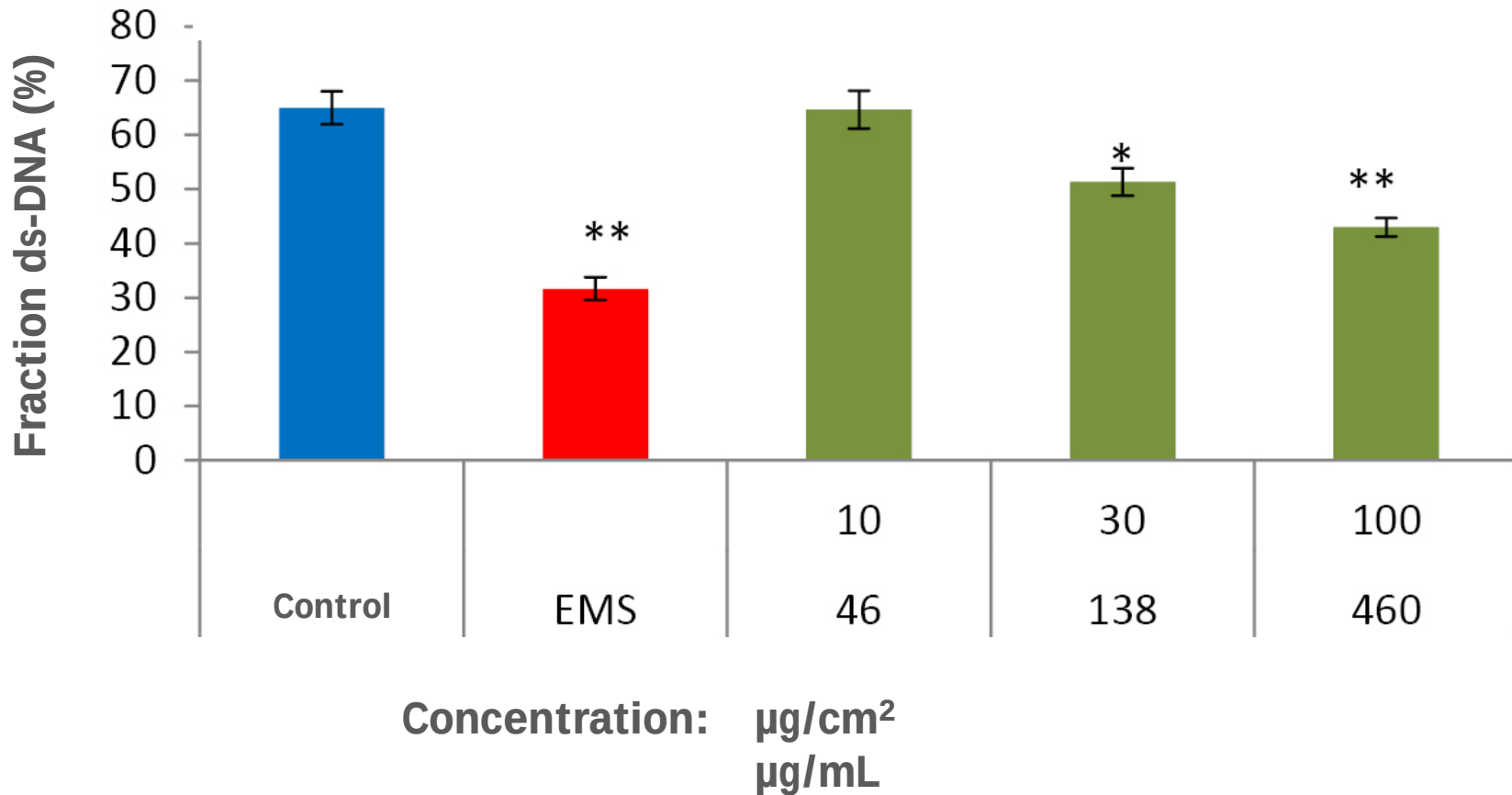
Miscanthus combustion particles (24 h)



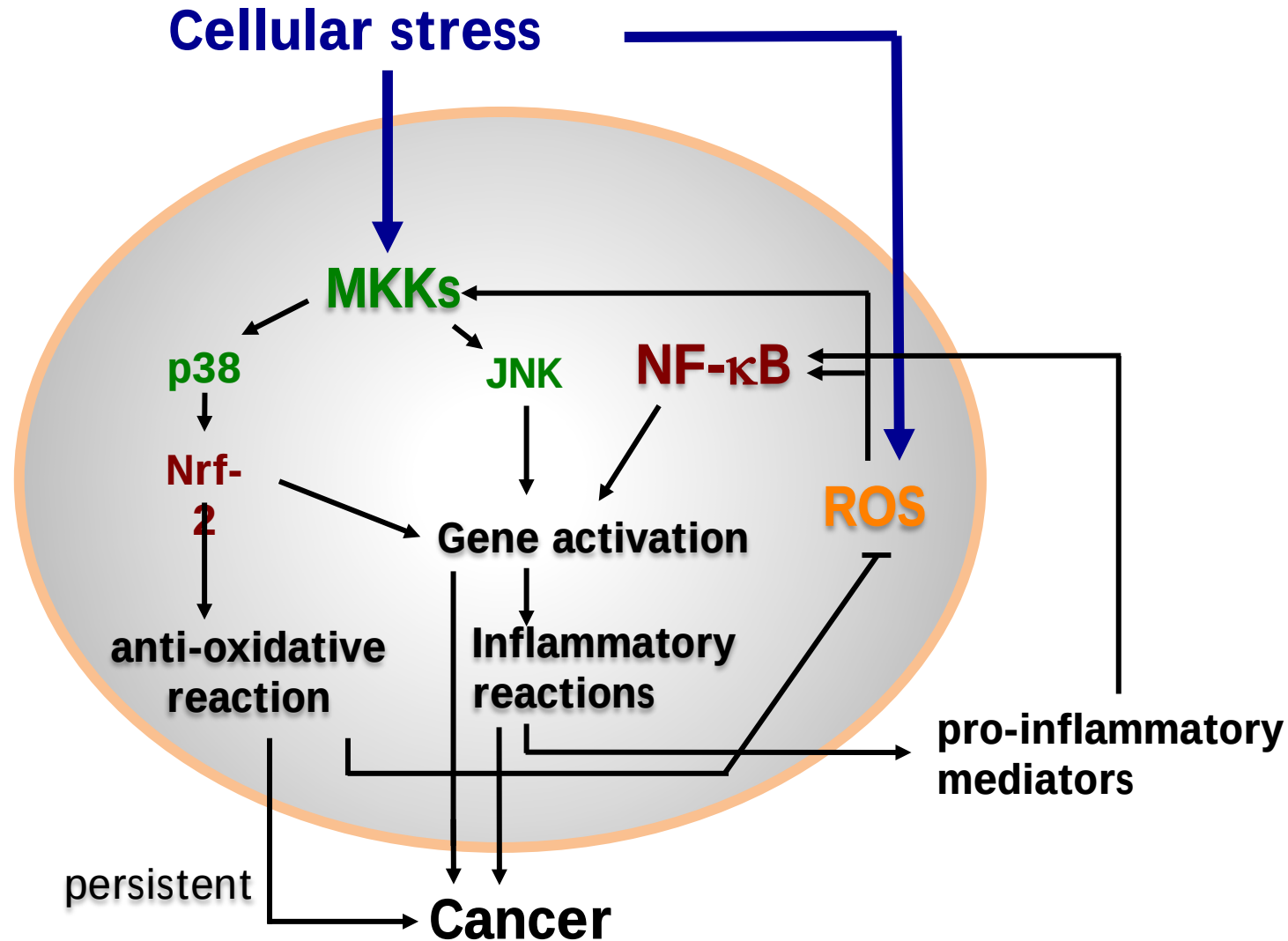
DNA Damage



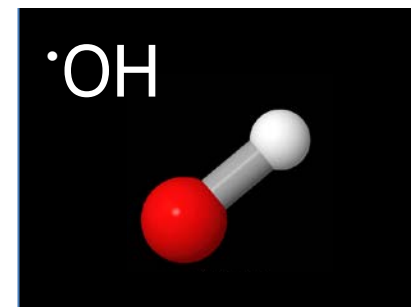
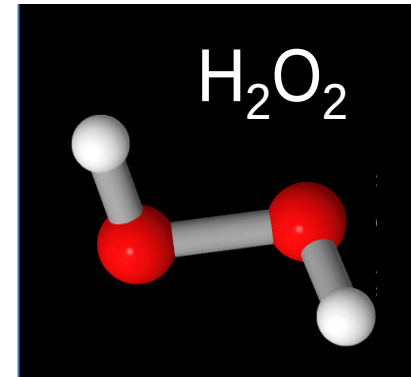
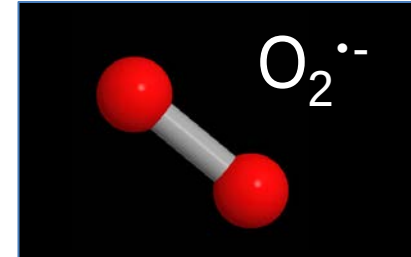
Beech wood combustion particles (24 h)



Stress-induced Reactions



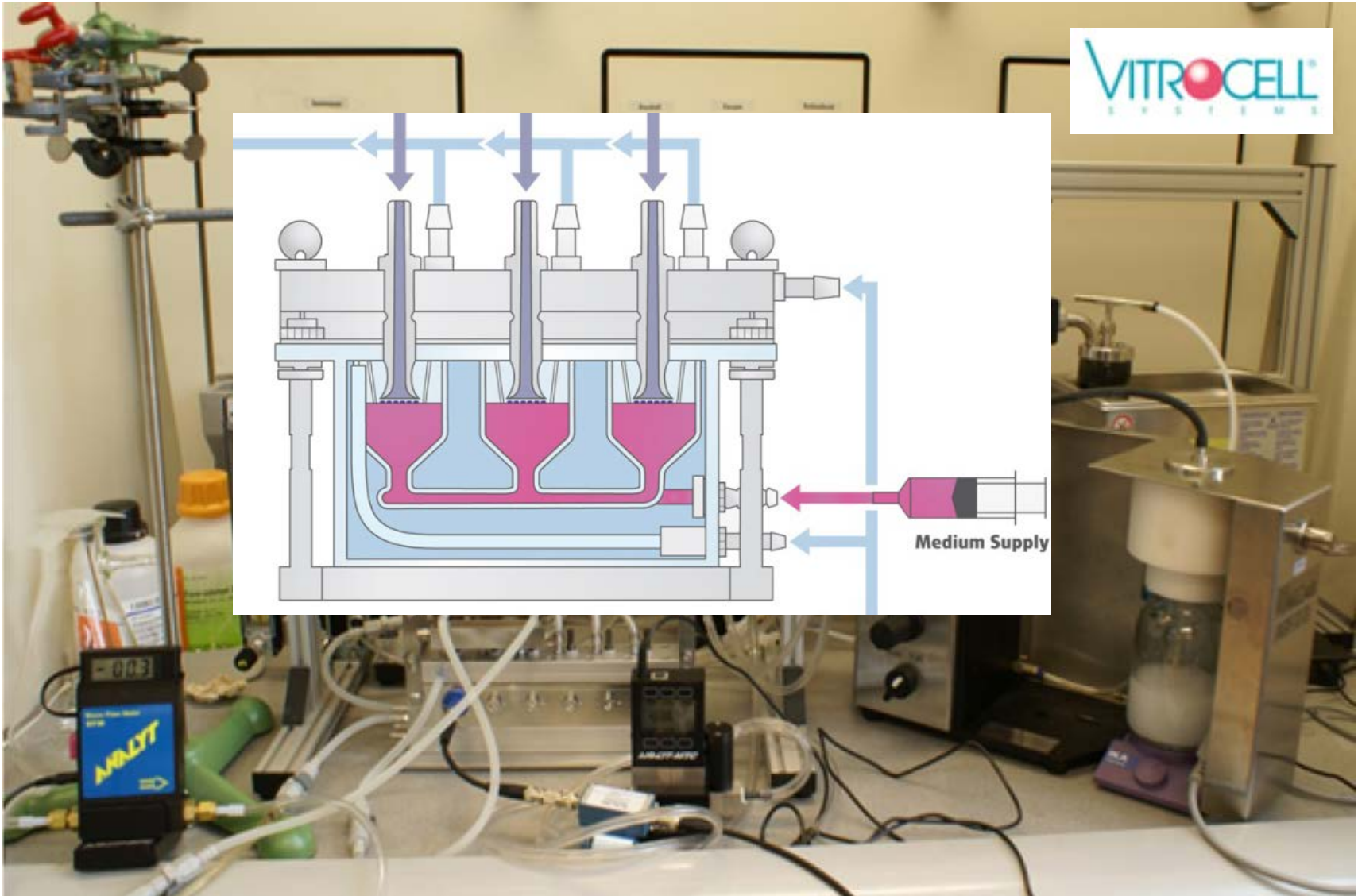
Oxidative Stress



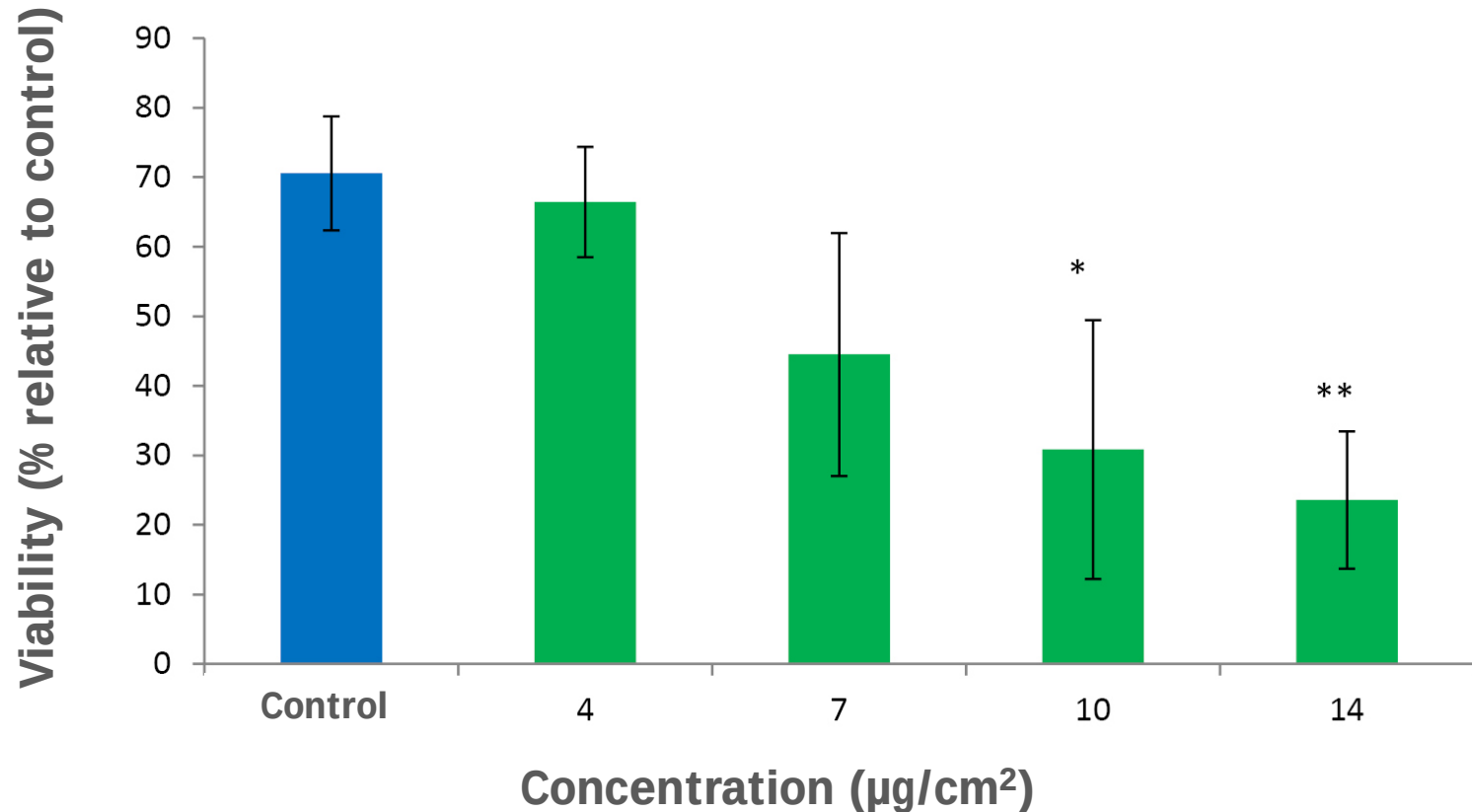
Air-Liquid Exposure



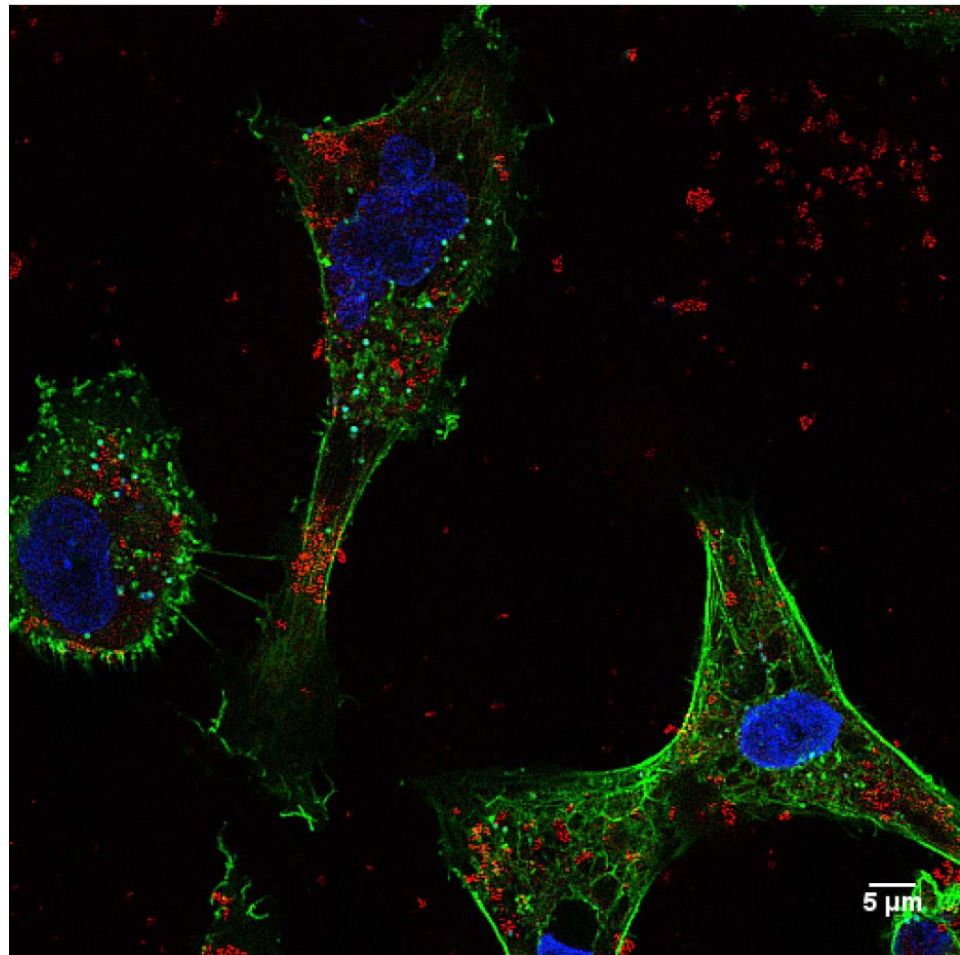
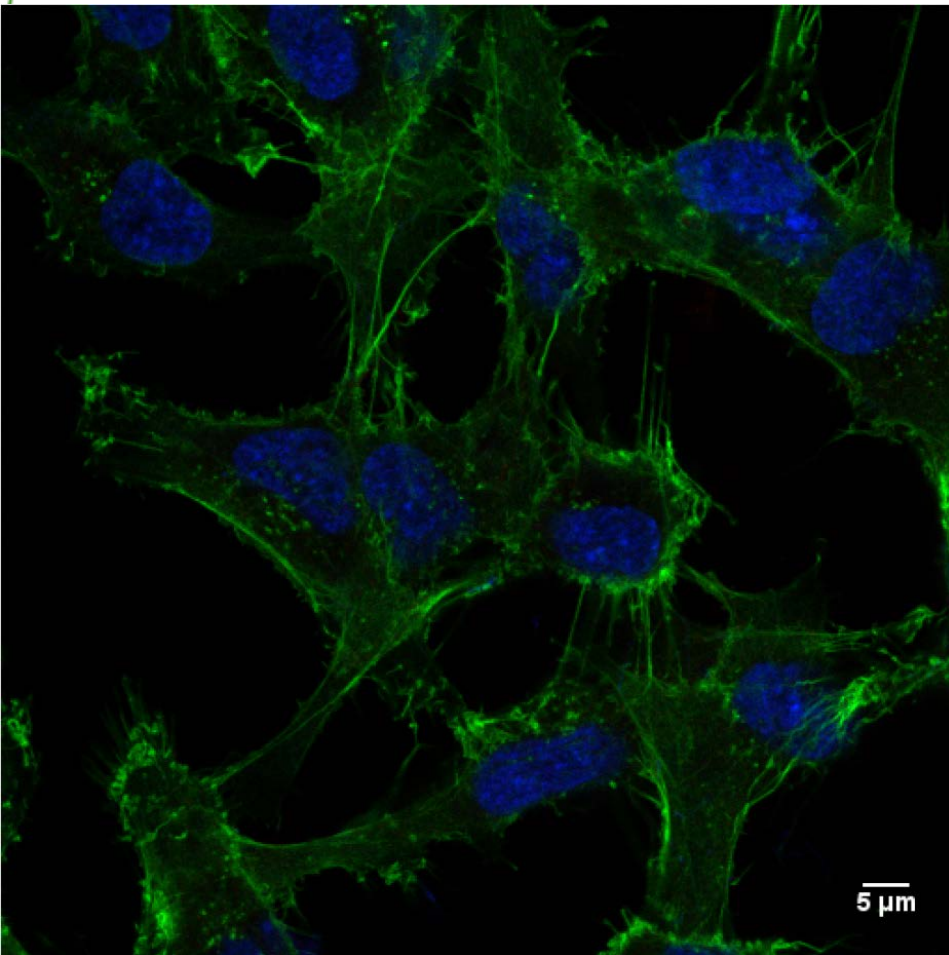
Air-Liquid Exposure



Spruce chip combustion particles (24 h)



Particle Uptake



CONCLUSIONS

- ✔ **Effects dependent on type of biomass used**
- ✔ **Dose-dependent effects strongest for beech wood**
- ✔ **Particle size influences genotoxic effects**
- ✔ **No significant NF- κ B activation**
- ✔ **No significant ROS formation observed**
- ✔ **Long-term effects remain to be tested**