19th CRC ON-ROAD VEHICLE EMISSIONS WORKSHOP
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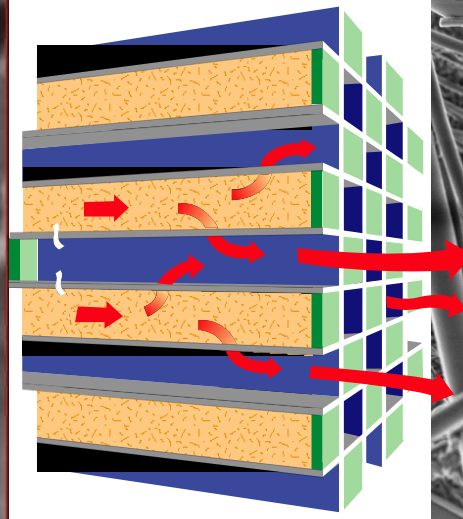
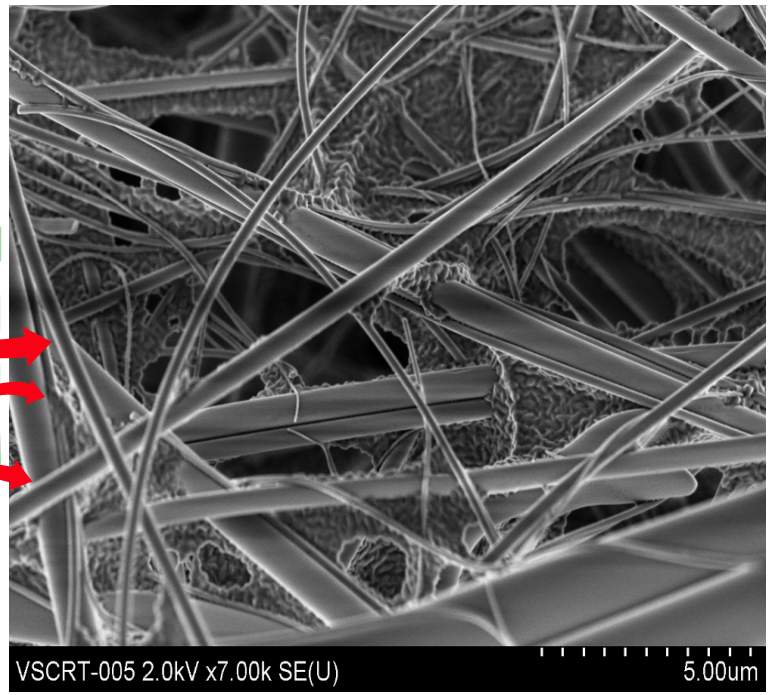
DPF + SCR RETROFITS AND THEIR IMPACT ON DIESEL EMISSIONS

Shaohua Hu, Jorn Herner, William Robertson, M.-C. Oliver Chang, Tao Huai, John Collins, and ALBERTO AYALA





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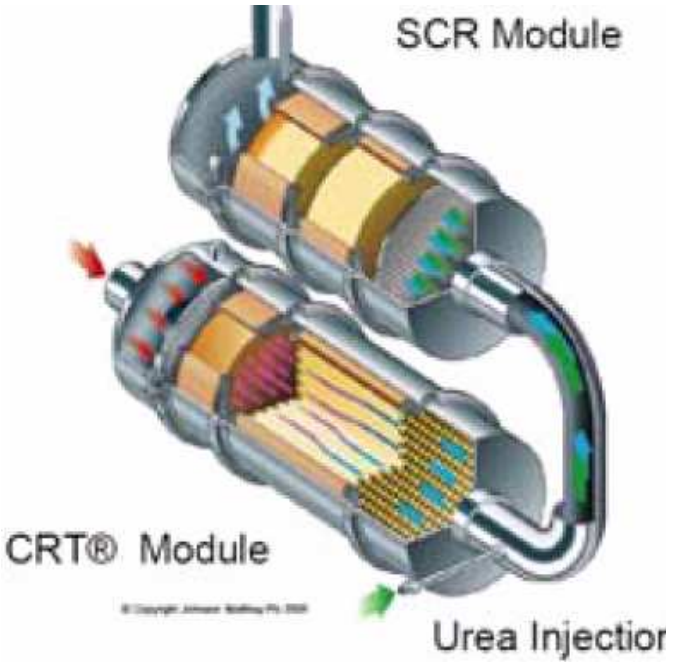
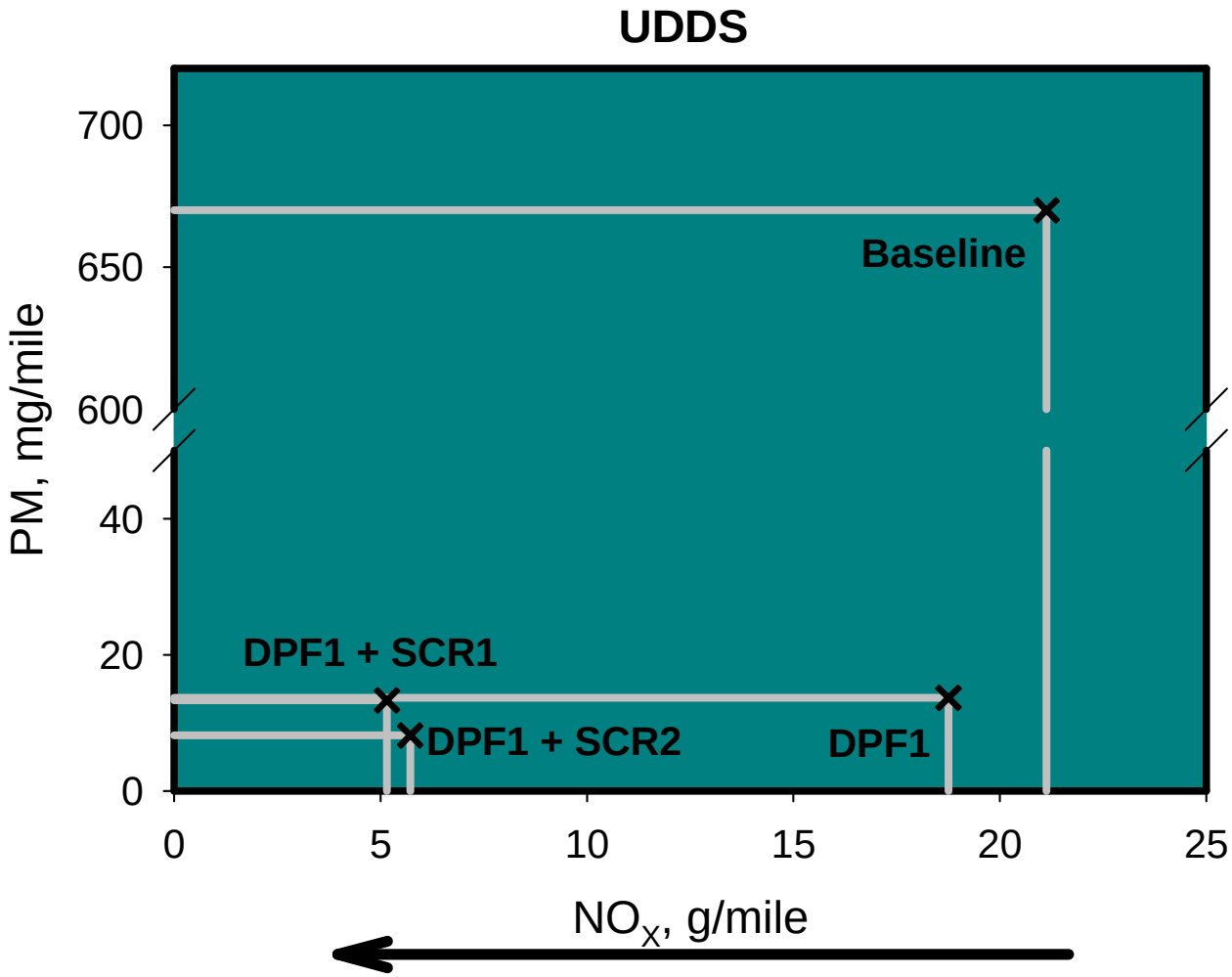
(*ACES +*) PRINCIPAL STUDY FOCUS IS 2010-type TECHNOLOGY: *SCR+DPF*

Fe-Zeolite-SCR + DPF
Vanadium-SCR + DPF



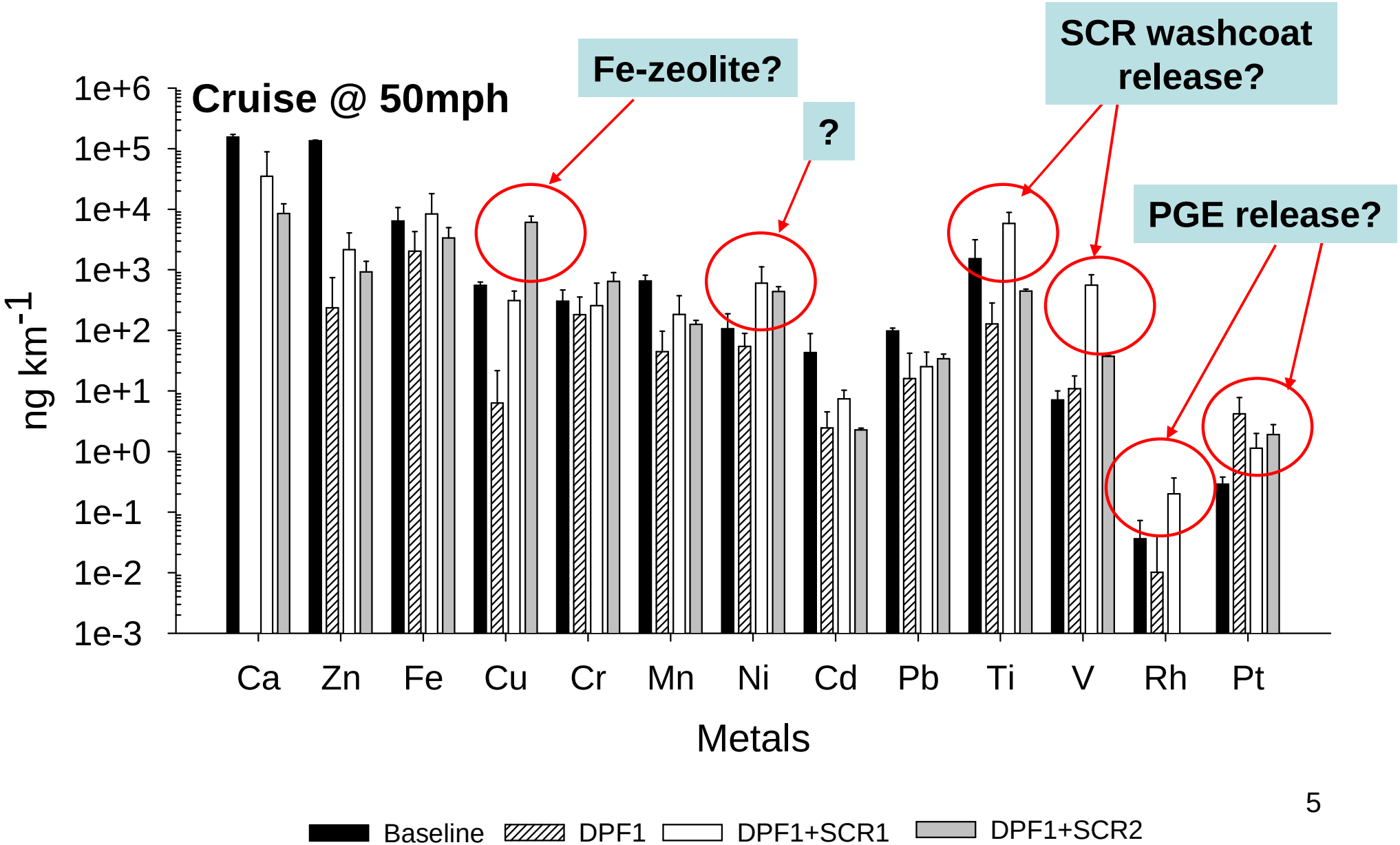


SCR retrofits >>> 75+ % reduction in NO_X
DPF retrofits >>> 90+ % reduction in PM

Key Observations for this Presentation:

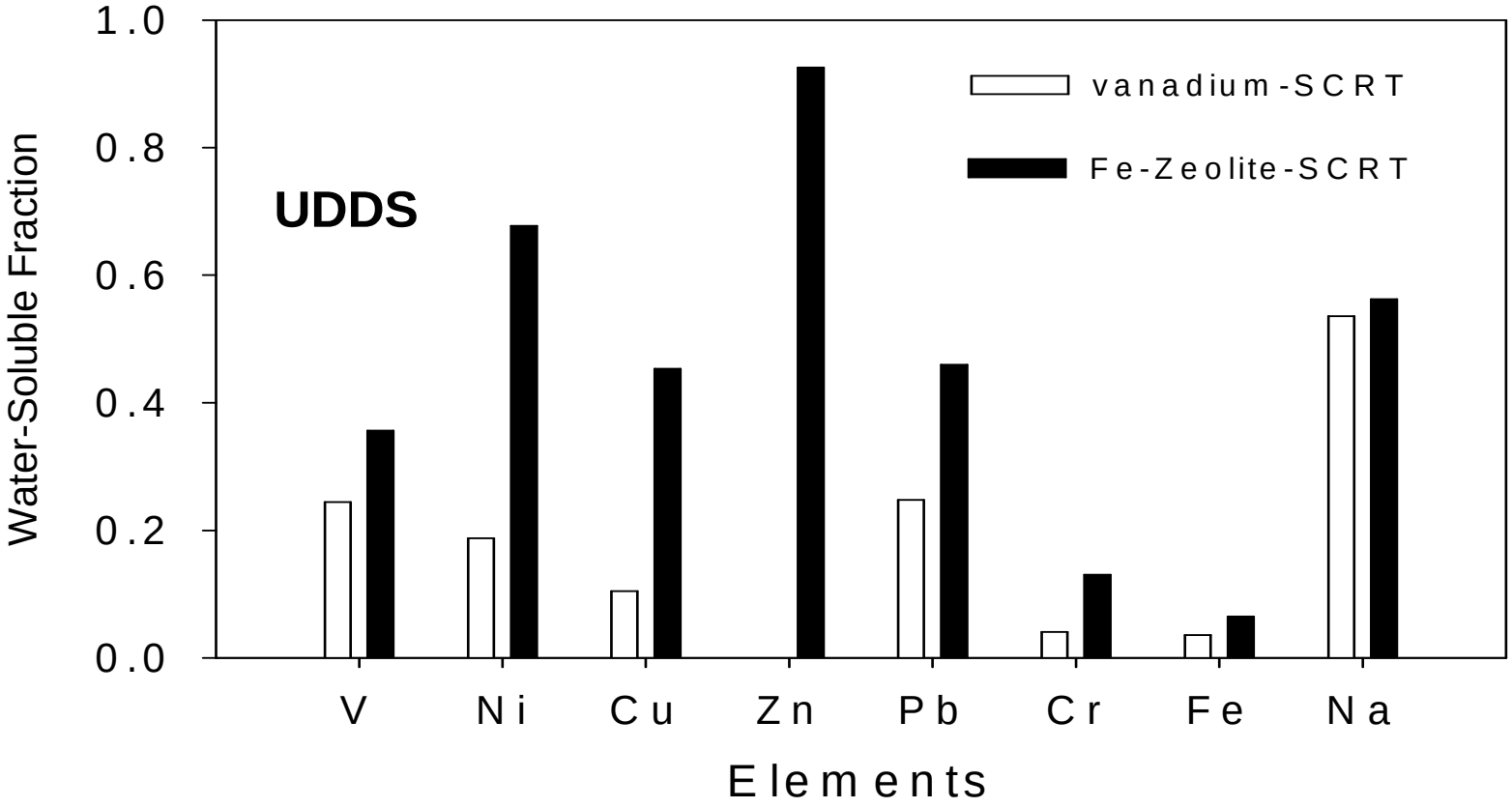
Metal emissions	– Strong dependence on driving cycle (i.e., exhaust temperature) and retrofit type – Possible release of SCR catalyst washcoat (V_2O_5 / TiO_2)
Ultrafine particle emissions	– Temperature drives formation for well-broken-in catalytic devices – Sulfate dominates chemical composition of ultrafine particles
Toxicity	– Significant reduction of overall toxicity by retrofits – Potency (toxicity/distance) correlates with decreasing sulfate nanoparticle number emissions

Increase in some metal emissions from retrofits



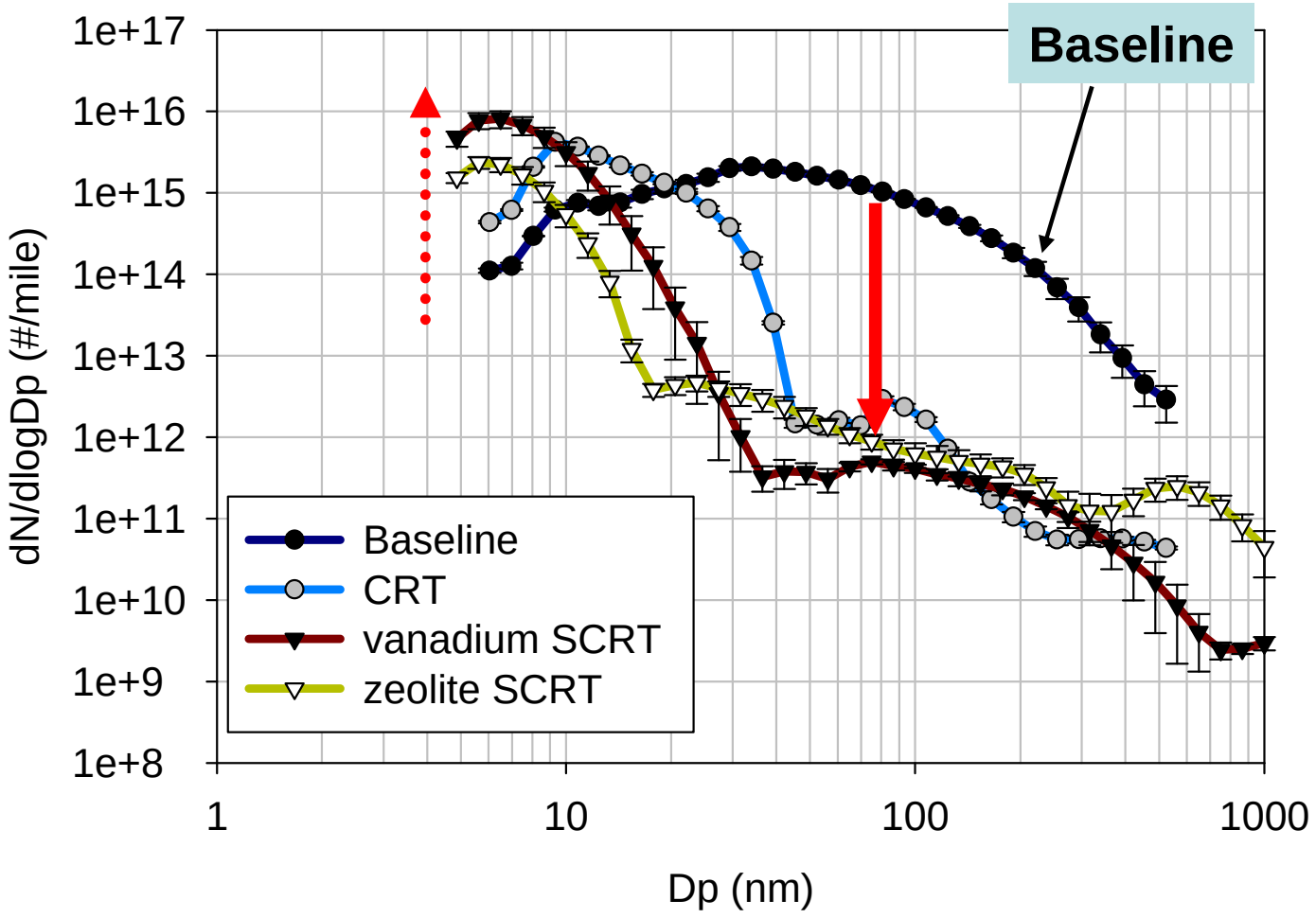
Water soluble metals could be **biologically active** and **promote** formation of **reactive oxygen species (ROS)**

Fe-Zeolite-SCR > Vanadium-SCR



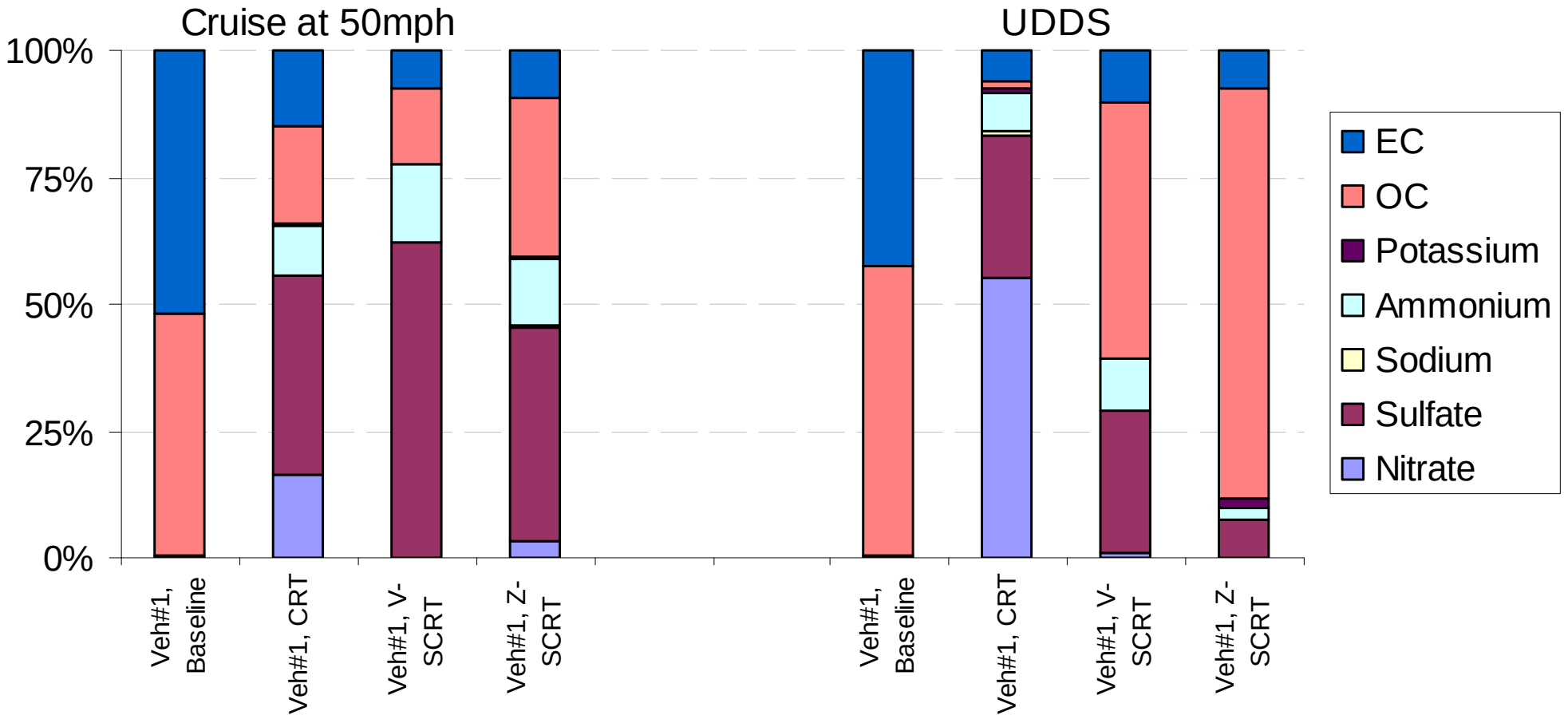
Trends generally consistent: alkali metals > alkaline earth metals > divalent transition metals > hydrolysable higher oxidation state transition metals

Retrofits can induce formation of sulfate nanoparticles



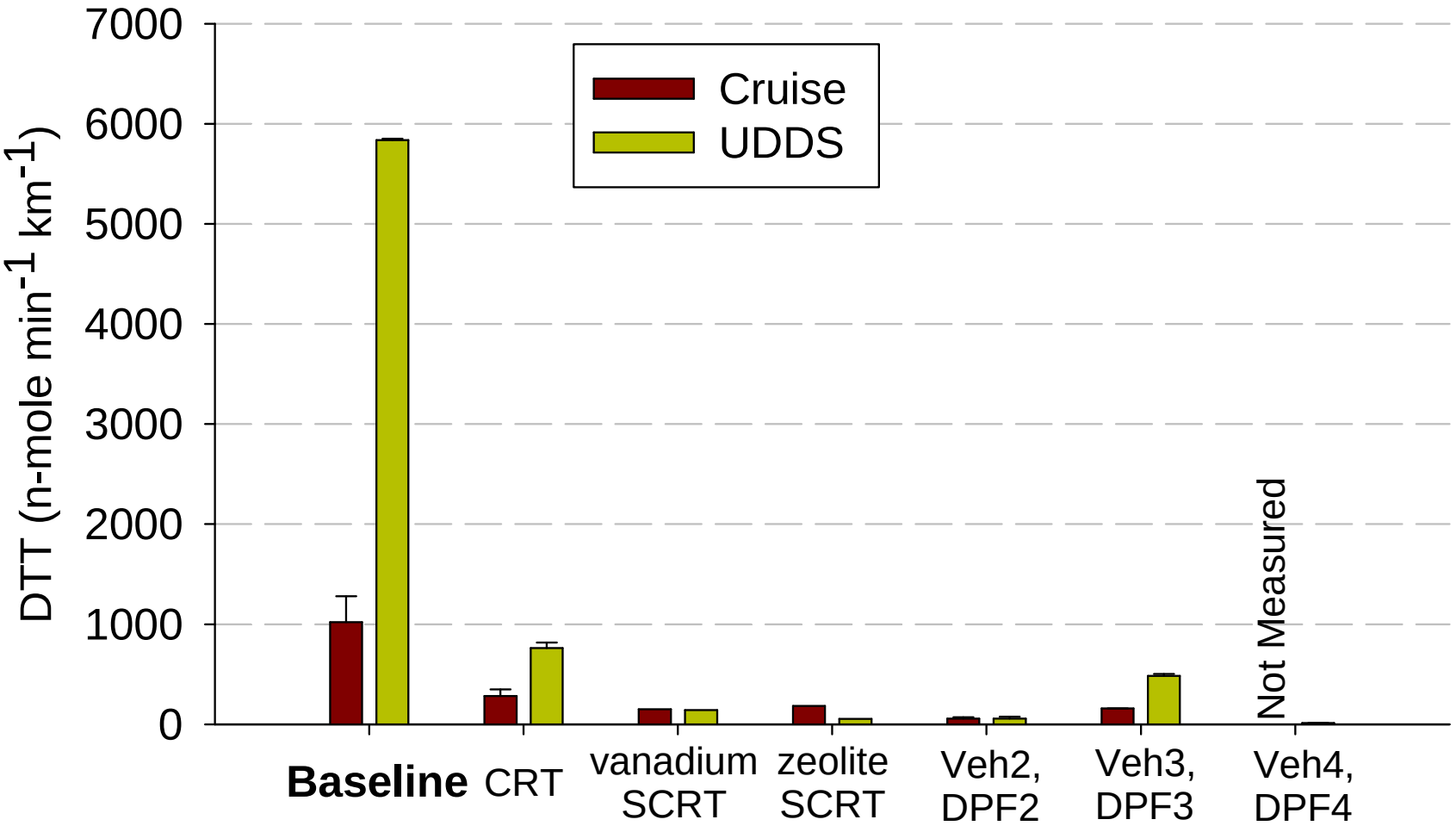
Exhaust **temperature** promotes substantial formation of nanoparticles for well-broken-in **catalytic** devices

Ions and Carbon : Sulfate and Nitrate dominate composition of particle emissions from retrofits

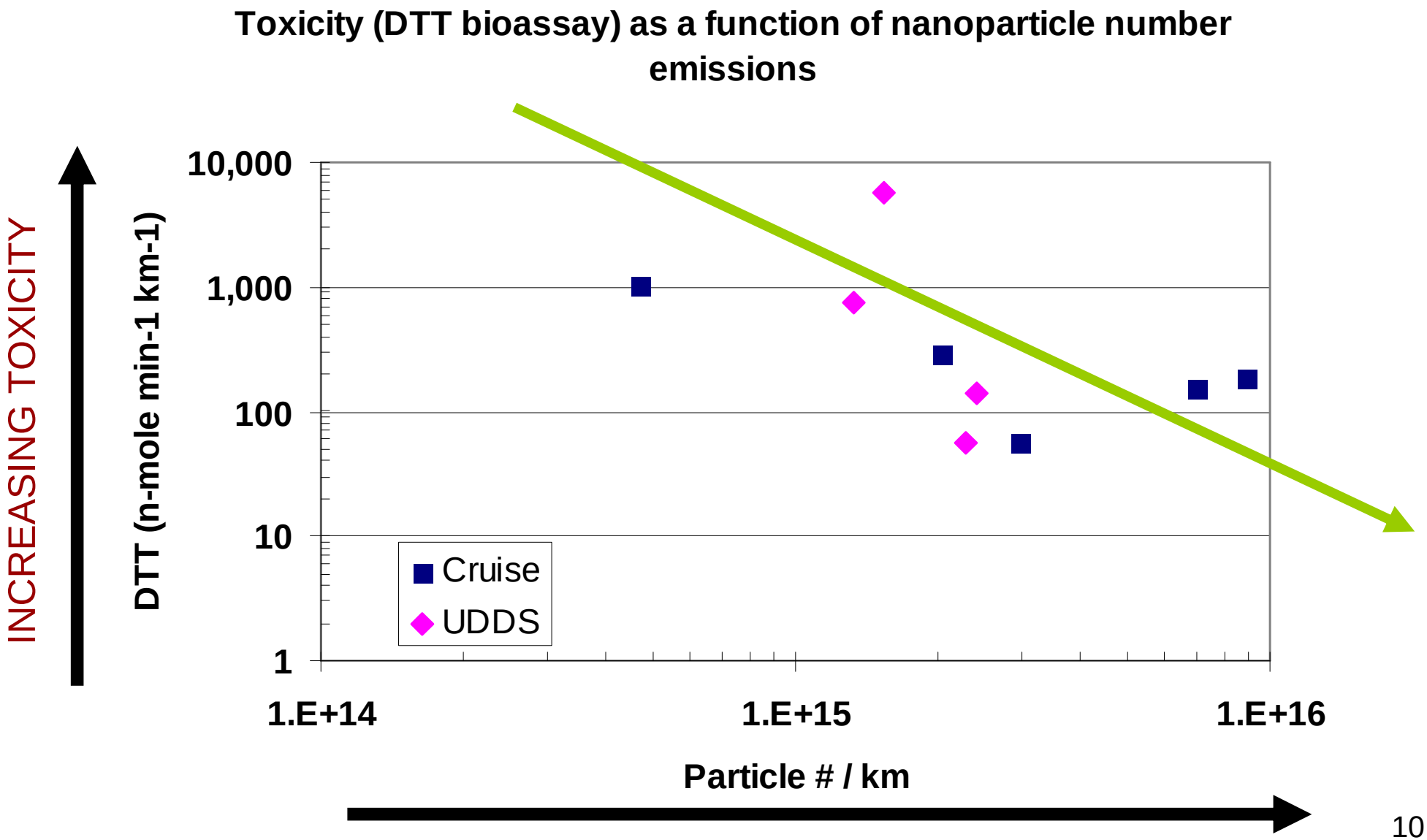


Oxidative Stress Potential of Total PM Per Distance Driven

Significant reduction of overall toxicity by retrofit



Higher nanoparticle emissions from retrofits correlate to lower toxic potency per distance



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