

PM Chemical Speciation

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PM Speciation Data Availability

Fuel Blends	Test Vehicle	Ions (cation/anion)	Carbon (IMPROVE_A)	Elements (ICP-MS)
CARB Diesel	C15 MBE 4000	SLB/Done SLB/Done	SLB/Done SLB/Done	UWM/Done SLB/finalizing
Soy	C15 MBE 4000	SLB/Done SLB/Done	SLB/Done SLB/Done	UWM/Done SLB/finalizing
Beef tallow	C15	SLB/Done	SLB/Done	
Renewable	C15	SLB/Done	SLB/Done	

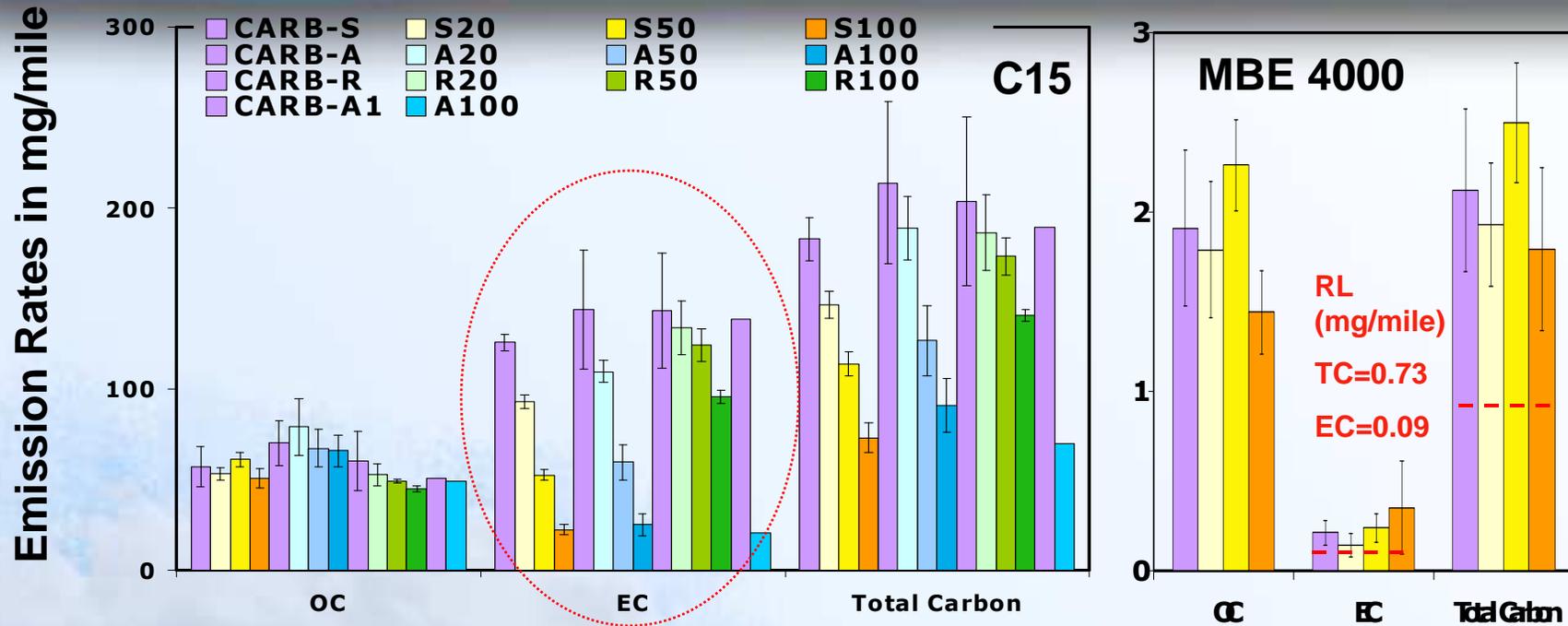
- Test cycle/duration:
 - UDDSx2 for C15
 - UDDSx2 **x3** for MBE 4000

Estimated Reporting Limit

	Nitrate	Sulfate	Ammonia (all cations)	Elemental carbon	Total carbon
C15	0.07	0.07	0.07	0.28	2.24
MBE4000	0.014	0.014	0.014	0.092	0.733

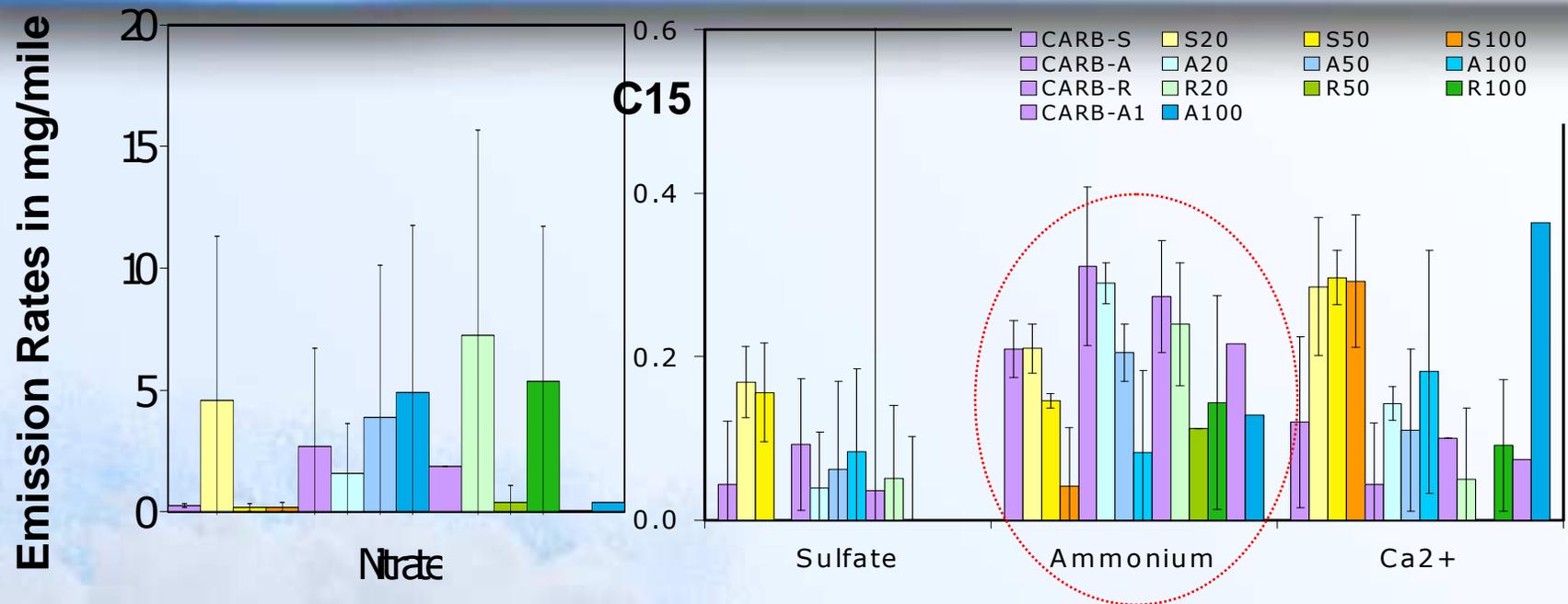
- Laboratory reporting limited estimated in mg/mile
 - Improved sensitivity for IC
 - Increased sample air volume
- Data quality assessment (blanks)
 - Blanks for carbon are all below reporting limit; all samples are above reporting limit
 - Most blanks for ions are below reporting limit

OC/EC Emissions



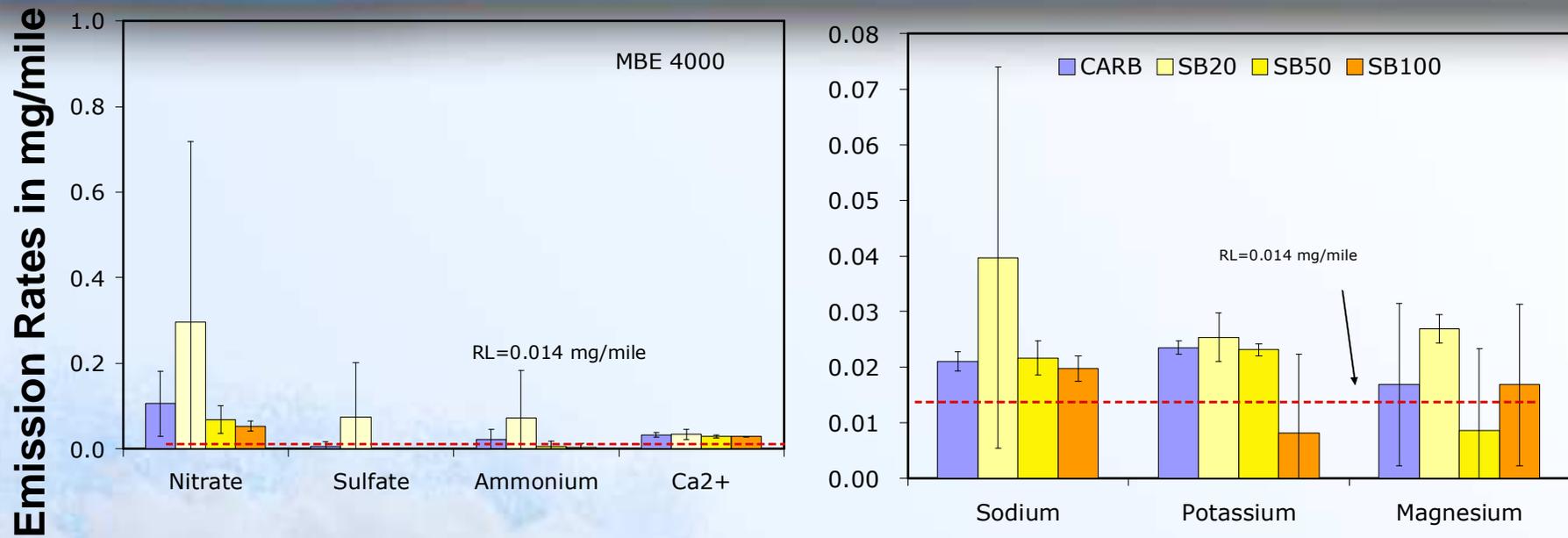
- Carbonaceous compounds comprise more than 95% of total PM mass
- Fuel impacts
 - With increasing biodiesel blend levels, EC emission rate declines; which is not always true for OC emissions
 - Biodiesel blend level will change the EC/OC ratios
- Engine/Technology impact
 - Greatest reduction in EC via DPF

Ions Emissions



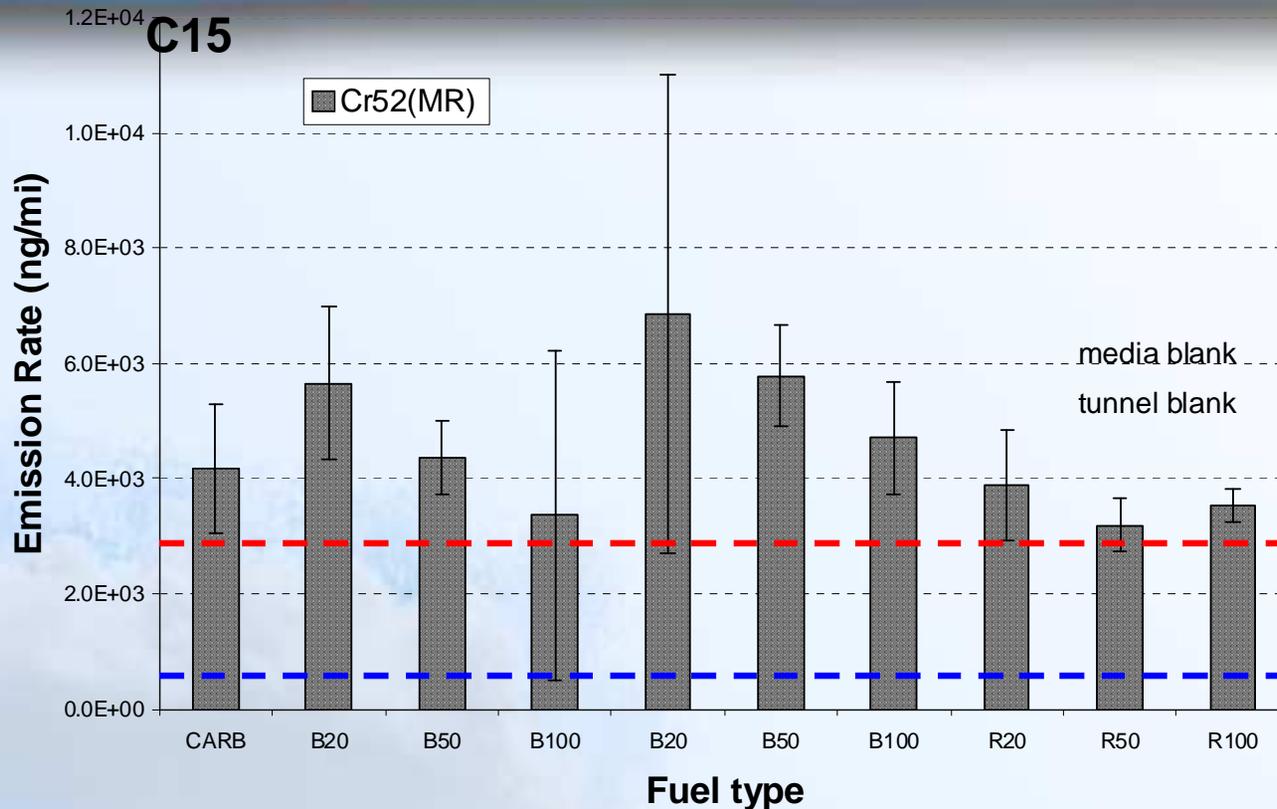
- Nitrate is the most abundant species, followed by ammonium, then sulfate.
- High test-to-test variability, and close to analytical reporting limit
- Average anion emissions are not correlated to biodiesel blend types or levels; except that average ammonium emissions decrease as biodiesel blend level increases.

Ions- continued



- Emission control technology also reduces emissions of ions
 - Samples are close to reporting limits
 - Soluble cations are reported for MBE 4000 due to the improved reporting limit

Trace Elements – C15



- Most abundant species include: P(31), Ca(42), Ca(44), Zn(66) \approx average 200 to 450 $\mu\text{g}/\text{mile}$; followed by Na, Mg, Al, and Fe at an order of magnitude lower
- Little to no correlations between element emissions rates and biodiesel blend levels/types

Summary

- **Fuel Effects**
 - Did not observe any unintended consequences for PM at different biofuel blend levels or with different engine technologies;
 - PM mass reduction primarily due to the EC reduction
 - Ammonia emission decreases as biofuel blend level increases.
- **Emission Control**
 - Primarily due to removal of EC via DPF
 - Reduction benefits are for all species
- **PM chemical profile**
 - Elemental carbon as the major compound without emission control and organic carbon with control technology
 - Charge balance for ions suggests collection of acid droplets
 - Sampling bias may become significant for post 2007 engines

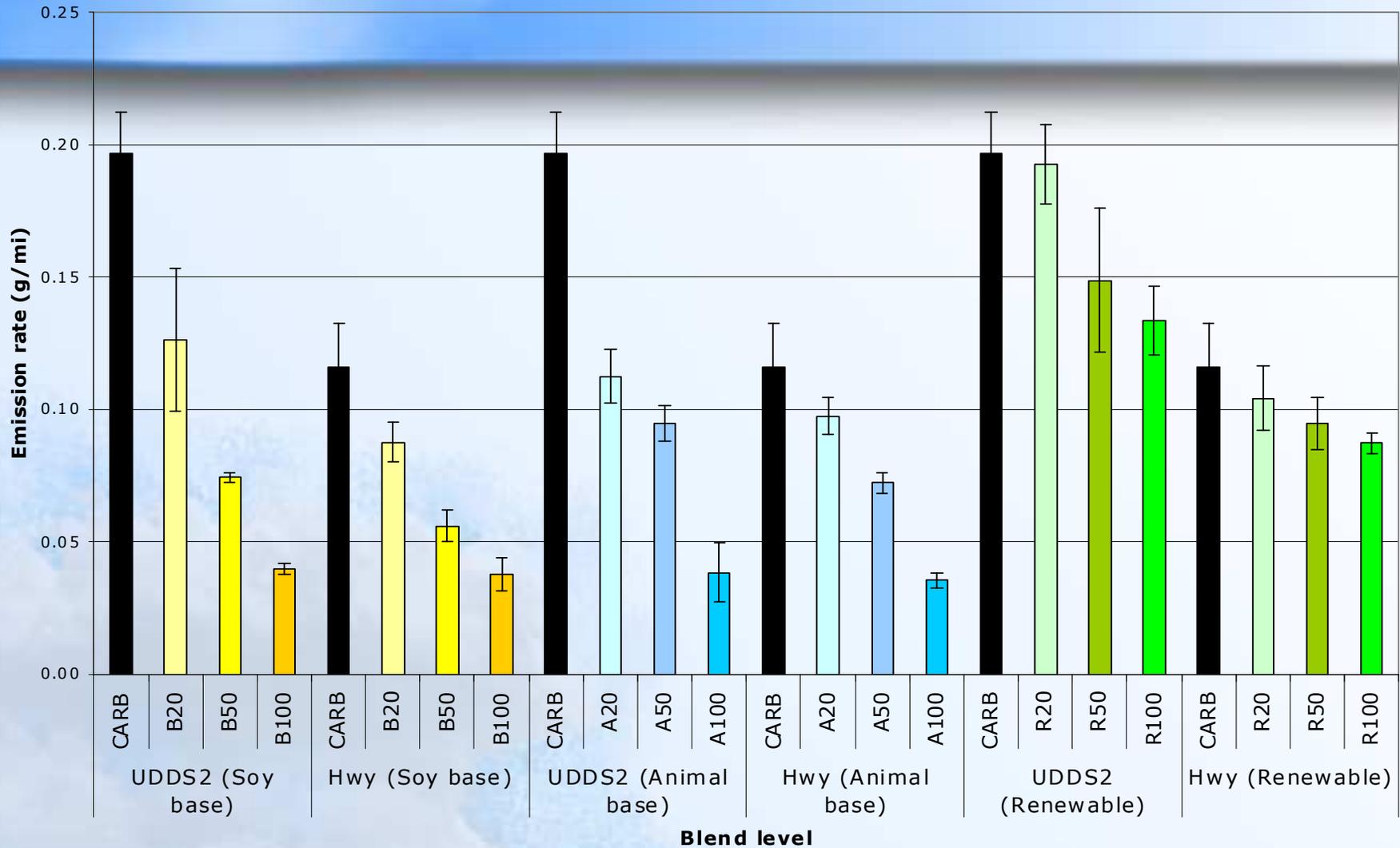
Backup Slides

Baseline PM mass Emission Rate

Project/Reports	Model Year	UDDS	Cruise-50mph
CRC E55/E59	All 1975-2003+	1.79 ± 0.13	1.11 ± 0.06
	1999 – 2002	1.04 ± 1.30	0.52 ± 0.79
	2003 +	0.50 ± 0.47	0.39 ± 0.49
NREL 2006	2003 Coach Motor	0.254 ± 0.022	N.A.
ARB Caterpillar C15	2001	0.197 ± 0.015	0.116 ± 0.016

- Emission rate in g/mile
- All data from HHDDT chassis dynamometer testing
- Vehicle weight 56,000lbs class, except NREL at 23,500lbs

PM mass emission rate for C15



Also presented in **poster platform 7E.04** "PM and Gaseous Criteria Pollutant Emissions from Biodiesel and Renewable Diesel Fuel Blends"