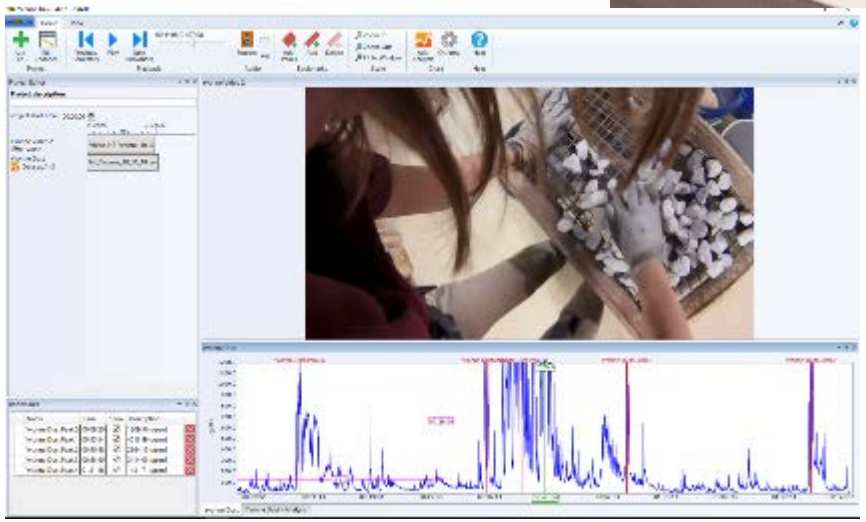
Field-based monitoring techniques for respirable dust and crystalline silica: A case study in a sandstone quarry



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Objectives of the case study

- To demonstrate the combined efficacy of the Helmet-CAM technology and Field-based RCS monitoring approach in aggregate mines to timely assess concentration levels and interventions status
- To investigate the variability of respirable dust and crystalline silica concentration levels in the quarry
- *The case study is not an exposure assessment study*

Methodology

Two site visits – October 2018 and July 2019; multiple-day visits

Area samples (overall 41 samples)

- Respirable samplers and sampling pump
- Collection time – up to 7 hours

Helmet-CAM packages (overall 26 sessions)

- pDR1500 real-time monitors
- Contour video camera
- Monitoring time – up to 3 hours
- Mobile workers or inside enclosed cabs

Three main areas selected – dry area (pit, crushers), wet plant, and QC lab

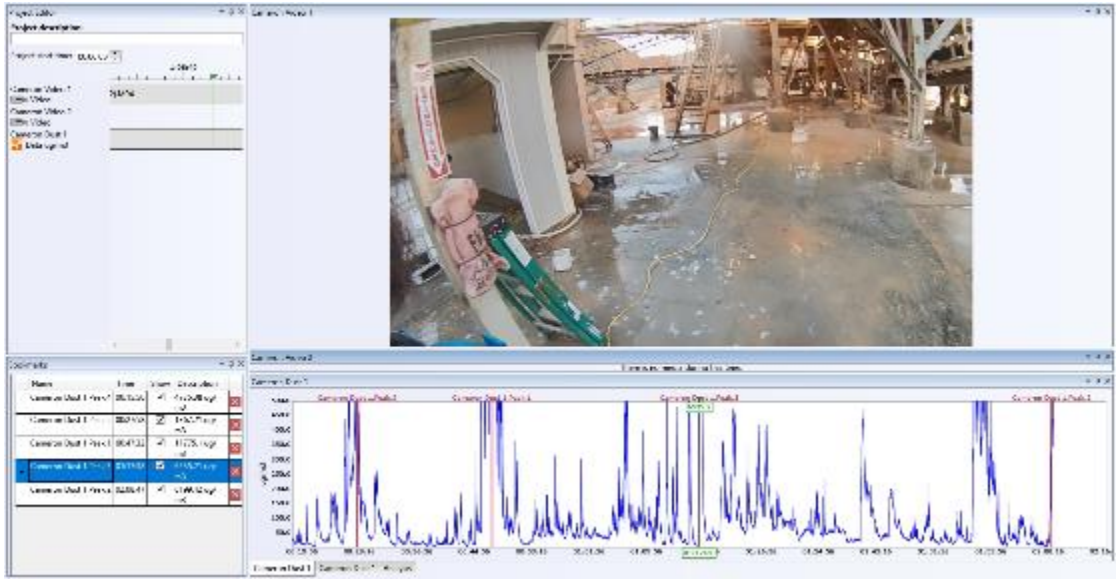
Methodology

Field-based analysis

- Estimation of crystalline silica (only alpha quartz) in respirable dust samples using a portable FTIR and the NIOSH software FAST
- Assessment of the Helmet-CAM sessions using the NIOSH EVADE 2.0 software

Laboratory analysis

- Crystalline silica quantification in samples via NIOSH7500 (XRD) method
- Respirable dust quantification in samples via NIOSH0600 (grav) method

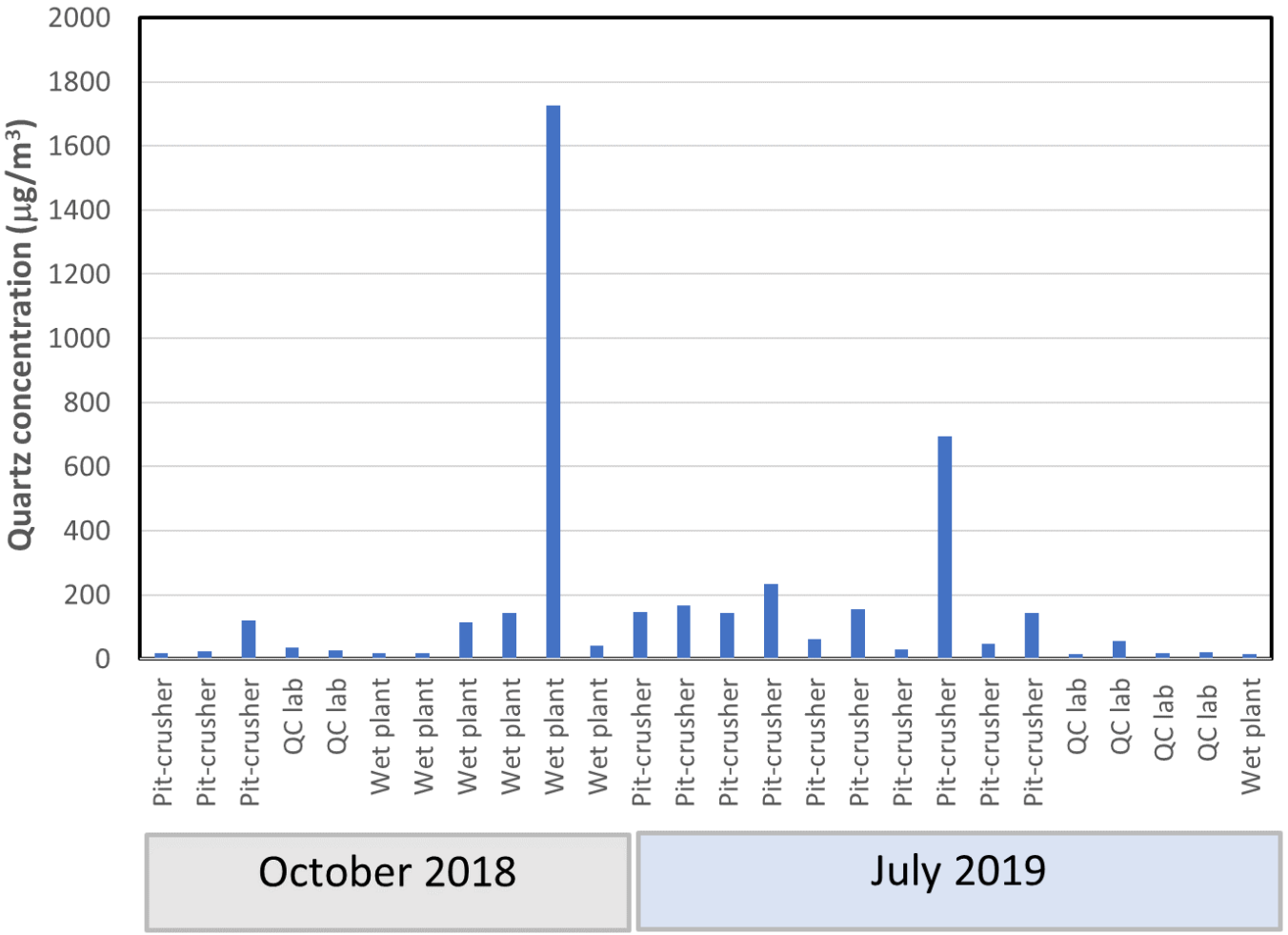


FAST
Field Analysis of Silica Tool

Results

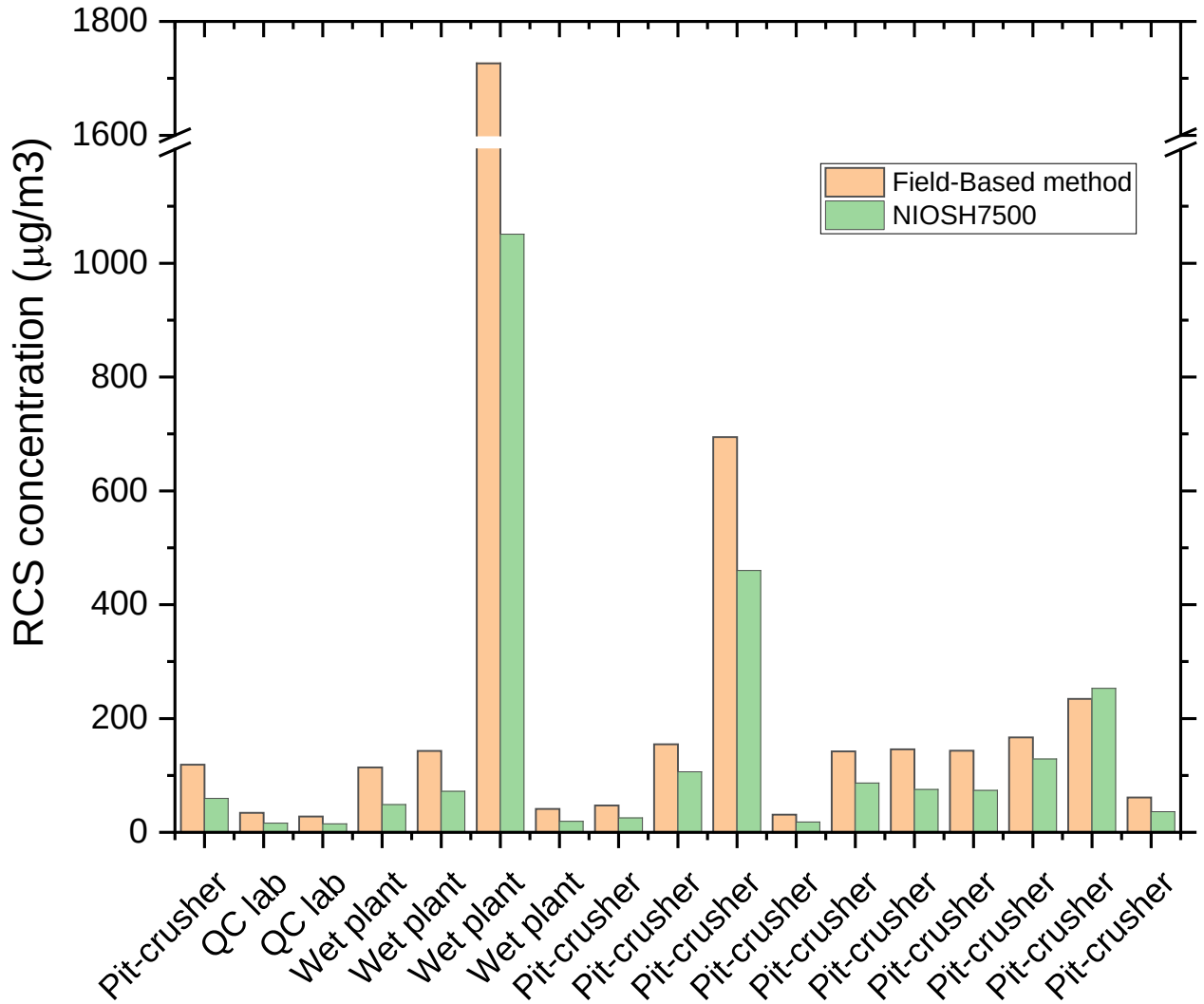
Field-based silica analysis – **area samples**
LOQ 13 ug – 15 samples below LOQ

- Dry area showed higher silica levels in July than in October
- The wet plant showed relatively high levels during the first visit – *unusual*; issue with control of dust identified and fixed
- Area samples collected in the QC lab showed low levels of silica



Results

How was the performance of the field-based approach to estimate silica in area respirable dust samples?



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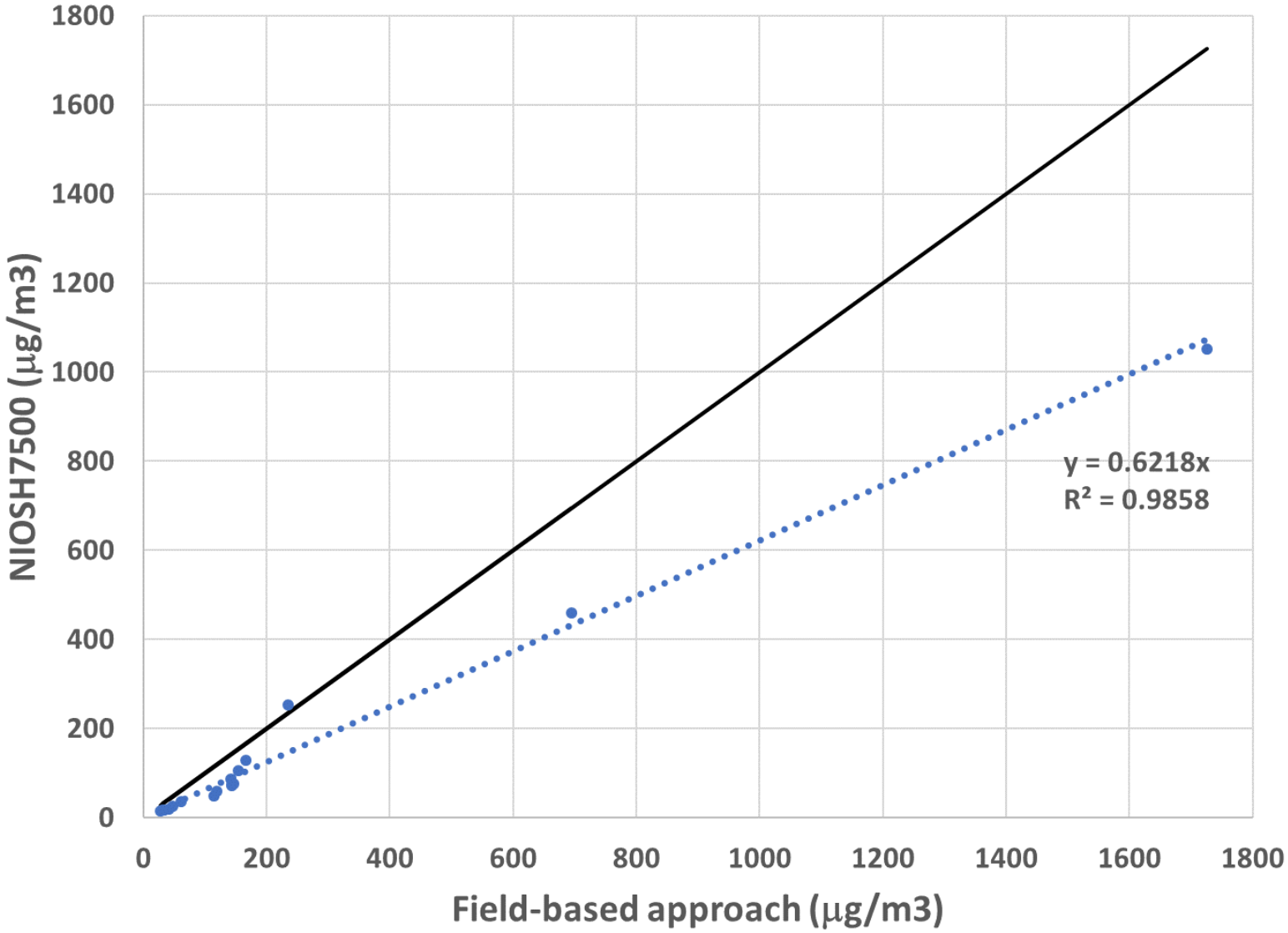
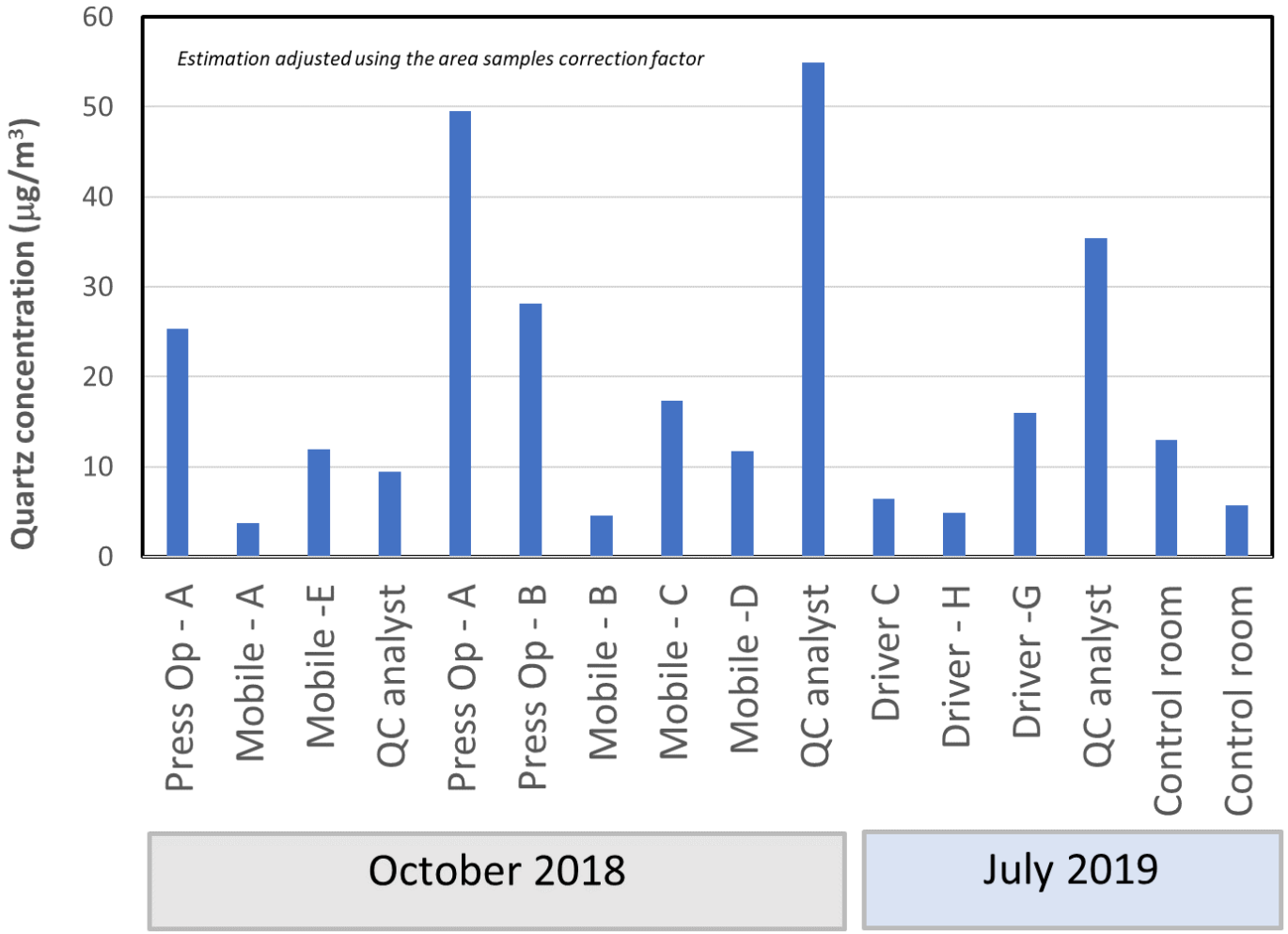


Results

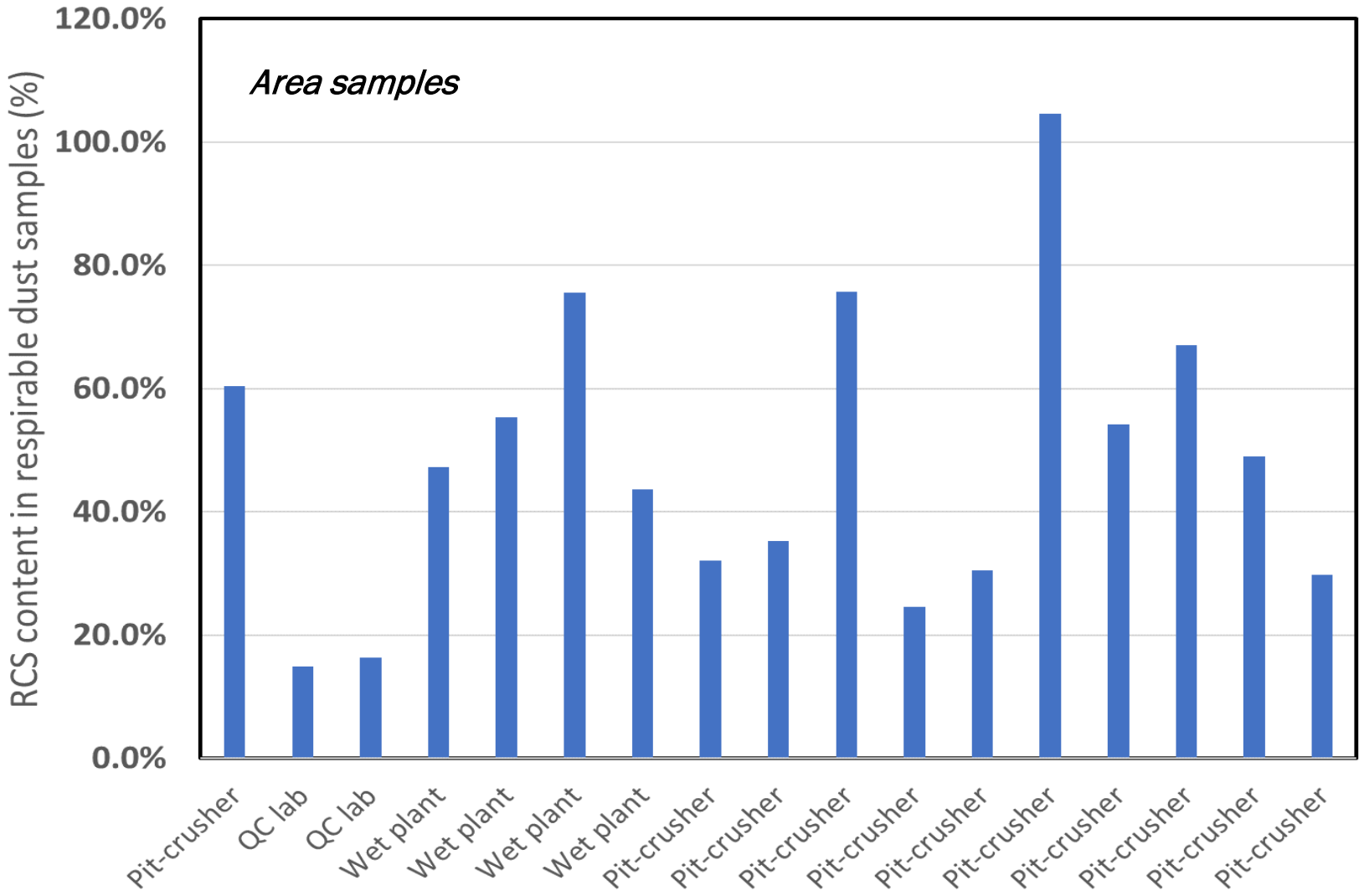
Field-based silica analysis – **real-time monitors**
LOQ 2 ug – 10 samples below LOQ

- Press operators (October 2018) and QC analyst showed the highest levels
- The levels detected inside enclosed cabs were or below LOQ or lower than 20 µg/m3
- Lab analysis on these samples returned all below LOQ level.



Results

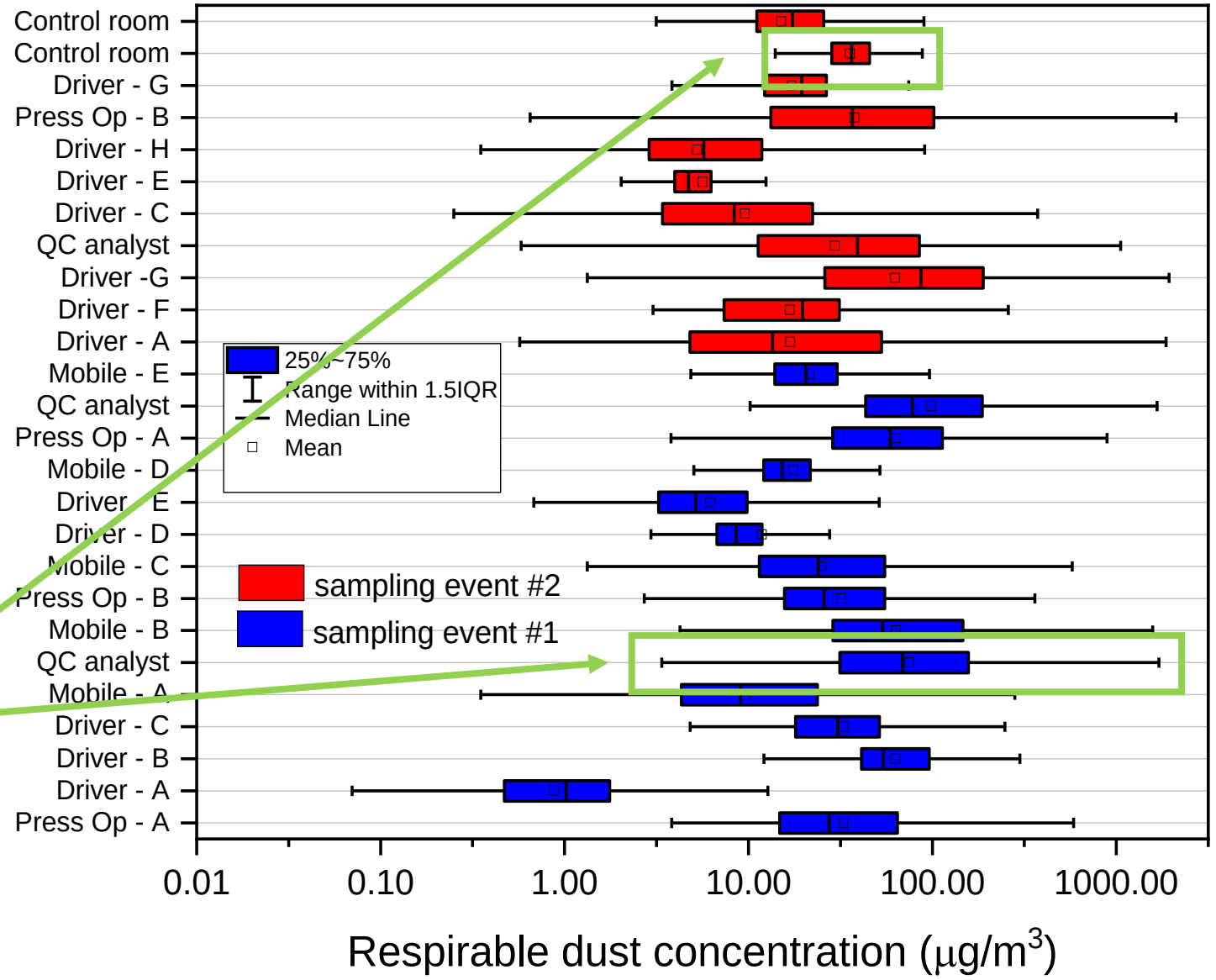
How variable was the silica content (%) in the respirable dust?



Results – real-time respirable dust monitors data

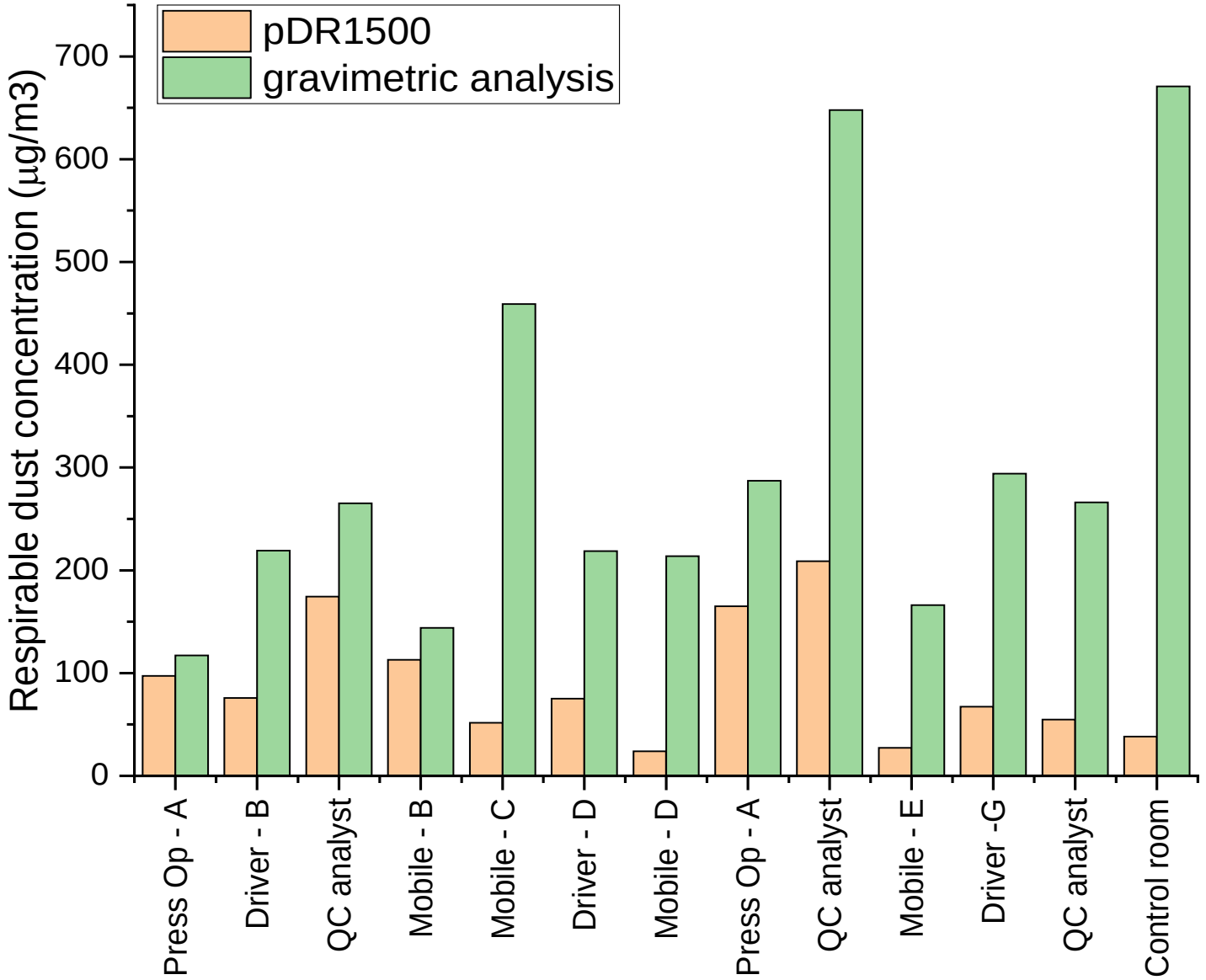
- We can obtain more information from real-time respirable dust monitors than simply average concentration levels
- The concentration levels for mobile workers and inside the cabs are similar for October 2018 (blue) and July 2019 (red).

The data distribution for each session can provide information on the variability of the levels within the session.



Results

How was the performance of the real-time respirable dust monitors to estimate average concentration?



Results

Can we correct the measurement of the real-time respirable dust monitors?

Gravimetric analysis can be used to correct the measurement of real-time respirable dust monitors in terms of average concentration level detected

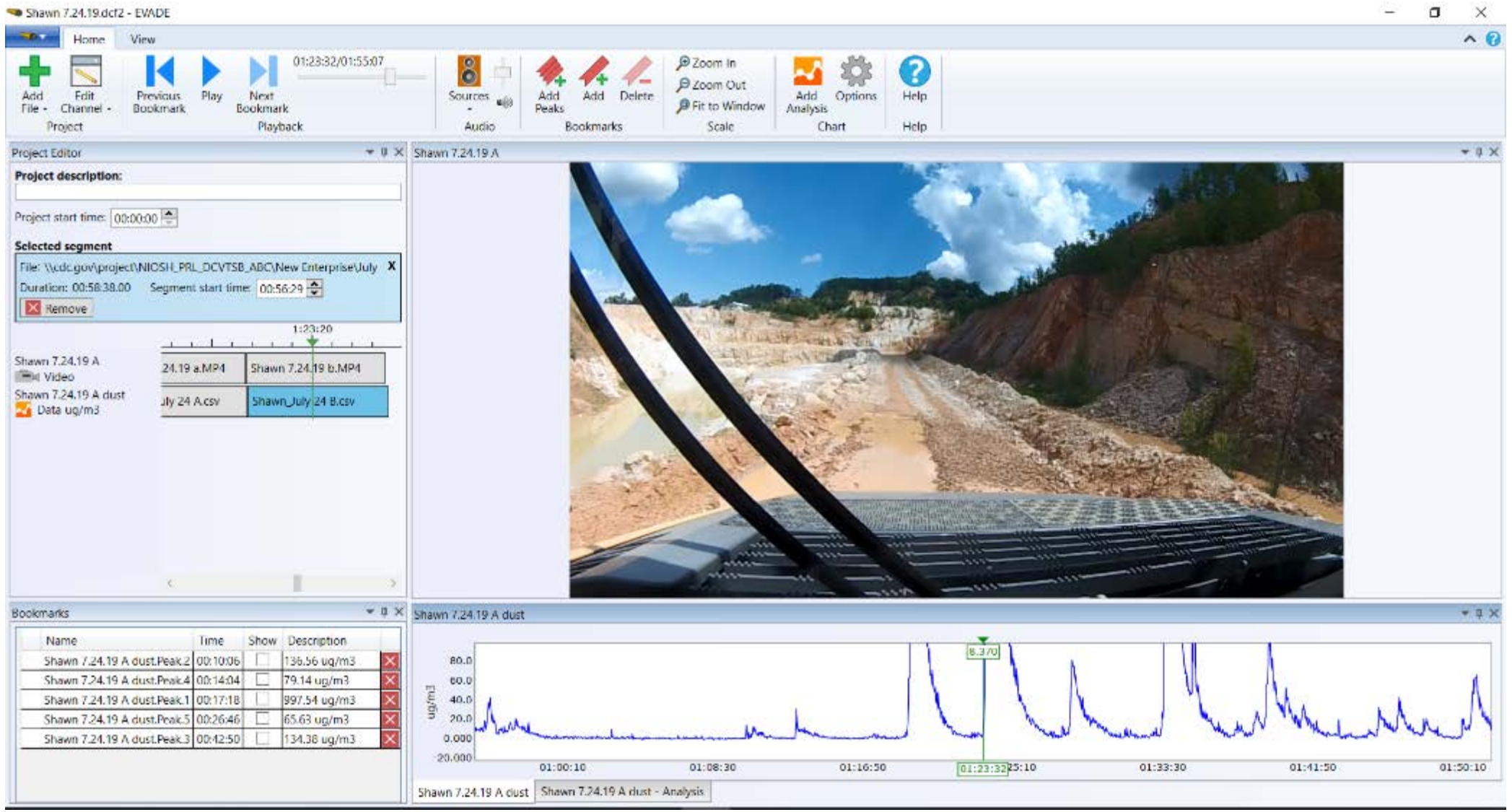
The correction was determined for 13 sessions (out of 26) due to LOQ of the gravimetric analysis – not enough mass collected

The ratio (correction factor) varied from 1.2 to 17.5 (mean 5.0).

	Arithmetic mean (µg/m3)	Concentration from gravimetric analysis (µg/m3)	Ratio
Press Op - A	97.3	117.2	1.2
Press Op - B	62.3	< 340	
Press Op - A	165.1	287.1	1.7
Press Op - B	116.9	< 114	
Driver - A	0.4	< 128	
Driver - B	75.7	219.0	2.9
Driver - C	48.0	< 128	
Driver - D	75.1	218.8	2.9
Driver - E	13.3	< 120	
Driver - A	7.1	< 131	
Driver - F	24.3	< 121	
Driver -G	67.2	294.0	4.4
Driver - C	28.9	< 243	
Driver - E	7.2	< 106	
Driver - H	8.5	< 130	
Driver - G	19.8	< 79	
QC analyst	174.4	265.2	1.5
QC analyst	208.9	647.9	3.1
QC analyst	54.8	266.0	4.9
Mobile - A	18.3	< 84	
Mobile - B	113.0	144.0	1.3
Mobile - C	51.7	459.2	8.9
Mobile - D	23.9	213.8	8.9
Mobile - E	27.3	166.1	6.1
Control room	38.2	670.9	17.5
Control room	19.2	< 51	

Results

EVADE project inside the enclosed cab of a haulage truck



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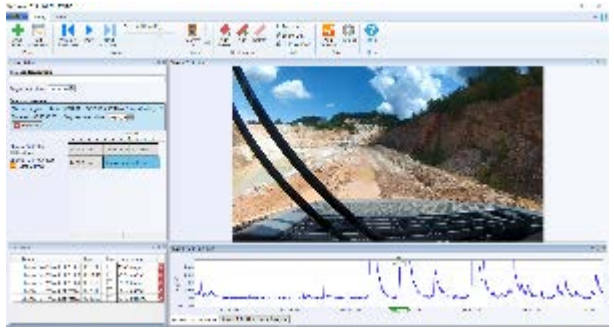

Dusty drilling activity done by contractors in the same area where the truck was passing by

- The protection from the cab was not perfect
- The contractor should use water while drilling to minimize dust generation

Sometimes the entire environment should be considered.

Summary and final remarks

- The Helmet-CAM and the field-based RCS monitoring approach have provided valuable information about the respirable dust and crystalline silica levels present in the quarry.

- Being field-based methods, they provide more timely information to operators. They are more versatile than traditional methods: from an implementation and economical perspectives.

- In the specific case study, high RCS levels were found in unexpected locations (wet plant): this reinforces the need of comprehensively and periodically assessing the RCS levels. The field-based method helps this approach.

- The field-based RCS monitoring approach results correlated well with the standard analysis. A site-specific correction factor was calculated, and it can improve the performance of the approach for future samples.

- The Helmet-CAM sessions provided a wealth of information in terms of respirable dust concentration levels within each session and between sessions. Each EVADE project brings this idea to a new level.

- Correcting the measurement of real-time respirable dust monitors is not always possible (LOQ grav) and the user should be aware of this constraint.

As a team we are looking forward to create other similar case studies especially in the aggregate mines industry.

Questions?

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