

# Instrumentation and Methods for Monitoring Concentrations of Particulates Emitted by Diesel Engines

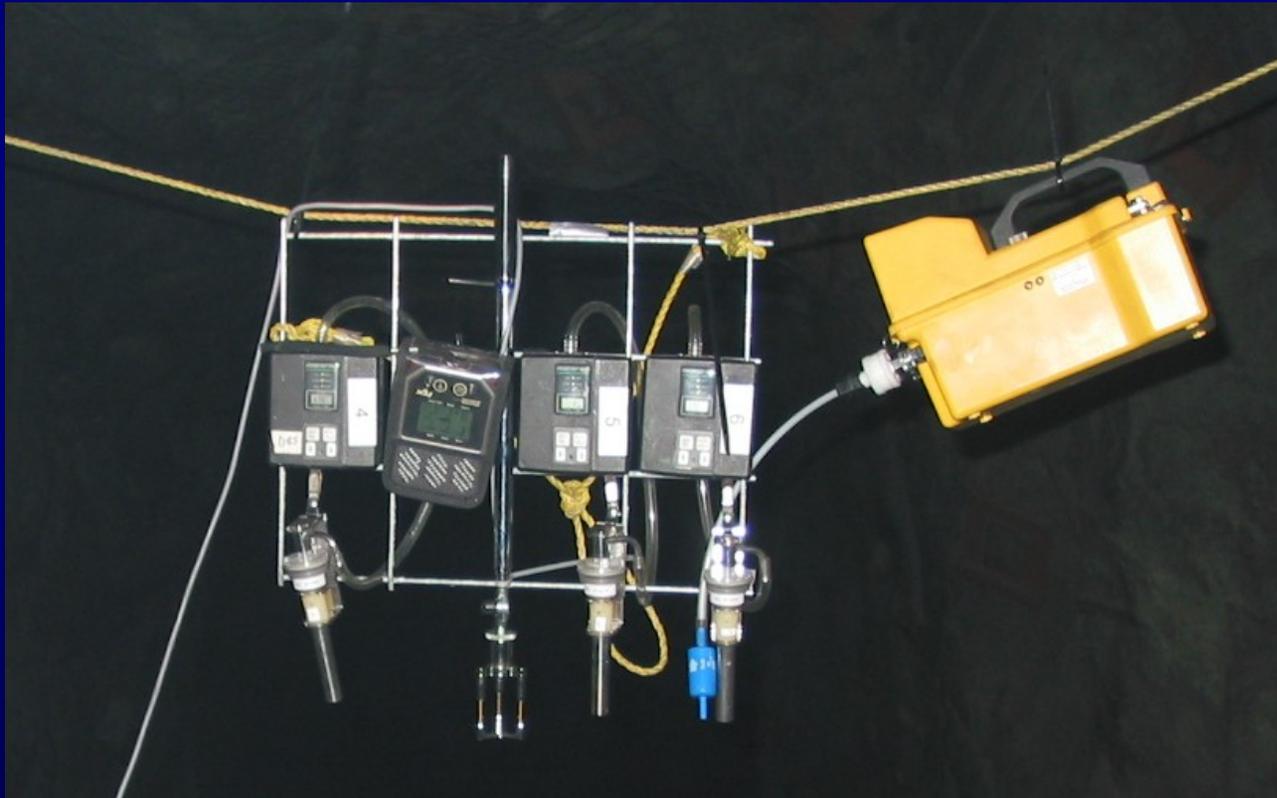
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# Why should we sample for DPM in underground mines?

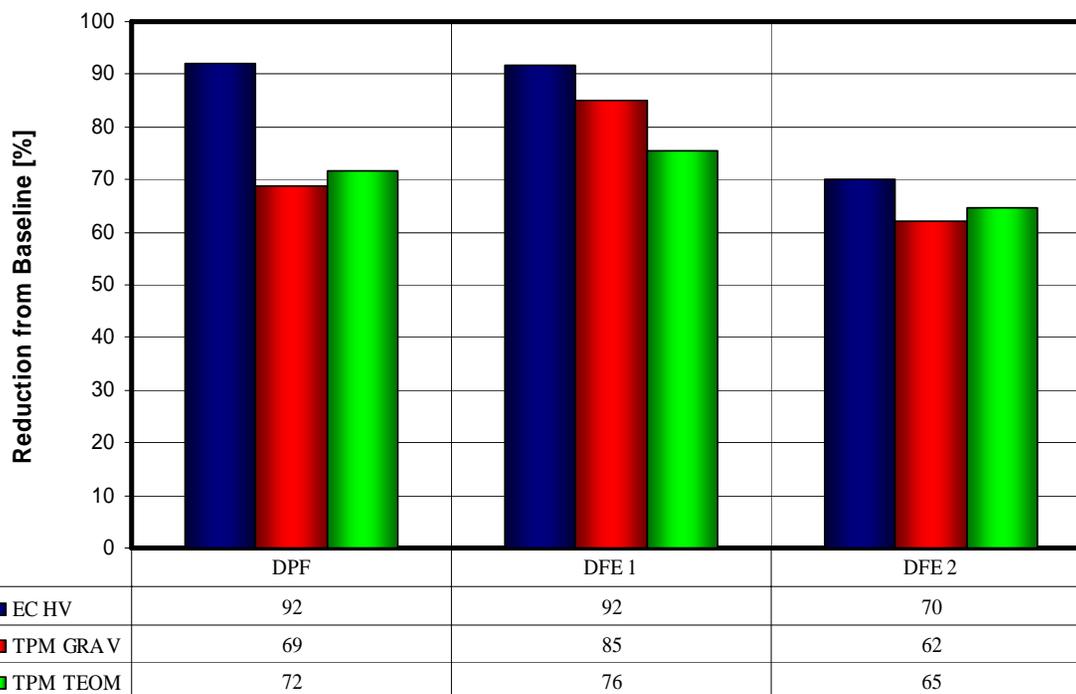


# Rules regulating exposure of underground miners to DPM

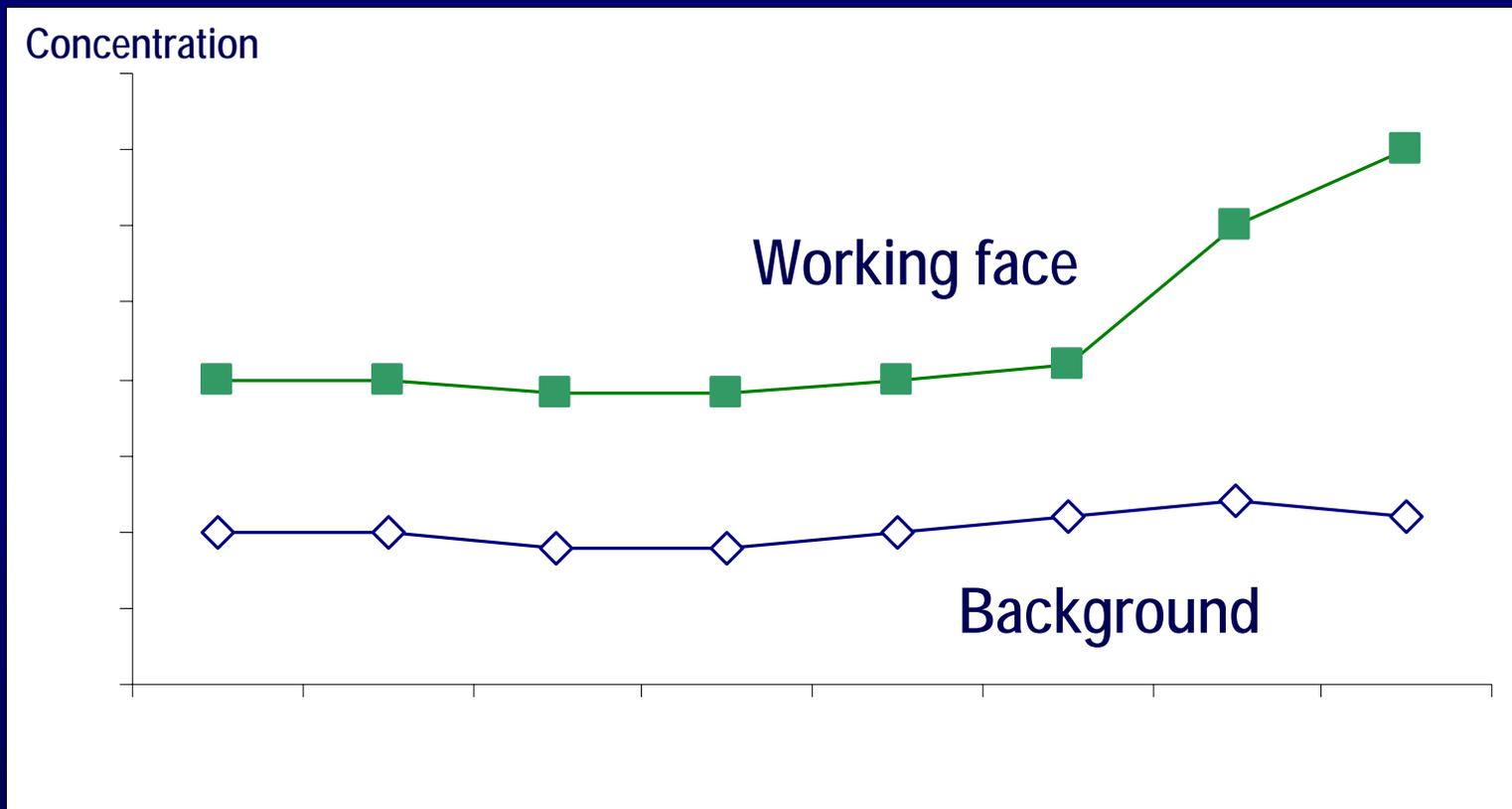
- ✦ Underground metal and nonmetal mines
  - ✦ 30 CFR Part 57.5060 - Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners;
  - ✦ Personal exposure limit, performance rule
- ✦ Underground coal mines
  - ✦ 30 CFR Part 72 - Diesel Particulate Matter Exposure of Underground Coal Miners.
  - ✦ Emissions standard, prescribed solution



# DPM sampling can help with estimating effectiveness of DPM control methodologies



# DPM sampling can help ensure the DPM control methods are working properly



# Form a sampling strategy prior to collecting any samples

- ✱ What question do you want answered?
- ✱ What type of samples do you need to collect?
- ✱ Where should you collect samples?
- ✱ Should you collect area or personal samples?

# Choose the proper sampling instrumentation

- ☀ EC, TC, Total DPM



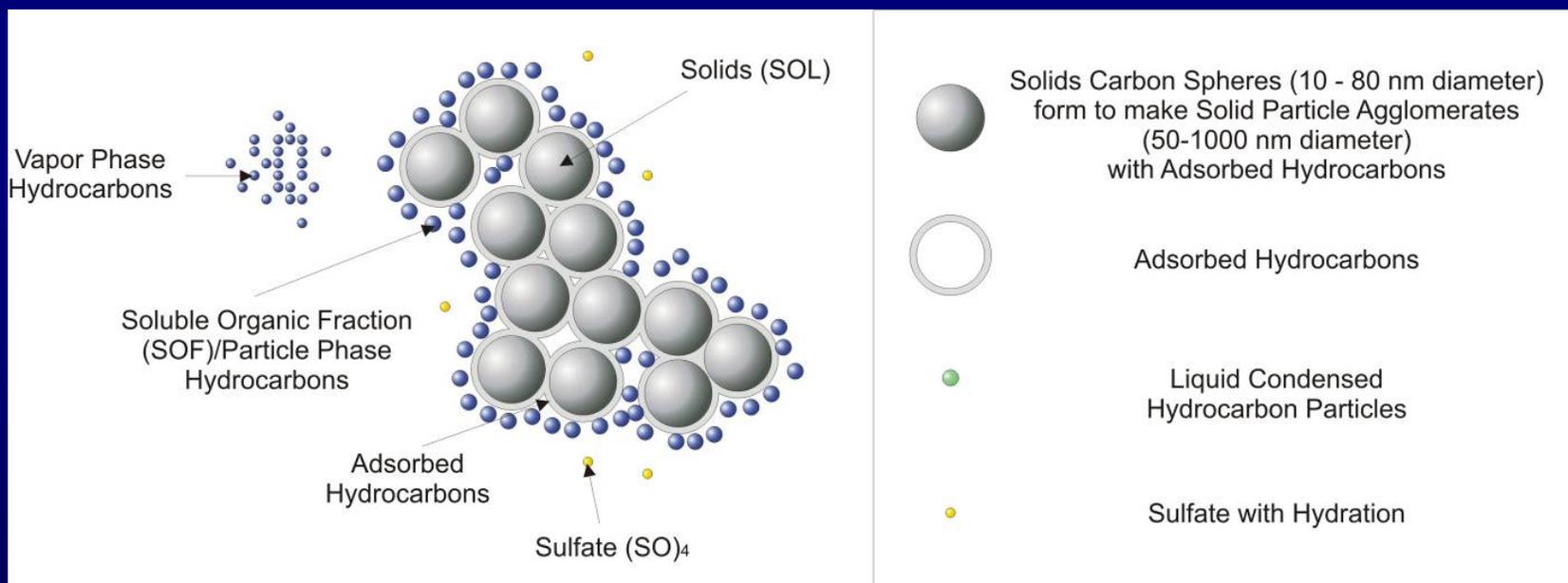
- ☀ Real time or time integrated



- ☀ Are gas measurements necessary?

# What is Diesel Particulate Matter (DPM)?

- ✦ EC is solid carbon (measured by 5040)
- ✦ Total DPM includes all components (measured by mass)



# Time integrated NIOSH 5040 samples

- ✦ Set pump flowrate for 1.7 lpm for 0.8  $\mu\text{m}$  cutpoint
  - ✦ It is important to check flowrate both before and after sampling.
  - ✦ Probably use this methodology when checking to ensure compliance.



# High Volume Sampling for total diesel particulate matter

- ✱ Uses a flowrate upto 1 l lpm
- ✱ Gravimetric analysis of filter



# Some monitors are currently available to measure particulate matter in real time

- ✦ Personal Data-Ram – Thermo Environmental
  - ✦ Light scattering technology (effective for 0.1 -10  $\mu\text{m}$  particles)



## Some monitors are currently available to measure particulate matter in real time

- ✱ Haz-dust 1004 – Environmental Devices Corporation
  - ✱ Allows real time and gravimetric sample collection
  - ✱ Real time measurements use a light scattering technology



# Personal dust monitor (PDM) is currently being tested to measure diesel particulate in almost real time

- ✱ Thermo Environmental
- ✱ Measures total particulate matter as mass. Not EC
- ✱ Belt wearable combination cap lamp and diesel particulate monitor
- ✱ Displays on monitor
- ✱ Stores data in memory for several weeks



# Personal EC Monitor is currently being tested to measure EC in almost real time

- ✦ Uses laser adsorption as a measure of EC concentration



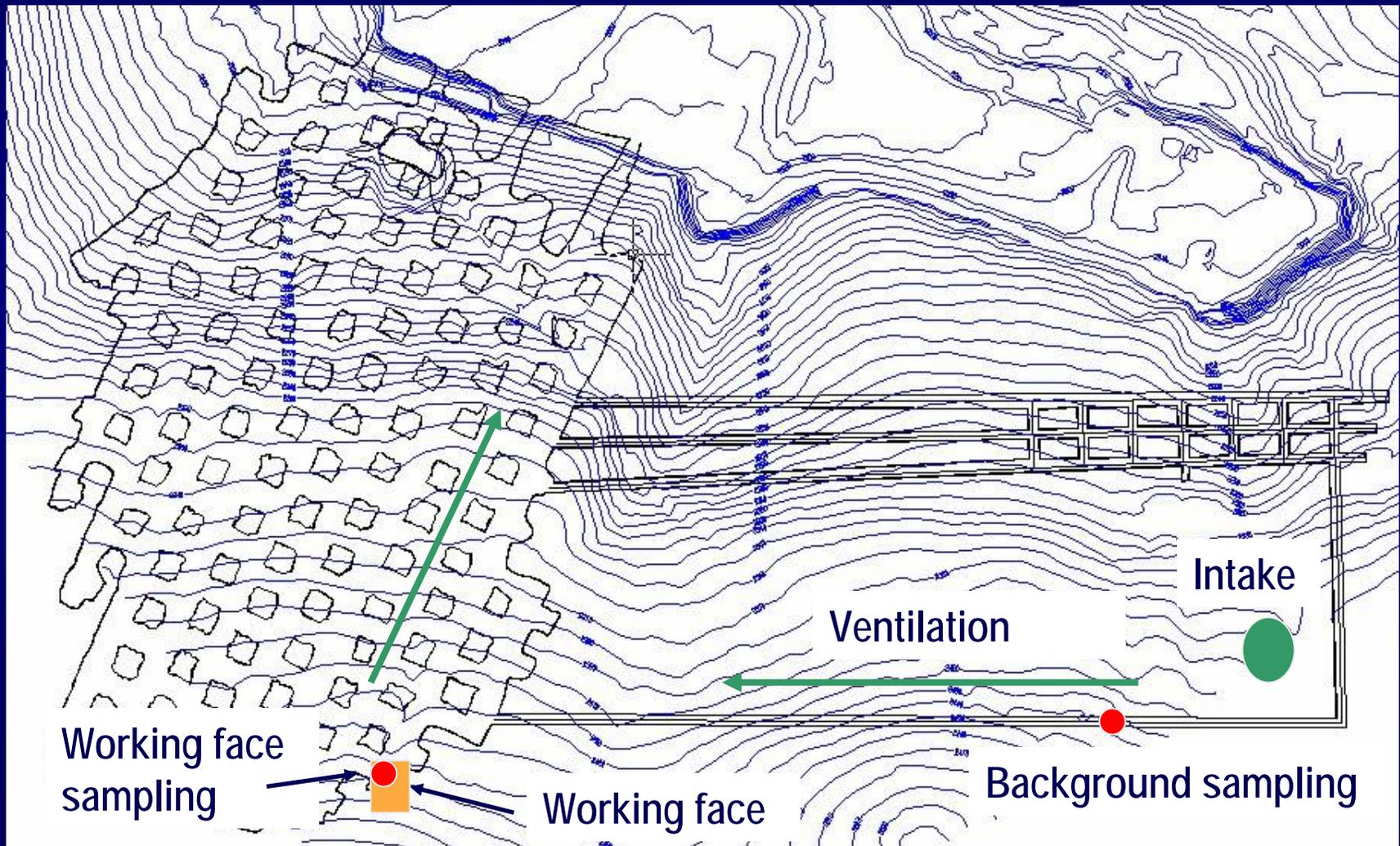
# Form a sampling strategy prior to collecting any samples

- ✱ What question do you want answered?
- ✱ What type of samples do you need to collect?
- ✱ **Where should you collect samples?**
- ✱ Should you collect area or personal samples?

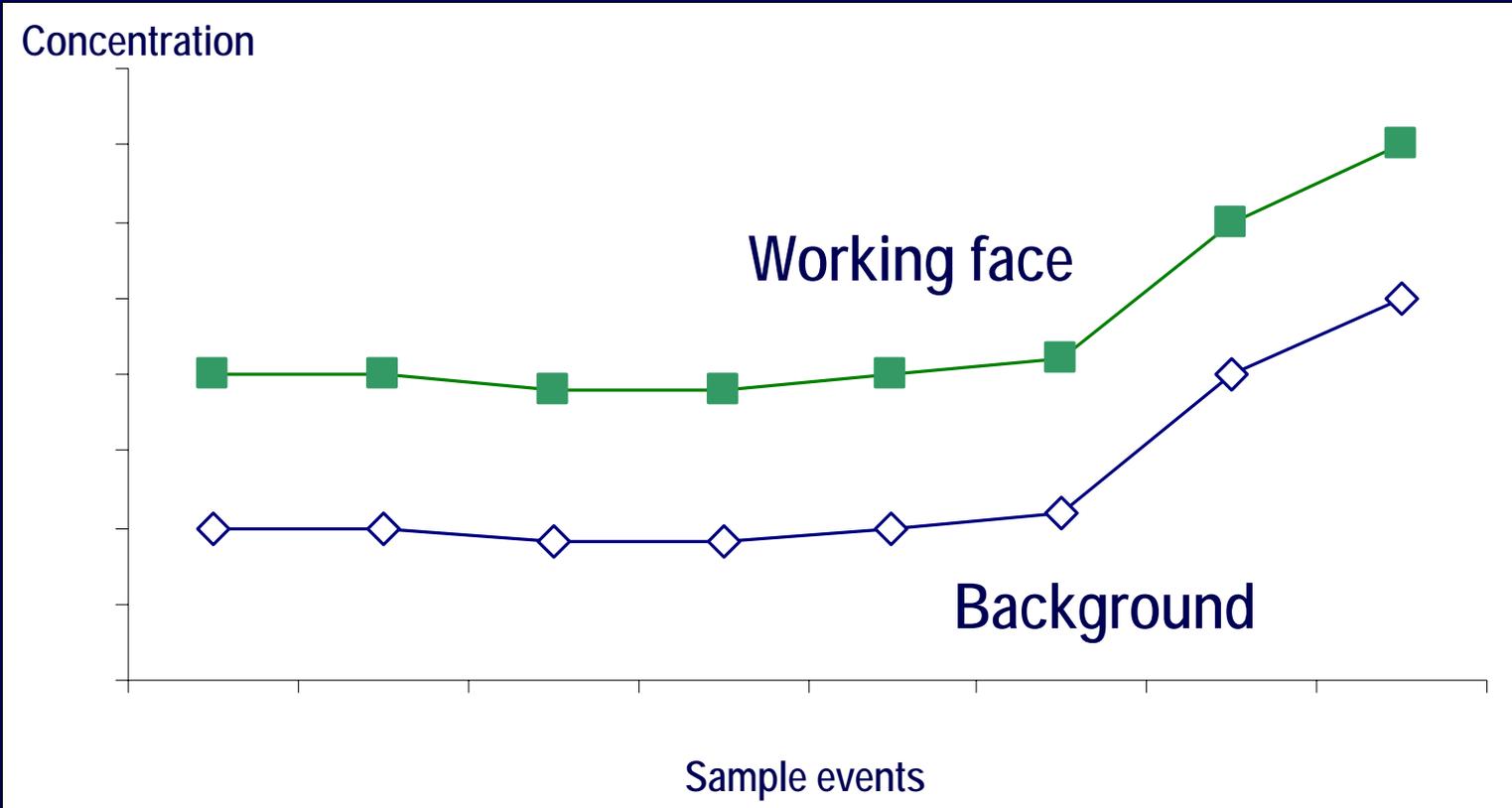
# **DPM concentrations are a result of DPM entering mine plus DPM emitted in mine**

- ✱ Background samples will measure the amount of DPM entering the working face
- ✱ Samples collected at the face will measure the amount of DPM to which miners are exposed.
- ✱ DPM emitted from the diesel equipment is the difference between background and working face measurements

# Where should the samplers be located ?



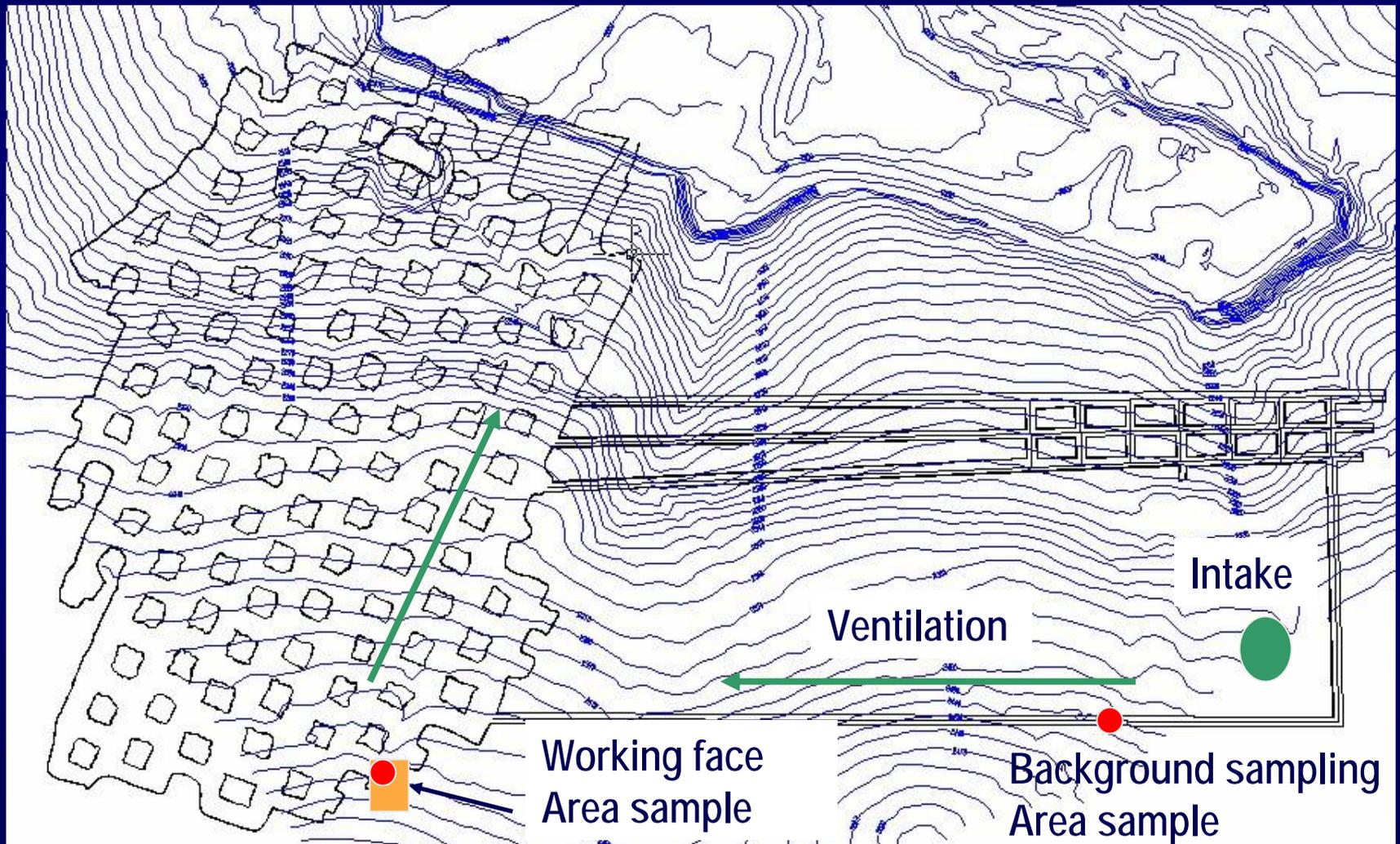
# What conclusion would we draw if we only did working face samples?



# Is it better to collect personal or area samples?

- ✦ What question needs answered?
- ✦ To check for compliance a personal sample may be necessary.
  - ✦ Need shift information on a particular miner
- ✦ To check for effectiveness of control technologies than an area sample may be better choice
  - ✦ Need information on DPM concentrations in work area

# Where should the samplers be located?



## An example of an area sample

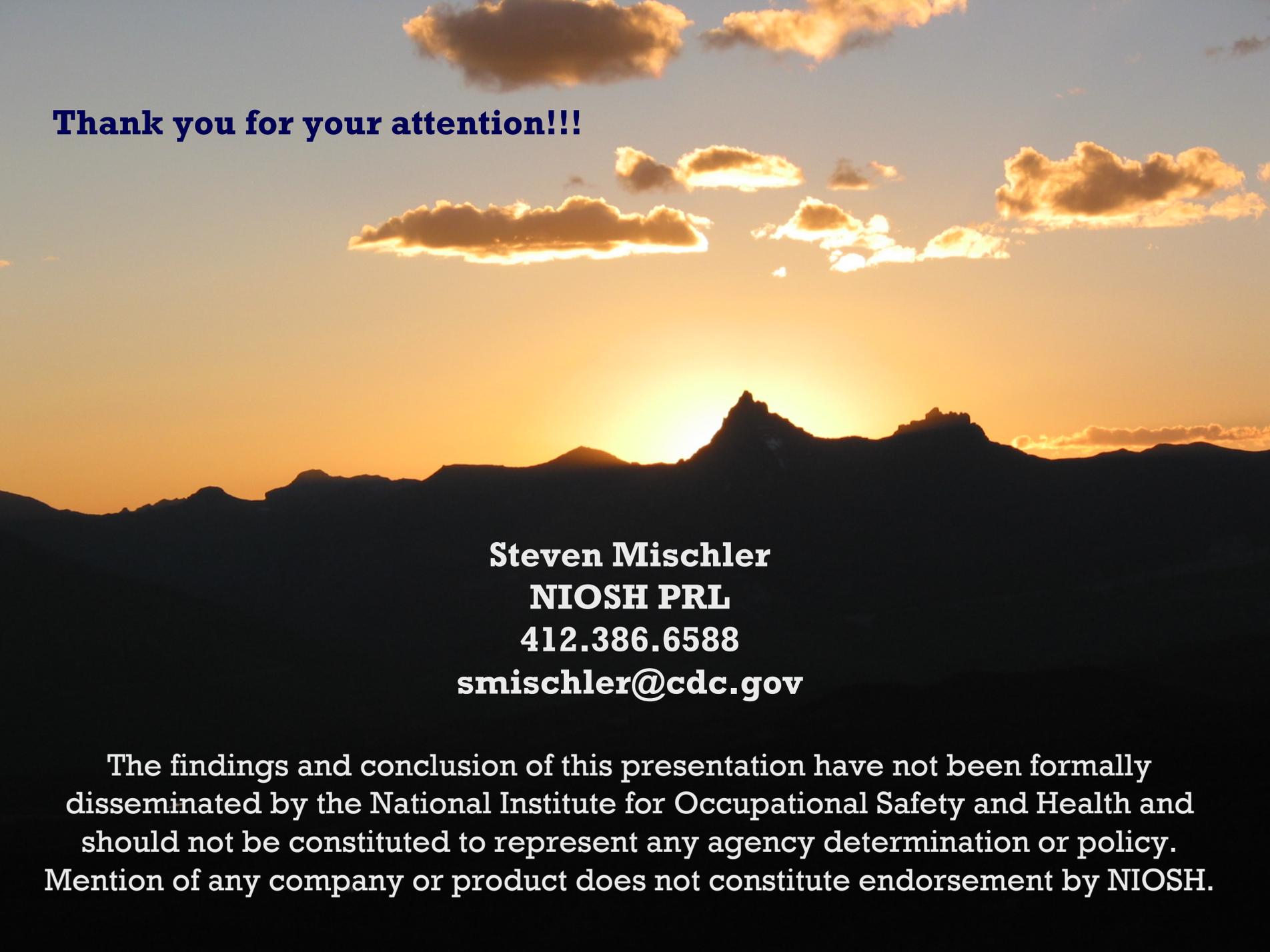


# Personal monitoring



# It is possible to measure DPM with currently available instrumentation

- ✱ Choose the reason for sampling.
  - ✱ Why is it necessary to sample for DPM?
- ✱ Develop a sampling strategy
  - ✱ What instruments?
  - ✱ Where to locate the samplers?
  - ✱ When to collect the samples?
- ✱ Implement the strategy with proper QA/QC
  - ✱ Calibrate

A sunset scene with a mountain range silhouette and scattered clouds. The sun is low on the horizon, creating a warm orange glow. The sky is filled with soft, golden clouds. The mountains in the foreground are dark silhouettes against the bright sky.

**Thank you for your attention!!!**

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