Grant: AFC618-01

Title: The Effect Of Dust Particles On Airway Mucus Viscosity And Mucociliary Transport

Organization: University of California, Merced

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Focus Area: Rock Dusting Effects

Project Summary: The objective of this proposed pilot project is to investigate the effect of airborne rock dust particles on airway mucin viscosity, the resulting mucociliary transport changes and underlying mechanisms. Understanding the interactive mechanisms between dust particles and airway mucins will facilitate the development of the improved practice/use protocol or updated selection criteria for rock dusts commonly used in coal industrial.

Hypothesis: Airborne coal dusts haven demonstrated to carry various amounts of positive charges. Our published study demonstrated that positive nanoparticles can reduce airway mucin swelling and dispersion potentially resulting in poor mucociliary transport and mucus accumulation. Our preliminary results also indicate that various metal ions and hydrophobic particles can potentially increase mucus viscosity. Considering these previous results and the complex nature of rock dusts (surface charges and chemical compositions), we proposed that hydrophobic surface and metal ions from rock dusts can interact with airway mucus to increase viscosity resulting in impaired mucociliary clearance and mucin accumulation that are commonly associated with COPD.

Specific Aim 1: *Major metal components (Al, Cu and Fe) and hydrophobic surface (hydrophobic particles) can reduce mucin swelling/dispersion and promote mucin aggregation.*

Various types of metal ions (Al, Cu and Fe) and hydrophobic nanoparticles (NPs) will be investigated for their reducing mucin dispersion capacity (viscosity increase). *In vitro* mucin swelling measurement will be utilized to assess the mucin swelling capacity. The same *in vitro* protocol to monitor airway mucin viscosity changes has been used in our previous studies.

Specific Aim 2*: Metal ions and hydrophobic particles cause slow and ineffective mucociliary Transport (MCT).*

In vitro MCT measured by particle transport on cultured airway epithelial cells has served as a standard for MCT measurements as described in details previously. Therefore, we choose this well-established lab model to assess MCT hindrance induced by Fe2+ (and Fe3+), Al3+ and Cu2+ and hydrophobic NPs.