The Salton Sea – Dust Emissions, Lung Inflammation, and Asthma

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The Salton Sea is California’s largest lake; while it is pretty in photos, it has a declining ecosystem, and increasing dust emissions are causing health problems.
The most severe health impact is the high incidence of childhood asthma; it is believed that the dust from the sea causes lung inflammation.
Our Research

- We are studying the effect of aerosol exposures using samples collected from various sites around the Salton Sea, and other more distant sites.
- Using an environmental exposure chamber (above), we expose mice continuously to aerosols for various periods, then look at lung inflammation and gene expression.
First, A Brief Immunology Lesson: Inflammation and Lung Disease

The Immune System can be induced by

- **Innate** immune triggers such as bacterial infection
  - Rapid first-responder (neutrophil) recruitment, rapid recovery and NO memory or amplification

- **Adaptive** immune triggers such as allergens (e.g., dust mite, ragweed) or viruses (e.g., flu, COVID)
  - Slow initiation, follows innate response, antigen (allergen) specific, includes memory
  - **Asthma is usually associated with ALLERGIC responses (adaptive)**

Thus, the character of the response provides clues to the causes
Dust Sources for Exposure Studies

- Dust was collected from several sites near Salton Sea, as well as from distant sites
  - Wister, Sonny Bono, both close to the southern end of the Salton Sea
  - Boyd Deep Canyon near Palm Springs
  - Dos Palmas near North Shore
(1) Wister and Sonny Bono dust triggers a neutrophil (innate) inflammatory response in exposed lungs (NOT allergic!). Similar results for Dos Palmas near North Shore

(2) NO inflammatory response to Boyd Deep Canyon dust

THUS, Proximity to the Salton Sea is associated with significant dust toxicity (Trevor Biddle, et al.)
Hypothesis: Proximity to Salton Sea/Playa and Toxicity

These maps suggest a relationship between exposed playa and toxicity
- Organic content at the shoreline; rate of playa exposure from 1985 to 2020
- Toxicity of dust correlates with proximity to freshly exposed playa (arrows)
Evidence for Playa Enrichment of Toxins

This is a summary of gene expression patterns after different exposures, from Salton Sea water (sea spray) to playa extract, to dusts near Salton Sea and distant sources. The data show evidence for a progression in responses from sea water to playa to dust. Importantly, the far right two exposures (dust from Salton Sea playa) induce significant lung inflammatory responses.
Salton Sea playa aerosol dust exposures show evidence for an *Innate* (not Adaptive Allergic) response in lungs, consistent with a response to microbial toxins

- Is there selective enrichment of microbial toxins by dust entrainment at the playa?
- What are these toxic components?
- Is this inflammatory response consistent with clinical asthma-like symptoms?
It is only getting worse; there is less fresh water runoff into Salton Sea, and with chronic drought and warming temperatures, the sea is drying up.