

# Pathological effects of inhaled mineral dust

The thick dust palls found close to dust sources pose a number of hazards to human health. When inhaled, many of these larger dust particles are eventually rejected by coughing.

Nevertheless, inhalation of large dust particles ( $>10\mu\text{m}$ ) may constitute a health risk if the mineralogy is toxic, regardless of where the grains lodge in the respiratory system.



## ***Pathological effects of inhaled mineral dust***

Of the finer dust particles (diameter  $< 10\mu\text{m}$ ) that remain in suspension in the atmosphere for much longer periods (the respirable fraction), most between  $10$  and  $5\mu\text{m}$  become trapped in the upper respiratory tract and are ultimately removed by coughing.

Particles finer than  $5\mu\text{m}$  frequently penetrate more deeply into the lungs to cause the pneumoconioses (which include silicosis, asbestosis, sarcoidosis, and other lung conditions).

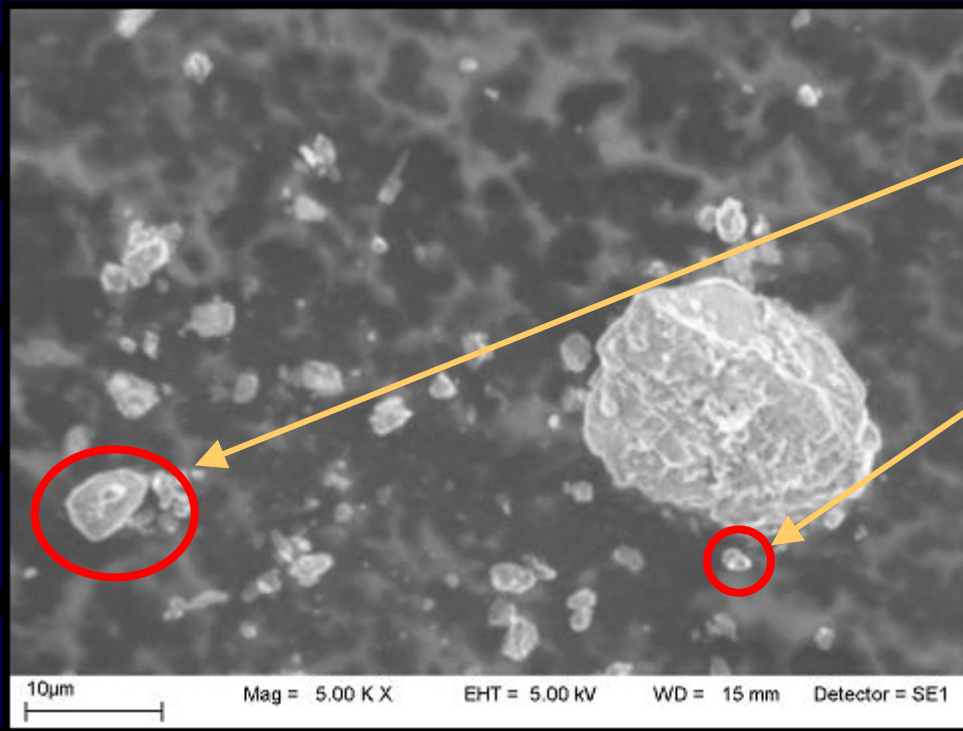
Silicosis: inflammation of the lung, leading to fibrosis, caused by foreign bodies, notably inhaled silica particles

Asbestosis: Degenerative fibrosis of the lung resulting from chronic inhalation of asbestos fibres.

*.....but many symptoms are non-specific in the absence of radiography.*

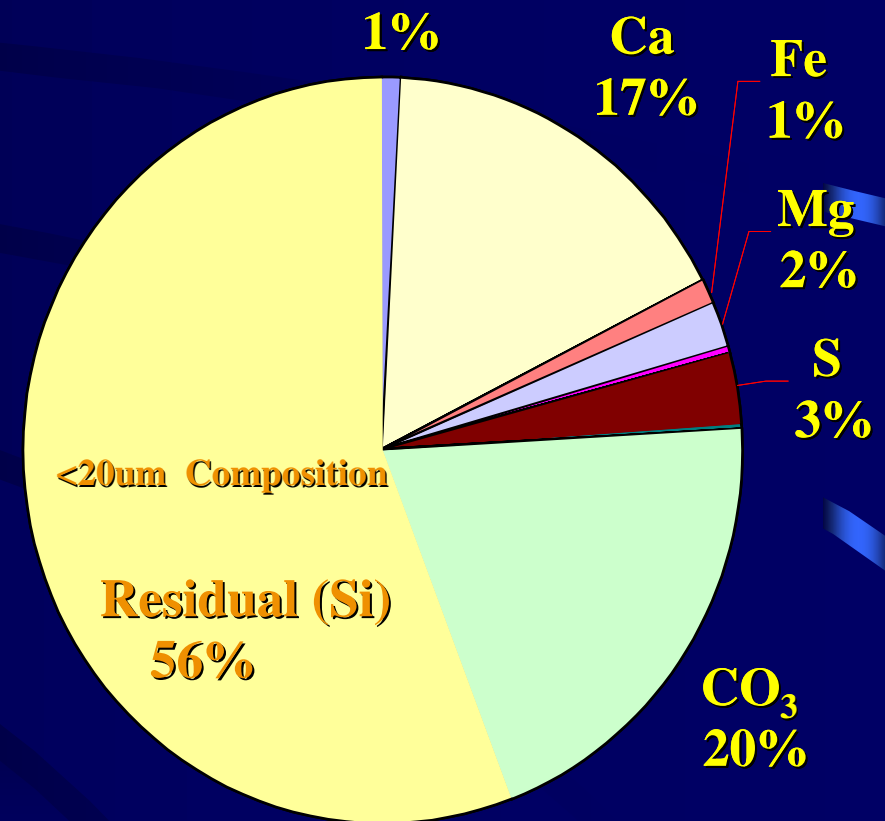
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400 of these particles can fit end-to-end across the Head of a Pin.

800 - 1000 of these particles can fit on the Head of a Pin.



## Summary

- As particle size decreases, % heavy metals increases.
- At or near maximum inhalation levels for several metals.

Courtesy CDR Mark B. Lyles, PhD, Naval Institute for Dental and Biomedical Res.

# Summary of the Biological Analysis

- *Hemolytic microorganisms*
- *Gram positive spore-formers*
- *Gram negative opportunists*
- *Fungi*



Courtesy CDR Mark B. Lyles, PhD, Naval Institute for Dental and Biomedical Res.



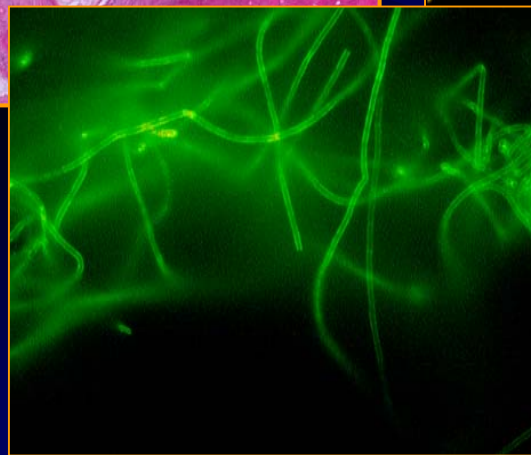
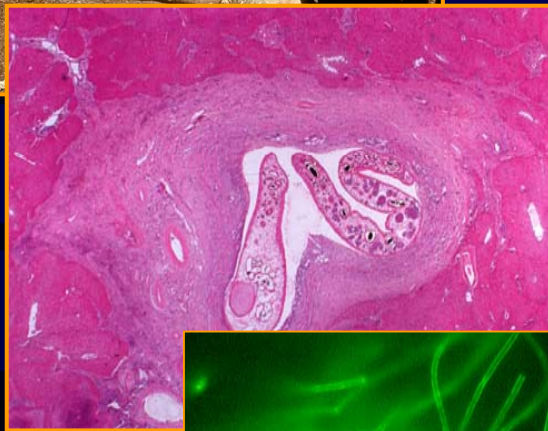
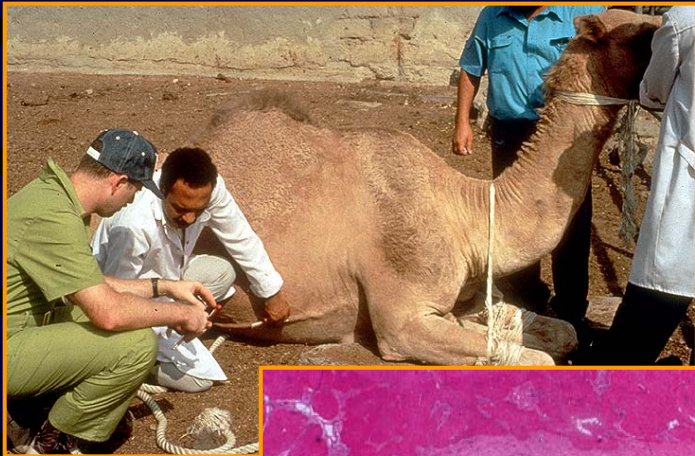
# History / Review of Literature

- ❖ Iraqi soils contain concentrations of Chromium up to 2272 ppm. (A. Gindy *et al.*, Petrography and petrochemistry of some zagroside geosynclinal calcarenites from north-eastern Iraq, *Sedimentary Geology*, **42**, (1985), p.279)
- ❖ Evidence of microbial transfer of pathogens via African Dust. (EA Shinn, *et al.*, African Dust and the Demise of Caribbean Coral Reefs, *Geophys Res Lett.* **27**, (2001) p.3027-32)
- ❖ Description of novel condition triggered by exceptionally fine sand of the central and eastern Saudi Arabian peninsula. Concludes that immunosuppression aggravated by opportunistic infections and other non-microbial ailments brought on by exposure to the ubiquitous fine sand of the area cause Persian Gulf Syndrome. (Korenyi-Both, *et al.*, Al Eskan Disease: Persian Gulf Syndrome, *Military Medicine*, **162**, (1997), p.001).
- ❖ Obstructive bronchitis and bronchiolitis in 86 autopsied casualties from Kuwait, with observation of sand particle in lung parenchyma. (NS Irey, Kuwait Casualties: Morphologic and Toxicologic Findings, NIH Technical Assessment Statement, April 27-29, 1994).
- ❖ From March through August 2003, 19 US military personnel developed pneumonia severe enough to warrant medical evacuation and mechanical ventilation; two died. (AF Shorr, *et al.*, Acute eosinophilic pneumonia among US military personnel deployed in or near Iraq. *JAMA*. 2004 Dec 22;**292**(24):2997-3005.)

**GEOLOGICAL FACTORS  
IN THE EMERGENCE AND RE-  
EMERGENCE OF  
INFECTIOUS DISEASE**

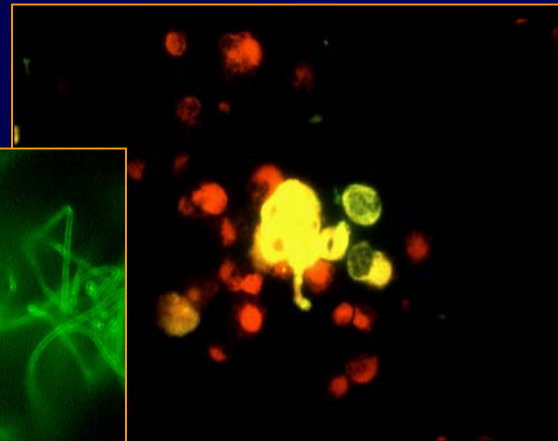
# Medical Geology and Emergence Diseases

New insights on the development, distribution and temporal/spatial mobility of diseases and natural environmental contaminants



Anthrax

AIDS



SARS

Emerging Infectious Diseases

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### Scientists Gear Up for Fight Against a Deadly Lung Disease

Identifying Virus Is First Step in Slowing Spread of SARS

By ROB STEIN  
Washington Post Staff Writer

As victims of a frightening new agent infections gaped for breath in hospital beds around Asia, Cynthia Goldsmith was peering through an electron microscope in a government lab in Atlanta at cells being torn apart by a mysterious microbe.

The sample had been rushed to Atlanta from Bangkok, where Carolyn Urban of the World Health Organization, who sounded the first alert that a new life-threatening disease was spreading in Asia, lay dying from the illness himself.

As she studied the specimen, Goldsmith, a biologist at the U.S. Centers for Disease Control and Prevention, realized she was glimpsing germs that usually attract little attention—viruses previously known to give people nothing worse than the common cold.

Research Hospital in Memphis. "If you think about the really bad organisms that have emerged in the last few years, like HIV, which researches have identified new coronavirus as most likely source of SARS. See OUTBREAK, A13, Col. 1

# OVERVIEW

- **Local geological factors**
- **Regional geological factors**
- **Global geological factors**



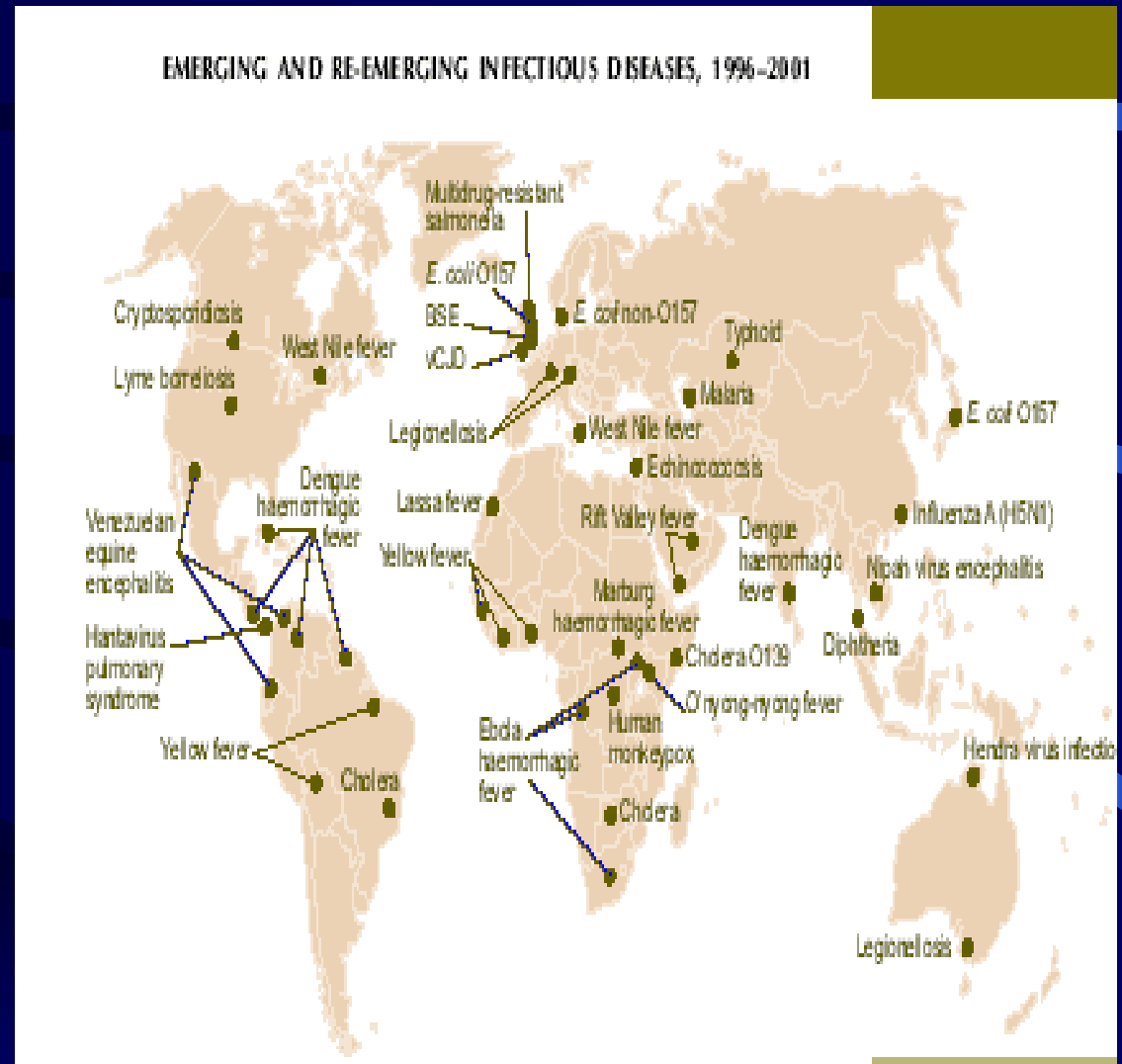
# INTRODUCTION

- Emergence of infectious diseases as public health problem

→ mosquito-borne diseases

→ Water-borne diseases

→ Dust-borne diseases



- Relate to environmental change

- Factors leading to emergence :

- urbanization,
- bioinvasion,
- climate change,
- travel and trade



# LOCAL GEOLOGICAL FACTORS



Increase in TB risk :

- double in South African Gold miners (Kleinschmidt, 1997)
- nine-fold among silicotic patients in Hong Kong (Chang, 2001).

Whorled, hyalinized,  
fibrous silicotic nodule



- risk remains elevated even after the exposure to silica dust has ceased
  - longer-term health surveillance (eg. volcanic eruptions, Weinstein, 2002).



TB of the lung with gross cavitation

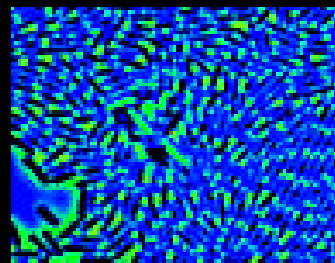
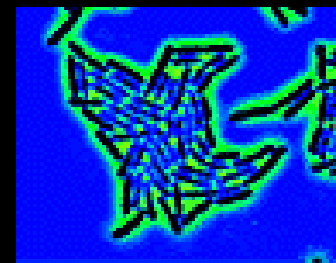
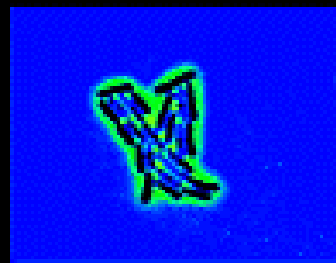
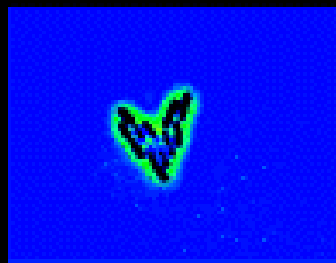
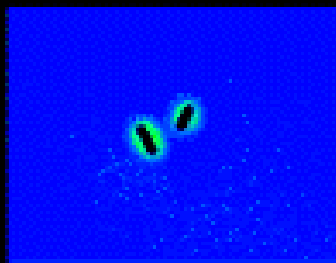
# REGIONAL GEOLOGICAL FACTORS



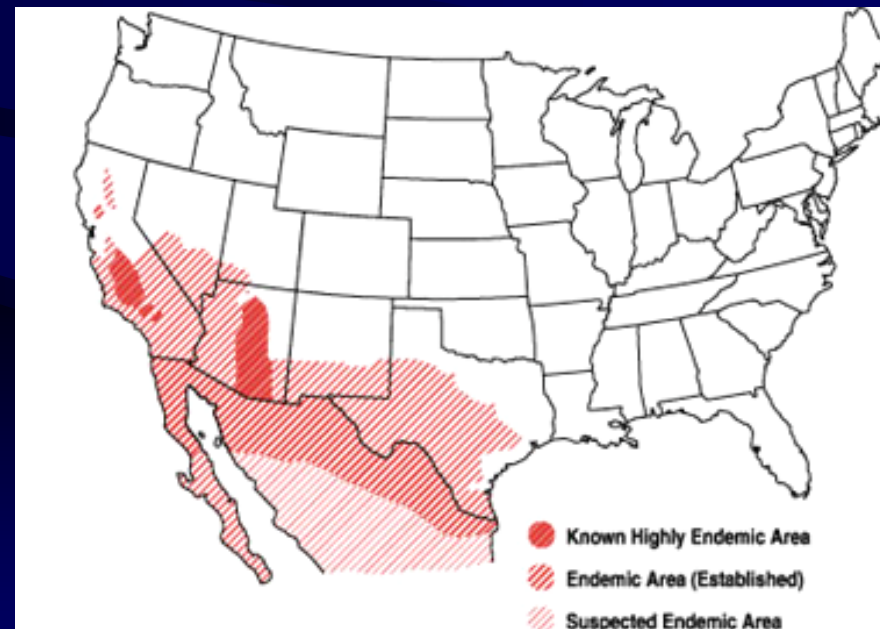
- Regional scale:
  - soil types
  - excesses or deficiencies of trace elements
- Human populations expand
  - anthropogenic change to geological environment



- Bacteria and fungi in sand- and dust-storms  
*Aspergillus*, *Actinomyces*, *Pseudomonas*, and  
*Staphylococcus* species (Kwaasi, 1998).

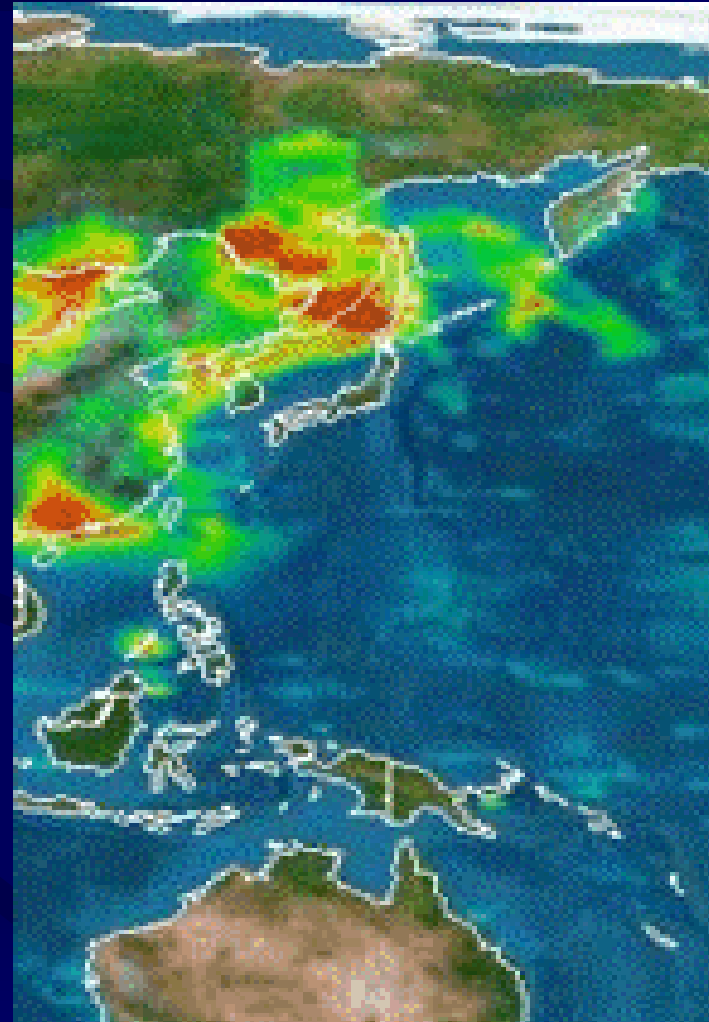


- Spores of the fungus *Coccidioides immitis*
  - Increase
  - Earthquake association

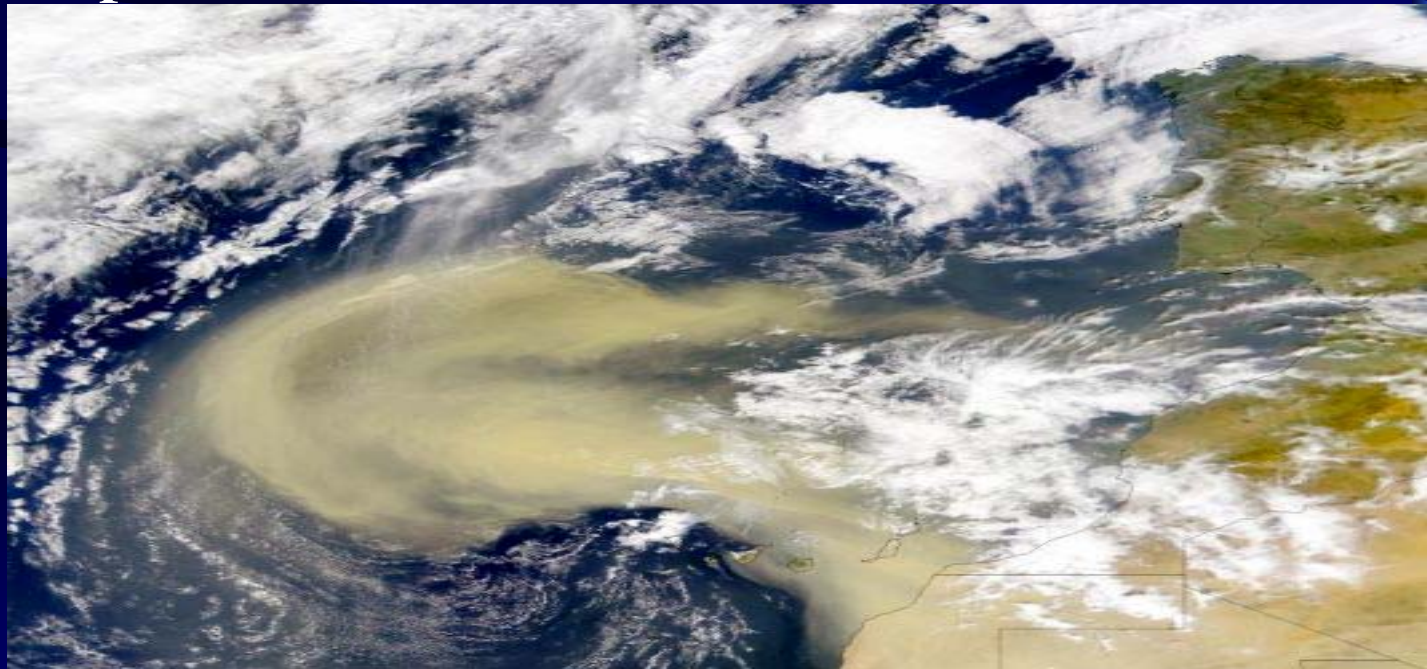


# GLOBAL GEOLOGICAL FACTORS

- Environmental change on a global scale:
  - Atmospheric
  - Hydrogeological
  - food production systems



- deforestation and water abstraction
  - wind erosion.
  - desertification
  - globally dispersed dusts.



# Addressing Emerging Infectious Disease Threats

- **Goal:** To develop a Global System with particular emphasis on: surveillance, assessment, response, control strategies and prevention of emerging infections.

Anthrax



Cutaneous leishmaniasis



Smallpox





Thank you!