Environmental Remediation of Areas Contaminated by Fukushima Nuclear Accident

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Radionuclide Distributions on Land Surface

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- Main radionuclides are ^{131}I, ^{134}Cs, and ^{137}Cs
- Very small amounts of ^{89}Sr, ^{90}Sr, ^{238}Pu, ^{239}Pu and ^{240}Pu were also released
- Most of these radionuclides deposited on forests and agricultural fields.

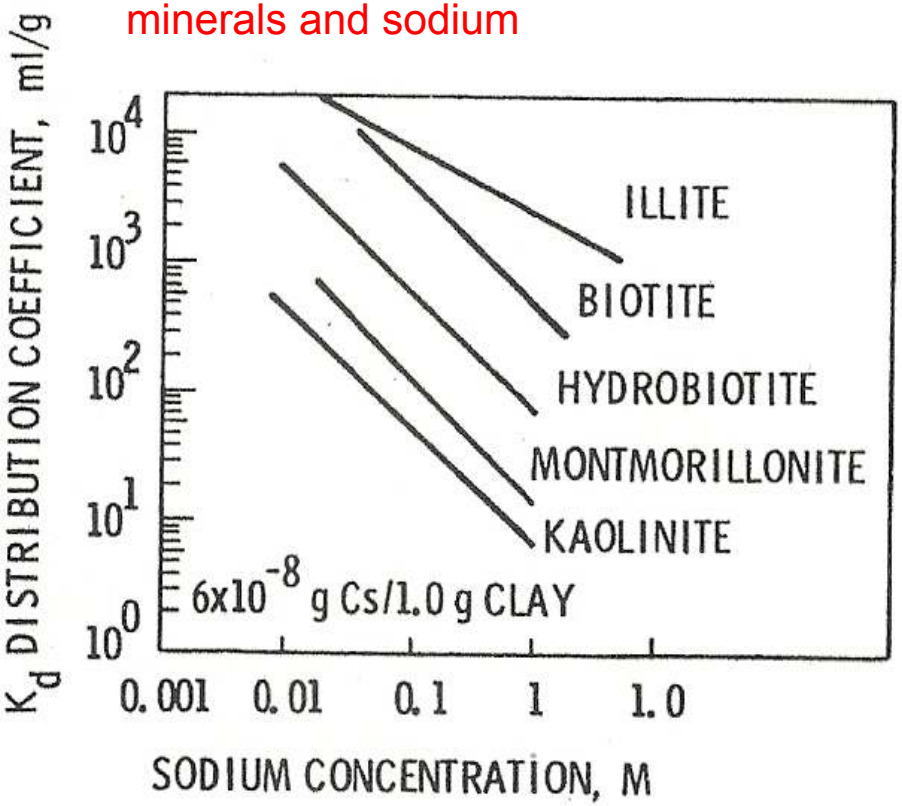
^{134}Cs in Bq/m^2

^{137}Cs in Bq/m^2

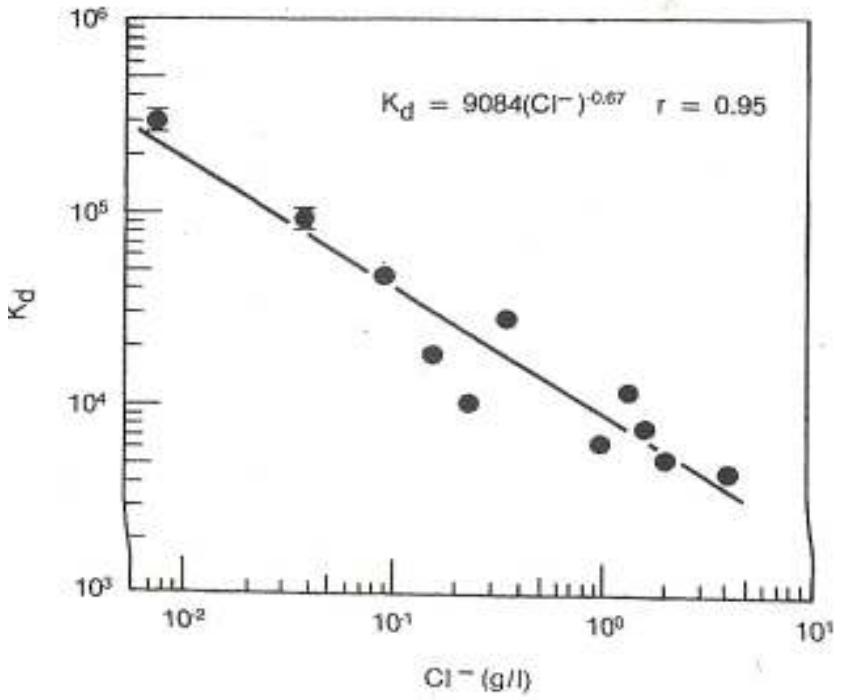
Cesium Behavior

- Cesium is strongly adsorbed by soil
- Most of cesium deposited on the surface soil still exist in the top 5 cm of the soil
- Soil erosion is a key for cesium deposited on the land surface to migrate.

Cesium adsorption variations with clay minerals and sodium

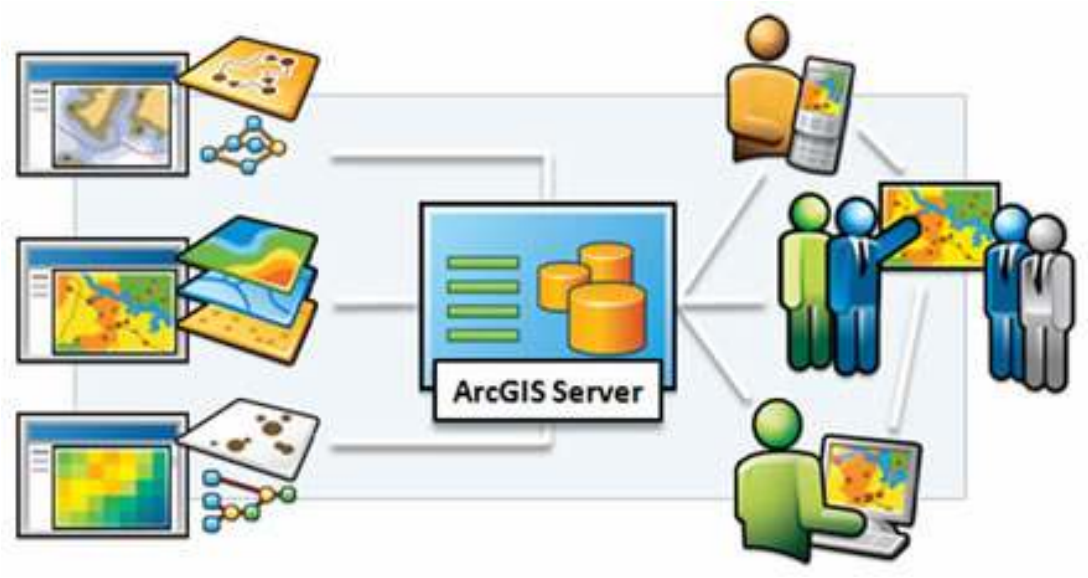


Cesium adsorption in fresh and salt water



Web-Based Environmental Remediation Decision Making System
Systematic, Science-based Comprehensive Planning

- **Distribution Map 1: Environmental parameter maps**
- **Distribution Map 2: Radionuclide transport parameter maps**
- **Distribution Map 3: Radionuclide migration and fate maps**
- **Distribution Map 4: Remediation distribution map**
- **Distribution Map 5: Remediation priority map**



Data connected to Web

Web Page

Analysis and Decision making

Main Remediation Methods

- Remove top several cm of soil
- Remove weeds and other groundcover
- Remove fallen leaves around houses
- Cut low-hanging tree branches and remove moss
- Wash roof, structure's outside wall, and road with high-pressure water jet
- Sand-blast the surface of a concrete road
- Remove dissolved cesium in water (e.g., a swimming pool) by zeolite
- Institutional control
  - Evacuate people within the 20-km zone and high radiation exposure areas (i.e., 20 mSv/year or greater radiation exposure)
  - Prohibit consumption of contaminated foods with 500 Bq/kg or higher
- others

Some Remediation Completed Sites

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Some Current Remediation Demonstration Sites

Minami Soma (top), Date (middle) and Kawamata (bottom) Sites









Some Remaining Remediation Issues

- Handle a large volume of collected soils, leaves and plants
- Waste storage of collected radioactive contaminants
- Waste volume reduction
- Waste treatment for cesium-contaminants
  - Removal of cesium from soils
    - very difficult in a large scale operation
  - Removal of cesium from water
    - available e.g., use zeolite and Prussian blue
  - Treatment of secondary waste
- Waste disposal
- Future cesium migration and accumulation in soil and water (subsurface water, rivers and the Pacific coastal water).