# Mercury Contamination Study

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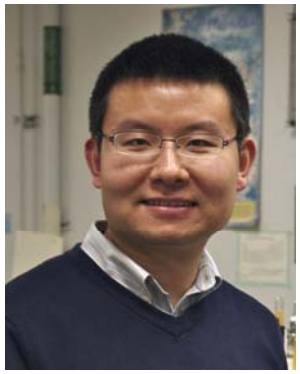
# Overview of Presentation

- Introduction of investigators
- Objectives of the mercury contamination study
- Valence states of mercury in soil
- Approaches of the study
- Schedules of the study
- Involvement of STIG
- Summary

# Introduction of the Investigators

- Dr. Haizhou Liu
  - Education
  - Research background
  - Role in the mercury study



- Mr. Dawit Wodorfa
  - Education
  - Research background
  - Role in the mercury study

# Objectives of the Mercury Study

- Determine the current valence states of the spilled mercury in contaminated soil in SSFL.
- Understand the spatial distribution of valence states of mercury in different areas of SSFL.
- Assess mercury remediation potential and recommend efficient *in situ* mercury remediation technology.

# What are the Valence States of Mercury?

- **Elemental mercury: 0 valence state**
  - One of the three valence states of mercury
  - Silver-color liquid that was traditionally used in thermometers
  - Not the most common form in natural environment
  - Alloy of mercury was used as dental fillings

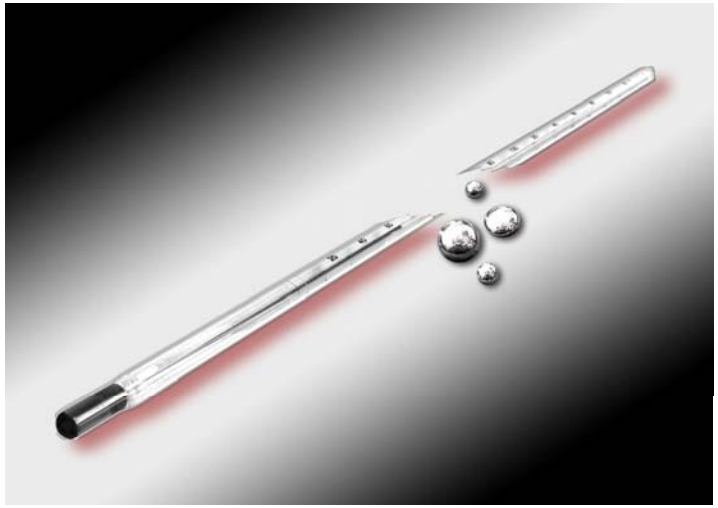


*Image source: Department of Community Health, State of Michigan*

# What are the Valence States of Mercury?

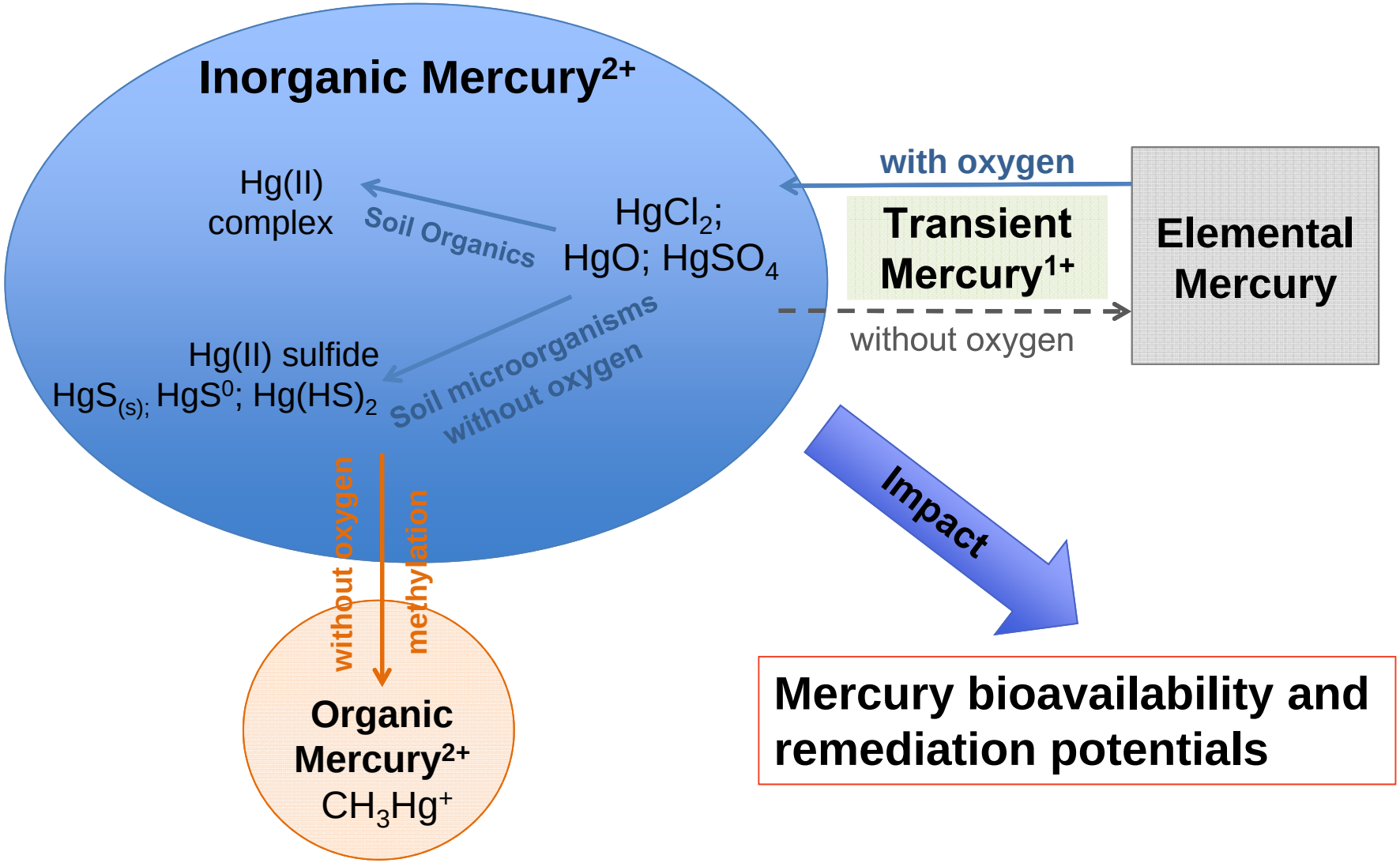
- **Mercury$^{2+}$: +2 valence state**
  - The most common form of mercury in the environment
  - Oxidized from elemental mercury
  - Can combine with other elements or compounds
  - Exists in both “inorganic” and “organic” forms
    - Solubility
    - Toxicity
    - Bioavailability

# What are the Valence States of Mercury?

- **Mercury$^{1+}$: +1 valence state**
  - Transient form of mercury between elemental mercury and mercury$^{2+}$
  - Can form some transient compounds
  - Mercury$^{1+}$ is used as standard electrode to measure solution pH

*Image source: http://www.alibaba.com/product-gs/438181316/YM_06_Saturated_calomel_electrode_Double.html*

# Valence States of Mercury in Soil



# Study Approaches

- **Chemical analyses of valence states of mercury**
  - Identify the methodology
  - Contracted analytical laboratory
  - Mercury speciation of different valence states
  - Analytical methods

# Mercury Analytical Methods

| Form of Mercury | Proposed Analytical Method |
|---|---|
| **Total Mercury** | Cold vapor atomic absorption spectroscopy (EPA method 7471A); Cold vapor atomic fluorescence spectroscopy (EPA method 1613E) |
| **Elemental Mercury** | Modified Cold vapor atomic fluorescence spectroscopy |
| **Mercury$^{2+}$** | Calculated as the difference between total mercury and elemental mercury |
| **Inorganic mercury$^{2+}$** | Sequential extraction to separate different forms of mercury$^{2+}$ |
| **Organic mercury$^{2+}$** | Acidic distillation, aqueous phase extraction and fluorescence detection (EPA method 1630) |

# Study Approaches

- **Collection of soil samples from SSFL**
  - Background sites
  - Selective sites with different levels of mercury contamination
  - Soil samples with different depths
- **Coordination with soil partitioning study**
  - Soil particles with different size fractions
  - Soil sequential extraction analyses
- **Coordination with bio- and phyto-remediation study**
  - Soil chemistry and site information
  - Evaluate mercury remediation potentials

# Schedule of the Study

| Year | 2013 | | | 2014 | | |
|---|---|---|---|---|---|---|
| Task | 2nd quarter | 3rd quarter | 4th quarter | 1st quarter | 2nd quarter | 3rd quarter |
| Literature Review | | | | | | |
| Sampling Plans | | | | | | |
| Field Sampling | | | | | | |
| Laboratory Testing | | | | | | |
| Data Review | | | | | | |
| Draft Report/Internal Review | | | | | | |
| Final Report | | | | | | |
| Additional Sampling Plans | | | | | | |
| Additional Field Sampling | | | | | | |
| Additional Lab. Testing | | | | | | |
| STIG Presentations | | | | | | |

# Involvement of STIG

- Sampling Plan
  - Information on selected sites
- Analytical techniques
  - Information on analyses of different valence states of mercury
- Study progress
  - Preliminary data review
  - Internal review of draft report
  - Final report

# Summary

- **Mercury contamination study**
  - Establish analytical protocol to obtain detailed data on different “forms” of mercury.
  - Quantify the current valence states of mercury in contaminated sites of SSFL.
  - Understand the speciation of mercury, especially mercury$^{2+}$ in soil particles.
  - Provide guidance on effective *in situ* mercury remediation technologies.

# Thank you

# Questions?