Natural Attenuation Soil Treatability Study

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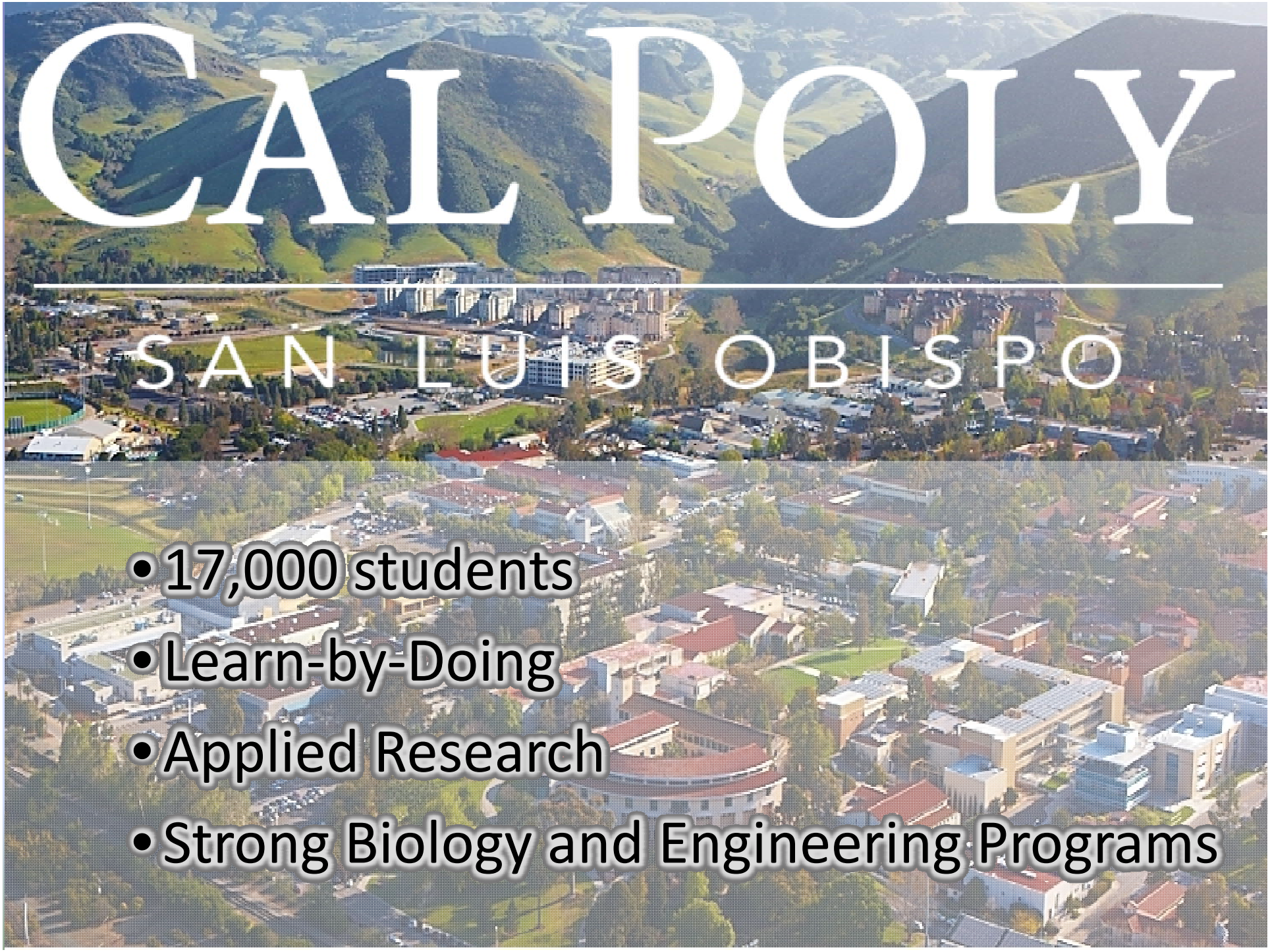
CAL POLY



- 17,000 students
- Learn-by-Doing
- Applied Research
- Strong Biology and Engineering Programs

What is Natural Attenuation?

- Natural processes reducing contaminant concentrations
  - Biodegradation
  - Geochemical processes

Natural Attenuation is not a "do-nothing" approach:

EPA guidelines require providing ***lines of evidence*** for monitored natural attenuation (MNA)

- **Time to remediation**

  Observed decreases in contaminants & prediction models

- **Mechanisms of remediation**
  - Identification of known biodegrading organisms in the field
  - Identification of biodegradation intermediates
  - Laboratory microcosm studies to show that biodegradation occurs under field conditions

- **Long-term monitoring of the site**

Research Questions

- Are the contaminants of concern amenable to natural attenuation based on published studies and data sets from other field sites?
- Is natural attenuation occurring at the SSFL?
- What rates of biodegradation could be expected in the field under natural attenuation conditions?

Research Plan

Phase 1: Literature review to examine feasibility of natural biodegradation of each contaminant

- Contaminants of concern
  - Dioxins
  - Poly-chlorinated biphenyls (PCBs)
  - Polyaromatic hydrocarbons (PAH)
  - Petroleum hydrocarbons (TPH)
- Mechanisms for biodegradation of each contaminant
- Published rates of biodegradation of each contaminant in field studies
- Assess potential for natural attenuation of Area IV soils based on published biodegradation rates for each contaminant

Literature Review Scope

- Biodegradation rates observed in laboratory studies
- Biodegradation rates observed in soils
- Microorganisms mediating biodegradation
- Biodegradation pathways
- Biodegradation intermediates
- Sequestration effects on bioavailability
- Reported feasibility of natural attenuation

Research Plan

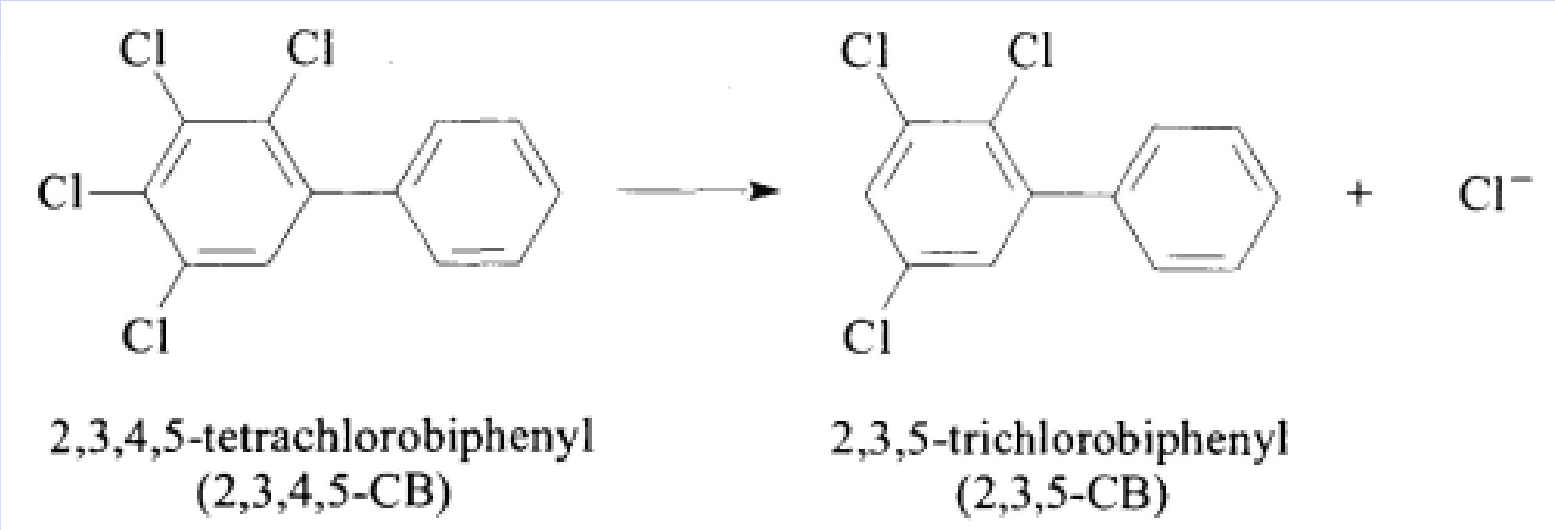
Phase 2: Use data from Bioremediation Study to examine and quantify natural baseline biodegradation rates of contaminants

1. Bioremediation study will identify bacteria and fungi at the site capable of degrading contaminants of concern (PCB, dioxins, PAH, TPH)
2. Bioremediation study includes microcosm experiment to determine biodegradation rates possible in Area IV soils – Controls indicative of natural attenuation
3. Phytoremediation study will also inform
4. →Estimate contaminant natural attenuation rates using control data from laboratory treatability studies.

Biodegradation Mechanisms

Example: Bioremediation of PCBs is often a two-step process:

1. Anaerobic dechlorination



2. Aerobic degradation

Expected Outcomes

Phase 1

Know which contaminants are likely to biodegrade under natural field conditions at Area IV

Phase 2

Model for potential rates of biodegradation of each contaminant in soils at Area IV

Proposed Research Timeline

	TASK	2013			2014			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4
PHASE 1	Introductory presentation to STIG							
	Prepare study plan							
	Submit draft study plan to DOE/DTSC/STIG							
	Present study plan to STIG							
	Submit final study plan to CDM Smith							
	Conduct literature review							
	Draft study report to DOE/DTSC/STIG							
	DTSC review of study results							
	Present draft study report to STIG							
PHASE 2	Receive interim Bio and Phyto. reports							
	Model contaminant loss rates							
	Draft Phase 2 report to DOE/DTSC/STIG							
	Phase 2 presentation to STIG							
	Final report to DOE/DTSC/STIG							

Questions?