



ENVIRONMENTAL REMEDIATION PROGRAM

Environmental and Chemical Metrology Area
Juan Ramón Candia, MSc, Program Director

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**About
Fundacion
Chile**



Fundación Chile is a non-for-profit privately owned corporation. It was created in 1976 by the Chilean Government and ITT Corporation of the United States.



The mission is to increase the competitiveness of human resources and production and service sectors by promoting and developing for the country high impact innovations, technology transfer and management.

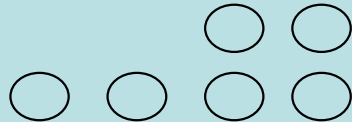
The Organization

Board

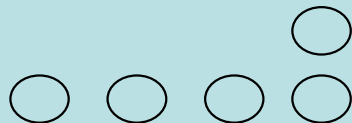
Corporate Management

Technology Centers

Business Units



Companies



- Annual budget MM US\$ 25 (in the Technology Centers)
- 85% of self-financing
- More than 60 companies created
- 500 Chilean professionals (Santiago, Concepción, Puerto Montt)
- Leadership in Latin America

Technology Centers

Agribusiness

Marine Resources

**Sustainable Forestry, Industry
and Tourism**

**Environment and Chemical
Metrology**

**Human Resources and
Information Technology**



Technology Transfer Mechanisms

**Joint ventures to create
new innovative companies**

**Sale and Licensing of
technologies**

**Dissemination of
Knowledge and Training**

Technological Services

In searching for market opportunities, Fundación Chile develops applied research that leads to innovation in products and processes.

The following are some historical examples of its business:

- Creation of two salmon farming companies that pioneered the industry's boom in the country
- Development of the technological concept of vacuum-packed beef, introducing centralized slaughtering and later sale of the boxed meat.
- Quality control and certification of export fruit.
- Introduction of berry crops in Chile.
- Creation of technology transfer groups in Chile's forestry sector.





**About the
Environmental
Area**

The Area aims to provide management solutions and alternative technologies for productive sectors as well as to guarantee the traceability and comparability of chemical measurements, in order to reduce environmental impacts and improve productivity and competitiveness.

The Environmental Area at Fundación Chile (formerly INTEC) has more than 20 years of experience working to improve the environmental conditions of Chilean companies and the country by carrying out high impact projects. During these years the Area has worked on a variety of productive sectors, including mining, agroindustry, manufacturing, tanneries, etc. This Area created and hosted for several years the National Cleaner Production Center.

- **Center for Cleaner Production: C+P audits and implementation plans. Improving industrial processes and clean technologies. C+P Training Programs for companies and consultants.**
- **Environmental Technologies: Assessment and recycling of industrial wastes. Adaptation and development of innovative and cost-efficient treatments for wastewater, which contains persistent or obstinate organic compounds, heavy metals, etc.**
- **Environmental Remediation: Identification, evaluation and management of the risks in contaminated sites. Plans and remediation technologies for sites contaminated by hydrocarbons.**
- **Sustainable Development: Energy efficiency, energy assessment of wastes and use of renewable energies. Development of projects involving the sale of carbon credits.**
- **Chemical Metrology Center: Quality assurance of testing laboratories and company laboratories following ISO Guide 17025. Inter-comparison trials and reference materials for water and wastewater analysis, with traceability to the NIST-USA.**

To adapt and develop methodologies, tools and remediation technologies for contaminated sites, in order to decrease health risks and reduce the environmental passive, focusing on mining, hydrocarbons, forestry and chemical industry



About the
Contaminated
Sites Issue







- Mining
- Forestry
- Fishing
- Aquaculture
- Agroindustry
- Manufacturing



What are contaminated sites
Where are they
How do we identify them
How do we measure de risk involved
How do we solve the problem
Where do we start



Defining the Problem

IDENTIFICATION	Inventory	PCS
INVESTIGATION	Historical study Preliminary investigation Detailed investigation	SCS CS
INTERVENTION	Remediation Monitoring Control	Problem under control

Identifying the Problem



Toxic Chemicals



Toxic Chemicals



Toxic Chemicals



Toxic Chemicals

Identifying the Problem



Mining Activities



Mining Activities



Mining Activities



Mining Activities

Identifying the Problem



Mining Activities



Mining Activities



Mining Activities



Mining Activities

Identifying the Problem



Industrial Activities



Industrial Activities



Industrial Activities



Industrial Activities

Identifying the Problem



Industrial Activities



Industrial Activities



Industrial Activities

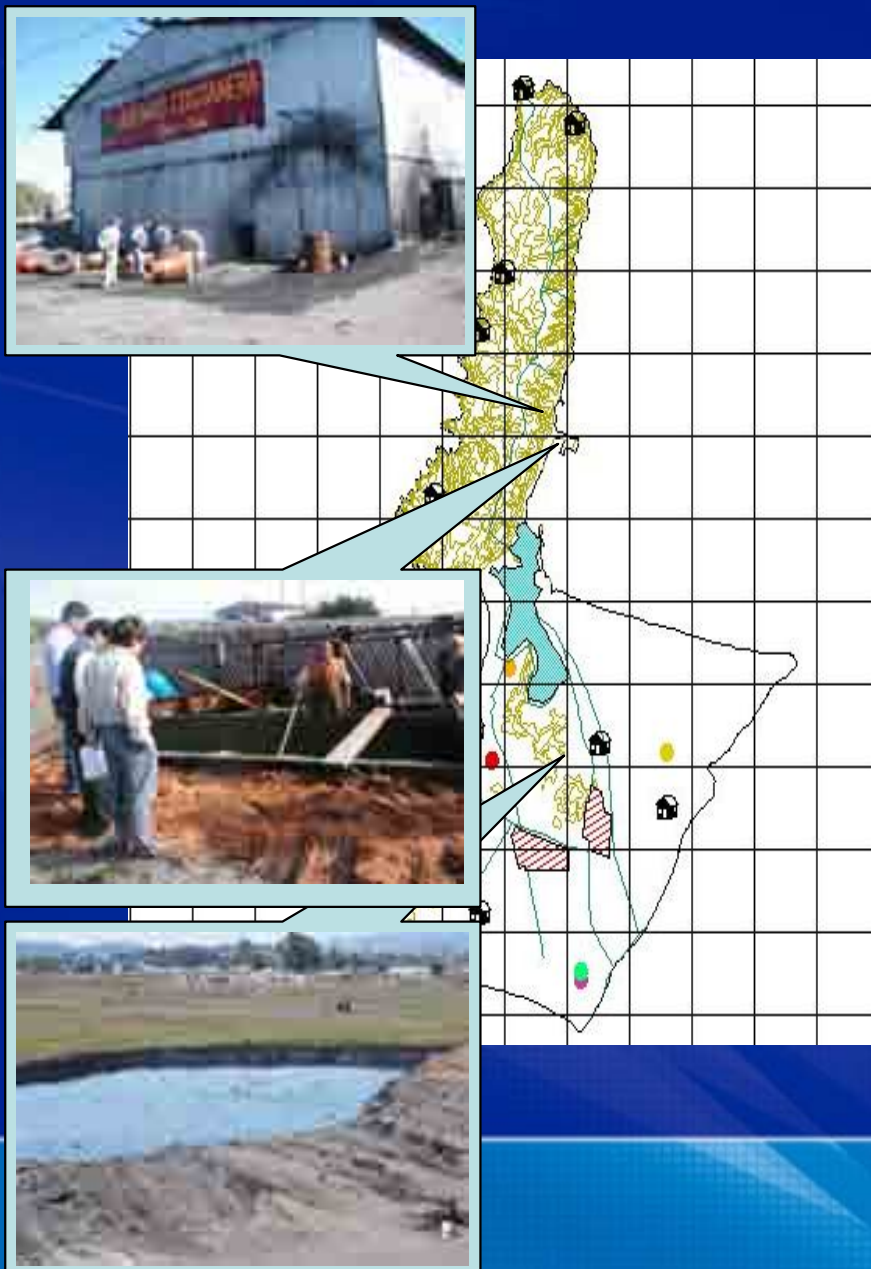


Industrial Activities

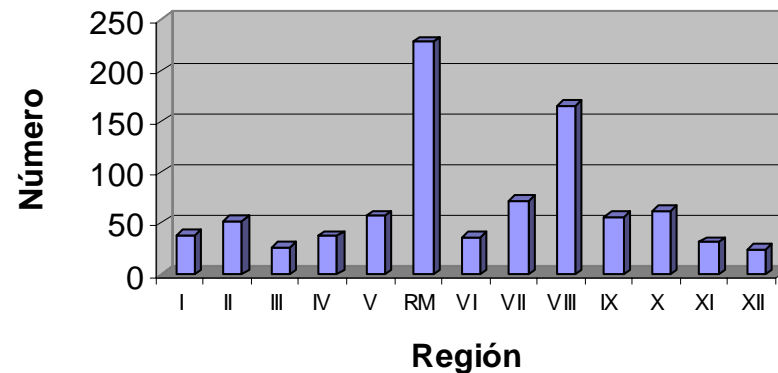


**About the
Programme**

Identifying the Problem



Sitios con Potencial Presencia de COP's



FICHA DE INSPECCIÓN DEL ÁREA

ID	Ficha Nº	Fecha de inspección	Nombre del sitio
10106	5	21-10-2003	FORESTAL NN
Actividad	Región	Comuna	
Aserrado y acepilladura de madera	VIII	Talcahuano	
Dirección	JAIME REPULLO 496 Y 531		
Contacto: Nombre	Contacto: Dirección		
ERICK TARP-HANSEN GYDESEN			
Contacto: Cargo	Contacto: Telefono/Fax	Contacto: email	
	111111111	NN@CTCINTERNET.CL	
UTM (x)	UTM (y)	UTM Datum	¿SITIO VISITADO?
671388	5929768	PSAD 56	SI

Fuente

Transporte

Receptores

Evaluating the Problem



Evaluación de Riesgos



Evaluación de Riesgos



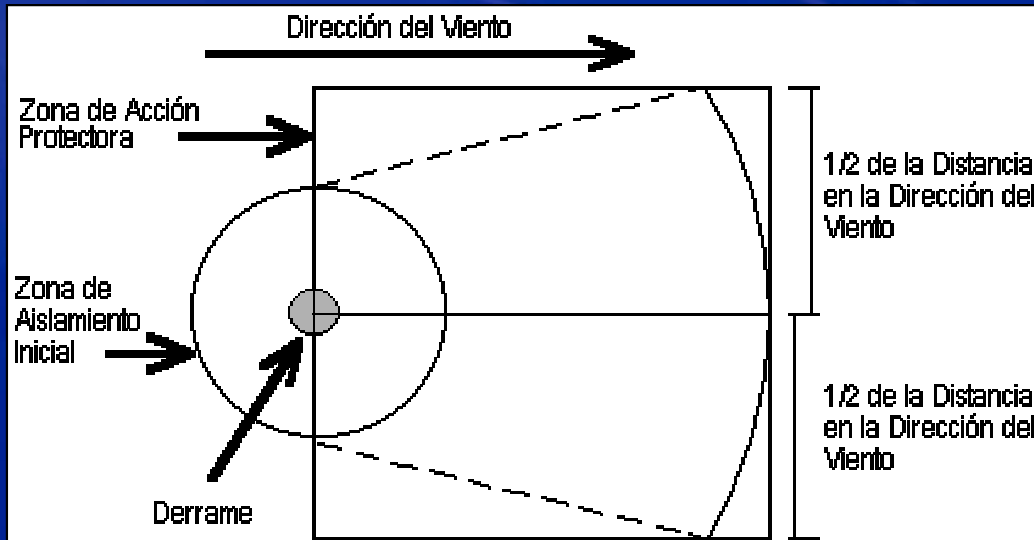
Evaluating the Problem



Metal	Concentration (ppm)
Arsenic	2
Copper	848
Chrome	1,1
Niquel	1,3
Lead	76
Talio	9
Zinc	212

Determinación de un Plan de Muestreo:

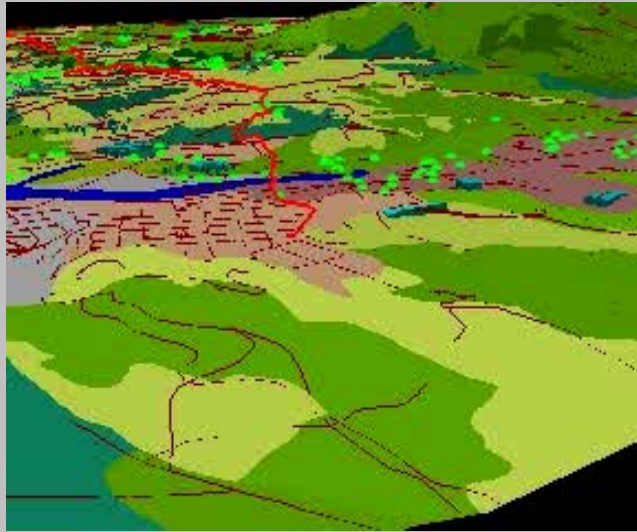
- Presupuesto: US\$5.000
- Análisis de congéneres de dioxina y furano más tóxico: dioxina 2,3,7,8-TCDD (Seveso) y el furano 2,3,7,8-TCDF
- Toma de muestras compuestas: matriz suelo superficial interior recinto industrial y polvo de filtro de mangas.



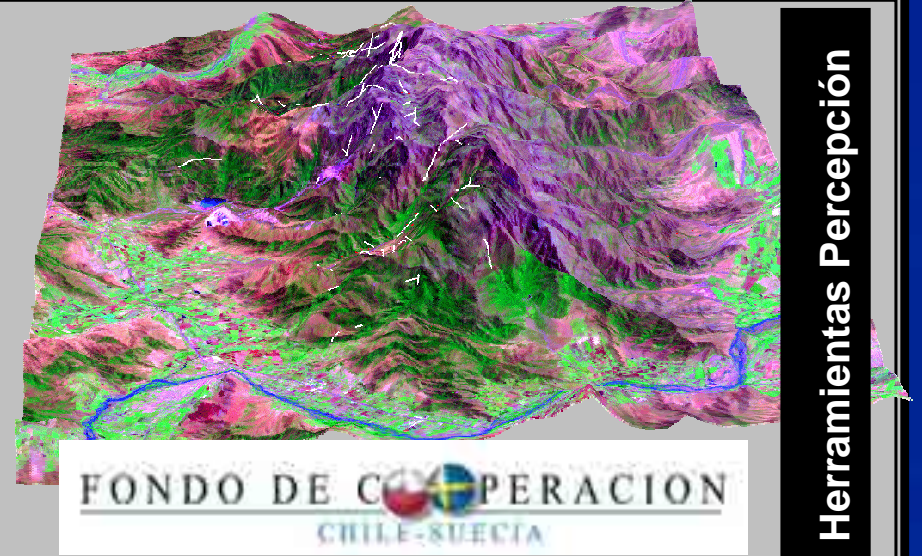
Remediating the Problem



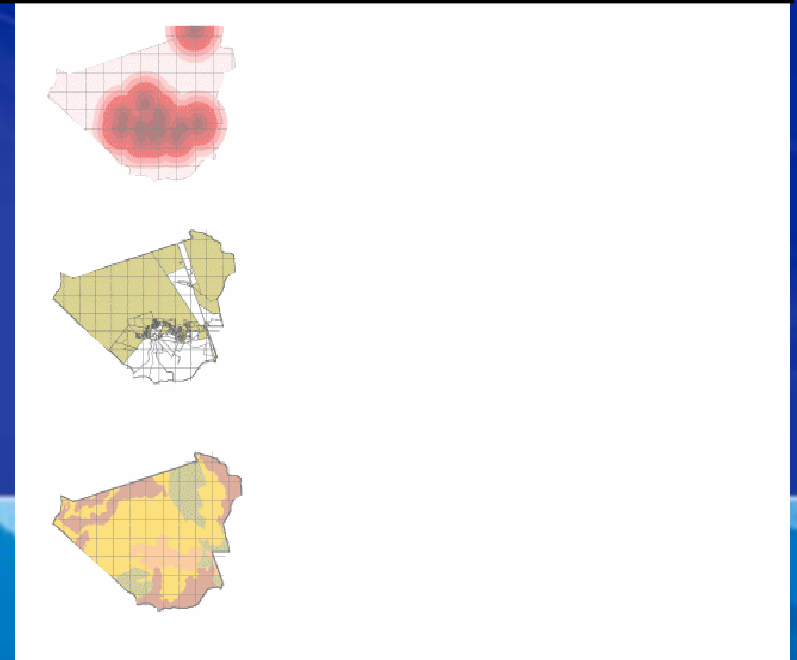
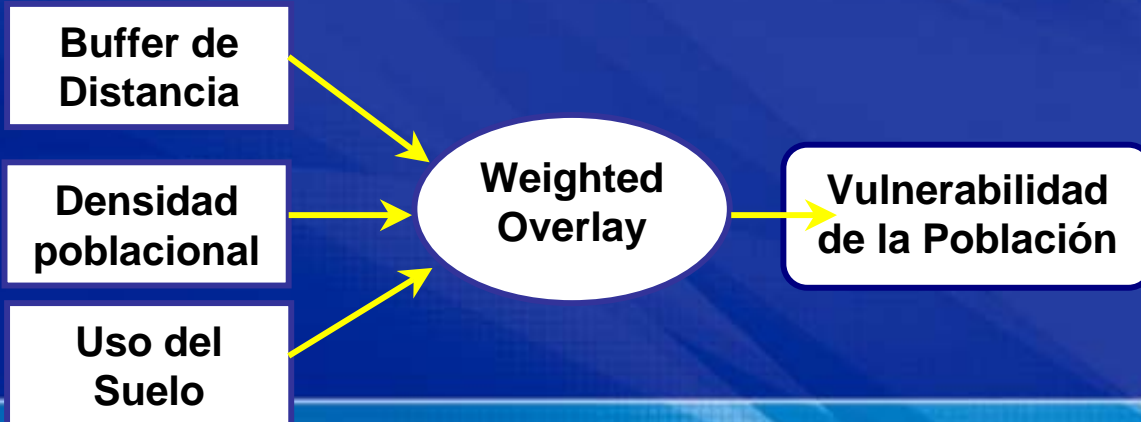
Support Tools

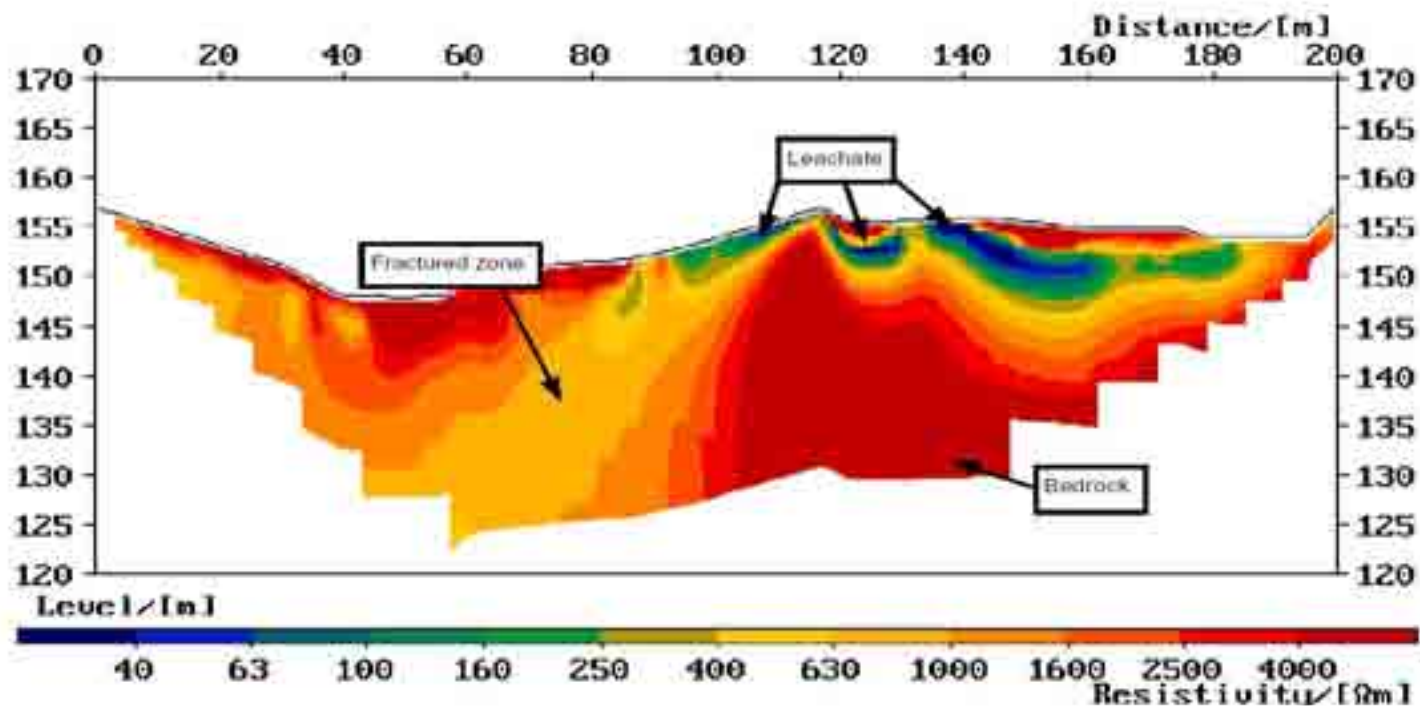


Mapas de Vulnerabilidad



Herramientas Percepción





Development of a toolkit for evaluating environmental risks associated to mining sites

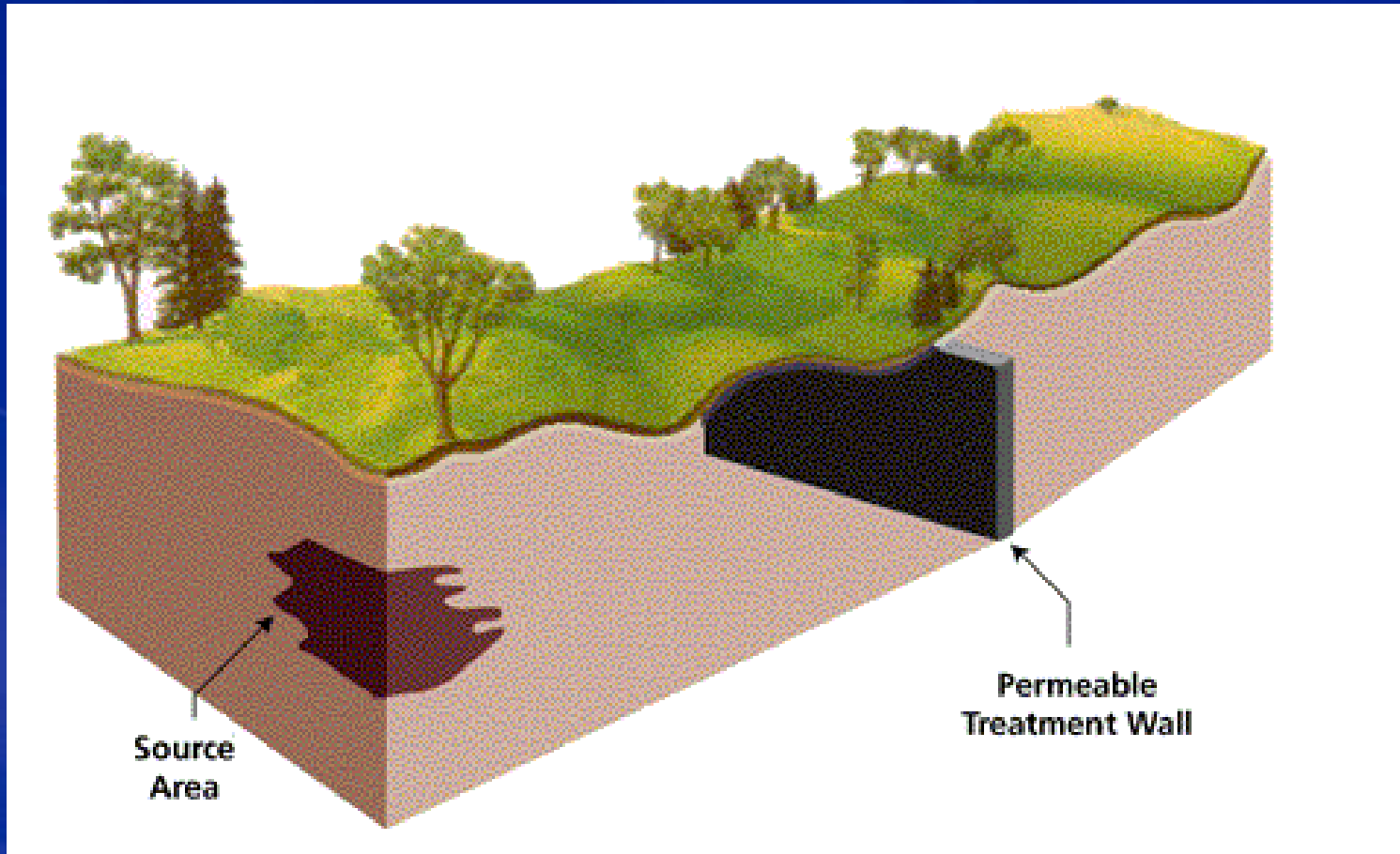


Desarrollo de un paquete tecnológico para la evaluación de riesgos ambientales de tranques de relave

Geofísica, Procesamiento de Imágenes Satelitales, Caracterización, Geotécnica, Modelación Hidrogeológica, Análisis de Muestras, Evaluación de Riesgo

1. Visión integral costo-eficiente del desempeño ambiental de la empresa minera.
2. Evaluación integrada del riesgo asociado a un tranque de relave empleando una metodología reconocida por las autoridades (Conama).
3. Identificación temprana de un potencial problema (prevención y ahorro futuro para la empresa).
4. Propuesta costo-eficiente de Plan de Cierre y Rehabilitación, Control y Monitoreo del tranque de relave que cumpla con lo establecido por las normativas actuales y futuras.
5. Permite caracterizar mineralógicamente las muestras obtenidas para evaluar el aprovechamiento de otros subproductos minerales contenidos en el tranque de relave.
6. Permite optimizar la ubicación de pozos de monitoreo y disminuir los costos asociados a las perforaciones.
7. Disminuir el riesgo futuro de generar impactos al medio ambiente.

PRB Project



Pilot project for treatment of metal contamination (mining site)



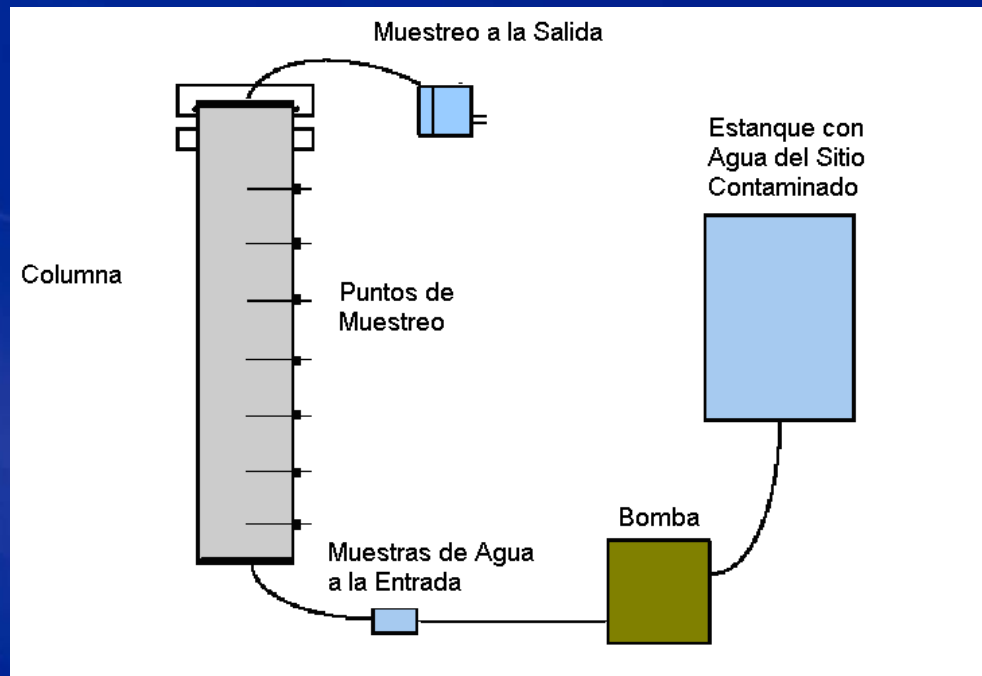
18 months project
Led by Fundacion Chile
Local and Int'l partners



Three Stages:

- 1) Site selection, site characterization, laboratory studies
- 2) Implementation of a pilot PRB, designing, monitoring, evaluation
- 3) Conforming a service to suit local needs

The PRB Project



Laboratory testing of four materials:

Modified Zeolites

Iron

Others materials

Zeolites can be modified on their surfaces in order to attain new properties. Chemical bonding of coordinating organic groups is the approach to obtain modified zeolites that are able to absorb heavy metals.

The organic groups are:

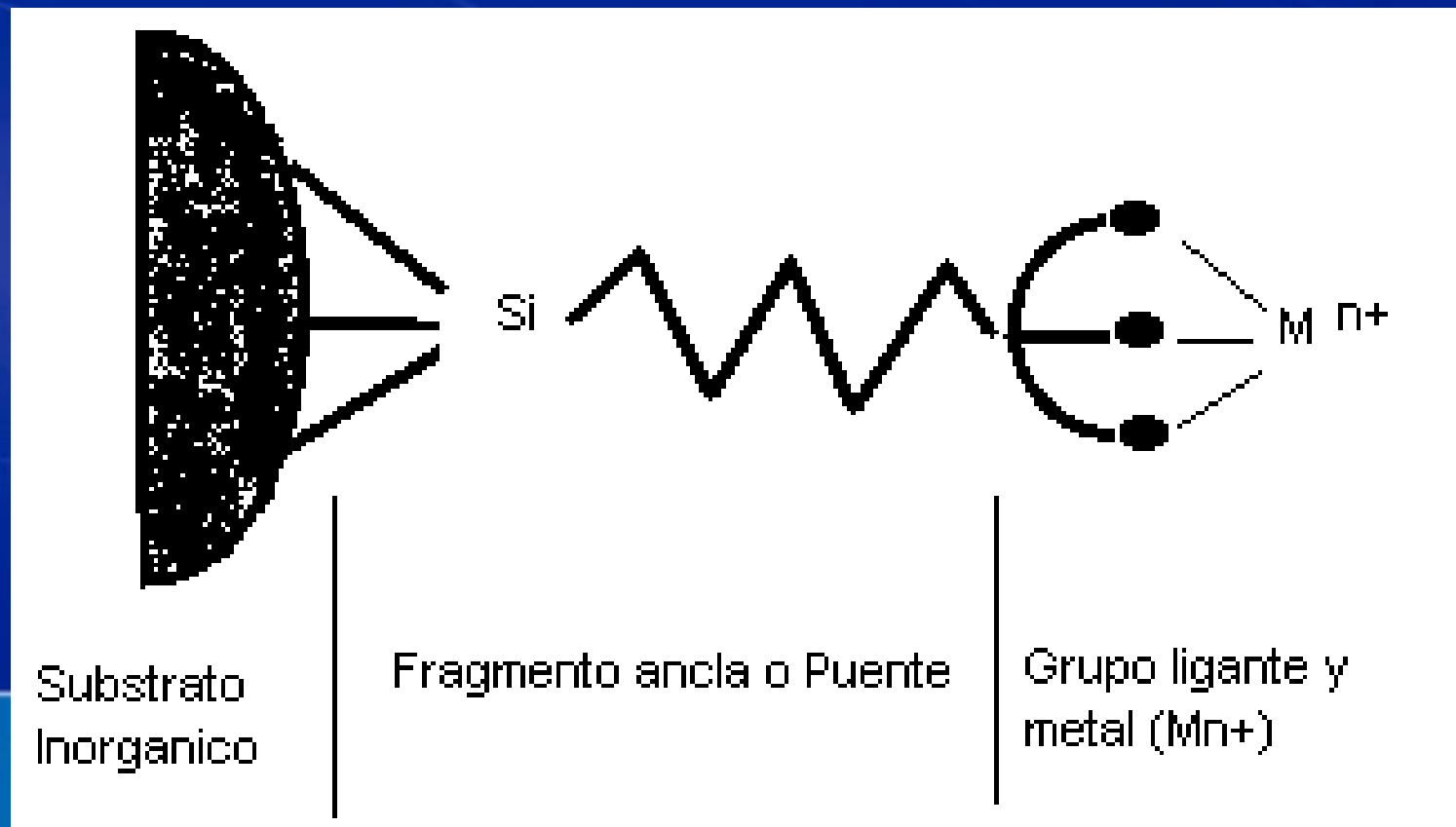
Thiol

Thiouronium

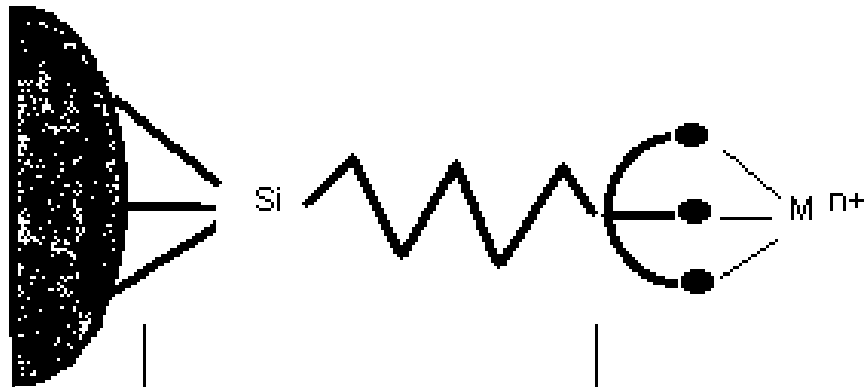
Amino

Iminodiacetate

The modified zeolites contain the substrate, natural zeolite; the anchoring organic fragment and the coordinating group, which are showed below:



Specificity of the coordinating groups



Substrato
Inorganico

Fragmento ancla o Puente

Grupo ligante y
metal (Mn+)

***Coordinating
groups***

Iminodiacetate, amino
Cu, Ni, Al, Fe, Zn

Thiouronium ***Pt, Pd, Rh, Ru***

Thiol ***Pb, Cd, Se***

IRON COVERED ZEOLITES

Zeolites covered with elemental iron are able to reduce arsenite and arsenate to elemental arsenic, which is immobilized by insolubility.

Degradation of Organic Halides by Elemental Iron

Redox potentials at pH = 7



Example

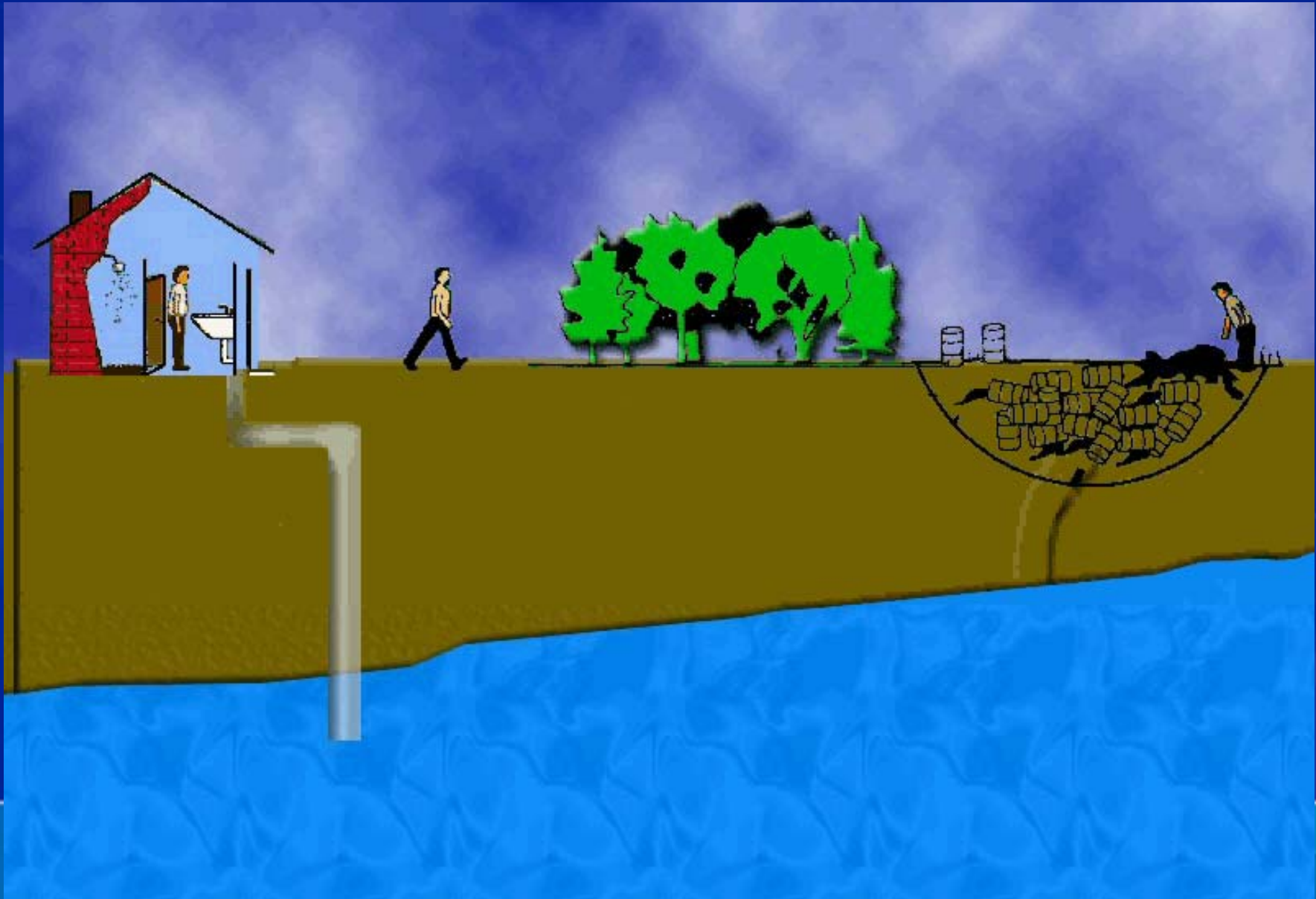




Evaluating health risks associated to mining sites potentially contaminated with mercury

- **Technological Services and Specialized Technical Assistance on:** risk evaluation, modelling of contaminants, adaptation of remediation technologies, monitoring of contaminated sites.
- **Public Interest Projects:** site identification, support policy development & regulation.
- **Training**

The Remediation Program



What have we done so far

- Develop and Propose a methodology for site identification and risk evaluation
- Building up a National Registry of POPs potentially contaminated sites
- Development of sensitivity maps for a petroleum company (pipeline)
- Evaluation and Removal of hazardous waste in an community area contaminated with asbestos
- Risk evaluations
- Sites preliminary inspections & Feasibility studies for site remediation
- Training of environmental agencies and private companies

What are we up to now



- Use of geophysics for detection of underground contamination
- Identification and prioritization of PCS in Fifth Region
- Evaluation of potentially mercury contaminated sites (IV R.)
- Adaptation and Pilot application of PRB
- Identification, evaluation and proposing measures for POP's contaminated sites, including a National Implementation Plan
- Application of advance oxidation for HC contaminated sites
- Potential conflict between agriculture products and mining activities
- RE of pentachlorophenol on the environment (VII R.)
- Phytoremediation of mining areas
- Organizing an Action Team on groundwater contamination

National & Int'l Partners

International

C&E

ECOREG

Texas University

Swedish Env. Ins.

SWECO

Environmental
Group

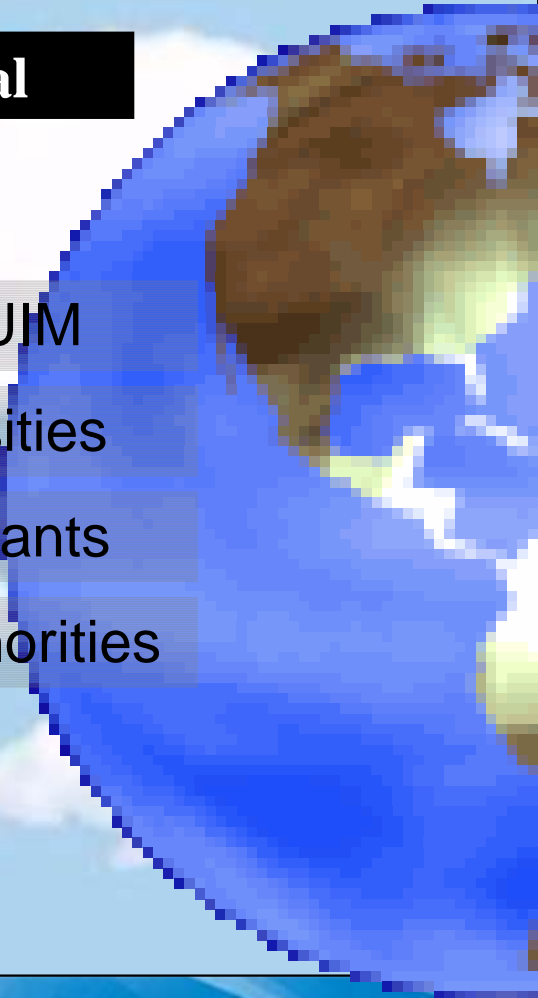
National

OXIQUIM

Universities

Consultants

Env. Authorities





END

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