

"Preservation and ecological restoration in tropical mining environment" : Technical, scientific and strategic perspectives.

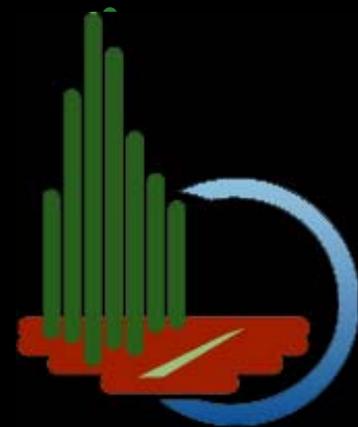
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Institut de recherche
pour le développement



July 2003
Noumea
New-Caledonia





Syndicat
des
Industries
de la Mine



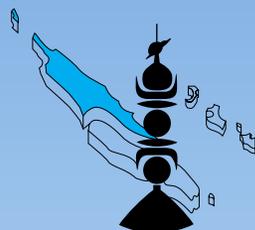
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This Meeting : Why?

Distribution of Ultramafic Rocks in New Caledonia



"Pirogue" River





Ore

Economy

- Annual Production : **100 000** tons metal nickel : **7% GNP**
- Future production: **200 000** tons
- Hydrometallurgy (Goro) + Pyrometallurgy (Koniambo, Doniambo)



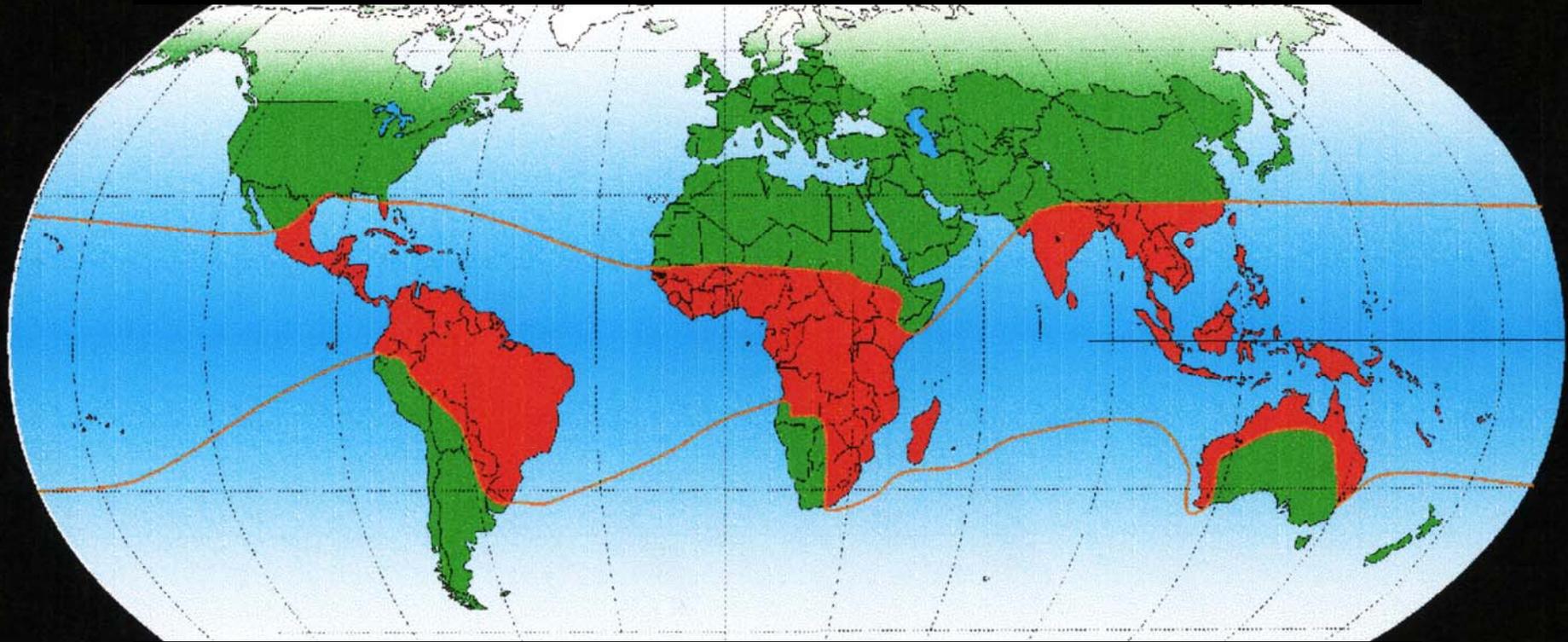
Biodiversity



New Caledonia is therefore a natural lab to study the issues from the mining activity in a very sensitive environment



Lateritic soils of the World



Awareness

- International awareness on **sustainable development** problems reaching beyond the scope of sustainable resources
- This concerns public authorities, mining operators, private consultants and research organisations
- **Precautionary principle**
- Rights to the environment



Sustainable Mining

- Reconstruct the **landscape**
- To Preserve and to Restore **biodiversity**
- Control surface runoff and erosion



Summary of the main results

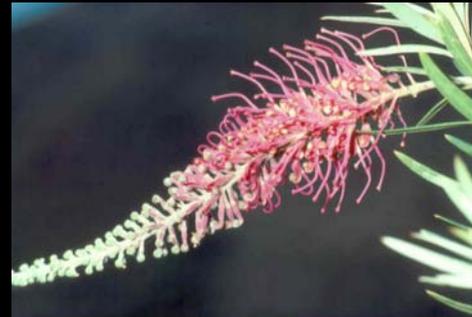


- A meeting on ecological restoration had to give **a central place to the flora**
- The plant is not an autonomous organism. It is unthinkable of, without **its environment**.
- It is therefore necessary to take into account at least 3 essential factors simultaneously:
 - The **Plant** within its ecosystem
 - **Water**, its quality and its paths
 - The **Human Societies**



The plant

- An extraordinary biodiversity and a **remarkable endemism** (80% endemism on ultramafic soils in New Caledonia)
Necessity to conserve this biodiversity by setting up **protected areas and conservatories**
- Great adaptation to the **environmental constraints**, of which metal toxicity
Necessity to understand the adaptation mechanisms through fundamental scientific research



Soil microorganisms and the invertebrates

- **Essential role** of microorganisms (free, symbiotic or linked) in the tropical mining environment

They participate to the plant adaptation to the specific environmental constraints

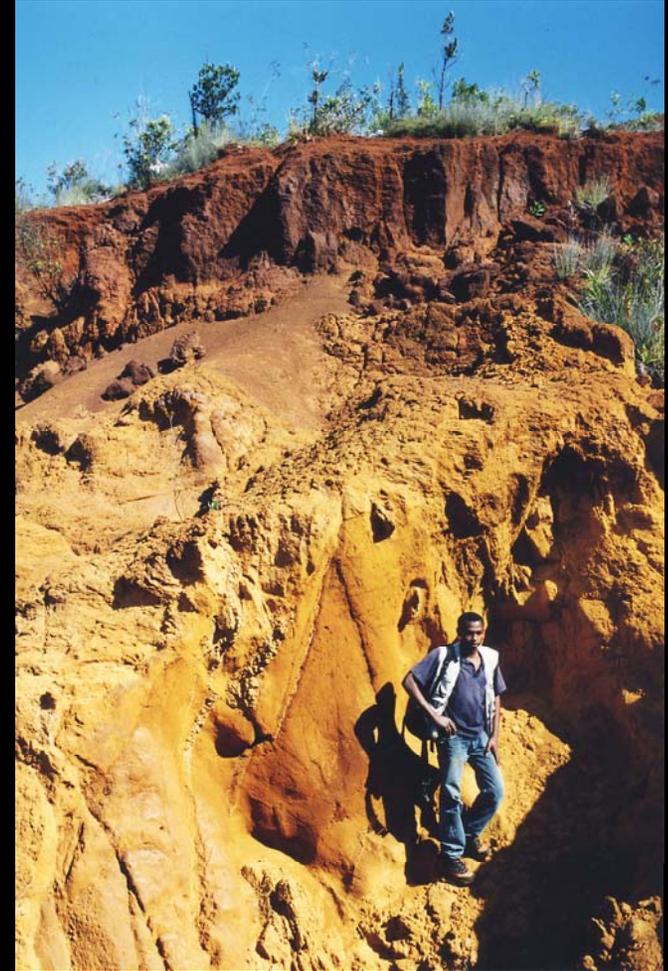
In particular mycorrhizae form a key group favouring **stress resistance**

- The **invertebrates** and particularly insects are important actors in these ecosystems. In New Caledonia, except for ants, this aspect should be developed



Soil functioning

- The soil is a **biogeochemical reactor** which controls the future and availability of metallic elements (solubility, immobility, transfers) by interactions between minerals, amorphous phases, microorganisms, roots and organic matter
- Importance of **the surface horizon** "top soil" which constitutes an organic matter, nutrient, seed and microorganism pool



Water management

- Three hydrodynamic media
 - Fractured medium (ultramafic rocks)
 - Fractured to porous medium (regolith)
 - Porous medium (top soils)
- The **connexion** and **circulation** conditions must be studied
- **Water quality** is not well known from the pore scale to the exploitation site scale (speciation, reactivity...)
- The study of old mine sites and rehabilitation trials give a guide for future proposals



Human Societies

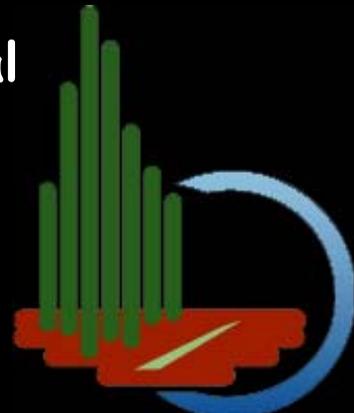
- **Humans societies** being at the centre of ecosystems, **sustainable development** must take into account the parallel growth of these communities
- Even if the local populations see the **economic development** very favourably they need to understand the impact of mining activity on there change in life style, the **communication effort** must therefore take into account the local cultures and customs.



From these results **practical scientific and strategic recommendations** have been formulated by the conference committee composed of mining operators, public research organisation and public bodies

Practical Recommendations

- Create a **legislation** setting exploitation standards
- Use a range of native species
- Preserve **"islands"** representative of the biodiversity within the mined sites (seed source, reference ecosystem)
- Create seed **orchards**
- Preserve and manage **top soils**: stocking conditions, conservation of biological potential
- Manage **fertility**: organic matter and symbiotic microorganisms
- Set up **technical data cards** for each eligible plant species for the industries
- Install a network to monitor **water quality**
- Allow **hydrological instalments** to mitigate environmental effects



Scientific Recommendations

The plant :

- Study species **phenology and physiology** (fruiting, pollen and seed dissemination, germination, mechanisms of metal resistance)
- Study the **population dynamics** of restored and natural protected sites (gene flux, genetic structure)
- Validate evolution **indicators** of dynamic recolonisation
- Enhance the plantation/sowing processes



Scientific Recommendations (2)

The soil :

- Study the **weathering/erosion** processes at the ecosystem scale (comparison of natural and perturbed environments)
- Study the **metal speciation** at the soil/plant/water interfaces (role of the organic matter and microorganisms)
- Characterise the **biological potential** of soils (seeds, fauna, symbiotic microorganisms)
- Experiment to optimise the topsoil management
- Look for **indicators** of soil evolution



Scientific Recommendations (3)

Water :

- Understand the **hydrodynamic conditions** of mine sites and the evolution of the effluents
- Acquire bio-physicochemical data enabling **water quality control**
- Look for **indicators** of water quality



Scientific Recommendations (4)

Human sciences:

- Study the socio-economic and cultural impacts of the mining projects : consequences on **local development**
- Undertake **ecotoxicology studies** on the food chains
- Database used as a reference for the elaboration of specific **regulation standards**



Strategic Recommendations



- Display this theme as a **priority** for the scientific organisations, in **partnership** with the local authorities, the private consultants and the mining companies.
- Focus the research on **specific workshops**, integrating the entire mining ecosystem in a multidisciplinary approach and at different scales.
- **Coordinate and structure** the research in New Caledonia in a local, regional and international setting.

Strategic Recommendations (2)

- Reinforce the training, emphasizing on a **professional training** interface with industry
- Create **botanical conservatories**
- Create **workshops** bringing together public institutions and private companies on specific questions
- **Perpetuate** this meeting on a period of **3 years**





Announcement



The next meeting will be held in **Perth Australia** in
2006

Cœur de Voh, Nouvelle-Calédonie, France. (S 20°57' E 164°41').

