

# Mine environment in NC



## 1 - SLN : Bernard PELLETIER

Mine and Environment : Historical account, new mining methods and revegetation



## 2 - IRD : Tanguy JAFFRÉ

Botanical characteristics of New Caledonia : Constraints for mining, opportunity for restoration.



## 3 - SIRAS Pacifique : Sophie LUÇON

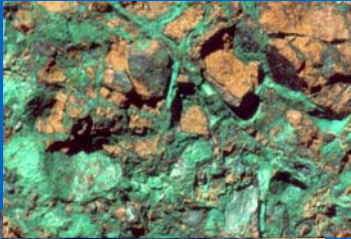
Industrial revegetation development in New Caledonia





# Mine and environment

B.Pelletier



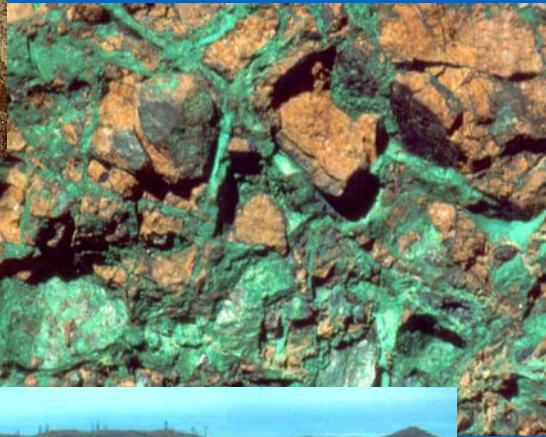
- Historical account
- Mining with a low impact on environment : new methods.
- Revegetation.
- Preservation of the New Caledonia plant biodiversity.



J. Garnier

# Before 1975

Garnierite : Ni-Mg silicates

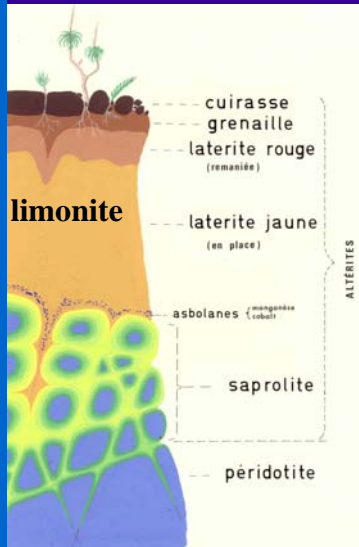


- From 1875 to 1975, nickel miners worked without concern for the environment.
- Before 1950, mining was mainly unmechanized, so, impact of mines on environment was moderate.





# From 1945 to 1975



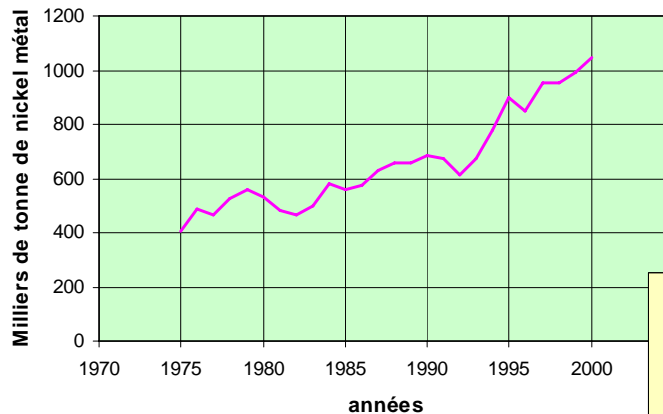
Thio, 1952



- At the end of World War II, the presence of the US army in NC helped mechanization which was necessary to mine saprolitic ores found under limonitic (lateritic) overburden and to increase the ore production from 0,2 Mth in 1950 to 1,8 Mth in 1957.

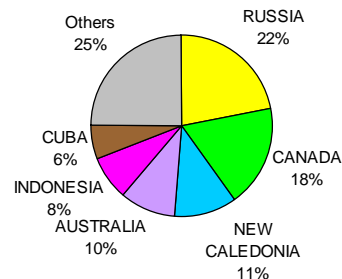
# New Caledonia in the World : 3rd nickel producer

Consommation annuelle mondiale de nickel

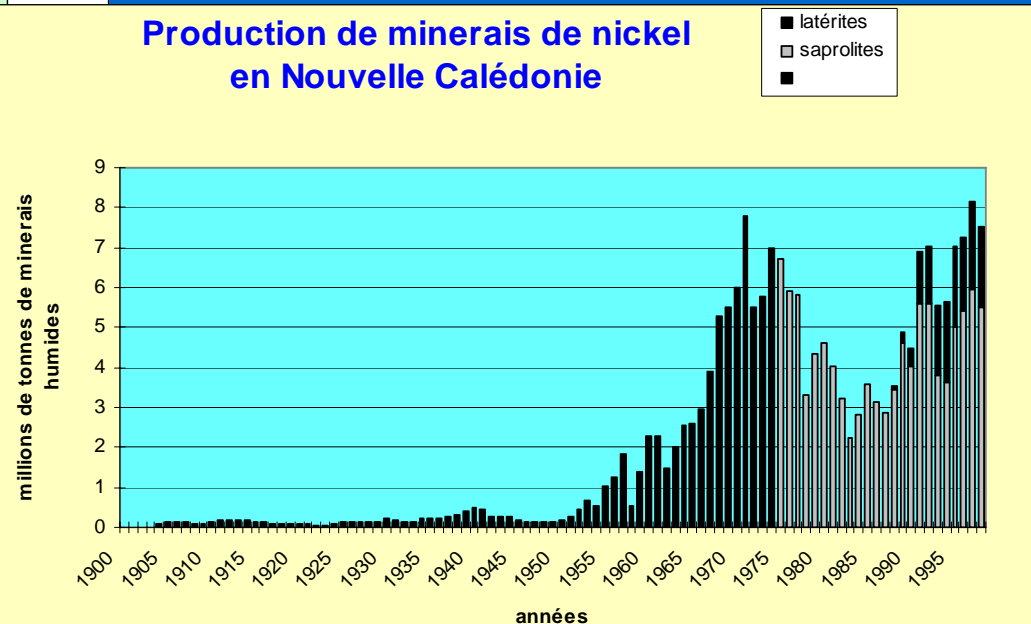


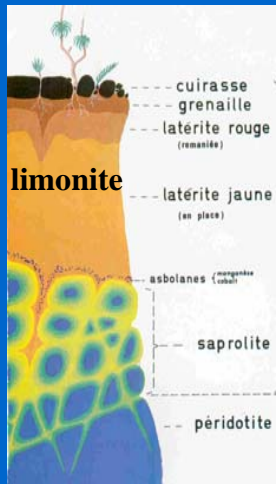
- Main use : stainless steels
- Nickel world consumption is now above 1 Mt per year

Nickel world mining production :  
1064 kt (1999)

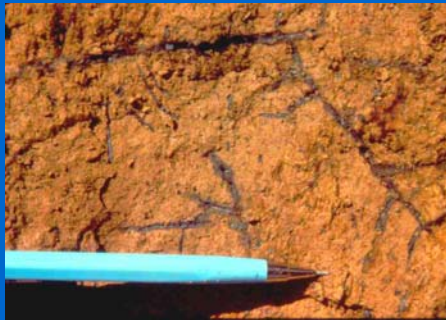


Production de minerais de nickel  
en Nouvelle Calédonie





# Waste materials from NC nickel mines



Limonites (laterites) are essentially iron oxy-hydroxydes (limonite-ferrihydrite, goethite)

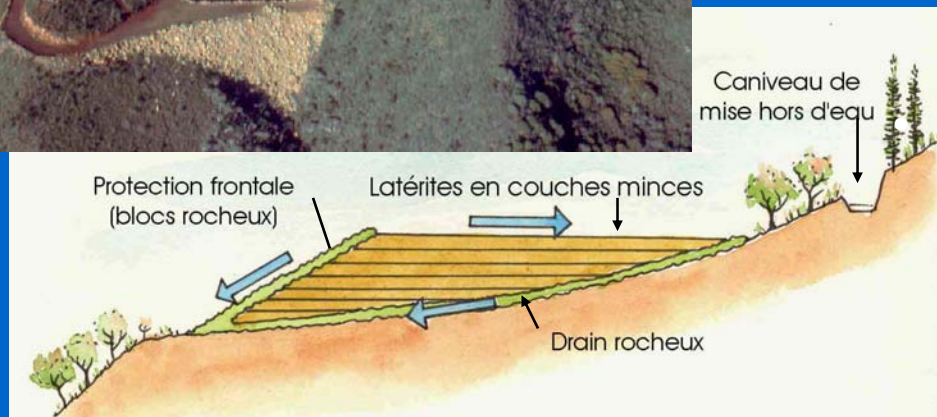
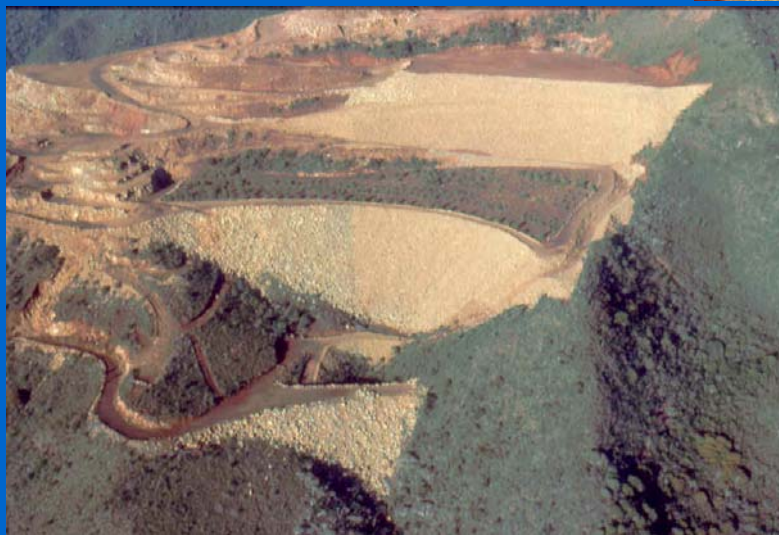


Saprolites are constituted of silicates (serpentine, clay minerals) and ferric oxy-hydroxydes mainly amorphous

- Unlike wastes produced by mining and processing of sulphide ores, wastes from New Caledonia nickel mines are chemically stable because they are soil constituents.



# Since 1975



Mining methods  
designed and  
implemented by SLN

- 1 - Limonite (laterite)  
waste dumps.
- Now used by all mining  
companies in NC.

Since 1975, about 300 Mth of  
waste materials (mainly limonitic  
overburden) have been safely  
stored on all mine sites, in New  
Caledonia.

# New mining methods



- 2 - Mining with a permanent natural berm to preserve the original slope vegetation below mines.



# New mining methods



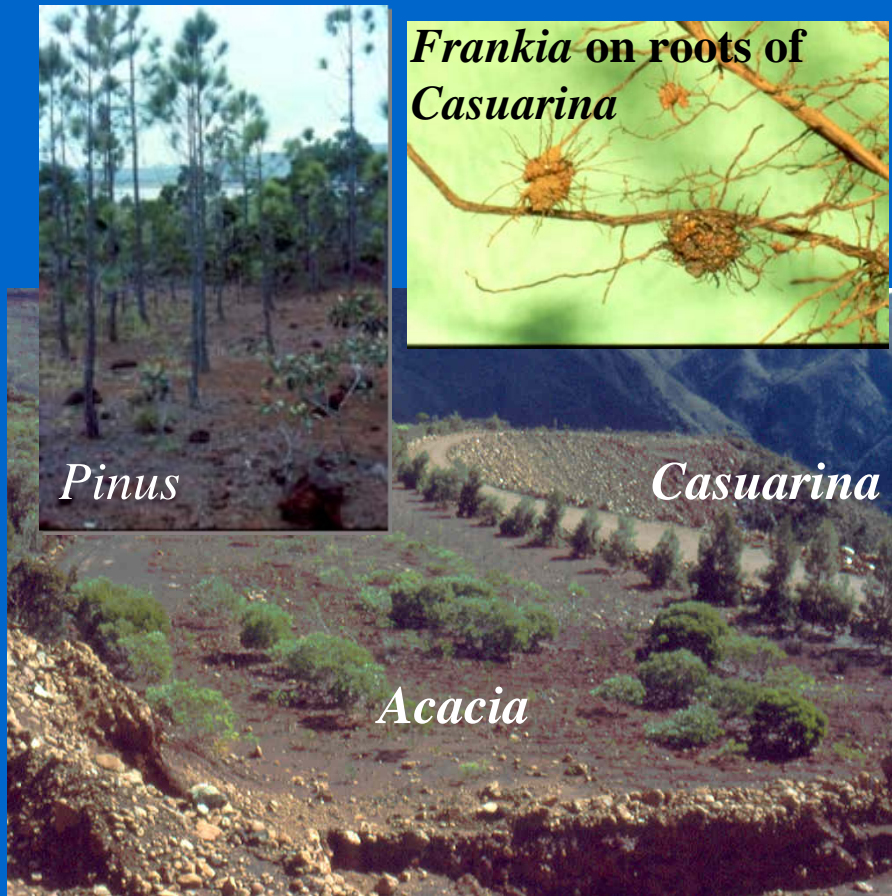
- 3 - Opening access roads with showels and trucks : removing material to prevent slope degradation.
- 4 - Water management (ditches, settling zones)

# New mining methods



- 5 - Drilling with light rigs carried by helicopter for grassroot (greenfield) exploration, since 1988, with helicopters Ecureuil

# Revegetation in the 70 's



- 1 - Experimental plantations with *Pinus caribea*
- 2 - CTFT (CIRAD) carried out several tests
- 3 - Preliminary **ORSTOM** studies : 1974-76 (1st Contract SLN-ORSTOM)

**2 convenient local ligneous species : *Acacia spirorbis* and *Casuarina collina* are living with symbiotic bacterias fixing nitrogen**



# Revegetation : 1987-88

- Analysis of revegetation strategies :
  - 1 - Surface improvement
  - 2 - Use of « top soil »
  - 3 - Local and pioneer plant species

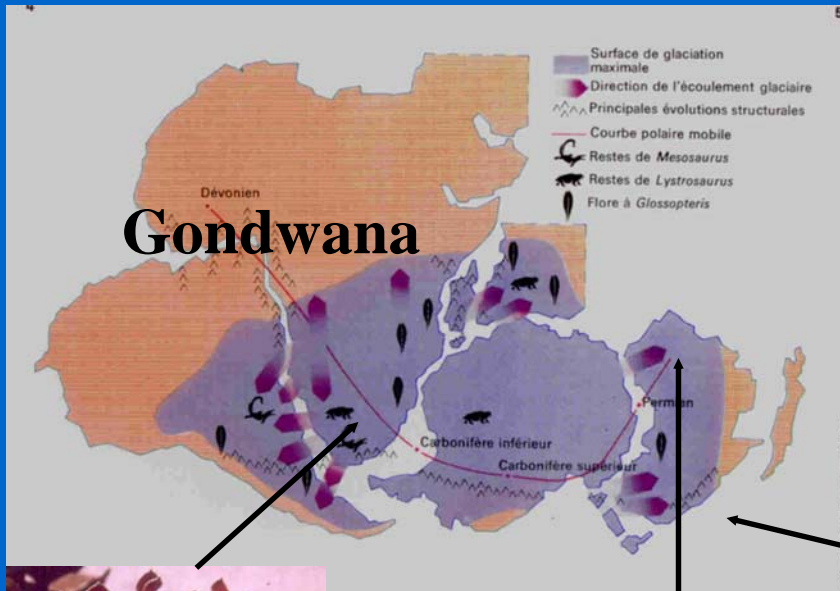


Alluvions / Limonite



*Grevillea gillivrayi*, Protéacées

# Originality of the NC flora



- NC flora has a gondwanian origin
- **75 % of endemic plant species** (Insularity since 60 à 80 M years)
- 3300 plant species in NC

Repartition of some Proteaceas



*Protea* : Africa

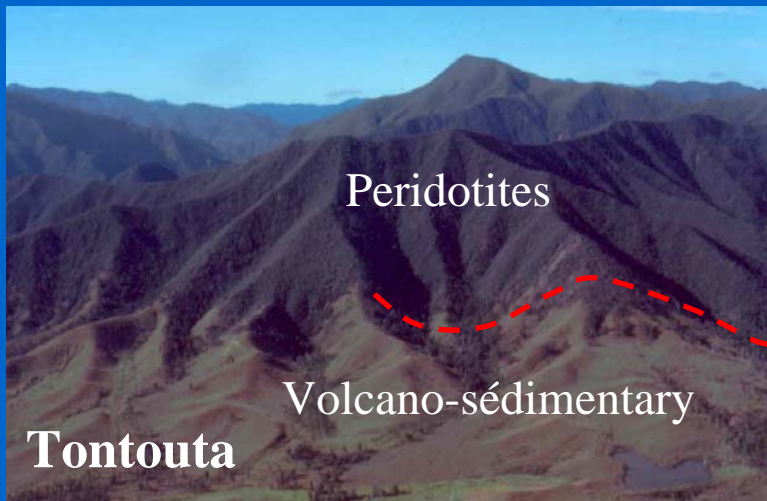


*Banksia* : Australia



*Grevillea* : New Caledonia

# Flora specificity on peridotites



- Formation of ultramafic massives (peridotites) occurred 37 M years ago
- Weathering of peridotites have given soils with Fe, Mg, Ni, Co, Mn, Cr,...
- The flora adapted, with more than 1000 plant species developing.



# Revegetation : 1987-88

- Revegetation methods
  - 1 - **Plantations** : local temporary employment. Méthod used in NC since the 70 's.
  - 2 - **Hydroseeding** : possibilities of seeding on steep slopes. SLN mid-term objective.



# Revegetation : 1988-91

- 2nd SLN-ORSTOM contract for 3 years (1988-91)
  - 1 - Local pioneer plant inventory : 67 species.

*Costularia comosa*



**5 endemic Cyperaceas  
species**



*Grevillea exul*

**62 ligneous species, most of  
them endemic**

# Revegetation : 1988-91

- 2nd SLN-ORSTOM contract for 3 years (1988-91)
  - 2 - Study of the local pioneer plant species reproduction : 40 species can be grown in nurseries, 35 from seeds and/or 15 by cuttings.





# Revegetation : 1991-94

- 3rd SLN-ORSTOM contract for 3 years (1991-94)
  - Germination study of the local pioneer plant species on mine sites in order to revegetate by hydroseeding.



Kouaoua



Thio - Ningua

# Revegetation 1993-95



Thio - Ningua



- CIRAD - ORSTOM - Province Sud - SLN trials : plantation of different local pioneer plant species on sapolites.

Thio - Camp des Sapins





# Revegetation 1994

- SIRAS Pacifique : operator for SLN since 1994.
  - A : Collecting, sorting and storage of seeds
  - B : Growing of seedlings in nurseries
  - C : Plantation
  - D : Hydrosseding





# Revegetation 1994 : seeding

- First hydroseeding with seeds of local pioneer plant species (Mainly endemic Cyperaceas).
- Test carried out by « Espaces Verts » under « SIRAS Pacifique » control.



April 1994



7 years later

# Revegetation since 1994



**1 year after seeding**



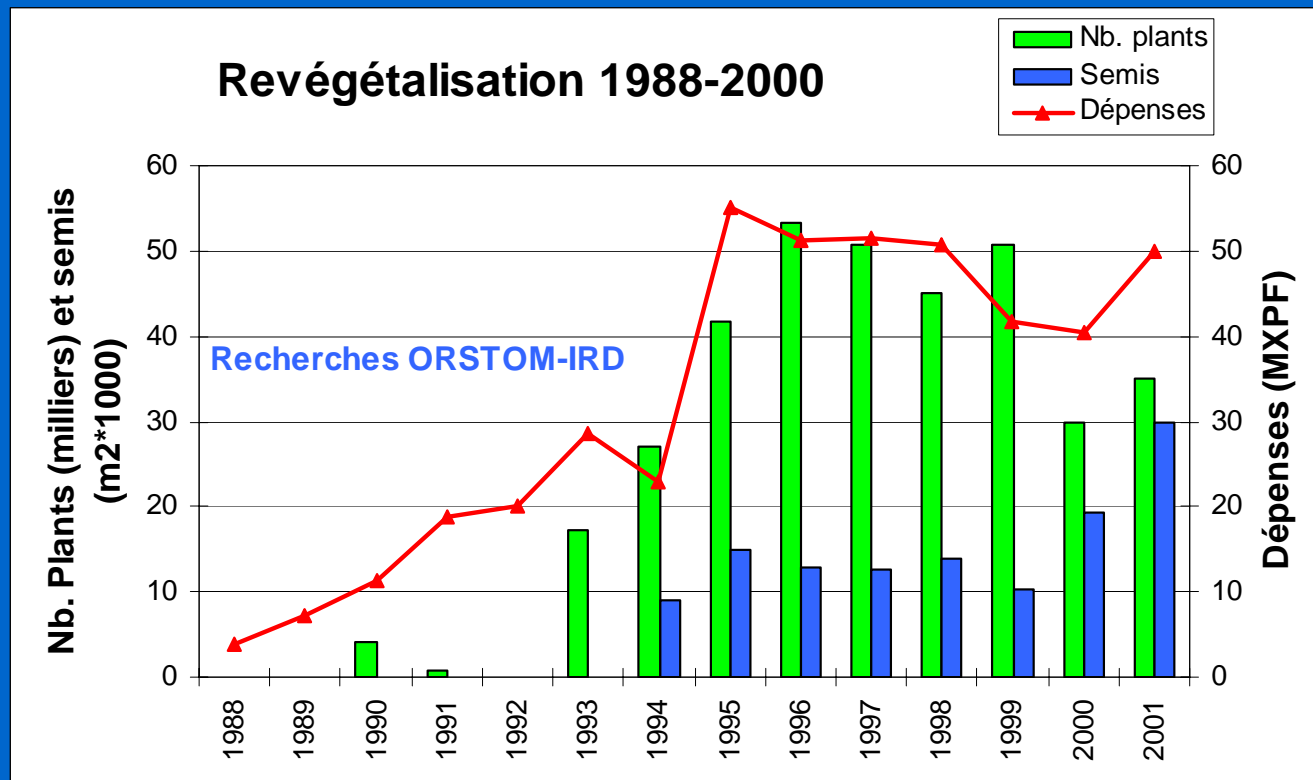
- SIRAS Pacifique :  
Improvement of  
hydroseeding by using  
temporary nurse plant  
species



**4 years after seeding**

# SLN revegetation

- Synthesis of revegetation studies, plantations and seedings financed by SLN since 1988





# Tiébaghi rare species preservation



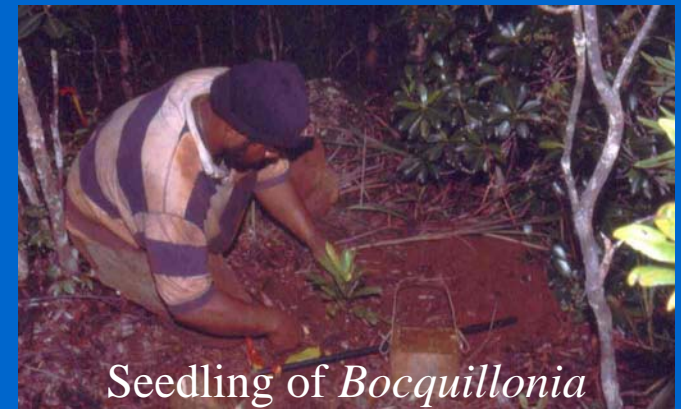
- 7 endemic species identified by IRD.
- Preservation scheme conceived with « SIRAS Pacifique »



*Neisosperma sevenetii*,  
Apocynaceas



*Macadamia ang.*  
Proteaceas



Seedling of *Bocquillonia*  
*castaneifolia*, Euphorbiaceas

# Revegetation : conclusions



- The revegetation of mine sites is possible, (but it remains relatively expensive).



- Fire is an important threat.



- NC plant biodiversity must be preserved, due to its originality.



# Mine and environment

- Mining is now conducted with concern for the environment, even before any legal regulation is put into operation in New Caledonia.



*Thank you for your  
attention*



*Xanthostemon, Myrtaceas*