



# **CONIFERS AFFORESTATIONS IN PATAGONIA: DO THEY TRIGGER CHANGES IN SOILS?**

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# Volcanic soils

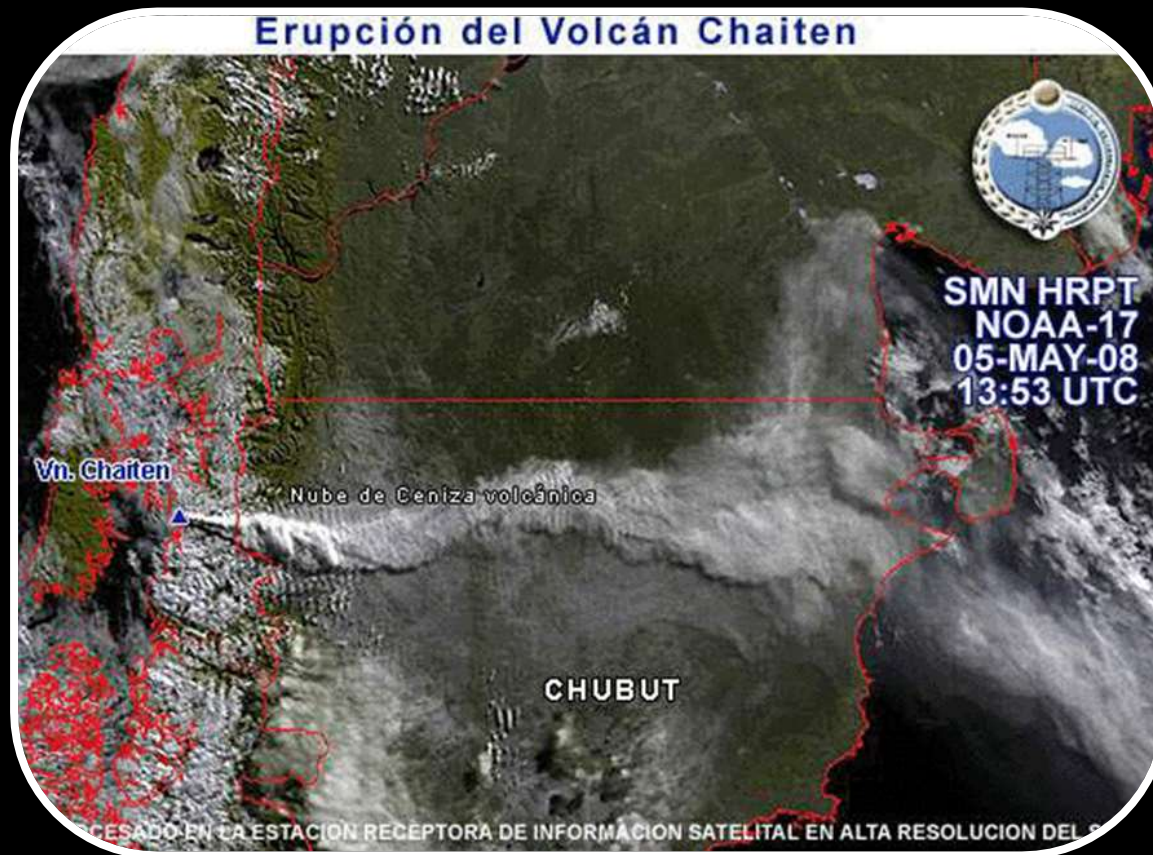


# Patagonian Andean Region

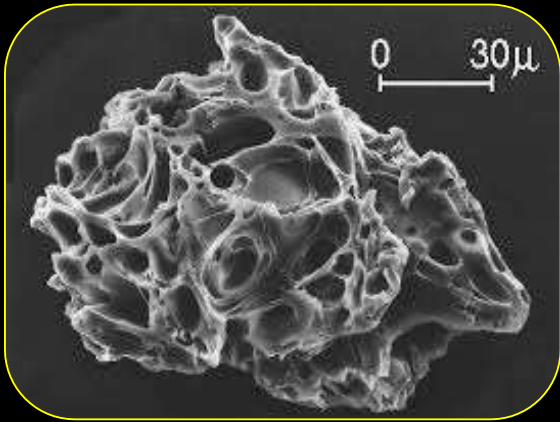




# Recent eruptions



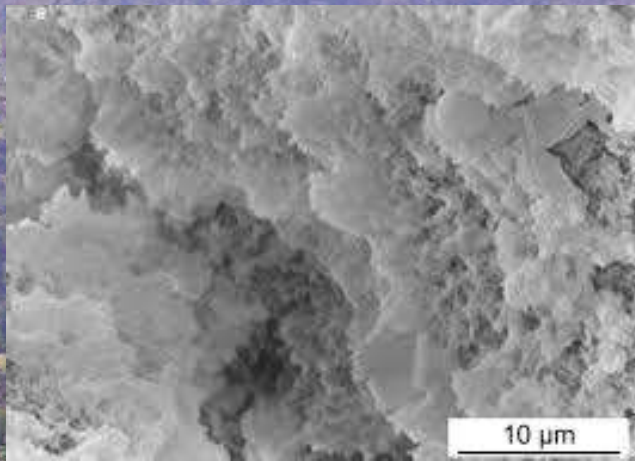
# Ashes and pumicite...



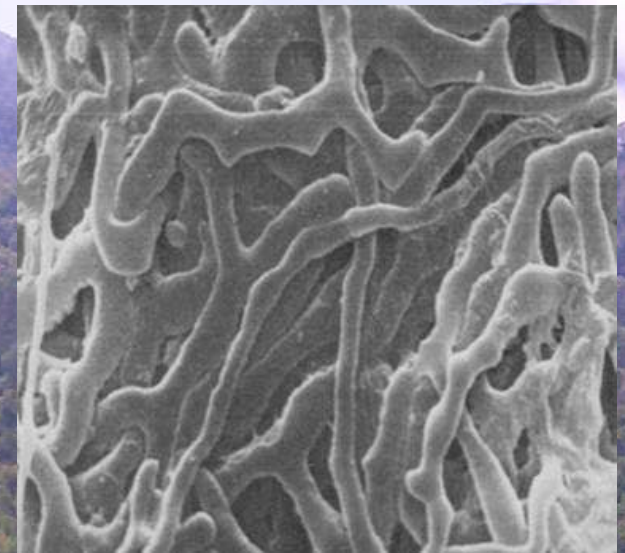


# Volcanic soils

## Non crystalline clays



**ALLOPHANE**



**IMOGOLITE**



✓ High porosity

✓ High water retention

✓ High organic matter content

✓ High physical and chemical fertility

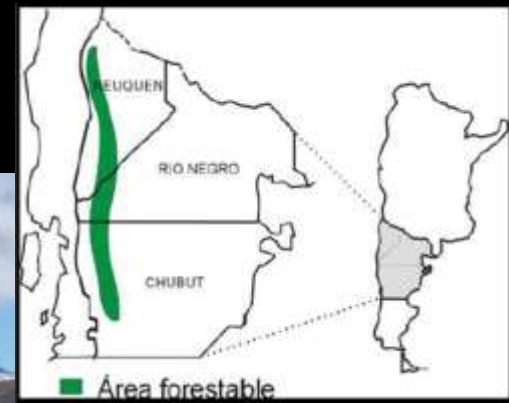




**Forest and agronomic aptitude in  
the Patagonian Andean Region  
depends on volcanic soils fertility**







**Even in degraded areas, subsurface soil keeps high fertility.**



# Degraded rangelands

Bare soil: 30 – 80%

Without non-crystalline clays

OM: 2-6%

Bulk density: 1,0-1,4 gcm<sup>-2</sup>

Storage water: 4-19%

With non-crystalline clays

OM: 6 - 11%

Bulk density : 0,8 – 1,0 gcm<sup>-2</sup>

Storage water: 20-30%



# Afforestations in degraded lands

## Changes in soils

Low fertility  
soils

↑ OM

↑ Porosity

↑ Structural  
stability

↑ Water  
retention

High fertility  
soils

↓ OM

↓ Porosity

↓ Structural  
stability





Chages direction depends on previous soil fertility



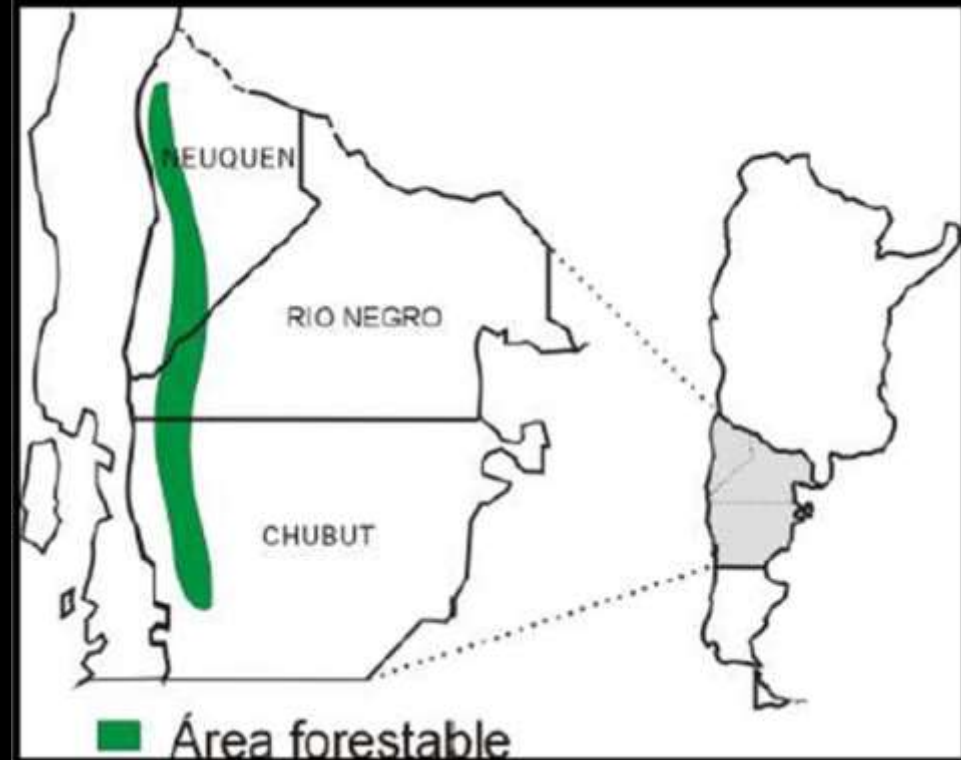
pH?

**PINES ACIDIFY  
THE SOIL!**



**Conifers afforestations  
from Patagonian Andean  
Region do not evidence  
an acidification process**

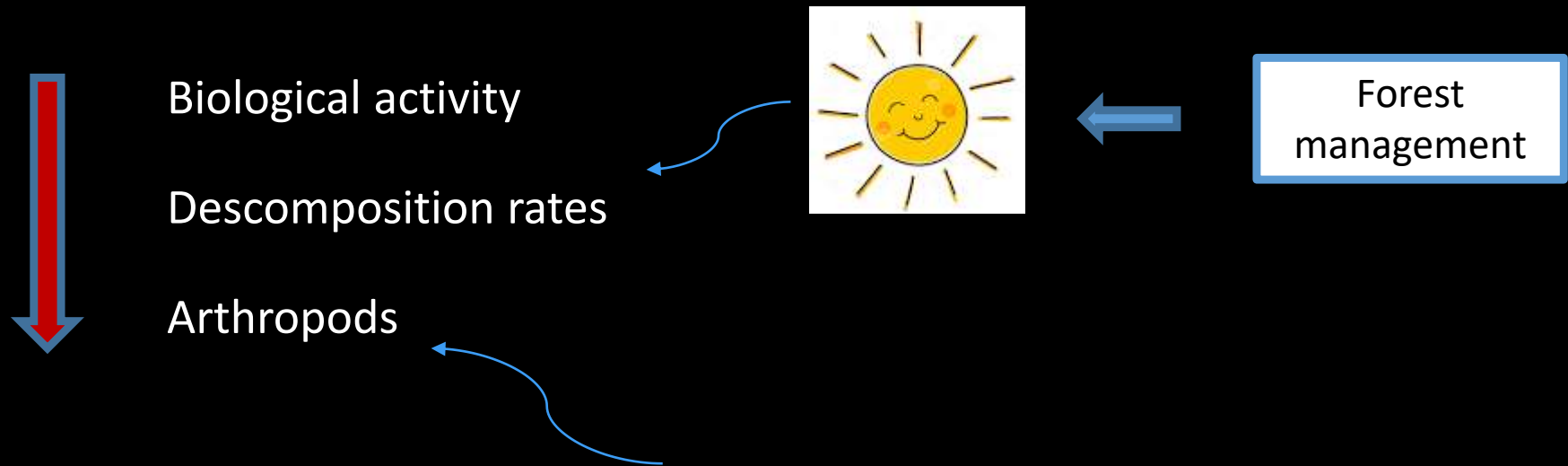
**pH ↓ 0,1 units**



*Buduba 2006*



# Afforestations negatively affects soil biology...



Diversity and abundance of key groups (Tenebrionids and Ants) depend on the age and management of the plantation

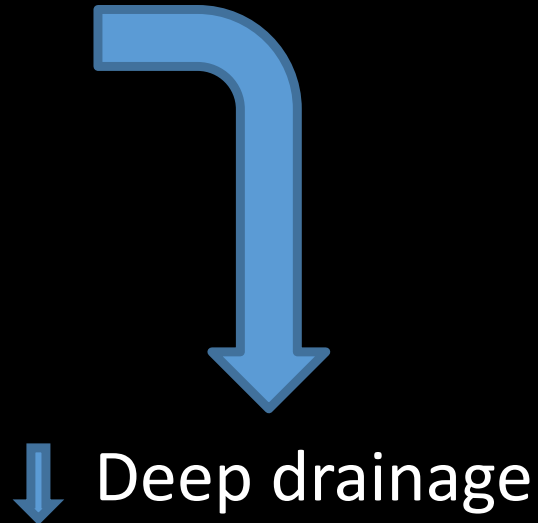
*Corley et al. 2006, Sackmann et al. 2008, Gómez et al. inédito*

## Soil water?...

Forest  
management

High transpiration rates (10% steppe vs.  
73% afforestation)

Rains interception (14 - 50)



Deep drainage

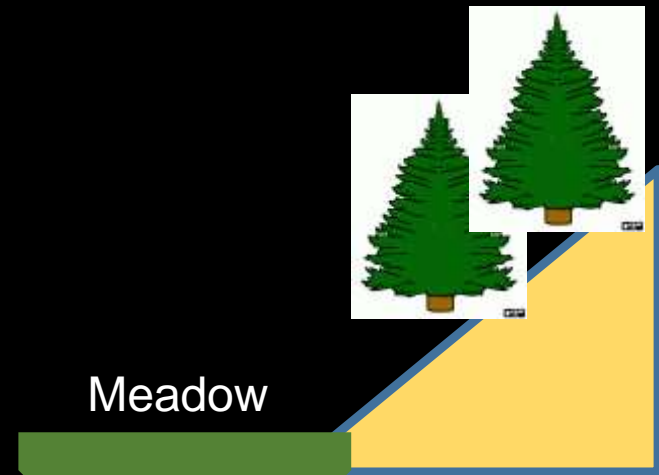
*Gyenge et al. 2016, Gomez et al. 2019*

*Milkovic et al. 2019*



# Soil water?...

Afforestation did not affect  
water table depth nor meadows  
production



# **VOLCANIC SOILS ARE HIGHLY ERODABLE**

## **WIND EROSION**



## **WATER EROSION**

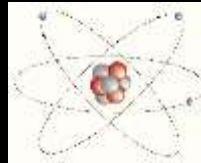


**IN VOLCANIC SOILS, EROSION INVOLVES SOIL  
MICROAGGREGATES (NON INDIVIDUAL PARTICLES)**



# Erosion rates

Radiocaesium ( $^{137}\text{Cs}$ )



Erosion rates reach values of  
 $30\text{m}^3 \text{ ha}^{-1} \text{ año}^{-1}$



Rangelands



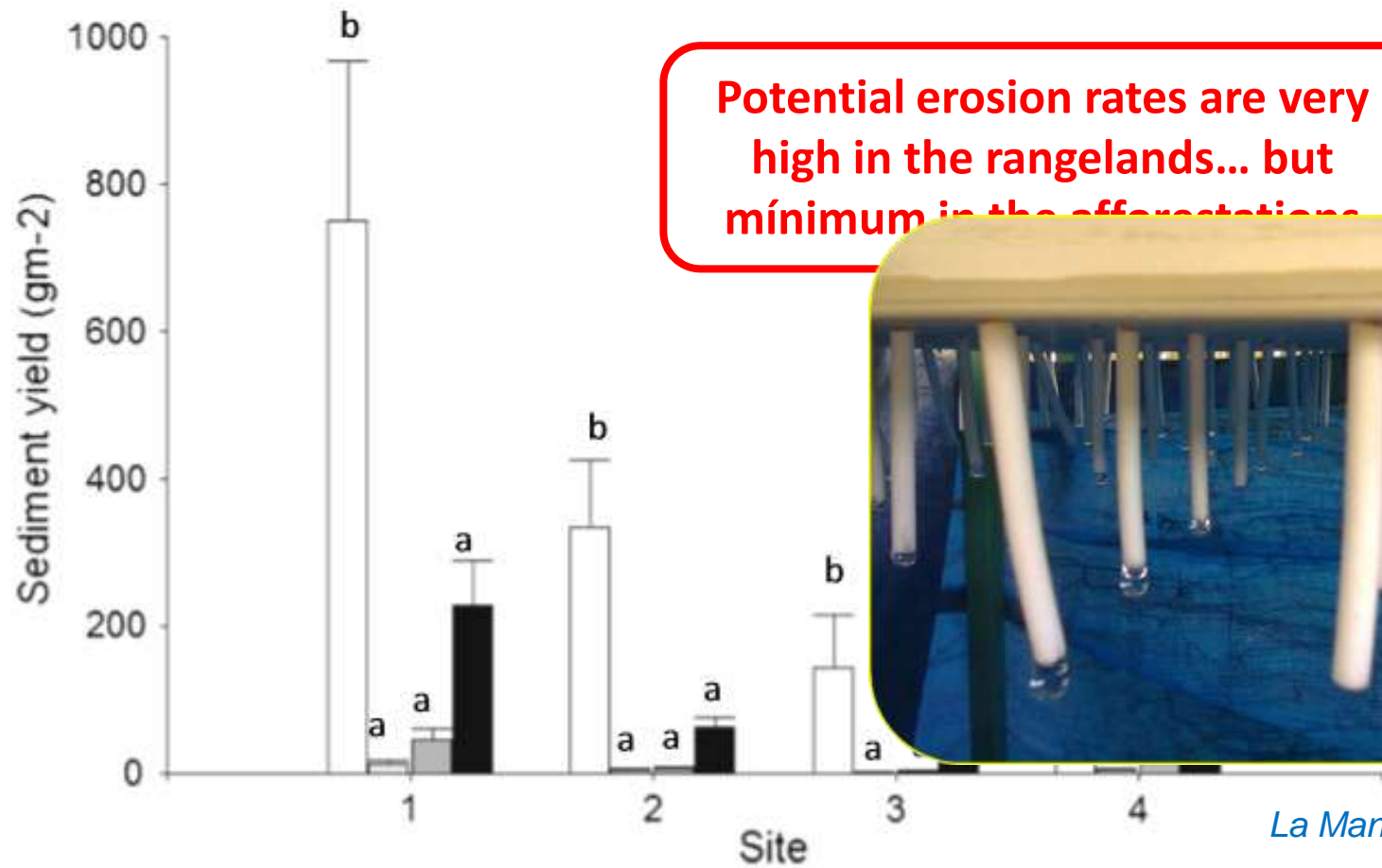
Afforestation



Oi remotion



O remotion



Potential erosion rates are very high in the rangelands... but minimum in the afforestations





# Afforestations entramp particules transported by the wind



Organic matter  
enrichment

Recent ash



2008



Organic  
horizon

Mineral +  
Organic



Soil cover  
Basal area  
Trees density  
Height  
Age

Soil grows under the afforestations



Soil growth rate:  
 $1\text{m}^3 \text{ ha}^{-1} \text{ año}^{-1}$

*Tarabini et al. 2019*

# CONIFERS AFFORESTATIONS IN PATAGONIA: DO THEY TRIGGER CHANGES IN SOILS?



Afforestation improve soil fertility  
and resistance to erosion





# CONIFERS AFFORESTATIONS IN PATAGONIA: DO THEY TRIGGER CHANGES IN SOILS?

↑↓ Physical and chemical soil properties

Changes depend on the previous fertility  
Soil changes are damped by their condition of volcanic soils



Non crystalline  
clays

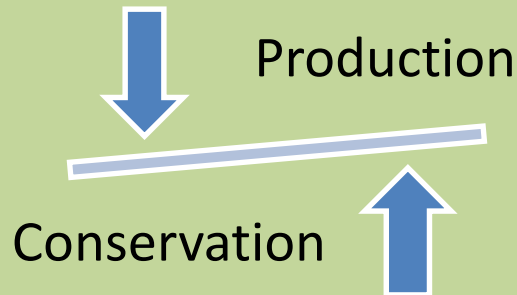


# CAN FOREST MANAGEMENT BALANCE NEGATIVE EFFECTS?

Litter  
descomposition  
rates

Biodiversity

**Management**



Physical and  
chemical  
properties

Soil water





*Muchas gracias...*