

# Soils of Rota

## Properties and Diversity

Jonathan Deenik, PhD

Department of Tropical Plant and Soil Sciences

University of Hawaii

Rota Grazing and Livestock  
Management Workshop

June 10-12, 2010

Photo: J. Deenik



# Outline

- Soil formation
- Importance of Soil
- Soil Basics
  - Soil composition
  - Texture and clay minerals
  - Soil pH and nutrient availability
  - Soil organic matter
- Soil distribution on Rota



# Soil Formation

$$\text{Soil} = f(\text{PM}, \text{Cl}, \text{O}, \text{R}, \text{T})$$

## Factors:

PM = parent material (rocks)

Cl = climate (precipitation and temperature)

O = organisms (plants and animals)

R = relief (topography, drainage)

T = time

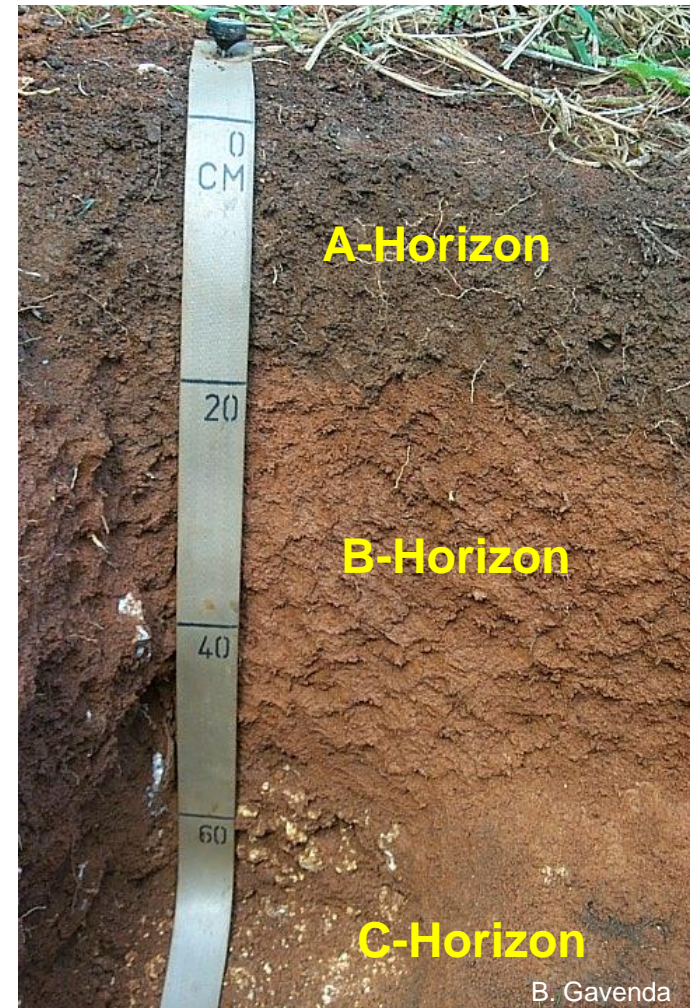




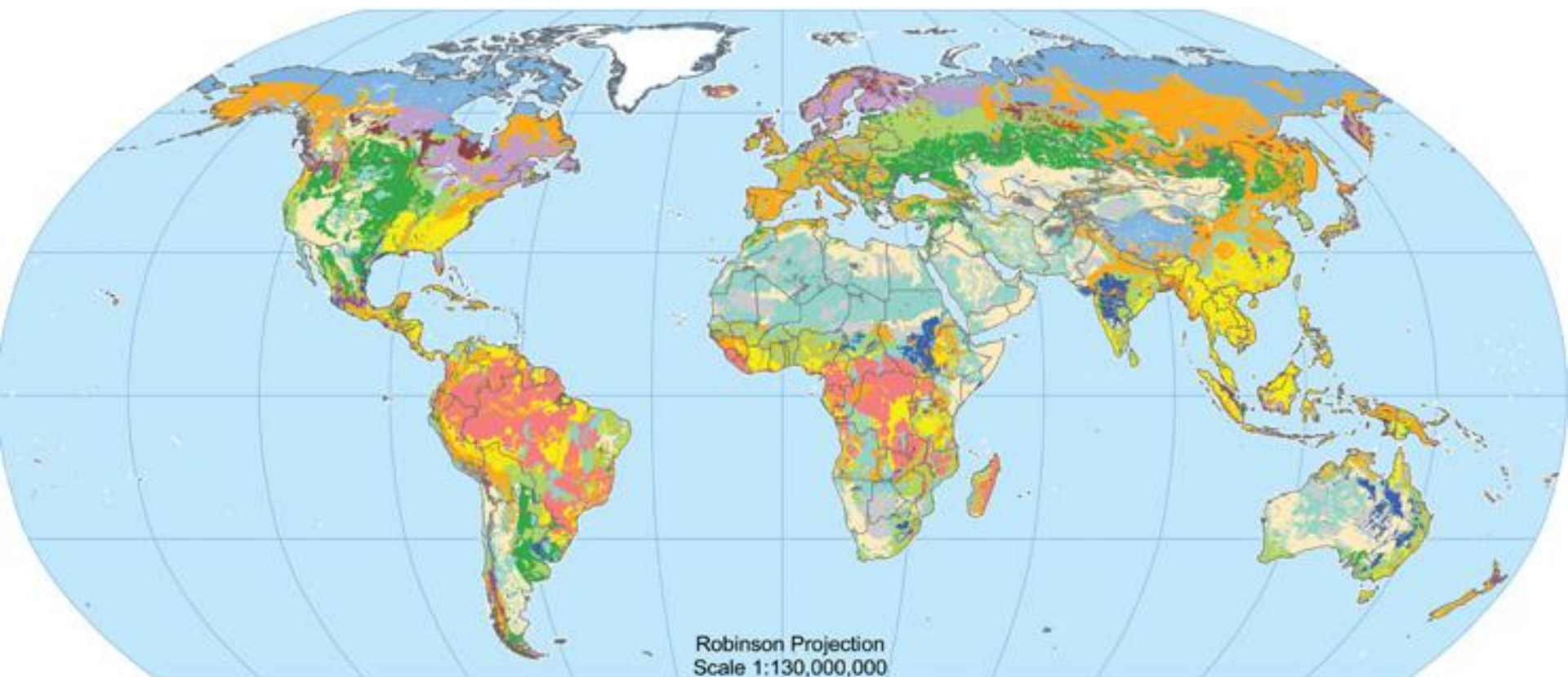
# Soil Formation

## Processes:

1. Additions
  - Water, organic matter, sediment
2. Losses
  - soluble compounds, erosion
3. Transformations
  - Organic matter to humus
  - Primary minerals to clay minerals
4. Translocations
  - Soluble compounds
  - Clays



# Global Soil Regions

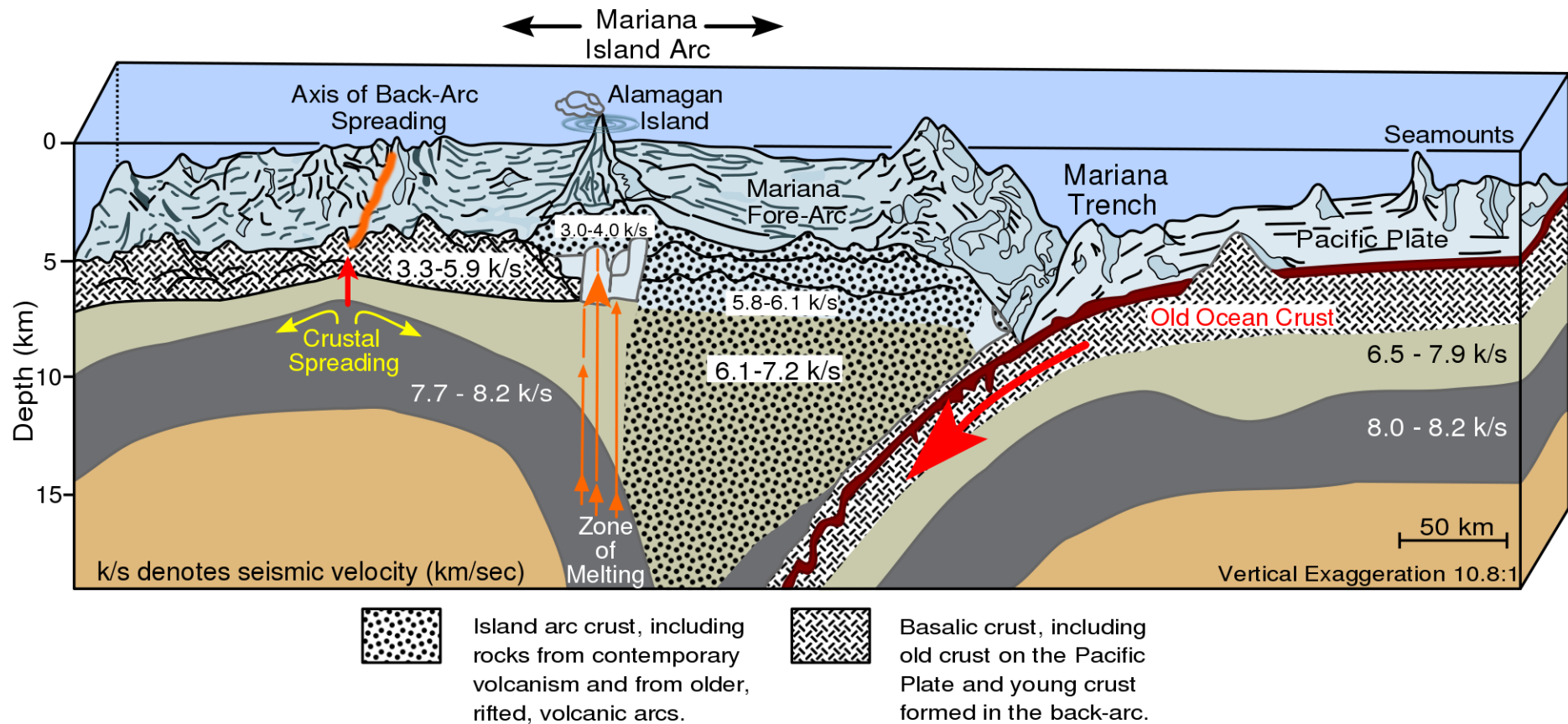


## Soil Orders

Alfisols	Entisols	Inceptisols	Spodosols	Rocky Land
Andisols	Gelisols	Mollisols	Ultisols	Shifting Sand
Aridisols	Histosols	Oxisols	Vertisols	Ice/Glacier



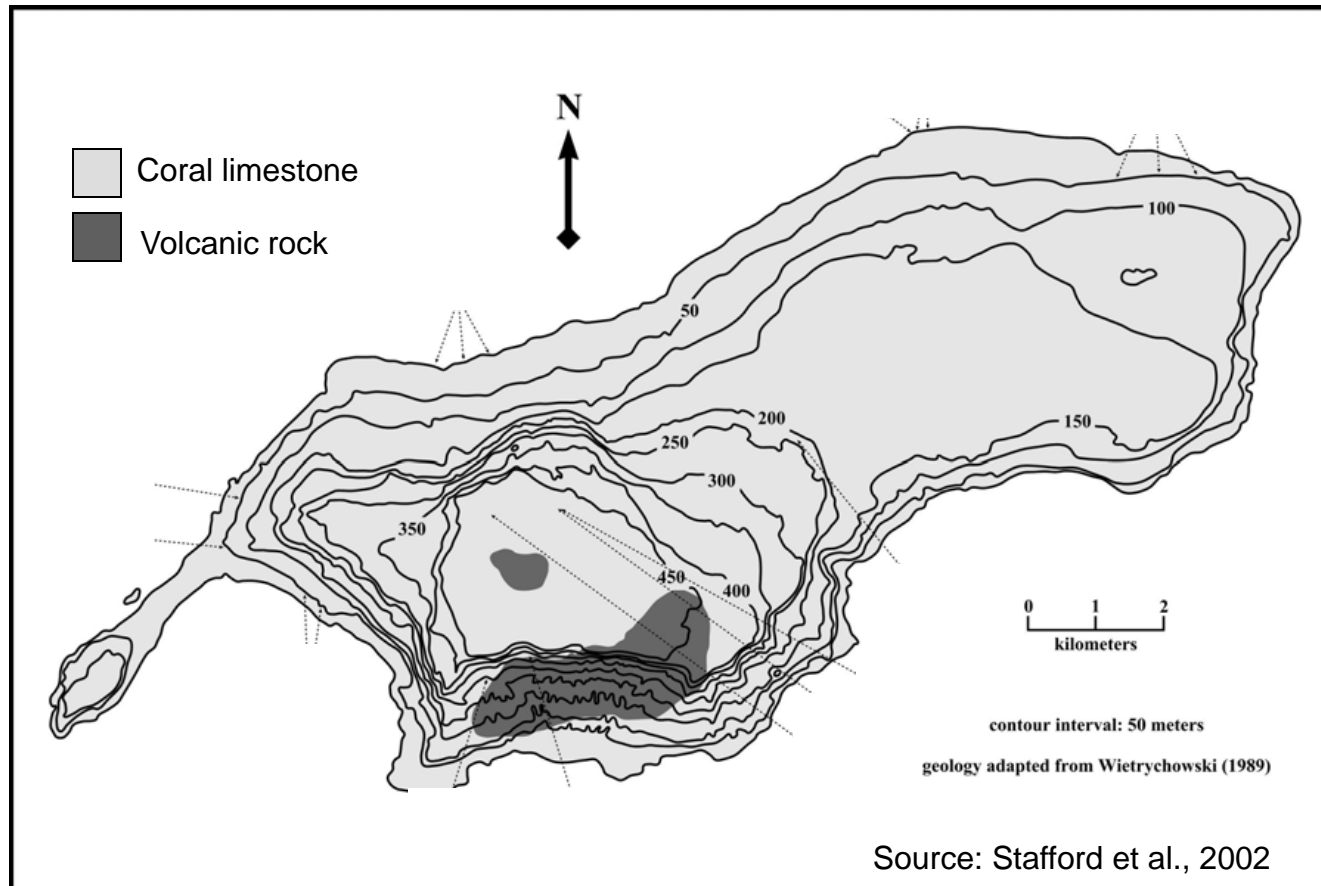
# Island Formation



## Cross-Section Sketch of Mariana Arc

(After Hussong and Fryer, 1981)

# Parent Material on Rota



- Parent material is mostly coral limestone with small exposures of volcanic rock

# Soil Formation on Rota

1. Parent material of Rota soils is predominantly volcanic ash.
2. The source of the ash is still unknown





# Luta soil series

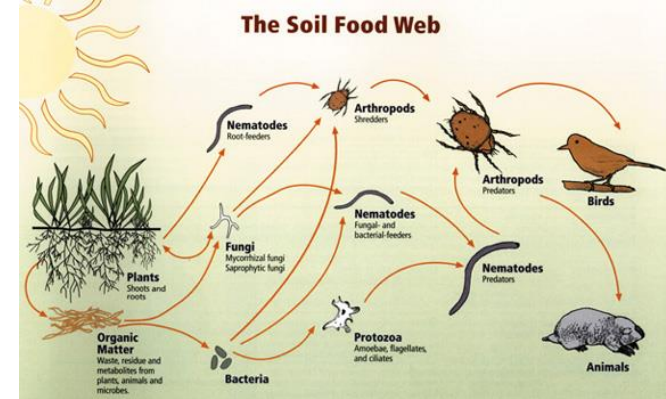




Medium for  
Plant growth



Habitat for  
Soil organisms



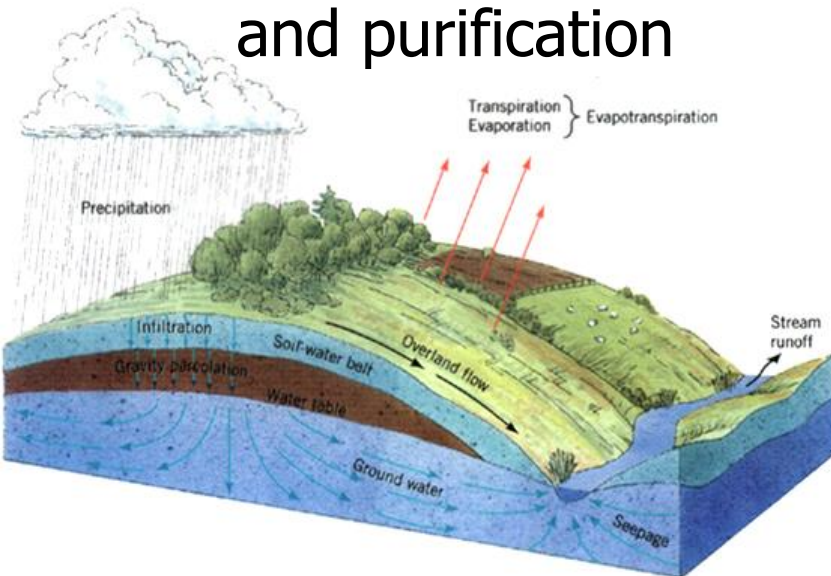
5

# Functions of Soil

Recycling  
system



Water supply  
and purification



Engineering Medium

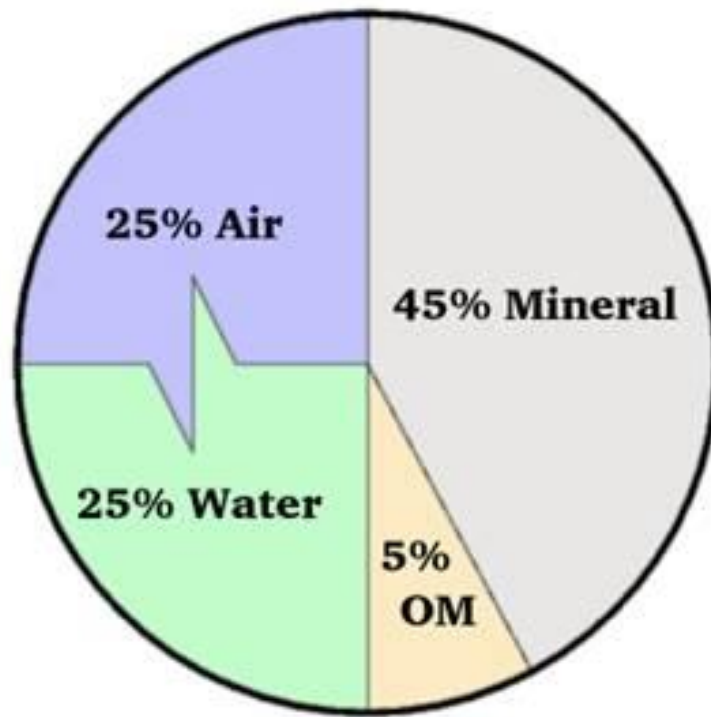




- Animal health begins with good nutrition
- Grasses and other plants are the source of nutrients
- Soils supply nutrients and store water for plant growth



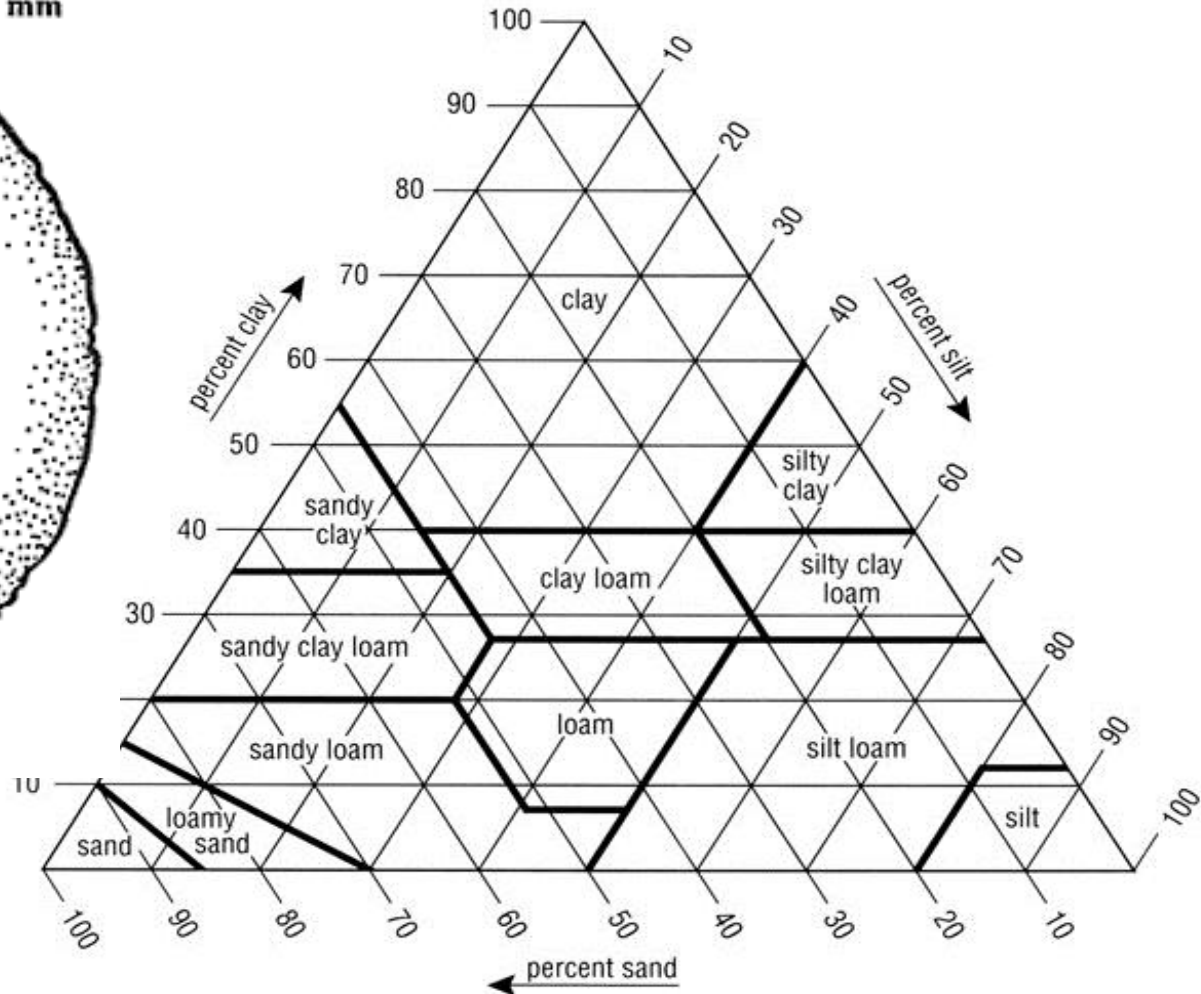
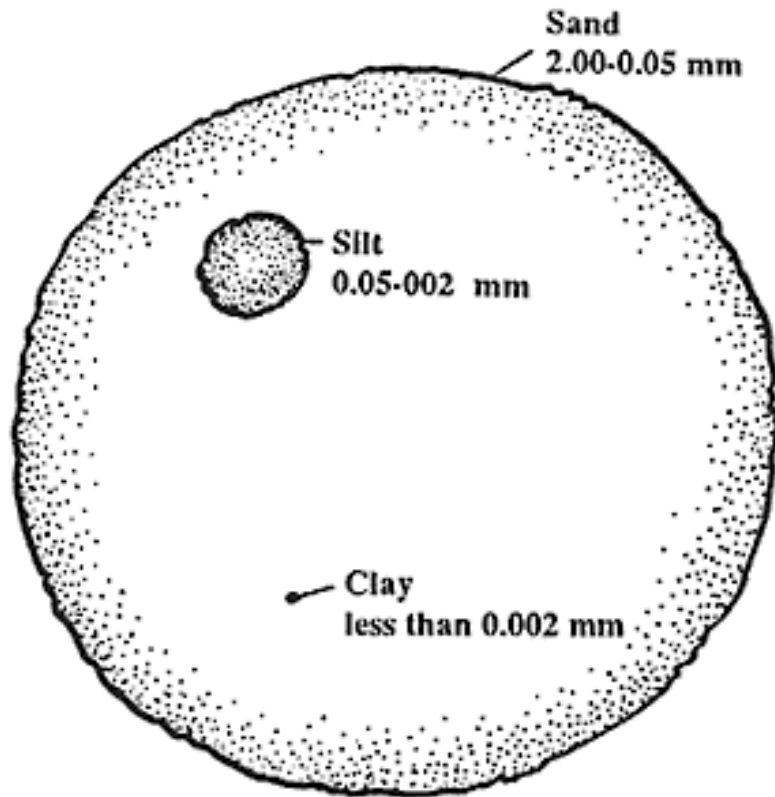
# Soil Composition



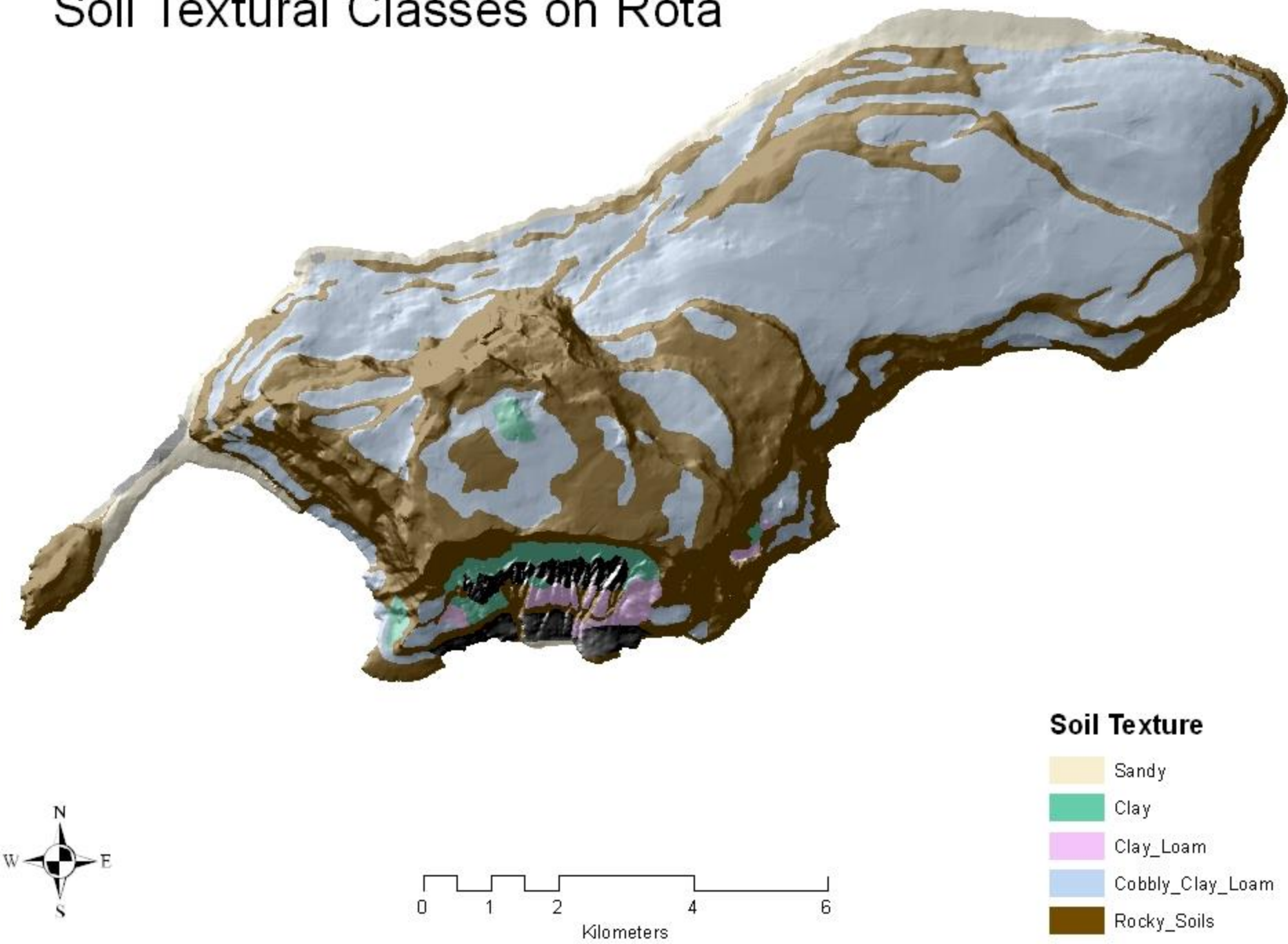
Photos: B. Gavenda



# Soil Texture



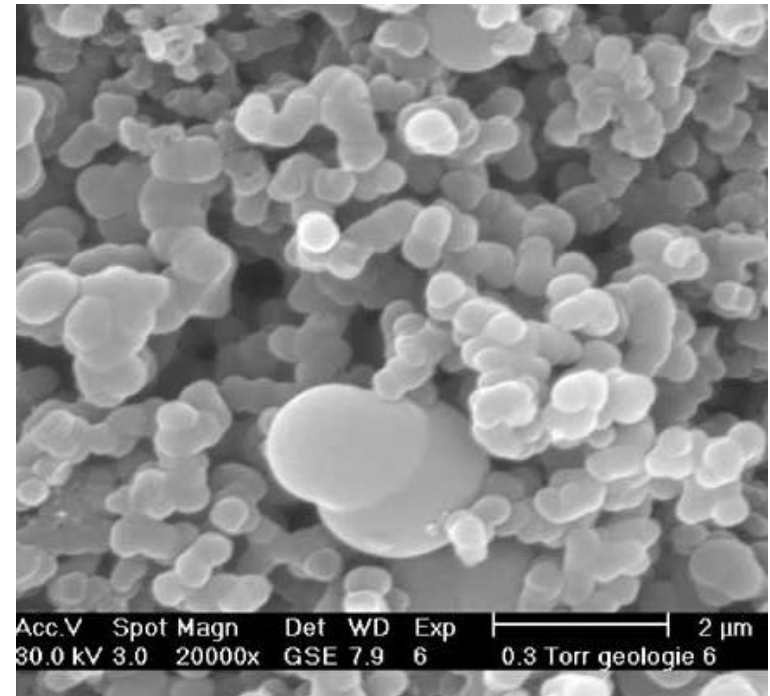
# Soil Textural Classes on Rota



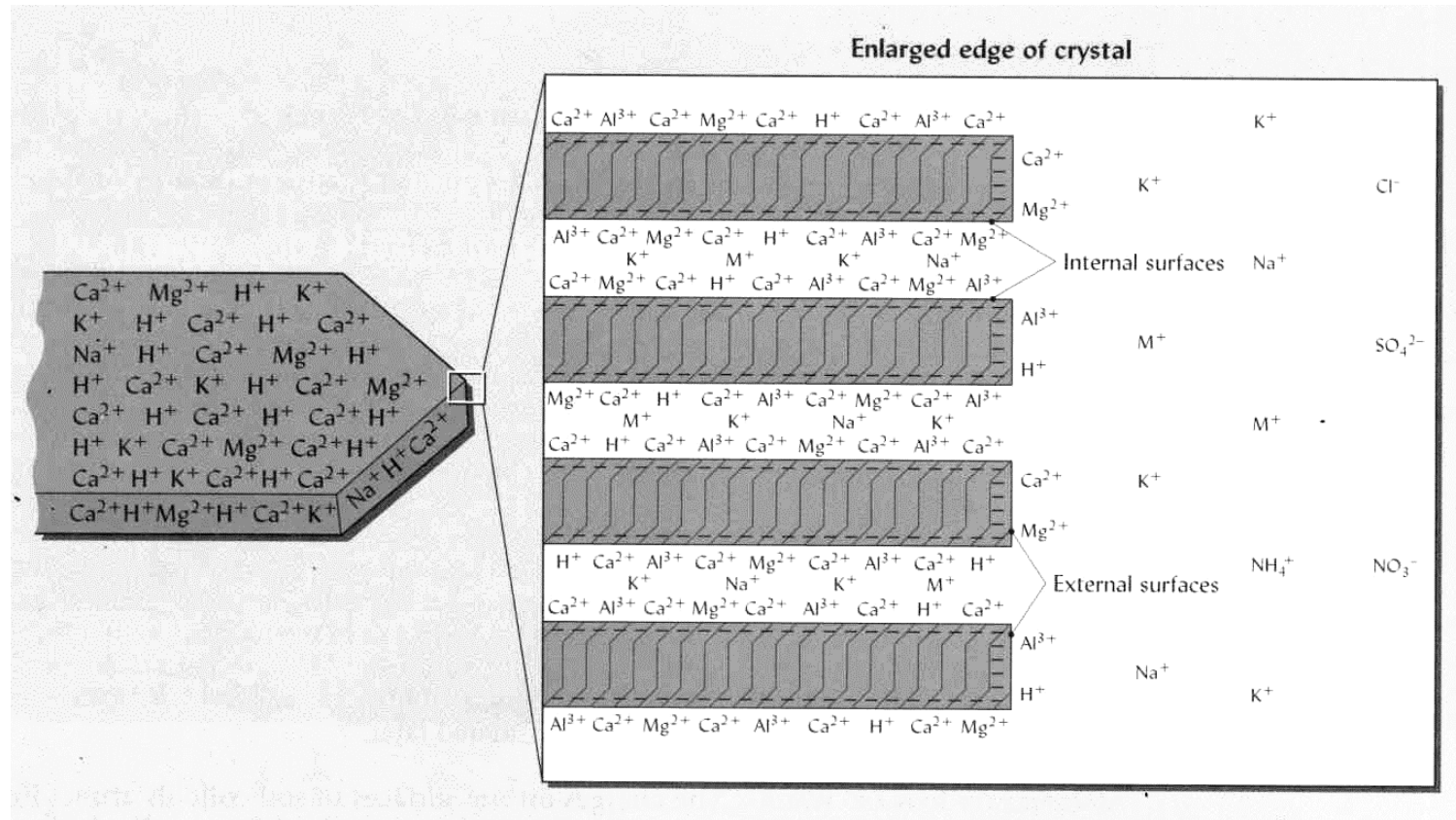


# Properties and Importance of Clay

- Properties
  - High surface area
    - 1 gram = 10 to 1,200 m<sup>2</sup>
  - Charged surfaces
    - Usually negatively charged
- Importance
  - High water holding capacity
  - Clay minerals in Rota soils fix phosphorus into insoluble forms



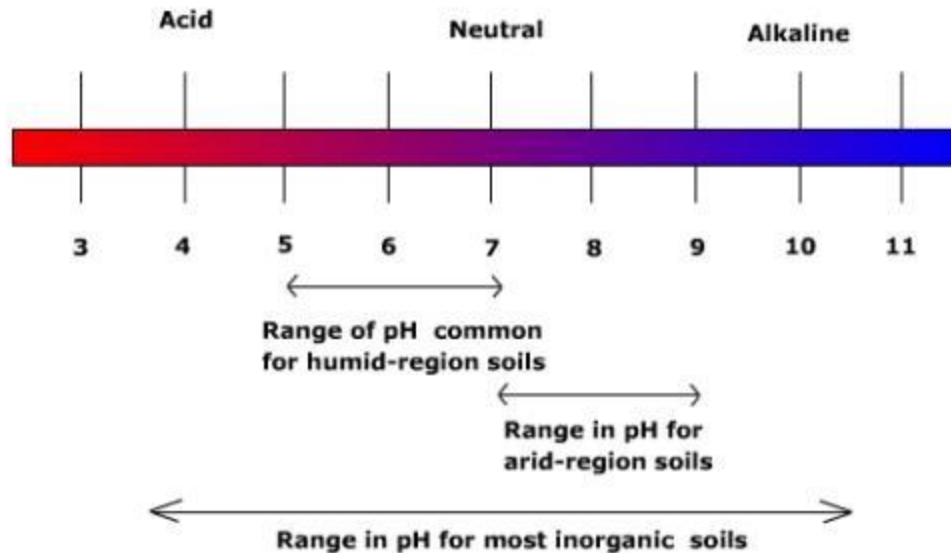
# Cation Exchange Capacity (CEC)



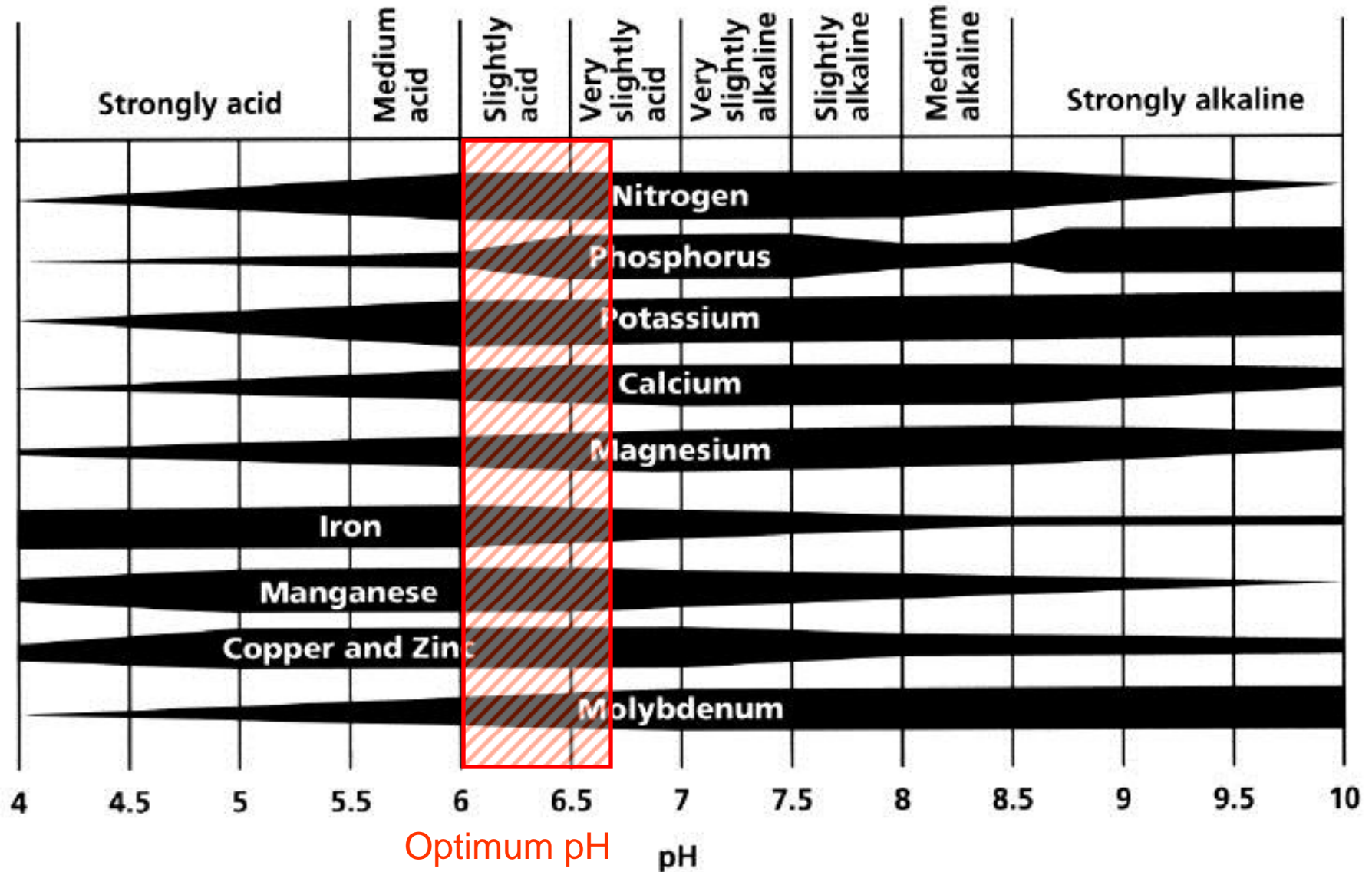
Negatively charged sites that adsorb cations:  
 $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^{+}$ ,  $\text{NH}_4^{+}$



# The pH Scale

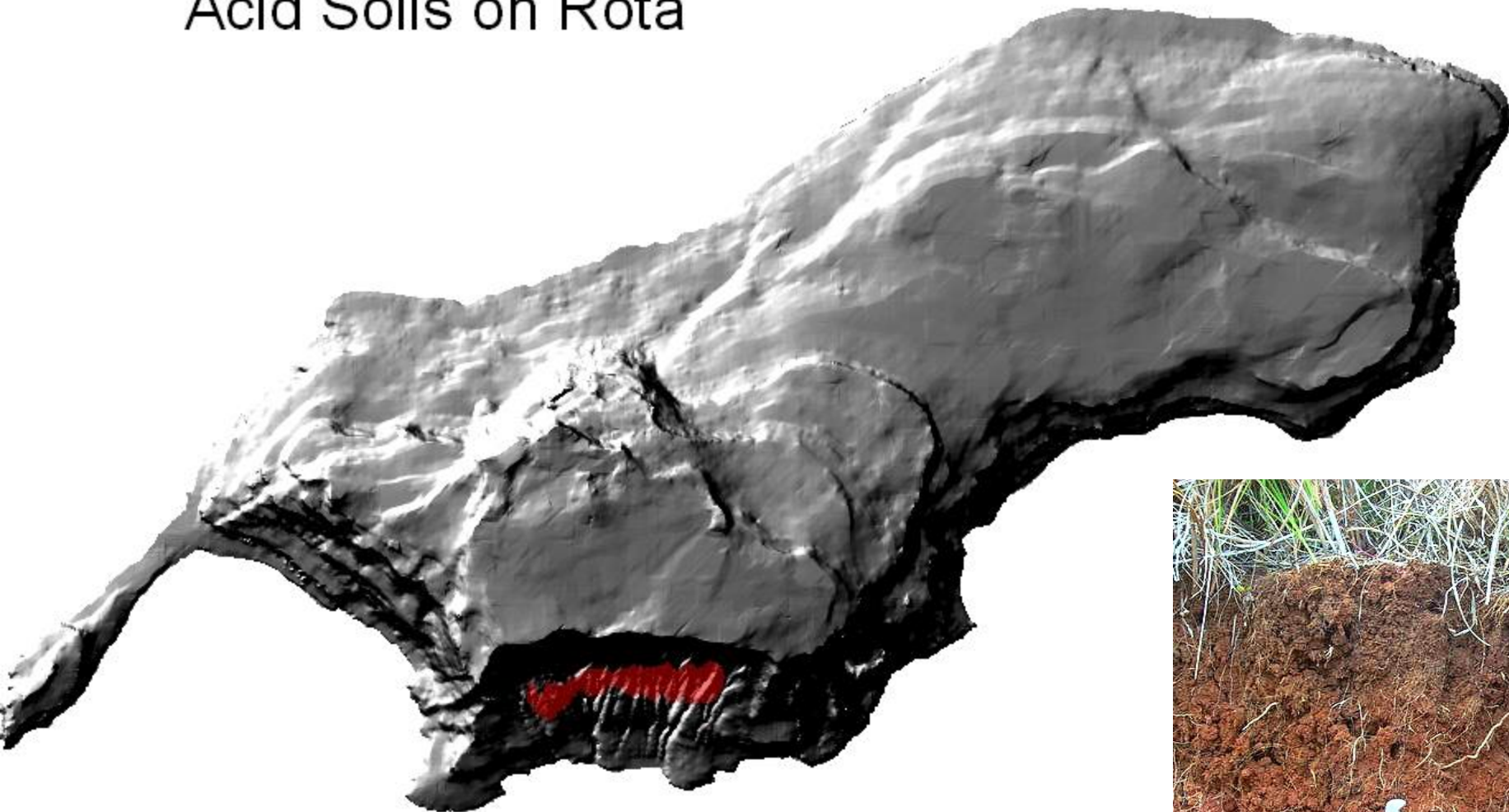


# Soil Acidity and Nutrient Availability





# Acid Soils on Rota



 Acid Soils

0 1 2 4 6  
Kilometers



# Role of Organic Matter in Soil

- **Physical**

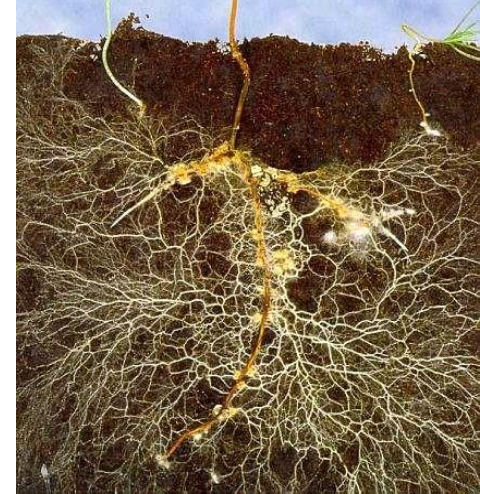
- Improves soil structure
- Increases water retention

- **Chemical**

- Increases nutrient availability (N & P cycling, solubility)
- Increases nutrient retention (CEC)
- Detoxifies Al

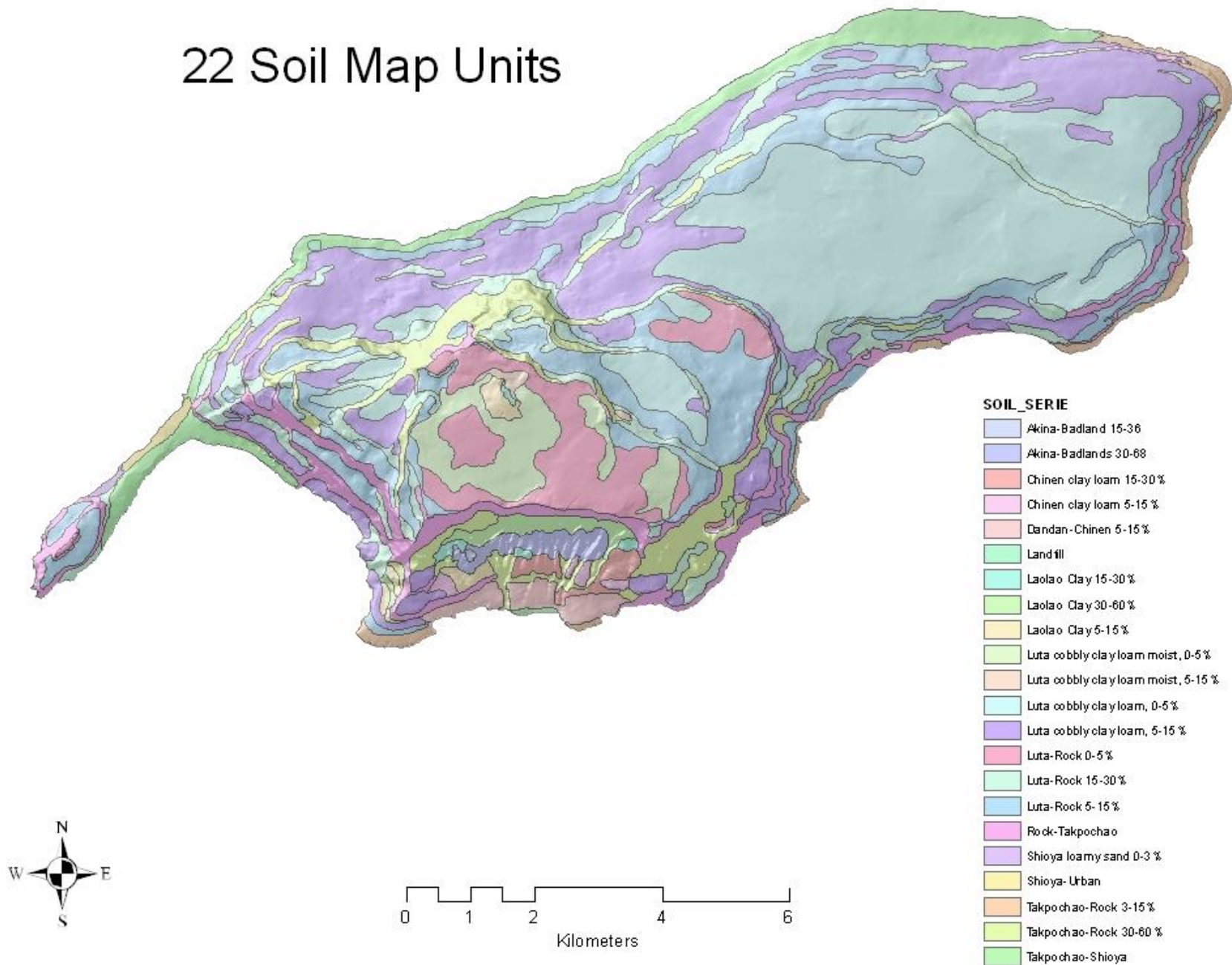
- **Biological**

- Increases microbial diversity
- N fixation (rhizobia), P availability (mycorrhiza)
- Increases pathogen suppression

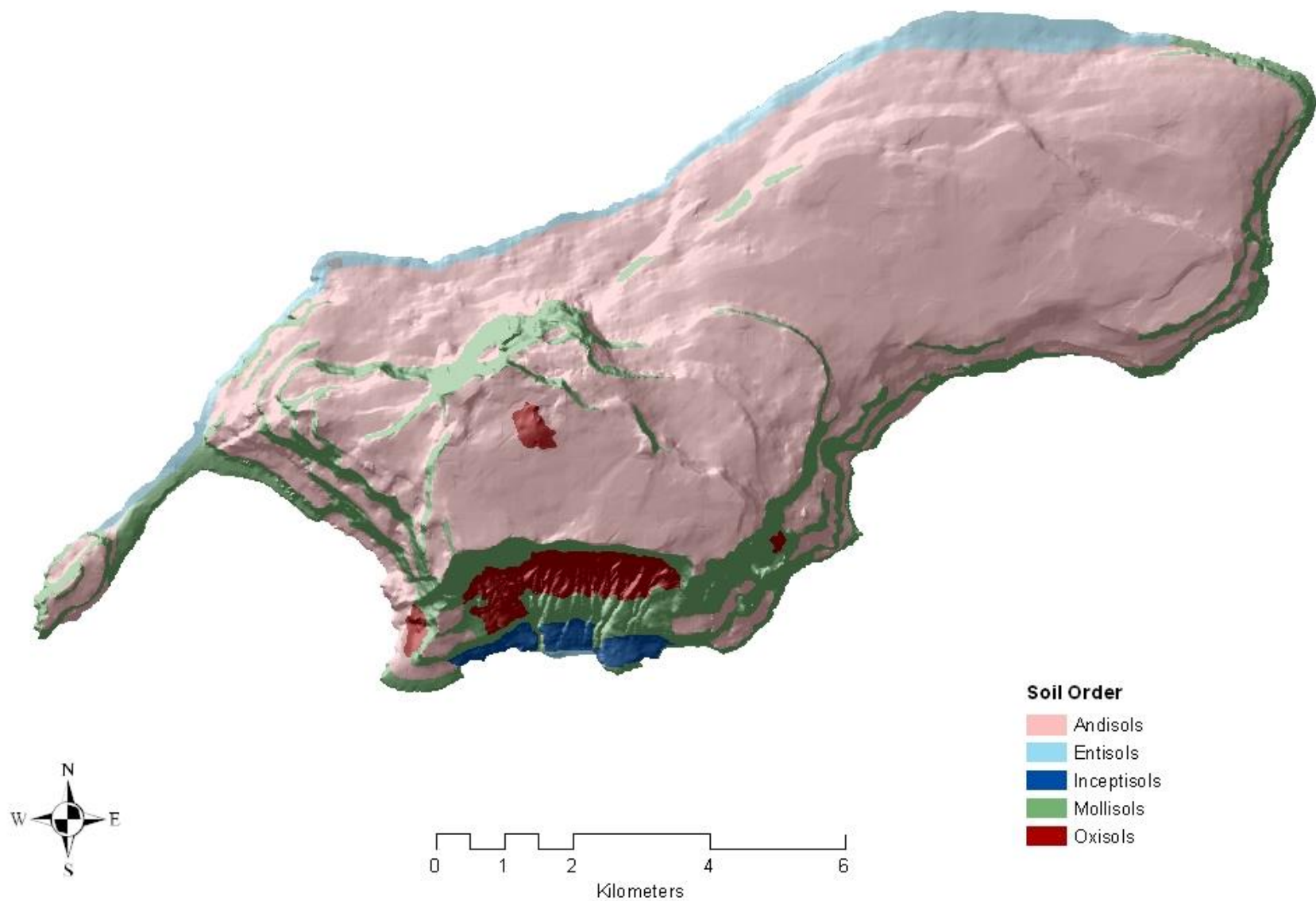




# 22 Soil Map Units

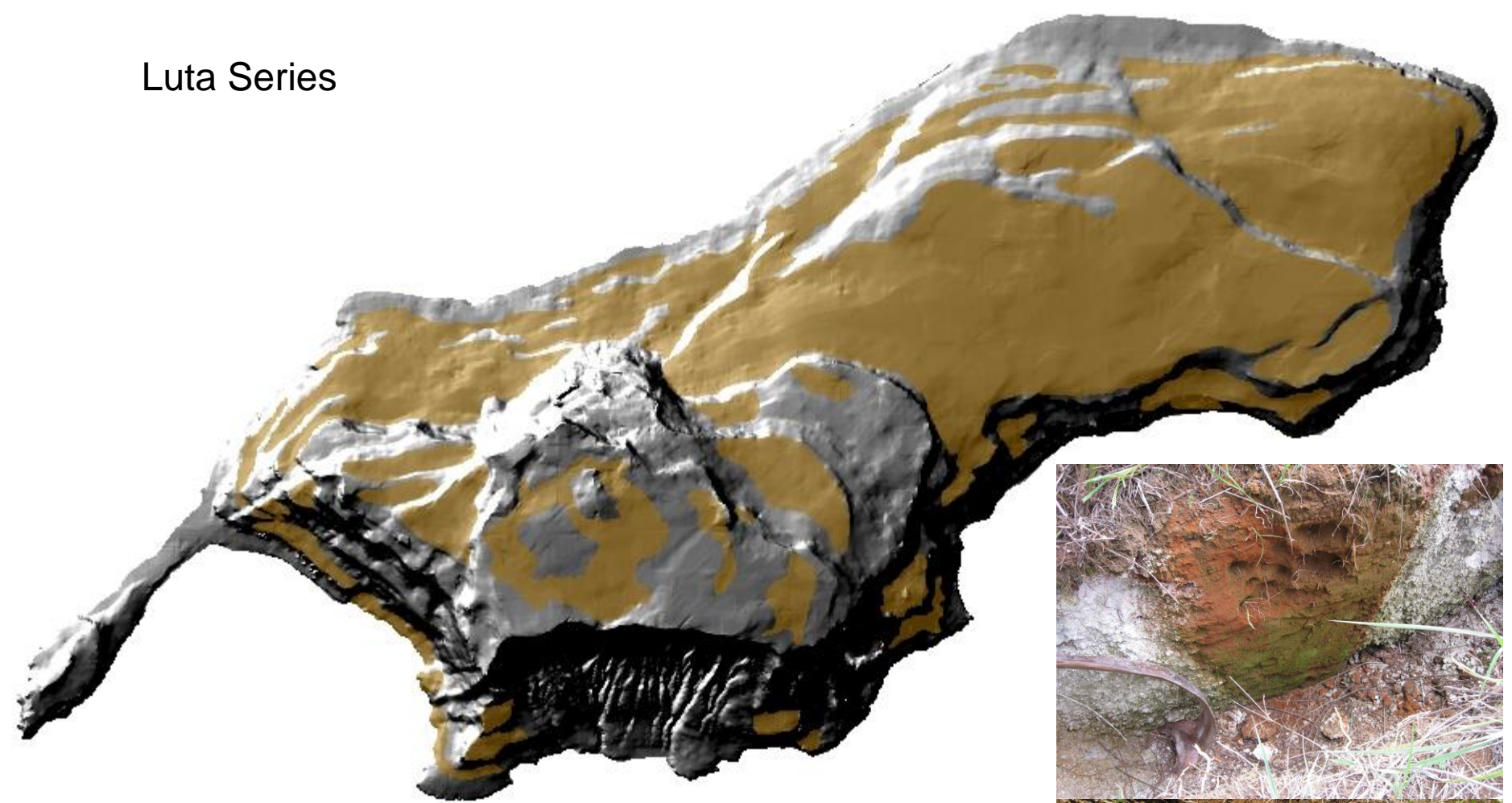


# Soil Orders on Rota

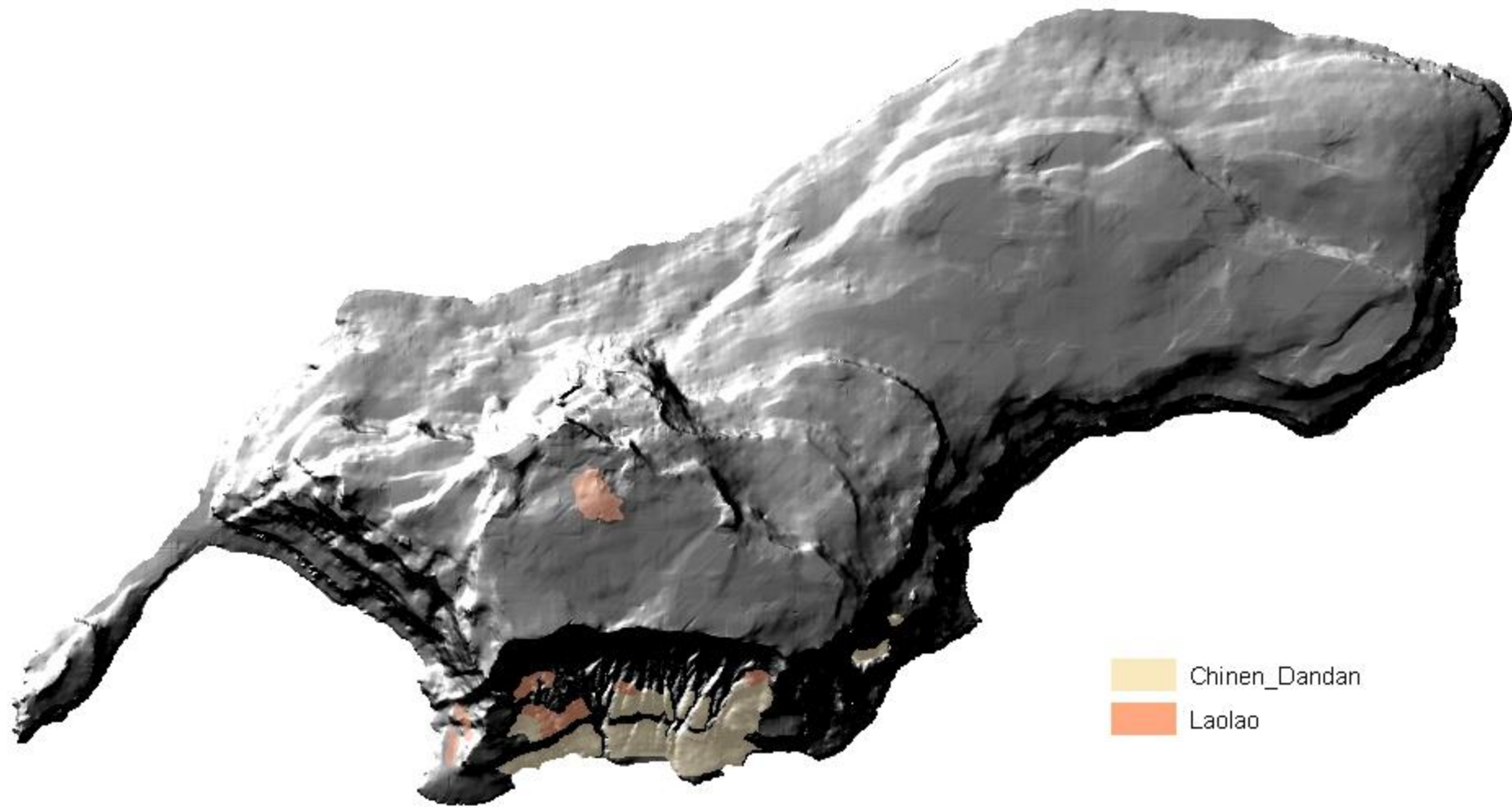




## Luta Series



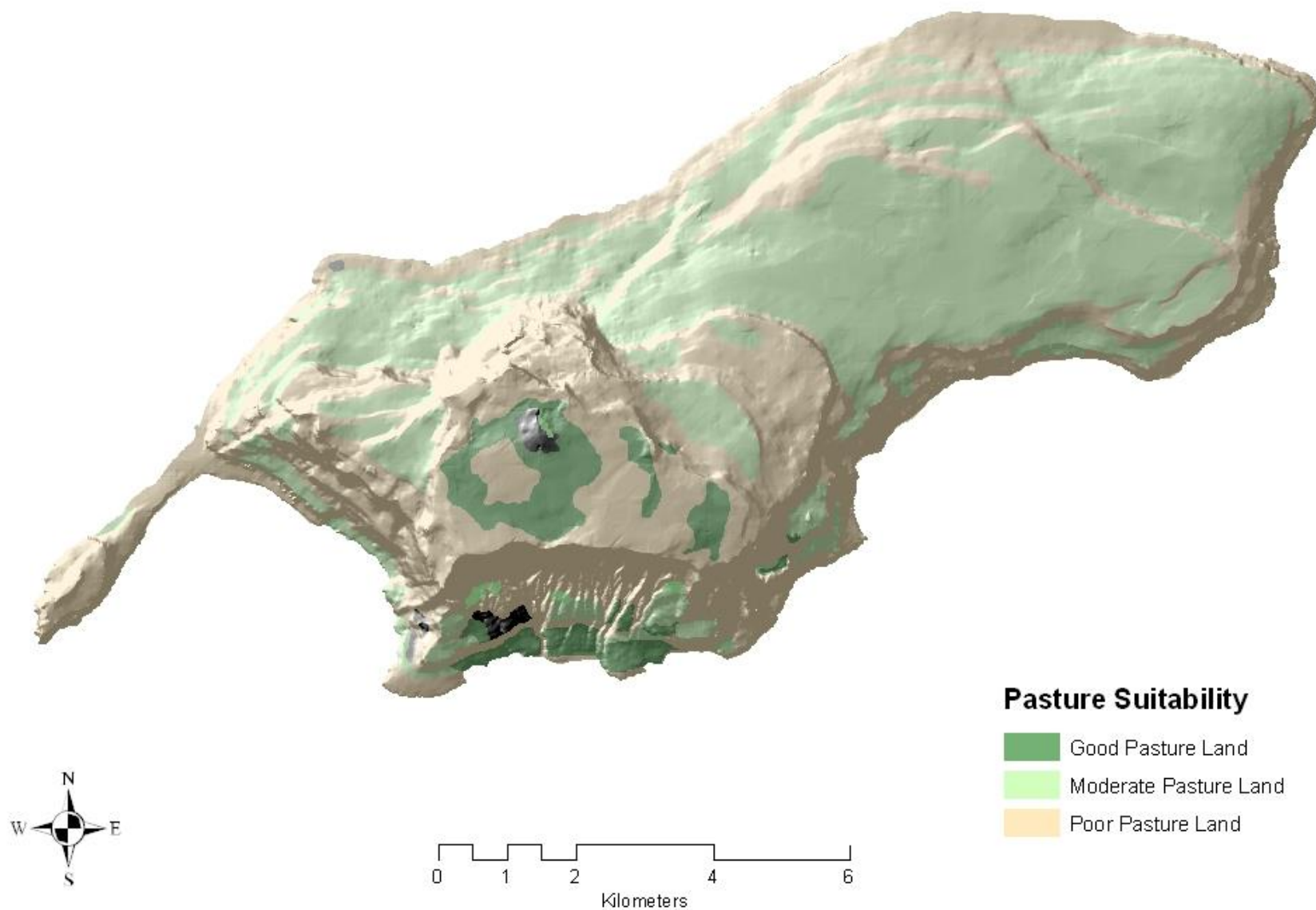
Horizon	%Clay	pH	% C	Ca	Mg	Na	K
					cmol <sub>c</sub> kg <sup>-1</sup>		
0-15 cm	14.0	7.3	11.0	42.5	4.2	0.2	0.2



Horizon	%Clay	pH	% C	Ca	Mg	Na	K
cmol <sub>c</sub> kg <sup>-1</sup>							
0-8 cm	52.9	6.8	7.62	50.4	2.9	0.2	0.2



# Pasture Suitability Classification





# Grazing Management and Soil Quality

compaction



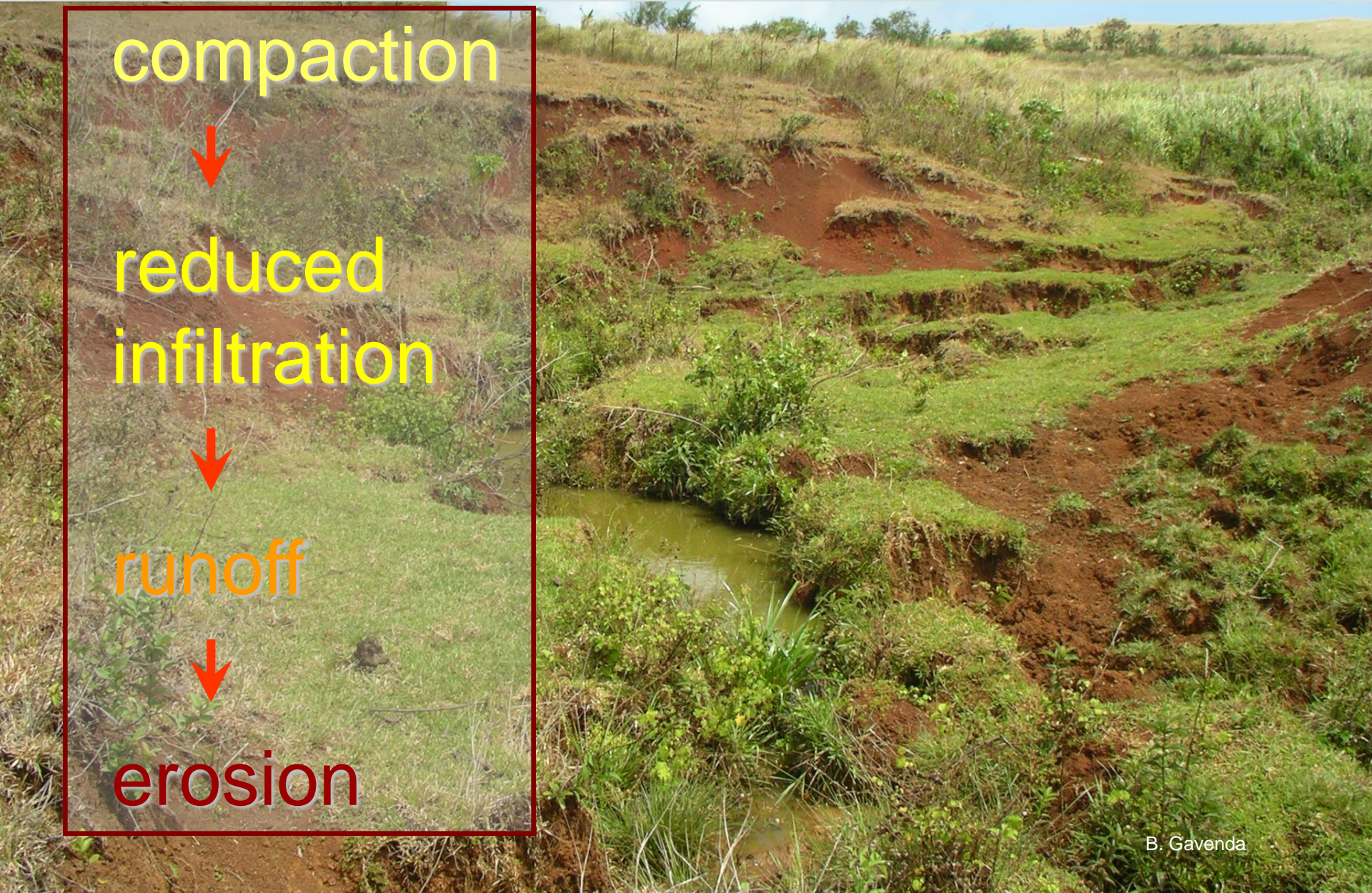
reduced  
infiltration



runoff



erosion





# Grazing Management and Soil Quality







**Soils are non-renewable!**