



VIII GeoSciEd 2018 – 8<sup>th</sup> Quadrennial Conference of the International Geoscience Education Organisation (IGEO)  
– *Geosciences for Everyone* –  
VIII Simpósio Nacional de Ensino e História de Ciências da Terra / EnsinoGEO-2018  
– *Geociências para Todos* –  
Campinas – Sao Paulo – Brazil, July 2018



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# Rocks, climate, weathering, erosion and the landscapes

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Many Precambrian areas present boulder fields in Brazil



Salto (SP) Lavras Park

# How does a field of boulders form?



Campinas (SP) D. Pedro I Hw.



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## Presentation objectives

- To review concepts about weathering
  - To integrate interdisciplinary data
- To study a relationship between rock cycle, regional climates, types and distribution of weathering processes
  - Implications: origin of soils and cycles of chemical elements on Earth



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# Useful references and image credits

- Carneiro C.D.R. 2012. As esferas terrestres se reciclam: o Ciclo das rocks. In: Y. Hasui, C.D.R. Carneiro, F.F.M.de. Almeida, A. Bartorelli. eds. 2012. *Geologia do Brasil*. São Paulo: Ed. Beca. p. 16-23. (Cap. 1).
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# Denudation = Weathering + Erosion

- Interaction of slow and long-lived phenomena
  - Modifying agents of landscapes... and human life

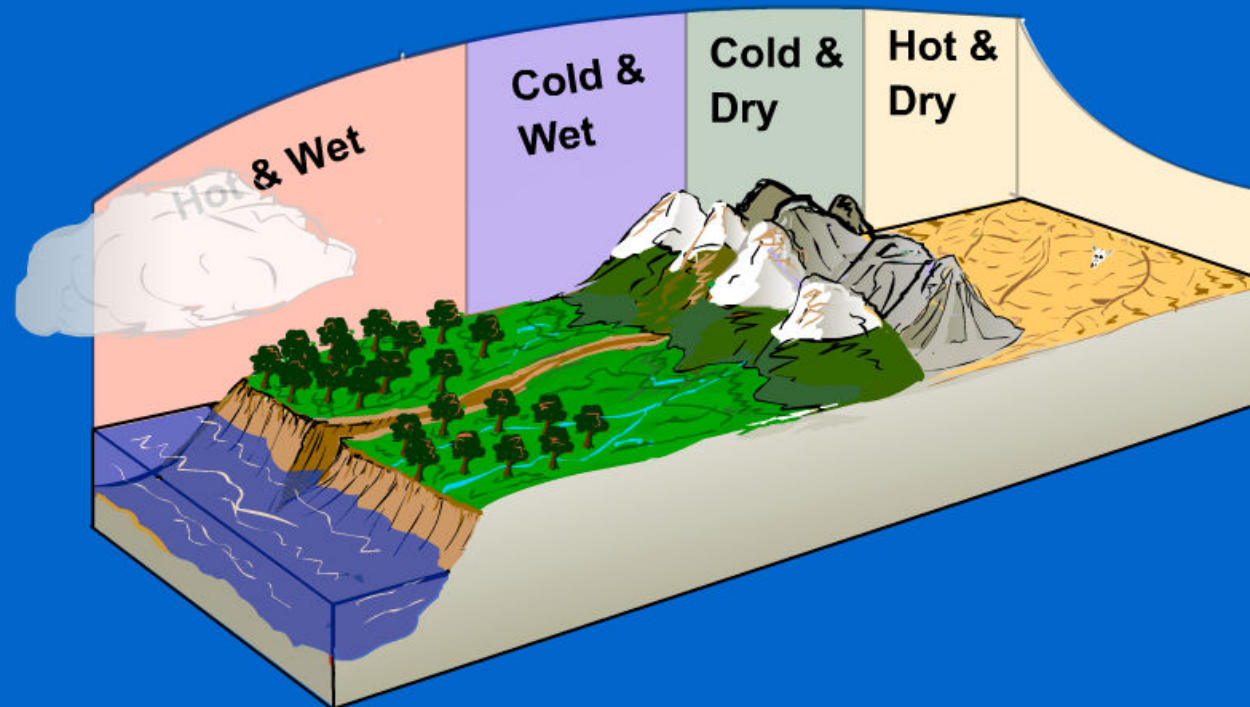


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## Weathering & Climate



[http://www.as.uky.edu/academics/departments\\_programs/EarthEnvironmentalSciences/EarthEnvironmentalSciences/Educational%20Materials/Documents/elearning/module07swf.swf](http://www.as.uky.edu/academics/departments_programs/EarthEnvironmentalSciences/EarthEnvironmentalSciences/Educational%20Materials/Documents/elearning/module07swf.swf)

Weathering destroys EVERYTHING







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# Classes of weathering

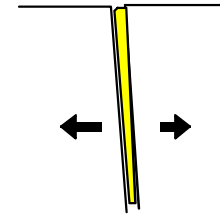
- Weathering: A group of mechanisms which modify the physical and chemical properties of rocks
- Weathering is divided into three classes:
  - **Physical**: changes the morphology, resistance and texture of rocks
  - **Chemical**: changes the composition and chemical structure of rocks
  - **Biological**: the activity of living beings can change the composition and chemical structure of rocks

# Physical weathering

## Mechanical processes

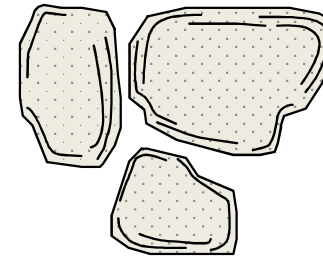
### Expansion pressure

*Cristal growth in pores and fractures*  
*Squeezing of water: an increase of 9% volume*  
*Salts: crystalization causes expansion*



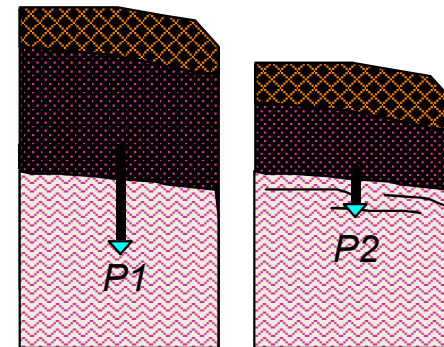
### Surficial spheroidal exfoliation

*Thermal condutivity of rocks*  
*Insolation in deserts and arid regions*  
*Variations day X night*



### Unloading fractures

*Elastic properties of rocks*  
*(+ water activity)*



# Contraction



# Dilation



A polar land subjected to expansion pressure of water



Fig. 7.12



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# Chemical weathering

- Water: principal agent of chemical weathering
- Mineral formed at deep conditions inside Earth's crust are unstable at the surface conditions
- Mineral surface stability is the opposite of the order of Bowen series



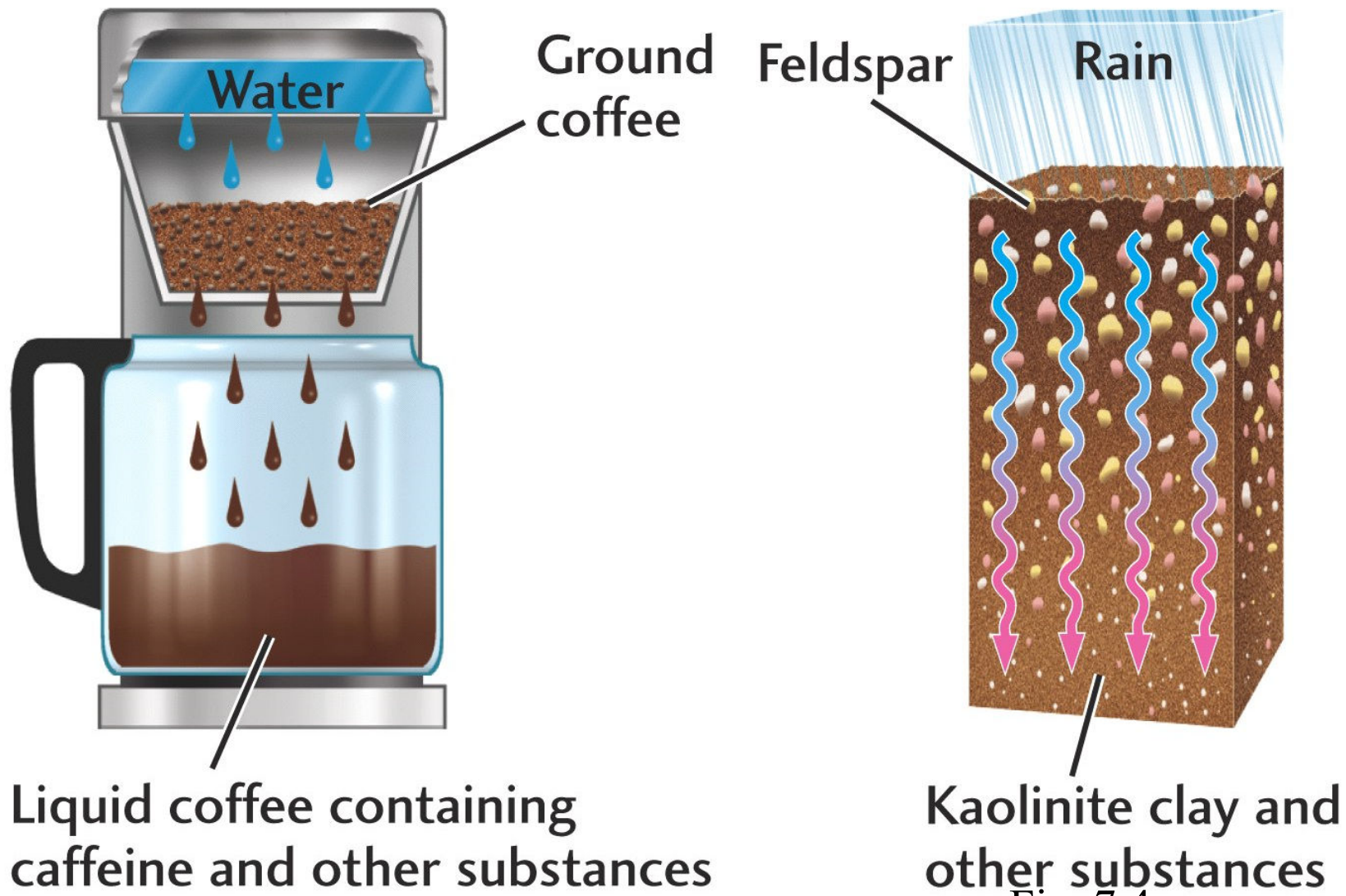
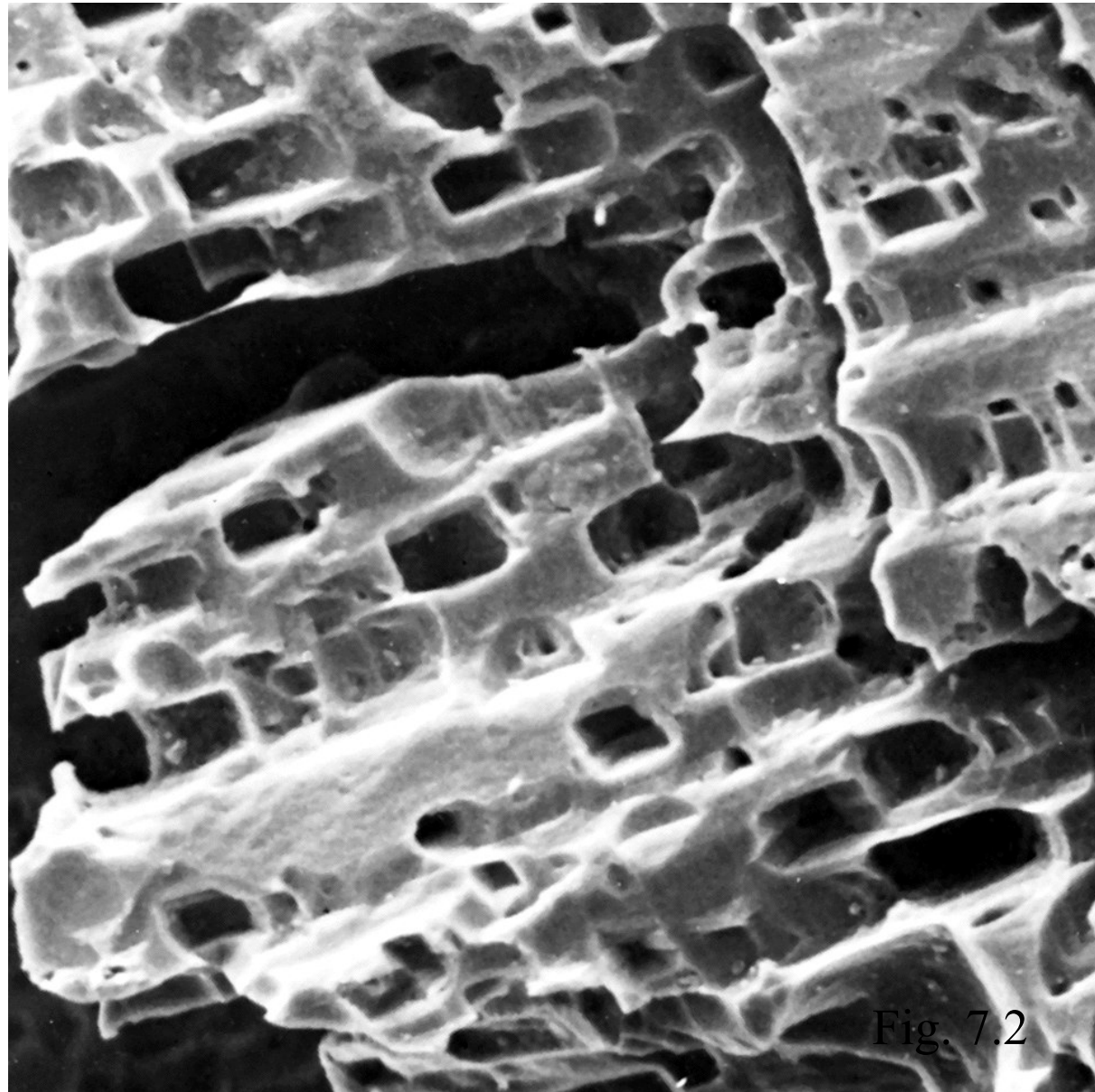


Fig. 7.4

# Chemical corrosion

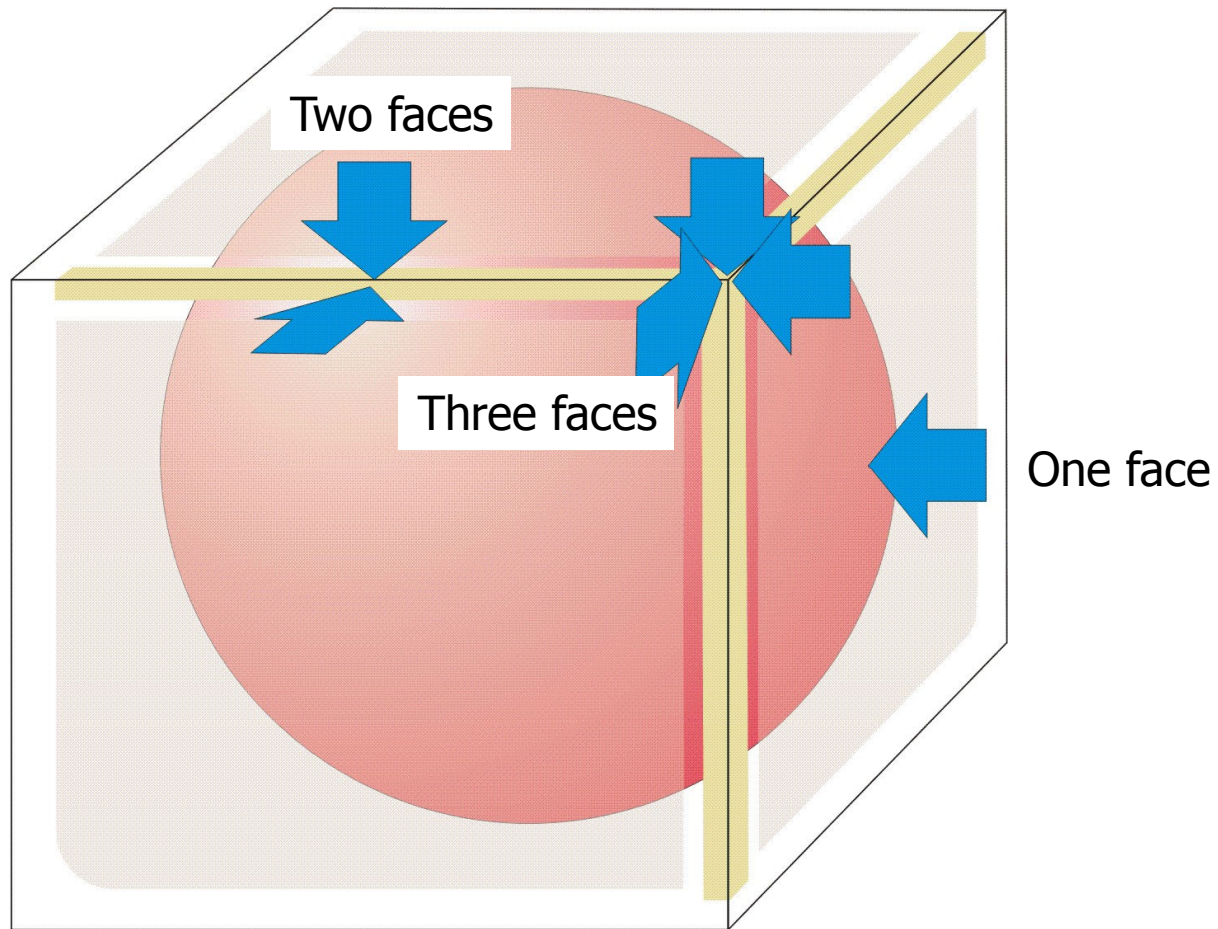






[http://rst.gsfc.nasa.gov/Sect2/Sect2\\_8.html](http://rst.gsfc.nasa.gov/Sect2/Sect2_8.html)

# Chemical attacks into particules





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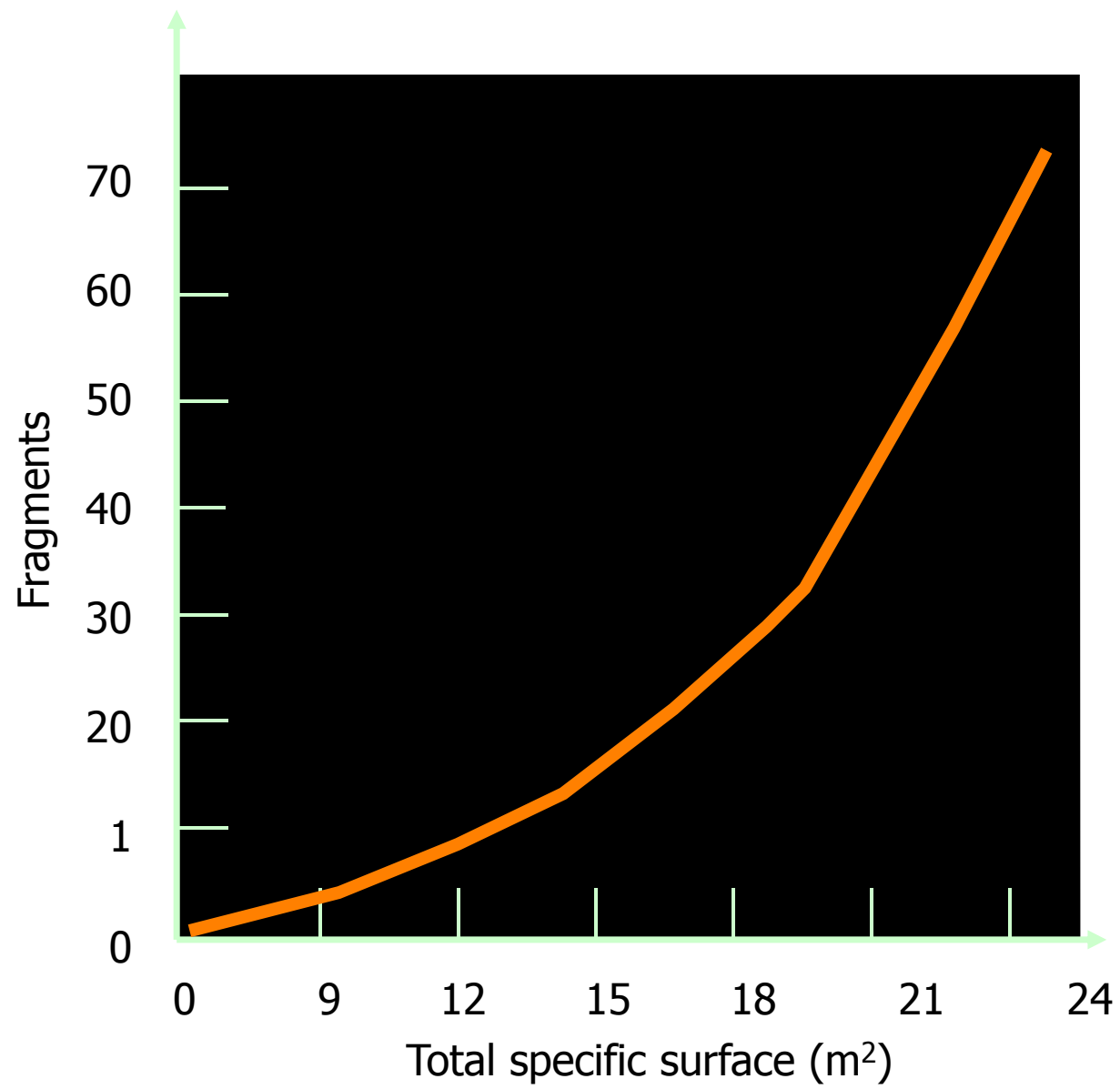
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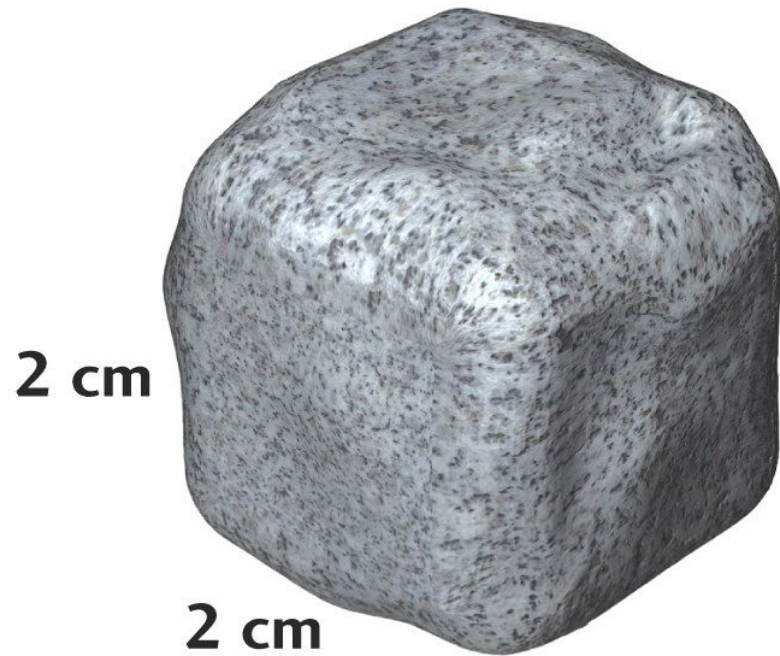


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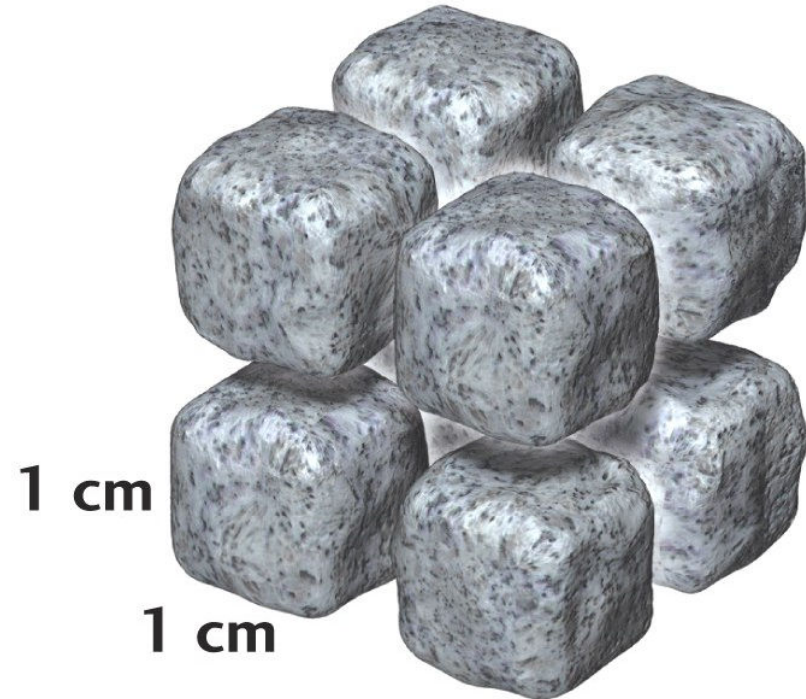
# Mineral particles suffer:

- Size reduction
  - Mudanças de composition
  - Cubos unitários ==> partículas
- Menor tamanho das partículas:
  - Acelera as transformations
  - Aumenta superfície específica
  - Facilita as reations químicas





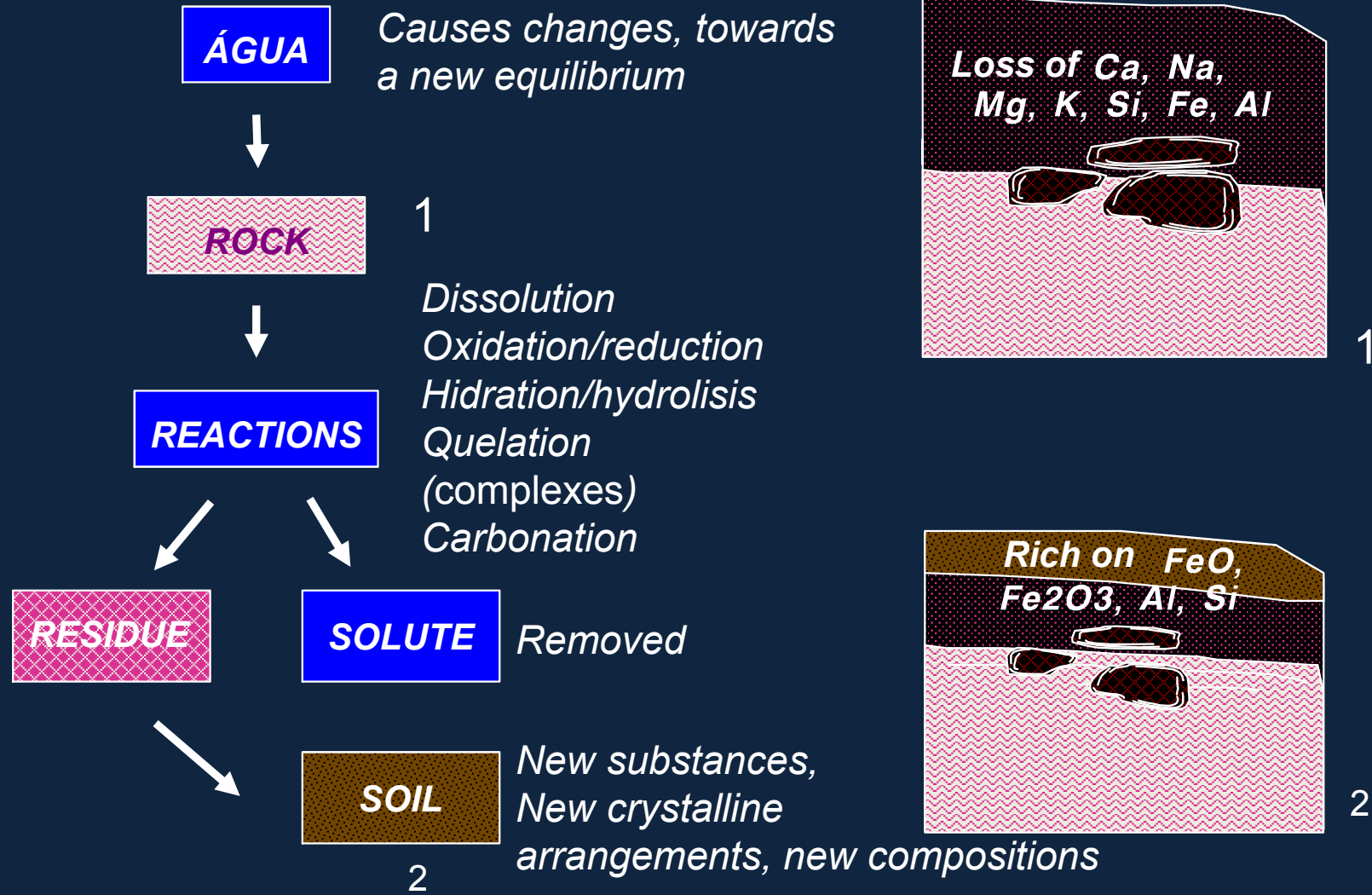
$$\begin{aligned} 2 \text{ cm} \times 2 \text{ cm} &= 4 \text{ cm}^2 \\ 4 \text{ cm}^2 \times 6 \text{ sides} &= 24 \text{ cm}^2 \\ &\text{(surface area)} \end{aligned}$$



$$\begin{aligned} 1 \text{ cm} \times 1 \text{ cm} &= 1 \text{ cm}^2 \\ 1 \text{ cm}^2 \times 6 \text{ sides} &= 6 \text{ cm}^2 \\ 6 \text{ cm}^2 \times 8 \text{ cubes} &= 48 \text{ cm}^2 \\ &\text{(surface area)} \end{aligned}$$

Fig. 7.5

# Chemical weathering Processes

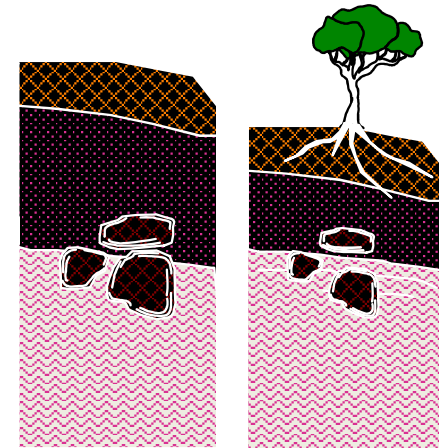


# *Biological weathering*

*Natural agents (animals and plants)*

- Auxiliary to physical and chemical processes

- Action of lichen and mosses
- Wedge action of roots
- Excavation by animals



- Important to form soils

Bacteria

- Highly active under reducing conditions
- Remove silica in tropical soils
- Form sulfides and humus (organic matter)





Fig. 7.11



# What about the boulder fields?



Campinas (SP) Rod. D. Pedro I

# A practical application...

Weathering of granite forming soils, Osasco, SP



# A PALEOCHANNEL OF TIETÊ RIVER OR AN AFFLUENT



Osasco (SP), Castello Branco Hw.

# A probable morphology for the paleochannel



Currently: decomposed boulders



# Denudation agents for the Tietê river paleochannel

- Continuous action: Complex local evolution
- Probable sequence of events
  - Formation of boulders on hills
  - Formation of a fluvial channel (paleochannel)
  - Granite bedrock
  - Filling-up of the fluvial channel by boulders
  - Abandonment of the channel by the river
  - Deepening of the river channel by erosion
  - Slow and prolonged weathering activity
  - Modern cuts by human action





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# Weathering and landscape change

- Analândia (SP)



Nothing lasts forever...

**THE END**





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