

What is a ground deformation model?

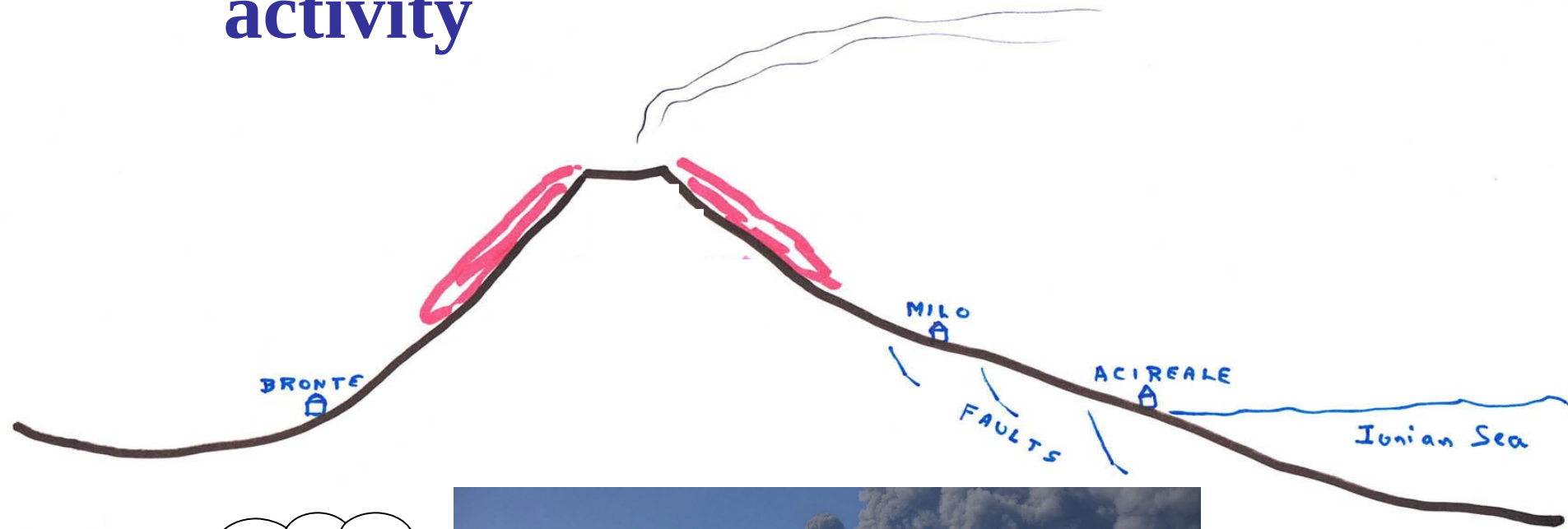
Cos'è un modello di deformazione del suolo?

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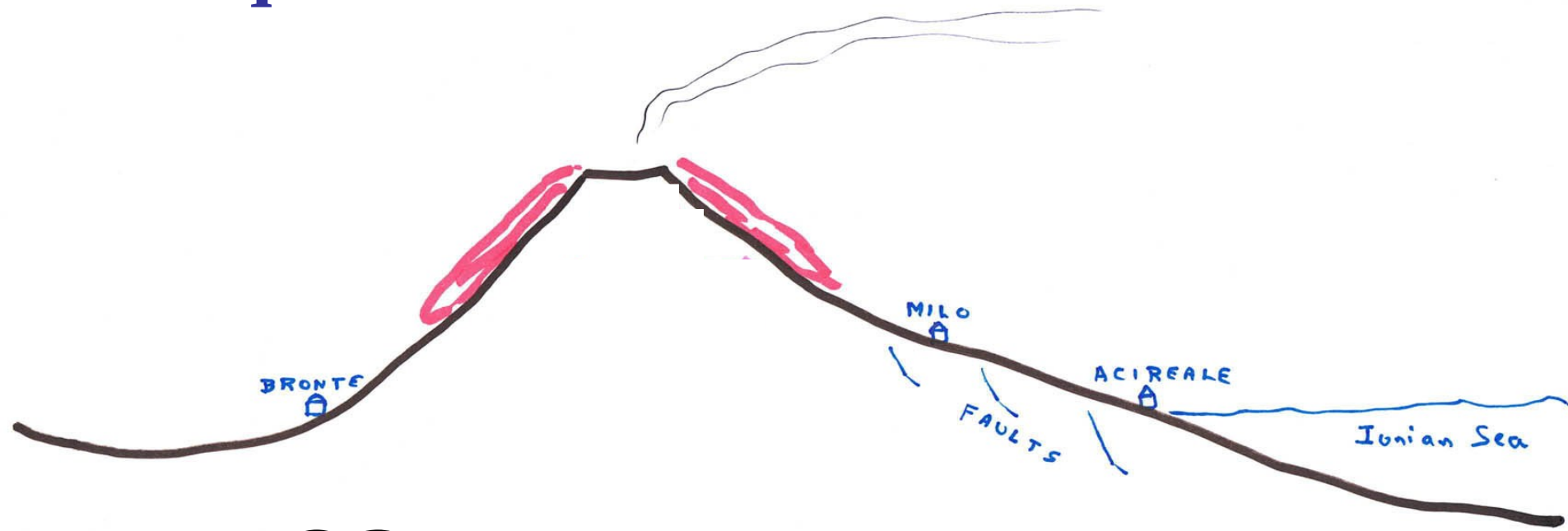
The volcanic activity



Cosa sta combinando?



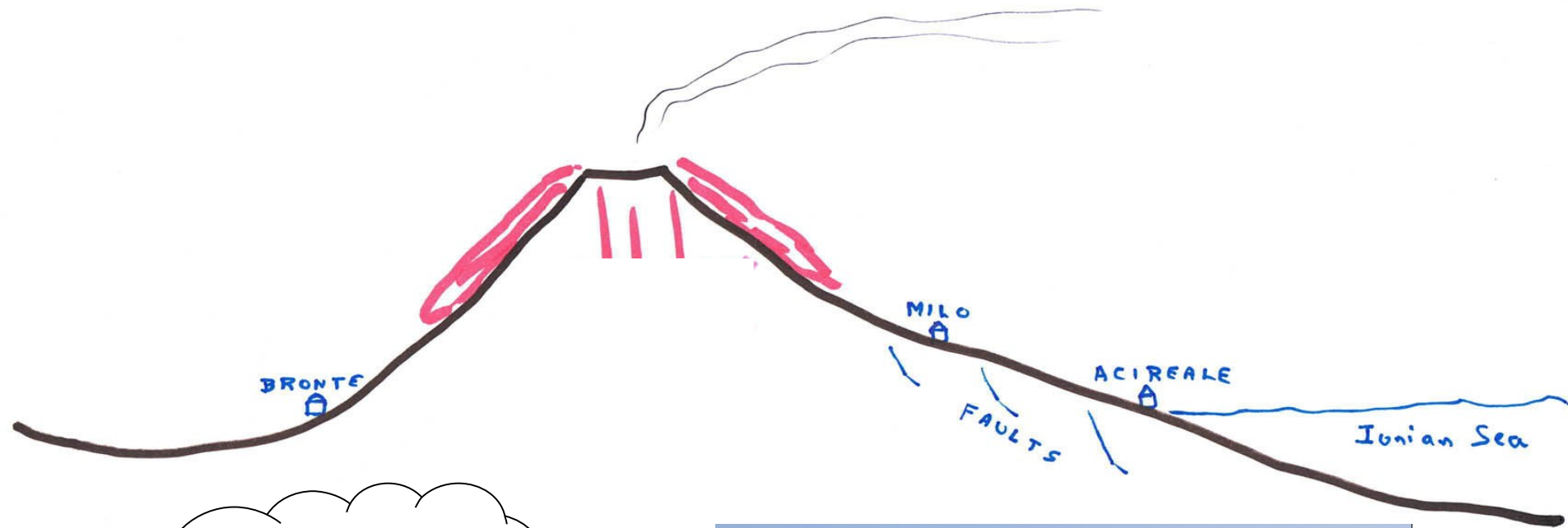
The questions



Che ci sta
dentro ? Come
funziona?



The observations



Il magma (la lava) arriva in superficie lungo fessure



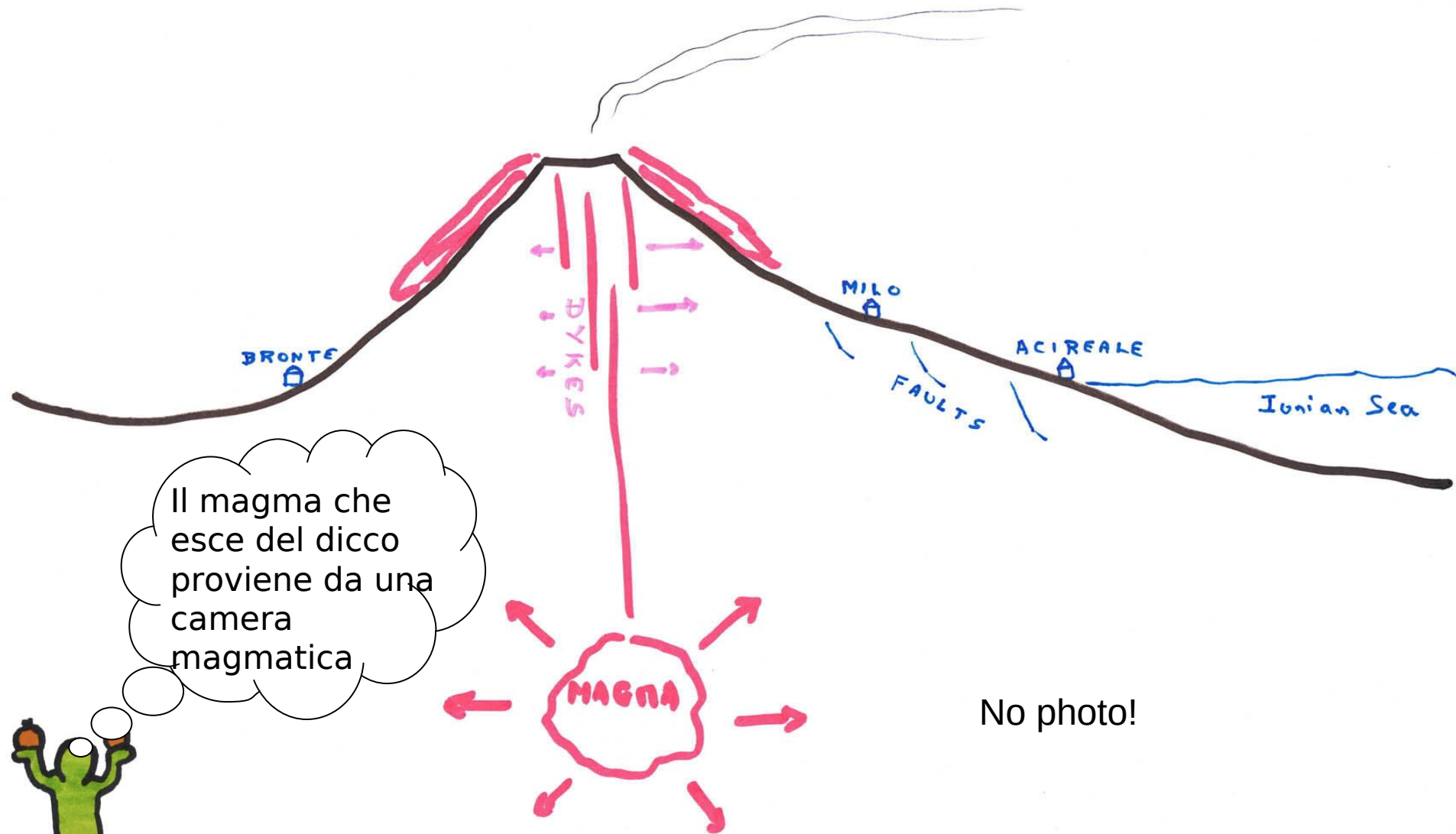
The hypothesis



Queste fessure,
chiamiamogli
dicchi, si
prolungono in
profondità



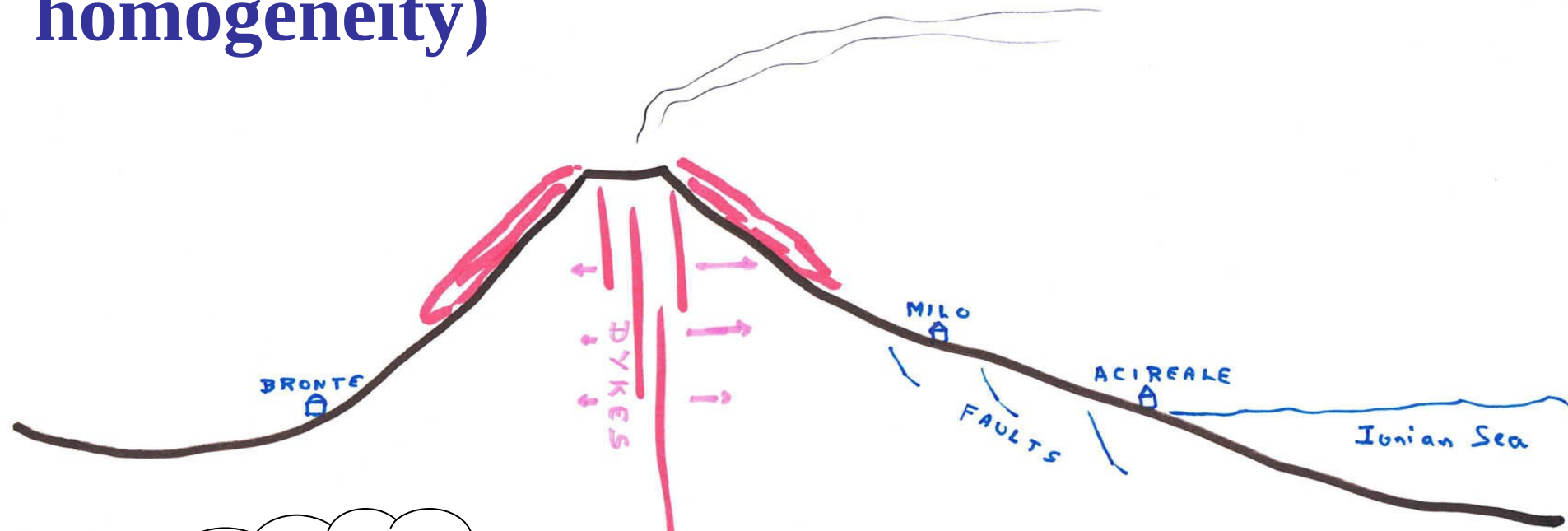
The second hypothesis



Il magma che esce del dicco proviene da una camera magmatica

No photo!

The third hypothesis (elasticity & homogeneity)



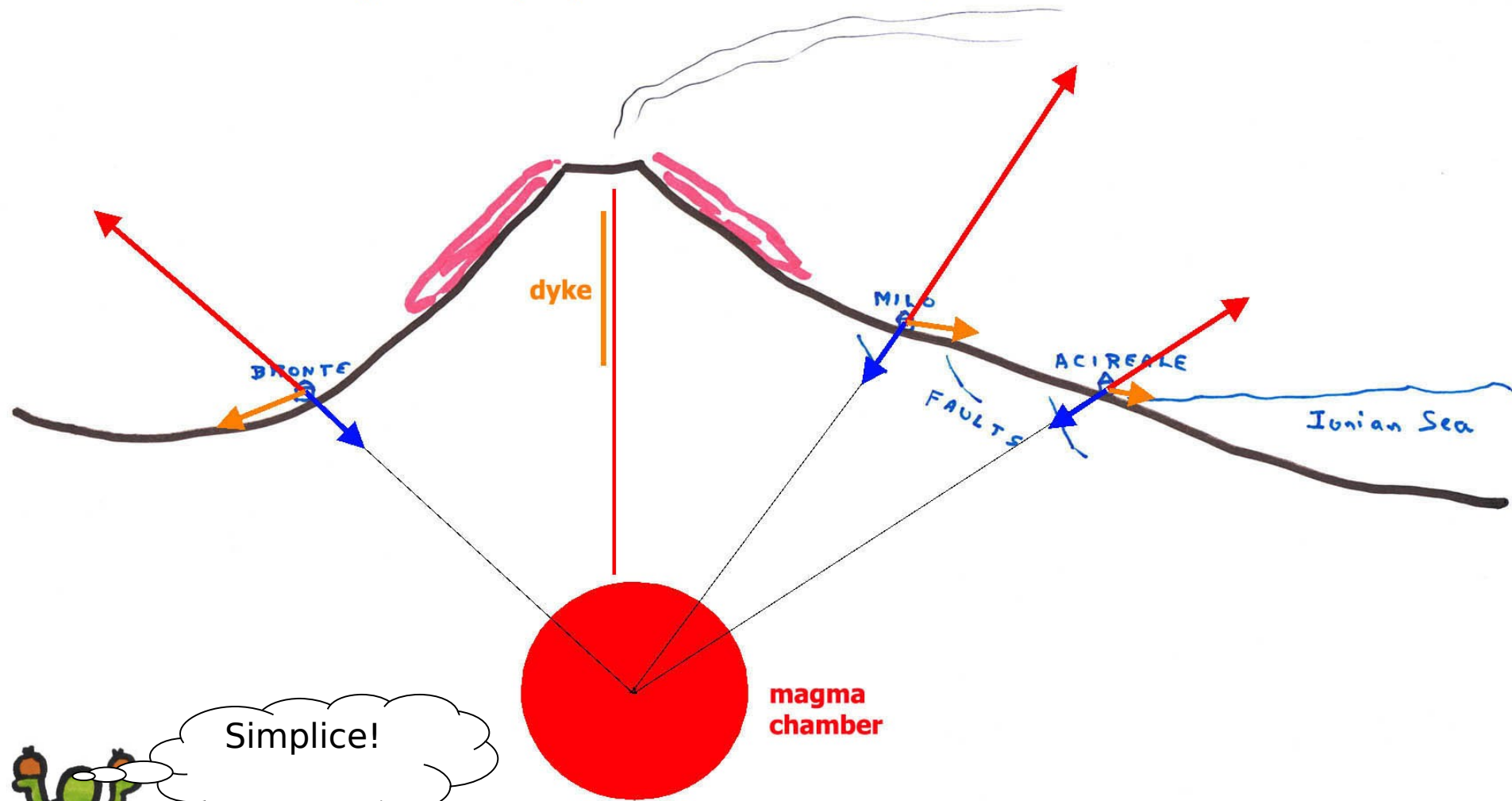
La montagna è
homogena e
elastica



La sismologia ci insegna che questa è un'ipotesi ragionevole, almeno all'inizio / Seismology teaches us that this is a reasonable hypothesis, at least to start with



The model (for the magma chamber)

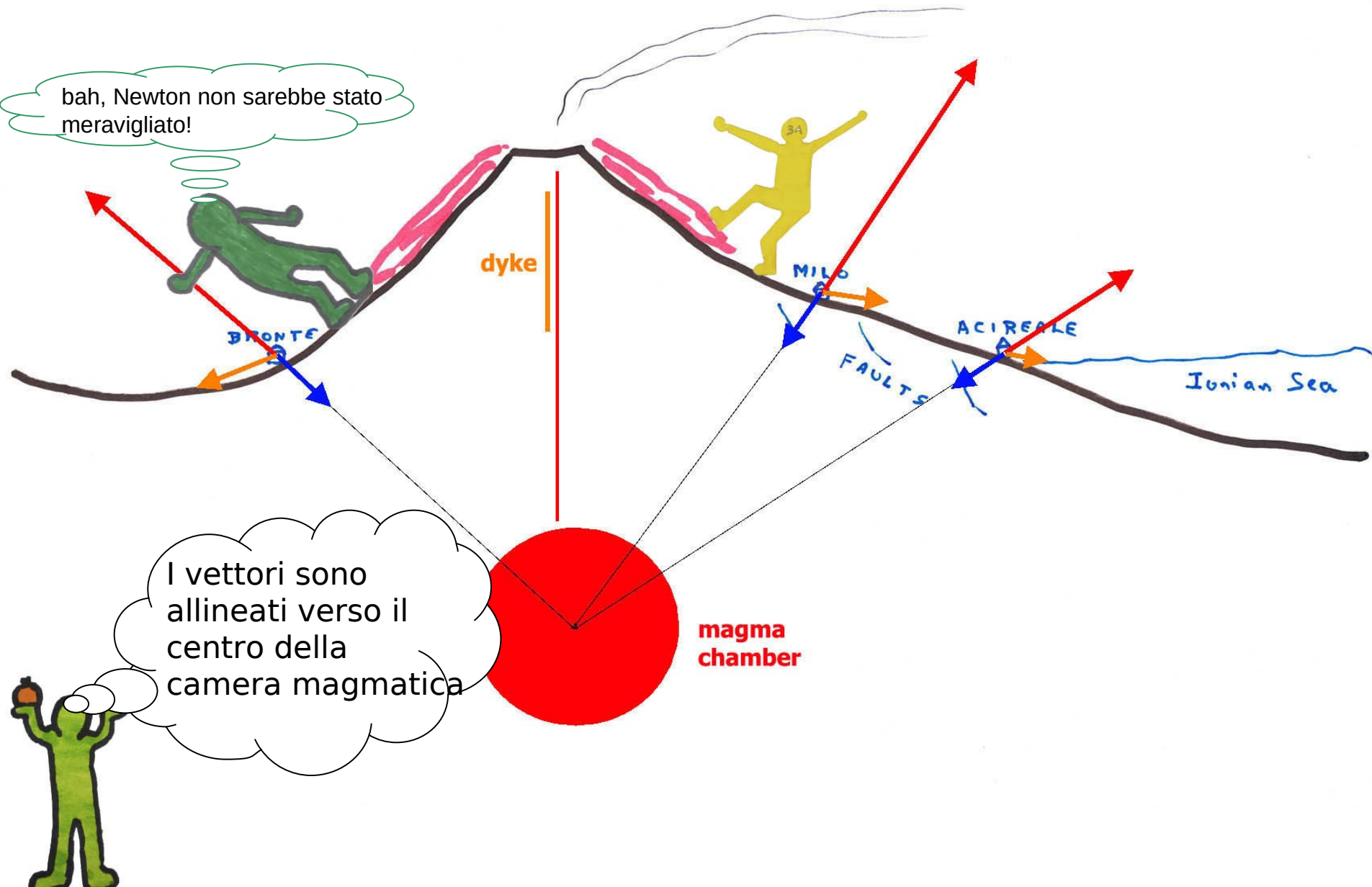


Simplice!

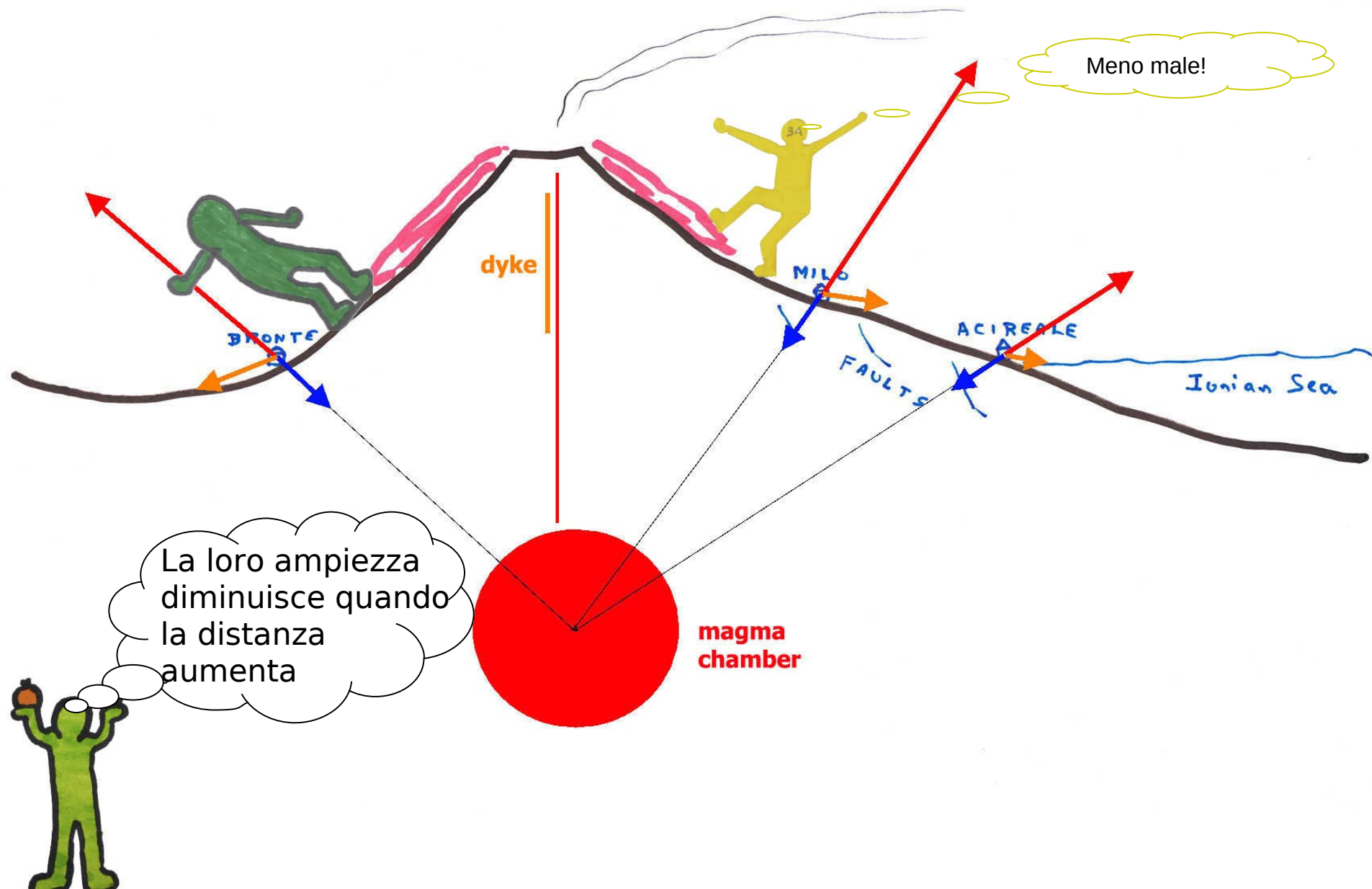
magma chamber

Ground deformation produced by a inflation of the magma chamber
Ground deformation produced by a deflation of the magma chamber
Ground deformation produced by a dyke intrusion at shallow depth

Property of the model



Another property of the model

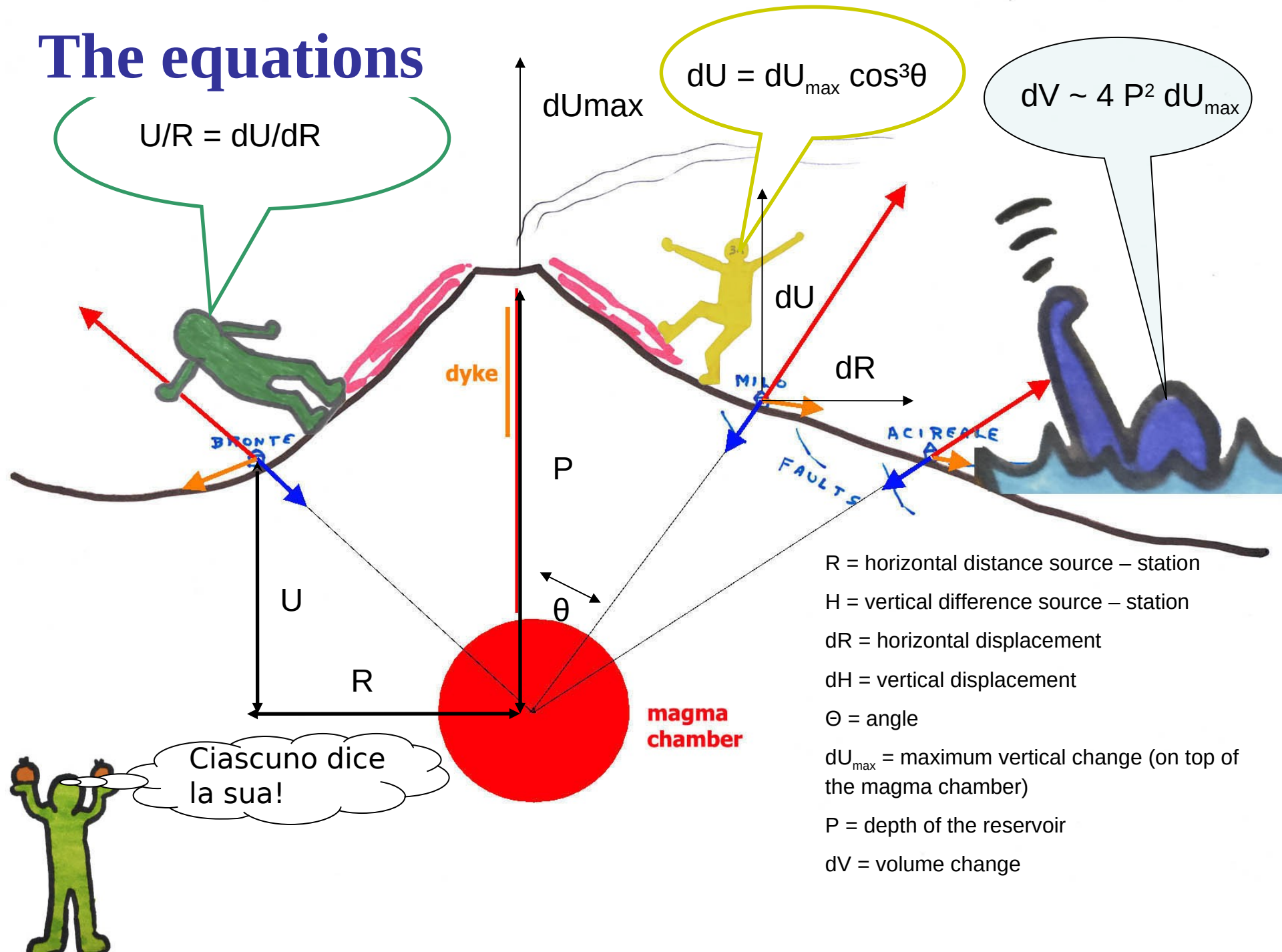


The equations

$$U/R = dU/dR$$

$$dU = dU_{\max} \cos^3 \theta$$

$$dV \sim 4 P^2 dU_{\max}$$



Ciascuno dice la sua!

R = horizontal distance source – station

H = vertical difference source – station

dR = horizontal displacement

dH = vertical displacement

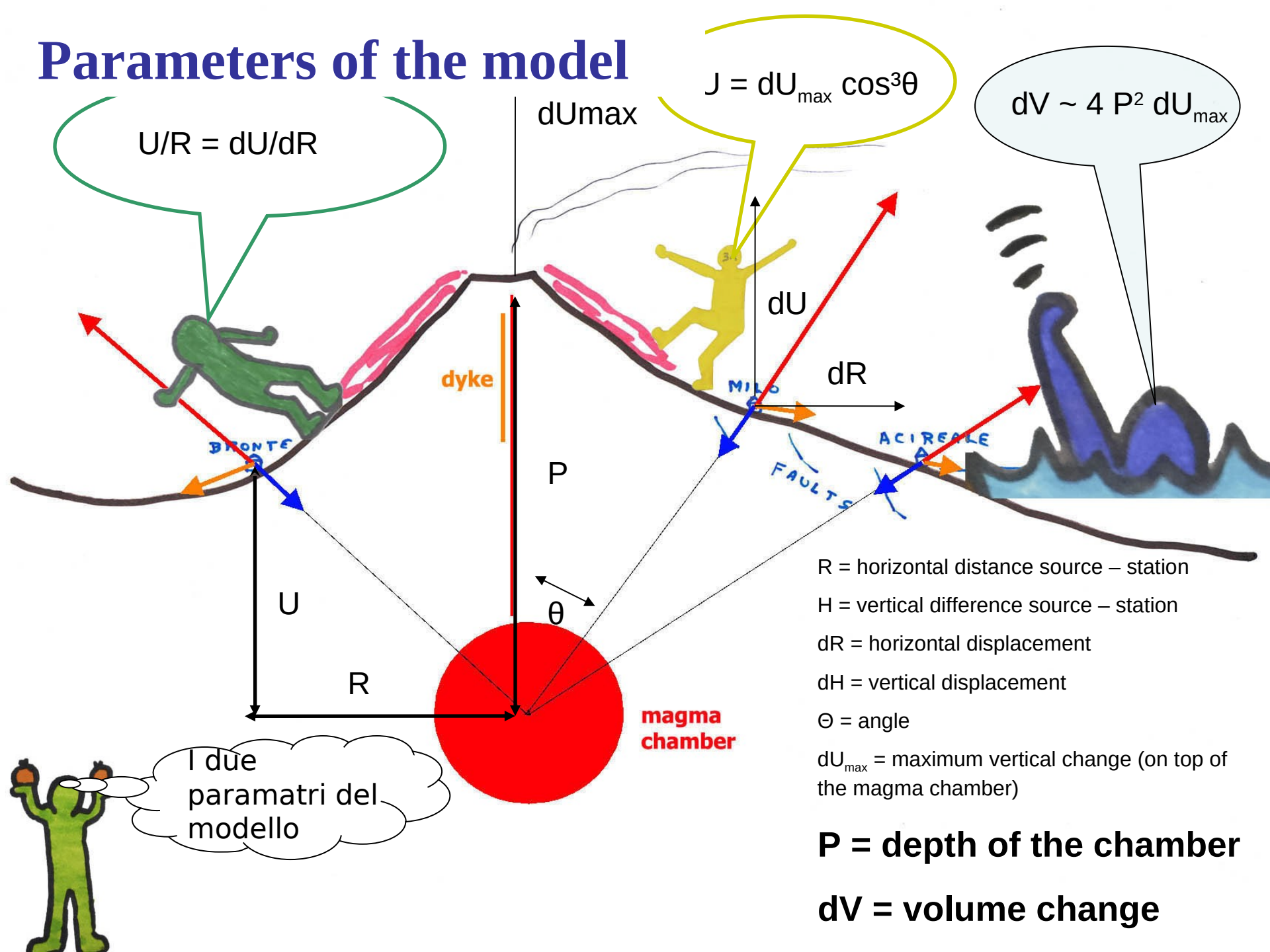
Θ = angle

dU_{\max} = maximum vertical change (on top of the magma chamber)

P = depth of the reservoir

dV = volume change

Parameters of the model



$$U/R = dU/dR$$

$$J = dU_{max} \cos^3 \theta$$

$$dV \sim 4 P^2 dU_{max}$$

dyke

P

BRONTE
MILO
ACIREALE
FAULTS

magma chamber

R = horizontal distance source – station

H = vertical difference source – station

dR = horizontal displacement

dH = vertical displacement

Θ = angle

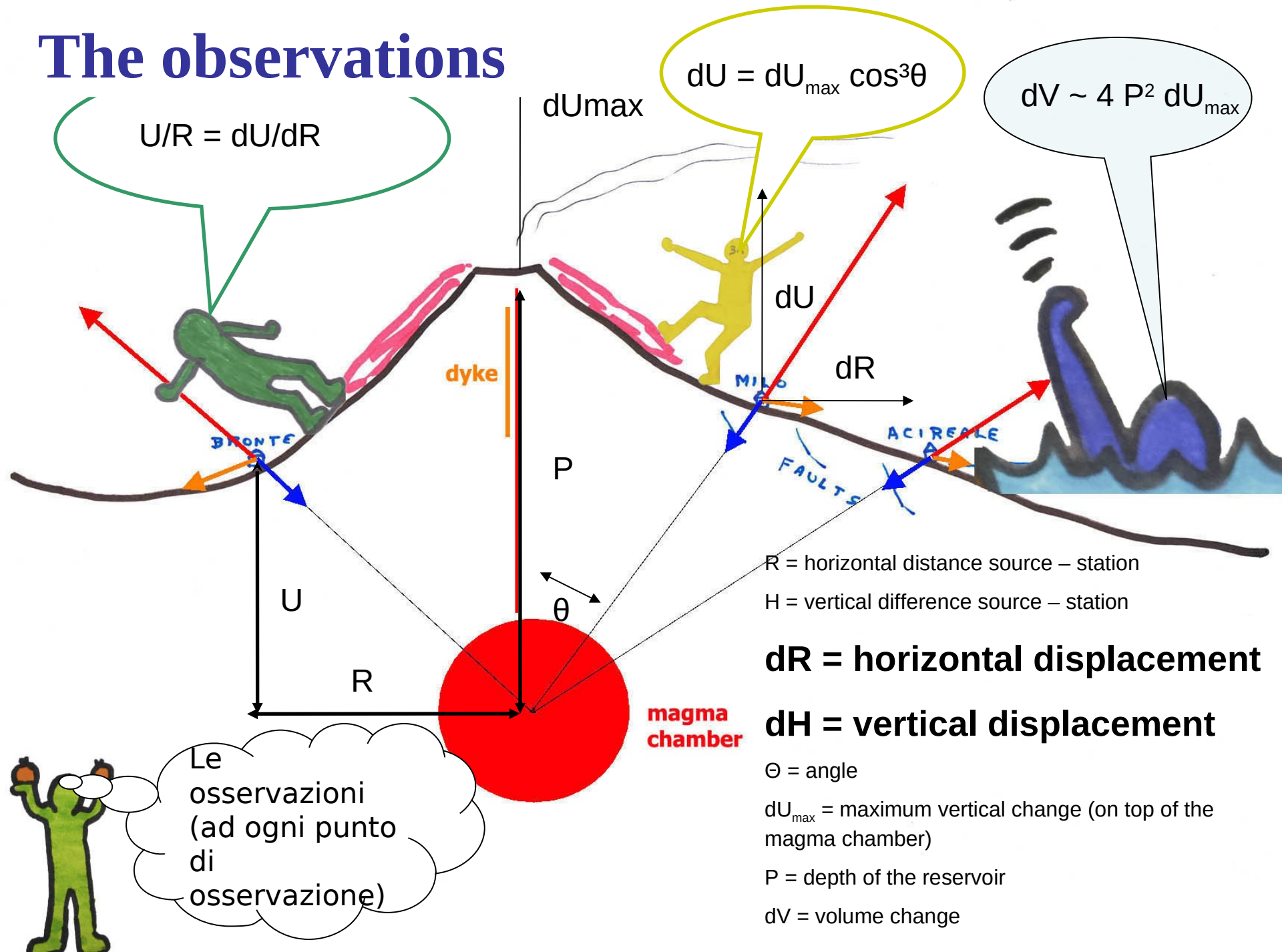
dU_{max} = maximum vertical change (on top of the magma chamber)

P = depth of the chamber

dV = volume change

I due paramatri del modello

The observations



$U/R = dU/dR$

$dU = dU_{max} \cos^3\theta$

$dV \sim 4 P^2 dU_{max}$

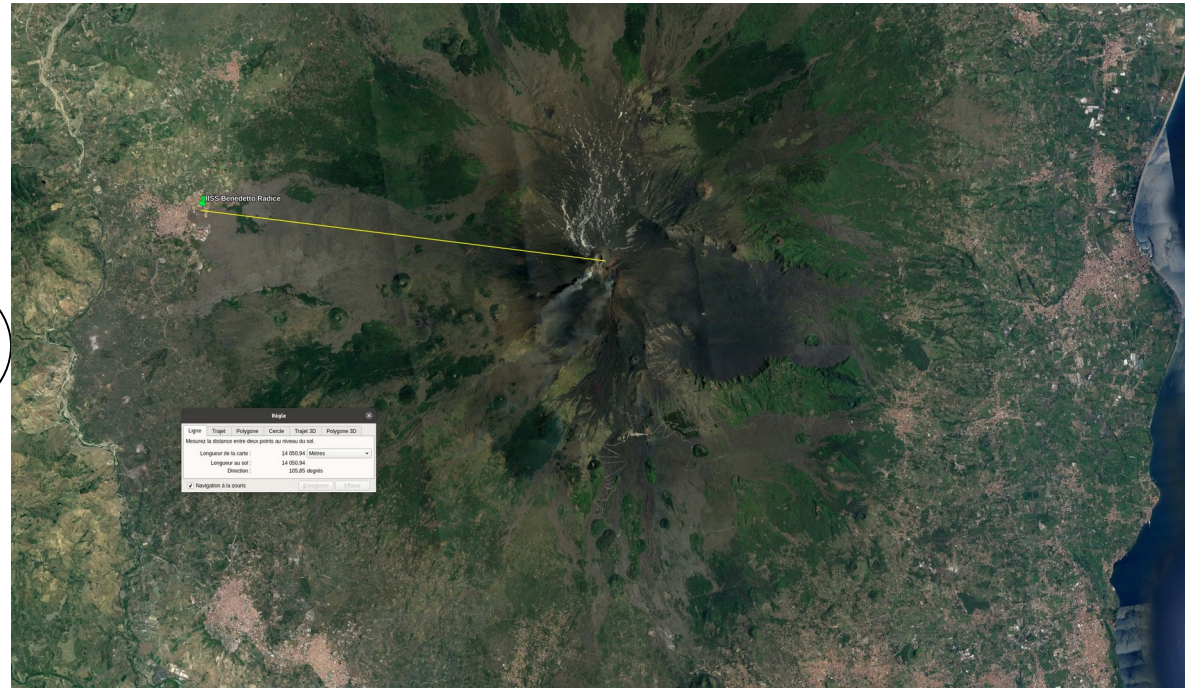
Le osservazioni (ad ogni punto di osservazione)

- R = horizontal distance source – station
- H = vertical difference source – station
- dR = horizontal displacement**
- dH = vertical displacement**
- Θ = angle
- dU_{max} = maximum vertical change (on top of the magma chamber)
- P = depth of the reservoir
- dV = volume change

Example of observation made in Bronte



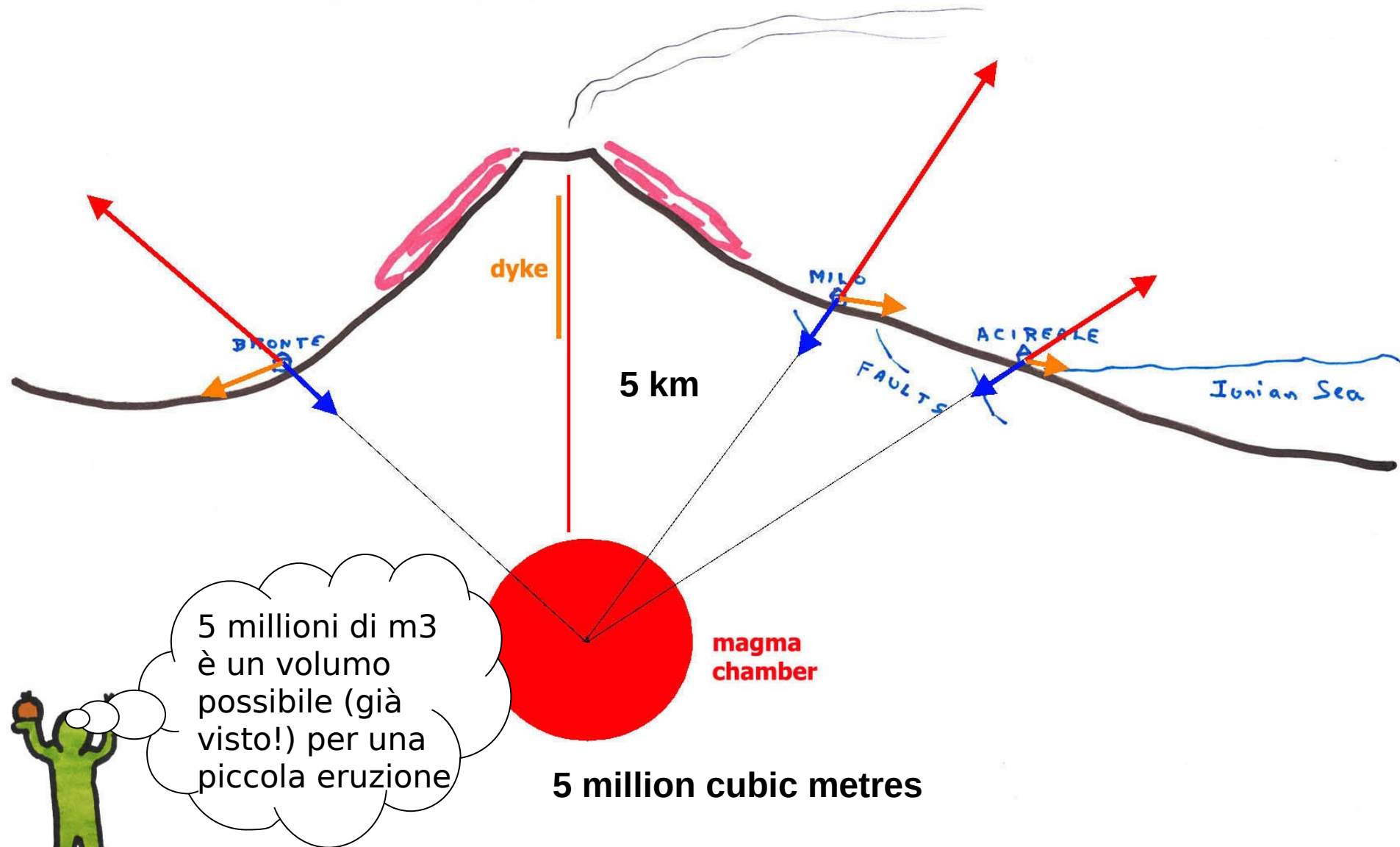
Il ricevitore GPS dell'IISS Benedetto Radice con Ugo Modica sulla terrazza



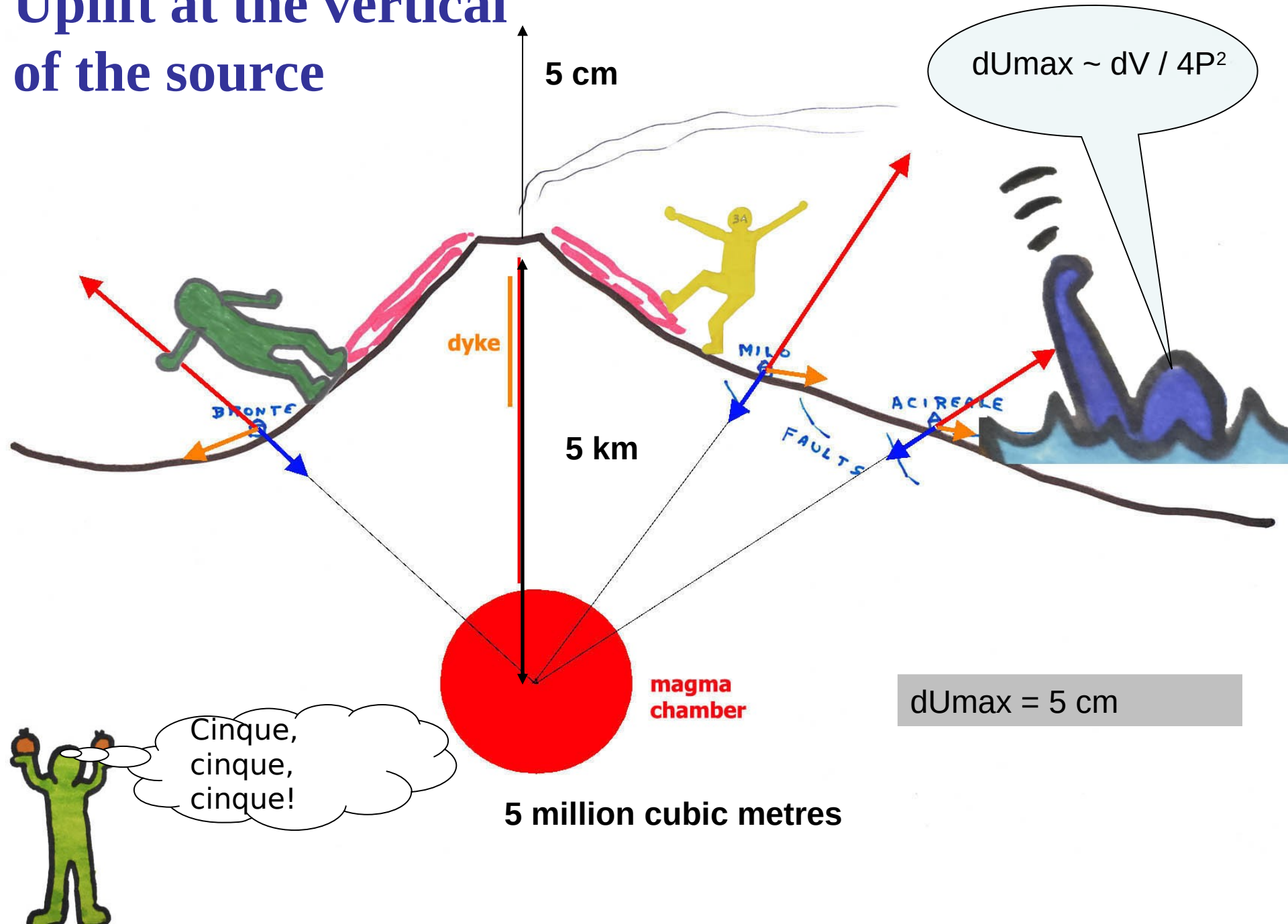
Bronte is ~14km west from the centre of Etna



Let us assume that $P = 5\text{km}$ and $dV = 5 \cdot 10^6\text{m}^3$



Uplift at the vertical of the source



$$dU_{\max} \sim dV / 4P^2$$

5 cm

dyke

5 km

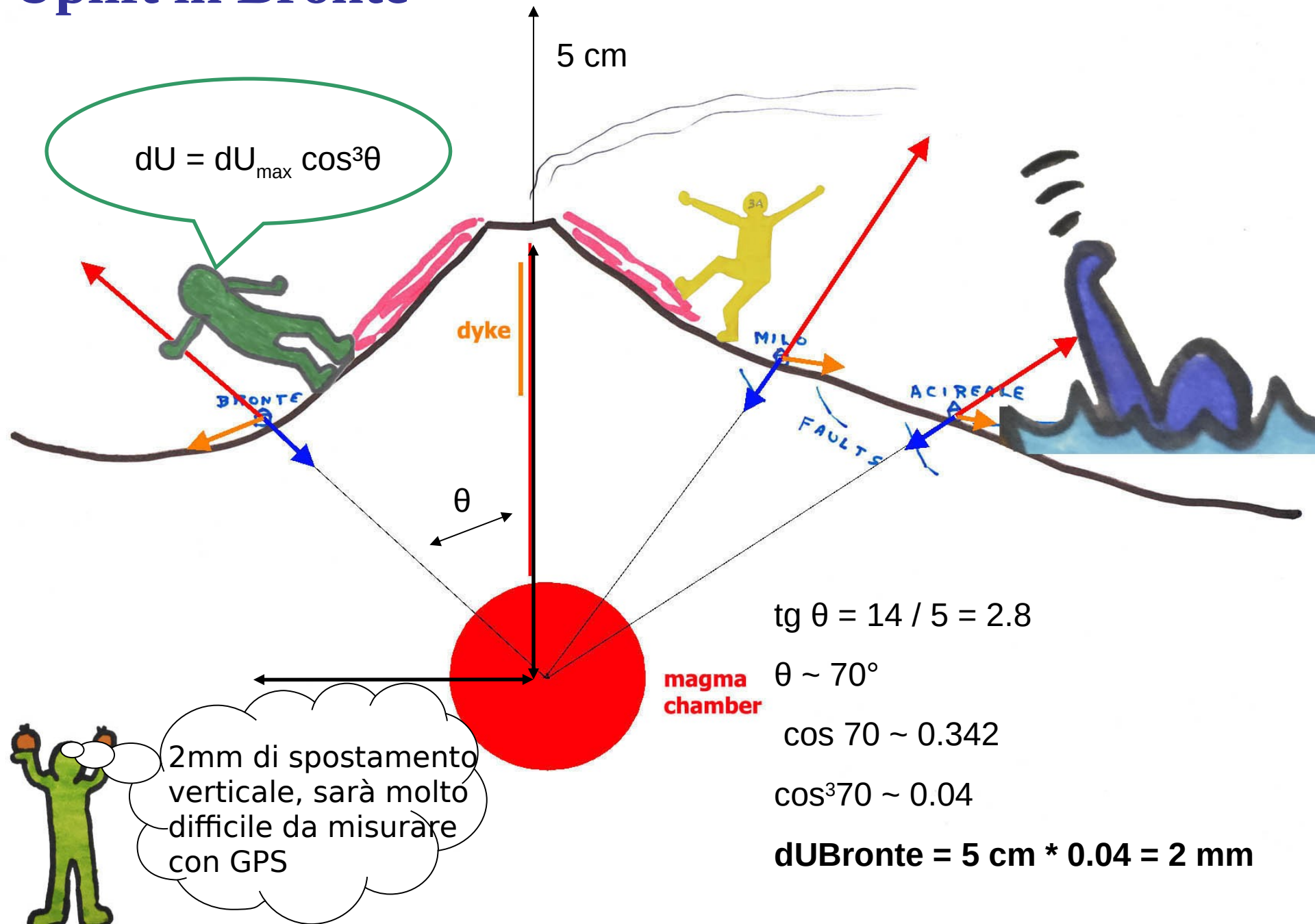
magma chamber

5 million cubic metres

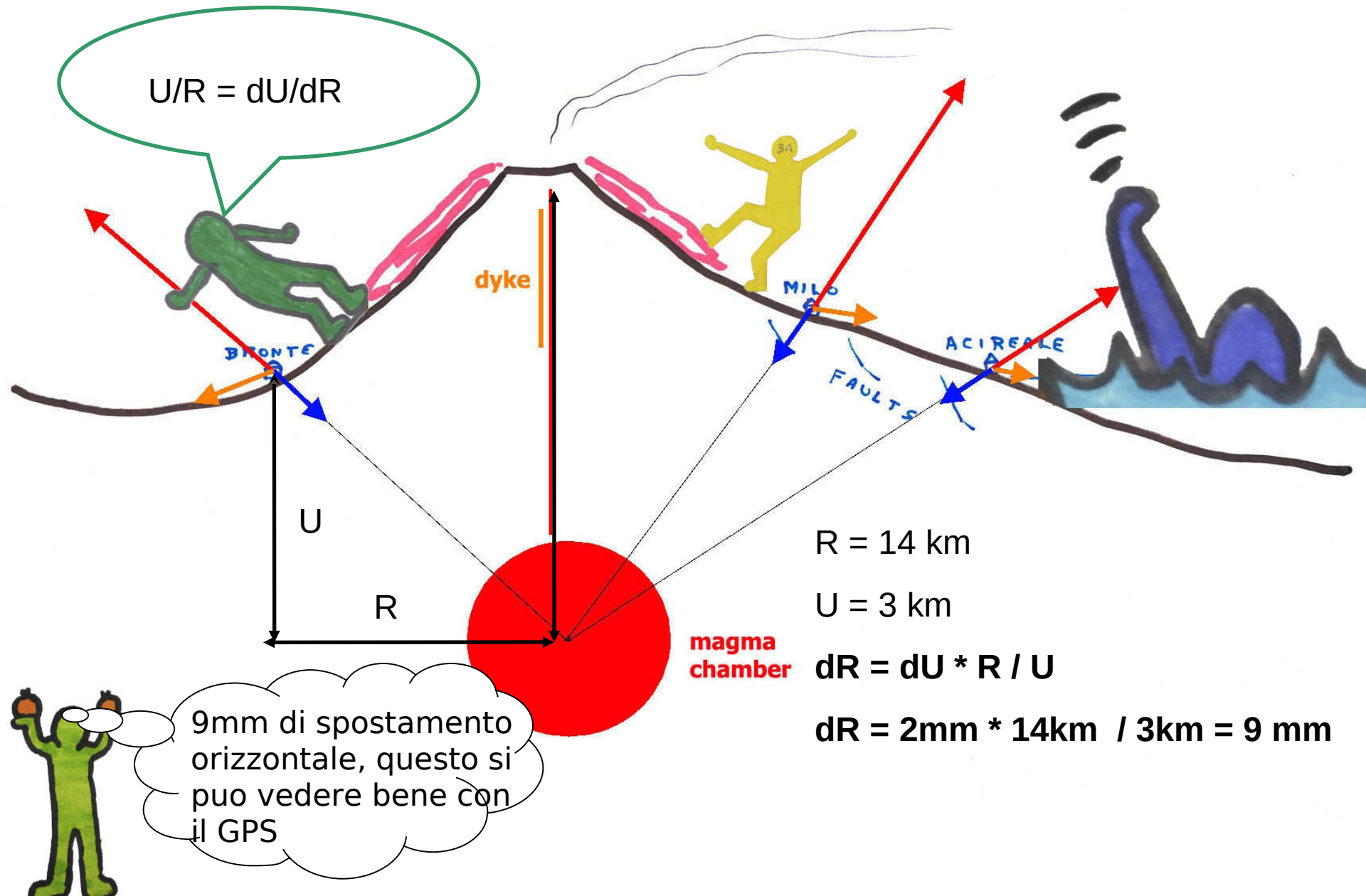
$dU_{\max} = 5 \text{ cm}$

Cinque,
cinque,
cinque!

Uplift in Bronte



Horizontal displacement in Bronte



E sarà un'altra storia!

Ciao a tutti!

