Modelling the ascent of picritic lunar magmas

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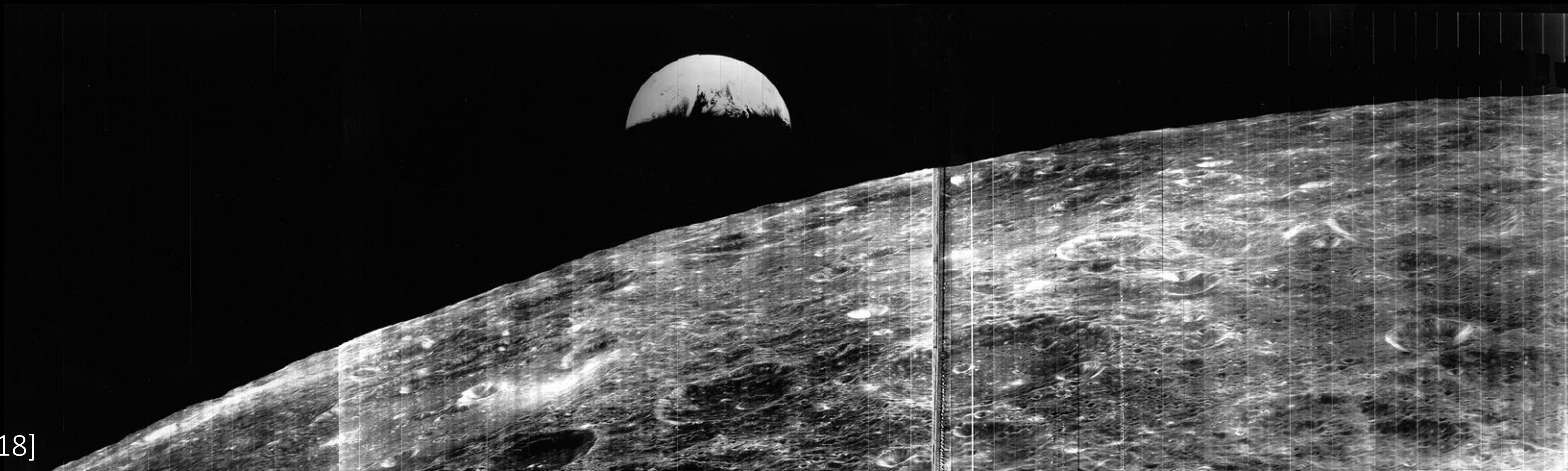
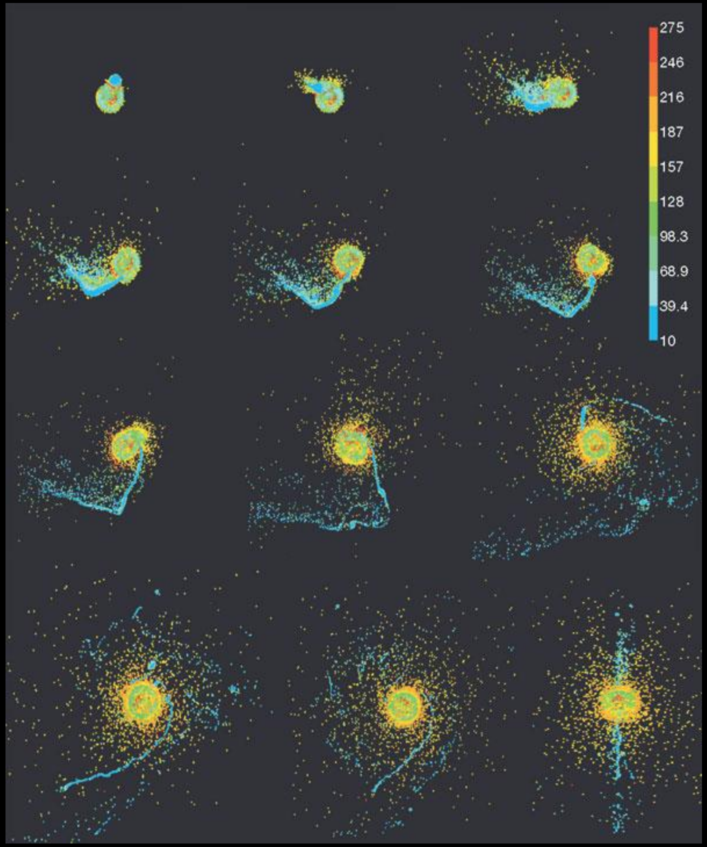


[NASA, 2018]

Introduction: using volcanology to understand lunar volatiles



Giant impact model [Canup and Asphaug, 2014].

- How volatile-rich was/is the lunar interior? (especially in the context of the evolving giant impact hypothesis)

- How did magma ascend?
(in particular, the most dense, high-Ti magmas)

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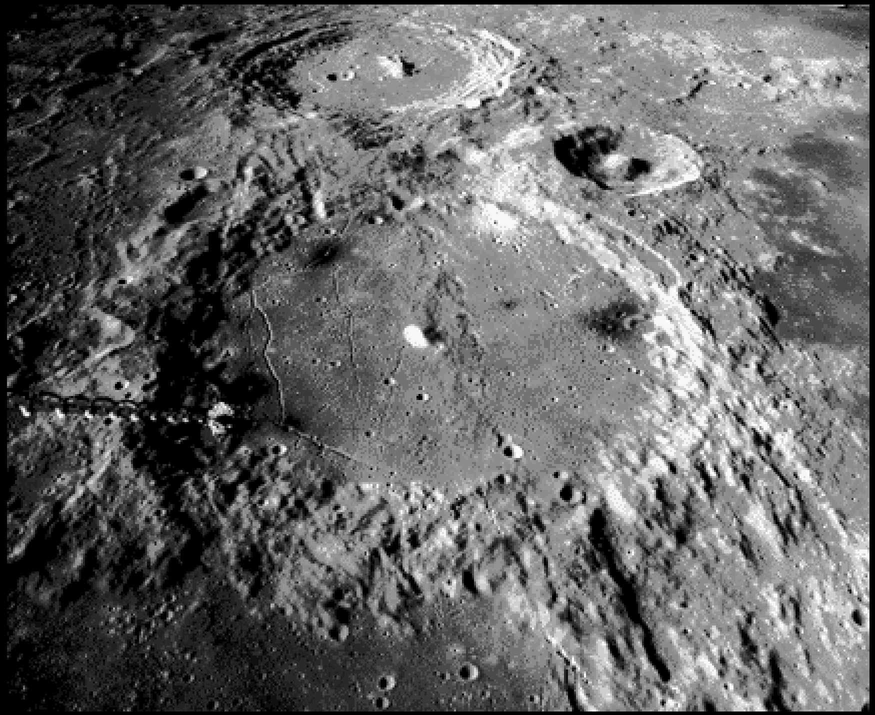

Apollo 16 image of pyroclastic deposits in Alphonsus crater [NASA, 1972].

- What were lunar volcanic eruptions like? (duration, explosivity, etc)
- Did outgassing from explosive eruptions ever form a lunar atmosphere?

Aim: to understand the role of volatiles in driving lunar magma ascent and eruption

Method: Magma Ascent Model


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ARTICLE

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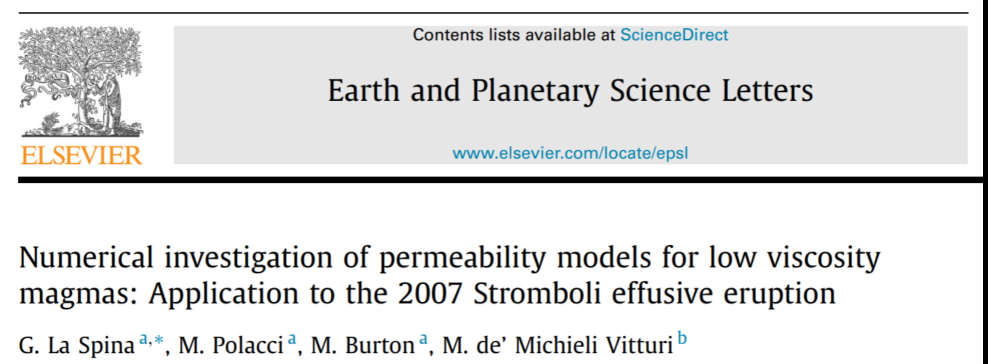
Role of syn-eruptive plagioclase disequilibrium crystallization in basaltic magma ascent dynamics

G. La Spina[1], M. Burton[1], M. de' Michieli Vitturi[2] & F. Arzilli[1]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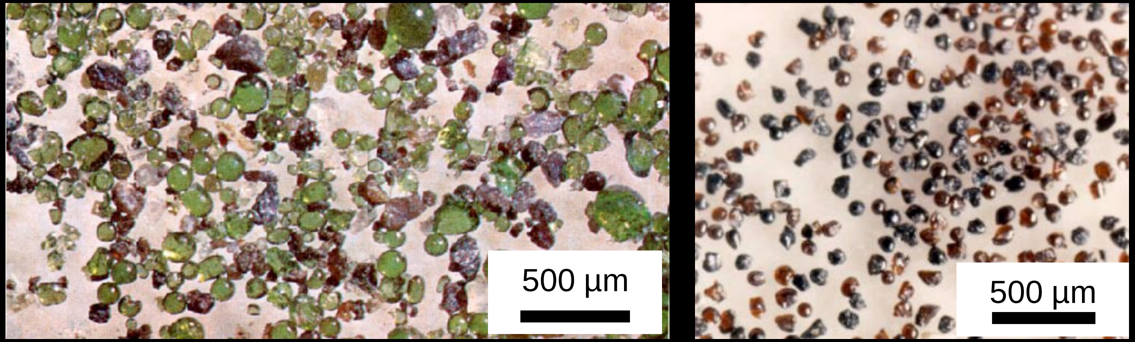
Numerical investigation of permeability models for low viscosity magmas: Application to the 2007 Stromboli effusive eruption

G. La Spina [a,*], M. Polacci [a], M. Burton [a], M. de' Michieli Vitturi [b]

- Parameters varied:
  - Magma composition: from low-Ti to high-Ti
  - Initial H_2O and CO content: based on measured and modelled values



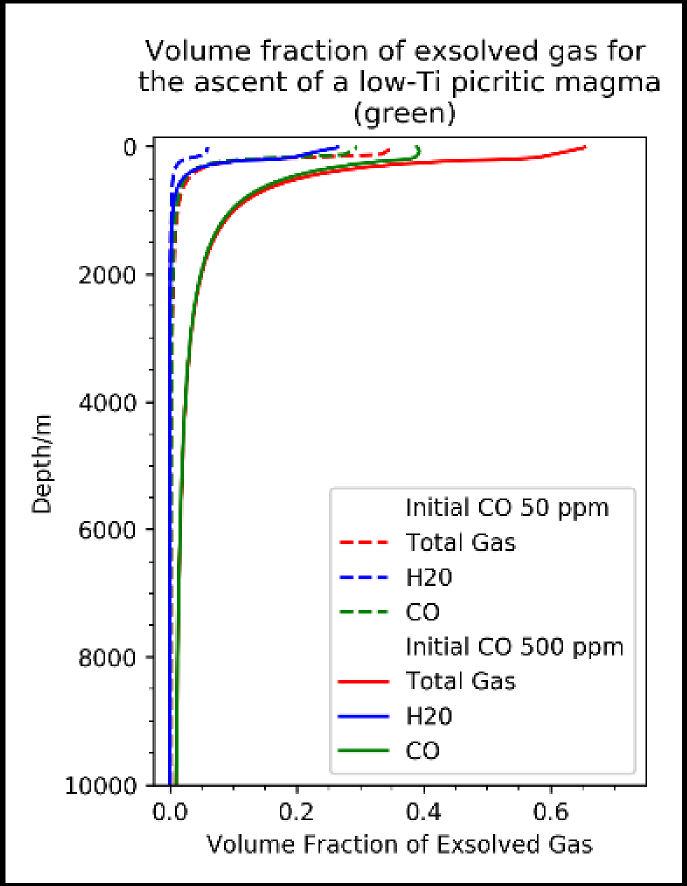
Pyroclastic glass beads from Apollo 15 and 17 missions [Carusi et al., 1972].

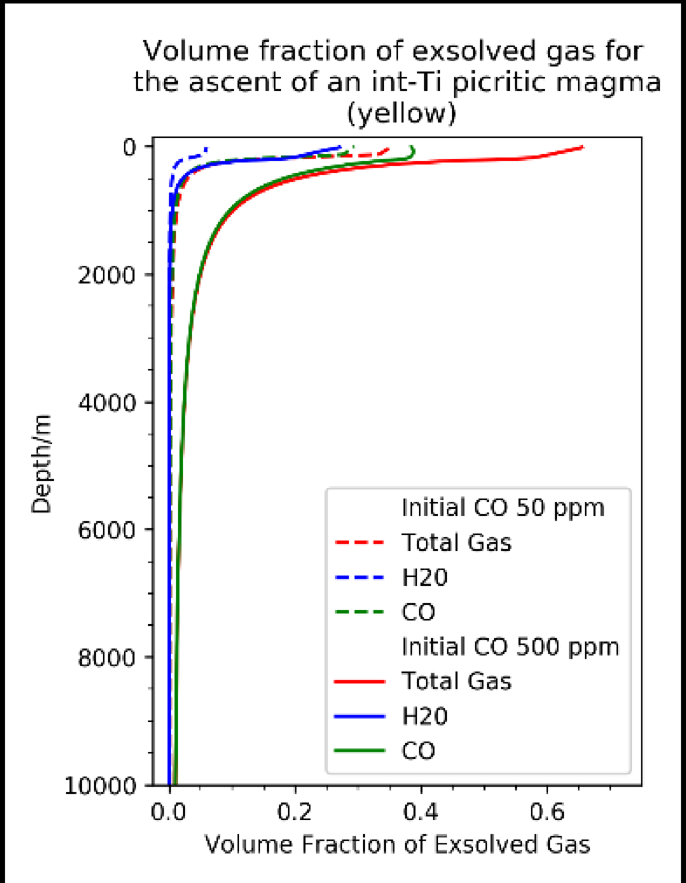
Method: Sensitivity Analysis

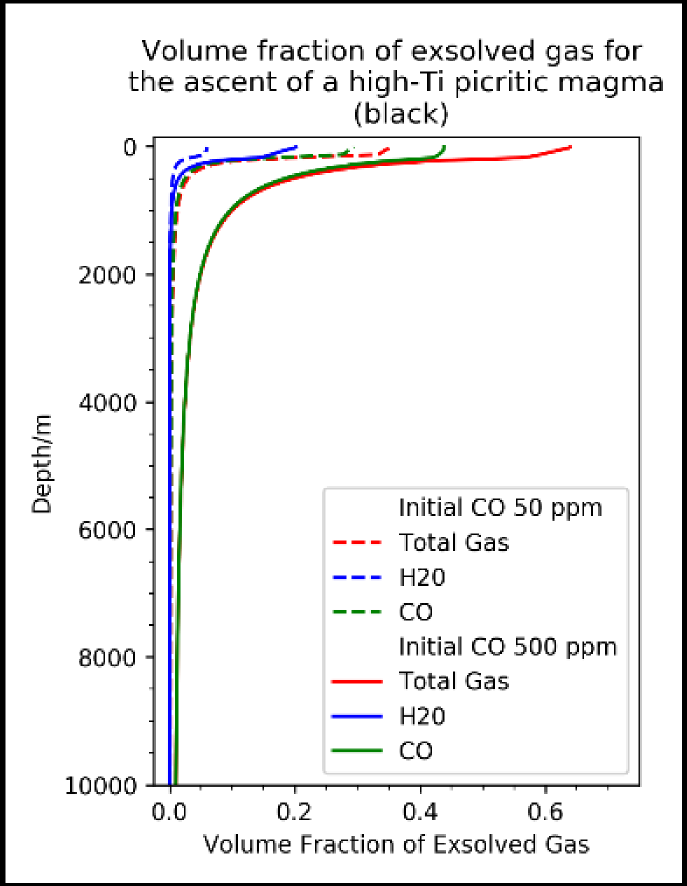
Input parameters analysed	Output parameters analysed
Temperature	Gas volume fraction
Pressure	Mass flow rate
Conduit radius	Exit velocity
H_2O content	Exit pressure
CO content	
Magma composition	

Results: Magma Ascent Model

Gas exsolution profiles:



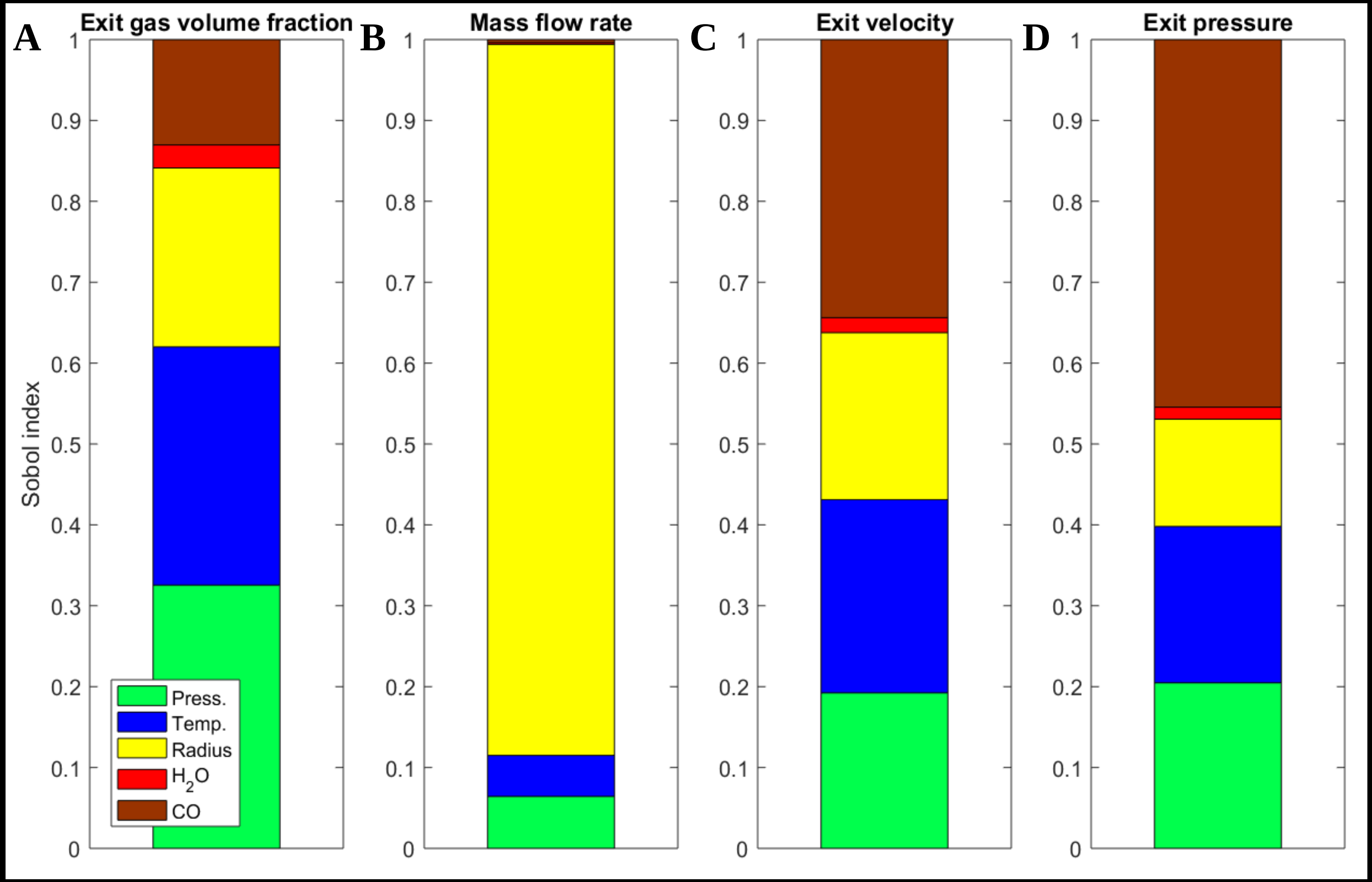




Results: Sensitivity Analysis

Sobol index plots:

- ➢ Very low-Ti picrite
- ➢ Shows relative importance of input parameters on selected outputs



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Conclusions

Based on magma ascent modelling and a sensitivity analysis:

- ➢ Melt composition did not have a large effect on magma ascent dynamics
- ➢ CO appears to have a stronger control on magma ascent dynamics than H_2O

Future work:

- ➢ Pyroclast dispersal model
- ➢ Ground truth models

** We have just submitted this work to JGR: Planets **

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