Volcano tectonics: spreading, and sagging etc...

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INTRODUCTION

• Volcano – tectonics
  Spreading
  Sagging
  Flank spreading
  Magma and spreading
  Tectonics and volcanics
Volcano-tectonics

Mount Haddington…

James Ross Island

an example of volcano load and substrata response...

Edifice

Ring around edifice
The factors in volcano tectonics
Spreading, Sagging, Extrusion and flank spreading

spreading

extrusion

sagging

Flank spreading
Magma – where is it?

spread

extrude

flank

sag

Cryptodome intrusion

Mass - pressure - viscosity
Spreading vs. Sagging
Spreading
sagging
Example of sagging in analogue model
Martian example: Ascraeus Mons

[Diagram showing a geological cross-section and labeled features]

- **Pre-flexural hypothetical surface**
- **Actual surface**
- **Pre-flexure base**
- **Actual base**

Labeled features:
1. [Labelled feature 1]
2. [Labelled feature 2]
3. [Labelled feature 3]
4. [Labelled feature 4]
5. [Labelled feature 5]
6. [Labelled feature 6]
Example of thrust on the flanks of Ascreaus Mons
Finite Element model of spreading / sagging
Extrusion (Socompa and Pajonales)
Extrusion and sagging at Mount Haddington
Some simple geology.....
Thrusts and strike-slip faults below Haddington

Evidence of strong fluid flow out from the volcano
Basal slip planes and fluid pathways
Simple model for Haddinton
Water escape on MARS
Martian analogue....
Flank spreading: Casita

1987

1998
Numerical model

ELFEN Finite element elastoplastic models

- strain localised = faults
- adaptive remeshing = large displacements

Contours of plastic strain:
- Low
- High

Fault

Pre-deformed shape

Unaltered cone

Altered area
Volcano + tectonic interactions
Strike-slip
Contractional tectonics
Explanation
Spreading structures

Big intrusions

Model with spreading, and intrusion

Intrusive system (type I & II volcanoes)

Natural case: example of Concepcion (Nicaragua)
Example of model

L2, T=35 minutes

schematic cross section

5cm

20°

0.7cm ductile layer

intrusion

collapse

graben

micro fractures

transversal graben

intrusion shape

10cm
view from the top of the intrusion

excrecence
cavity

picture facing east side

flat summit

silicone
cylindrical basement
Natural Example: La Réunion Island

Big viscous intrusive complex, small fluid dykes make up a rift...
Conclusions

• Many forms of volcano tectonics
  - Spreading, sagging, extrusion, flank spreading
• Strong relationship between regional tectonics and volcano tectonics
• Strong interplay between gravity deformation and magma intrusions
• Volcano-tectonics can cause collapse and debris avalanches
• Useful for studying other planets, and our own...
• Still much more to find out.

Field work, modelling, geophysical exploration etc...