Pre-eruptive ground deformation of Azerbaijan mud volcanoes detected through satellite radar interferometry (DInSAR)

Tectonophysics 637 (2014) 163–177

Speaker: Yi-Huei, Cho
Advisor: Loung-Yie, Tsai
Date: 2016/12/08
Outline

• Introduction
• Method
• Result and Discussion
• Conclusion
• Future Work
• References
Introduction
Introduction
Introduction

TRIGGERS

Eruption
Introduction

• Mud volcano eruption: deeply buried sediments, saline waters, gases (CH$_4$), mud and fragments of country rock.

• Mud volcanoes are usually developed at convergent plate margins.
  (Brown, 1990; Higgins and Saunders, 1974; Kopf, 2002)
Introduction

• The eastern Greater Caucasus in Azerbaijan hosts the highest density of mud volcanoes in the world. (Jakubov et al., 1971; Guliyev and Feizullayev, 1997)

• Using the differential interferometry (DInSAR) technique applied to ENVISAT data.
Method

• Two Synthetic Aperture Radar (SAR) image → DInSAR -----------------(Hanssen, 2001)

• Two SAR image → InSAR → DTM → Time

   → Differential → DInSAR

• Line of Sight, LOS 衛星視距方向
Method

- Two SAR → DInSAR -----------------(Hanssen, 2001)

\[ \Delta \phi_{\text{Int}} = \left( \varphi_{\text{Topo}} + \varphi_{\text{Mov}} + \varphi_{\text{Atm}} + \varphi_{\text{Noise}} \right) + 2k\pi. \]

- \( \varphi_{\text{Topo}} \): the effect of the different positions of the sensor at each acquisition time named topographic component.
- \( \varphi_{\text{Mov}} \): deformation contribution.
- \( \varphi_{\text{Atm}} \): the effect of atmospheric propagation.
- \( \varphi_{\text{Noise}} \): is the sum of the instrumental noise and the contribution of the physical changes of each measured object which can affect radar response.
Method
Result and Discussion

• The present study indicates that satellite radar interferometry represents a suitable tool for studying mud volcano activity.
• The results contribute to a wider understanding of the processes driving ground deformation at mud volcanoes.
Conclusion

• Ground deformation patterns of mud volcanic edifices:
  1. simultaneous uplift and subsidence areas.
  2. fluid pressure and volume variations.
  3. long eruption of mud volcanoes
     → subsurface fluid–mud inflation and redistribution
Conclusion

• Mud volcanoes and magmatic volcanoes display some similarities:
  1. ground deformation.
  2. fluid pressure and gas volume variations.
  3. pre-eruptive stages.
Future Work
References

- title page: http://azerbaijan24.com/about/azerbaijan_cities/absheron_peninsula/mud_volcanoes/
- mud volcanoes: http://jgs.lyellcollection.org/content/168/1/49/F10.expansion.html
- Line of Sight, LOS: http://www.nhazca.it/images/satellite.jpg
THANKS FOR YOUR ATTENTION