Proposed Studentship

Volcano-tectonic modelling of magma chambers, ring-faults, unrest, and eruptions in the Tianchi Volcano, China

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Project Description:

The Tianchi (Changbaishan) Volcano, located at the boundary between China and North Korea, is widely regarded as the most dangerous volcano in China. Like other volcanoes in China, it is an intra-plate volcano. The volcano is thought to be supplied with magma from a chamber that is currently at 2-9 km depth, and most probably with a centre at around 5 km depth below the volcano. Crude estimates indicate that the chamber may be 20 km in diameter and with a volume of 600 km3. The volcano is polygenetic and complex, being partly composed of a basaltic shield and partly of a trachytic composite volcano on top of the shield, with comendite ash flows being the most recent eruptives. The Millennium eruption (VEI ≥7), which occurred at around AD 934-1085 (some narrow this range to AD938-946), produced between 96 and 172 km3 of deposits, or around 30 km3 of dense magma, and is one of the largest eruptions on Earth during the past 1100 years. A 5-km-diameter collapse caldera, the site of Heaven Lake, formed during the eruption. Subsequently, there have been as many as 6 eruptions in the Tianchi Volcano, the most recent one being in 1903, but all are disputed (recent suggestions are 1-4 eruptions during this period). The Changbaishan Volcano Observatory, operating since 1999, documented a volcanic unrest from 2002-2005, including numerous earthquakes, ground deformation, and gas emission, indicating that the shallow magma chamber and/or an associated geothermal system beneath the volcano was inflating.

The main aim of this project is to provide a volcano-tectonic model of the Tianchi Volcano and relate it to other similar volcanoes worldwide. The model includes the conditions for magma-chamber formation under intra-plate conditions, the state of stress in the volcano, and the likely volcano-tectonic evolution of the chamber and the associated volcano in the near future. In particular, the project aims at answering the following questions in view of the recent unrest:

1. What are the most likely location and size and shape of the shallow magma chamber below the volcano, and how does this information relate to current understanding of magma-chamber evolution in similar volcanoes?

2. What are the conditions for the rupture and dyke injection from the shallow magma chamber?

3. In view of the present (limited) knowledge about the internal structure of the volcano, and its state of stress, what is the likelihood that an injected dyke will reach the surface to supply magma to an eruption?

4. In case an eruption occurs, and in view of the recent deformation, seismicity, as well as magma composition and rheological properties in the past eruptions, what would be the likely volume of eruptive materials and explosivity of the eruption?

5. In view of current knowledge, including points 1-4 and information from other similar volcanoes worldwide, what is the likelihood of renewed caldera collapse during eruptions in the near future?

6. In case a caldera collapse (or slip on the existing ring fault) occurs, how would the collapse likely affect the volume and style of the eruption?

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Applicants are requested to send an additional copy of their CV directly to the lead supervisor of the project in which they are interested. Please also contact the supervisor if you have any questions about the project itself.