A Seismological Portrait of the Anomalous 1996 Bardarbunga Volcano, Iceland, Earthquake

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Summary

1. The 1996 Bardarbunga volcano earthquake was preceded by the SW rift with Tungurahua, the largest phase in Europe. An earthquake with Mw 5.6 and a strong non-double-couple (NDC) radiation pattern occurred beneath the caldera on 29 September, 1996. In January 1996, the earthquake was followed by a swarm of seismic and eruptive events. Using a 3D model of the Icelandic crust and upper mantle, we performed a full moment tensor inversion method using re-processed Green’s functions. We investigated the earthquake with a point-source full moment tensor (FMT) inversion method using re-processed long period ground motion recordings and computed synthetic seismograms for comparison with observations. We find that the earthquake had a large finite-source component in the Iceland Hotspot Project seismic experiment.

2. Background

The main event of 1996 Bardarbunga earthquake, an Mw 5.6 earthquake, was the first in a sequence of events that resulted from the caldera drop caused the earthquake. The caldera drop could have increased the pressure in the magma chamber and this indicates the presence of finite-source effects. Using a 3D model of the Icelandic crust and upper mantle, we performed a point-source full moment tensor (FMT) inversion method using re-processed Green’s functions and computed synthetic seismograms for comparison with observations. We find that the earthquake had a large finite-source component.

3. Full moment tensor complete-waveform (point-source) inversion, observations and sensitivity tests

How well point-source approximation describes moment tensor of real sources? In some cases, the point-source approximation may not be adequate. In this study, we investigated the earthquake with a point-source full moment tensor (FMT) inversion method using re-processed Green’s functions.

4. Kinematic Finite-Source Inversion

Verification of the structural model of Iceland and finite source effects

We conducted a finite-source simulation of the Bardarbunga volcano earthquake and used a 3D model of the Icelandic crust and upper mantle. We find that the earthquake had a large finite-source component.

Probabilistic finite-source inversion

We developed a finite-source simulation of the Bardarbunga volcano earthquake and used a 3D model of the Icelandic crust and upper mantle. We find that the earthquake had a large finite-source component.

5. Conclusions and references

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The area confined to the actual rupture extent by the moment tensor solution is a combination of slip on the main fault and sliding on the adjacent fault. The moment tensor solution is also used to determine the orientation of the fault plane and the orientation of the slip vector.

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