Seismic Trends in Recent Bezymianny Eruptions

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A digital broadband seismic network recorded seismic activity at Bezymianny from 2006 to 2010. This instrumentation complimented the analog monitoring network operated by the Kamchatka Branch of Geophysical Services (KBGS) by providing seismic records within a few kilometers of the summit that recorded on scale during the height of explosive eruptions and captured the very low frequency component of the ground motion. This network was in place for nine significant explosive episodes. These eruptions included short explosions of juvenile material, dome collapses and periods of sustained eruption lasting hours.

In the past two decades, Bezymianny has settled into a relatively stable eruption pattern with sub-Plinian eruptions occurring on a roughly semi-annual basis. This pattern suggests a steady state process in which each eruption returns the volcano to a similar state. After several months of quiescence, the thresholds for explosion are again exceeded and a short-lived but relatively powerful (VEI 2-3) eruption ensues. The key objective in explaining recent activity is to determine the feature(s) that are controlling this relatively unusual quasi-periodic activity. One option is that the eruption consistency reflects a very steady flux of homogeneous magma into the crustal reservoir several kilometers below the summit. Pressure builds in this reservoir until it is sufficient to ream out the conduit and erupt explosively. A second explanation holds that the lava dome that has reoccupied the crater following the catastrophic 1956 eruption is currently acting as a control gate for eruptions. This “cap” provides a constant lithospheric load and a consistent barrier in temperature, density and mechanical properties. Because the dome has changed little in the past decade it has provided a consistent threshold to overcome for eruption. These two models can be characterized, albeit oversimplified, as “bottom-driven” and “top-driven” eruption models. A critical distinction between the two models is whether eruptions are being fed from a deep source (below kilometers of conduit) or a shallow source (just under dome).

Clues to the validity of either model can be found in the eruption seismic records. In this talk we present evidence for and against these models based on eruption energies and durations, earthquake locations, precursory seismic activity, multiplet earthquakes and very long period (VLP) eruption seismicity.