# THE 1707 M8.7 HOEI EARTHQUAKE TRIGGERED THE LARGEST HISTORICAL ERUPTION OF MT. FUJI

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## How can an earthquake trigger a volcanic eruption?

Large magnitude earthquakes can trigger volcanic eruptions by static stress changes on magmatic systems or by the passage of seismic waves that may induce magmatic processes in magma chambers. Magma chambers that are already pressurized may be sensitive to the stress changes. Consequently, an eruption may be triggered.

We investigate the spatio-temporal correlation between two great Japan earthquakes, the 1703 Mw 8.2 Genroku and 1707 Mw 8.7 Hoei earthquakes, and the 1707 VEI 5 eruption of Mt. Fuji 49 days after the 1707 earthquake.

Eruptive history of Mt. Fuji and history of great Nankai Trough earthquakes

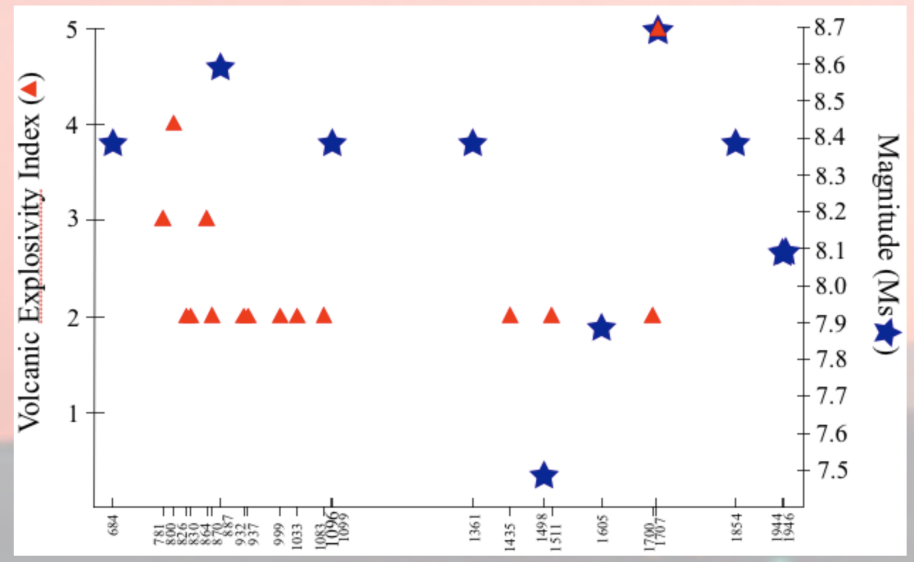



**Figure 1.** Eruption data are from the Global Volcanism Program. Earthquake data are from the National Geophysical Data Center.

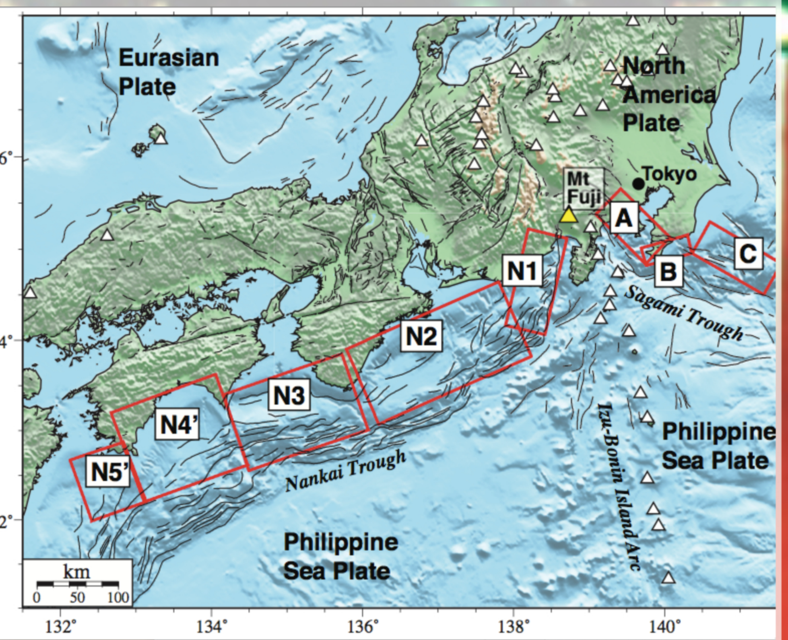



**Figure 2.** Map of the rupture surfaces of both the 1703 Genroku (segments A, B, C) and the 1707 Hoei (N1, N2, N3, N4', N5') earthquakes (Shishikura et al., in prep, An'naka et al., 2003, and Furumura et al., 2011). Other faults (black lines), Holocene volcanoes (white triangles), and Mt. Fuji (yellow triangle) are also shown

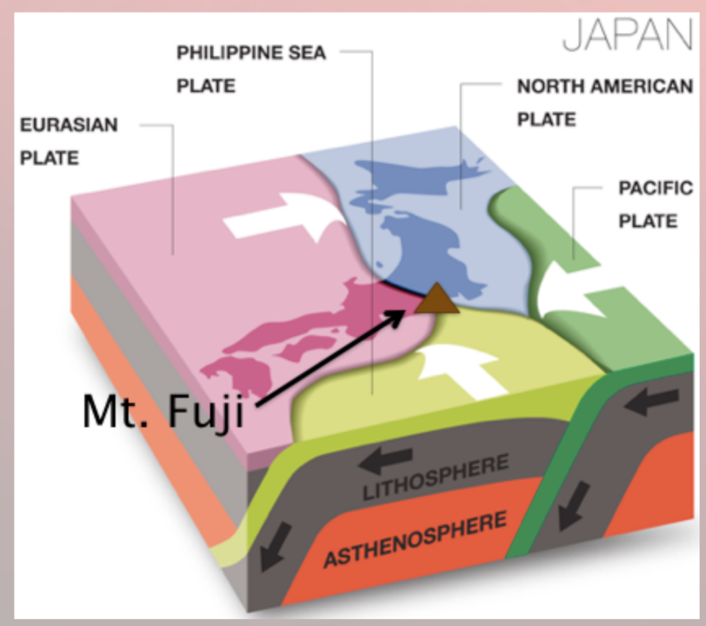



**Figure 3.** Mt. Fuji is located at the triple junction of the Eurasian (EU), North American (NA), and Philippine Sea (PH) plates. Although Mt. Fuji is a subduction zone volcano, it usually erupts basaltic magma because of a tear in the subducting PH plate (Aizawa et al., 2004)

## Stress models of the Genroku and Hoei earthquakes

We modeled the stress change and dilatational strain created by slip from the two earthquakes on Mt. Fuji's magmatic system (magma chambers and dike).

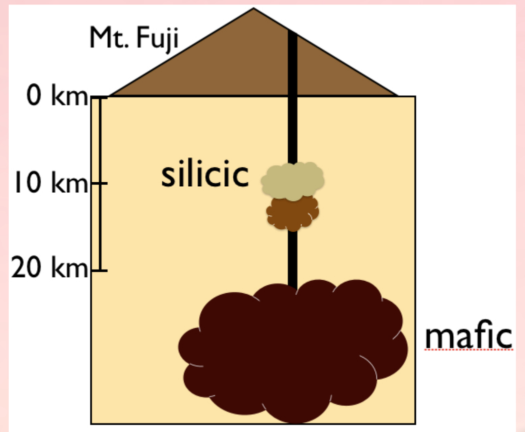



**Figure 4.** Mt. Fuji magmatic system prior to the earthquakes. The dacitic (tan), andesitic (light brown), and basaltic (maroon) magma chambers are shown at their estimated depths (Aizawa et al., 2004; Kaneko et al., 2010). The dike connects the chambers to the surface

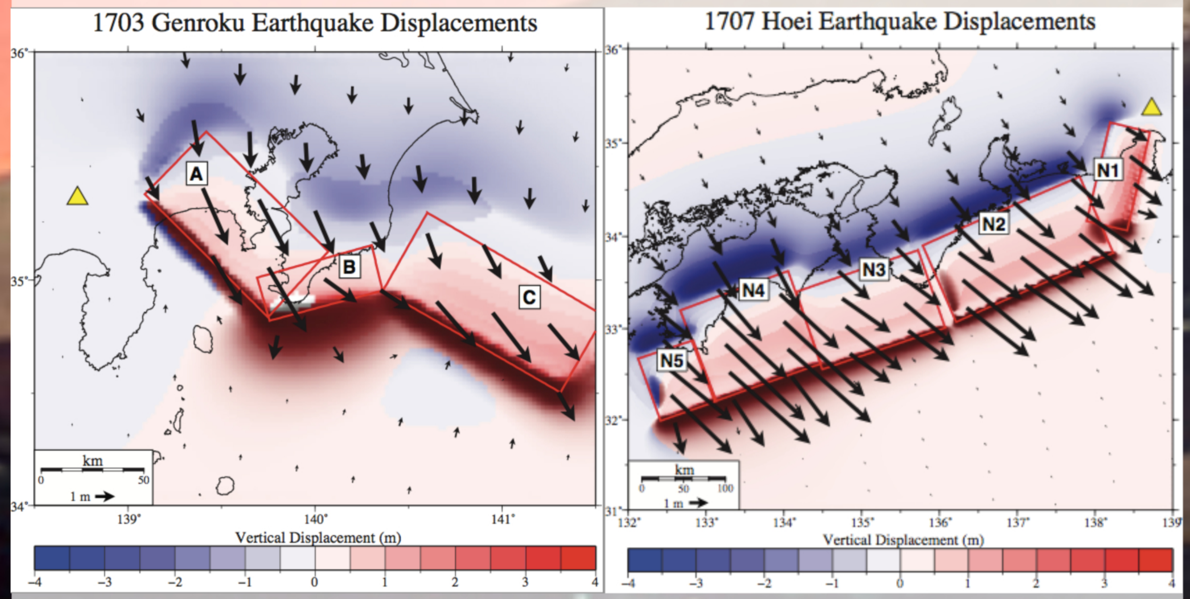



**Figure 5.** Estimated coseismic vertical (color scale) and horizontal (black vectors) displacements for the Genroku (left) and Hoei (right) earthquakes based on the fault source models of Shishikura et al. (in prep), Ishida (1992), An'naka et al. (2003), and Furumura et al. (2011).

## The Genroku and Hoei Earthquakes Compressed Mt. Fuji's Magmatic System

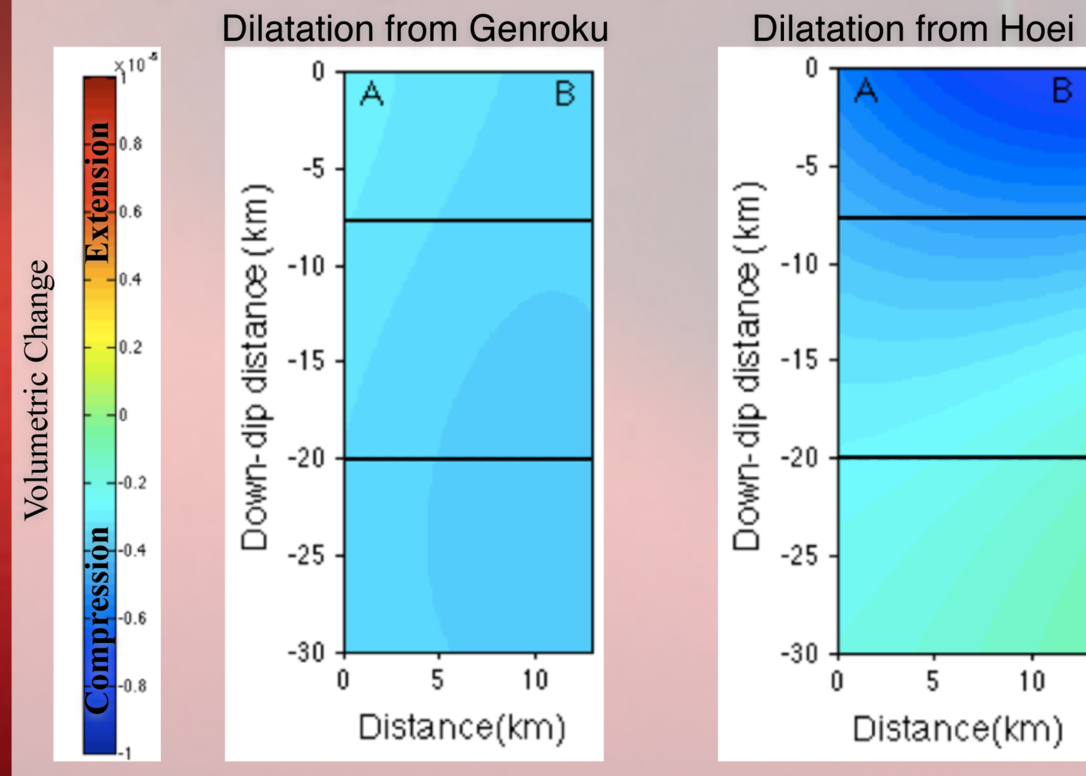



**Figure 6.** Dilatational strain from the Genroku and Hoei earthquakes on the Mt. Fuji magmatic system measured along the dike from NW to SE. Positive values indicate extension and negative values indicate compression. The lines at 8 and 20 km represent the location of the dacitic and basaltic magma chambers, respectively.

## The Genroku Earthquake Hindered Mt. Fuji's Eruptive Activity

Increased normal stress (negative normal stress change) clamped the dike system and impeded eruption.

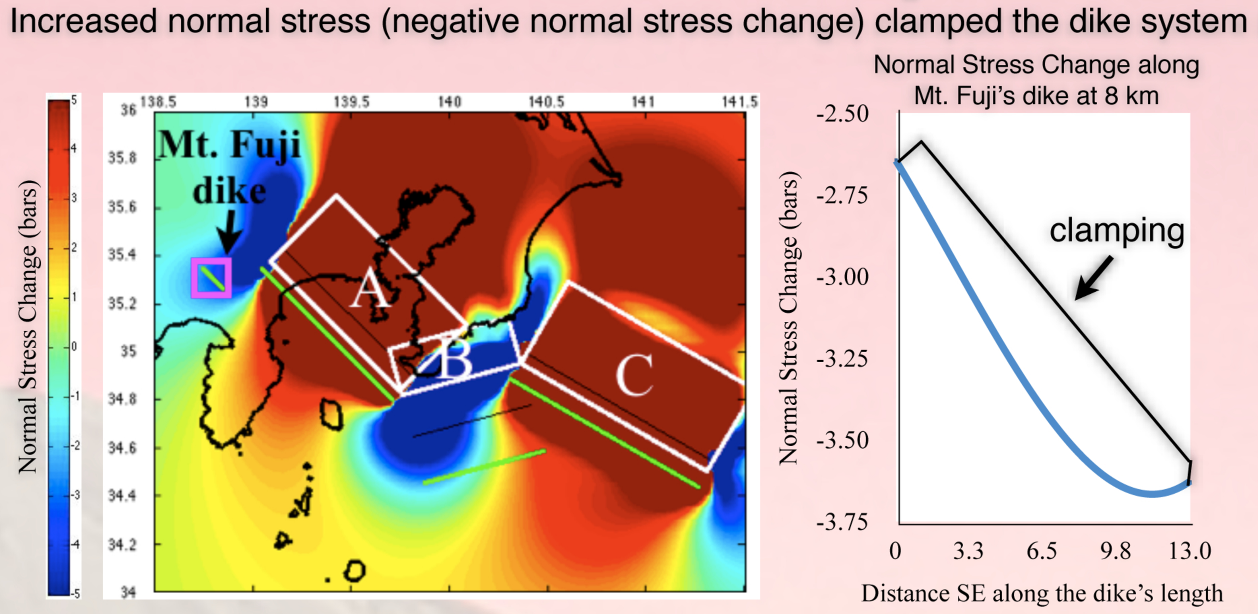



**Figure 7.** Map view of the normal stress change on the Mt. Fuji magmatic system due to the 1703 Genroku earthquake (left). The modeled dike is located in the pink box. Normal stress along the dike at a depth of 8 km (right)

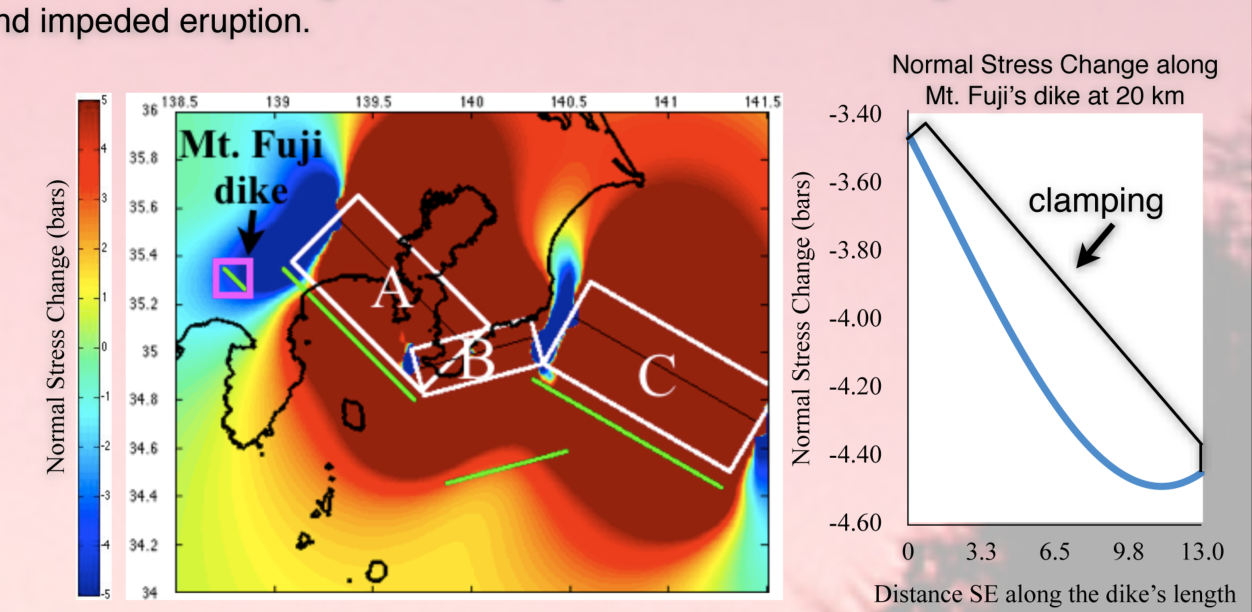



**Figure 8.** Map view of the normal stress change on the Mt. Fuji magmatic system due to the 1703 Genroku earthquake (left). The modeled dike is located in the pink box. Normal stress along the dike at a depth of 20 km (right)

## The Hoei Earthquake Triggered the Mt. Fuji Eruption

Decreased normal stress (positive normal stress change) unclamped the Mt. Fuji dike and facilitated magma migration and eruption.

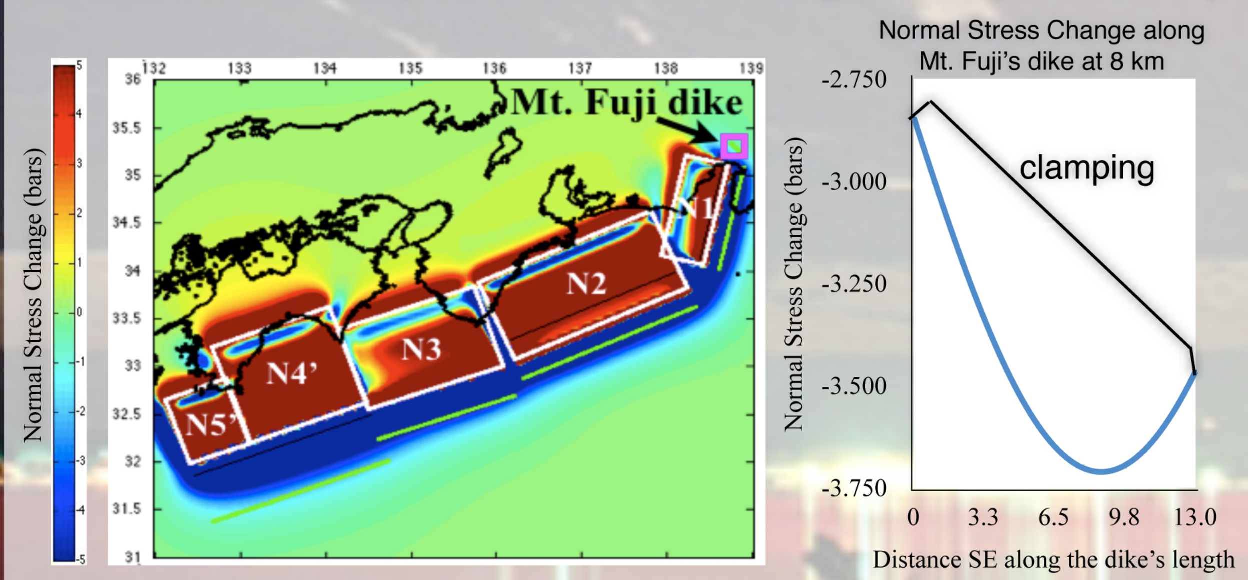



**Figure 9.** Map view of the normal stress change on the Mt. Fuji magmatic system due to the 1707 Hoei earthquake (left). The modeled dike is located in the pink box. Normal stress along the dike at a depth of 8 km (right)

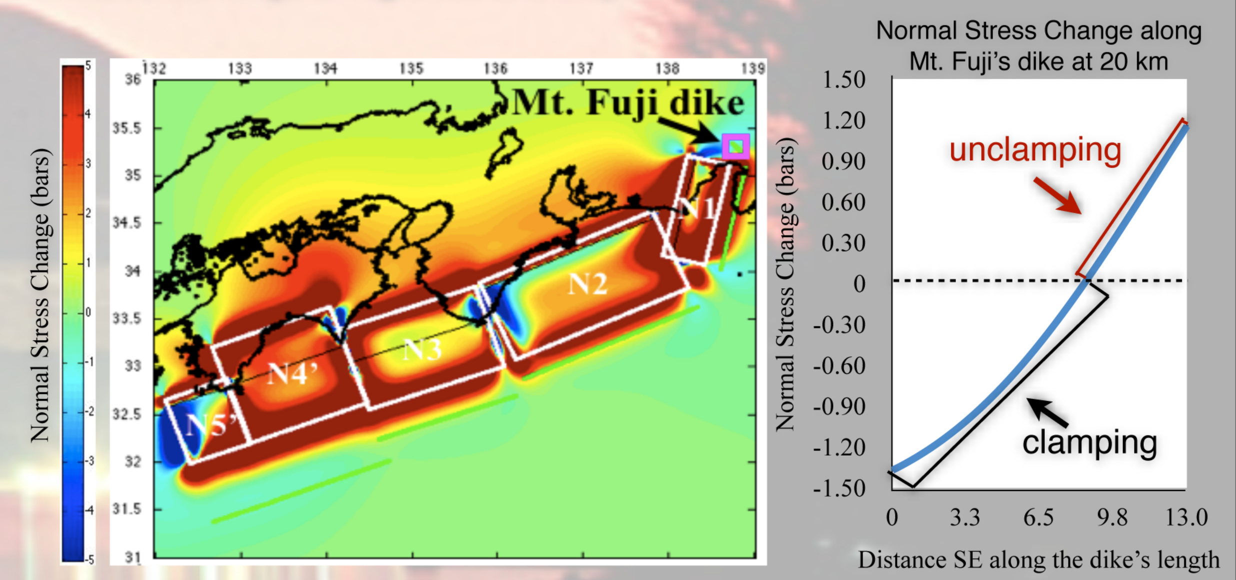
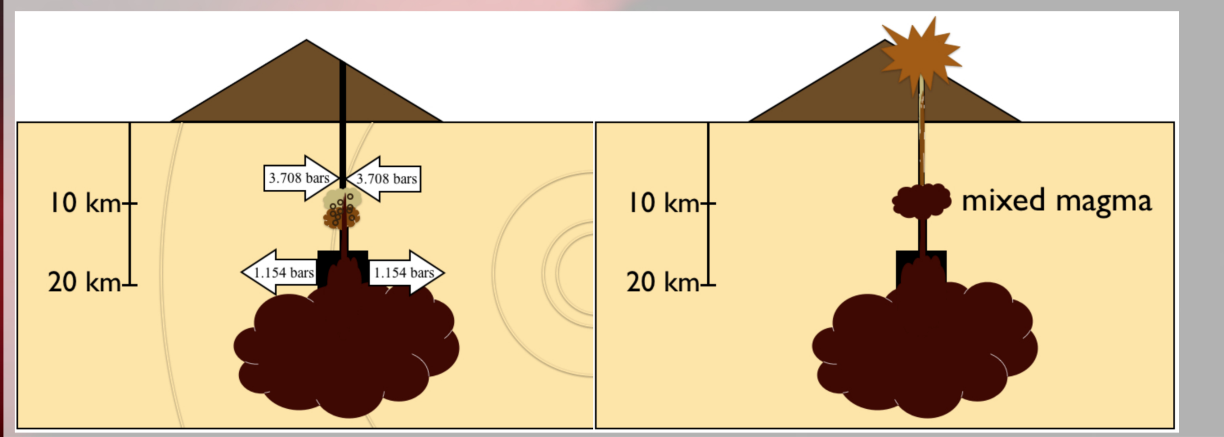



**Figure 10.** Map view of the normal stress change on the Mt. Fuji magmatic system due to the 1707 Hoei earthquake (left). The modeled dike is located in the pink box. Normal stress along the dike at a depth of 20 km (right)

## Stress Changes, Magma Migration and Mixing, and Eruption Triggering

The stress change and compressional strain generated by the 1707 earthquake triggered the eruption of Mt. Fuji by permitting opening of the dike and ascent of basaltic magma to the andesitic and dacitic magma chambers (see below). The injection of basaltic magma into the more evolved magmatic system induced magma mixing and a Plinian eruption ensued.




## Implications of this study

Understanding the mechanisms that trigger a volcanic eruption can help to further the science of eruption prediction. This, in turn, could help save money, property, and most importantly LIVES!

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