Shear-wave splitting analysis of stress field perturbations around an active magmatic conduit

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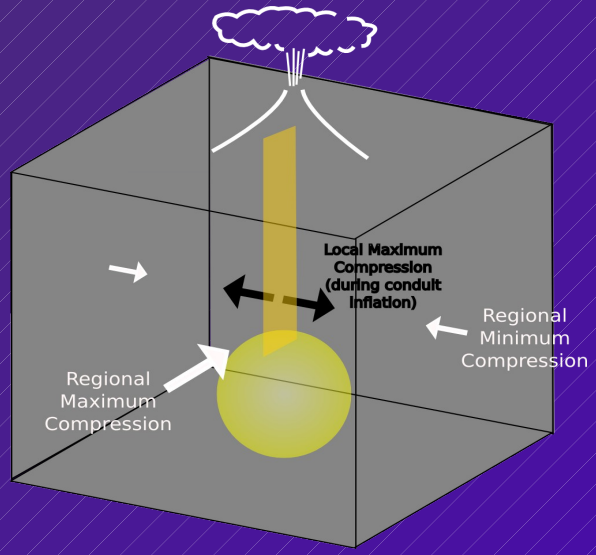
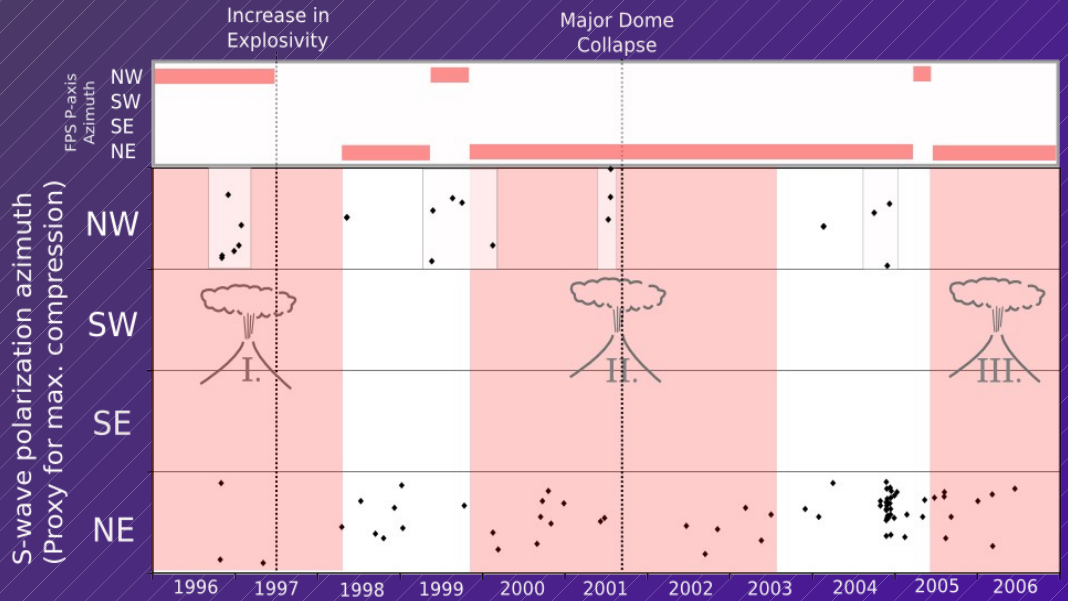
Model of ~90° stress field reorientation preceding volcanic eruptions: Volcanic conduits, which in most cases are crack-like structures, dilate in response to an influx of magma in the direction of least resistance, or minimum compression in the regional (background) stress field. This dilation induces an ephemeral local stress field with local maximum compression oriented in the direction of regional minimum compression:

We aim to test this model by conducting two independent analyses (shear-wave splitting and fault-plane solutions) of stress field orientation using seismic data from a single eruption (the 1995-present eruption of the Soufriere Hills Volcano, Montserrat) with multiple phases of eruption and quiescence. In theory, contemporaneous local stress field reorientations should be observed by both independent techniques.





Independent analyses of local stress field orientation beneath Soufriere Hills show similar and contemporaneous changes throughout the study period. This finding validates the use of volcanic stress field analysis as a monitoring technique and argues for the initiation of of baseline stress monitoring at potentially active volcanoes.