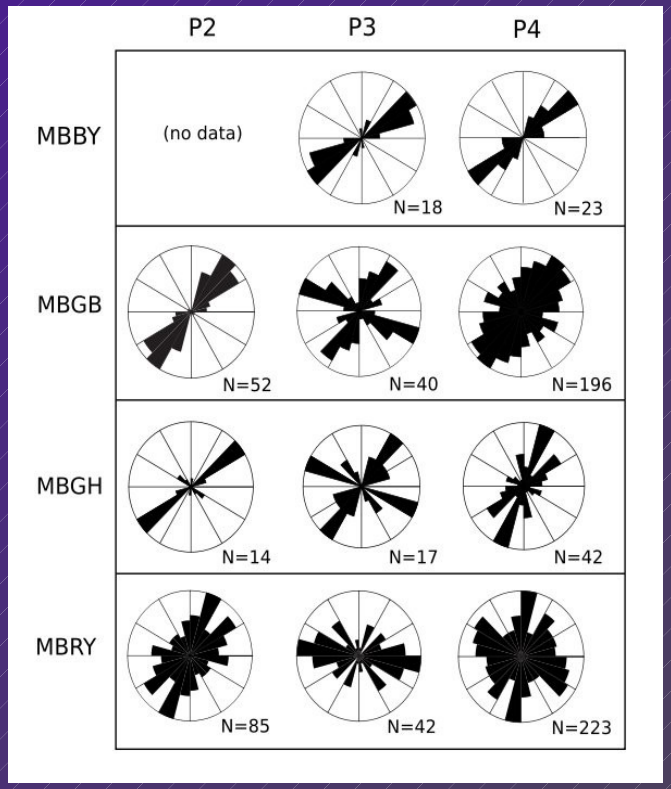
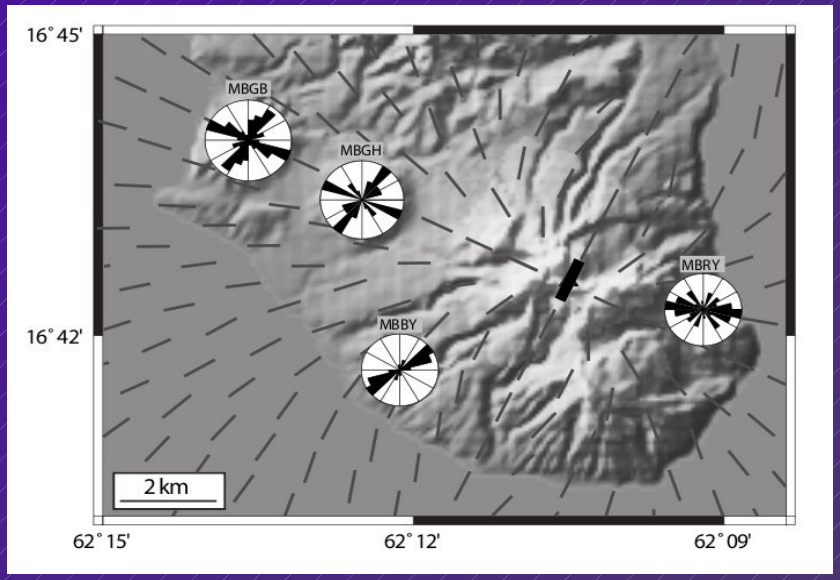
Forward modeling of shear-wave splitting images volcanic conduit inflation months prior to eruption

Diana C. Roman, Department of Geology,
University of South Florida Tampa, FL

Volcanic conduits, which are typically crack-like structures known as dikes, dilate in response to an influx of magma. This dilation induces an ephemeral local stress field with azimuthally-dependent orientations, as seen at right during a six-month period (P2) preceding eruption at the Soufriere Hills Volcano, Montserrat.

We modeled the observed local stress field orientations through a numerical simulation of dike inflation. As seen below, we are able to closely reproduce the observed pattern of local stress (measured through analysis of shear-wave splitting in regional earthquakes) with a simple model involving inflation of a NE-trending dike.





Shear-wave splitting analyses of the local stress field orientation beneath Soufriere Hills show systematic changes consistent with magma pressurization beginning six months prior to eruption. 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.