Summary. In the last decade, considerable effort has been devoted to developing tomographic images of the seismic structure of mid−ocean ridges and hot spot volcanoes. These images have provided a wealth of information about the distribution of magma, and have resolved several important issues concerning the role of these features in tectonics, crustal genesis, etc. Nevertheless, the models have for the most part been put to descriptive and qualitative uses. Their application to quantitative models of non−seismological phenomenon have been fairly limited, which is ironic given that they provide a very quantitative and detailed description of the subsurface. Here we propose to use a particular tomorgaphic model − one that includes Axial volcano and nearby poirtions of the Juan de Fuca Ridge − to develop quantitative 3D models of stress and temperature in this region. We will compare the predictions of these models with geodetic, heat flow and seismicity data, and use them to attempt to explain some puzzling features of these data.

The new tomographic model was constructed using data from a 1998 airgun−to−OBS active imaging experiment. The imaged area includes a 40 by 40 km region around Axial volcano, and includes both the central Axial magma chamber and a smaller, apparently unconnected magma chamber on the Coaxial segment of the Juan de Fuca region. The model also includes variations in Moho depth, which are quite strong, with the Moho deepening to about 11 km beneath the center of the volcano (from about 8 km at its flanks). We plan to convert this compressional velocity model to 3D stress/deformation and thermal models that can be run using the inexpensive and commercially−available BEASY boundary−element method code.

A fairly large and diverse body of geophysical data are available for Axial volcano and its environs, collected during a decade−long interval that includes two major volcanic eruptions. These measurements include extensometer, tilt, and subsidence measurements made with ocean bottom sensors deploy around the volcano, seismicity measurements made with SOSUS and with OBS’s, and heat flux estimates made by tracking thermal plumes emanating from hydothermal fields. Each of these measurements has features that are currently unexplained, but which may be related to the effect of magma, and the very large lateral gradients in material properties and temperature that it causes.