Integrating seismic anisotropy into geodynamic models of crustal deformation

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Geodynamic models are wonderful tools to test our physical understanding of geologic processes. Geodynamic models that reproduce geologic observations provide confidence that the mechanisms modeled are at least similar to those in nature, and in such situations the models may be used to make predictions and provide new hypotheses that can be tested. The best models are those that are consistent with multiple observations. To help understand the deformation processes occurring in the middle and lower continental crust where direct sampling is not possible, a geodynamic model must include elasticity, and make predictions of seismic properties associated with particular deformation processes. Prediction of seismic anisotropy has been widely included in geodynamic models of mantle flow, but not for those concerning crustal deformation. This contribution is focused on integrating elasticity and seismic anisotropy into geodynamic models of crustal processes so that seismic observations may also be used to support a model's utility. Rock elasticity is a function of mineralogy and crystallographic preferred orientation (CPO). Geodynamic models are capable of predicting finite strain, which is related to development of mineral CPO, however this relationship is not fully characterized. We have collected a dataset of mineral CPOs from the Pelham and Chester gneiss domes with the goal of defining relationships between CPO strength and strain for these rocks deformed at mid-crustal conditions. It is not always possible to quantify strain in naturally deformed rocks, so we will use a combination of quantitative and qualitative observations of strain magnitude. Our current dataset consists of EBSD measurements from approximately 60 samples that cover a range of mineralogy and apparent strain magnitude. The relationships defined from this dataset will be integrated into a basic geodynamic model to predict the seismic anisotropy associated with gneiss dome exhumation.