

(I) A COUPLED GEOCHEMICAL AND GEODYNAMICAL APPROACH TO  
SUBDUCTION ZONE MODELING  
&  
(II) DEVELOPMENT OF COLOR IN GREENISH QUARTZ

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*"Nothing is easy.  
Nothing good takes 5 minutes."*

- GRR lab truisms

## ABSTRACT

## (I)

We couple a petrological model with a 2D thermal and variable viscosity flow model to describe and compare fundamental processes occurring within subduction zones. We study the thermal state and phase equilibria of the subducting oceanic slab and mantle wedge and constrain fluid flux, presenting model results spanning normal ranges in subduction parameters. Coupling between the chemistry and the dynamics results in the development of a stable slab-adjacent low-viscosity region defined by hydrous phases and higher concentrations of water in nominally anhydrous minerals, bounded by the water-saturated solidus.

Subduction parameters are significant to the position of dehydration reactions within the slab and the geochemistry of fluids initiating flux melting. Modeling of fluid transport mechanisms and potential melt migration processes based on coupled modeling with the addition of fluid-mobile trace elements was performed. There is a progression of geochemical characteristics described in previous studies of arc lava datasets that can be duplicated with these models.

A localized low-viscosity, low-density geometry within the wedge, predicted by coupled modeling of the Izu-Bonin system, is required to match observations of topography, gravity, and geoid anomalies. Based on this, predictions can be made as to specific low-viscosity geometries associated with geophysical signals for other subduction zones based on regional subduction parameters.

## (II)

Naturally occurring greenish quartz found within the context of amethyst-bearing deposits is not simply the result of the exposure of amethyst to thermal bleaching. Rather, it can represent a set of distinct color varieties resulting from the changing chemical and thermal nature of the precipitating solution. Greenish quartz occurs at the Thunder Bay Amethyst Mine Panorama, Thunder Bay, Ontario, Canada, in several distinct varieties. Spectroscopic, irradiation, and controlled heating studies show that changes in salinity and temperature of the hydrothermal system that produced the deposit and changes in quartz growth rate are reflected in coloration. As the system evolved, a minor ferric component appears to change position from interstitial to substitutional within specific growth sectors. Greenish colors within the quartz are consistently correlated with the speciation of hydrous components.

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