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

Thesis by

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In Partial Fulfillment of the Requirements

for the Degree of

Doctor of Philosophy

California Institute of Technology

Pasadena, California

2008

(Defended February 15, 2008)

ACKNOWLEDGMENTS

I would like firstly to thank my advisors. Paul Asimow and Mike Gurnis have provided support, guidance, patience, and have great ability to teach as well as to inspire. Their excitement and willingness to explore the gray areas of interdisciplinary geoscience have allowed this work to be done. George Rossman, whose love of science and deep sense of curiosity have been an incredible inspiration, demonstrates every day why teaching is the best job there is.

Secondly, and equally importantly, I would like to thank Paula Antoshechkina, mentor and friend. She and I have worked very closely for over three years in the development of the GyPSM model, and she has provided guidance, advice, and a strict attention to detail that were essential not only to this project, but to my learning how to be a scientist. She was always willing to share her considerable expertise, whether it be regarding geochemistry or a wide range of programming languages, and is an excellent and patient teacher.

Thanks to Chad Hall, who was heavily involved in the early stages of the GyPSM-S project, and to Eh Tan, who provided excellent help with ConMan whenever asked. Thank you to Elizabeth Miura Boyd and to Chi Ma for analytical help. Mike Baker and Jed Mosenfelder were very helpful in the lab with my early work in high-pressure experimental geochemistry.

I am appreciative of the chance to have been a teaching assistant for both George Rossman and John Eiler, both excellent instructors. Additional thanks to John for acting as academic advisor.

I am indebted to my friends: Laura, Julie, Nicole, Brandy, Ryan, Charlie, Sarah, Chris, Lydia, Elisabeth, Liz J., Nathan, Cody, Rhea, and Kris. Thank you to Tessa and Saffie for always being there when I needed them. Thanks to my family for always supporting me on my unconventional higher educational path that started at Peabody Conservatory and is ending at Caltech.

And, finally, I thank Craig, my wonderful husband and best friend, for his sense of humor, for seeing me through all of this, and for always giving me unconditional support, encouragement, and confidence. I thank our son, for making things interesting.

"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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