Taxonomy Of Magma Mixing I:
Magma Mixing Metrics And The Thermochronometry Of Magma Hybridization Illuminated With A Toy Model
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I: Introduction

Two-component systems with complete or near complete immiscibility exhibit eutectic composition temperatures (T_e) and bulk compositions (X_e) of both end-members. These isobaric specific heats are taken as constants independent of temperature and composition. At igneous temperatures, CP varies remarkably little with temperature composition to

II: Thermodynamics of Hybridization Illustrated By Toy Model

Temperature (T) is and pressure (P) is constant. The phase diagram of the toy system is depicted in Fig. 4. To ensure the validity of the calculations, the toy system has a binary eutectic phase diagram, meaning it only has two phases in equilibrium, which is represented by two curves on the phase diagram.

III: Analysis

For fixed initial parameters, the two initial conditions of \( X_e, T_e, \) and \( T_0 \) determine the state of hybrid magma (H). There are thus possible mutually exclusive Phase Assemblage Outcomes (PAO) [see Fig. 1]. How each of these PAO arises

IV: Results

Plots were conducted on a population of over 4000 realizations within which magma (crystal + liquid) or both and magma (crystal + liquid) or both. The calculated results were: PAO = 100% (magma + liquid) mixing; PAO = 100% (crystal + liquid) mixing.

V: Conclusions

• In many magma mixing scenarios, the T of the hybrid magma (H) is less than the T of the magmas (M and R) that mix. This can lead to some interesting phenocryst compositional profiles.

• The tendency for hybrid magma (H) to be "attracted" to the invariant point is common, particularly in magma-magma mixing.

• Expression of crystallization in H can be highly variable and is sensitive to the mixing conditions (i.e. \( \phi_f, \phi_l, Y_H, T, \) and \( T_f \)).

• Experimentation with stoking blocks of different masses \( T_f \) into magma (crystal + liquid) or both suggests a sensitive dependence on mass, bulk composition and T of the stoked rods.

• Toy model provides valuable insights into complex multi-component, multi-phase systems (see next poster, MCS)