

CIDER 2017 Geochemistry Tutorial Overview

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Goals:

- A. Introduction to Geochemical Databases
- B. Introduction to Data Filtering and Plotting
- C. Introduction to Thermobarometry with Data from Geochemical Databases

Geochemical Databases Resources:

1. Geochemical Databases.pdf – list of a popular geochemical databases and what each contain

Data Filtering & Plotting Resources:

2. Petrology_Big_Data_Best_Practices.pdf – thoughts and tips on handling large geochemical datasets ((contributed by A. Kent)
3. Basic_bootstrap_v1.xls – tool for bootstrap approach to minimizing sampling bias in large geochemical datasets (contributed by A. Kent)

Mantle-Melt Thermobarometry Resources:

Reverse Crystallization Tools

1. Olivine_fractionation_CIDER.xls – *tool for calculating melt evolution during olivine addition with variable K_D* (contributed by P. Wallace)
2. Matlab polyphase fractional crystallization code (folder) – *multiple phase fractionation code (contributed by C. Till (ASU) and S. Brown (MIT)). Detailed methods explained in Till, 2017 Supplement.pdf* – for today's purposes use “crystallize.m”
3. Ternary_plotting_tool_compare_to_expts.xls – *Excel tool for plotting a primitive basaltic composition to compare to primary nominally anhydrous melt compositions for plagioclase, spinel and garnet lherzolite predicted with models of Till et al., 2012 & Grove et al., 2013. Useful to assess how close to equilibrium with mantle and what minerals need to be added to return to mantle equilibrium.*

Mantle-Melt Thermo. Resources

Cascades_Bas_Bas_And.xls – *dataset of basalts & basaltic andesites compiled from GEOROC, PetDB and NAVDAT (contributed from C. Till) to use for P-T calc.s*

Lee et al. 2009

1. F.xls – *Lee et al., 2009 tool for oliv fractionation correction + use of Lee et al., 2009 silica activity thermobarometry* (available for download with Lee et al., 2009)
2. Lee et al., G-cubed, 2009

Till et al., 2012

3. Till et al., 2012 P-T calcs spreadsheet – *Excel file for using Till et al. 2012 mantle thermobarometer (use only after primitive melt corrected for fractional crystallization)* (contributed by C. Till)
4. Till et al., JGR, 2012
5. Calc-Mineral_components.xlsx – *Excel file for converting major element wt% oxide compositions into oxygen mineral components after Grove, 1993.*

Other

6. Till, 2017 Supplement.pdf – *pdf explaining methodology for reverse fractional crystallization calculations, comparison of mantle-melt thermobarometers and a worked example using the Till et al., 2012 mantle-melt thermobarometers* (available for download with Till, 2017).
7. Till, Am. Min. 2017

Instructions:

Part 1:

1. Geochemical Databases discussion
2. Explore “Basic_bootstrap_v1.xls”

Part 2:

3. Open and explore “Cascades_Bas_Bas_And.xls” dataset
4. Pick a couple of samples to investigate their conditions of last mantle-melt equilibration (i.e., mantle-melt thermobarometry)
5. Return to equilibrium (equil. With Fo90 olivine) with the mantle using either:
 - a. an olivine-only reverse fractionation calculation (use “Olivine_fractionation_CIDER.xls”), return to equilibrium with Fo90 with 15% Fe³⁺
 - b. a multi-phase reverse fractionation calculation (use “crystallize.m” in “matlab polyphase fractional crystallization code”)
6. Calculate P and T of mantle melt equilibration using either:
 - a. Lee et al. 2009 “f.xls”
 - b. Till et al. 2012 “Till et al., 2012 P-T calcs spreadsheet.xls”
 - i. Need to calculate the Olivine component composition of calculated primary melt as part of input for Till et al. thermobarometers – to do this use “Calc_Mineral_Components.xlsx” in Till et al. 2012 folder, enter in major elements on far left and drag columns down. Use olivine component value from purple box.
7. Try playing around with the effect of H₂O on your calculated T & P
8. Email your results to Christy for a short presentation (christy.till@asu.edu)