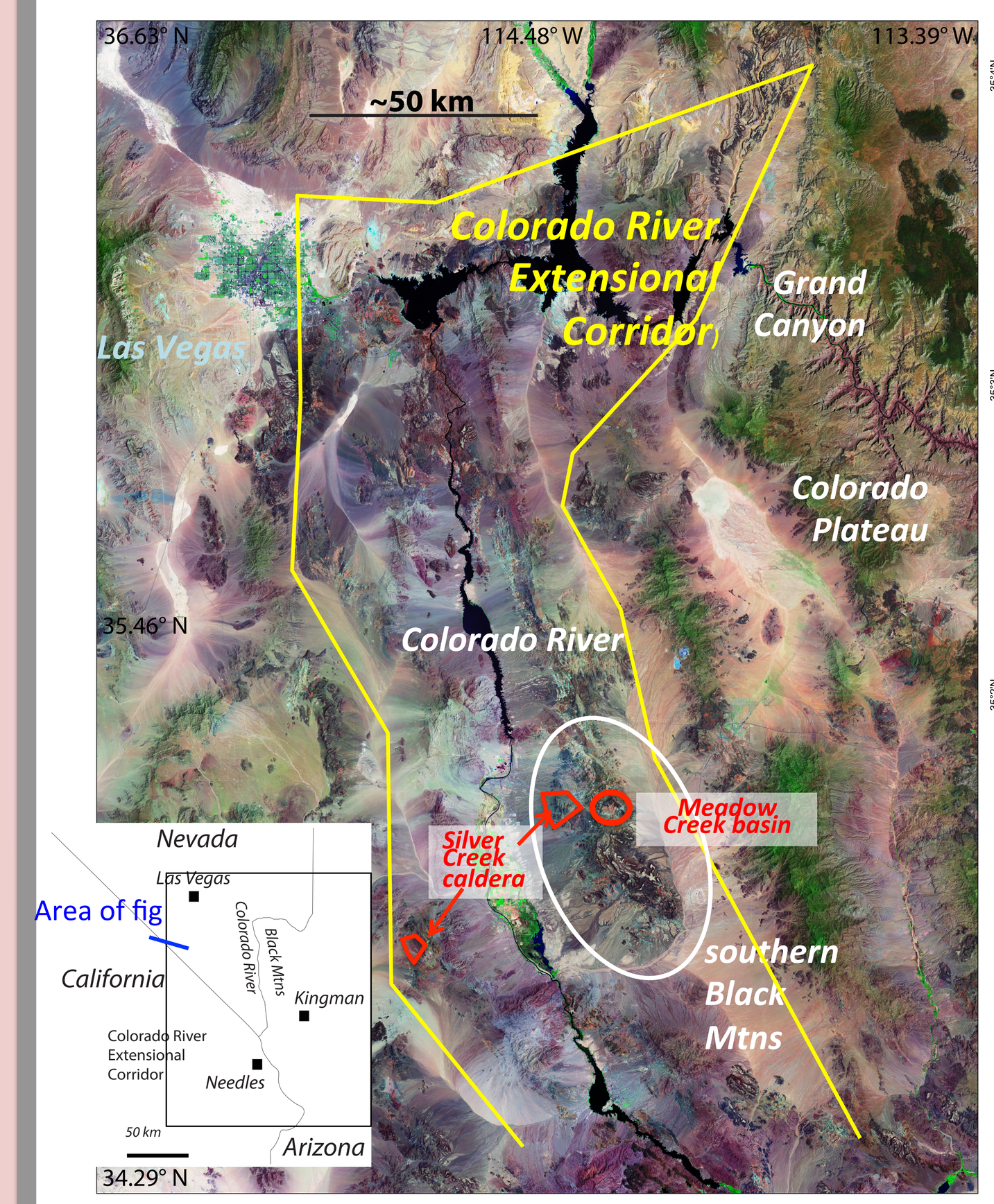
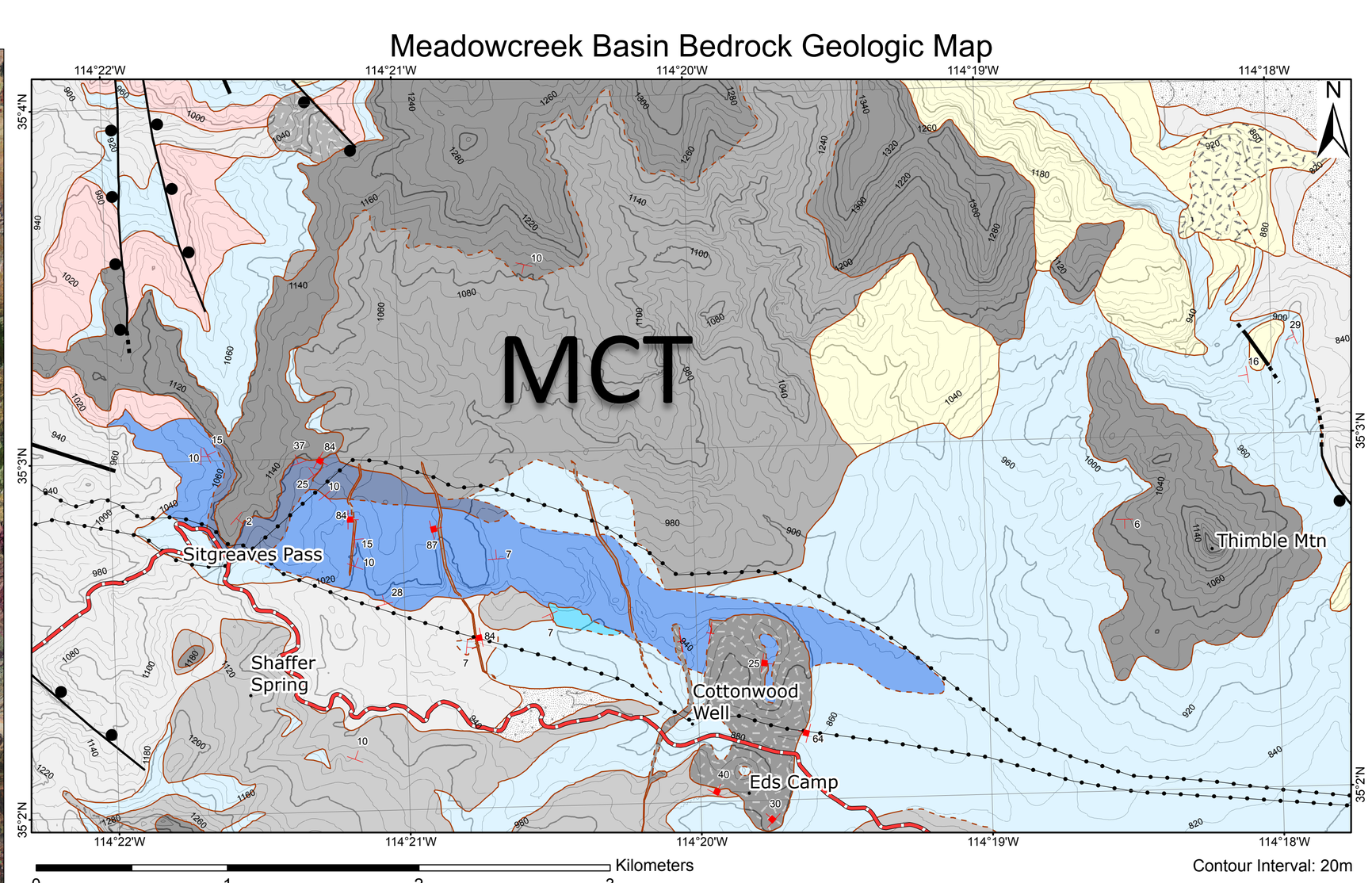
Geochemical and Petrologic Investigation of Open System Processes of post-Supereruption Meadow Creek Trachyte in Southern Black Mountains, AZ

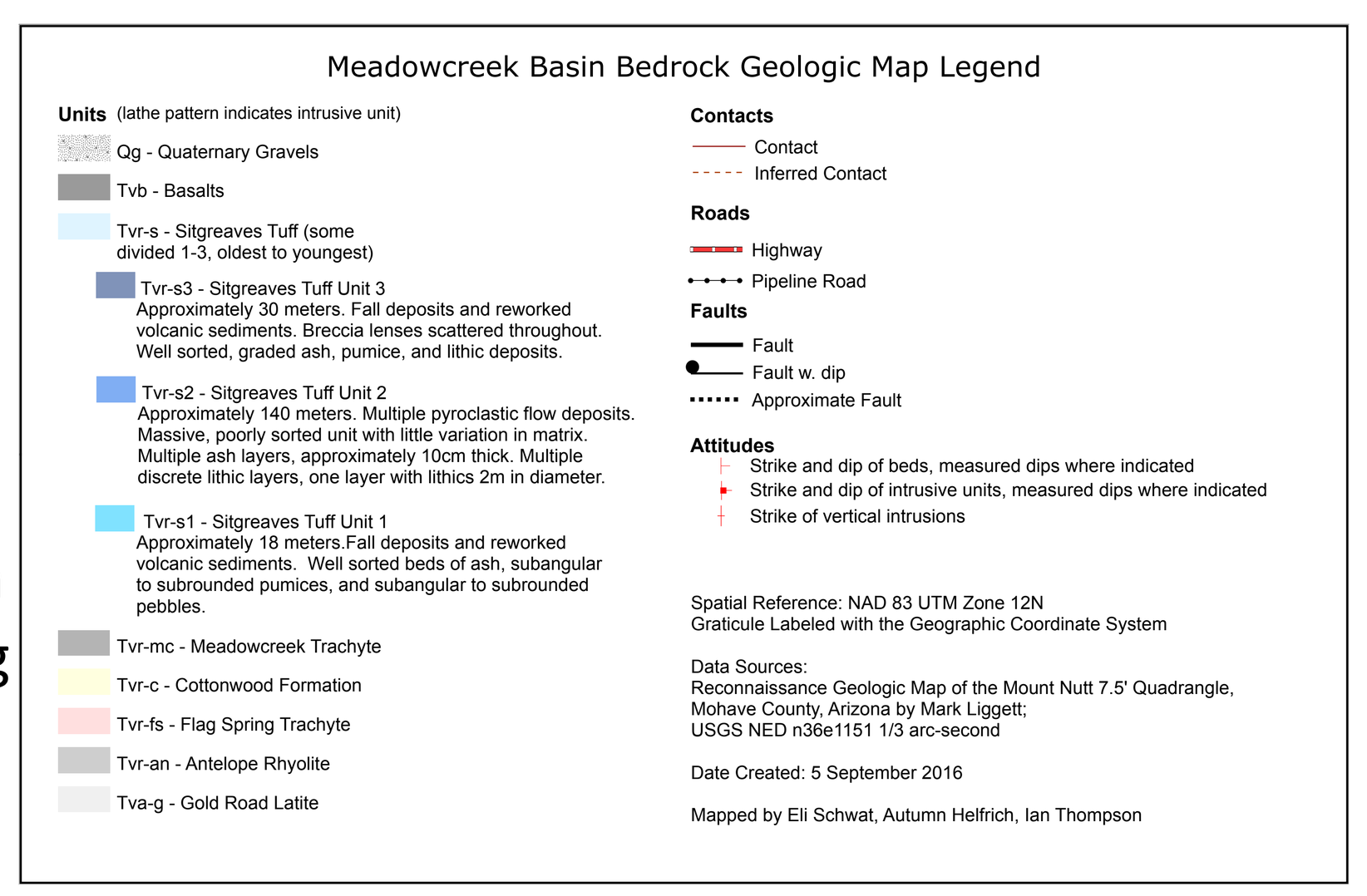
COLLINS, Emma, Department of Geology and Environmental Geosciences, College of Charleston, **SCHLAERTH**, Hannah L, Department of Geology, Kent State University, **MILLER**, Calvin, Earth and Environmental Sciences, Vanderbilt University, **CLAIBORNE**, Lily L., Earth and Environmental Sciences, Vanderbilt University, **FOLEY**, Michelle, Department of Earth and Environmental Sciences, Vanderbilt University, and **CRIBB**, Warner, Geosciences, Middle Tennessee State University, *collinsel2@g.cofc.edu*

Introduction

- Meadow Creek Trachyte (MCT) erupted 17.58 +/- 0.05 Ma (McDowell et al 2016). Located in the Black Mountains volcanic center in the Colorado River Extensional Corridor of NW Arizona MCT erupted ~1.2 Ma after the nearby Peach Spring supereruption (<10km to caldera)
- Previous zircon and whole rock Hf isotopic data (McDowell et al 2016) indicate that zircons formed in a more isotopically juvenile environment than the host lava, indicating open system processes.







(Left) Locator map of the Colorado River Extensional Corridor. Area of study falls in Meadow Creek basin.(Right) Map showing area of study. MCT denoted Tvr-mc (Schwat et al 2016).

Methods

Field Work- observed field relations and surrounding context of MCT

XRF- performed XRF analysis yielding whole rock data for samples found in various localities within MCT as well as separated samples of the light and dark bands of the banded portions of MCT.

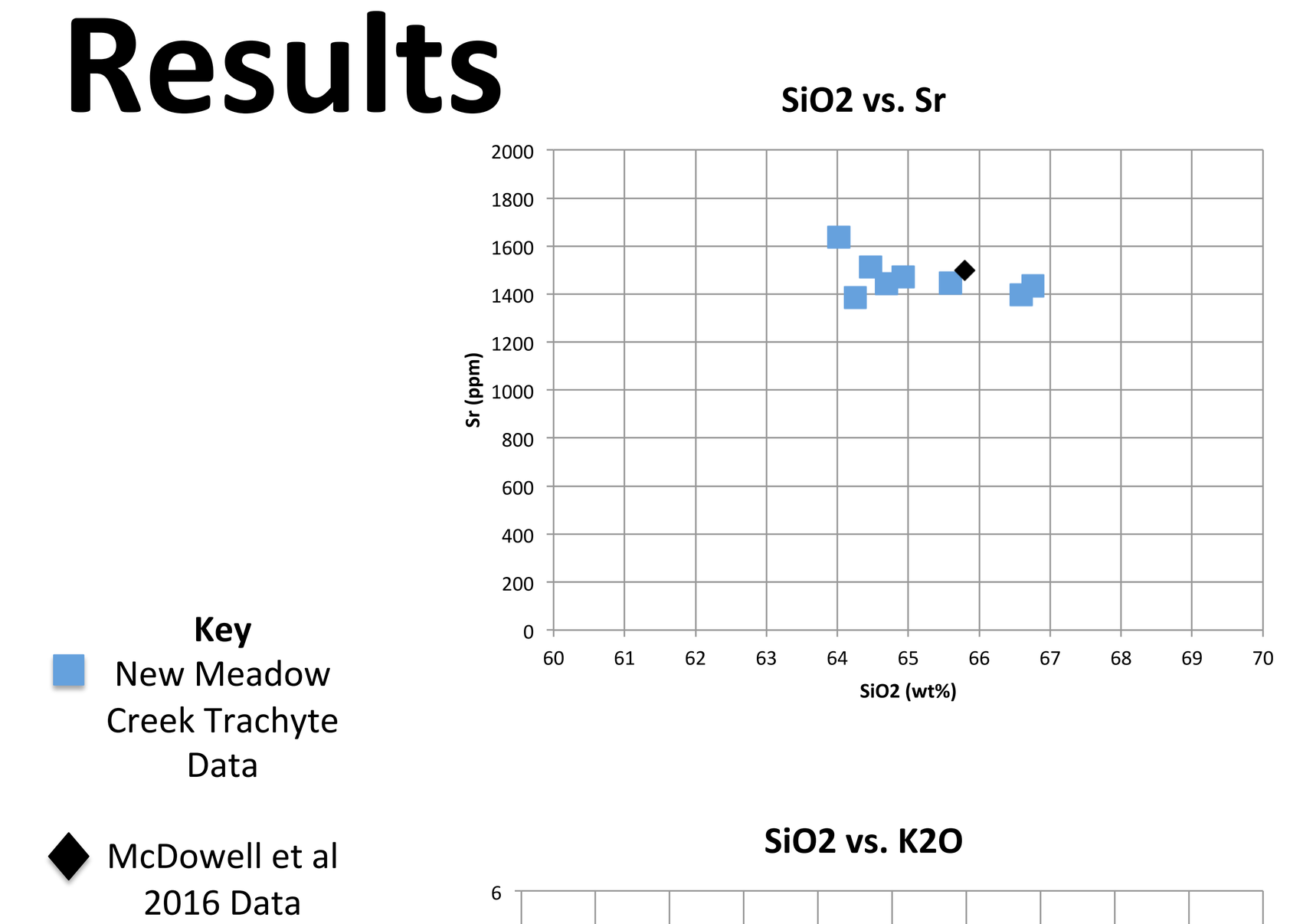
SEM-EDS- collected compositional data of phenocrysts and megacrysts, including compositional data from zones within zoned feldspar megacrysts

Optical Microscopy- observed the textures and phase assemblages of MCT samples in thin section

MCT in field context

Results

Auto-breccia from within MCT.



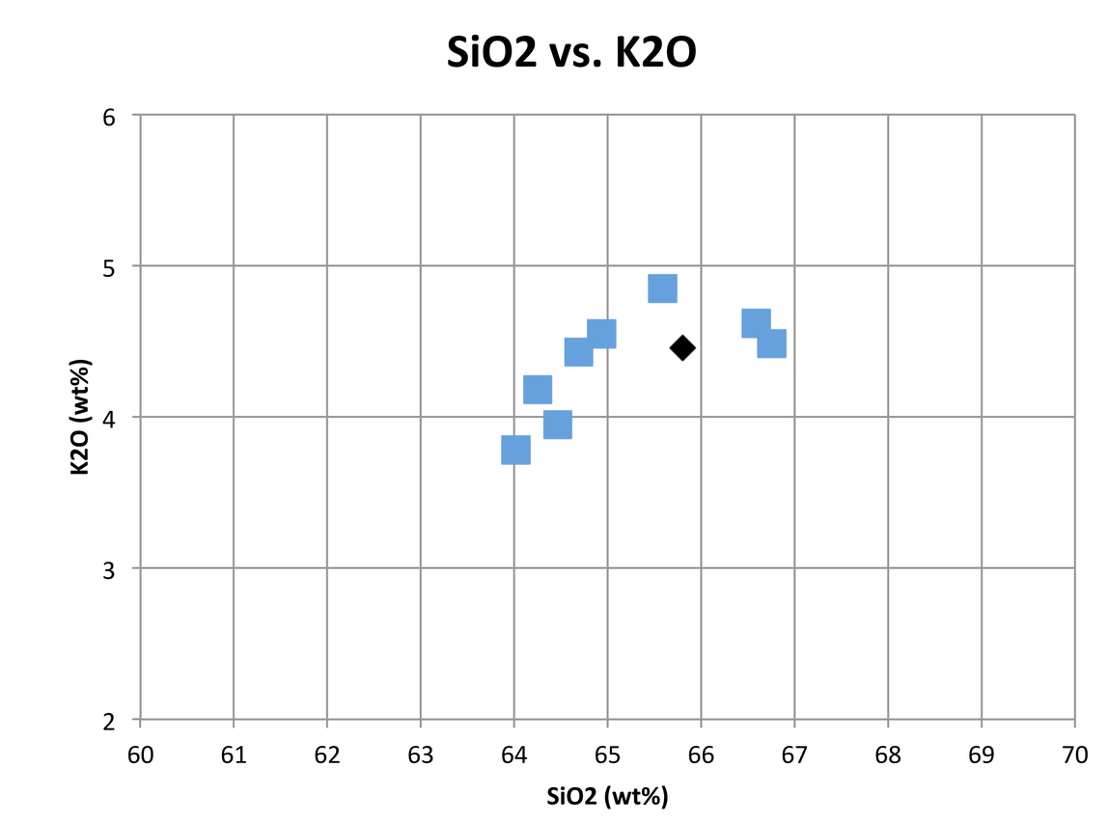
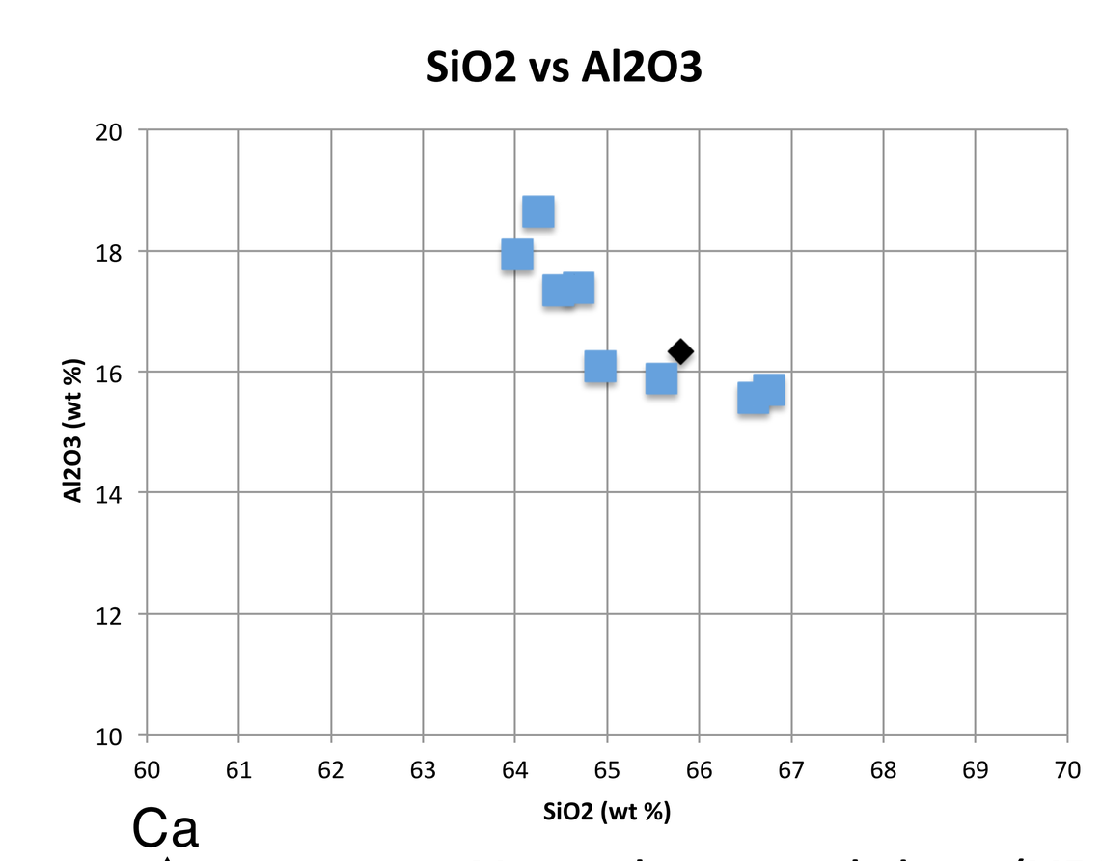
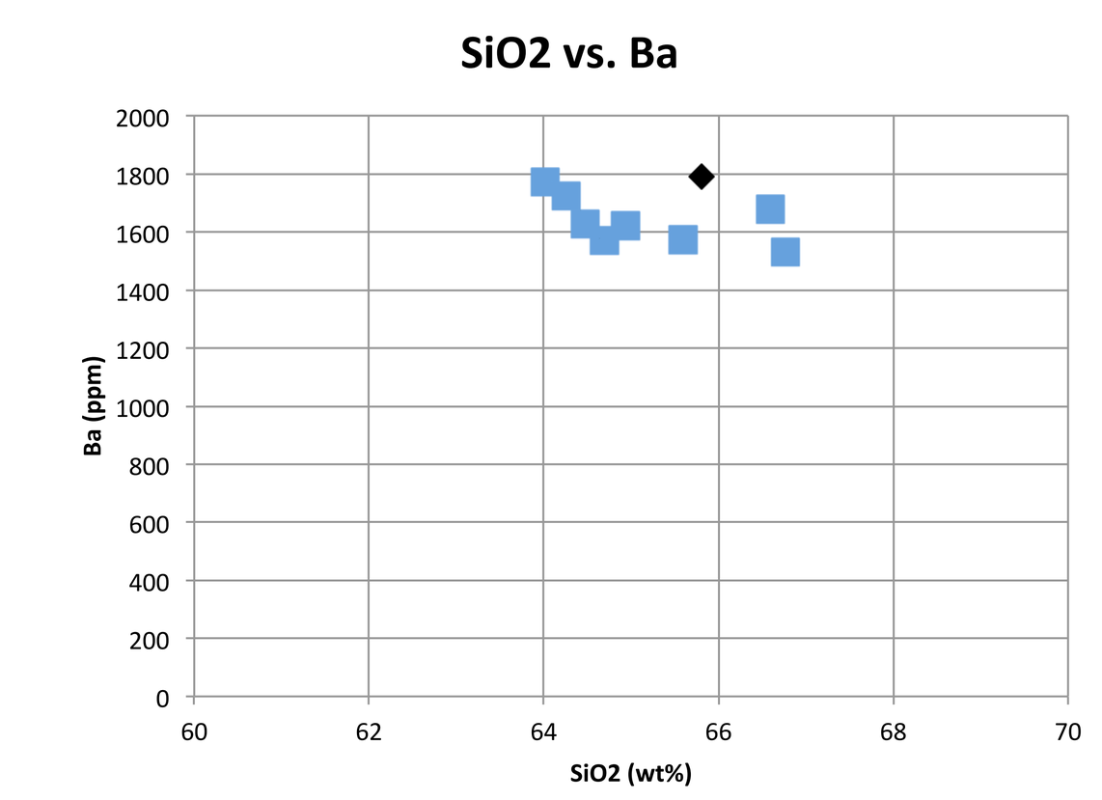
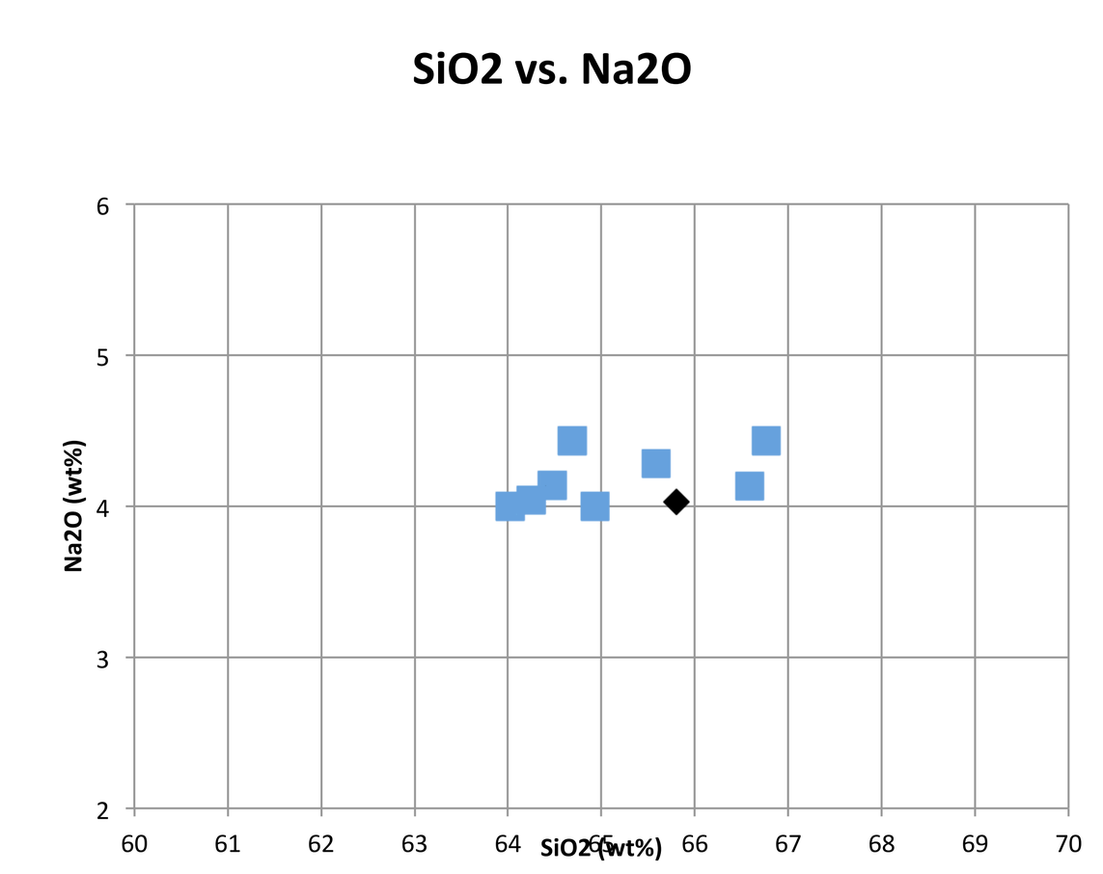


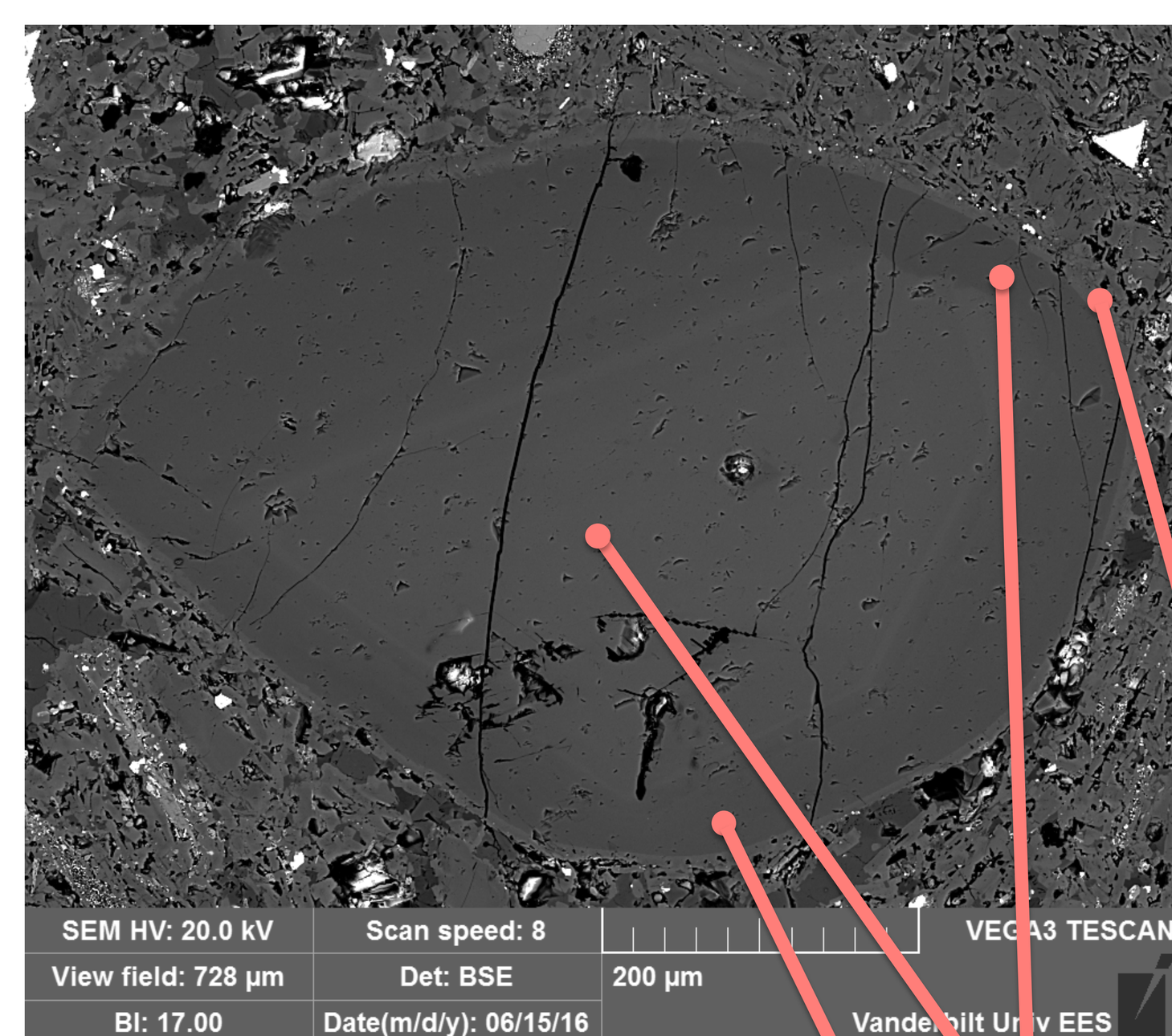
Photo of banding and megacrysts in MCT







New elemental data (XRF) for MCT samples, including analyses of contrasting bands, reveal narrow compositional range that matches the few previous analyses (McDowell et al, 2016; Thorson, 1971 [PhD thesis]). Compositions cluster around 65 wt% SiO_2, with moderately elevated K_2O, Na_2O, and Ba, and very high Sr.



SEM-EDS image of anti-rapikivi zoned feldspar with apparent ternary composition reaction rim.

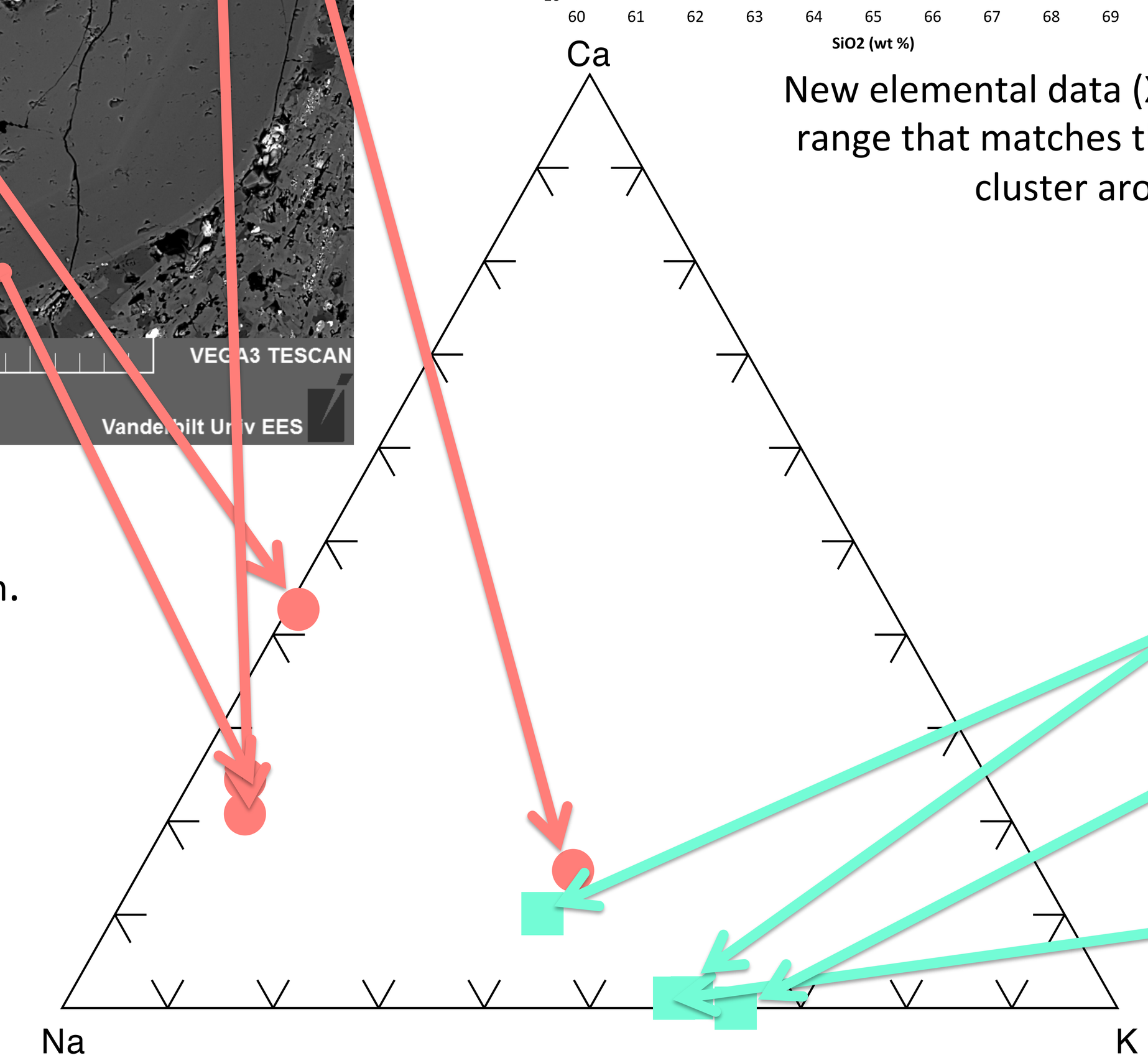
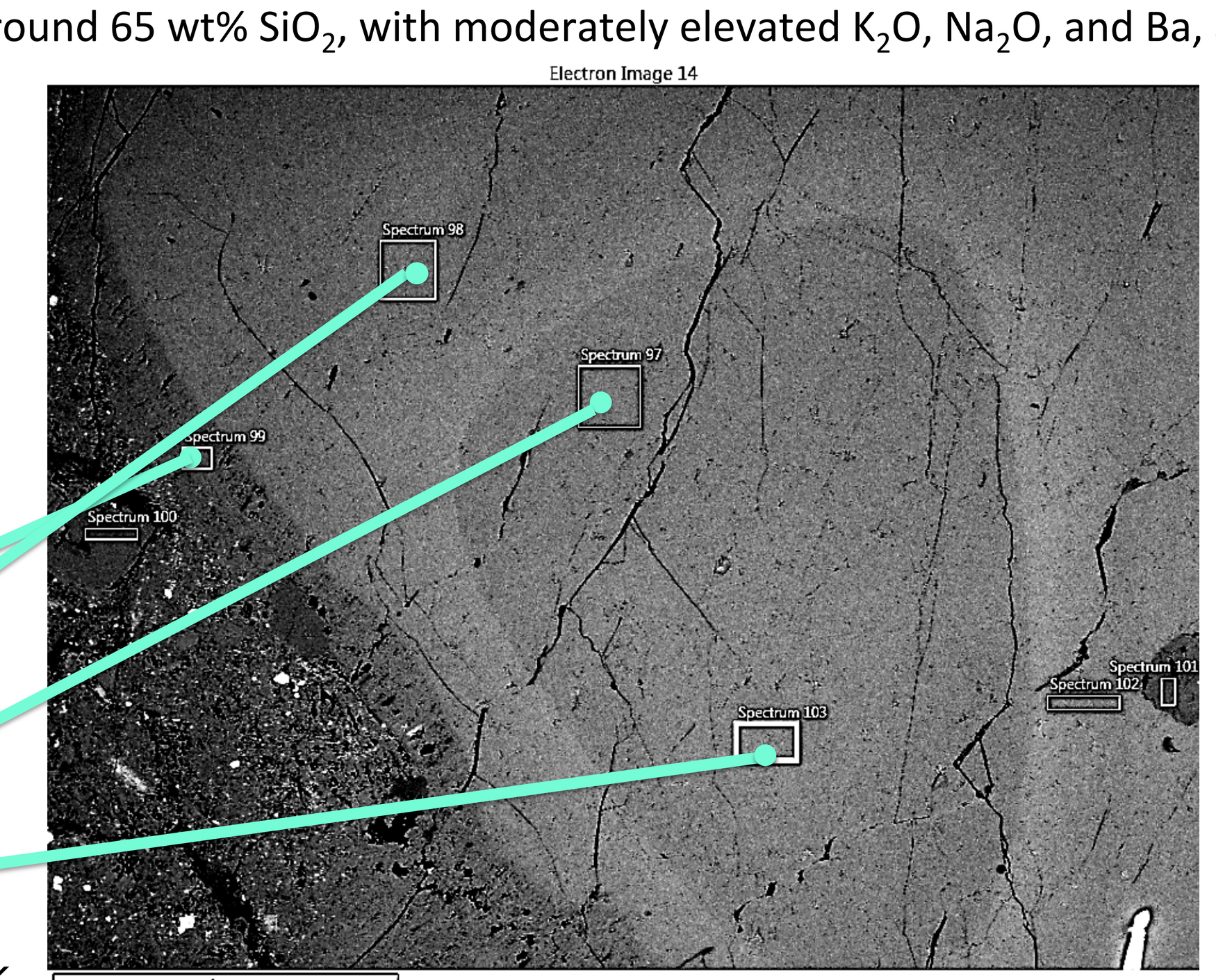


Diagram of compositions of zones within feldspar phenocrysts.



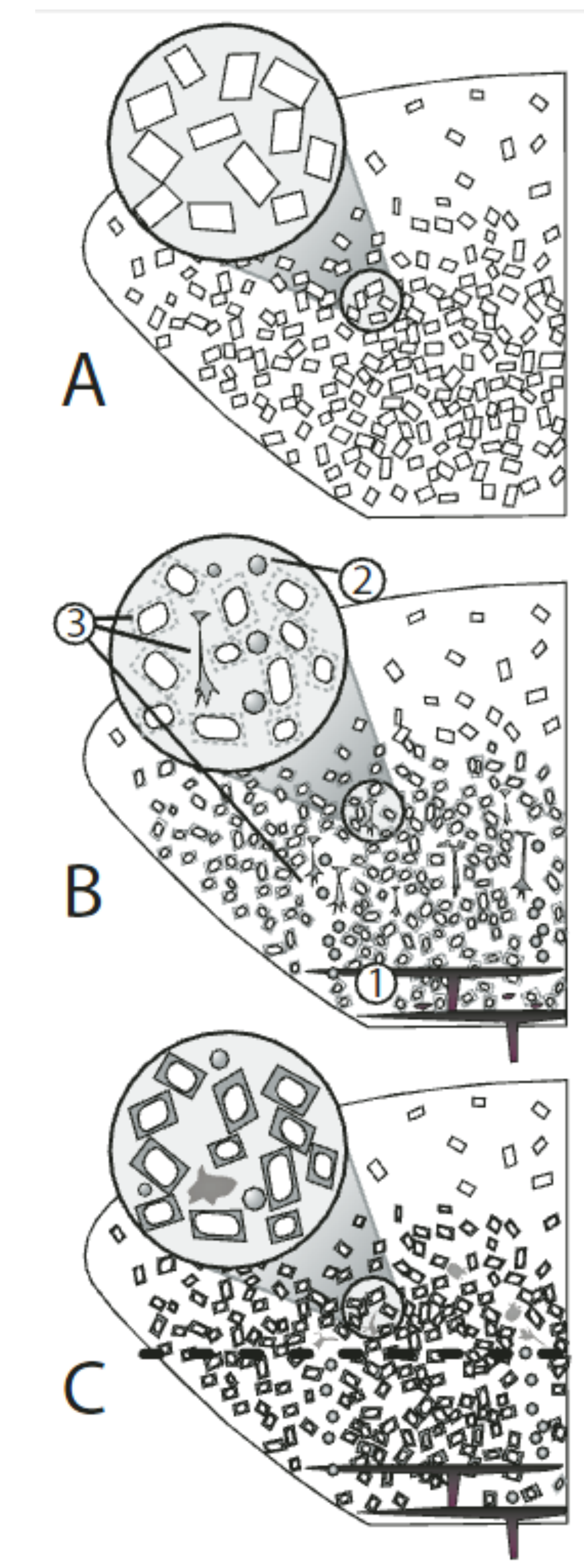
SEM-EDS image of alkali feldspar phenocryst with an Or_{60} core and apparent ternary composition rim.

Plagioclase and alkali feldspar megacrysts ranged from ~0.2cm up to 5 cm.

Discussion

- Sieve textures, strongly resorbed quartz, and variation of composition in and resorption geomteyr of feldspar zones indicate disequilibria and diverse origins.
- MCT contains a wide phenocryst assemblage including alkali feldspar, plagioclase, biotite, amphibole, quartz, clinopyroxene, sphene, apatite, zircon, magnetite, and ilmenite – hinting at entrainment of crystals from diverse magmas.
- Bulk compositions, including samples of separated distinct flow bands, fall in a narrow range (64-67wt% SiO_2), suggesting that banding evident in the field does not represent distinct magmas and magmas were effcetively mixed on hand sample scale.
- High concentrations of aluminum in amphiboles (ranging from ~8- ~17 oxide wt%) suggests that amphiboles equilibrated in highly variable conditions, and hint at deep storage of the magma (Schmidt 1992)
- Limited lateral extent (3km), exposed thickness (300m) (Schwat et al 2016), auto brecciated margins, and lack of distinct flow units suggest that MCT is a dome that formed a topographic high against which younger Sitgreaves Tuff was deposited in buttress unconformity.

Interpretations



A. Magma forms in the crust, crystallizing normally with euhedral crystals.
B. Magmas meet and mix as a result of open system processes, creating disequilibria and inhospitable environment for some phenocrysts. Resorption occurs and crystals become strongly resorbed
C. Zoned pheno/ xenocrysts form as a result of the recharge.

Illustration via Wark et al (2007) from a study in which temperature and depth were determined in a stratified magma chamber using the compositions of various zones in crystals. Wark et al used different compositions of zones and cores to indicate the different temperatures and depths at which the crystals existed throughout the evolution of the magma, similarly to how we used the composition of the zones of megacrysts to indicate the crystals' history in various magmatic environments.

MCT reflects sample-scale mixing of diverse melt and solid materials, possibly indicating remobilization of plutonic cumulate (as in Cashman and Blundy 2013) and entrainment into ascending magma.

Acknowledgements

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