An Investigation of Characteristics of the Magma Chamber Represented by the Cape Ann Plutonic Suite

Aaron Beltzer, Department of Geosciences, University of Massachusetts, Amherst, MA 01003

Over the course of several weeks in the summer of 2015 me and my field partner, Paul Southard, did a reconnaissance of the Cape Ann Pluton in eastern Massachusetts. Our goal was to test several main questions.

- How well does the plutons geometry hold up to the model that William Dennen produced while mapping from 1972-1975?
- Could the style of intrusion of the Cape Ann Pluton be similar to the Mafic and Silicic Layered Intrusion model of Wiebe and Collins (1998)?
- What about the role of water – is there a variation in water content within the pluton?
- Is this pluton related to the Coastal Maine Province (along strike to the N)?

We chose to map and perform our fieldwork in several well-known (geologically famous) locations on the island of Cape Ann: Lane's Cove, Andrew's Point, and Rafe's Chasm. At Lane's Cove numerous contacts between Cape Ann granite and K-feldspar quartz syenite are exposed. Several larger enclave-like mafic bodies consist of a plagioclase-phyric groundmass with large purple plagioclase crystals (see Fig. 1) and glomerocryst "rafts" scattered throughout. These field relations provide evidence for transport of deep sourced mafic material up through the dominantly felsic pluton. At Andrew's point, several miles northeast of Lane's Cove, there is a large exposure of single feldspar granite. This variation of granite (single feldspar), along with exposures of pegmatitic blue quartz crystals, indicates that there is a significant variation in water content within the pluton itself. Further to the South, the Rafe's Chasm area's granite hosts a 2.5 m wide composite dike (described by Ross, 2014), consisting of aphyric basaltic margins and an intermediate interior rich in mafic enclaves and K-feldspar phenocrysts. Field relations are consistent with assimilation of felsic magma by basaltic magma, with resorbed K-feldspar phenocrysts providing evidence of the assimilation event (Ross, 2015). Just east of this dike (see Fig. 2) is a previously undescribed rock unit that appears to be a very shallow (hypabyssal) intrusive unit or a roof pendant of rhyolite. The unit (~20 m wide) is porphyritic, with euhedral resorbed melt inclusion-bearing quartz phenocrysts and large (up to 0.5 cm) K-feldspar phenocrysts in a very fine-grained matrix interpreted as devitrified glass (see Fig 3). Finally, and perhaps the most interesting of all varieties of granite that we mapped is a rapakivi granite (another previously undescribed unit) that outcrops at Coolidge Point (see Fig. 4). Both full section and high-resolution microprobe maps were produced for the plutonic rocks of Cape Ann. The scale and variety of textures indicative of magma interaction and disruption of cumulate layers suggest that the pluton might be the result of repeated influxes of mafic magma into a dominantly felsic chamber, consistent with the MASLI model of Wiebe and Collins (1998), and similar to contemporaneous plutonic complexes on the coast of Maine.

Figure 1. Contact between plag-phyric mafic enclave and host granite. Note the large purple plagioclase megacryst and the sharp contact between the mafic and felsic rocks.

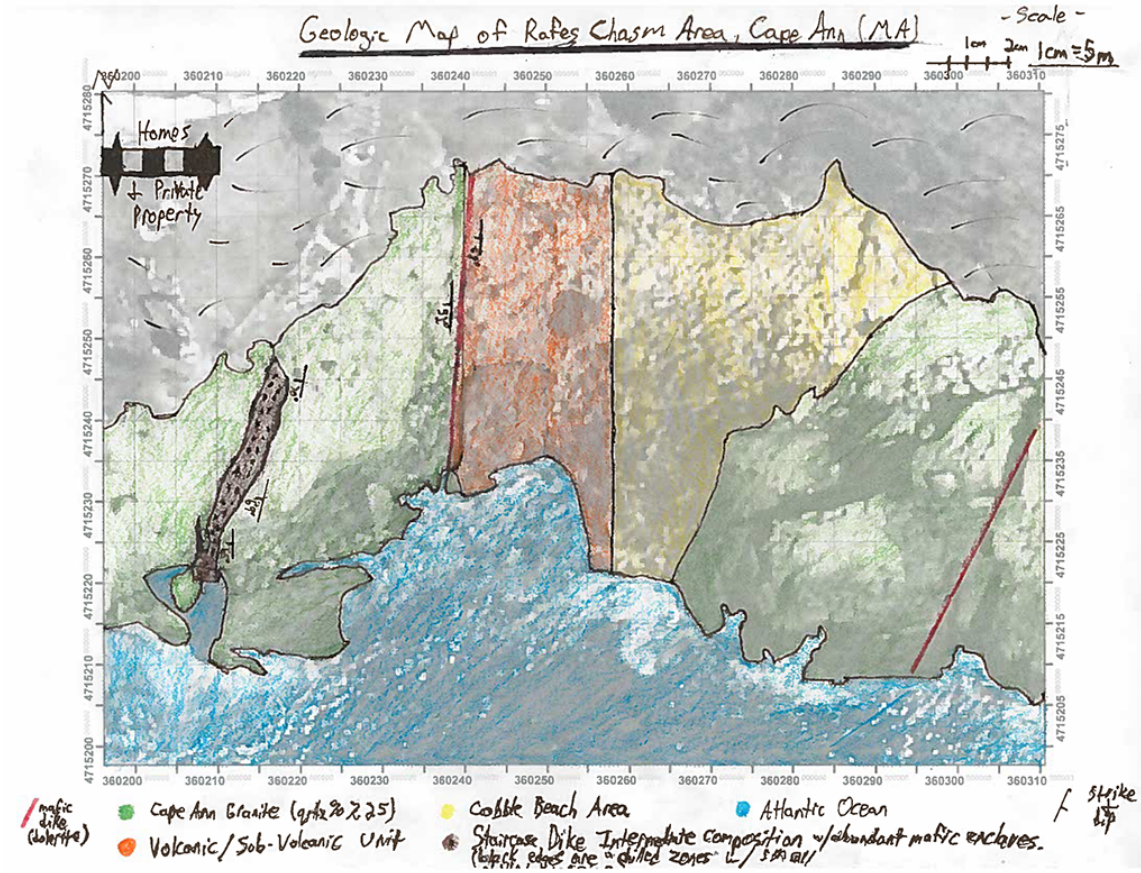

Figure 2. Geologic Sketch Map of the Rafe's Chasm Area (Gloucester), Cape Ann, MA

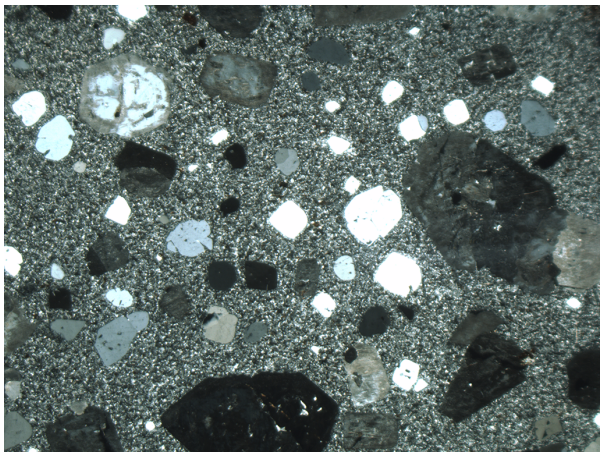

Figure 3. Thin section (sample Ca-9b) of Rafe's Chasm volcanic unit displaying resorbed melt-inclusion bearing quartz phenocrysts and large K-feldspar phenocrsysts in a fine grained matrix interpreted as devitrified glass.

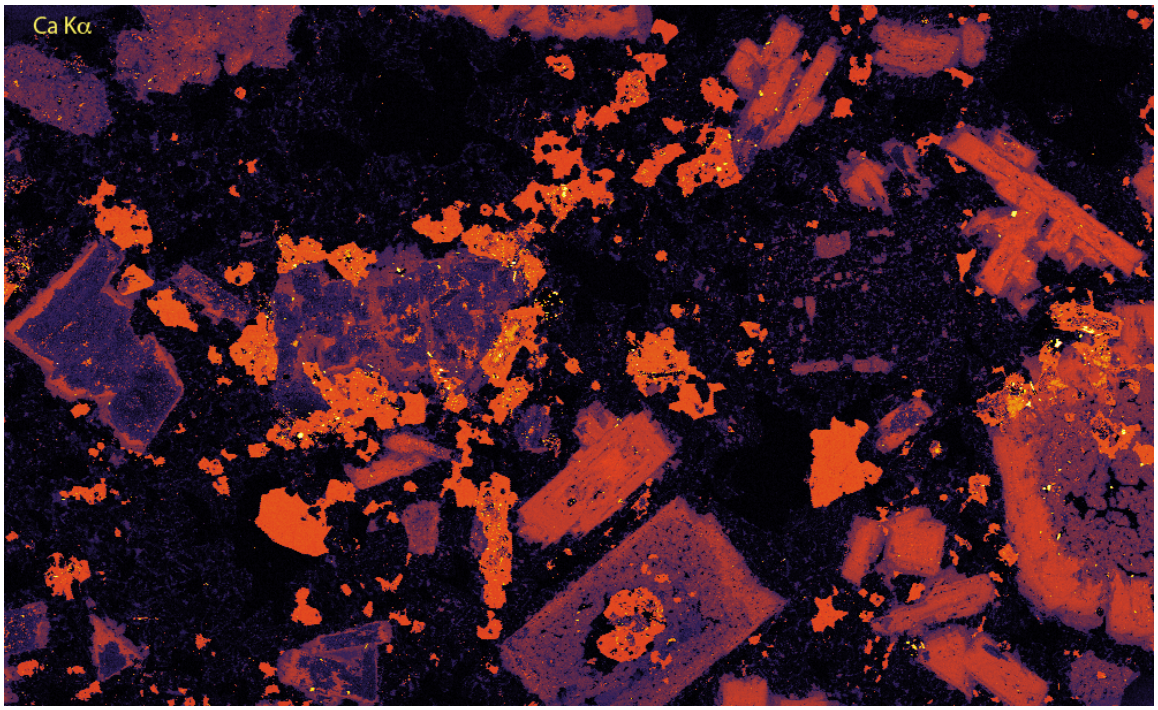

Figure 4. Ca Kα WDS map of Coolidge Point rapakivi granite sample Ca-15x. Note the calcium rich rims surrounding the more sodic cores in the feldspar phenocrysts. These cores may have grown via depressurization (unlikely in the case of this particular pluton as it likely remained at depth for a significant period of time), a change in water content (likely a factor because of the evidence for water variation within the pluton), or via an influx of mafic magma (likely for this pluton because of the observed evidence for contamination of the felsic magma by deeper level mafics).