Supplementary Material B

Alaska Volcano Observatory alert and forecasting effectiveness: 1989-2017

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# For determining composition

We generally classify the composition of the eruptive products using Le Maitre et al. (2002) and bulk-rock SiO2 content, with >52 wt % as basalt (B); 52 to 57 weight percent as basaltic andesite (BA); 57 to 63 weight percent as andesite (A); and >63 weight percent as dacite (D). We do not take into account total alkali content for our purposes, and it is worth noting that some eruptions/volcanoes would fall in the “trachy” portion of the total alkali silica diagram due their alkali rich nature (Bogoslof 1992, for example).

When products of a given eruption or eruptive period span the boundary of two or more compositional fields, we assign the field in which most analyzed samples fall.

## Akutan (BA)

The most recent analyzed lavas are from 1978 eruption and are basaltic andesite (55.4–55.7% SiO2). Scoria from base of the active cone matches this composition (Richter et al., 1998).

## Amukta

No compositional information exists for erupted products of this volcano.

## Atka (BA)

The youngest sampled deposit from Atka is a basaltic andesite bomb, and BA is the common composition of Holocene aged Atka rocks (Yogodzinski, pers. commun.). In the Holocene, Atka has produced compositions that range from basalt to dacite.

## Augustine 2005-2006 (A)

Range of compositions is 56.5 to 63.3 weight percent SiO2 (Larsen et al., 2010).

## Bogoslof (BA)

Seven analyses of the 1992 lava dome range from ~50 to 52 weight percent SiO2 (M. Harbin and C. Nye, unpublished data) and we classify them here as basalt (B) though their elevated alkalis place them in the trachybasalt to basaltic trachyandesite field. As yet there are no bulk-rock analyses of erupted material from the 2016–2017 eruption. Mineral assemblage and analyses suggest that the 2016 magma may be slightly less mafic than 1992 (lower anorthite content in plagioclase, for example; P. Izbekov, unpublished data). We assign a BA for the 2016-2017 eruption.

## Chiginagak (A)

Holocene lavas at Chiginagak have an SiO2 range of 55.3-61.8 weight percent; the average SiO2 value for 36 analyses is 58.4 weight percent (Schaefer et al., 2017). We classify as andesite (A).

## Cleveland (A)

Lavas from the recent period of activity are fairly homogeneous andesites with approximately 57–60 weight percent SiO2 (P. Izbekov, personal communication). We classify as andesite.

## Fourpeaked (A)

The only published whole-rock data for Fourpeaked volcanic rocks are from Fierstein and Hildreth (2008), who give 6 analyses that include 3 andesites: 1 basaltic andesite, and two dacites. There is no age information included with the samples. We assign andesite as the composition.

## Gareloi (BA)

Youngest known eruptive products from Gareloi are shoshonite lavas that erupted sometime between 1950 and 1980, and have 53.4–53.5 weight percent SiO2 (Coombs et al., 2012). Technically shoshosites based on elevated alkalis, we classify them here as basaltic andesite. It is worth noting that prior to these deposits, the last major eruption in 1929 produced latites and trachytes with 58–61 weight percent SiO2.

## Iliamna (A)

An unpublished manuscript by T. Miller describes Holocene rocks as spanning the andesite compositional range, though some published basalt analyses can be found (Kienle et al., 1983). We therefore assign andesite.

## Kanaga (BA)

For the 1906 eruption, 3 of 4 analyses are basaltic andesite. For 1994 eruption, one lava analysis is BA, whereas one “ash” attributed to 1994 was andesitic (Miller et al., 2003). Holocene-age lava flows of the cone are about half and half andesite (8) and BA (11) (Miller et al., 2003); we give the designation BA for the youngest erupted products of this volcano.

## Kasatochi (A)

The 2008 eruption produced nearly equal proportions of BA and A scoria (Nye et al. 2017; Neill, 2013). Because the bottom of the first main unit (Unit 2) consists of andesite, we infer that andesite magma reached the surface and erupted first in quantity. Thus the character of the magma ascent is best characterized by A.

## Kiska (A)

The 1990 eruption of Kiska is thought to have produced the lava flow at Sirius Point. A single analysis yielded a whole-rock composition of 57.8 weight percent SiO2 (Coombs and Cottrell, unpublished data). Other young lavas from Kiska are also andesitic.

## Little Sitkin (A)

No analyses of historical products exist for Little Sitkin. Holocene lavas and pyroclastic rocks span the andesite field with 57–62 weight percent SiO2 (Coombs, Larsen, Neal, and White unpublished data).

## Makushin (A)

According to McConnell et al., (1998), the only known historic unit at Makushin is Qmob, a bomb layer with andesitic whole-rock composition. Almost all Holocene tephras are andesitic in composition (Bean, 1999). We give a designation of andesite (A) for Makushin.

## Martin (A)

Glassy dense and scoriaceous blocks of the cone of Mount Martin are andesitic (59-61 weight percent SiO2; Hildreth and Fierstein, 2003). These are the youngest analyzed deposits from the volcano.

## Okmok (B, BA)

Lapilli and bomb ejecta from the 2008 eruption have whole-rock compositions that cluster tightly around 55 weight percent SiO2 (Larsen et al., 2013). The 1997 eruption, in contrast, produced basaltic compositions (Larsen et al., 2013).

## Pavlof (BA)

The 2013 and 2014 eruptions produced basaltic andesites with 53.0–53.4 weight percent SiO2 (Waythomas et al., 2017). We do not know specific compositions of products of other recent eruptions, but the majority of analyzed samples from Pavlof are basaltic andesites (Mangan et al., 2009); therefore we assign BA to all Pavlof eruptions.

## Redoubt (A)

Both the Redoubt 1989–90 and 2009 eruptions were compositionally well-characterized and produced lava and pyroclasts that spanned the andesite spectrum (Nye et al., 1994; Coombs et al., 2013).

## Seguam/Pyre Peak (BA)

Jicha and Singer (2006) state that the 1992–1993 eruption produced basaltic andesite.

## Semisopochnoi (BA)

Recently active vents of Sugarloaf and Cerberus are basaltic andesite; older caldera forming eruption products are andesitic (Coombs et al., in press).

## Shishaldin (B)

The 1999 eruption of Shishaldin produced basalts with 49.0–49.4 weight percent SiO2, and other recent products are also basaltic (Stelling et al., 2002).

## Spurr/Crater Peak (BA; A)

The 1992 eruptions of Crater Peak produced fairly uniform dark gray scoria, with an average composition of 56.7 weight percent (Nye et al., 1995). No historical eruptions of Spurr summit have occurred, but Holocene lavas from Spurr summit are middle andesites (Nye and Turner, 1990). Thus for the 2004–2006 unrest episode we assign an A, but for the 1992 eruptions we assign a BA.

## Takawangha (BA)

Youngest geologic units from Takawangha are basaltic andesite (actually trachybasaltic andesite), including the “wrinkled rug lava” which appears to be only a few hundred years old (Jicha et al., 2012).

## Tanaga (BA)

Tanaga lavas span the compositional range from 49.7–57.4 weight percent SiO2; most analyses are in the basaltic andesite field (Jicha et al., 2012). Lavas are undated but thought to be generally Holocene in age. The youngest dated Tanaga tephra is basaltic andesite at 800 yr BP (Coombs unpublished data). Also of note is that youngest tephras on island appear to all be from Sajaka, including one dated at 200 yr BP; these are all basalt.

## Veniaminof (BA)

SiO2 range is 54.1–54.8% (3 samples) for the active intracaldera cone (C. Bacon, pers. commun., 2017). We assign BA.

## Westdahl (BA)

A single analysis of a sample from the 1991 eruption has 54.6 weight percent SiO2 (George et al., 2003). We assign BA.

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