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PRELIMINARY DATABASE OF QUATERNARY VENTS IN ALASKA

by
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View looking northeast of the Emmons Lake Volcanic Center – the caldera rim is in the foreground, and Mt. Emmons, Hague, Double Crater, Little Pavlof, Pavlof, and Pavlof's Sister stretch to the northeast. Photo courtesy of Ryan Hazen, October 21, 2008.

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Introduction

The Alaska Volcano Observatory (AVO) uses an informal set of names for about 140 "volcanoes"—see http://www.avo.alaska.edu/volcanoes/. Some names refer to large, complex volcanic centers, while others indicate only a specific cone. This publication expands the list of 140 volcanoes to include all volcanic vents where magma has reached the surface over the past 2.6 million years, and currently comprises 1,187 entries. This database of all known (published, or unpublished with permission) Quaternary volcanic vents was developed to better describe the nature and character of Quaternary volcanism in Alaska and specifically to aid in the discussion of spatial and temporal patterns of Alaska volcanism.

This list is a preliminary starting point, and we hope that it is updated and expanded by the addition of newly discovered subaerial and submarine vents. We invite the community of volcanologists who study Alaska volcanism to help us develop this database by adding new vents as they are discovered and by improving the geologic descriptions of known vents as new information becomes available.

What's in this publication

For each vent, the following information is listed:

- its place in geographic and volcanic hierarchies
- a broad morphology designator (for example, cone, dome, stratovolcano, etc.)
- a location (latitude and longitude)
- a confidence ranking for the location
- a confidence ranking for whether or not the feature is a vent
- an age of youngest eruption (magma reaching the surface of the earth)
- a short text field describing the basis for the age designation

For vents with published information, we also link the vent to one or two essential publications that give information on the vent's age, or depict it on a map or figure.

Each vent is assigned to a broad morphology descriptor, where applicable. Where morphology is uncertain, the term "vent" is used. The list also contains 30 shield or suspected shield volcanoes, and 114 stratovolcanoes, stratovolcano remnants, or suspected stratovolcanoes.

At present, the database includes a total of 1,187 vents, most of which fall within the Pleistocene or suspected Pleistocene epoch (fig. 1). In addition, there are 89 historical* or suspected historical vents, 309 Holocene or suspected Holocene vents, and 116 vents of Quaternary or possibly Tertiary age. *AVO loosely defines the historical period in Alaska as about post-1700, the earliest dates of written records of Alaska volcanism.

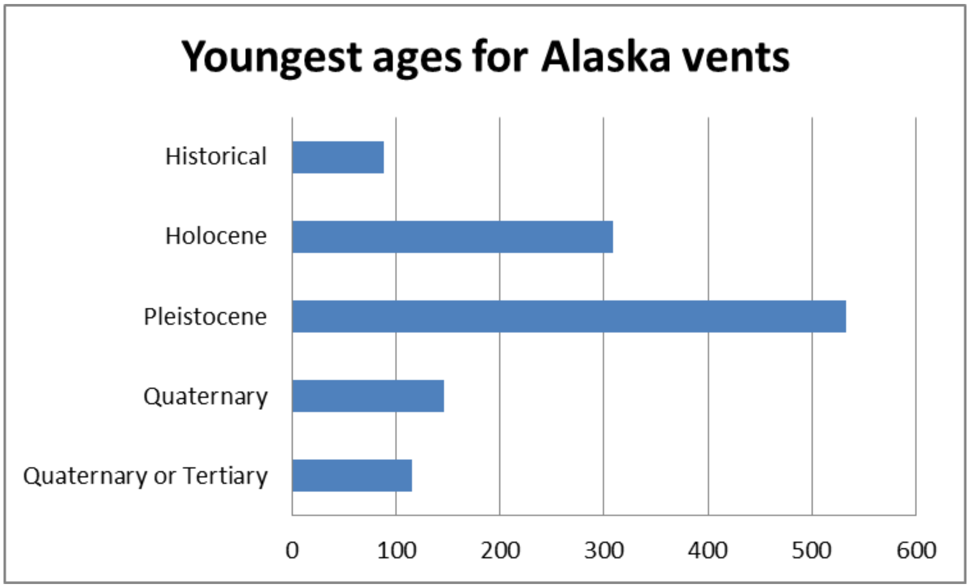

Figure 1: Number of vents by age group.

Dataset limitations

This list attempts to note all the locations where magma is known to have reached the surface in the last 2.6 million years. Given the spotty coverage of geologic mapping, geophysical studies, geochemical analyses, and geochronology in Alaska, this list is incomplete. Vent locations come from published and unpublished sources, and are subject to limitations of mapping scale and various mapping priorities, as well as problems such as erosion, glaciation, or destruction of the vent. An additional uncertainty arises around eroded domes or plugs—whether or not many of these features ever had a vent that made it to the surface is often unknown.

Largely because of unavailable data, this list also does not adequately address the problems of trying to determine locations for vents that are now obscured or obliterated (during caldera formation, perhaps). There are also complications in determining the criteria that might be used to either group or separate vents. For example, should Redoubt's series of domes (1989, 1990, 2009) be considered as distinct vents? What about Gareloi's 1929 linear trend of vents? For some volcanic centers, we could group those vents that we know to be magmatically related at some level. However, for much of Alaska, we do not have the depth of knowledge required to make such a determination.

Listed below are vents that we encountered that posed significant complications (such as the ones listed above), and an explanation or discussion of the criteria used to make the final designation.

Table 1. Highlights of some vent issues.

Center/volcano/vents	Issue
Redoubt's series of historical domes	Spatially very close to one another; these domes reasonably represent a single vent. However, this report includes known locations for the historical domes.
Gareloi's chain of craters, formed in 1929	Formed during one eruption in 1929; a linear trend of craters from the summit to near the shore. This database does not currently store line information, only points.
Akutan	Akutan comprises many features that may or may not ever have had subaerial expression prior to erosion. This compilation includes features more likely to represent volcanic domes with magma that reached the surface.
Kookooligit	No map exists that depicts a point for each monogenetic cone. Although we selected many vents on the basis of topography, there are certainly vents we failed to include.
Koyuk–Buckland volcanic field	We have a poor understanding of vent locations and their ages in the K–B volcanic field.
Yukon Delta	We have a poor understanding of the ages of many of these vents.
Imuruk	We have a poor understanding of vent locations and their ages.
Calderas	Typically calderas are not listed here as a separate vent type, or given a location; for most calderas, a point is not an appropriate vent depiction. Calderas often have additional vents that have formed in the caldera, and those are listed in this compilation. Caldera formation also obscures previously existing vents. Because we know people often search for a list of calderas in Alaska, we provide a list in table 2.
Submarine vents	This publication includes only a small number (~60) of unpublished submarine vents, and we are aware of many more candidates. We hope to add many more to a future version of this publication.
Southeast Alaska vents	We are aware of many unpublished vents newly discovered and dated in Southeast Alaska. We hope to add them to a future version of this publication.

Table 2. List of Quaternary Alaska volcanoes with known or suspected calderas with a minimum diameter of 2 km or with large semicircular scarps. Locations provided are approximate centers of the most-prominent calderas, and may differ from locations of summits, vents, or high points on caldera rims. Areas were calculated as simple ellipses, using caldera width and length as minor and major axes.

Volcano	lat (°N)	long (°E)	width (km)	length (km)	area (km^2)	Comments
Circular and semi-circular calderas known to have tens of cubic kilometers of associated pyroclastic flow deposits						
Aniakchak	56.91	-158.15	10	10	79	Two Holocene caldera-forming eruptions (Miller and Smith, 1987).
Veniaminof	56.20	-159.37	8	10	63	More than two Quaternary caldera-forming eruptions (Miller and Smith, 1987).
Emmons Lake Volcanic Center	55.36	-162.03	9.5	17.5	131	Multiple overlapping calderas, multiple extensive Quaternary ashflow sheets (Mangan and others, 2009).
Fisher	51.68	-164.37	10	17	134	Caldera outline is a combination of several curved segments; caldera-forming eruption 9,400 y BP (Stelling and others, 2005).
Okmok	53.43	-168.14	10	12	94	10 × 10 km younger caldera (~2050 yBP) nested inside a ~12,000 yBP 10 × 12 km caldera (Byers, 1959; Larsen and others, 2007).
Semisopochnoi	51.94	-180.38	6.5	8	41	Up to 50 m of coarse pyroclastic flow deposits associated with post-glacial caldera formation (Coats, 1959).
Circular and semi-circular calderas known or likely to have a few to many cubic kilometers of associated pyroclastic flow deposits						
Wrangell	62.00	-144.04	4	6	19	Late Holocene caldera with ashflow exposed principally along the Chetaslina River (Richter and others, 1995b)
Kaguyak	58.61	-154.06	2.7	3	6	Caldera formation about 5,000 yBP, with associated dacitic pyroclastic flows (Fierstein and Hildreth, 2008).
Katmai	56.27	-154.98	2.8	4.5	10	Collapsed during the 1912 eruption from Novarupta, but was not the primary eruptive source. An unusual instance of syneruptive flank subsidence (Hildreth and Fierstein, 2012).
Ugashik	57.72	-156.39	4	4.5	14	Caldera formation via eruption and collapse likely around 40,000 yBP (Miller, 2004).
Black Peak	56.56	-158.79	3	3	7	Caldera forming around about 4600 radiocarbon yBP, with 100 m thick ash-flow tuffs in nearby drainages (Miller and Smith, 1987; Adleman, 2005).
Akutan	54.14	-165.98	2.4	2.6	5	Holocene summit caldera, possibly an older caldera to southwest of summit (Miller and Smith, 1987; Richter and others, 1998).

Makushin	53.89	-166.93	2	2	3	Dimensions very approximate; caldera outline obscured by ice. Caldera formed between 8800 and 7900 radiocarbon yBP (McConnell and others, 1998).
Yunaska	52.64	-170.65	3.4	3.4	9	Two calderas; the younger is likely Holocene (Lamb and others, 1992).
Seguam, western	52.32	-172.00	3.2	3.4	9	Explosion caldera formed in late Holocene (Jicha and Singer, 2006)
Seguam, eastern	52.32	-172.51	3	3.5	8	Sector collapse and explosive lateral blast at about 9,000 years ago (Jicha and Singer, 2006)
Large circular or semi-circular scarps formed during edifice failure.						
Spurr	61.30	-152.25	5	7	27	Hot pyroclastic flows directly overlie distal debris avalanche deposits and provide strong evidence for a magmatic component to collapse (Miller and others, 1998).
Kanaga	51.92	-177.15	4.0	4.0	13	Andesitic pyroclastic flows up to 10 m thick provide evidence of magmatic component to caldera collapse and debris flow formation (Coats, 1956).
Sajaka	51.88	-178.18	1.7	?	10	Pumiceous pyroclastic flow deposits provide strong evidence for magmatic trigger to late Holocene sector collapse (Coombs and others, 2007).
Gareloi	51.79	-178.79	E: 1 NW: 3	E: ? NW: ?	E: 6 NW: 18	Scars associated with two small-volume collapses exist (east and northwest); a third collapse (north) is inferred from bathymetric data (Coombs and others, 2007).
Tanaga	51.88	-178.14	>10	>7.5	>60	Deep-seated collapse between 240ka and 120ka (Coombs and others, 2007)
Great Sitkin	52.08	-176.11	7.9	>5.4	>25	Deep-seated Pleistocene collapse, subaerial and submarine evidence (Coombs and others, 2007).
Large crater-like features						
Churchill	61.42	-141.72	2	4	6	Source of late Holocene White River ash (Richter and others, 1995a).
Novarupta	58.27	-155.16	2	3.6	6	Vent obscured, but presumably flared and much smaller at depth than at surface. Formed during 1912 eruption (Hildreth and Fierstein, 2012).
Frosty	55.07	-162.84	3.0	3.5	8	Possible additional 2 × 2.3 km crater adjoining to north of main summit crater; both presumed Pleistocene (Waldron, 1961).
Herbert	52.75	-170.12	2.1	2.1	3	Caldera morphology is quite clear; Herbert remains unstudied (Wood and Kienle, 1990)
Postulated calderas lacking complete geographic expression and geologic confirmation						
Skookum Creek	62.39	-143.14	4.5	10.0	35	Seven ~3 Ma domes form a possible ellipse about 4.5 × 10 km that “may reflect leakage of magma along the walls of a subsiding caldera” (Richter and others, 1995b).

Tanada	62.29	-143.57	6.0	8.0	38	Eroded large shield and remnant summit caldera (Richter and others, 2006)
Jarvis	62.02	-143.62	5.0	9.6	38	Flat-lying mid-Pleistocene lava flows inferred to be intracaldera fill. Mapped extent suggests multiple overlapping sub-circular regions of such flows (Richter and others, 2006).
Capital	62.42	-144.11	4.0	4.0	13	450 m of thick, flat-lying 1 Ma andesite flows inferred to be intracaldera fill, although precaldera edifice is absent (Richter and others, 1995b).
Sanford	62.21	-144.13	9.0	11.0	78	Caldera inferred from structural and stratigraphic relations in poorly exposed older rocks. Neither intact caldera rim nor caldera-forming deposits are known (Richter and others, 1994).
Morzhovoi	55.21	-162.49	5.3	6.0	25	Postulated Pleistocene caldera defined by ring of relatively high remnants of ancestral cone with radial, outward dips (Waldron, 1961).
Westdahl	54.52	-164.64	8.5	8.5	57	Current morphology of western flank especially suggests a large shield volcano truncated at 800–1,000 m elevation by a caldera rim. Geologic confirmation is lacking despite attempts to locate such evidence (Game McGimsey, written commun., 2014).
Atka	52.23	-174.20	7.0	9.0	49	Central shield with caldera formation 300,000 – 500,000 years ago. 80 percent of caldera rim is inferred; western 20 percent exposed and mapped (Miller and others, 1998; Gene Yogodzinski, written commun., 2014).
Little Sitkin	51.95	-181.46	4.8	4.8	18	Caldera postulated to explain geometric arrangement of erosional remnants of old lava; postulated caldera boundary largely covered; no deposits from caldera-forming eruption identified. A younger 1.7 × 2.5 km caldera is also postulated (Snyder, 1959).
Davidof	51.97	-181.67	1.9	2.1	3	Davidof, Pyramid, and Lopy islands are thought to form the eastern part of the rim of a caldera in an otherwise submerged volcano, possibly late Tertiary in age (Nelson, 1959).

Table and Field Descriptions

A brief summary of abbreviations used and table and field information is included below.

Abbreviations used:

- Is = Island
- Mt = Mount
- Mtn(s) = Mountain(s)
- MF = monogenetic field
- WWMF = Western Wrangell monogenetic field

Table and field information:

Table: AK_Q_vents: The table recording basic information for each vent. Fields in AK_Q vents:

vent_id: An internal, database-assigned unique number for each vent.

Topgroup: This column is intended to place each vent in a broad geographic region of the state: Plate interior; Aleutian arc; Wrangells; and Southeast Alaska.

Region: This column further locates the vent in each **Topgroup**, and is largely a geographical descriptor.

Subregion: This column assigns a vent to a volcanic center or geographic cluster of volcanoes. Rear-arc vents/volcanoes are broken out into different volcanic centers at this level of the hierarchy (for example, Katmai area and Katmai rear-arc).

Volcano: Assigns a vent to a specific volcano/volcanic edifice.

Vent_Name: Designator for a specific vent. Whenever a name for a vent is in use, either formally or informally, we have attempted to use that name. For the numerous features without any designation, we have assigned labels based on the geographic area (often the quadrangle) and a number.

Feature: Broad designation of what kind of vent is represented. In cases of uncertainty, "vent" is used. The term "caldera" is not used as a vent type, as calderas have many different formation processes and their vent location(s) are typically obscured.

Vent_conf:

1: very confident that this feature is actually a volcanic vent
2: this feature is likely a volcanic vent
3: while reasonable that this is a volcanic vent, and many are published as a vent, we are much less confident.

LatDegree and **LongDegree:** Location information, decimal degrees WGS84 datum. Although 5 decimal places are specified, see the "Loc_conf" column for precision information.

Loc_conf:

1: location is confidently known within a few hundred meters
2: location is known within a few hundred meters to a couple of kilometers
3: location is not well known; location given is likely within 2–10 kilometers

Age_text_1: A short description of how or why the vent was assigned a specific "Last_erupt" age, intended to represent the time period of last known eruption. To make this file more useable in GIS software, text strings longer than 254 characters are broken into subsequent Age_text fields.

Last_erupt:

Historical: Vent has erupted in Alaska's historical time period (since about 1700). The dash is followed by the date of the last eruption. A question mark following the date means the historical record does not provide enough information to determine unequivocally that the event was a volcanic eruption, but it is suspected of being an eruption.

Holocene and Suspected Holocene:

- Holocene: Known to have had an eruption during the Holocene epoch (last 11,000 years)
- Suspected Holocene: Strongly suspected of having had an eruption during the Holocene epoch

Pleistocene and Suspected Pleistocene:

- Pleistocene: Known to have had an eruption during the Pleistocene epoch (11,000 years –2.6 million years ago)
- Suspected Pleistocene: Strongly suspected of having had an eruption during the Pleistocene

Quaternary and Suspected Quaternary:

- Quaternary: Known to have had an eruption during the Quaternary period (0–2.6 million years ago)
- Suspected Quaternary: Strongly suspected of having had an eruption during the Quaternary

Quaternary or Tertiary:

- The vent's most recent eruption is unknown, but likely lies in the early Quaternary or late Tertiary.

Table: full_citation: Table of citation information for each reference used in this list

CitationID: Internal unique number for each reference, assigned by the originating database
FullCitation_1: To make this file more useable in GIS software, text strings longer than 254 characters are broken into a second subsequent FullCitation fields.

Table vent_reference: This table joins vents to references. Although some vents could logically be joined to hundreds of references, for the purposes of this publication, the references per vent have been limited to those references that detail age information about the vent, or depict the vent on a geologic map. There are a few vents with no references; these draw from unpublished data.

vent_ref_id: Unique primary key per row, assigned by the database
vent_id: A unique id for a vent, as found in table AK_Q_vents
CitationID: A unique ID for a reference, as found in table full_citation.

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