

Appendix. Lightning at Volcanoes from Literature Search

Volcano	VEI	Date	Plume Height (km)	Comment+	References
Akutan	2	10 Apr. 1992	4	day	J. Paskievitch, writt. comm., 1992
Ambrym	-	19 Oct. 2004	3-3.7	day@ 5-8pm	J. Seach, writt.comm., 2005
Anak Krakatoa	3	1933	-	-	Simkin and Fiske, 1983
Anatahan	-	6 Apr. 2005	-	17:26 UT	G. Ellrod, writt. comm., 2005
Aniakchak	3	1 May 1931	-	-	Volc. Quarterly, 1995
Arenal	3	29 Jul. 1968	>10	day	Melson, 1994
Asama	4	1783	-	-	Krafft, 1993, p.88-89
Aso	2	13 Jun. 1979	2	day	McClelland et al., 1989
Aso	-	19 Jun. 1979	-	-	McClelland et al., 1989
Aso	-	1 Aug. 1979	-	-	McClelland et al., 1989
Aso	-	2-3 Aug. 1979	-	-	McClelland et al., 1989
Aso	-	4 Aug. 1979	-	-	McClelland et al., 1989
Aso	-	8-9 Aug. 1979	-	-	McClelland et al., 1989
Aso	1	6 Sep. 1979	0.7	day	McClelland et al., 1989
Augustine	4	23 Jan. 1976	-	night?	Kienle & Swanson, 1985
Augustine	3	27 Mar. 1986	11	night	J. Kienle, pers.comm., 1992
Augustine	3	13 Jan. 2006	10.2	day 13:24UT CG	BLM, unpublished data
Augustine	3	13 Jan. 2006	10.2	day 17:47UT CC	AVO, unpublished data
Augustine	3	13 Jan. 2006	10.5	day 20:22UT	AVO, unpublished data
Augustine	3	14 Jan. 2006	13.5	night 03:58UT	AVO, unpublished data

Augustine	3	14 Jan. 2006	10.2	night 09:14UT	AVO and BLM, unpublished data
Augustine	3	17 Jan. 2006	13.5	day 16:58UT	AVO, unpublished data
Augustine	3	28 Jan. 2006	10.5	05:31UT 365 fl	Thomas et al., submitted
Augustine	2	28 Jan. 2006	3.8	08:37UT 1 fl	Thomas et al., submitted
Augustine	3	28 Jan. 2006	7.2	11:04UT 28 fl	Thomas et al., submitted
Augustine	3	28 Jan. 2006	7.0	16:42UT 6 fl	Thomas et al., submitted
Augustine	2	29 Jan. 2006	3.8	00:40UT 35 fl	Thomas et al., submitted
Augustine	3	29 Jan. 2006	7.2	20:19UT 2 fl	Thomas et al., submitted
Augustine	3	30 Jan. 2006	7.2	12:28UT 0 fl	Thomas et al., submitted
				Vent discharges only	
Augustine	3	30 Jan. 2006	7.2	15:22UT 2 fl	Thomas et al., submitted
Bandai	-	1888	-	-	Woodcut at Bandai museum
Bezimianny^	5	31 Mar. 1956	-	day	Gorshkov, 1959
Bulusan	3	15 Apr. 1981	8	night	McClelland et al., 1989
Cerro Negro	3	1971	-	-	J. Viramonte (photo), in: Fisher et al., 1997
Chaiten^	4	2-3 May 2008	20	day	GVN 2008; Natl. Geogr., 2008
Chaiten	2	24-28 May 2008	5	day	R. Thomas, unpub. data
Chikurachki	2	19 Nov. 1986	1	-	BVE, 1989; SEAN, 1986
Chikurachki	3	20 Nov. 1986	11	-	BVE, 1989; SEAN, 1986
Cleveland	2	24 Aug. 2006	3-4	day	AVO unpublished data
Colima	-	30 Jan 2005	-	day	N. Varley, writt. comm., 2005
Colima	2	26 Mar. 2005	5	-	N. Varley, writt. comm., 2005

Colima	-	30 May 2005	-	03:36	N. Varley, writt. comm., 2005
Colima	-	2 June 2005	-	00:22	N. Varley, writt. comm., 2005
Colima	-	5 June 2005	-	14:20	N. Varley, writt. comm., 2005
Colima	-	6 June 2005	-	23:05	N. Varley, writt. comm., 2005
Colima	-	9 June 2005	-	21:54	N. Varley, writt. comm., 2005
Colima	-	5 July 2005	-	18:21	N. Varley, writt. comm., 2005
Colima	-	27 July 2005	-	04:13	N. Varley, writt. comm., 2005
Colima	-	16 Sept 2005	-	10:47	N. Varley, writt. comm., 2005
Colima	-	27 Sept 2005	-	05:08	N. Varley, writt. comm., 2005
El Chichon	4	4 Apr. 1982	>10	night	Havskov et al., 1983
El Chichon	4	3 Apr. 1982	>10	night	Natl. Geogr., 1982
Etna	3	1819	-	-	Krafft, 1993, p.105
Etna	2	3-4 Aug. 1979	-	night	McClelland et al., 1989
Etna	2	16-17 Apr. 1980	3?	night?	McClelland et al., 1989
Fernandina	4	11 June 1968	-	-	Simkin & Howard, 1970
Fernandina	3	8 Aug. 1978*	4.5-6	night	McClelland et al., 1989
Fuego	2	16 Sep. 1978*	1.1	day	McClelland et al., 1989
Fuego	2	22 Mar. 1979	2.5	day	McClelland et al., 1989
Galeras	2	7 June 1993	7?	-	GVN 1993
Galunggung	3	early Aug. 1982	?	night	Katili & Sudradjat, 1984
Galunggung	3	9 Oct. 1982	8	day	McClelland et al., 1989
Galunggung	3	16 Oct. 1982	-	night	Katili & Sudradjat, 1984
Galunggung	3	3 Dec. 1982	-	day	McClelland et al., 1989

Galunggung	-	phase 2, 1982	-	-	Gourgaud et al., 1989
Galunggung	-	1982	-	-	Krafft, 1993, p.96
Gorely^	2-3	1980-81 or 1984-86	-	day	Fedotov & Masurenkov, 1991
Grimsvotn	3	3 Oct 1996	-	day	Benediktsson, 1996 (video)
Caldera					
Grimsvotn	3	18-28 Dec 1998	10	night	Arason et al., 2000; Arason 2005
Caldera					
Grimsvotn	3	1 Nov. 2004	13	night	Arason 2005
Caldera					
Heimaey	3	1973	-	-	Brook et al., 1973
Hekla^	3	2000	-	-	Arason 2005
Hibok-Hibok	2	1951	-	-	Alcaraz, 1989
Hudson	3	8 August 1991	12	-	GVN 1991; Volcanes de Chile
Hudson	5	12 August 1991	>12	-	GVN 1991
Izu-Oshima	3	15-22 Nov. 1986	16	day	Ondoh, T., 1990
Kamchatka	-	June 1778	-	thunder	Clarke, 1821
Karymsky	3	13 Oct. 1996	-	-	AVO Bimonthly, 1996
Kasatochi	5	7 August 2008	15	-	AVO unpublished data, 2008
Katmai	6	1912	25+		Erskine, 1962
Katla	4	1755	-	-	Anon., 1863
Kilauea	2	1924	-	day	Natl. Park Service display; Stearns, 1925
Komagatake	4	17 June 1929	-	day and night	Poster display, 1995; video

Krakatau	6	1883	-	-	Francis, 1976; Lane, 1966; Judd, in Symons, 1888 Simkin and Fiske, 1983
Krakatau	1	10 Jul. 1978	0.4-0.5?	-	McClelland et al., 1989
Krakatau	1	2-5 Oct. 1978	0.2-0.4	day	McClelland et al., 1989
Krakatau	2	14 Sep. 1979	1.5	day	McClelland et al., 1989
Krakatau	2	20 Oct. 1981	0.6-2	day	McClelland et al., 1989
Krakatau	-	17 May 1997	-	night	Lyvers, M., writ. comm. 1997
Lamington	3	18 Jan. 1951	5.2	night	Taylor, G.A.M., 1958; Thompson, D., 2002
Lamington	3	19 Jan. 1951	6.7	night	Taylor, G.A.M., 1958
Lamington	3	25 Jan. 1951	5.0	night	Taylor, G.A.M., 1958
Lamington	3	27 Jan. 1951	6.2	night	Taylor, G.A.M., 1958
Lamington	2	28 Jan. 1951	2.8	night	Taylor, G.A.M., 1958
Lamington	2	29 Jan. 1951	3.5	night	Taylor, G.A.M., 1958
Lamington	2	30 Jan. 1951	2.5	night	Taylor, G.A.M., 1958
Lamington	1	5 Feb. 1951	<1	night	Taylor, G.A.M., 1958
Lamington	2	2 Mar. 1951	3.7	night	Taylor, G.A.M., 1958
Langila	2	12 Nov. 1982	3?	night	McClelland et al., 1989
Langila	3	26 Dec. 1982	9	day	McClelland et al., 1989
Manam	3	27 Mar. 1982	6-7	day	McClelland et al., 1989
Manam	2	30 Jun. 1987	-	-	BVE, 1990
Manam	-	23-24 Nov. 2004	-	-	A. Tupper, writt. comm., 2005

Manam	-	2 Dec. 2004	6.1	early evening	J. Seach, writt. comm., 2005
Manam	-	19 Dec. 2004	18.3	-	A. Tupper, writt. comm., 2005
Mayon	3	24 Sep. 1984	15	day	McClelland et al., 1989
Montserrat	3	1995?	-	day	"World's Deadliest Volcanoes" (video)
Mount St. Helens	5	18 May 1980*	22	day	McClelland et al., 1989; Rosenbaum and Waitt, 1981
Mount St. Helens	2?	late Jul. 1983	3.5-4.5	-	Cobb, 1980
Ngauruhoe	3	29 Mar. 1974	?	night	Nairn et al., 1976
Okmok	4	12 July 2008	16	day	Larsen et al., 2009
Okmok	2	2 Aug 2008	3	day	J. Larsen, pers. comm. 2008
Okmok	2	3 Aug 2008	3	day	J. Larsen, pers. comm. 2008
Pacaya	2	1973	?	night	W.C. Buell photo
Paricutin	2-3	1943-1952	-	-	Luhr & Simkin, 1993; Green, 1944
Pavlof	2	4 Nov. 1996	7.5?	day	J. Painter, pers.comm.,1997
Pavlof	2	30 Aug. 2007	6.1	day	J. Smith, pers.comm.,2007
Pele	4	9 Jul. 1902	-	-	Anderson & Flett, 1903; Blong, 1984
Pinatubo	4	12 June 1991, 08:51	20	faint (day)	Sabit et al., 1996; D. Harlow, pers. Comm.
Pinatubo	4	14 June 1991, 22:18	20	night	Sabit et al., 1996
		22:52		thunderstorm	Hoblitt et al., 1996
Pinatubo	-	15 June 1991, 01:15	-	night	Sabit et al., 1996
Pinatubo	-	15 June 1991, 01:40	-	night	Sabit et al., 1996
Pinatubo	6	15 June 1991, 13:42	33	day and night	C. Newhall, writt. comm.;

		(climactic)			Tremendous lightning, T. Murray & D. Harlow, pers. Comm.
					multiple locations including fringes,
					Cloud-to-ground and cloud-to-cloud
Pinatubo	3?	13 July 1991	-	night	M. Dolan, photo, VSSAC calendar 1995
Rabaul	4	19 September 1994	20	day and night	GVN, 1994
Vulcan and Tavurvur					
Redoubt	2-3	14 Dec. 1989-	7-12	night and day	Hoblitt, 1994; Miller and Chouet, 1994
		16 Jan. 1990			
Redoubt	2	15 Feb. 1990	>10	184 flashes (fl), Hoblitt, 1994; Hoblitt and Murray, 1990	
				8 min delay	
Redoubt	2	21 Feb. 1990	9	2+ fl, 11 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	24 Feb. 1990	9	7 fl, 11 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	28 Feb. 1990	8	16 fl, 9 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	4 Mar. 1990	12	3 fl, 5 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	9 Mar. 1990	10	13 fl, 9 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	14 Mar. 1990	12	20 fl, 6 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	23 Mar. 1990	>10	3 fl, 10 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	1	29 Mar. 1990	?	5 fl, 5 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	6 Apr. 1990	9	9 fl, 8 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	15 Apr. 1990	>10	9 fl, 15 min del	Hoblitt, 1994; Hoblitt and Murray, 1990
Redoubt	2	22 Mar 2009	5.5	night	R. Thomas, unpub. data. 2009
Redoubt	3	23 Mar 2009	13.4	night	R. Thomas, unpub. data. 2009
Redoubt	3	26 Mar 2009	18.9	night	R. Thomas, unpub. data. 2009

Redoubt	3	27 Mar 2009	15.5	night	R. Thomas, unpub. data. 2009
Redoubt	3	28 Mar 2009	13.1	night	R. Thomas, unpub. data. 2009
Redoubt	3	4 Apr 2009	15.2	day	R. Thomas, unpub. data. 2009
Rinjani [#]	-	Jun 1994	10	night	web photo; GVN 1994
Ruapehu	2	1945	-	-	Blong, 1984
Ruapehu	3	11 Oct. 1995	10	night	GVN, 1995; Schneider, 1995
Ruiz	2-3	11 Sep. 1985*	-	day and night	McClelland et al., 1989
Sakurajima	4	1914	-	-	Abe, 1979
Sakurajima	2	6 Dec. 1976	3	night	McClelland et al., 1989
Sakurajima	2	24 Nov. 1979	1?	night	McClelland et al., 1989
Sakurajima	2	28 Nov. 1979	2	day	McClelland et al., 1989
Sakurajima	2	10 Nov. 1979	1.5-2.3	day	McClelland et al., 1989
Sakurajima	2	4 Dec. 1979	1	day	McClelland et al., 1989
Sakurajima	2	17 Dec. 1979	>1	night	McClelland et al., 1989
Sakurajima	2	24 Dec. 1979	2.3	night	McClelland et al., 1989
Sakurajima	1	25 Dec. 1979	0.8	day	McClelland et al., 1989
Sakurajima	2	26 Dec. 1979	2.1	-	McClelland et al., 1989
Sakurajima	2	17 Feb. 1988	2.5	night 03:09	Ryan, 1994 (photo by T. Takayama)
Sakurajima	-	18 May 1991	2.5&	night 23:08	Fisher et al., 1997; SVO photo, 1991
Sakurajima	2?	?	?	night	Natl. Geogr., 1993
Santa Maria	5	24-26 Oct. 1902	-	-	Sapper, 1905
Sao Miguel	-	12 June 1811	0.3	-	Tillard, 1812; Clarke, 1821

(Azores offshore)

Shishaldin	3	19 April 1999	16	day	Thompson et al., 2002
Shiveluch^	4	Nov. 1964	-	-	Gorshkov & Dubik, 1970
Shiveluch^	-	27 Feb. 2005	-	12:00 UT	S. Senyukov, writt. comm., 2005
Soputan	3	26 Aug. 1982	15	night	McClelland et al., 1989
Soputan	2-3	9 Nov. 1982*	5	night	McClelland et al., 1989
Soufriere,	4	30 Apr 1812	-	day	Clarke, 1821
St. Vincent		1902	-	-	Anderson and Flett, 1903; Blong, 1984
Soufriere	3	1979	-	-	Shepherd et al., 1979
St. Vincent					
Spurr	4	9 July 1953	18.3	day	Juhle and Coulter, 1955; Wilcox, 1959
Spurr	3	27 June 1992	14.5	day	Davis & McNutt, 1993; McNutt & Davis 2000
Spurr	3	18 August 1992	13.7	day	Davis & McNutt, 1993; Paskievitch et al, 1995 McNutt & Davis 2000
Spurr	3	17 September 1992	13.9	night	Davis & McNutt, 1993; McNutt & Davis 2000
Stanchio?		7 August 1707	-	thunder	Clarke, 1821
					name not listed in VOTW
Stromboli(?)	2	?	-	night	Krafft, 1993, cover
Stromboli	3	1907	-	-	Perret, 1924
Surtsey	3	Nov. 1963	-	-	Anderson et al (1965)
Surtsey	3	Feb. 1964	-	day	Anderson et al (1965)
Taal	4	1911	-	-	Pratt, 1911
Taal^	4	1965	-	-	Carroll & Parco, 1966

Taal	2	6 Sep. 1976*	0.2-2.2	night	McClelland et al., 1989
Taal	1	10 Oct. 1976	0.5	night	McClelland et al., 1989
Tarawera	5	1886	-	-	Pond & Smith, 1886
Tavurvur	-	2007?	-	night	Natl. Geogr., 2007
Thera	6	1470 BC	-	-	Pounder (1980)
Tokachi	3	1926	-	day	H. Okada, pers. comm., 1995
Tokachi	3	29 June 1962	12	day	H. Okada, pers. comm., 1995
Tokachi	2	24 Dec. 1988	-	night	Katsui et al., 1990
Tolbachik	4	1976?	-	night	Fedotov & Masurenkov, 1991
(new)					
Tolbachik	-	July 1975	-	night	E. Gordeev photo
Ulawun	3	6-7 Oct. 1980	7-10	day and night	McClelland et al., 1989
Ulawun	3	29 Sep. 2000	10.7	night	AIREP (A. Tupper, writt. Comm.. 2004)
unknown	3	-	-	night?	Saavedra and Ramis, 1991, p.99
Usu	3	7 Aug. 1977	12	day	McClelland et al., 1989; Kikuchi and Endoh, 1982
Usu	2	13 Sep. 1978	2.5-3	night	McClelland et al., 1989; Niida et al., 1980
Usu	2	24 August 1978	-	-	Niida et al., 1980
Usu		9 April, 2000	0.5	night 8:40pm	J. Seach, writt. comm., 2005
Vesuvius	5	79 A.D.	-	day and night	Francis, 1976; Krafft, 1993, p.32,40
Vesuvius	4	1631	-	-	Hamilton, 1772
Vesuvius	3	1660	-	-	Krafft, 1993, p.24-25

Vesuvius	3	1707	-	-	Goldsmith, 1852
Vesuvius	3	1767	-	-	Krafft, 1993, p.145
Vesuvius	3	7 August 1779	-	midnight	Clarke, 1821; Krafft, 1993a
Vesuvius	3	15 June 1794	-	night	Clarke, 1821
Vesuvius	3	31 May 1806	-	evening	Clarke, 1821
Vesuvius	3	Oct 1822	-	-	S. Martino Museum (painting); Krafft, 1993b
Vesuvius	4	1872	-	-	Palmieri, 1873
Vesuvius	3	1906	-	Al rich	Jaggar, 1906; Lane, 1966; Perret, 1924
Vesuvius	3	Mar. 1944	-	-	Shore 1975; Viemeister, 1972
Vulcano	3	18 August 1888	3-4	day	Mercalli, 1907; MacDonald, 1972
Vulcan	3	29-30 May 1937	-	day and night	Johnson & Threlfall, 1985; McKee et al., 1985
Westdahl	3	6 Feb. 1978	8-10	night?	McClelland et al., 1989

^ probable lightning (strong atmospheric electricity)

& reported as "cinders > 2,500 m"

@ local thunderstorms nearby

* thunder or rumbling reported

+ abbreviations: fl - flash; CC - cloud-to-cloud; CG - cloud-to-ground; UT - Universal Time; min - minute; del - delay

new reports based on photos May 2008; data added to table only but not included in analyses

For Redoubt eruptions, "11 min del" means 11 minute delay from onset of eruption to first lightning flash

Additional abbreviations: BLM - Bureau of Land Management; AVO - Alaska Volcano Observatory;

BE - Bulletin of Volcanic Eruptions; SEAN - Scientific Event Alert Network; GVN - Global Volcanism Network;

UT - Universal Time; VOTW - Volcanoes of the World; VSSAC - Volcanological Society of Sacramento;

VEI - Volcanic Explosivity Index

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