

Updated Volcanic Data (Ammann and Naveau, 2003)

Year	Volcano	Lat	Lon	VEI	NHem-Ice	SHem-Ice	Dust Veils
1443	? Soufriere de Guadeloupe (C-14c: 1440)	16.05	61.7W	P	I,R	I,Co	
1452	Kuwae, Vanuatu	-16.8	168.5E	6	I,C,R?,Lw	I,Co,Lw	
1459	? Pele,W-Indies	14.82	61.17	?	I,G,C,R,Lw	I	
1463	? Kelut, Java	-8.0	112.3E	3	I,R	I	
?1490	? unknown	trop		?	I	I	
?1504	? Atitlan, Guatemala	14.58	91.2W	3?	C,R	Co?	L
1512	? Sangeang Api, Sunda	-8.18	119.1E	3			
	? Gunungapi Wetar, Banda	-6.64	126.7E	3	G?,R	I	
1522	? Santa Ana, El Salvador	13.85	89.6W	3			
	? Arenal, Costa Rica (C-14: 1525)	10.46	84.7W	4	I	I,M	
1554	? Merapi, Java	-7.54	110.4E	3	I,G?,R,A	Co?,M?	L
1568	? Savo, Salomon Islands	-9.13	159.8E	3			
	? Billy Mitchell (C-14: 1580)	-6.09	155.2E	6	I,G?	I	
1571	? unknown	trop		?	I,G,C	Co?	
1586	Kelut, Java	-8.0	112.3E	5?	I,G,C,R	I,Co?	L
1595	Raung, Java	-8.1	114.0E	5?			
	Ruiz, Colombia	4.9	75.3W	4	I,G,R?	I,Co,Pa	L
1600	Huynaputina, Peru	-16.6	70.85W	6?	I,G,C,R,Lw?	I,Co,Pa,Lw?	L
?*1605	Momotombo, Nicaragua	12.42	86.5W	4	I,G?,A	M	L?
*1619	? unknown	trop		?	I,G,R?	I,Co	
1622	? Colima, Mexico	19.51	103.6W	4			
	Raoul Island, Kermadec (C-14: 1630)	-29.0	177.9W	4	I?,C,R	I,Co	
1641	Parker, Indonesia	-6.06	124.5E	6	I,G,C,R	I,Co	L
1660	? Teon, Banda	-6.92	129.1E	4?			
	? Guagua Pichinchia, Ecuador	-0.17	78.6W	4	I,G	I,Co?	L
1665	? Long Island, New Guinea (C-14: 1660)	-5.35	147.1E	6?	I,G,R	I,Co?	L
1674	Gamkonora, Indonesia	1.38	127.5E	5?	I?,G,C,R	Co,M?	L
1680	Tongkoko, Sulawesi	1.5	125.2E	5?	C,R?	I,Co?	L
1693	Serua, Banda	-6.3	130.0E	4?	I,G,C,R?	I,Co	L
1712	? Awu, Indonesia	3.67	125.5E	3	I,G?,C	I,Co?	L
?1721	Raoul Island, Kermadec (C-14: 1720)	-29.0	177.9E	4			
	Cerro Bravo, Colombia (T)	5.09	75.3W	4	I,G?,C,A?,R?	I	
1728	? Sangay, Ecuador	-2.03	78.3W	3	I,G,C,R	I,Co	
?1737	Fuego, Guatemala	14.47	90.88W	4?	G,C	Co?	
1744	Cotopaxi, Ecuador	-0.68	78.4W	4	I,C,R?	I	L
?1749	? Taal, Philippines	14.0	120.9E	3	I?,R?	I	
1752	? Little Sunda, Indonesia (Tambora?)	-8.0(?)	118E?		G?,C	I,Co?	L
1760	Michoacan, Mexico	19.48	102.3W	4			
	Makian, Indonesia	0.32	127.4E	4?	I,G,R?	Co?,Le?	L
1774	? Papandajan, Indonesia	-7.32	107.7E	3			
	? Tungurahua, Ecuador	-1.47	78.4W	3	G?,C?,R?	I	L
1789	? unknown	trop		?	I,C	I	
1794	? San Martin, Mexico	18.57	95.2W	4?	I?,G	I	
1808	unknown	trop		?	I,G,C,A?,R,Lw,Da	I,S,Co,Da,Pa,Lw	L
1813	Soufriere St. Vincent, W-Indies	13.33	61.2W	4			
	Awu, Indonesia	3.67	125.5E	4?			
	Suwanose-Jima, Japan	29.5	129.7E	4	I,R	I,Da	L
1815	Tambora, Sunda	-8.25	118E	7	I,G,C,A?,R,Da,Lw	I,S,Co,Da,Pa,Lw	L
1823	Galunggung, Java	-7.25	108.1E	5	I,G?,C?,A?	Co?,Da,M	L
1831	Babuyan Claro, Philippines	19.52	121.9E	4?	I,G,C,A?,R,Lw	I,S?,Co,Lw	L
1835	Coseguina, Nicaragua	12.98	87.6W	5	I,G,C,Lw	I,S?,Co,Lw	L
1861	Makian, Indonesia	0.32	127.4E	4?	I,G,R?	S,Co	L
1880	Fuego, Guatemala	14.47	90.9W	4?			
	Cotopaxi, Ecuador	-0.68	78.4W	3	I,C	I	
1883	Krakatoa, Sunda	-6.1	105.4E	6	I,G,C,R,Lw	I,S,Co,Lw,Bo	L,St
1890	Colima, Mexico	19.51	103.6W	4	I,G,A?,R?	I,S?,Co,Bo?	St
1902	Pele, W-Indies	14.82	61.2W	4			
	Soufriere St. Vincent, W-Indies	13.33	61.2W	4	I,G,C	I,Co	L,St
1903	Santa Maria, Guatemala	14.76	91.5W	6?	I,G,C,R	I,Co,Bo	L,St
?1911	Lolobau, SW-Pacific	-4.9	151.2E	4			
	Taal, Philippines	14.0	120.9E	4			
	Semeru, Java	-8.1	112.9E	3	I,C	I,Co?,Bo?	Ha
1928	Paluweh, Sunda	-8.32	121.7E	3	I,G,A?,St	LF?,Bo?	St
1953	Ambrym, Vanuatu	-16.0	168.1E	4+			
	Lamington, New Guinea	-9.0	148.1E	4			
	Bagana, SW-Pacific	-6.0	155.2E	4	I,G?,A?	I,LF?,Bo?	L*
1963	Agung, Sunda	-8.34	115.5E	4	I?,C,A?	I,Co,LF,Bo	L,DH,Sa
1968	Fernandina, Galapagos	-0.37	91.5W	4	I,G,C,A,R	I?	L,Sa
1974	Fuego, Guatemala	14.47	90.9W	4	C,R?	LF?,Bo	HR,V,Sa
1982	El Chichon, Mexico	17.36	93.2W	5	I,G?,A,R,Z	LF	Th,Ho,Sa
1991	Pinatubo, Philippines	15.13	120.3E	6	A,Z	CoD,Di,Kr	Mi,Mc,Sa

Table 1: Eruption List derived from ice cores - *Year*: Year of sulfate deposition, ± 1 year due to different seasonality of eruptions. *age correction of -2 or -3 years for GISP2 probable *de Silva and Zielinski* (1998); *Volcano*: potential source volcano from the Smithsonian Catalogue (*Simkin and Siebert*, 1994); *Lat*: Latitude of eruption, *trop*: tropical eruption due to sulfate deposition in both hemispheres; *VEI*: corresponding Volcanic Explosivity Index from Smithsonian Catalogue, listed for comparison, but not a criterion for the selection process. *P*: Plinian eruption; *NHem-Ice*: Ice core data indicating a sulfate spike in a Northern Hemisphere core. *SHem-Ice*: Ice core data indicating a sulfate spike in a Southern Hemisphere core. *Dust Veils*: Label L if a eruption is registered in Lamb’s Dust Veil Index (*Lamb*, 1970), and in 19th and 20th century for observed perturbations in the lower stratosphere. *L**: *Lamb* (1970) refers to a note from Arakawa and Tsutsumi (1956) that no volcano but nuclear bomb tests in the tropical Pacific might be responsible for the veil. (Sources: *A* : Agassiz ice (*Fisher and Koerner*, 1994; *Zheng et al.*, 1998); *Bo* : *Boutron* (1980) : Pb and Zn as proxies for volcanic deposits; *C* : *Crowley* (2000) : Re-evaluation of Crete data by *Hammer et al.* (1980); *Co* : *Cole-Dai et al.* (1997a); *CoD* : *Cole-Dai et al.* (1997b); *Da* : *Dai et al.* (1991); *DH* : *Dyer and Hicks* (1968); *Di* : *Dibb and Whitlow* (1996); *G* : GISP2 (*Mayewski et al.*, 1993; *Zielinski et al.*, 1994; *Zielinski*, 1995); *Ha* : *von Hann* (1915); *Ho* : *Hofmann* (1987); *HR* : *Hofmann and Rosen* (1977); *I* : *IVI* (*Robock and Free*, 1996); *Kr* : *Kreutz et al.* (1999); *L* : *Lamb* (1970); *Le* : *Legrand and Delmas* (1987); *LF* : *Legrand and Feniet-Saigne* (1991); *Lw* : *Langway et al.* (1995); *M* : *Moore et al.* (1991); *Mc* : *McCormick et al.* (1995); *Mi* : *Minnis et al.* (1993); *Pa* : *Palais et al.* (1990); *R* : GRIP ECM and Acidity: *Clausen et al.* (1997); *S* : *Stenni et al.* (1999); *Sa* : *Sato et al.* (1993); *St* : *Stothers* (1996); *Th* : *Thomas et al.* (1983); *V* : *Volz* (1975); *Z* : *Zielinski et al.* (1997).)

References

- Boutron, C., Respective influence of global pollution and volcanic eruptions on the past variations of the trace metals content of Antarctic snows since 1880's, *Journal of Geophysical Research*, *85*, 7426–7432, 1980.
- Clausen, H. B., C. U. Hammer, C. S. Hvidberg, D. Dahl-Jensen, J. P. Steffensen, J. Kipfstuhl, and M. Legrand, A comparison of volcanic records over the past 4000 years from the Greenland Ice Core Project and Dye 3 Greenland ice cores, *Journal of Geophysical Research*, *102*, 26,707–26,723, 1997.
- Cole-Dai, J., E. Mosley-Thompson, and L. G. Thompson, Annually resolved southern hemisphere volcanic history from two Antarctic ice cores, *Journal of Geophysical Research*, *102*, 16,761–16,771, 1997a.
- Cole-Dai, J., E. Mosley-Thompson, and L. G. Thompson, Quantifying the Pinatubo volcanic signal in south polar snow, *Geophysical Research Letters*, *24*, 2679–2682, 1997b.
- Crowley, T. J., Causes of climate change over the past 1000 years, *Science*, *289*, 270–277, 2000.
- Dai, J., E. Mosley-Thompson, and L. G. Thompson, Ice core evidence for an explosive tropical volcanic eruption 6 years preceding Tambora, *Journal of Geophysical Research*, *96*, 17,361–17,366, 1991.
- de Silva, S. L., and G. A. Zielinski, Global influence of the AD 1600 eruption of Huaynaputina, Peru, *Nature*, *393*, 455–458, 1998.
- Dibb, J. E., and S. I. Whitlow, Recent climate anomalies and their impact on snow chemistry at South Pole, 1987 - 1994, *Geophysical Research Letters*, *23*, 1115–1118, 1996.
- Dyer, A. J., and B. B. Hicks, Global spread of volcanic dust from the Bali eruption of 1963, *Quart.J.R.Met.Soc.*, *94*, 545–554, 1968.
- Fisher, D., and R. Koerner, Signal and noise in four ice-core records from the Agassiz ice cap, Ellesmere Island, Canada. Details of the last Millennium for stable isotopes, melt and solid conductivity, *The Holocene*, *4*, 113–120, 1994.
- Hammer, C. U., H. B. Clausen, and W. Dansgaard, Greenland ice sheet evidence of post-glacial volcanism and its climatic impact, *Nature*, *288*, 230–235, 1980.
- Hofmann, D. J., Perturbations to the global atmosphere associated with the El Chichón volcanic eruption of 1982, *Reviews of Geophysics*, *25*, 743–759, 1987.
- Hofmann, D. J., and J. M. Rosen, Balloon observations of the time development of the stratospheric aerosol event of 1974-1975, *Journal of Geophysical Research*, *82*, 1435–1440, 1977.

- Kreutz, K. J., P. A. Mayewski, M. S. Twickler, S. I. Whitlow, J. W. C. White, C. A. Shuman, C. F. Raymond, H. Conway, and J. R. McConnell, Seasonal variations of glaciochemical, isotopic and stratigraphic properties in Siple Dome (Antarctica) surface snow, *Annals of Glaciology*, *29*, 38–44, 1999.
- Lamb, H. H., Volcanic dust in the atmosphere; with a chronology and assessment of its meteorological significance, *Transactions of the Royal Philosophical Society of London*, *A266*, 425–533, 1970.
- Langway, J., C. C., K. Osada, H. B. Clausen, C. U. Hammer, and H. Shoji, A 10-century comparison of prominent bipolar volcanic events in ice cores, *Journal of Geophysical Research*, *100*, 16,241–16,247, 1995.
- Legrand, M., and R. J. Delmas, A 220-year continuous record of volcanic H_2SO_4 in the Antarctic ice sheet, *Nature*, *327*, 671–676, 1987.
- Legrand, M., and C. Feniet-Saigne, Methanesulfonic acid in South Polar snow layers: A record of strong El Niño?, *Geophysical Research Letters*, *18*, 187–190, 1991.
- Mayewski, P., G. Holdsworth, M. Spencer, S. Whitlow, M. Twicker, M. Morrison, K. Ferland, and L. Meeker, Ice-core sulfate from three northern hemisphere sites: source and temperature forcing implications, *Atmospheric Environment*, *27A*, 2915–2919, 1993.
- McCormick, M. P., L. Thomason, and C. R. Trepte, Atmospheric effects of the Mount Pinatubo eruption, *Nature*, *373*, 399–404, 1995.
- Minnis, P., E. F. Harrison, L. L. Stowe, G. G. Gibson, F. M. Denn, D. R. Doelling, and J. W. L. Smith, Radiative climate forcing by the Mount Pinatubo eruption, *Science*, *259*, 1411–1415, 1993.
- Moore, J. C., H. Narita, and N. Maeno, A continuous 770-year record of volcanic activity from East Antarctica, *Journal of Geophysical Research*, *96*, 17,353–17,359, 1991.
- Palais, J. M., S. Kirchner, and R. J. Delmas, Identification of some global volcanic horizons by major element analysis of fine ash in Antarctic ice, *Annals of Glaciology*, *14*, 216–220, 1990.
- Robock, A., and M. P. Free, *The volcanic record in ice cores for the past 2000 years*, vol. I 41 of *NATO ASI Series*, pp. 533–546, Springer, Berlin, Heidelberg, 1996.
- Sato, M., J. E. Hansen, M. P. McCormick, and J. B. Pollack, Stratospheric aerosol optical depth, 1850–1990, *Journal of Geophysical Research*, *98*, 22,987–22,994, 1993.
- Simkin, T., and L. Siebert, *Volcanoes of the World*, 2 ed., Geoscience Press, Inc. and Smithsonian Institution, Tucson, AR, 1994.

- Stenni, B., R. Caprioli, L. Cimino, C. Cremisini, O. Flora, R. Gagnani, A. Longinelli, V. Maggi, and S. Torcini, 200 years of isotope and chemical records in a firn core from Hercules N  v  , northern Victoria Land, Antarctica, *Annals of Glaciology*, *29*, 106–112, 1999.
- Stothers, R. B., Major optical depth perturbations to the stratosphere from volcanic eruptions: Pyrheliometric period, 1881–1960, *Journal of Geophysical Research*, *101*, 3901–3920, 1996.
- Thomas, G. E., B. M. Jakosky, R. A. West, and R. W. Sanders, Satellite limb-scanning thermal infrared observations of the El Chich  n stratospheric aerosol: First results, *Geophysical Research Letters*, *10*, 997–1000, 1983.
- Volz, F. E., Volcanic twilights from the Fuego eruption, *Science*, *189*, 48–50, 1975.
- von Hann, J., *Lehrbuch der Meteorologie*, 3rd ed., Verlag Chr. Herm. Tauchnitz, Leipzig, 1915.
- Zheng, J., A. Kudo, D. A. Fisher, E. W. Blake, and M. Gerasimoff, Solid electrical conductivity (ECM) from four Agassiz ice cores, Ellesmere Island NWT, Canada: high-resolution signal and noise over the last millennium and low resolution over the Holocene, *The Holocene*, *8*, 413–421, 1998.
- Zielinski, G. A., Stratospheric loading and optical depth estimates of explosive volcanism over the last 2100 years derived from the Greenland Ice Sheet Project 2 ice core, *Journal of Geophysical Research*, *100*, 20,937–20,955, 1995.
- Zielinski, G. A., P. A. Mayewski, L. D. Meeker, S. Whitlow, M. S. Twickler, M. Morrison, D. A. Meese, A. J. Gow, and R. B. Alley, Record of volcanism since 7000 B.C. from the GISP2 Greenland ice core and implications for the volcano-climate system, *Science*, *264*, 948–952, 1994.
- Zielinski, G. A., J. E. Dibb, Q. Yang, P. A. Mayewski, S. Whitlow, and M. S. Twickler, Assessment of the record of the 1982 El Chich  n eruption as preserved in Greenland snow, *Journal of Geophysical Research*, *102*, 30,031–30,045, 1997.