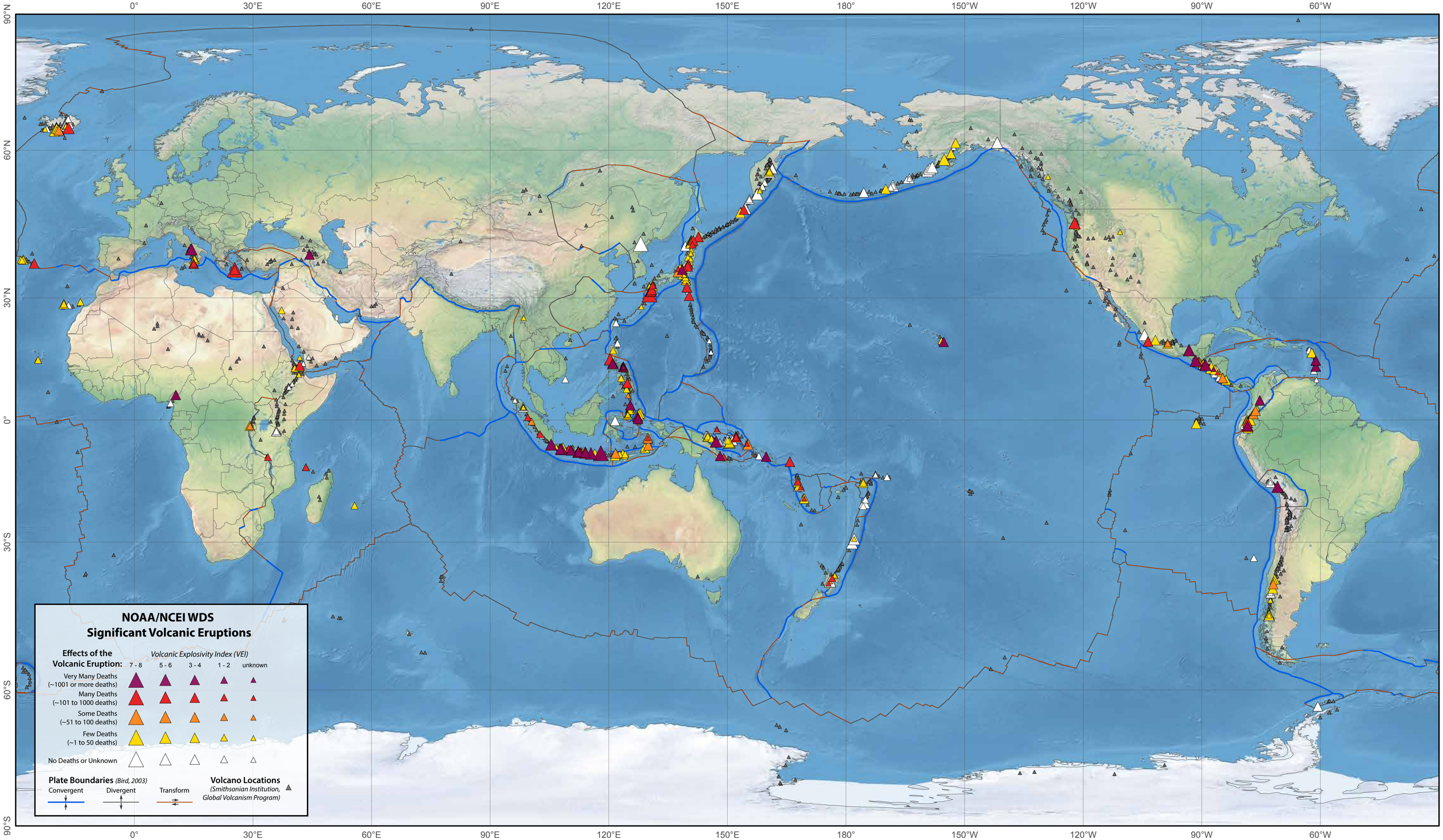
Significant Volcanic Eruptions 4360 B.C. to A.D. 2023



Patterson Cylindrical Projection

Symbol drawing order: more deaths on top of fewer deaths; smaller VEI eruptions on top of larger VEI eruptions.

unesco
Intergovernmental Oceanographic Commission

ITIC

NOAA

ICSU
WORLD DATA SYSTEM

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NOAA's National Centers for Environmental Information (NCEI) and co-located World Data Service (WDS) for Geophysics and the International Tsunami Information Center (ITIC), a UNESCO/IOC-NOAA partnership, have collaborated to produce a map showing significant volcanic eruptions. The information comes from the NCEI Significant Volcanic Eruptions Database which includes volcanic eruptions from 4360 B.C. to A.D. 2023 meeting at least one of the following criteria: resulted in moderate damage (approximately USD $1 million or more), caused fatalities, produced a large eruption with a volcanic explosivity index (VEI) of 6 or larger, generated a tsunami, or was associated with a major earthquake. VEI is a simple 0-8 index of increasing explosivity that combines quantitative data with descriptions from observers (Newhall and Self, 1982).

There are over 850 eruptions in the database. The global distribution of these eruptions is 25% Central and South Pacific, 17% East Asia, 16% Europe, 15% Southern Asia (including western Indonesia), 7% Central America and the Caribbean, 7% North America and Hawaii, 7% South America, 3% Africa, 2% Kamchatka and the Kuril Islands, and 1% Middle East. The majority of the volcanic eruption information comes from eyewitness observations that are now enhanced with satellite data. Dating methods (e.g., radiocarbon and tephrochronology) are used when there is an absence of human observations.

The total number of deaths due to volcanic eruptions is over 300,000 and the total damage is over USD $10.8 billion (2023 dollars). These numbers are probably underestimates, however, since the actual numbers are unknown for many events. Tables 1 and 2 list the deadliest and largest (VEI ≥ 6) eruptions in the last 4,000 years. Eruptions can also generate deadly tsunamis (Table 3). For example, most of the 36,000 deaths from the 1883 Krakatau explosion resulted from the tsunami.

The events in the NCEI Significant Volcanic Eruptions Database were gathered from the Smithsonian Institution's Global Volcanism Program (GVP), the U.S. Geological Survey, volcano catalogs, national and government databases and reports, post-event reconnaissance reports, journal articles, newspapers, internet sources, email, and other documents. For a complete listing of references used to compile the database, please visit: http://www.ngdc.noaa.gov/hazard/

Triangles on the map represent the location, VEI, and number of deaths for significant volcanic eruptions. Gray triangles represent all volcanoes that did not cause death or damage based on the GVP catalog.

References:
Newhall C. G., and S. Self. 1982. The volcanic explosivity index (VEI): an estimate of explosive magnitude for historical volcanism. J Geophys Res (Oceans & Atmospheres), 87: 1231-38.

Venzke E, R. W. Wunderman, L. McClelland, T. Simkin, J. F. Luhr, L. Siebert, G. Mayberry and S. Sennert (eds.). Global Volcanism, 1968 to the Present. Smithsonian Institution. (http://volcano.si.edu/reports_bgvn.cfm).

Global distribution of significant volcanic eruptions

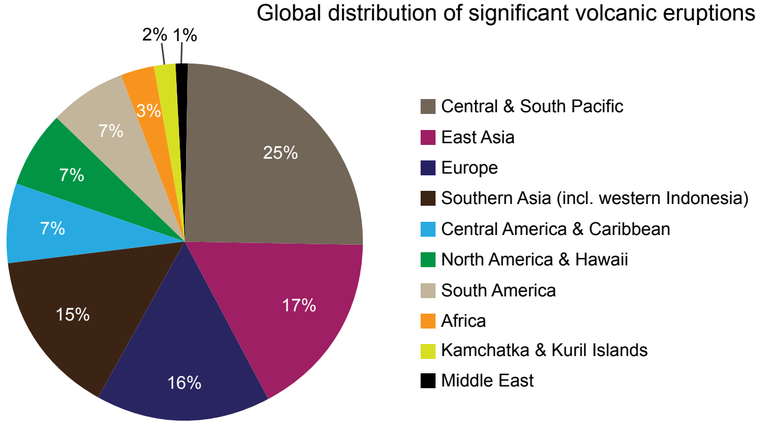

Table 1. Volcanic eruptions causing 1,000 or more deaths

Date					Deaths	
Year	Mon	Day	Name, Location	*VEI	Eruption	Tsunami
79	8	25	Vesuvius, Italy	5	2,100	
450			Ilopango, El Salvador	6	30,000	
1568			Savo, Solomon Islands	3	[L]1,000	
1586			Kelut, Java, Indonesia	5	10,000	
1600	2	19	Huaynaputina, Southern Peru	6	1,500	
1631	12	16	Vesuvius, Italy[T]	5	4,000	
1638			Raung, Java, Indonesia	4	1,000	
1640			Tungurahua, Ecuador	3	5,000	
1660			Long Island, PNG[T]	6	[L]2,000	
1672	8	4	Merapi, Java, Indonesia	3	3,000	
1711	12	11	Awu, Sangihe Is, Indonesia	3	3,000	
1760			Makian, Halmahera Is, Indonesia	4	2,000	
1772	8	12	Papandayan, Java, Indonesia	3	2,957	
1775			Gamalama, Halmahera, Indonesia	3	1,300	
1783	8	5	Asama, Honshu, Japan	4	1,491	
1784	4		Grimsvotn, Iceland	4	**9,350	
1790	11		Kilauea, Hawaii, USA	4	5,405	
1814	2	1	Mayon, Luzon, Philippines	4	1,200	
1815	4	10	Tambora, Lesser Sunda Is, Indonesia[T]	7	**60,000	***
1822	10	8	Galunggung, Java, Indonesia	5	4,011	
1840	7	2	Ararat, Turkey	3	1,900	
1845	2	19	Ruiz, Colombia	3	1,000	
1856	3	2	Awu, Sangihe Is, Indonesia[T]	3	2,806	***
1875			Mayon, Luzon, Philippines		[R]1,500	
1883	8	27	Krakatau, Indonesia[T]	6	2,000	34,417
1892	6	7	Awu, Sangihe Is, Indonesia[T]	3	1,532	
1902	5	7	Soufriere St. Vincent, West Indies[T]	4	1,680	
1902	5	8	Pelee, Martinique[T]	4	28,000	
1902	8	30	Pelee, Martinique[T]	4	1,500	
1902	10	25	Santa Maria, Guatemala	6	**10,000	
1911	1	30	Taal, Luzon, Philippines[T]	3	1,335	50?
1919	5	19	Kelut, Java, Indonesia	4	5,110	
1930	12	18	Merapi, Java, Indonesia	3	1,369	
1951	1	21	Lamington, New Guinea, PNG	4	2,942	
1963	3	18	Agung, Lesser Sunda Is, Indonesia[T]	5	1,028	
1982	3	29	El Chichon, Southern Mexico	5	1,879	
1985	11	13	Ruiz, Colombia	3	23,080	
1986	8	21	Oku Volcanic Field, Cameroon, Africa		1,700	
1998	10	30	San Cristobal, Nicaragua		[R]1,620	
2006	11	30	Mayon, Luzon, Philippines	1	[R]1,266	

[T] The eruption generated a tsunami
*Volcanic Explosivity Index: 2 = small, 3 = moderate-large, 4 = large, ≥ 5 = very large
**Total deaths includes eruption and subsequent indirect causes (e.g. famine and disease)
***Deaths, but the actual number is not known
[L] Based on legends
[R] Rain triggered lahars, no eruption

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Table 2. Significant volcanic eruptions with VEI ≥ 6

Date					Deaths	
Year	Mon	Day	Name, Location	*VEI	Eruption	Tsunami
-1610			Santorini, Greece[T]	7		***
-1460			Taupo, New Zealand	6		
-1370			Pago, New Britain, PNG	6		
-1050			Pinatubo, Luzon, Philippines	6		
-250			Raoul Island, Kermadec Is, New Zealand	6		
-100			Okmok, Aleutian Is, Alaska, USA	6		
-50			Apoyeque, Nicaragua	6		
50			Ambrym, Vanuatu	6		
60			Bona-Churchill, Eastern Alaska, USA	6		
233			Taupo, New Zealand	6		
240			Ksudach, Kamchatka	6		
450			Ilopango, El Salvador	6	30,000	
653			Dakataua, New Britain, PNG	6		
683			Rabaul, New Britain, PNG	6		
710			Pago, New Britain, PNG	6		
847			Bona-Churchill, Eastern Alaska, USA	6		
930			Ceboruco, Mexico	6		
946			Changbaishan, Eastern China	7		
1280			Quilotoa, Ecuador	6		
1477	2		Bardarbunga, Iceland	6		
1580			Billy Mitchell, Bougainville, PNG	6		
1600	2	19	Huaynaputina, Peru	6	1,500	
1660			Long Island, PNG[T]	6	[L]2,000	
1815	4	10	Tambora, Lesser Sunda Is, Indonesia[T]	7	**60,000	***
1883	8	27	Krakatau, Indonesia[T]	6	2,000	34,417
1902	10	25	Santa Maria, Guatemala	6	**10,000	
1912	9	6	Novarupta, Alaska Peninsula, USA	6	2	
1991	6	15	Pinatubo, Luzon, Philippines	6	**800	

[T] The eruption generated a tsunami
*Volcanic Explosivity Index: 2 = small, 3 = moderate-large, 4 = large, ≥ 5 = very large
**Total deaths includes eruption and subsequent indirect causes (e.g. famine and disease)
***Deaths, but the actual number is not known
[L] Based on legends

Table 3. Volcanic eruptions that generated deadly tsunamis

Date					Deaths		
Year	Mon	Day	Name, Location	*VEI	Eruption	Tsunami	Total
-1610			Santorini, Greece	7		***	***
766	7	20	Sakura-jima, Kyushu, Japan	3	***	***	***
1640	7	31	Komaga-take, Hokkaido, Japan	5		700	700
1741	8	23	Oshima-Oshima, Hokkaido, Japan	4		2,000	2,000
1781	4	11	Sakura-jima, Kyushu, Japan	4	23	15	38
1792	5	21	Unzen, Kyushu, Japan	2	***	15,000	15,000
1815	4	10	Tambora, Lesser Sunda Is, Indonesia	7	**11,000	***	[I]60,000
1856	3	2	Awu, Sangihe Is, Indonesia	3	2,806	***	2,806
1871	3	3	Ruang, Sangihe Is, Indonesia	2		400	400
1883	8	27	Krakatau, Indonesia	6	2,000	34,417	36,417
1888	3	13	Ritter Island, PNG	2		***	***
1911	1	30	Taal, Luzon, Philippines	3	1,335	50?	1,335
1928	8	4	Paluweh, Lesser Sunda Is, Indonesia	3	98	128	226
1930	9	11	Stromboli, Italy	3	5	1	6
1933	1	8	Kharimkotan, Kuril Islands	5		2	2
1937	5	29	Rabaul, New Britain, PNG	4	507	***	507
1965	9	28	Taal, Luzon, Philippines	4	355	355	**355
2018	2	22	Krakatau, Indonesia	3		437	437
2022	1	15	Tonga Islands, Tonga	5		6	6

*Volcanic Explosivity Index: 2 = small, 3 = moderate-large, 4 = large, ≥ 5 = very large
**Tsunami and eruption deaths could not be separated
***Deaths, but the actual number is not known
[I] Total of 60,000 deaths from the eruption and subsequent famine and disease, which includes 11,000 from the bomb impacts, tephra falls and tsunami