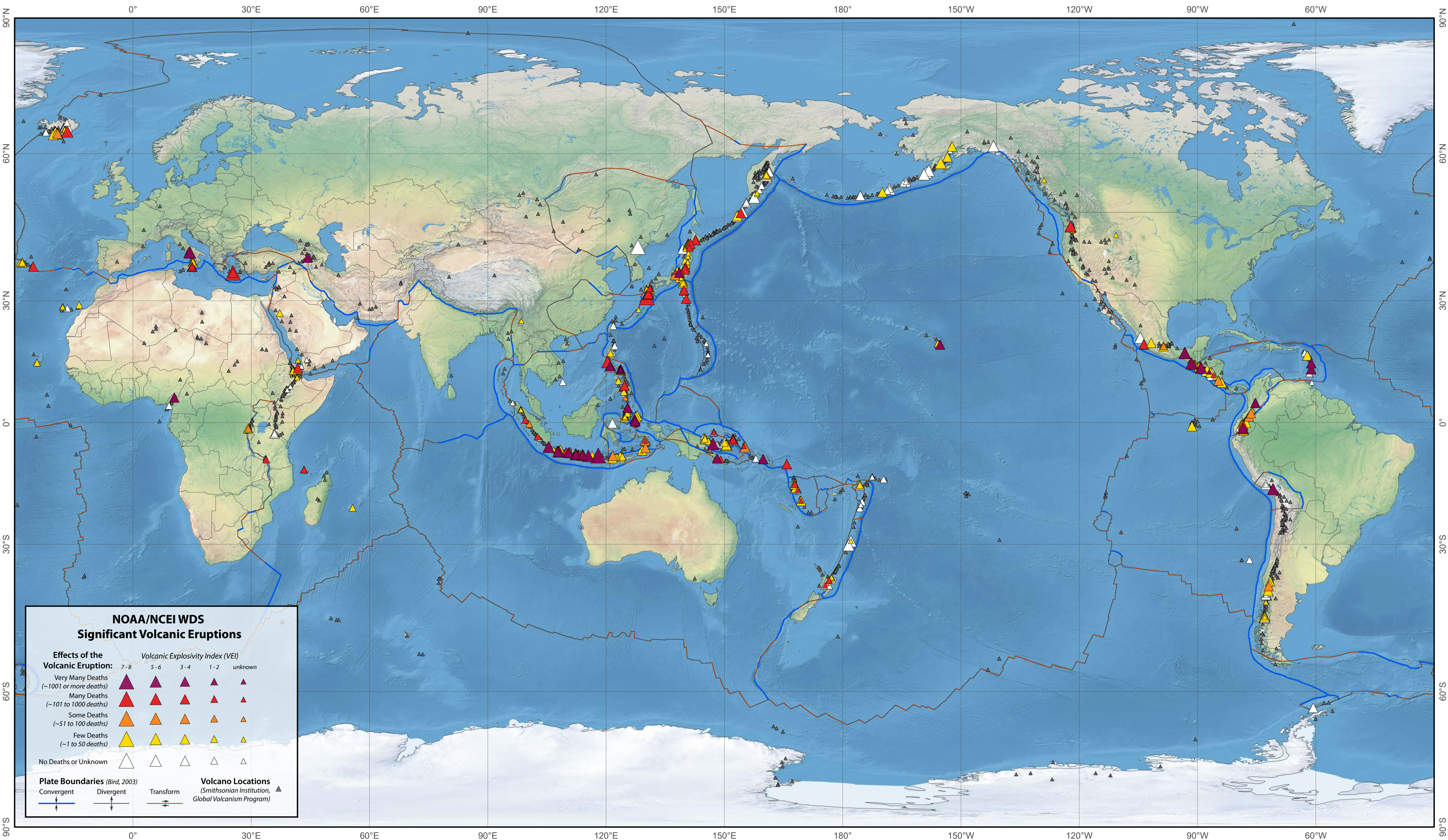


Significant Volcanic Eruptions 4360 B.C. to A.D. 2022



Patterson Cylindrical Projection

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

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. 2022 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 800 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 \$8.9 billion (2020 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).

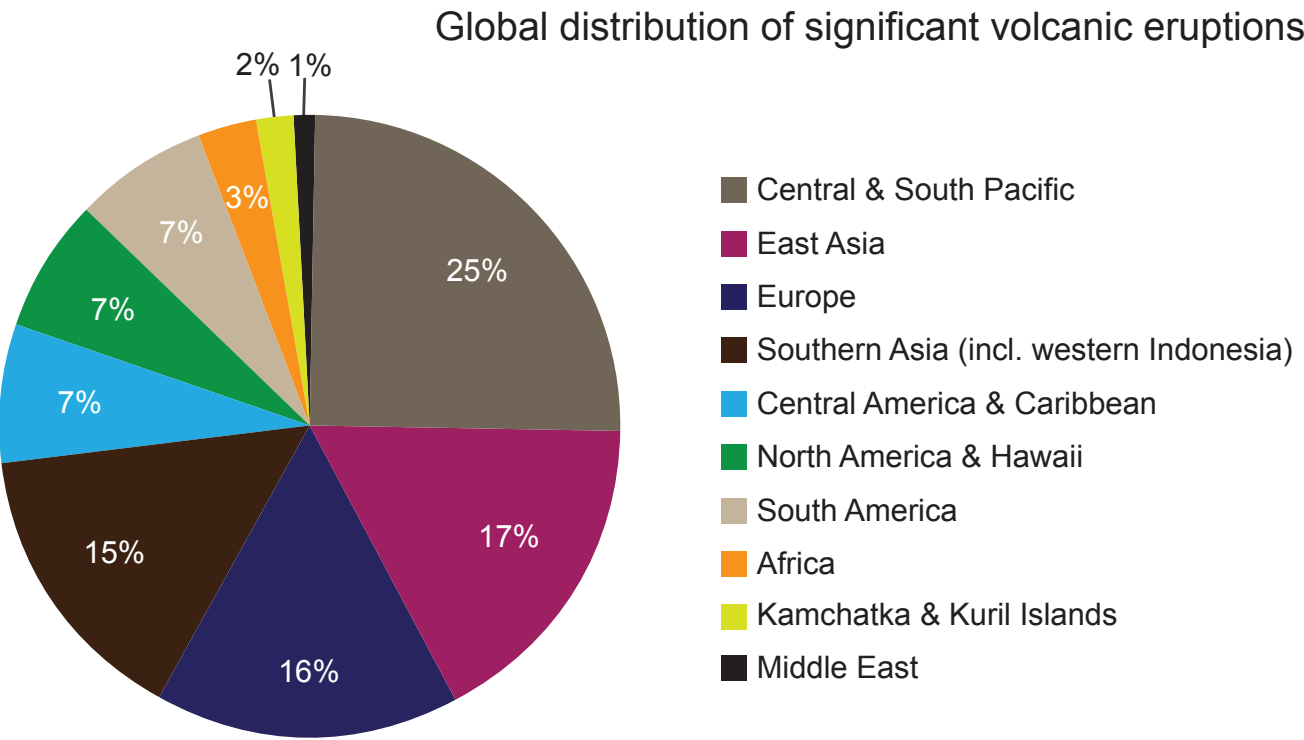


Table 1. Volcanic eruptions causing 1,000 or more deaths						
Date			Name, Location	Deaths		
Year	Mon	Day		*VEI	Eruption	Tsunami
79	8	25	Vesuvius, Italy	5		2,100
450			Ilopango, El Salvador	6		30,000
1568			Savo, Solomon Islands	3	^L 1,000	
1586			Kelut, Java, Indonesia	5		10,000
1600	2	19	Huaynaputina, 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
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
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

Table 2. Significant volcanic eruptions with VEI ≥ 6						
Date			Name, Location	Deaths		
Year	Mon	Day		*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			Name, Location	Deaths		
Year	Mon	Day		*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	*** '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	[^] -		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

^l 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

[^] VEI yet to be determined