**Samalas Paper-by-Paper**

(Guillet et al., 2017)

* the Largest Sulphur rich eruption of the common era
* Eruption magnitude and VEI of 7
* >40 km3 of dense magma was expelled during the eruption
* Eruption column estimated to have reached altitudes of 43km
* But climate models tend to over predict NH surface air cooling compared to proxy records
* Historical archives: Mediaeval texts attest to significant and widespread climate anomalies over Western Europe in the spring-autumn of 1258. Report cold, excessive rainfall, and cloudiness (impact on agriculture 🡪 Grape Harvest dates significantly delayed (1-2 weeks later than after Tambora). But doesn’t account for change in grape varieties/agricultural practices. In Germany *Annals of Speyer* refer to 1258 as *munkeliar* (dark year) suggesting dense dust veil. In England (Chronicle of John de Taxster) and Italy (Annales Ianuenses) a very dark lunar eclipse is also recorded for 1258. In Japan, *Mirror of the East* reports a wet, cold summer accompanied by heavy rainfall and strong winds. But contemporary sources limited beyond Europe.
* Use tree-ring network to show average surface cooling of -0.7C in 1258 and -1.2C in 1259.
* Use tree-ring network and ice core δ18O records to determine heterogeneity of NH summer cooling: cooling of -1.4 to -2C over Siberia and western Europe (associated with frost rings). In contrast in Quebec, Alaska, and Scandinavia cooling is limited – suggests internal climate variability outweighed volcanic forcing. Warm anomalies in Alaska (+0.3C) could be due to positive ENSO phase (El Nino likely to occur 1-2 years after an eruption). El Nino conditions inferred from tree-ring and sediment proxies for 1258/59.
* All sources agree on reduction in climate anomalies by 1260-61 (disagrees with models that exclude aerosol microphysics).
* Cooling is comparable to 1453, 1601, and 1816 – but Samalas released more sulphur? Cooling not linear with sulphur emissions.
* Aggravated ongoing famines in Western Europe and Japan

(Lavigne et al., 2013)

* Largest volcanic sulphur release of the past 7,000 yrs
* First identified Samalas volcano as source of 1257 eruption (Samalas Volcano/ Segara Anak caldera, Lombok Island, Indonesia)
* 40.2 +/-3 km3 DRE of magma was deposited
* Eruption column of 43km (+/-8.6km) – calculated from contour maps of lithic and pumice clasts. Also calculate MER, intensity, and duration
* Magnitude of 7 is a minimum estimate (see paper), intensity of 12
* Pumice fallout deposits and PCDs
* Radiocarbon dating of charcoal confirms mid-13th century eruption and glass geochemistry matches Ice core deposits
* Stratospheric sulphate load is two to eight times higher than Tambora or Krakatoa respectively
* Interhemispheric transport of tephra and sulphate confirms low latitude eruption
* *Babad Lombok* (historical record from Indonesia) records a catastrophic caldera forming eruption.
* Suggest caldera formed due to collapse associated with the withdrawal of large volumes of volatile-saturated magma.
* Historical records report a warm winter in Western Europe in the winter of 1257/58. Winter warming is a dynamic atmospheric response to tropical high-sulphate eruptions.
* Preferential tephra deposit to the west, indicative of easterly trade winds during the dry season, thus suggests eruption date between May and October 1257.

(Wade et al., 2020)

* Simulate climatic impacts of sulphate and halogen emissions. Sulphate cooling matches well with proxy records, but little evidence of significant halogen injection (only 1% of halogen inventory reaching stratosphere).
* Simulations that don’t include aerosol microphysics overestimate surface cooling compare to proxy records
* Aerosol size is very important for climatic effect. SO2 self-limiting effect.
* Co-emitted halogens potentially contribute to catastrophic ozone breakdown
* Surface cooling best reconstructed with a May – July eruption date
* Ozone depletion due to Samalas halogen emissions has yet to be conclusively proven or disproven, though unlikely to be high.

(Vidal et al., 2016)

* 158+/-12Tg of SO2 (1.8 times more than Tambora 1815), 227+/-18Tg of Cl, and up to 1.3+/-0.3Tg of Br within a day. Approx. 126Tg of SO2 injected into stratosphere
* New geochemical method to determine volatile emissions based on major and trace element chemistry of melt inclusions
* Halogen injection into the atmosphere depends on how much is scavenged – which depends on background conditions.

(Vidal et al., 2015)

* Four-phase continuous eruption: P1-3 are Plinian/Ultraplinian. P2 is phreatomagmatic. P4 is fountaining and column collapse.
* Total DRE of 33-40km3: 7-9km3 DRE of pumice Plinian fall deposits, 16km3 of PDC deposits, and 8-9km3 DRE of co-PDC ash (as far as 660km from source)
* Eruption dynamics are consistent with an efficient dispersal of sulphur-rich aerosols
* Lombok is located in the eastern Sunda arc associated with the subduction of the Indo-Australian plate beneath the Eurasian plate. (Simons et al 2007).
* Column height of 38-43 km with a wind speed of 12m/s

(Baroni et al., 2019)

* Ice core analysis shows Samalas has the lowest positive slope of all volcanoes analysed (where the slope indicates the efficiency of the draining of 10Be atoms by volcanic aerosols depending on the amount of SO2 released and the altitude it reaches in the stratosphere)
* Due to large amount of SO2 emitted which exhausted the oxidants responsible for the formation of sulphate, and altitude of SO2 injection.
* 10Be deposition is enhanced after stratospheric eruptions (Baroni et al., 2011).

(Bierstedt., 2019) – Master’s Project

* Weather effects due to Samalas eruption recorded in Icelandic Chronicle, *Íslendinga Saga.*

(Burke et al., 2019)

* Large tropical eruptions (bipolar events) lead to sulfate deposition in both Greenland and Antarctic ice cores, as plume injected sulphur aerosols into stratosphere to be transported globally.
* Limitation in ice core age uncertainty
* S undergoes mass dependent fractionation when it reaches the ozone layer – so δS can be used to determine if S was stratospherically or troposphericly transported
* Samalas has a non-zero Δ33S so at least some SO2 reached the stratosphere/ > 20km.
* Plus Δ33S and δ34S are strongly correlated for Samalas suggests all SO2 was deposited from the stratosphere.

(Mutaqin and Lavigne, 2019) – couldn’t access full article.

* 1257 Samalas Eruption recorded in Babad Lombok and Babad Suwung (written sources complied in the 16th centuary containing oral stories and myths). They describe the formation of the caldera, ash fall and PDCs on Lombok and surrounding islands.

(Kern, Zoltán; Pow, Stephen; Pinke, Zsolt; Ferenczi, László, 2021) - couldn’t access full article.

* Suggest weather changes due to Samalas eruption (e.g suggest it shifted the Asian Monsoon) may have played a significant role in the breakup of the Mongol Empire.
* E.g suggest could have contribute to epidemics, drought, famine and resulting political instability.
* I consider this doubtful.

(Fell, Henry ; Baldini, James ; Dodds, Ben, 2017) - couldn’t access full article.

* Suggest 1257 Eruption and related climatic effects may have enhanced vector borne transmission of bacteria responsible for the Black Death.
* Also seems like something of a leap.

(YANG et al., 2017)

* Use laclustrine sediments in South China Sea to identify volcanic eruptions and material. Based on Ti, Al, Fe2O3 contents of sediments as well as Nd and Sr isotope compositions.
* Abrupt peak in Al, Ti, and Fe2O3 at ~ 1300AD. Nd/Sr isotope compositions are also compatible with volcanic source.
* Slight time offset suggested to be due to error in C-14 dating

(Stothers, 2000)

* Location of 1257 eruption still unknown. Timing and impact is someway off. Claims eruption linked to plague and famine throughout Europe, the Middle East – even goes as far as claiming eruption may be linked to “the bizarre social phenomena” of the flagellant movement in Europe…?
* Very tenuous links. Most useful to reference in justifying the importance of understanding the climatic impact so that historians can stop invoking Samalas for all 13th century catastrophes…

(Gennaretti et al., 2014)

* New network of tree ring chronologies from NE North America recording regional July-August temperatures.
* Tree ring chronologies support successive eruptions between 1257 and 1300AD being responsible for the onset of the little ice age – tree rings show an abrupt shift toward lower average temperatures coinciding with the 1257 eruption
* Couldn’t find an exact number for Samalas summer temperature anomaly (approx. 2C)
* Large 1809 and 1815 (Tambora) also caused significant cold shifts
* Samalas preceded and followed by additional eruptions: 1227, 1275, 1284. However, tree ring chronologies only show negative temperature anomalies lasting between 2-10yrs.
* Uncertainty over role of subsequent eruptions in triggering the little Ice age.
* Tree rings also record heterogeneous impact of volcanic forcing on climate; NENA shows a particularly marked response

(Liu et al., 2020)

* CESM to model the impact of the 1257 eruption on summer hydroclimate change over Europe.
* Suggest significant summer surface air temperature (SAT) cooling over Europe (-3.61C) – but this is greater than proxy records?
* Summer precipitation over Europe shows a dipole distribution characteristic of north-south reverse phase – WHAT IS THIS? Negative NAO phase with positive SLP anomaly?
* Precipitation increases up to 0.42 mm/d in year 1 over Southern Europe, while it decreases by −0.28 mm/d in year 1 over Northern Europe – doesn’t appear to agree with historical records?
* Suggest Samalas forcing takes two decades to disappear??
* Highlight climatic impact likely modulated by predisposing EAP towards it’s negative phase

(Timmreck et al., 2009)

* Demonstrate that the size of the aerosol particles needs to be included in simulations especially to explain the climate response to large eruptions.
* The temperature response weakens because increased density of particles increases collision rate and therefore aerosol growth.
* Samalas has much larger sulphate forcing than Pinatubo but not a significantly higher temperature response – consistent with aerosol particles being much larger than those observed after Pinatubo.
* Only simulations of the volcanic aerosol size distribution with a fully coupled aerosol chemistry and microphysics model can provide a consistent time-varying data set of aerosol optical parameters

Reference list

* Baroni, M., Bard, E., Petit, J. and Viseur, S. (2019). Persistent Draining of the Stratospheric 10 Be Reservoir After the Samalas Volcanic Eruption (1257 CE). *Journal of Geophysical Research: Atmospheres*.
* Burke, A., Moore, K.A., Sigl, M., Nita, D.C., McConnell, J.R. and Adkins, J.F. (2019). Stratospheric eruptions from tropical and extra-tropical volcanoes constrained using high-resolution sulfur isotopes in ice cores. *Earth and Planetary Science Letters*, 521, pp.113–119.
* Gennaretti, F., Arseneault, D., Nicault, A., Perreault, L. and Begin, Y. (2014). Volcano-induced regime shifts in millennial tree-ring chronologies from northeastern North America. *Proceedings of the National Academy of Sciences*, [online] 111(28), pp.10077–10082. Available at: https://www.pnas.org/content/111/28/10077 [Accessed 13 Aug. 2021].
* Guillet, S., Corona, C., Stoffel, M., Khodri, M., Lavigne, F., Ortega, P., Eckert, N., Sielenou, P.D., Daux, V., Churakova (Sidorova), Olga V., Davi, N., Edouard, J.-L., Zhang, Y., Luckman, Brian H., Myglan, V.S., Guiot, J., Beniston, M., Masson-Delmotte, V. and Oppenheimer, C. (2017). Climate response to the Samalas volcanic eruption in 1257 revealed by proxy records. *Nature Geoscience*, 10(2), pp.123–128.
* Lavigne, F., Degeai, J.-P. ., Komorowski, J.-C. ., Guillet, S., Robert, V., Lahitte, P., Oppenheimer, C., Stoffel, M., Vidal, C.M., Surono, Pratomo, I., Wassmer, P., Hajdas, I., Hadmoko, D.S. and de Belizal, E. (2013). Source of the great A.D. 1257 mystery eruption unveiled, Samalas volcano, Rinjani Volcanic Complex, Indonesia. *Proceedings of the National Academy of Sciences*, 110(42), pp.16742–16747.
* Liu, B., Liu, J., Ning, L., Sun, W., Yan, M., Zhao, C., Chen, K. and Wang, X. (2020). The Role of Samalas Mega Volcanic Eruption in European Summer Hydroclimate Change. *Atmosphere*, [online] 11(11), p.1182. Available at: https://www.mdpi.com/2073-4433/11/11/1182 [Accessed 14 Aug. 2021].
* Mutaqin, B.W. and Lavigne, F. (2019). Oldest description of a caldera-forming eruption in Southeast Asia unveiled in forgotten written sources. *GeoJournal*, [online] 86(2), pp.557–566. Available at: https://link.springer.com/article/10.1007/s10708-019-10083-5 [Accessed 10 Aug. 2021].
* Stothers, R.B. (2000). *Climatic Change*, [online] 45(2), pp.361–374. Available at: https://link.springer.com/article/10.1023/A:1005523330643 [Accessed 13 Aug. 2021].
* Timmreck, C., S. Lorenz, Crowley, T.J. and Jungclaus, J.H. (2009). Limited temperature response to the very large AD 1258 volcanic eruption. [online] ResearchGate. Available at: https://www.researchgate.net/publication/38139475\_Limited\_temperature\_response\_to\_the\_very\_large\_AD\_1258\_volcanic\_eruption [Accessed 29 Aug. 2021].
* Vidal, C.M., Komorowski, J.-C., Métrich, N., Pratomo, I., Kartadinata, N., Prambada, O., Michel, A., Carazzo, G., Lavigne, F., Rodysill, J., Fontijn, K. and Surono (2015). Dynamics of the major plinian eruption of Samalas in 1257 A.D. (Lombok, Indonesia). *Bulletin of Volcanology*, 77(9).
* Vidal, C.M., Métrich, N., Komorowski, J.-C., Pratomo, I., Michel, A., Kartadinata, N., Robert, V. and Lavigne, F. (2016). The 1257 Samalas eruption (Lombok, Indonesia): the single greatest stratospheric gas release of the Common Era. *Scientific Reports*, [online] 6(1). Available at: https://www.nature.com/articles/srep34868.
* Wade, D.C., Vidal, C.M., Abraham, N.L., Dhomse, S., Griffiths, P.T., Keeble, J., Mann, G., Marshall, L., Schmidt, A. and Archibald, A.T. (2020). Reconciling the climate and ozone response to the 1257 CE Mount Samalas eruption. *Proceedings of the National Academy of Sciences*, 117(43), pp.26651–26659.
* YANG, Z., LONG, N., WANG, Y., ZHOU, X., LIU, Y. and SUN, L. (2017). A great volcanic eruption around AD 1300 recorded in lacustrine sediment from Dongdao Island, South China Sea. *Journal of Earth System Science*, [online] 126(1). Available at: https://link.springer.com/article/10.1007/s12040-016-0790-y [Accessed 13 Aug. 2021].