MH370 – What can we say about Sinabung Volcano ashes?

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Executive Summary

Considering Miss Kate Tee's testimony of the sighting of an aircraft in an orange glow, a question arose: what could have been the origin of such a visual phenomenon? As the official investigation final report mentions the release of volcanic ashes advisories on the day of the disappearance of MH370, investigating on the actual presence on ashes was worth doing.

This analysis demonstrates that the transport of Mount Sinabung volcano ashes could have carried them in the vicinity of Kate Tee's boat at the right time on March 7th. It is thus possible that the aircraft flew through this cloud of light particles which could have created the orange glow described by the sailor.

1. Introduction

On her blog on 31 May 2014 [1], sailor Katherine Tee reported her sighting of an airplane during the night of March 8th, 2014 at different times, possibly the MH370.

In that night, at about 02:20 Indonesian time i.e. March 7th, 19:20 UTC, heading to Phuket, she and one crew member witnessed the flyby of an aircraft very close to their sailing boat. During the sighting the aircraft appeared as a rising star, then an orange glow ... which later "turned into a visible plane". This was analysed in detail in [8] and published at www.mh370-caption.net.

This paper addresses the possibility that the orange glow could be coming from the encounter of volcanic ashes released by Mount Sinabung in Sumatra.

2. Mount Sinabung

The final investigation report [2] mentions that volcanic ash advisories (VAA) were issued on that day because of ashes originating from Mount Sinabung at [3.17°N; 98.392°E]. The VAA were released at 06:27 UTC and at 18:37 UTC on March 7th. But in fact, the volcano had been active long before as documented by the volcanic ash advisories released by Volcanic Ash Advisory Centre (VAAC Darwin) from 10th January onwards.

The volcano elevation is 8070ft. In the first quarter of 2014, its eruptions were reported and produced ash plumes as high as 2000m to 4000m (5500 to 13000ft).

¹ CAPTION Initiative, see www.mh370-caption.net

The distance between the volcano and the sailing boat was about 310Nm which is a short range as shown in Figure 1.



Figure 1: Location of Kate Tee's boat relative to Mount Sinabung

After 1200 years, the volcano woke up in August 2010 with a phreatic activity which ceased in September 2010. It stayed relatively quiet until September 2013 where explosions arose sending ashes up to 9km above its summit i.e. an altitude of \sim 11km (\sim 36 000ft) as the volcano elevation is 8070ft (\sim 2460m). Illustrations of the recent events are provided in Figure 2.



Figure 2: Snapshots during Mount Sinabung major events- (Reproduction of Fig 4 of [3])

In Mid-January 2014, a first major dome collapse occurred with a large increase of SO_2 emission rates starting the most eruptive phase.

This was called Phase E which saw an average emission of several thousands of tons of gas and material per day until end of February and hundreds of them by beginning of March 2014 when its activity became steadier and tagged as Phase F. On the 5th and 6th of March, more than 460 tons have been released [4].

Figure 3 and Figure 4 include satellite and International Space Station shots of Mount Sinabung activity on 6th and 9th of March 2014 showing the exhaust plume during this period.



Figure 3: Sinabung volcano plume on 6th Marc 2014 (NASA Courtesy – [5])



Figure 4: Mount Sinabung captured from International Space Station on 9th March, 2014 – (NASA) on the left of the photo

During Phase E, eruptions were reported to produce ash plumes as high as 7000m above the vent (altitude \sim 31 000 ft).

Ash samples have not been systematically analysed. But in Phase D, they were regularly examined and they included so called juvenile material representing 50-80% of the volume. This consisted of 60-70% of fresh glass, 25-30% of feldspar and 5-10% of pyroxene and iron-oxide. In addition, a high proportion of silicic bulk components was detected. A higher Cl concentration was also measured during the degassing emissions than during earlier phases.



Figure 5: Sinabung ash particles >250 µm under plain polarized light – (Reproduction of Fig 6 of [3])

At the beginning of Phase E, SO₂ mass released has been the only parameter monitored more or less regularly. It is a colourless transparent gas. On the images of March 6^{th} and 9^{th} , a grey volcano plume is visible over the coastal area. This indicates that it was containing opaque material in addition to SO₂ gas.

During these particular days, the concentration of SiO₂ (Silicon dioxide also called Fumed Silica) had not been measured or estimated since the beginning of Phase E where 60% of the total weight came from this component [3] as illustrated in Figure 5. Thus, these very thin particles most likely represented a significant portion of the volcano plume in the first week of March as visible in Figure 3 with extremely low bulk density between 0.03 to 0.15g/cm³. This low density along with its typical dimension <150 µm allows it to travel easily when carried away by the wind. A typical example of such a long-distance journey of particles is the well-known crossing of the Mediterranean Sea by sand grains coming from Africa and landing in Italy and France.

3. 2014 dome collapse and Phase E consequences

The final investigation report [2] mentions two volcanic ash advisories issued on 7th March 2014 which concern areas in the surroundings of the volcano as illustrated in red in Figure 6. In fact, these areas are superimposed but more importantly they are located near the volcano and thus very far from Kate Tee's boat location.



Figure 6: Geographical zones (superimposed in red) concerned by the Volcano Advisories of 7th March 2014

To reach the boat vicinity on March 7th, ashes must have left the volcano location earlier i.e. some days or/and possibly a week past depending on the meteo and wind transport effect. Thus, the focus should be on understanding the travel time and the path of the ash cloud from Mount Sinabung location to the boat location during the 1st week of March.

Thanks to the study done in [3], we know that there were emissions of thousands of tons of ashes during February 2014 and still of some hundreds of tons very early in March. In addition, Volcanic Ash Advisory Centre Darwin (VAAC Darwin) released an average of four VAAs per day concerning Mount Sinabung from 10th January to 7th March onwards. This confirms that the volcano quasi constantly emitted ashes during the week before the 7th of March. All VAAs included a red alert level which is the most severe level according to the international Aviation Colour Coding scheme. This level is defined as "Eruption is underway with significant emission of ash into the atmosphere occurring".

4. Modelling ashes transport from Mount Sinabung to Kate's boat

Now that it is established that the volcano continuously emitted ashes until beginning of March at least, the next step is to understand if and how the ashes were transported up to the area where the boat was sailing i.e. close to $[6.63^{\circ}N; 94.44^{\circ}E]$ at about 19:00UTC on the 7th of March.

The publicly available NOAA tool [6] from the Air Resources Laboratory has been used to simulate ashes transport and dispersion in a period starting few days before the 7th of March. The public version of the HYSPLIT tool has limitations. It allows to simulate eruptions during 48h time windows only and to compute the transport of their plume with a limited time horizon of up to 48h.

Nevertheless, a series of simulations were performed considering eruptions starting every day from 27th February till 7th March 2014. Two sets of meteo data (Reanalysis and GDAS 1d°) were used for consolidating and cross-checking the results. In the simulations, the possible accumulative effect of ashes in the vicinity of the boat could not be evaluated due to the limitations of the simulation tool. Only the transport and the passage of the ashes were evaluated in correspondence with the timing of Miss Tee's sighting.

The results of the dispersion simulations show that, on March 7th, from 12h UTC to 21h UTC ashes could have been transported and reached the vicinity of the boat mainly at altitudes from sea level up to 20 000 ft.

Within the limitations of the model, Figure 7 to Figure 10 illustrate the most relevant results on the dispersion cloud evolution in time and also as a function of the eruption start time. The black dot representing the boat remains in the cloud during the time window from 18h UTC to 21h UTC at least. Annex 1 provides more detailed simulation reports.



Figure 7 Dispersion simulated < FL200 at 12hUTC and 18hUTC on March 7th from eruption at 18hUTC on March 5th. (black dot represents Kate Tee's boat)



Figure 8: Dispersion simulated < FL200 at 15hUTC and 21hUTC on March 7th from eruption at 21hUTC on March 5th. (black dot represents Kate Tee's boat)



Figure 9: Dispersion simulated < FL200 at 18hUTC and 24hUTC on March 7th from eruption at 0hUTC on March 6th. (black dot represents Kate Tee's boat)



Figure 10: Dispersion simulated < FL200 at 21hUTC, March 7th and 3hUTC, March 8th from eruption at 3hUTC on March 6th. (black dot represents Kate Tee's boat)

Recalling the 2-days limitation of the simulation tool, one can extrapolate that the superimposition of earlier emissions would increase the density of ashes in the cloud at that location of this point in time.

5. And the glow turned into a visible plane...

The concentration information inside the plume is not available both for the time of eruption and the "arrival" time. An interesting information coming out the simulations is that the wind transported the cloud below the altitude of 20 000 ft and basically not above. In case of ashes encounter, the recommended flight operational procedure to flight crews is to reduce the engine operating temperature via a descent with the expectation to get cleaner air at a lower flight level. Thus, it is probable that the people in command might have attempted such an avoidance manoeuvre to fly below the ash cloud even though the VAAs stated the altitude was Sea Surface to 12000ft.

Nevertheless, the severity level was red and as such indicates that a substantial quantity of ashes was expelled from the volcano. Thus, one can expect that a certain level of ash concentration existed around 19:00UTC on March 7th in the vicinity of the boat. But the concentration was probably not as severe as at the time of their emission considering the dispersion surface of the simulated cloud at 19:00h on March 7th. The accumulation across several days should be considered also.

The appearance of the plane - as described by Miss Tee at about 19h05 UTC - seems to correspond also to the entry of the plane into the ash cloud which reinforces her testimony.

Item E8 of [8] raises the question of the strange orange fuzzy halo around the aircraft as seen by Miss Tee.

According to Skybrary [9], ash rock particles produce electrical discharges when hitting the metal surface of an aircraft and at night, generally create a St Elmo fire. But the colour is not necessarily orange but more in the blueish part of the visible spectrum.

So, the main reason for having an orange glow could come from the ignition of the tiny ashes particles inside the engines producing an orange flux of burning particles in the exhaust gases. Thus, this tends to indicate that the aircraft was not flying at cruise level but much below which correlates the flying level reported by the sailor's sighting.

6. References:

- [1] original: <u>https://saucysailoress.wordpress.com/2014/05/31/i-think-i-saw-flight-mh370/</u> 31 May 2014
- [2] Safety Investigation Report, The Malaysian ICAO Annex 13 Safety Investigation Team for MH370, 02 July 2018
- [3] Gas and ash emissions associated with the 2010–present activity of Sinabung Volcano, Indonesia, S. Primulyana, C. Kern, A. Lerner, U. Saing, S. Kunrat, H. Alfianti, M. Marlia, Journal of Volcanology and Geothermal Research 382 (2019) 184–196
- [4] Appendix A of [3]: Combined Geochemical, Seismic, and Lava Extrusion dataset for Sinabung 2010-2016 activity
- [5] eoimages.gsfc.nasa.gov/images/imagerecords/83000/83314/Sinabung_oli_2014065_Irg.jpg
- [6] NOAA Modelling tool publicly available: https://www.ready.noaa.gov/HYSPLIT_ash.php
- [7] Plausible Explanation for the "Orange Glow" of the Mystery Airliner, <u>http://www.edtruthan.com/kt/20140811/</u> - 11 Aug. 2014 (Ed. Truthan)
- [8] MH370 What can be learnt from Kate Tee's sighting? 30th Sept. 2021 Jean-Luc Marchand, CAPTION, <u>www.mh370-caption.net</u>
- [9] www.skybrary.aero/index.php/Volcanic_Ash

Annex 1:

Simulation of eruption on 5th March at 18h UTC during 48h and transport during 48h finishing on 7th March at 18h UTC.







Simulation of eruption on 5th March at 21h during 48h and transport during 48h finishing on 7th March at 21h.





Simulation of eruption on 6th March at 0h during 48h and transport during 48h finishing on 8th March at 0h.

