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Comparison of Galunggung1982-83 and Eyjafjalla-2010 Eruptions: definition of eruption dynamics from 3D Ash Surface Morphology

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We consider that all works, concepts on aviation safety, security codes, establishment of warning systems etc begin in 1982, when two commercial jumbo jets en route to Australia across Indonesia suffered loss of engine thrust from ingesting volcanic ash from the erupting Galunggung Volcano, Java, and descended more than 20,000 ft before the engines could be restarted (Casadevall, 1991). It is not the only incident of this kind but this Galunggung eruption had a pionner character attracting attention on aviation safety against volcanic eruptions in international community. As the needs for precautions on aviation safety against volcanic ash encounters began with Galunggung 1982 eruption and as we all concerned by the measures taken by ICAO due to Eyjafjallajökull-2010 eruption, we aimed to investigate this last huge airspace perturbing eruption and compare the volcanic ashes produced by those two eruptions. Volcanic ash characterization should be most important parameter to understand how the eruption concerned unrolled. Galunggung 1982-83 eruption was exceptionally long, lasting about nine months between 5 April 1982-8 January 1983). During this well known eruption, the composition of the erupted magma evolved from andesite (58% SiO_2) to Mg-rich basalt (47% SiO_2), while the style of the eruption changed drastically through time (Katili and Sudrdajat, 1984; Sudrajat and Tilling, 1984; Gourgaud et al., 1989 gourgaud etal 2000). Paralel to chemical changes and water consumption, eruption dynamic was also changed and occured in three eruption phases with different eruptive styles as an initial Vulcanian phase (5 April-13 May), a phreatomagmatic phase (17 May-28 October) and a Strombolian phase (3 November-8 January), have been recognized (Katili and Sudradjat,1984). We examined the surficial morphological features of proximal tephra collected from Galunggung and Eyjafjalla volcanoes. Surface texture and morphology of volcanic ash particles change according to various fragmentation mechanisms. Several common types of ashes produced during phreatomagmatic fragmentation process bear blocky-equant, mosslike, plate-like and drop or spherical shapes, besides, magmatic fragmentation leads to the formation of vesiculated fragments. We applied some quantitative statistical parameters for surface descriptors of volcanic ashes such as “Average roughness of profile (Ra), Maximum valley height of roughness profile (Rv), profile irregularities of roughness profile, Surface Area (SA), Volume (V), Fractal Dimension of Roughness (DAS)”. We compared quantitative morphological data acquired from both eruptions. The grain size distribution of Eyjafjalla-2010 eruption, ash surface morphology, tephras types and textural parameters exhibit that magma input was important during the first phase (14-16 April) than following days. First phase ashes have either tubular vesicles as classically known for plinian deposits or curviplanar cut vesicles and some brittle fracturations, characteristics of phreatomagmatism. Interestingly, coarse fragmentation happened after the first phase. There is great similarities between two eruptions, but in reverse sens that in Galunggung, the eruption started with vulcanian style then phreatomatism and lasted with strombolian activity. Besides in Eyjafjalla-2010, eruptive phase started with basaltic activities at the North, then phreatomagmatism and toward the end a slight vulcanian style happened.