



Eruption dynamics of the 2010 summit eruption at the Eyjafjallajökull volcano (Iceland): Magma fragmentation, tephra stratigraphy and transport

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The 14 April to 8 June 2010 summit eruption of Eyjafjallajökull volcano was a sustained explosive to mixed event of small to moderate size (0.17 km^3 DRE) and intensity. The eruption is divided into four distinct phases (I-IV), each typified by particular style of activity. Phase I mark the onset of eruption in the early hours of April 14 and lasted to April 18. It is further divided into two stages. Stage 1 represents the first 15-17 hours of activity when the eruption melted its way through the ice-filled summit caldera and is typified by phreatomagmatic activity producing jökulhlaups and steam-dominated and ash-poor plumes rising up to 9 km. At $\sim 18:30$ on April 14 a dark ash-laden plume emerged from the summit vents denoting the onset of stage 2, which lasted through April 18. It was characterized by pulsating explosive (Vulcanian-like) activity with periodicity in the range of 10s to 100s of minutes and driven by mixed magmatic and phreatomagmatic fragmentation events. Each pulse was typified by a steady stream of explosive events with periodicity of seconds to minutes that supported a 5-7 km high ash-rich eruption plume. The most voluminous ash producing pulses took place in the afternoons of 14, 16 and 17 April. Start of Phase II began on April 19 and is demarcated by significant drop in the intensity of explosive activity and onset of lava emission, lasting to May 4. This phase was characterized by intense volcanic tremor, yet the eruptions plumes were small (typical height = 2-3 km) and ash-poor, except on April 28 when it rose to ~ 7 km. Activity was pulsing with small discrete explosions at intervals of minutes and the tephra produced contained abundance of fluidal and highly vesicular pumice grains. Onset of Phase III is signified by cessation of lava emissions around May 5 and at the same time intensity of volcanic tremor drops significantly. At the start of Phase III the explosive activity intensified with renewed production of ash-rich plumes rising to heights in excess of 5 km. The style of activity resembled that of stage 2 of Phase I and may have been driven by mixed magmatic and phreatomagmatic fragmentation. The phase III tephra contained sulphur crystals, which had not been observed in the tephra from earlier phases of the eruption. Phase IV is the final phase, lasting from May 19 to June 9 and represents a period of declining eruption intensity. Total amount of tephra produced in the eruption is about 0.15 km^3 DRE and that of lava 0.023 km^3 DRE, which gives an average discharge of about $50 \text{ m}^3/\text{s}$ DRE or four times that of preceding Fimmvörðuháls eruption.