Degassing at Anatahan volcano during the May 2003 eruption: Implications from petrology, ash leachates, and SO_2 emissions.

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On 10 May 2003, Anatahan volcano (located at N 16°21′/E 145°40′ on the Mariana arc) entered its first historical eruptive episode, sending ash to >12km into the atmosphere. Abundant accretionary lapilli, quenched pumice textures, and hydrothermal minerals in the lower eruptive deposits indicate hydromagmatic interaction and active mining of the pre-eruptive hydrothermal system. Sulfur budget calculations based on residual melt and estimated pre-eruptive magmatic S contents, estimates of the erupted mass of magma, and total SO_2 output estimates require an additional source of S other than the erupted magma. Multiple lines of evidence, including high SO_2 emissions early in the eruption, the presence of accretionary lapilli and hydrothermal minerals in the early eruptive deposits, quenched pumice textures, and cation and anion ratios and abundances in ash leachates suggest that a S-rich free volatile phase exsolved from a large magma body. Magmatic volatiles were stored as components of the hydrothermal system (pressurized gases, hydrothermal fluids, and/or hydrothermal minerals) to be remobilized early in the eruption to contribute to the total SO_2 output.

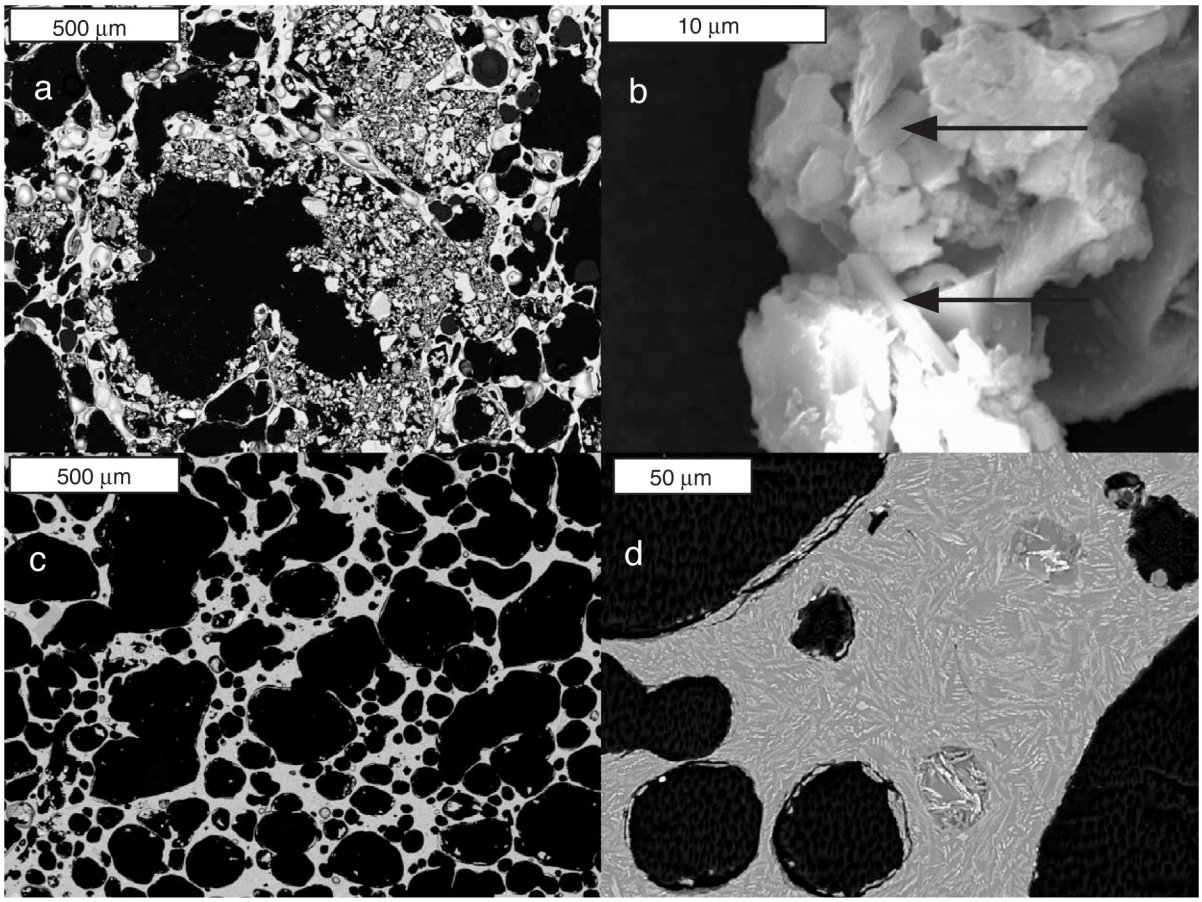

Figure: SE images of Anatahan pumice and ash from the May 2003 eruption. a: pumice with high connectivity from unit 11a (eruptive phase 1) showing ash in larger vesicles. b: Ash from unit 11a, arrows point to euhedral calcium sulphate minerals. c: Pumice from upper unit (12T, eruptive phase 4) with bimodal bubble size distribution. Larger vesicle population has well developed connectivity. d: Microlite rich (mainly plagioclase and clinopyroxene) bubble wall in pumice from unit 12T. This shows how the eruption began with a hydrothermal phase (phase 1) and evolved into a magmatic phase (phase 4) and provides evidence for hydrothermal sulfur contributed to the SO_2 flux measured in the atmosphere during the eruption.

de Moor, J. M. et al. Degassing at Anatahan volcano during the May 2003 eruption: Implications from petrology, ash leachates, and SO_2 emissions. J. Volcanol. Geotherm. Res. 146, 117-138 (2005).