

Tephra fall deposits of the 22-23 April 2015 Calbuco eruption: new field data and potential health hazard from ash characterization

Jorge Romero¹, Frederick Swanson², Julia Jones³, Elizabeth Rovere⁴, Florencia Reckziegel^{5, 6}, Claire J. Horwell⁷, Romina Daga⁸, Daniele Morgavi⁹, José Viramonte⁵, Gustavo Villarosa¹⁰, Fabio Arzilli¹¹, Margherita Polacci¹

¹Universidad de Atacama.

²U. S. Forest Service.

³Oregon State University.

⁴SEGEMAR.

⁵CONICET.

⁶Universidad Nac. Salta.

⁷IHR, Durham University.

⁸Centro Atómico de Bariloche.

⁹Perugia University.

¹⁰Universidad de Comahue.

¹¹Manchester University

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On 22-23 April 2015 Calbuco erupted 0.26-0.28 km³ of bulk tephra (Jan 2016 mapping). Scanning electron microscopy (SEM), mechanical and laser grain size, X-ray diffraction (XRD) and X-ray fluorescence (XRF) analyses were carried out on 4 proximal (5-30 km downwind; DW) and 12 distal (100-280 km DW) tephra samples from this eruption, in order to assess its spatial variations and potential impacts on human and animal health. Also, contours of PM₅ (PM₅ = <5 μm), PM₁₀ and PM₂₀ concentrations at ground level were computed with FALL3D. Tephra is polymodal at proximal (<6 km DW) areas, while at greater distances (30 and 100 km) it is unimodal, with the exception of a bimodal region 200 km DW. The ash is basaltic andesite in composition (~55.4 wt.% SiO₂), and is composed of plagioclase, volcanic glass, pyroxene (augite, diopside and orthopyroxene) and lithics. Crystalline silica was not recognized via XRD (e.g. quartz, cristobalite or tridimite). The ash particles are low-vesicular, blocky glass shards, with relatively thick inter-vesicular walls, while fibrous particles were not observed within any sample. The <63 μm fraction averages 47 wt.% of bulk ash. The 'thoracic' (<10 μm) fraction ranges from 3.9 to 14.3 wt.% (13.08 ±5.23 theoretical wt.%) and consists of irregular shards and blocky particles with inclusions of Fe Ti oxides, which are seen to aggregate and coat larger glassy fragments (<100 μm). The 'respirable' ash (<4 μm) comprises 0.3-5.6 wt.% (5.55 ±2.22 theoretical wt.%) in all samples. These characteristics suggest that any potential health hazard of Calbuco ash would be related to grain size or chemical features but not to morphology or crystalline silica content, thus silicosis is not expected. New studies should include leachate analyses, plus clinical and epidemiological studies at areas affected by abundant fine ash recognized by direct sampling and FALL3D modeling.