Characteristics of tephras from the initial stages of the eruption of Cordon Caulle Volcanic Complex eruption (Southern Andes), June 2011

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The Cordon Caulle Volcanic Complex (CCVC, 2236 m.a.s.l.), in the Southern Andes near the boundary between Chile and Argentina, is a large NW-SE-oriented volcanic chain (dated from late Pleistocene to Holocene). The Complex is the largest active geothermal area of the southern Andes located in a 6 x 13 Km wide volcano-tectonic depression. On June 4th, 2011, a large, long-lasting eruption was initiated, ejecting during the first week approx. 4x106 m3 of pyroclastic materials. Prevailing winds coming from the west dispersed ashes to the east affecting extensive areas in Argentina as far as 1300 km from the source volcano. Two months after the eruption, additional 2.5 x106 m3 of ashes had been accumulated affecting 7.5 x106 hectares in the countryside of Argentina. This contribution synthesizes the study of samples collected on a daily-basis during the first week of the eruption in different locations, both close and far away from the source volcano. A multidisciplinary physical-chemical approach is based on studies performed on particles size, morphology and chemical analyses, which were carried out with laser grain-size measurements, SEM-EDS microscopy and the XRD techniques. The obtained results allowed to recognize a complex tephra variability in the initial stages of the eruption.

From June 4th to 13th the eruption was characterized by episodic stages, and thereafter a relative stability was reached, according to the reports provided by SERNAGEOMIN (Chile). Following the beginning of the eruption, two events of column collapse were registered on June 5th and 13th respectively. On June 5th the eruption reached its higher intensity (VEI 5 = Plinian). The sampled tephras from CCVC collected in different Argentine localities during that period, are siliceous, mostly fine sand and silt/clay-sized with relatively high amounts of particles smaller than 4 micrometers in size, that correspond to the respirable fractions (up to 10 percent of the bulk sample in the nearby regions and higher as they are blown-out by wind). The chemical data indicate a basaltic and rhyolitic composition with trachyandesitic particles, observed in the near-source samples (Villa Angostura and Bariloche), whereas in distal localities are particularly rhyolitic (Buenos Aires and Puerto Madryn, located more than 1000 km East). Significant results have been also obtained on the short-term transformation of volcanic ashes. According to the performed chemical data, after June 7th the tendency of high silica ash content was increasing. Cristobalite (SiO2 polymorph) was detected in the approx. 5 micrometers size-fraction of the studied samples from the initial days of the eruption. This, together with the relatively large amount of respirable fractions, made the first stages of this eruption highly hazardous to human health and environment.