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Chemistry of ash-leachates: a reliable monitoring tool for volcanic activity

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Real-time volcanic hazard assessment requires the integrated interpretation of data obtained with different monitoring methods, particularly when people may be at risk. One of the methods rendering earliest precursory variations reflecting the internal state of a volcano is the geochemical analysis of gases, ground or lake waters related to volcanic systems, and volcanic ash. At Popocatépetl volcano, Central México, chemical fluctuations of the soluble cover of volcanic ash particles has proved to reflect diverse characteristics of the eruption types. Chloride, sulfate and fluoride concentrations of ash leachates have been consistently measured within the current eruptive episode beginning in December 1994. Particularly, main anions presented diverse relative concentrations in periods of dome extrusions, contrasting with hydrothermal activity or quiescence. Multivariate statistical analysis revealed that higher proportions of fluoride in the leachates corresponded to new dome emplacements and relatively higher sulfate concentrations to hydrothermal ashes, although these results may be ambiguous at times. However, different sulfur isotopic ratios were measured in sulfate from ashes erupted during periods dominated by hydrothermal activity to those emitted during dome emplacement. Additionally, ascent of fresh magma was reflected on high fluoride concentrations jointly with low 34S-SO4 isotopic values. It is thus recommended to maintain persistent analyses of ash-leachates from on-going eruptions as a monitoring tool at active volcanoes.