CONTINUOUS GAS MONITORING WITH A CHROMATOGRAPH AND AN ALPHA SCINTILLATION COUNTER ON MERAPI VOLCANO, INDONESIA

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A set of devices consisting of a gas chromatograph, an alpha scintillometer and a temperature sensor especially designed to monitor high-temperature volcanic gases was successfully operated over weeks at the fumarolic area of the Merapi summit, Indonesia. The complete unit operates automatically and is remote controlled by radio link.

Concentrations of H_2O, CO_2, SO_2, and ^{222}Rn and ^{220}Rn activity as well as the fumarole temperature were measured every 35 minutes over several days. Figure 1 shows a representative variation in concentrations of H_2O, CO_2, and SO_2 as well as the $^{222}Rn/^{220}Rn$ activity ratio versus time for the time interval of May 23rd to 24th, 1997.

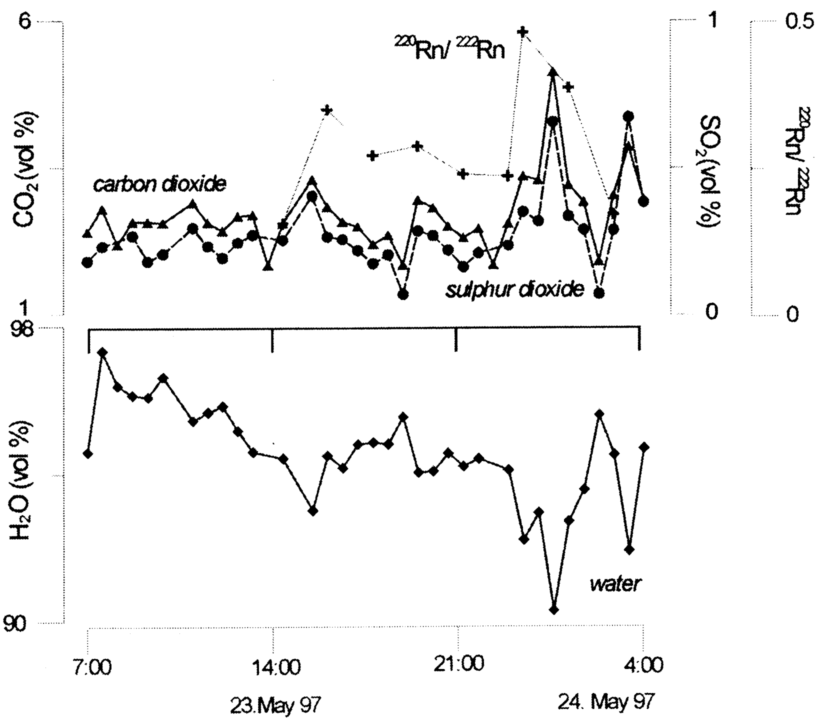

Figure 1: Representative variation in concentrations of H_2O, CO_2, and SO_2 as well as the $^{222}Rn/^{220}Rn$ activity ratio versus time for the time interval of May 23rd to 24th, 1997.

The composition of the gas emitted from Merapi shows relatively strong variations. The gas mixture is composed mainly of H_2O (90 to 98 %) followed by CO_2 (2 to 5 %) and minor amounts of SO_2 (0.1 to 0.5 %). Concentrations of SO_2 and CO_2 increase periodically when concentrations of H_2O decrease. Simultaneously the $^{220}Rn/^{222}Rn$ ratio increases, which is interpreted to be due to a higher gas velocity (Yoshikawa et al. 1990, Matsuo 1986).

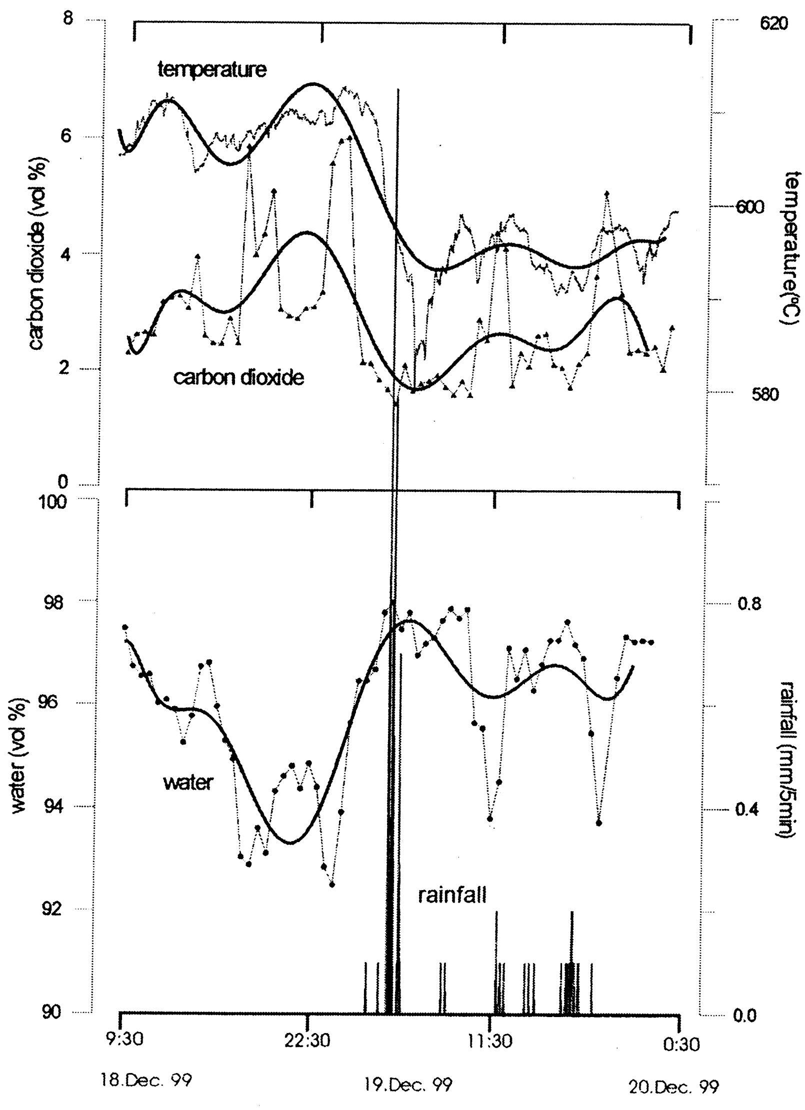

Figure 2: CO_2 and H_2O concentrations as well as the fumarole temperature and rainfall between the 18th to 20th of December 1999

Figure 2 shows raw data and polynominal smoothing curves of the CO_2 and H_2O concentrations and the fumarole temperature as well as rainfall between the 18th to 20th of December 1999. During the heavy rain, the highest water concentrations and the lowest temperatures are measured, meaning that cold meteoric water is entering the fumarole system. This result is supported by isotopic ratios of hydrogen and oxygen of the Woro gas condensates which are interpreted to be a mixture of magmatic and meteoric water.

We explain the gas concentration variations and temperature changes with mixing of gases originating from two different sources. Carbon dioxide, and sulphur dioxide originate from the hot magma and are mixed with gas, which is cooler and richer in water, possibly fed by rain water. Therefore, variation in water concentrations and temperature in the fumarole, is a result of meteoric water incorporation.

Another effect responsible for the variation in gas concentrations is a stronger degassing of the magma, in other words gas pulses with higher gas velocities. A regular stronger degassing of the magma causes an increase in gas velocity as well as an increase in the ratio of magmatic gas to meteoric water. This leads to higher CO_2 and SO_2 and lower H_2O concentrations in the fumarole gas.

Literature:

Matsuo S. (1986): activity report of Japanese Group for the chemical prediction of volcanic eruption. Peridico di Mineralogia, 55(1), pp 39-53.

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