

Zeta-potential measurement of volcanic rocks from Miyake-jima volcano

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Introduction

Self-potential (SP) variations were observed simultaneously with the tilt-step events of the 2000 Miyake-jima volcano activities (Sasai et al. 2002). These SP variations were accompanied by very long-period seismic pulses (VLP pulses) with a duration of about 50s, and waveforms of SP anomalies were similar to VLP pulses. The SP anomalies are ascribed to the electrokinetic effect (streaming potential) which could be induced by the fluid injection. In order to give quantitative interpretation of the SP variations we need to investigate zeta-potential to which streaming potential is proportional.

Experimental Procedure

We measured zeta-potential with streaming potential method. The zeta-potential is obtained from the streaming potential coefficient and absolute dielectric permittivity and liquid viscosity and pore fluid conductivity. The streaming potential coefficient is determined from the slope of the electrical potential versus the pore fluid pressure difference between two edges of sample plug.

Four rock samples were used in this study, three of them were sampled from Miyake-jima volcano and the other one was sampled from Kozu-shima Island. Each rock sample was crushed into particles of 0.1~0.3 mm size. Before measurement crushed samples were washed adequately with distilled water and with KCl solution which was used for background electrolyte.

At the beginning of each measurement the electrolytic concentration was set to be 10^{-3} mol/L of KCl, and then the pH was controlled by adding HCl or KOH to the electrolyte between pH 2 and pH 12 to investigate dependence of zeta-potential on the pH. All experiments were conducted at 25 degree C.

Result

Two samples have isoelectric point (a pH where zeta-potential is zero) at about pH 2. Above isoelectric point zeta-potential is negative and increases in magnitude with pH. The other two samples have no isoelectric point and their zeta-potential are always negative in the pH range of this measurement (pH 2~12).

Between pH 3 and pH 8 the zeta-potential of all the samples range about -10mV~-25mV and their changes with pH are rather small. This value is much smaller in magnitude than values of previous studies (e.g., Ishido and Mizutani, 1981).