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Zeta potential measurements of various rocks for SP interpretations

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Recently, self-potential (SP) measurement has been applied on many volcanoes to investigate subsurface hydrothermal or ground water system within a volcanic edifice. SP anomalies of large scale are often observed on active volcanoes, which are interpreted as streaming potentials caused by electrokinetic effects in porous medium. The streaming potential is generated when fluid flow takes place in the electrical double layer at a solid/liquid interface in porous medium. Zeta potential is the electrical potential at a particular plane in the double layer and plays an important role in generating the streaming potential. While zeta potentials for individual minerals or common rocks are reported in some laboratory experiments in the past, there are few studies which discuss the consistency of laboratory data of rock samples with the SP distribution in a real field. In the present study, we conducted zeta potential measurements for volcanic rocks of various kinds sampled from Aso caldera, southwestern Japan, in order to give a quantitative interpretation for the results of our SP survey in the same field (Hase et al., 2003).

midskip As a result of our experiments for 32 samples, it is clarified that the zeta potential ranges from approximately ĄE0 to +20 mV from sample to sample. It is noteworthy that almost half of the total number of samples (14 of 32) showed positive values of zeta potential. We also obtained the iso-electric point (IEP) of these samples, the value of pH at which zeta potential apparently becomes zero. As the IEP is generally controlled by chemical composition of a sample, it seems possible to classify and evaluate the effect of mineral composition of a sample on the zeta potential. We performed the XRF measurements in order to specify the chemical composition of rock samples. Comparing the chemical composition and IEP, all the principle elements but TiO and P2O5 show clear correlations with the IEP. While some elements increase the

IEP, others decrease it.

Heretofore most of the SP studies have been done assuming that the zeta potential takes negative values because SiO2 has been considered to be the dominant material that controls the zeta potential in natural rock samples. However, our experiments have revealed that it is not always the case. Additionally, it is clarified that the zeta potential of rocks are also dependent on the elements other than SiO2. These results suggest the necessity of measurements of zeta potential even for a qualitative interpretation of a field data of SP as well as a quantitative evaluation of it.