Low sulfur pillow basalts from deep submarine flank of Hualalai and Mauna Loa volcanoes

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Submersible-based exploration of basaltic rocks west flank of the Hawaii Island, mostly at 2000 to 5000 m depths, was a focus of Japan – USA joint research during two cruises by the Japan Marine Science and Technology Centre (JAMSTEC) in 2001-02. The observation of the dives and recovered samples are sumerized, based on the twelve recent submersible dives and numerous newly obtained samples from the deep submarine flanks of Hualalai and Mauna Loa. Whole-rock compositions have been determined by XRF and titration for about 200 samples recovered by submersibles.

All fresh samples are tholeiitic basalts that define a tight linear trend**.** Mauna Loa samples are almost identical to those from Hualalai samples and historical Mauna Loa lavas. The variations in bulk composition are mainly controlled by modal abundances of olivine phenocrysts.

Two types of low-S basltic rocks are recognized off Hawaii Island: subaerially erupted pahoehoe and a’a lava, submarine erupted pillow lava. In general, such submarine erupted low-S pillow basalts have been explained as subaerially erupted shore-line crossing lavas. However, sulfur contents in the pillow basalts are correlate positively with iron-oxidation state (Figure 1). This implies that the degassing process were carried out at low f_{O2} conditions. Dive observations and topographic characteristics also dose not support the idea that low-S pillow basalts are originated by shore-line crossing. The degassing process of Mauna Loa and Hualalai volcanoes probably different from rift systems.

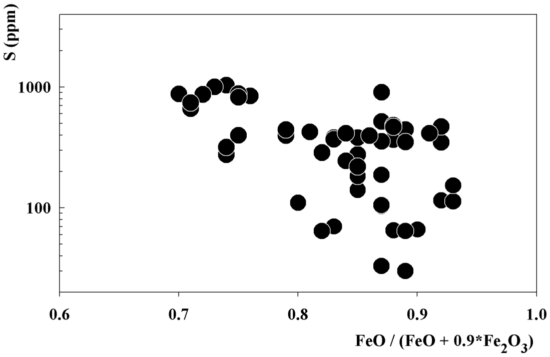

Figure 1: Sulfur vs. Iron-oxidation of deep submarine tholeittic pillow basalts

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Behavior of iron during rhyolite weathering over 52,000 years by spectro-colorimetry

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Although iron (hydr)oxides are commonly formed during rock weathering, their characterization by conventional methods such as XRD or electron microscope is usually very hard because of their small particle size, poor crystallinity, and low concentration. Quantitative measurement of rock color by spectro-colorimetry combined with differential dissolution method is an effective method for characterizing the iron (hydr)oxides. As a case study of the behavior of iron during weathering, four rhyolites from Kozushima Island, different in eruption ages (1.1-, 1.8-, 26-, 52-ka) and weathering degrees, were studied. They are considered to have had similar whitish color at the time of eruption. However, at present more weathered lavas have more yellowish to brownish color. The amount of Dichionite-Citrate reagent soluble iron increases with elapsed weathering time, which confirms the formation of iron (hydr)oxides. As standards of iron (hydr)oxides, various contents (0-100 wt%) of fine grained ferrihydrite(F), goethite(G), hematite(H), lepidocrocite(L) were mixed with fine grained white amorphous SiO_2, and the colors were determined. Fig. 1 shows the colors of powdered rhyolites plotted with the colors of iron (hydr)oxides. The colors of 1.1- and 1.8-ka lavas are close to the color trend of F whereas those of 26- and 52-ka lavas approach to that of G. This implies that the initial stage of weathering is dominated by the formation of F and as weathering proceeds the transformation of F→G progresses. It is estimated from the change of rock color that the rate constant for the reaction of F→G in the field is about 3×10^{-5} /yr, which is about 1,800 times smaller than previously reported rate constants based on laboratory experiments. The slow rate in the field may be attributable to the presence of Si and Al included in F as impurity.

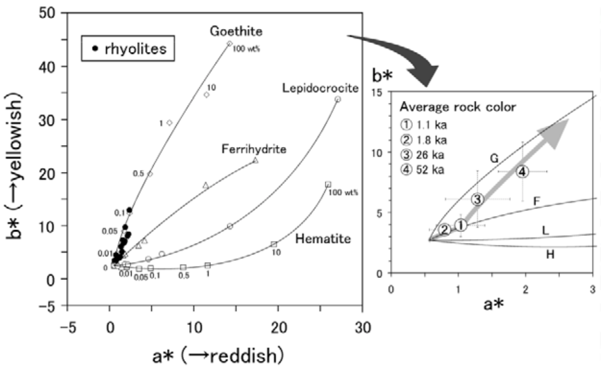

Figure 1: Colors of four rhyolites plotted with the colors of various contents of standard Fe (hydr)oxides.