HYDROGEOLOGY OF LUSI

Lambok M. Hutasoit

Applied Geology Research Group, Dept. of Geological Engineering,
Institute of Technology Bandung
Jl. Ganesha 10 Bandung 40132, West Java, Indonesia
lambok@gc.itb.ac.id

The LUSI phenomenon involves hydrogeology to a large extent, starting from the origin of the abnormally high fluid pressure (overpressure), the mechanism that caused the eruption, and lastly, how the eruption can affect the environment in and around the area, in form of land subsidence and groundwater contamination and depletion. It has been about nine months since the mud volcano erupted, but, to the author's knowledge, there has not been any comprehensive study concerning the above matters, which must involve other geologic branches. Based on this fact, it is not impossible that the handling of the impacts of the phenomenon on the environment will not achieve its objectives.

In handling the impacts one engineering question that must be answered by geologists is when the eruption will stop. Hydrogeologically, in order to answer the question, the first necessary step is to determine the age of the fluid by using isotopes. If the fluid is old (Tertiary), it is trapped fluid, while, if the fluid is young (Quaternary), it is recharged somewhere. For the first condition, naturally, the eruption will stop after a certain time, while, for the second condition, the eruption will never stop. Unfortunately, this proposed study has not been carried out either.

Five groundwater samples from the LUSI area and its surrounding have been chemically analyzed for major anions (Cl^-, HCO_3^-, and SO_4^{2-}) and cations (Na^+, K^+, Ca^{2+}, and Mg^{2+}). The samples were taken from the main vent, a bubble near the main vent, the mud volcano in Karang Anyar, a hot spring in Bangil, southeast of Sidoarjo, and a spring in Trawas. The result shows that:

1. There is a significant difference in water chemistry between the main vent and the bubble. Cl^-, Na^+, Ca^{2+}, and Mg^{2+} in the main vent water are much higher. The

water may be from different sources, or both are from the same source, but the bubble water has been diluted by shallow groundwater. The second case implies that the pressure in the eruption area may be depleting so that shallow groundwater is able to enter the area. If the pressure is still high, then flow from the eruption area will enter the shallow groundwater. If this hypothesis is correct, then land subsidence will take place due to decreasing pore pressure. This condition should be considered seriously because there are many human activities in the eruption area, which may be affected by the land subsidence.

2. Ion balance calculation shows the values of -0.6 and -3.9 from the main vent and the bubble, respectively. This means that there are still cations, may be heavy metals, in the waters. This condition should also be seriously considered in relation with groundwater contamination.

3. Plot of the chemical data in Piper Diagram shows that the hot spring has different hydrogeologic system with the bubble and the main eruption.

4. The main vent and the bubble, which have high concentration of cations and anions, may act as potential source of groundwater contamination.

In addition to groundwater sampling, very limited data, rate of discharge from seven springs and two self flowing groundwater wells, were obtained during a short survey. It was reported that there had been no significant change in the rate after the LUSI eruption, which means that at the surveyed points, LUSI had not caused groundwater depletion.