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Abstract. The research area is one of the Wonogiri gold producer. In this region there are nearly 30 gold processing locations. This area has a steep morphology which is part of Mt. Mas. The work of the gold processing is a part time job besides for the local farmer population. To get the gold bearing rocks, are by digging holes manually around Mt. Mas, while gold processing is carried out in their homes. As a result of these activities, then identified the distribution of mercury in the surrounding settlements. Analytical methods used in this study is the measurement mercury content using Hg meter on altered rocks, soil and using XRF (X-Ray Fluorescence) for plant samples. This results of research shows that there are conducted on mercury contents in the altered rocks, soil and plants showed significant mercury contents in altered rocks, soil and plants. This proves that mercury has polluted the environment surrounding residents, both of people living in the hill down on the lower plain areas. The results of this study are expected to be used as reference to help overcome the pollution of the area.

1. Introduction

Mining waste materials containing heavy metals Hg, Fe, Pb, As, Cu, Cd, Zn, Cr and S which are toxic [1, 2, 3]. It is very dangerous to humans, plants and animals. This mine waste can pollute the environment through the media water and air [4], so that it can pollute the environment.

Mercury is a trace element in the earth's crust which is only about 0.08 mg/kg [5]. Cinnabar (HgS) is the most common natural source of mercury [6, 7]. In addition, sulphide minerals, such sphalerit (ZnS), wurtzite (ZnS), chalcopyrite (CuFeS) and galena (PbS), can also contain trace amounts of mercury. Cinnabar is soluble in water, but due to weathering of rocks and soil erosion, then cinnabar can release mercury into the aquatic environment [8]. Mercury is a heavy metal that is very dangerous if taken into the body of living beings such as humans, animals, and plants [5]. The previous study [9] states that the type of mercury found in the organs of living beings, such as fish, is methyl mercury (CH_3Hg^+) or dimethyl mercury ($(CH_3)_2Hg$). Cases of mercury poisoning were quite famous [10, 11] was the case that occurred in Minamata Bay, Japan in the 1950s. The chemical industry which operates around the Minamata Bay dumping mercury waste into the waters of the bay and caused mothers who consume seafood obtained from Minamata Bay gave birth to children with congenital defects. In that case, of the 111 poisoning cases, 43 people died [12].

The spread of mercury in the research area is quite extensive because the deployment location in the population area. This is supported by research site is an alteration zone which is the source of the metal element and also the processing and waste disposal is in the settlements each resident.

The research location is in the hamlet of Mesu, Boto, District Jatiroto, Wonogiri Central Java Province. This location is a gold mine that whole processing of gold was at each house (see Figure 6).

2. Data and Method

Mercury is a heavy metal that is a liquid and gas type. So the method of analysis has to do with geological mapping. To study of mercury levels in the study area and its effect on plants, mercury measurements were performed in alteration rocks, soil and some plants. Measurements of mercury in alteration rocks and soil use Hg meter, while the measurement of mercury in plants using X-Ray Fluorescence (XRF). The pH meter used to study the content of the acidity of soil and alteration rocks. The results of this research will be presented on geological and mercury distribution map.

3. Result and Discussion

3.1. Geological Setting

The research area was an area of hills morphologies were composed by volcanic breccias, andesite intrusion and andesite lava that have undergone hydrothermal alteration (Figure 1, 2). The geology based on [13] research areas compiled by Nglanggran volcanic breccias (Oligocene). Volcanic breccias interbedded with tuff, volcanic sandstone, andesite lava and andesite intrusion. Characterize of volcanic breccias were massive, textured grains supported texture, andesite fragments, matrix of volcanic material and silica cement. The andesite intrusion generally has undergone a process of alteration. The altered andesite intrusion was colored red-gray, fresh color dark gray, hypocrystaline, faneric-afanitic, subhedral minerals, inequigranular, mineral composition are pyroxene, hornblende, plagioclase in groundmass volcanic glass. The secondary minerals were present in andesite intrusion was chlorite, quartz and hematite.

Figure 1. The hilly morphology of research area.

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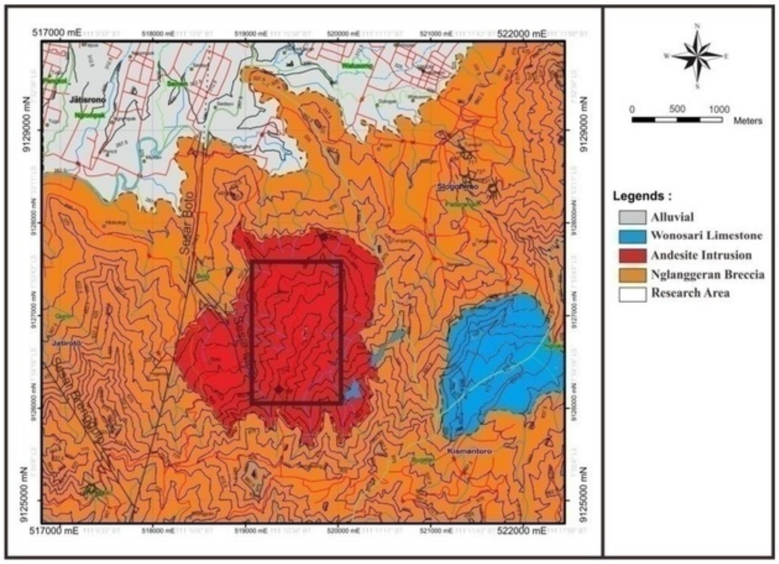

Figure 2. Geological map (black box is a research area).

The type zone of surface alteration that has been found in the study area was advanced argillic. In this type of alteration minerals of advanced argillic were found some of minerals as clay mineral, quartz, alunite, hematite, pyrite and fine cinnabar (Figure 3).

Figure 3. Outcrop of advance argillic alteration in Mesu area.

3.2. Mercury distribution

Measurements of mercury using Hg-meter (Figure 4) conducted on several locations both on alteration rock and gold processing area. The levels of mercury in Mesu area measured by Hg-meter were 0-0.06 mg/cm^3, while the green zone has a content of 0-0.01 mg/cm^3 mercury. The yellow zone has a content of 0.01-0.02 mg/cm^3, and the orange zone has a content of 0.021-0.04 mg/cm^3. The red zone has a content of mercury around 0.041-0.06 mg/cm^3 (Figure 5).

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Figure 4. Measurement of mercury in soil by using Hg-meter.

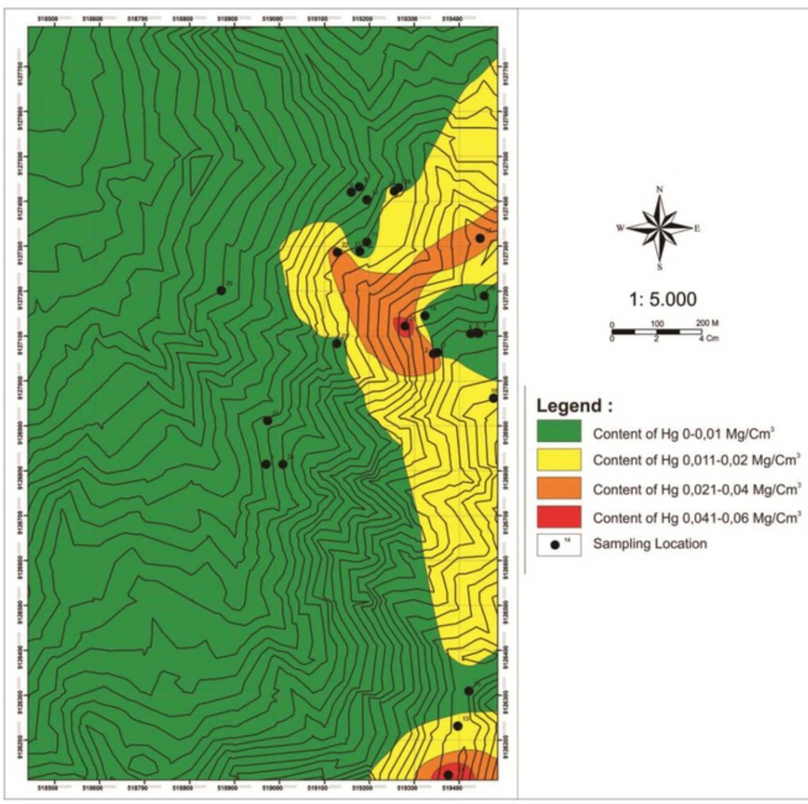

Figure 5. The distribution mercury in Mesu area.

The highest distributing of Hg was at site 20 and 14. Site 20 was a gold processing with high intensity was at residential locations (Figure 6).

Figure 6. Gold processing that was in the human settlement and mercury measurement using Hg-meter in mine waste

Site 14 was the site of mining and mercury measurements done at the rocks undergo advanced argillic alteration. It was to know that the alteration rocks has naturally contains mercury. The results of mercury measurements in alteration rocks and soils were presented in Table 1.

Table 1. Measurement mercury concentration on altered rocks and soil

Sample Name	**Hg (mg/cm^3)**	**pH**	**Sample Name**	**Hg (mg/cm^3)**	**pH**
80	0.001	7.0	A 14	0.060	5.2
81	0.021	5.0	A 15	0.000	0.0
82	0.001	4.4	A 16	0.013	5.8
83	0.006	4.6	85	0.036	4.5
84	0.001	6.0	86	0.003	5.0
A 6	0.000	5.0	87	0.002	6.6
A 7	0.001	4.8	88	0.044	5.2
A 8	0.002	6.4	89	0.001	5.8
A 9	0.001	4.8	90	0.036	4.4
A 10	0.002	6.6	91	0.001	4.8
A 11	0.001	5.7	92	0.004	5.7
A 12	0.019	6.8	93	0.003	6.2
A 12 b	0.001	5.0	94	0.001	5.2
A 13	0.012	5.8	95	0.006	5.6
A 14	0.060	5.2	96	0.000	4.0

Results analysis of Hg content in plants was the range of 0.0041-0.0168%. Samples were taken of plant that was consumed by the community in this area. The results of this analysis shows that the plants were consumed by people have contained Hg quite high. For example, mercury levels contained by kale leaves and bay leaves containing 0.0168% mercury (Figure 7).

(a) (b)

Figure 7. Type of plants containing 0.0168% mercury concentrations of plant; (a) kale leave and (b) bay leave

4. Conclusion

Hg element derived from the gold processing using the amalgamation process and also formed naturally from the alteration rocks. The spread of Hg was controlled by the topography, bedrock and water flow. Mercury in the soil was already polluting the local people as well as animals and plants.

5. Acknowledgments

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