International Journal of Engineering and Science Applications
ISSN 2406-9833

IJESCA

Geochemical Soil Survey for Au Exploration in the Uluwai Village in Toraja, South Sulawesi

A. Maulana[1], Musri[2] and L Huan[3]
[1]Department of Geology Engineering, Hasanuddin University, Makassar 90245, Indonesia
[2]School of Geoscience and Info-physics, Central South University, Chansa, 410083, China.
email: adi-maulana@unhas.ac.id

ABSTRACT

A Geochemical soil survey was carried out over an area of approximately 25 km2 in Uluwai Village, Toraja Regency, South Sulawesi in order to select the promising areas for gold occurrences. The survey area is situated in the southern part of Toraja near the border with Enrekang Regency, about 340 km north of Makassar, the capital of South Sulawesi Province. The survey area is underlain within the Latimojong Complex, composed of metasedimentary sequence (upper Cretaceous) surrounded by Tertiary sedimentary rocks (Eocene to Miocene) of Toraja and Makale Formation. During the detailed survey, a total of 40 soil samples were taken using the grid pattern of 100 m by 50m. All samples were analyzed for Au, Ag, As and other metals (Cu, Zn, Bi, Co, Mo, Pb and U) using Atomic Absorption Spectrometer method after aqua regia digestion. The result shows that three Au and As anomalous sample were detected and the areas show similar directional patterns with the NW direction of the main regional fractures. From the detailed soil survey, two Au anomalous areas were finally proposed as promising prospects for the next Au exploration stage (geophysical investigation and drilling process).

Keywords: geochemistry; soil sampling; gold; Uluwai; South Sulawesi

1. INTRODUCTION

History of gold and ore mineral exploration in South Sulawesi Province has been dated since colonialization era according to formal report [1;2]. In 1980`s a group of local people tried to dig some holes near Toraja and Enrekang border and find some quartz veins contain some gold. Local government office staff also reported the placer gold occurrence in Malua River in Enrekang which originated from Uluwai area in the north. Previous workers have reported a report on the gold and base metal occurrence in Uluwai area, South Sulawesi using geological mapping and stream sediment sampling method [3;4]. The two reports have indicated the prospect of gold and other economic metal occurrence in the region and proposed recommended areas to be intensively studied. In order to shed light on spatial distribution of the gold and other economic metals, geochemical soil sampling was conducted in the some recommended areas. The objective of this study is to investigate the use of soil sampling in mainly weathered surface terrain at Uluwai area to find the promising area for gold mineralization.

A. Regional Geology

As shown in Fig. 1, Sulawesi Island can be geologically divided into four tectonic provinces; namely Northern Sulawesi, Western Sulawesi, Eastern Sulawesi dan Banggai –Sula Province. The Eastern Sulawesi can be further divided into three parts; North-West, Central West, and South West. The research area is located in the southern

portion of the Central West (SW) part. Based on regional geology report [4], the area is a complex of terranes that formed by three major Neogene, N-S trending, tectonic domains consisting of (from west to east): (1) an active fold belt in which Pliocene and Miocene volcanogenic rocks are involved in west-vergent thrusting extending up to the Makassar Strait; (2) a central belt which composed of a submarine Miocene volcano-plutonic arc that has been deformed and overlies an Oligocene-Eocene clastic and carbonate platform with Latimojong Mesozoic Basement metamorphic and sedimentary rocks thrust over its eastern margin on west-vergent faults; and (3) an accreted Cretaceous-Paleogene ophiolite which called as Lamasi Complex found between the Latimojong Basement Complex and Bone Bay.

The local geology of Uluwai area is dominantly composed of basement rocks and controlled by both regional and local structure. The western major of this block is represented by an easterly dipping thrust, whereas the eastern margin is defined by a major basement structure [6]. The main lithologic unit overlying the Uluwai prospect is the Late Cretaceous Latimojong Formation, which consists of phyllites, slates, basic to intermediate volcanic, limestone, and schists representing a platform and/or fore arc trough, flysch sequence. This formational unit overlies basement metamorphic rocks complex composed of a thick sedimentary package that has been subjected to a low-grade, green schist facies metamorphism. The rocks are generally light-dark grayish-green, foliated, typically fine-grained with protolith probably ranging from mudstone to siltstone to fine-grained sandstone.

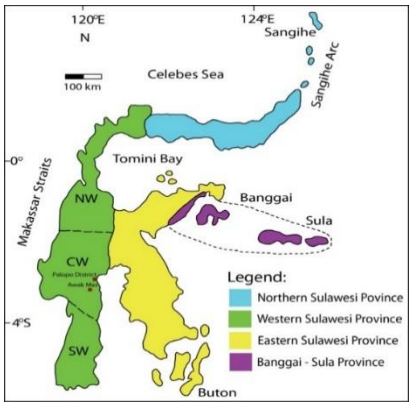

Fig. 1 - Tectonic province divison of Sulawesi Island [1].

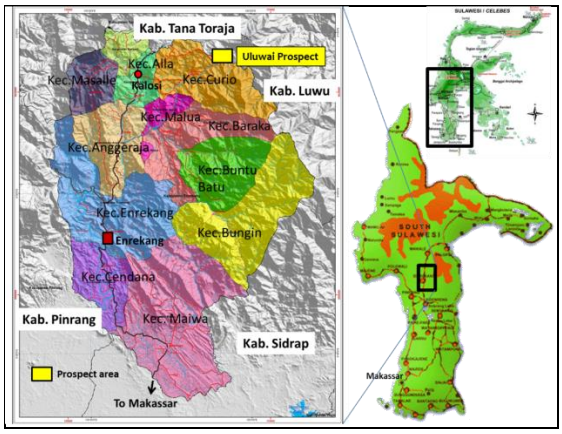

Fig. 2 - Location map of Uluwai area.

2. METHODOLOGY

Soil samples are generally collected on a rectangular pattern, generally with closer spacing of sample sites along more widely spaced sample lines. The optimum spacing between sampling lines and sample sites depend on the topographic condition of the surveyed area. In the field, we take at least 2 samples from the anomaly on a sampling line. Generally, sample spacing for soil sampling are defined as 100m by 100m or 100m by 50m. However, in particular place the spacing dimension is relatively dense. For detailed anomaly detection samples are commonly collected at 100m intervals on 100m spaced lines with infill sampling down to 50m on 100m spaced lines. Soil sample collection in the field activities can be seen in Fig. 3.

Traditionally, soil geochemical surveys have targeted the finer fraction (<120 μm), transition between clay-rich B horizon and C

horizon since cations present will be largely adsorbed onto clays. This will be influenced by the type of clays in the soil, for example kaolinite and illite have very low cation exchange capacities, whereas smectites have high cation exchange capacities. In the deeply weathered regolith of tropical region like Uluwai area, most of the cations are probably hosted in iron and manganese oxides/oxyhydroxides, carbonates and residual rock and quartz grains (as particles of other host minerals). The coarser fraction (up to 2-3 mm) will target these soil components and a number of studies have shown that the 0.1-2 mm fraction generally gives a stronger response for most target and pathfinder elements. The simplest option is to take a bulk sample of material less than 3 mm in size, which will include grains of lithic and Fe-rich lithic material and the finer clays and granular carbonate. The soil sampling campaign make use of hand auger to collect the samples. Sample collection activities are shown in Fig. 3.

All soil samples were sent to Interteks Laboratory in Jakarta for the analysis of Au , As and other metal such as (Cu, Zn, Bi, Co, Mo, Pb and U) using Atomic Absorption Spectrometer method after aqua regia digestion. All samples were dried in the sun and sieved to -10 mesh. After drying a t 1 0 5°C for 24 to 48 hours, they were disaggregated in a mortar and sieved for -80 mesh fraction. Samples were analyzed for Au by using Fire Assay Atomic Absorption Spectrophotometry after digestion of 10 g samples with aqua regia. The analytical detection limit is 1 ppm. The samples containing over 0.5 ppm Au were analyzed using air acetylene flame AAS, and the analytical detection limit is 20 ppb.

Fig. 3. Soil sampling collection activity in the field. Sample of soil were taken using hand auger.

3. Result And Discussion

Soil sampling programs was classified as shallow soil samples as the depth is 10-100 cm. The near surface layer (< 50 cm) of many of soil samples has a large component of dust or has been partly eroded and disturbed by agricultural activities. The near-surface zone of the soil may also contain ferruginous lag fragments which retain a geochemical signature from their source. The sample profile in the Uluwai Village project is generally made up of:

A-horizon: generally called as “Dark Soil” in which organic-rich layer, composed of leaf litter, plant roots and dark brown or black soil, sand or gravels. Approximate thickness is from 0 to 30cm.

B-horizon: generally called as “Clay” and considered as transitional zone, mainly composed of clay-rich layer with no primary textures and contain low organic materials. Some bedrock fragments (angular to rounded) maybe present but can be uncertain of weather it is in situ or locally transported. Approximate thickness is from 10 to 100cm [~70cm in average].

C-horizon: generally called as “Clay rock”, characterized by primary textures evident in clay or weathered rock. Moderately to highly weathered bedrock (primarily as clay) ranging to

near fresh rock is found. Total depth to this horizon ranges from 40 to 170 cm (average 95cm depth).

Following the previous recommendation, the soil sampling method was undertaken over an area of 25 km^2. A total of 140 soil samples were collected using the grid patterns of 200 m by 100 m. From the geochemical survey for Au and As, an area of 10 km^2 was selected for the detailed geochemical survey. A total of 40 soil samples were taken using the grid patterns of 100 m x 50 m (Fig. 4). We sent 10 soil samples for preliminary study of Au anomaly from the survey area. The number of soil samples containing over the detection limit for Au is 3. The number of soil samples having less than 1 ppb Au (analytical detection limit) is 7 among the total of 10 soil samples which were collected during the detailed surveys. It is shown from the result that three sample contain significant Au content. Sample B-08 located in the central portion of concession area has 1.07 ppm of Au whereas sample B-09, approximately located 200 meter east of B-08 contain 0.172 ppm Au and sample B-17, located in the southeastern part of B-08 and B-09, contain 0.533 Au. It is very interesting to note that these three samples show similar directional patterns with the NW direction of the main regional fractures [7]. Fig. 5 showed the proposed area for further study stage in order to evaluate the vertical distribution of the gold and other economic metals.

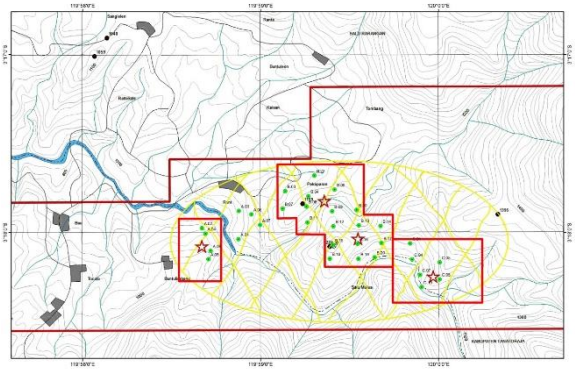

Fig. 4. Soil sampling distribution map

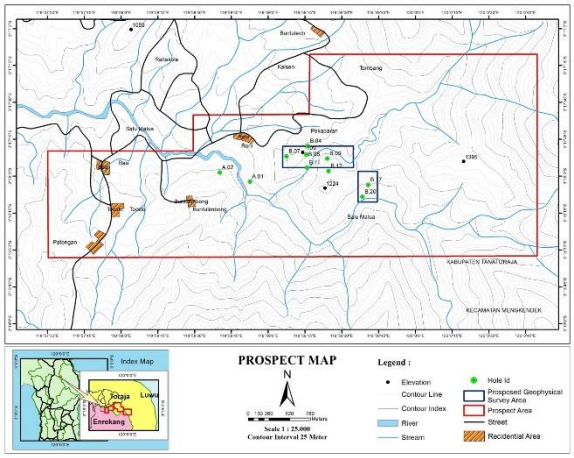

Fig. 5. Proposed area for further exploration stage (geophysical survey and drilling program)

4. CONCLUSIONS

The results from soil geochemistry indicate that the Au anomaly occur in Project area from Horizon C, especially in the hole B-08, B-09 and B-17. The Au content ranges from 0.53 – 1.17 and to some extent correspond with other element especially Cu and Zn. The Au anomaly is mostly concentrated in the central part of the surveyed area, especially in B-08. It is very interesting to note that these three samples show similar directional patterns with the NW direction of the main regional fractures.

ACKNOWLEDGEMENT

This research is supported by *Penelitian Dasar 2019 Kemenristekdikti* under contract No. 9/E1/KP.PTNBH/2019. We would like to extend our deep gratitude to Ikhwan Abbas for drafting the map and local people of Uluwai for escorting us during the survey.

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