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International Journal of Engineering and Science Applications
ISSN: 2406-9833
IJEScA

Stream Sediment Geochemical Study for gold target in Malua River Prospect, Enrekang, South Sulawesi

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ABSTRACT

In order to get a better insight into gold occurrence in the western flank of Latimojong Mountain, a field work study campaign focusing on stream sediment sampling activity was completed along Malua River or locally called as Salu (River) Malua in Curio and Malua Area, Enrekang, South Sulawesi. Stream sediment study is aimed to investigate the possible sources of anomalous element particularly gold concentration within the studied area. In addition, the project was to delineate ground within the study area that shows economic potential for gold mineralization. A total of 32 stream sediments samples were collected during the field work and 20 samples were sent to laboratory and analyzed for gold and other base metal elements (Cu, Pb, Zn, Ag, As, Sb, Mo). Au was analysed using Fire Assay (FA) method, whereas Cu, Pb, Zn and Ag method were analysed using Atomic Absorption Spectrometry (AAS) method and As, Sb and Mo were analysed using X-ray fluorescence (XRF) method. Based on sample distribution and the occurrence of gold, a threshold of 10 ppb Au is considered. Two samples collected from LP20 and LP32 returned gold value in threshold range (7 – 14 ppb). Other sample show lower value (less than 0.5 ppb). The result suggests a single population density attributed to the metasedimentary rocks in the Latimojong Formation (eastern to northeastern part of the concession). Two anomalous target zones namely Buntulimbong and Buntukaok and tentatively combined as Patongan anomaly in the northeastern part of the concession have been delineated for further work. Interpretation of the result suggests that mineralization appears to be associated with lithological boundary between Toraja Formation and Latimojong Formation. The result of the survey indicates that Curio-Malua concession has good exploration potential and significant potential for lode gold mineralization within a favorable geologic terrain.

Keywords: Stream Sediments, Gold, Malua River, South Sulawesi

1. INTRODUCTION

Sulawesi Island has been well known for its unique and complex geology [1] [2]. This island shows evidence of plate convergence involving subduction of oceanic plate, continent-continent collision, arc-continent collision, sediment accretion and emplacement of ophiolite and exhumation of high-pressure metamorphic rocks [2]. The geological complexity of the island has produced some contrasting tectonic provinces and ore minerals deposit as shown in Fig. 1. One of the significant ore minerals found in this island is gold deposit which is mainly in the form of hydrothermal deposit such as epithermal and porphyry deposit. However, some metamorphic- and sedimentary-hosted gold deposit occurrences have been reported from some areas [3]. In south Sulawesi, gold deposits have been found in Awak Mas region, Luwu Regency in the eastern flank of Latimojong Mountain (Fig. 1).

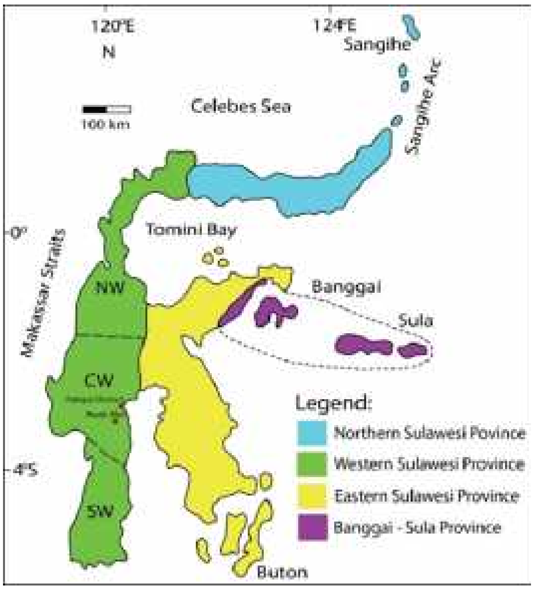

Fig 1. Tectonic province of Sulawesi Island [3] (van Leeuwen & Pieter, 2012)

The deposit area is dominated by the late Cretaceous Latimojong Formation consisting metasedimentary and low grade metamorphic rock. There is no other gold deposit reported in surrounding areas despite the width distribution of Latimojong Formation. Nevertheless, small scale mining activities have found gold in small amount using traditional method such as panning in the western flank of the Latimojong Mountain, particularly in Salu Malua area in Enrekang Regency. In order to get a better insight into gold occurrence in the western flank of Latimojong Mountain, intensive geological study should be conducted. One of the early stages of gold exploration is stream sediment geochemistry survey. This report is to investigate the possible sources of anomalous element particularly gold concentration in Salu Malua district. Stream sediment sampling campaign was conducted along Malua River or locally called as Salu (River) Malua.

2. METODOLOGY

Stream sediment sampling was carried out to cover approximately 20 km following the river flow from northeastern to southwest (Fig. 2). The main objective of this program was to identify gold-anomalous area for further work. The sampling was done at density of 2 samples per square kilometer. A total of 32 stream sediment samples were collected and 20 prospective samples were chosen to be analyzed.

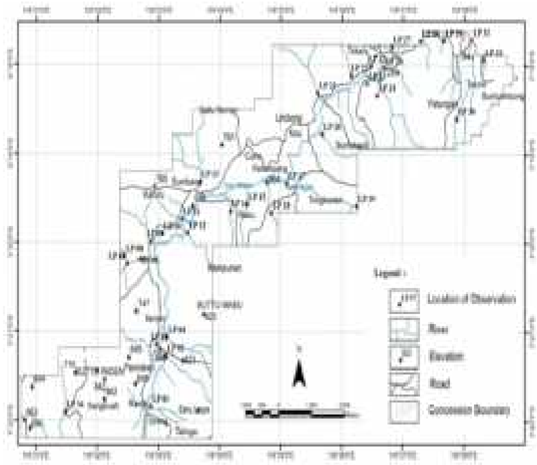

Fig 2. Stream sediment sample location

Sampling station were located at first order (unbranched) and second-order (below the junction of two first-order) stream as shown on BAKOSURTANAL topographic map at a scale of 1:50.000 (Fig.4). Stream sediment samples were collected using conventional method from mostly first order and 2nd order streams. Sample of the most organic-free sediment available were collected from channels and active streams.

A series of stream sediment sample collection activity are shown in Fig. 3. The samples are composite of material collected across the full width of the channel or, where necessary, along an active bar deposit. Areas where the sediment was composed predominantly of coarse-grained material were avoided to insure that sufficient fine-grained and a meaningful amount of material would be contained in the sample. Areas with well-sorted, fine-grained sediment commonly tend to have natural concentration of low-density quartzo-feldsphatic minerals and would not contain material from mineral deposits located upstream; these areas were also avoided. Fine-grained, heavy minerals tend to occur with coarser-grained minerals and rock fragments because of their similar behavior during deposition. Therefore, poorly sorted, coarse-grained, sand- to silt-size material was collected when available. All material was passed through an 8-mesh stainless steel screen on site to remove pebbles and cobbles before further processing. Wet samples were air dried, then sieve through
80-mesh stainless steel screen.

Each sample of about 2 kg constituted composite from at least four sites across the stream bed, 10-15m on either side of the sampling point. Fine silt sediments were collected as much as possible, avoiding the organic material. Care was also taken to collect samples from up a tributary above the point of influence of water flow from the main stream.

Artificial traps (boulders, waterfalls & trees) were completely avoided as the exercise intends to avoid any coarse or nugget gold. However, advantage is taken of natural depositional environment where the energy of the stream is greatly reduced or zero like meanders where very fine particles are naturally deposited as a result of very low velocity. The samples were kept in a well labelled polythene sample bags for easy and safe transportation. The sample sites were immediately indicated on the field map and the site on the field flagged with a red flag bearing the sample number. Garmin GPSMap 60CSx was used to assist in locating the sample points.

All the samples were sent to Intertek laboratory at Jakarta. Prior to dispatch to the laboratory, all samples were checked to ensure that labels and seals are intact to avoid contamination and tampering. Care was also taken during sampling and handling to avoid the introduction of any foreign material that could give bias results. Au was analysed using Fire Assay (FA) method, whereas Cu, Pb, Zn and Ag method were analysed using Atomic Absorption Spectrometry (AAS) method and As, Sb and Mo were analysed using X-ray fluorescence (XRF) method.

Fig 3. Stream sediment sample collection activity

3. Result And Discussion

A. Distric Geology

District geology of the research areas is predominantly composed of Eocene-Oligocene shale-sandstone from Toraja Formation and pre-Tertiary metasedimentary rock of Latimojong Formation in the northeastern part. District geology is adopted from some previous workers [1], [4], [5] (and regional geology map [6] (Fig. 4).

Malua River district is situated in the western part of the Latimojong Complex. To the west it is separated from the Eocene Toraja Formation by an easterly dipping thrust, whereas the eastern margin is defined by a major basement structure (mélange) against which the Lamasi Ophiolite Complex is juxtaposed.

The Latimojong Complex comprises the weakly metamorphosed Latimojong Formation, an Upper Cretaceous turbiditic flysch sequence with intercalations of andesitic volcanics and limestone, and low-higher grade metamorphic basement rocks, including phyllite, amphibolite and other schist types, serpentinite and metadolerite, showing in places highly contorted foliation (Fig. 5). The metamorphic units are intruded by plugs and stocks of diorite, monzonite and syenite, probably belonging to the Neogene high - K calc - alkaline to alkaline suites. It is the metasedimentary sequences of Latimojong Formation which contains some mineralized quartz vein and alteration, and therefore the focus of our exploration.

The Toraja Formation is the basal unit overlying the basement of Latimojong Formation, and it is generally described as clastic, non-marine to marginal marine sedimentary sequences which was deposited in fluvio-deltaic environment. The Makale Formation is divided into limestone lithofacies and a clastic lithofacies. This formation forms a karst topography in the limestone lithofacies with the thickness of about 500 m. Limestone outcrops occur as massive, intensely karsted, isolated pillar, lensoid shaped bodies and broad platform. The limestone is composed of skeletal fragments of foraminifera with smaller amounts of coralline algae, coral bivalves, echinoderm plate, rare ostracods, and large foraminifera.

The Enrekang Volcanic Series developed from a magmatic arc (volcano-plutonic complex) which was established during the middle to late Miocene [1]. It is best characterized as a thick well-bedded volcanic/volcanoclastic deposit comprised of interbedded tuffs, andesites ash flows, tuffs, lapilli tuffs, tuff breccias, tuffaceous sandstone and mudstones and siliciclastic turbidites.

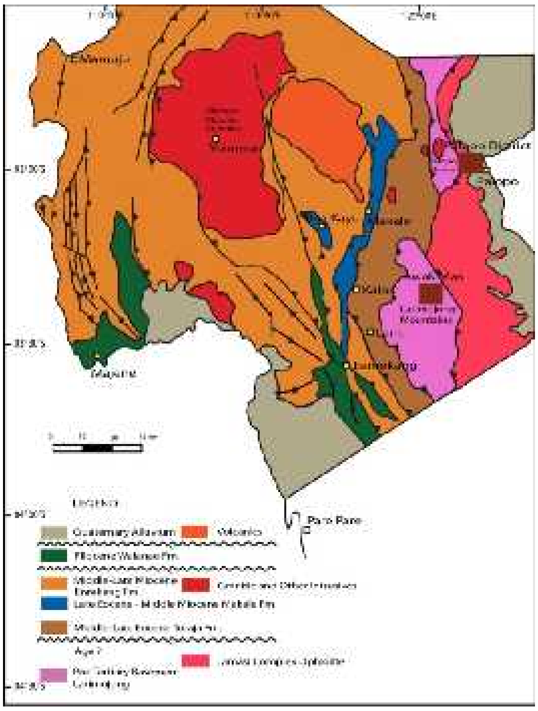

Fig 4. Local Geology of research area (shown by yellow box) [1]. Note the close proximity to Awak Mas Gold Deposit (shown by red box) in the eastern part.

B. ***Geochemical Results***

Result of geochemical analyses from stream sediment samples are It is interesting to note that the anomalies samples are from two areas which attach to the border of Latimojong Formation (Fig. 6). The mineralization suggests a general NE - SW mineralised trends. Individual values include 0.014 Au ppm (equal to 14 ppb) and 0.007 Au ppm (equal to 7 ppb). The anomaly distribution also suggests a single population density attributed to the main rock type (Latimojong metasediments) on the concession area.

Fig 5. Phyllite with quartz vein found in lower part of Latimojong Formation (up). Red mudstone showing slaty cleavage of Upper Toraja Formation (down).

This is expected as gold have been found within Latimojong metasedimen in Awak Mas deposit in the eastern flank of Latimojong Mountain which is still in the same geological terrain with the concession as seen in Fig. 2. given in Table 1. Based on the sample results, coupled with the geological condition gave the threshold value of about 10 Au ppb. Statistics of results for the 32-stream sediment sample analyzed indicate that 2 of the samples (LP-20 and LP-32) are in the range of the threshold value of 10 Au ppb whereas other samples show insignificant value of gold.

Table 1. Geochemical result of stream sediment sample

Sample No	Au (ppm)	Cu (%)	Pb (%)	Zn (%)	Ag (ppm)	As (ppm)	Sb (ppm)	Mo (ppm)
Method	FA50	GA30	GA30	GA30	GA30	XR01	XR01	XR01
LP-01	<0.005	0.01	<0.01	0.01	<5	5	<1	1
LP-02	<0.005	<0.01	<0.01	0.01	<5	7	<1	<1
LP-03	<0.005	0.01	<0.01	0.01	<5	4	<1	1
LP-05	<0.005	0.01	<0.01	0.01	<5	<1	<1	<1
LP-09	<0.005	<0.01	<0.01	<0.01	<5	3	1	<1
LP-12	<0.005	<0.01	<0.01	0.01	<5	4	<1	<1
LP-13	<0.005	<0.01	<0.01	<0.01	<5	4	1	<1
LP-14	<0.005	0.01	<0.01	0.01	<5	3	1	<1
LP-15	<0.005	<0.01	<0.01	<0.01	<5	4	2	<1
LP-16	<0.005	<0.01	<0.01	<0.01	<5	2	1	<1
LP-17	<0.005	<0.01	<0.01	0.01	<5	8	1	<1
LP-18	<0.005	<0.01	<0.01	0.01	<5	6	1	<1
LP-19	<0.005	<0.01	<0.01	0.01	<5	8	<1	<1
LP-20	0.014	<0.01	<0.01	0.01	<5	7	2	1
LP-22	<0.005	<0.01	<0.01	0.01	<5	3	2	1
LP-24	<0.005	<0.01	<0.01	0.01	<5	5	2	<1
LP-27	<0.005	<0.01	<0.01	<0.01	<5	4	<1	<1
LP-28	<0.005	0.01	<0.01	0.01	<5	4	2	1
LP-29	<0.005	<0.01	<0.01	<0.01	<5	7	1	<1
LP-30	<0.005	<0.01	<0.01	0.01	<5	13	1	<1
LP-31	<0.005	<0.01	<0.01	<0.01	<5	6	1	1
LP-32	0.007	<0.01	<0.01	<0.01	<5	14	<1	1

The stream sediment survey conducted on the concession delineated two anomalous target zones (Fig. 6). These are:

- Buntulimbong anomaly
- Buntukaok anomaly

The above anomalies are within the border between upper part of Toraja red mudstone and metasedimentary Latimojong Formation.

For the purpose of discussing anomalous area, the concession area is subdivided into Buntulimbong and Buntukaok anomalies. Due to their close proximity, these two anomalies can be tentatively combined as Patongan anomaly as seen in Fig. 6.

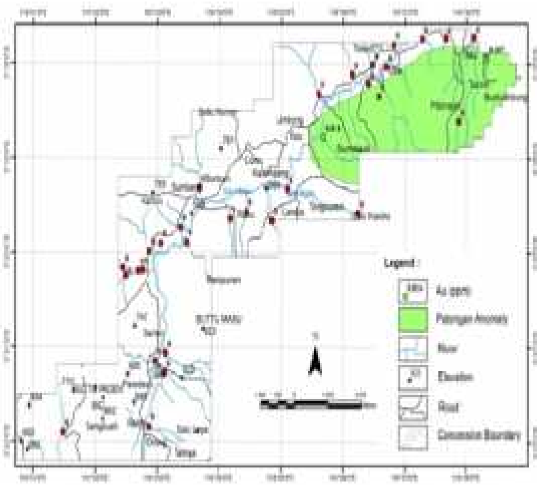

Fig 6. Gold (Au) Anomalous zone distribution map

1. Buntulimbong Creek: Consisting of interlayered sandstone and siltstone from Toraja Formation and boulder of phyllite, quartzite from Latimojong Formation. The stream flowing from Latimojong Mountain in the east.
2. Buntukaok Creek: Consists predominantly of red mudstone in the lower part, phyllite, quartzite and small portion of metasedimentary rocks. This area is mostly bounded by the lithology boundary to the northeast.

4. CONCLUSIONS

This recent works has identified new area of mineralization peripheral to known resources at the Malua River prospect. We recommend continuing the detail geological mapping and soil geochemistry study which focus on the two anomalies. The stream sediment survey conducted on the concession delineated two anomalous target zones: 1)

Buntulimbong anomaly and 2) Buntukaok anomaly.

Interpretation of the result suggests that mineralization appears to be associated with lithological boundary between Toraja Formation and Latimojong Formation. The result of the survey indicates that Curio-Malua concession has good exploration potential and significant potential for lode gold mineralization within a favorable geologic terrain.

ACKNOWLEDGEMENTS

This study is a part of Research Grant from International Collaboration Research and International Publication Scheme 2017 from KEMENRISTEKDIKTI. We would like to extend our gratitude to local people in Malua and Curio District, Enrekang for constant support during field work.

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