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Field Characteristic of Metamorphic-Hosted Gold Deposit in Sulawesi, Indonesia: An insight into Awak Mas Prospect, South Sulawesi

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ABSTRACT

Metamorphic-hosted gold deposit is found in Awak Mas, South Sulawesi. This area is characterized by mountainous topography in the western part and relatively flat area in the eastern part and consists of Pre-Tertiary, Tertiary and and Quaternary rocks. Some samples including host-rock, basement and quartz vein were collected and observed during 4 days field work. Mineralization is recognized by the occurrence of pyrite and irregular body of silicified breccia vein. Two main styles of mineralization consists of 1) broad and shallow-dipping zones of sheeted and stockwork quartz veining and associated alteration that conform to the shear fabric, especially within the dark, graphitic mudstones; 2) steeper dipping zones of quartz veining and breccias associated with high-angle faults cutting both the flyschoid cover sequence and basement metamorphic rocks. Gold mineralization is considered as mesothermal deposit which is characterized by albite-pyrite-silica-carbonate alteration overprinted the ductile fabric associated with deformation and metamorphism. The gold is commonly hosted within the flysch sequence and associated with abundant quartz veining and silica albite-pyrite alteration. However, the association of gold and quartz is not ubiquitous and some vein zones are locally barren of mineralization.

Keywords: *Metamorphic-hosted, gold deposit, mesothermal, Sulawesi, Awak Mas*

1. INTRODUCTION

Sulawesi Island is located in the central part of Indonesian Archipelago which has a relatively complex geological setting [1], [2]. One of the geological complexities of this island is the pattern of metallogenic provinces [3], (Fig. 1). Sulawesi arc has been known as a mineralized metallogenic province with some gold mineralization in a variety of porphyry, epithermal as well as metamorphic-hosted style [4], [5], [6], [7]. Many works have been done in gold occurrence in porphyry and epithermal system from this island [5], [7] but study on metamorphic-hosted gold deposit is still lacking. As gold price and demand has increased in the past seven years while production has decreased, study on the gold occurrences in the metamorphic-hosted in this island is significant.

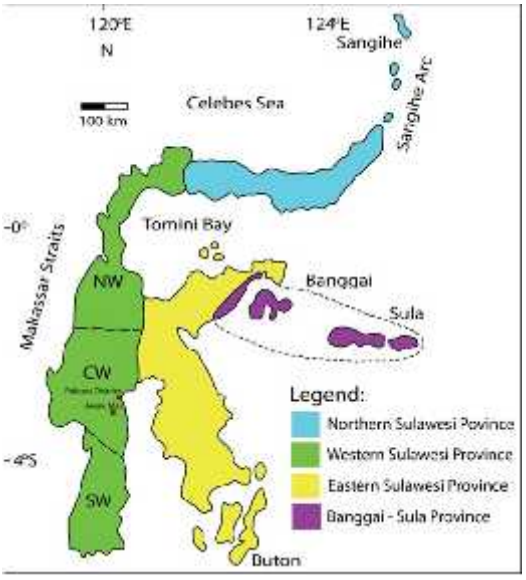

Fig 1. Division of Geologic Province in Sulawesi [9].

Gold occurrence in metamorphic terrain has been reported from many areas and discussion on the process responsible for gold formation is still in a debate [8]. In Sulawesi, metamorphic-gold deposit occurs in Awak Mas in South Sulawesi [3]. Report on the gold occurrence this area is very limited and only restricted to the general geological report. In this paper, we will overview the characteristic of the metamorphic-hosted gold deposit in Sulawesi, particularly from Awak Mas prospect based on our field work observation. Gold mineralization is distinctly mesothermal in character, atypical of the more ubiquitous low temperature or epithermal precious metal mineralization within many island arc environments in Indonesia.

A. Regional Geology

A.1 Research Location Map

The Awak Mas area is located in South Sulawesi Geologic Province. This area is characterized by mountainous topography in the western part and relatively flat area in the eastern part consisting of Pre-Tertiary, Tertiary and and Quaternary rocks (Fig, 2.a). The geology of Awak Mas area (Fig. 2.b) is dominated by the late Cretaceous Latimojong Formation, consisting of phyllites, slates, basic to intermediate volcanics, limestone and schist representing a platform and/or fore arc trough flysch sequence. The Latimojong Formation overlies basement metamorphic rocks dominated by phyllites and slates. Both sequences have been intruded by late-stage plugs and stocks of diorite, monzonite and syenite. To the east of the metamorphic block, basic intermediate intrusives, pyroclastics and volcanogenic sediments comprising the Mesozoic Lamas Ophiolite Complex appears to have been obducted into a position effectively overlying the younger flyschoid sequence and basement metamorphics during continental accretion. Figure 1 details the structural trends that

occur on and in the immediate vicinity of the Awak Mas gold deposit.

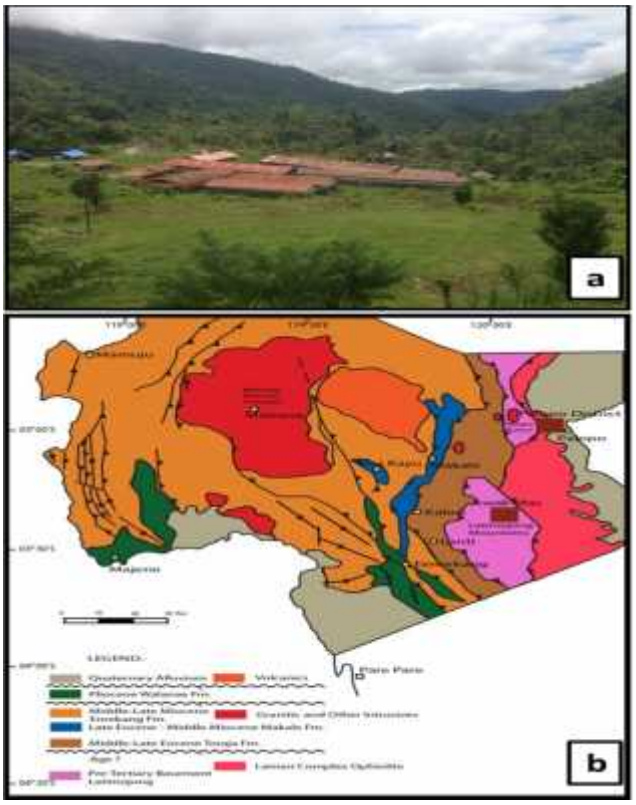

Fig 2 a. Morphology of Awak Mas deposit showing mountainous topographic in the western part and relatively flat area in the eastern part; 2b. Regional Geology of Awak Mas area.

2. METHOD

Field work campaign was conducted for 4 days to observe and take some samples including host-rock, basement, quartz vein and mineralization. In order to obtain a better understanding on the mineralization style, core observation was also conducted in some core drilling samples.

3. RESULT AND DISCUSSION

A. Mineralization

Mineralization is recognized by the occurrence of pyrite and irregular body of silicified breccia vein (Fig. 3a). The gold mineralization in Awak Mas is predominantly hosted within the Upper Cretaceous flysch sequence known as Latimojong Formation which commonly associated with abundant quartz veining and accompanied by albite-pyrite-quartz-carbonate alteration which overprints ductile fabrics (Fig 3b).

Mineralization is preferentially localized in the dark graphitic mudstone with minor amount in the green mudstone, especially when these rocks are tectonically interleaved with the dark mudstone. It is also found in the basement schist associated with shear zones in the ophiolitic sequences.

Two main styles of mineralization are present. The first represents broad, shallow-dipping zones of sheeted and stockwork quartz veining and associated alteration that conform to the shear fabric, especially within

the dark, graphitic mudstones (Fig 4a). The other style consists of steeper dipping zones of quartz veining and breccias associated with high-angle faults cutting both the flyschoid cover sequence and basement metamorphics (Fig. 4b). Late-stage, north-northeast trending normal faults locally disrupt or offset mineralization. A surface layer of consolidated scree and colluvium averaging 3 m to 4 m (maximum 15 m) in thickness veneers the deposit. The base of weak oxidation within the mineralized sequence typically is within 20 m of surface.

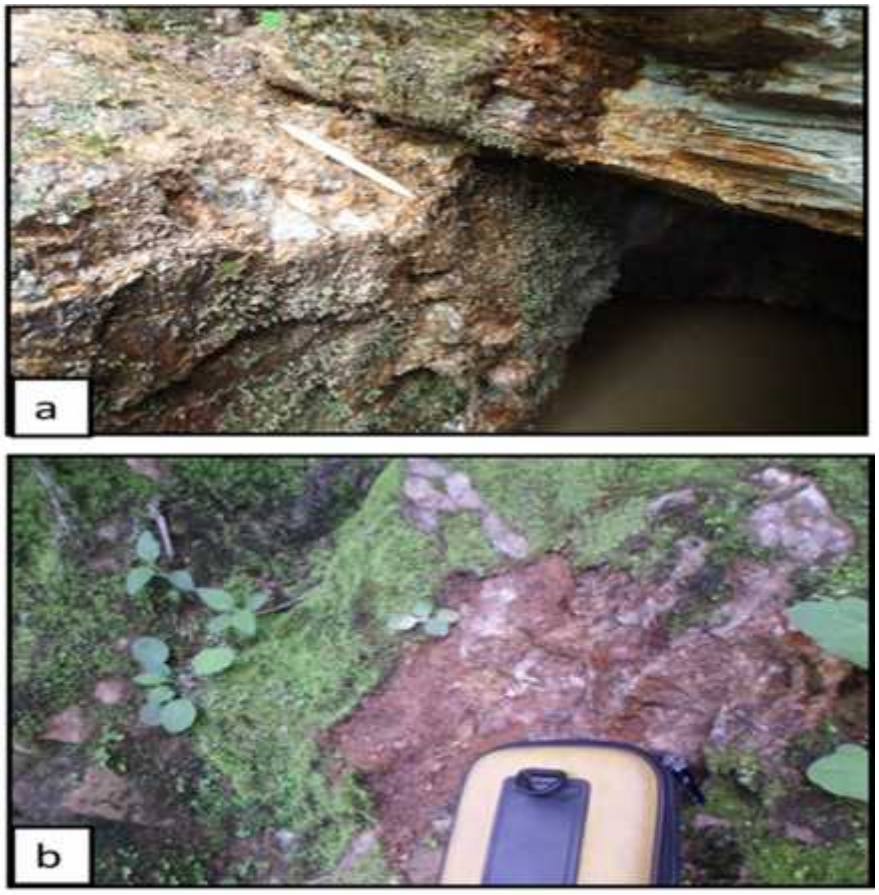

Fig. 3a. Pyrite and other sulfide occurrence as an indication of mineralization; 3b. Typical quartz vein within albite-pyrite-quartz-carbonate rocks in Awak Mas.

Fig. 4a. Shallow-dipping zones of sheeted and stockwork quartz veining; 4b. Steeper dipping zones of quartz veining and breccias associated with high-angle faults

B. Gold Mineralization

Gold mineralization is distinctly mesothermal in character, atypical of the more ubiquitous low temperature or epithermal precious metal mineralization within many island arc environments in Indonesia. Gold is associated with sulphur-poor, sodic-rich fluids introduced at a relatively late stage in the tectonic history. Albite-pyrite-silica-carbonate alteration, which accompanies gold deposition, clearly overprints the ductile fabric associated with deformation and metamorphism in the older basement lithologies.

The majority of gold mineralization, including the Awak Mas deposit, is predominantly hosted within the flysch sequence, which typically dips at between 15° and 50°, generally towards the north. They are associated with abundant quartz veining and silica albite-pyrite alteration, however the association of gold and quartz is not ubiquitous, with some vein zones appearing to be locally barren of mineralization (Fig.5).

Fig. 5. Barren quartz vein in mudstone

4. CONCLUSION

1. Mineralization process in Awak Mas region is recognized by the occurrence of pyrite and irregular body of silicified breccia vein.
2. Two styles of mineralization occur in the studied area including: a) broad and shallow-dipping zones of sheeted and stockwork quartz veining and associated alteration that conform to the shear fabric, especially within the dark, graphitic mudstones; b) steeper dipping zones of quartz veining and breccias associated with high-angle faults cutting both the flyschoid cover sequence and basement metamorphic rocks.
3. The gold mineralization is classified as mesothermal deposit in which albite-pyrite-silica-carbonate alteration overprinted the ductile fabric with deformation and metamorphism.
4. The gold is commonly hosted within the flysch sequence and associated with abundant quartz veining and silica albite-pyrite alteration. However, some vein zones are locally barren of mineralization.

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