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AN ANALYSIS OF ALTERATION STRYLES ASSOCIATED WITH GOLD-COPPER MINERALISATION AT MAY CLAIMS, CHINHOYI-GURUVE GREENSTONE BELT.

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INTRODUCTION.

- Worldwide, giant gold deposits are hosted in shear-zones within greenstones belts, for example in the Abitibi Greenstone Belt in Canada and in the Yilgarn Craton in Australia (Campbell and Pitfield, 1994).
- Gold deposits in Zimbabwe generally stretches between Archean and Proterozoic eons, with various structural controls of mineralization (Campbell and Pitfield, 1994).
- The deposits can be broadly classified into stratiform and non-stratiform deposits, and may be found associated with base metals (Bartholomew, 1990).
- Native gold is sometimes found as dendritic filiform structures and as rounded nuggets.
- Gold also occur in reefs, veins, stockworks, replacement and impregnation lodes of gold-bearing sulphides, eluvial (rubble) and alluvial deposits in various lithologies (Wiles, 1957 and Warner, 1972).
- The Muriel Mine with its reef deposit, has been a competitive producer of gold with copper as a byproduct, and was rated as the 11^{th} gold producer in 1986 (Bartholomew, 1990).
- Copper comes from the associated sulfides which include pyrite, chalcopyrite and pyrrhotite.

INTRODUCTION CONTINUED.

- The May claims (study area) are owned by Muriel Mine, and are adjacent to Muriel Mine premises.
- Now there is an intended resuscitation of the abandoned ancient May Mine, but there is need to identify the orebody and delineate it owing to unavailability of the ancient exploration data for this area to aid in ore body interpretation.
- In this respect, this study focused on finding the spatial association of mineral alterations and the geological structures, with respect to Au-Cu mineralization hosted in the May claims for a further interpretive analysis.

LOCATION OF STUDY AREA.

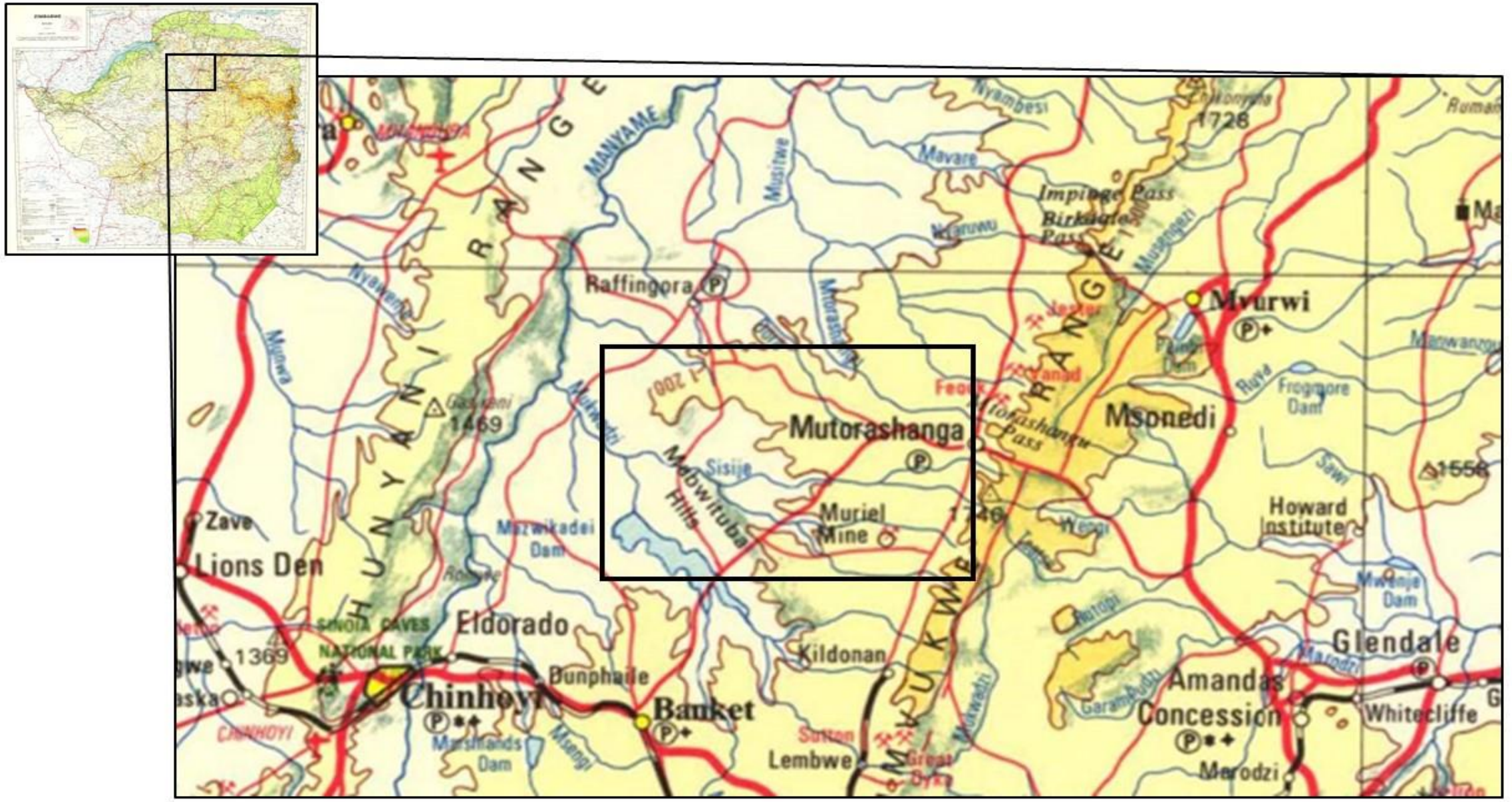


Figure 1: An insert from the relief map of Zimbabwe, showing the location of the study area, Mutorashanga. (Adopted from the relief map of Zimbabwe, 1984).

REGIONAL GEOLOGIC SETTING.

- The area of study is in the east-trending arm of the Chinhoyi-Guruve Greenstone Belt, which is truncated against the NNE-trending Great Dyke at its eastern extremity (Campbell and Pitfield, 1994).
- Potassic granites occur to the north along the greenstone contact whilst tonalitic gneisses are represented in the terrain to the south (Worst, 1960; Campbell and Pitfield, 1994).
- The Muriel Mine mineralization lies within the eastward extension or splay of the Eldorado Shear Zone, that affects the Chinhoyi Greenstone Belt and is associated with gold deposits, notably Golden Kopje, Eldorado, Ayrshire and Muriel (Blenkinsop *et al*. 1996).

REGIONAL GEOLOGIC SETTING CONTINUED.

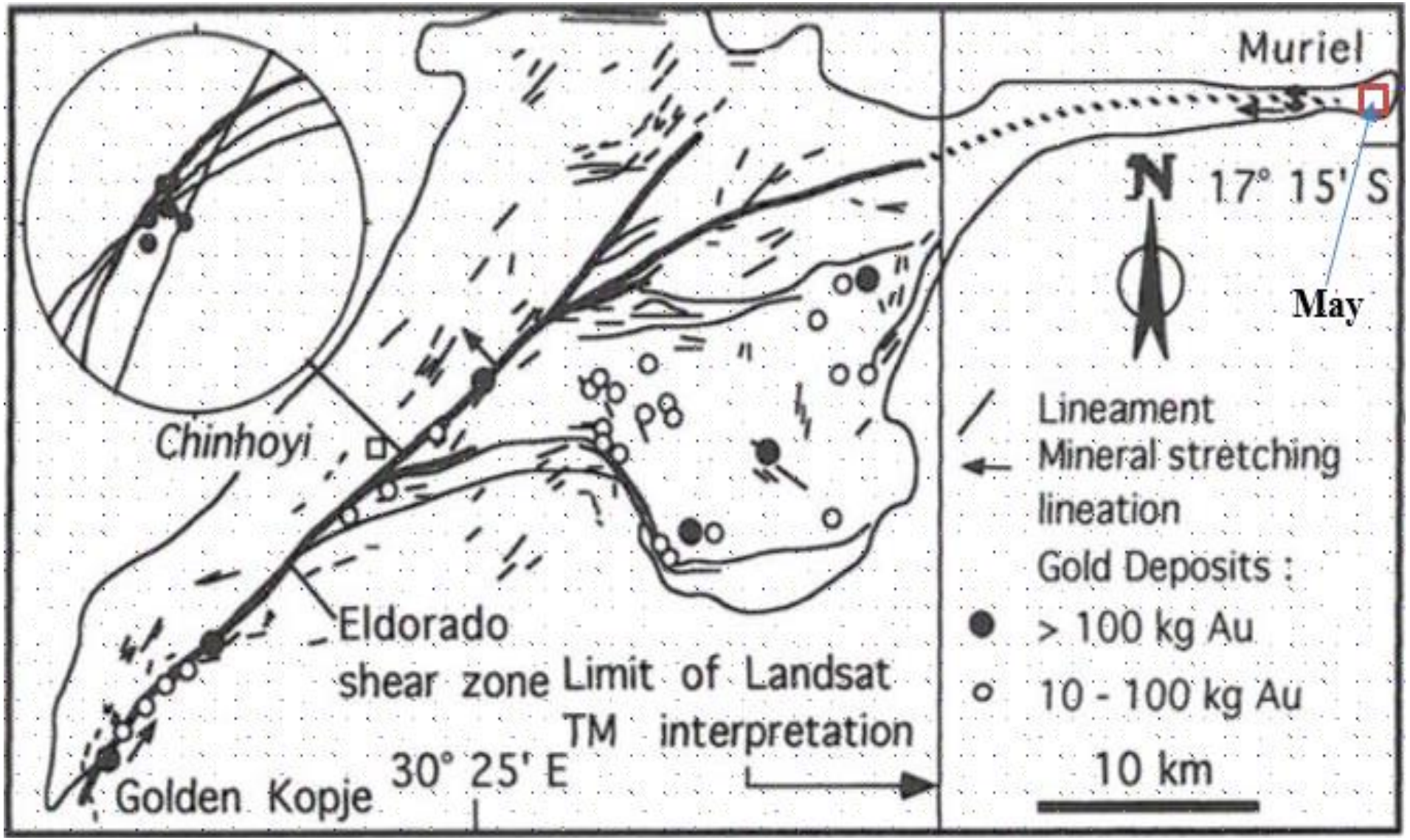


Figure 2: An outline of the southern part of Chinhoyi, showing associated gold deposits and the study area. Adopted from Blenkinsop *et al.*, 1996

LOCAL GEOLOGY.

- The Muriel Mine orebodies plunge steeply to the west on average at about 65 to 70°, and are hosted in hornblende schist, feldspar porphyry and sericite schist (Blenkinsop *et al*., 1996; Stagman, 1961).
- May claims area is dominated by meta-basalt, diorite, quartzite, feldspar porphyry, granites, serpentinites and ultra-mafic units (Kamutunga 2017).
- Most structures dip steeply to the north with local steep southerly dips. The May claims also showed a westerly plunge of structures.
- Sulphides include chalcopyrite, pyrrhotite and pyrite with magnetite present in certain sections. Veins present consist of milky to dark/smoky quartz.

PREVIOUS WORK DONE.

- Prior to the opening of Muriel, the only mine with any recorded production in this area was the May Mine, 3 kilometres to the east of Muriel Mine.
- This mine was pegged by the Scottish Mashonaland Gold Mining Company in 1914, and operated it up to 1916, and was thereafter judged unviable and more or less abandoned (Chamber of Mines, 1960).
- They milled 10 900 tonnes of ore which yielded 130 Kg of gold.
- Muriel Mine had been effectively owned and run by Lonrho's Coronation Syndicate up until the transfer to the present owners, Pan African Mining which took over in 1999.
- Approximately 33.612 tons of gold and 13.759 tons of Copper as a by-product have been produced from the mine since 1932.
- Now investigations are ongoing as to the feasibility of mining around the Cairngorm and May prospects located farther east towards the Great Dyke margin.

PROBLEM STATEMENT.

- Pan African Mining Private Limited-Muriel Mine intends to resume production at May Mine, but the information pertaining to any exploration done in these claims during those ancient times is unavailable (for use in interpretive analysis and orebody modelling).
- The absence of this critical data prompted this study since there is need to define the orebody and delineate it. Determining the mineralization style and extent are some of the key aspects that aid in orebody delineation.
- The intended study seeks to find the spatial alteration assemblages in association with gold-copper mineralization as at the adjacent Muriel Mine to aid interpretations.

JUSTIFICATION.

- Citing the current investigations on the feasibility of mining and intention to resume production around the May prospects, the results of this research can aid in orebody analysis and interpretation. Henceforth, a dire need to delve into this research.

OBJECTIVES.

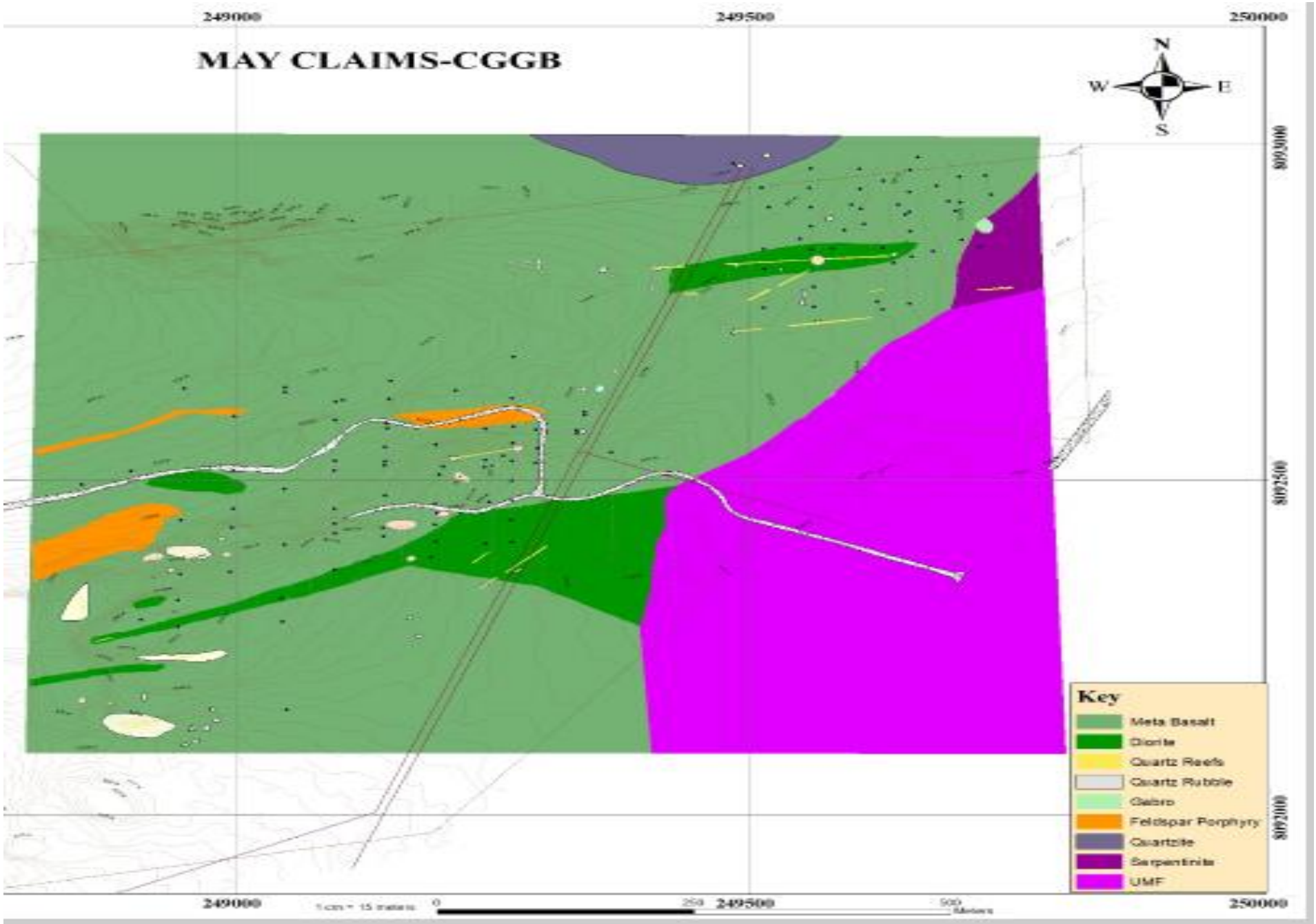
❖The objective:

- To find the spatial association of mineral alterations and the structures with gold-copper mineralization around May claims.

METHODOLOGIES.

- Literature review
- Geological mapping
  - Surface mapping
  - Trench mapping
- Petrographic analysis
- Sampling and assaying

GEOLOGICAL MAP OF THE AREA.



RESULTS: FIELD RELATIONS.

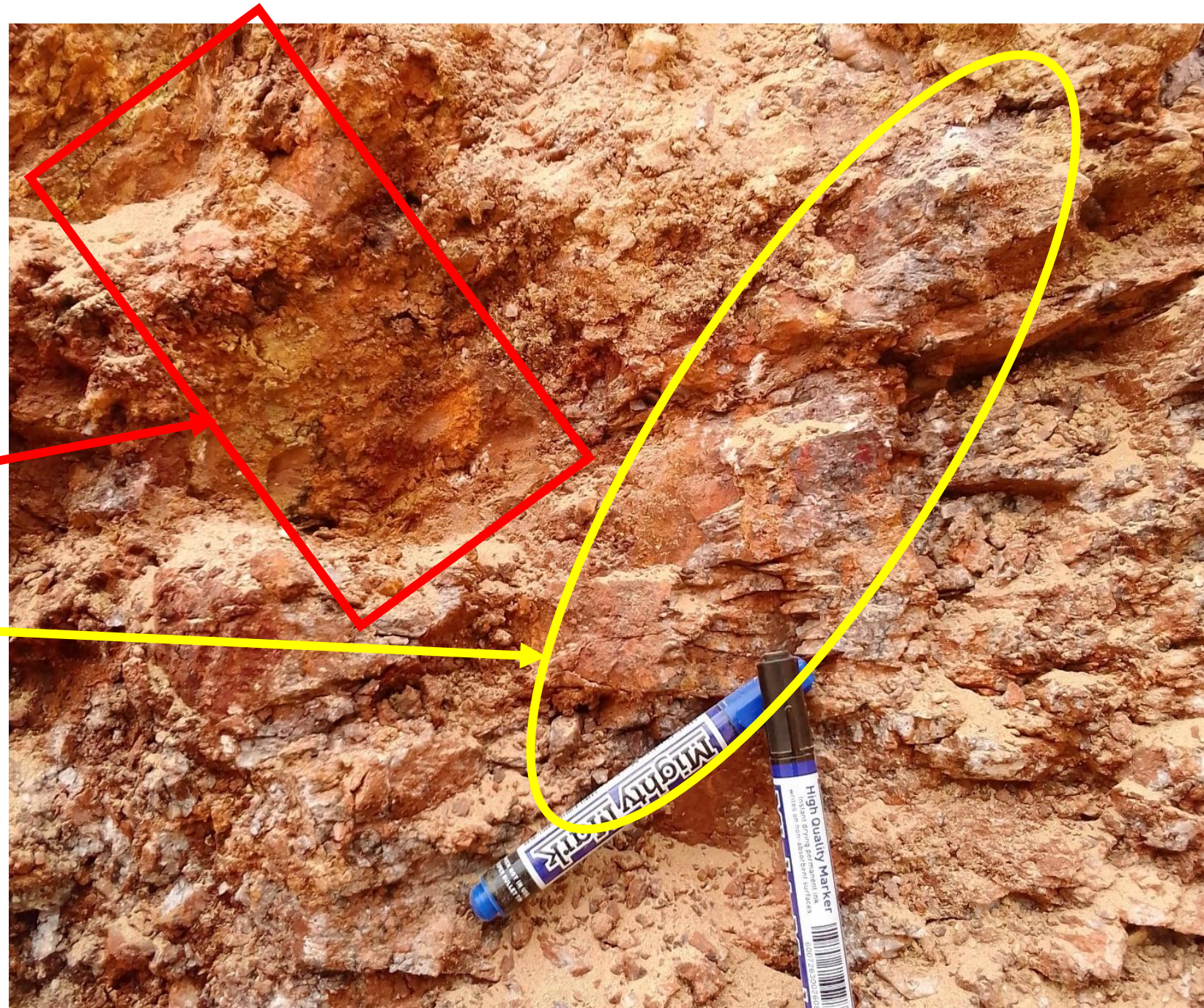
Foliation and mineral banding in meta-basalt outcrop.

Quartz vein and stringers within a meta-basalt outcrop.

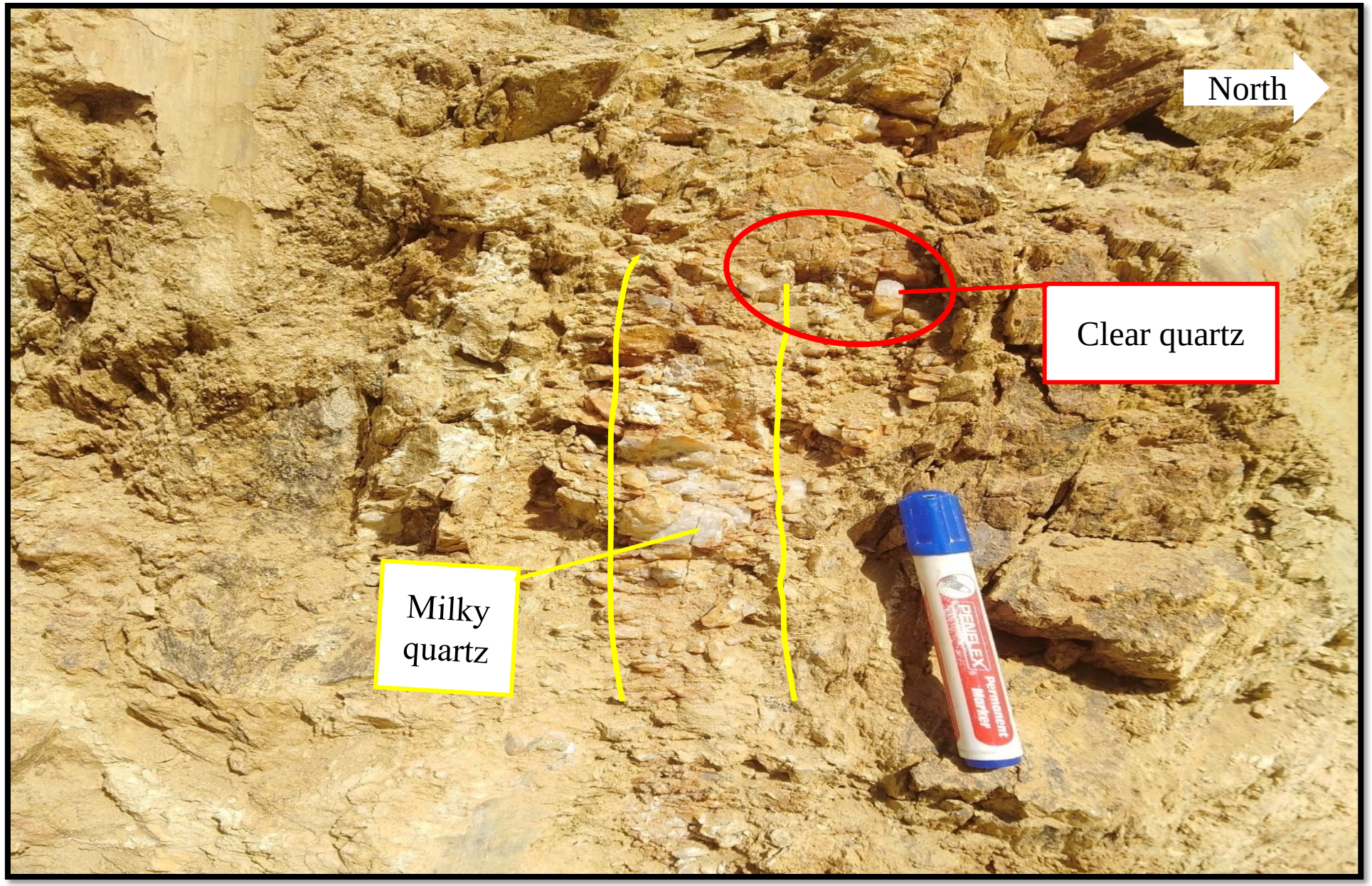
RESULTS: FIELD RELATIONS.

Strong limonite zone with honey colored quartz

and an overall high oxidation.



RESULTS: FIELD RELATIONS.



Milky and clear quartz in a weakly chloritized background.

RESULTS: FIELD RELATIONS.

- Fractured meta-basalt showing a band of silicification (upper part).
- Quartz stringers are visible at the lower part.

RESULTS: HAND SPECIMEN ANALYSIS.

- A meta-basalt specimen from May claims, with milky quartz on its surface.
- Disseminated sulphides visible on its surface.
- Weak chloritization observed in green patches.
- Also identified are the micas, both muscovite and biotite.
- (Sample location: 249259; 8092582)

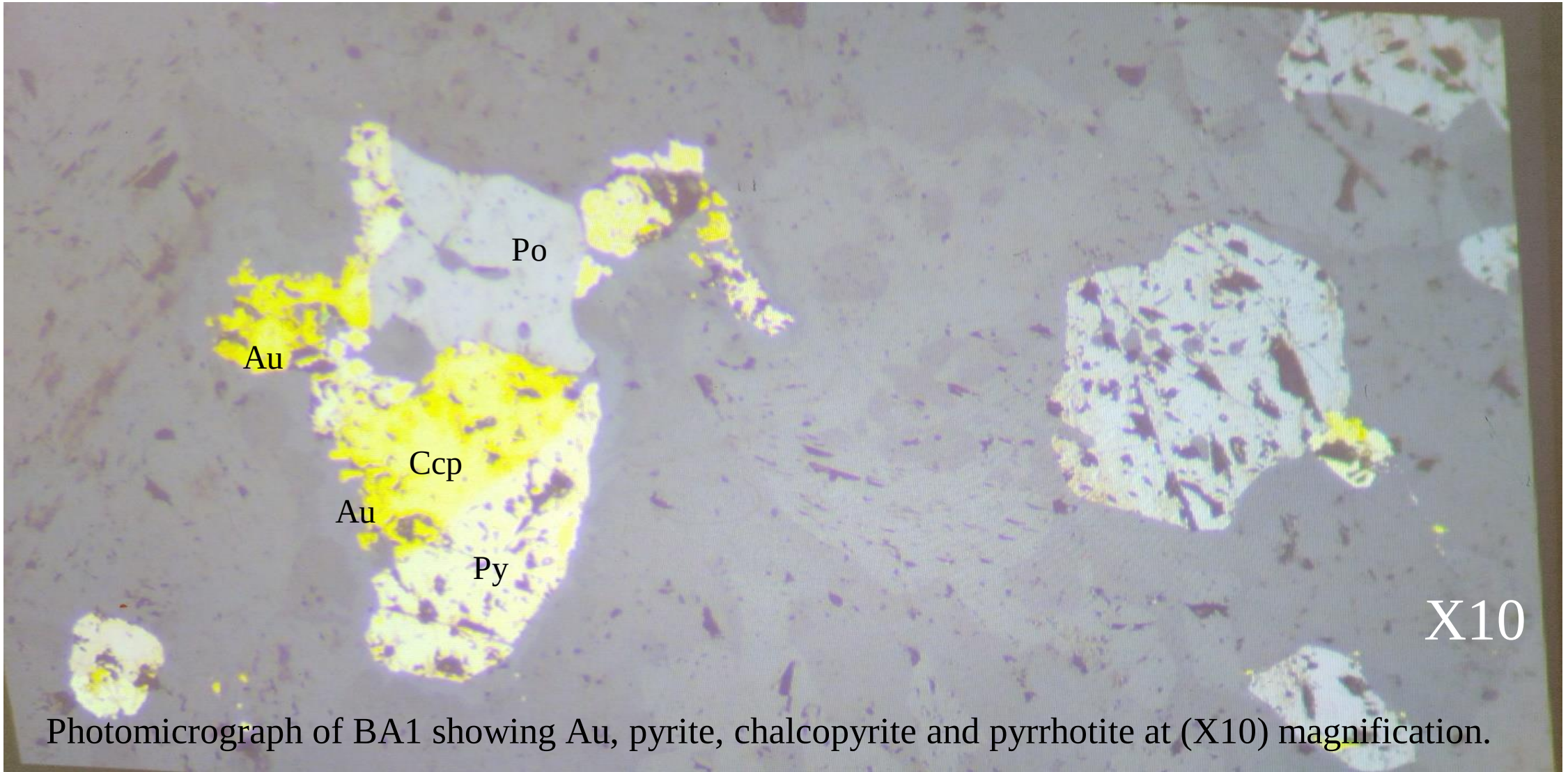
RESULTS: HAND SPECIMEN ANALYSIS.

- A surface meta-basalt specimen from May claims showing both malachite and azurite. Products of transformation of the primary mineral, pyrite.
- (Sample location: 249242; 8092595)

RESULTS: HAND SPECIMEN ANALYSIS.

- Smoky quartz which was found to be associated with both meta-basalt and diorite at May Mine.
- (Sample location: 249269.2; 8092582)

RESULTS: THIN SECTION ANALYSIS.



Photomicrograph of BA1 showing Au, pyrite, chalcopyrite and pyrrhotite at (X10) magnification.

ASSAY RESULTS.

Sample ID	Coordinates		Assay values		Lithology/Mineral
	Eastings (X)	Northings (Y)	Gold (g/t)	Copper(ppm)	
BSP 1	249569.1	8092830	2.89	*	Di
BSP 2	249570	8092826	2.47	*	Di
BSP 3	249577.3	8092827	2.03	*	Di
BSP 4	249581	8092831	3.51	*	Di
BSP 5	249632	8092775	7.47	4.29	MB
BSP 6	249631	8092771	1.75	*	MB
BSP 7	249186	8092380	1.62	*	Di
BSP 8	249241	8092567	20.0	*	Smoky quartz
BSP 9	249253	8092561	30.0	*	Honey quartz
BSP 10	249249.2	8092550	0.18	3.02	MB
BSP 11	249249.3	8092547	0.44	1.92	MB
BSP 12	249250	8092543	1.24	*	MB
BSP 13	249253	8092541	0.76	*	MB
BSP 14	249251	8092539	0.88	3.05	MB
BSP 15	249249.7	8092538	2.23	*	MB
BSP 16	249270	8092540	18.02	*	Qtz reef
BSP 17	249215	8092526	49.14	*	Qtz reef
BSP 18	249271	8092544	0.63	2.31	MB
BSP 19	249270	8092543	0.62	2.22	MB
BSP 20	249270	8092538	0.41	*	MB
BSP 21	248845.9	8092380	0.36	*	FP
BSP 22	249044.1	8092327	1.68	*	Di
BSP 23	249250	8092532	0.76	2.83	MB
BSP 24	249250.6	8092498	0.07	3.28	MB
BSP 25	249251	8092492	3.21	*	MB
BSP 26	249251	8092490	1.27	*	MB
BSP 27	248843.7	8092468	1.68	*	MB
BSP 28	248951	8092391	1.08	2.74	MB
BSP 29	248951.2	8092390	1.26	1.85	MB
BSP 30	248886.5	8092281	0.65	*	Di
BS1	249242	8092595	*	*	MB
BP1	249750	8092875	*	*	Gb
BA1	249259	8092582	*	*	MBQ
BA2	249256	8092569	*	*	MBQ
BA3	249242.2	8092573	*	*	MBQ
BA4	249245	8092571	*	*	MBQ
BA5	249269.2	8092582	*	*	MBQ
BAW6	249112	8092521	*	*	MB
* Not assayed					

AAS Machine assay results sheet.

ASSAY RESULTS.

Lithology	Average Au assay values(g/t)	Structural features	Alteration/Remarks
MB	1.44	Intact/sheared rock, Fractured MB/Qtz veins/stringers. Reef systems in sheared MB/Di	Disseminated sulphides/Oxidized rock. Silicified MB to varying intensities. Limonite + chlorite in alternating zones
Di	2.12	Sheared	Oxidation + chloritization
FP	0.36	Sheared	Oxidation + chloritization

SUMMARY.

Objective	Methodologies	Observations	Overall conclusions
To find the spatial association of mineral alterations and the structures with gold-copper mineralization around May claims.	**Geological mapping:** Surface geological mapping and trench mapping (to delineate structural units and alterations that could be hosting mineralization).	• Fractures and joints, • Quartz veins and stringers, • Foliations and lineation, • Limonite and chloritic alteration in shears; • Sericitization only present at feldspar porphyry to meta-basalt transition; • Fresh and unaltered lithologies also identified.	The gold-copper mineralization at May claims is hosted in hydrothermally fractured, jointed, sheared zones that are altered and oxidized across different lithologies.
	Lithological logging (to characterize the observed lithologies)	• Meta-basalt and silicified meta-basalt is associated with limonite formation and chlorite alteration. • Diorite is associated with varied degrees of oxidation. • Disseminated sulphides present in meta-basalt and silicified meta-basalt, and massive remobilized sulphides in joints and fracture filling. • Feldspar porphyry is associated with sericitization. • Existence of fresh, unaltered lithologies is some regions.	

SUMMARY CONTINUED.

Objective	Methodologies	Observations	Overall conclusions
	Thin section analysis (to identify gold associate mineral assemblages).	Gold is associated with the sulphides pyrite, chalcopyrite and pyrrhotite.	Mineralization is associated with silicification, sulphidization; limonite formation and chlorite alterations. However, apart from the identified structures and alterations, the results of this study showed that there is also economic mineralization in intact and unaltered lithologies at May claims.
	Sampling and assaying (to determine the assay value for the sampled area).	• Sheared and altered zones gave an average of 1.44g/t. • Exceptional values found in quartz veins/reefs at some points. • Silicified meta-basalt associated with the identified sulphides yield the same as sheared zones. • Unaltered intact lithologies in some zones also yield similar values of gold as those observed at sheared and altered. • Copper readings averaging 2.75ppm were observed in localities with sulphides across different lithologies.	

DISCUSSION OF RESULTS.

- Geological mapping showed that the study area is characterized by metabasalt, diorite, felspar porphyry, ultra-mafic units, serpentinite and minor quartzites and gabbroic lithologies.
- Minor sericite schist was observed as an alteration product from feldspars in feldspar porphyry at its contact with meta-basalt, a metamorphic reaction defined as sericitization.
- Mineralization is structurally controlled with influence of mineral alteration and sulphidization.
- The structural features and mineral alteration assemblages at May claims are similar to those at Muriel Mine area.

CONCLUSION.

- The results suggest that economic mineralization at may claims is structurally controlled with a mere influence of mineral alteration.
- Au-Cu mineralization is hosted in hydrothermally fractured, jointed, sheared zones that are altered and oxidized across different lithologies.
- Mineralization is associated with silicification, sulphidization; limonite and chlorite alterations. Serpentinized regions bear no Au-Cu mineralization.
- From the discoveries made, the gold is found in association with sulphides of copper which are pyrite, chalcopyrite and pyrrhotite.
- However, apart from the identified structures and alterations, the results of this study showed that there is also economic mineralization in intact and unaltered lithologies, for example, meta-basalt.

RECOMMENDATION.

- Particular attention required in the sampling and marking of ore body at intact and unaltered zones to avoid neglect of some points with economic mineralization.
- The vertical extent of structures and alterations with mineralization would suggest that open cast may not be very successful hence, underground method can be recommended in the case of deposit extraction.

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- CONTRIBUTIONS

- QUESTIONS

- THANK YOU.