Microstructural and Petrological analysis of the epithermal mineralization of the Jinguashi region, Taiwan.

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Abstract

Jinguashi is one of the few areas in Taiwan where gold deposits formed through shallow hydrothermal processes. The main rock compositions in this area include quartz andesite and the sandstone-mudstone sequence of the Nangang Formation. This study uses both 2D thin section analysis and 3D CT scanning to clarify and quantify the mineral composition and petrological features. Four types of hydrothermal alteration systems were identified. The first is sericitization of sandstone, which increases the sandstone's porosity (from 0% to 31%) as the surrounding rock is replaced by mica minerals (from 88% to 64.8%). Silicification of the sandstone fills the pores with quartz and reduces the heavy mineral content (from 7% to 2%). Silicification of the andesite causes the heavy minerals to be almost entirely eroded, leaving large cavities, with porosity increasing from 1% to 21% as the matrix is replaced by quartz. The brecciation of mudstone involves hydrothermal fluids fracturing the rock, leaving behind heavy minerals (19%) and quartz as the fluids pass through the fractures. Lastly, chloritization of the andesite results in the growth of iron-bearing heavy minerals, increasing the proportion of heavy minerals (from 3% to 10%) and the matrix proportion (from 7% to 21%).

Introduction

The Jinguashi area is renowned for its rich gold and copper deposits, making it a site of significant geological interest. The region's geological composition primarily consists of sandstone and andesite, both of which have undergone extensive hydrothermal alteration. Hydrothermal mineralization refers to the geological process where high-temperature fluids infiltrate and alter the mineral composition and microstructure of host rocks. This study focuses on analyzing the impact of these hydrothermal processes on the structural changes in sandstone and andesite within the Jinguashi area, while also exploring the relationship between these alterations and potential gold mineralization.

Rock Samples:
The primary materials for this study consisted of rock samples collected from the Jinguashi area.

Sedimentary rock Samples: labeled as NKE-01, NKE-03, and NKE-08.
Andesite Samples: labeled as BSE-01, BSE-06, and KLE-03.

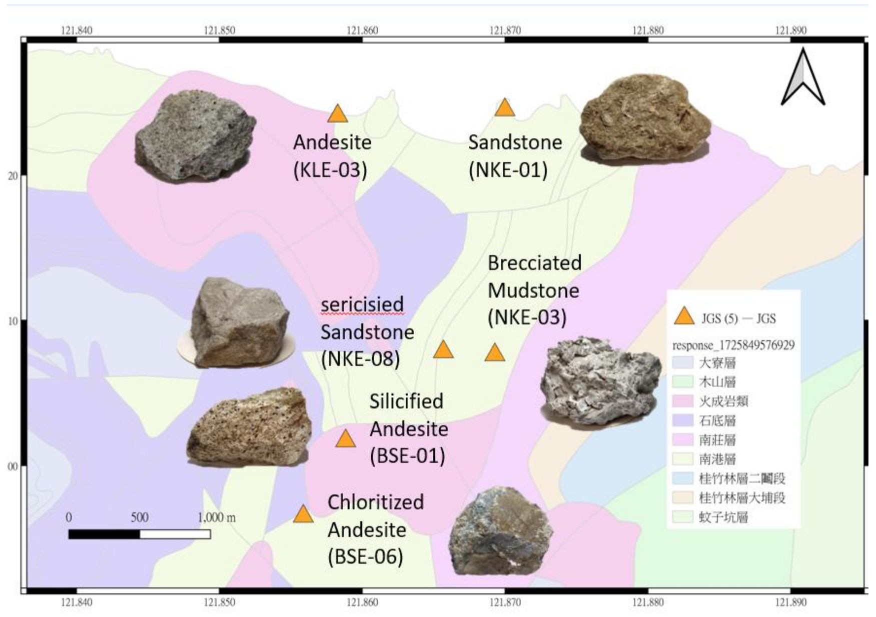


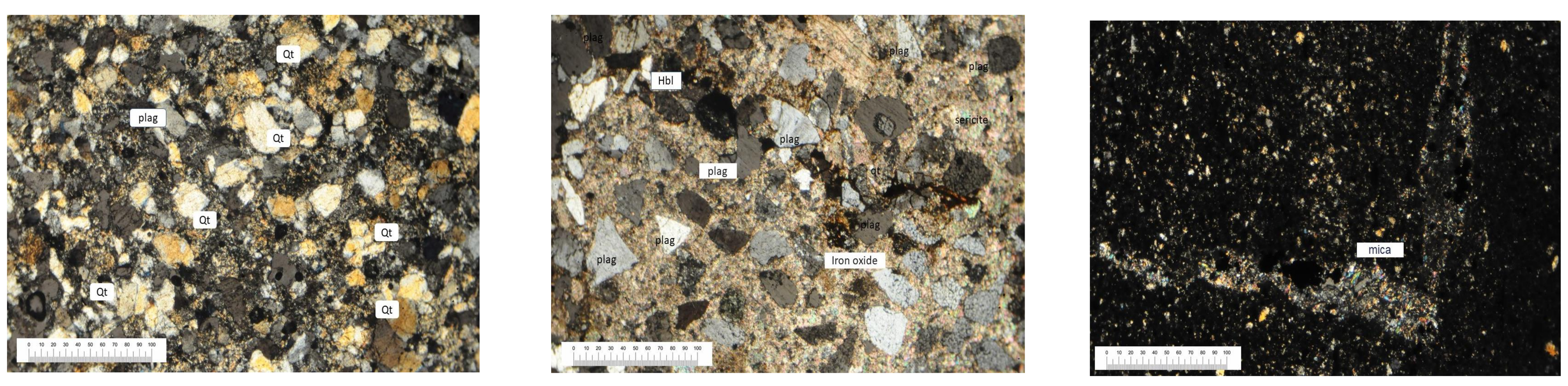
Fig. 1. The total samples and sample point in Jinguashi .

Discussion

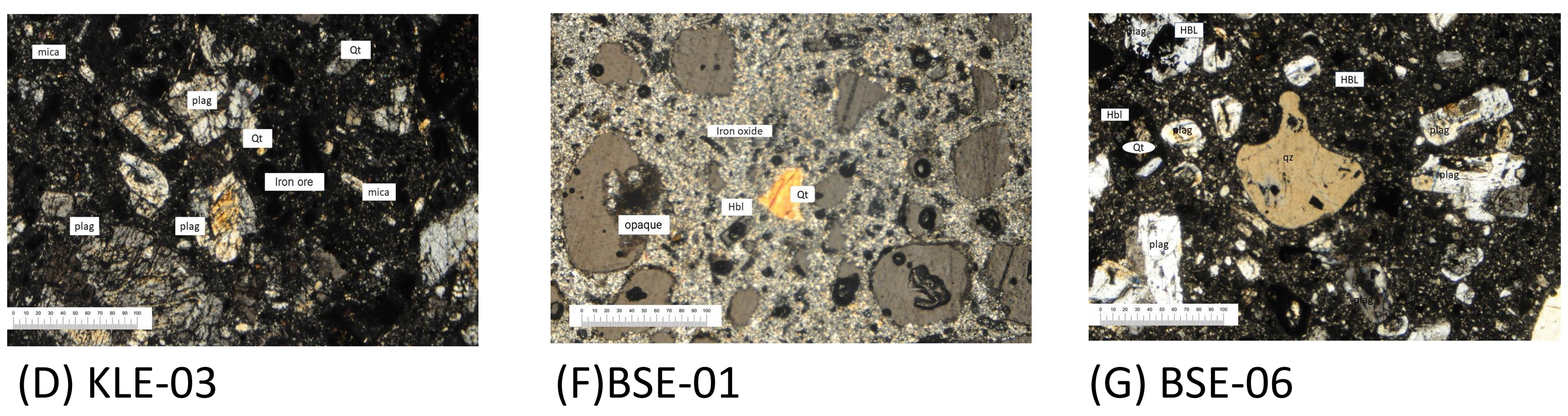
Tab. 1 Analysis Data Consolidation Table

		unaltered NKE-01	Sericited NKE-08	Brecciated NKE-03
sandstone	mineral assemblage	Qt: 69.96% Plag:18.72% Opaque mineral: 11.2%	Sericite+qt+plage:64.81% iron oxide:3.49%	Qt+pyrite:7.1% White mica:24.3%
	vacancy	6.79%	4.91%	2.04%
	Heavy mineral	7.01%	2.06%	19.07%
	Matrix %	0 %	31%	68.5%
		unaltered KLE-03	**Silicified BSE-01**	**Chloritistion BSE-06**
andesite	mineral assemblage	Qt+plag (71.2%) opag (21.3%)	Sericite +qt+plage:48. 5 % iron oxide:18.5% Hole:17.8%	Qt+pyrite:65.11% Hbl+iron oxide:7.62%
	vacancy	1.79%	21.15%	2.44%
	Heavy mineral	3.67%	0.25%	10.1%
	Matrix %	7%	15.2%	27.26%

In Figure 4(A),Sericitization reduced grain size and increased porosity, indicating hydrothermal fluid influence on metal mineral deposition.
(B) Silicification increased porosity and brittleness, suggesting a connection to gold mineralization and regional mineral potential.
(C) Brecciation caused microfractures and reduced porosity, potentially hindering fluid migration and affecting mineral deposition.
(D) Chloritized andesite showed increased quartz and chalcopyrite content, indicating a possible link to gold mineralization processes.



(A) NKE-01 (B) NKE-08 (C) NKE-03

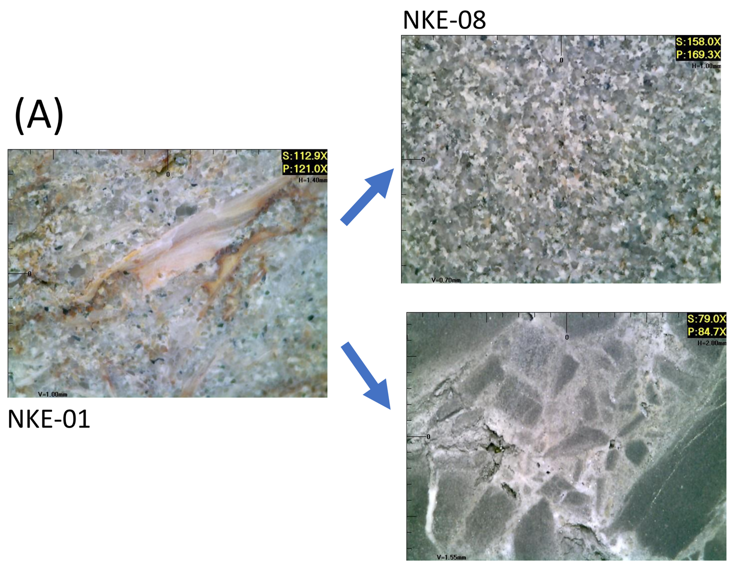


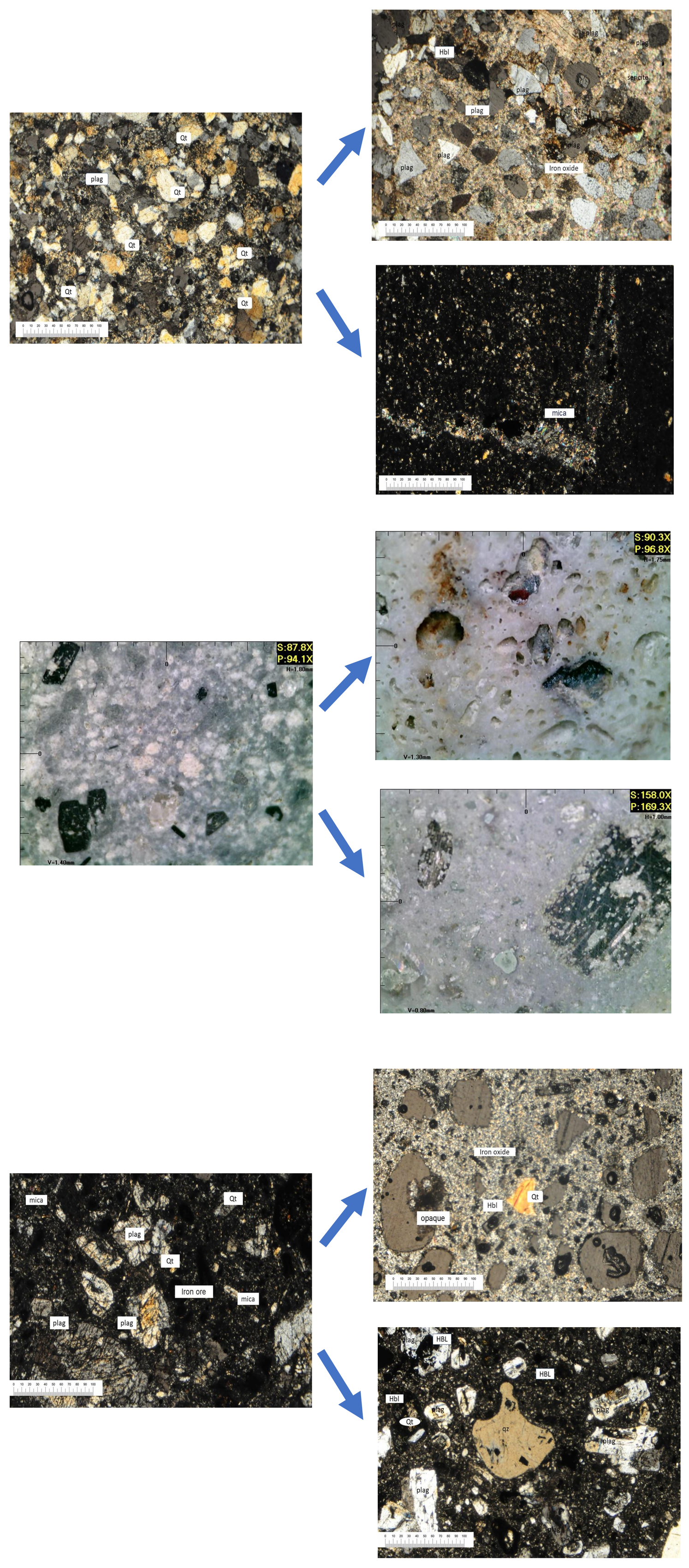
(D) KLE-03 (F)BSE-01 (G) BSE-06

Analytical result

Petrography

Thin-Section Preparation:
1.Cut a slab using a machine .
2.Perform initial lapping of the slab.
3.Attach the slab to a glass slide.
4.Section the slab.
5.Final lapping.





In the sedimentary rock sample, the rock images reveal distinct characteristics, including the presence of clay minerals (Fig 2. A) and variations in grain size. (Fig 2. B)

In the andesite rock sample, the rock images reveal characteristics, including an increase in matrix and compositional changes (Fig. C), as well as the erosion and disappearance of heavy minerals (Fig. D).

Fig 2. (A) The rock photo of erosion changes in sedimentary rocks. (B) The thin section photo of erosion changes in sedimentary rocks. (C)) The rock photo of erosion changes in andesite. (D) The thin section photo of erosion changes in andesite.

Image Pro Plus:
1. Import microscopic images.
2. Use the color separation tool to select minerals (Figure 3).
3. Calculate the proportion of each color, particle size.

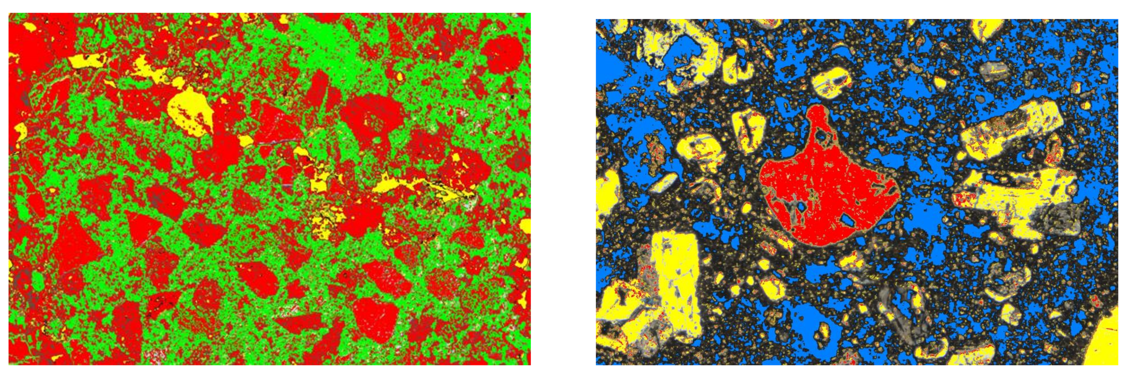


Fig. 3 Color Separation Results of the (A) sedimentary Rock (B) andesite.

In Figure 3(A), the red classification represents quartz, green represents the matrix, and yellow represents opaque minerals.
In Figure 3(B), the red classification represents quartz, yellow represents feldspar, and blue represents amphibole and opaque minerals.

Conclusion

This study shows that hydrothermal processes significantly altered the microstructure and mineral composition of sandstone and andesite in the Jinguashi area. Sericitization and silicification increased rock porosity, promoting fluid migration and metal deposition, while brecciation reduced porosity, hindering fluid flow. Chloritization, with increased quartz and chalcopyrite, may have contributed to gold enrichment in the area

Reference

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