

GEOLOGICAL AND GEOCHEMICAL CHARACTERISTICS OF THE PAC LANG GOLD DEPOSITS, NORTHEASTERN VIETNAM AND THEIR POTENTIAL PROSPECTS

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Introduction

Gold, with its captivating allure and enduring value, has fascinated humanity for centuries. From ancient civilizations to modern-day societies, this precious metal has played a significant role in shaping economies, cultures, and even the course of history. Understanding the origin and formation of gold deposits has been a subject of intense scientific investigation, with researchers striving to unravel the intricate processes that lead to their creation. One aspect that has recently garnered attention is the denudation of gold deposits, which refers to the erosion and stripping away of overlying rocks and sediments, ultimately exposing the concealed gold beneath.

Geological background

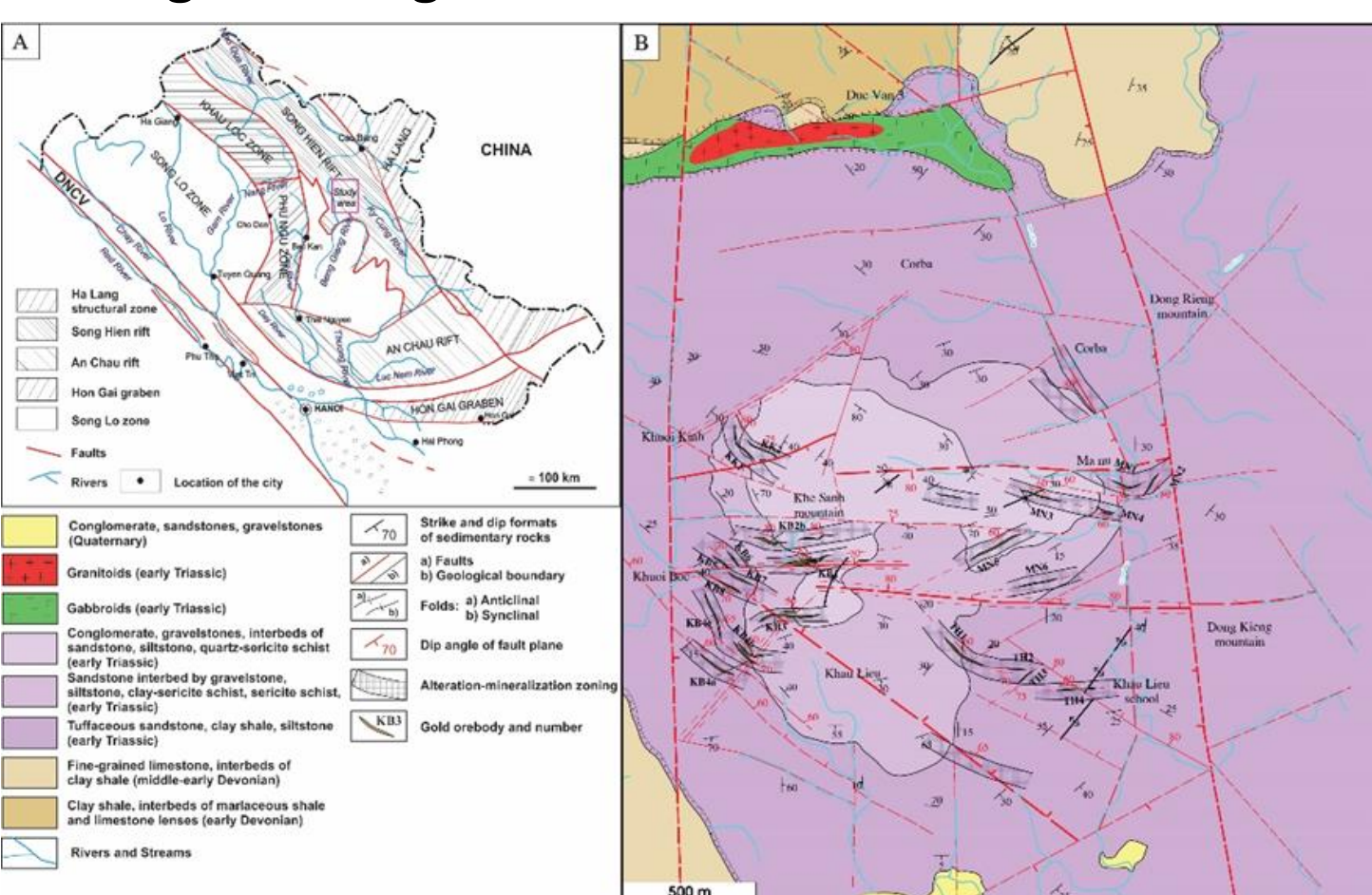


Figure 1. A-Tectonic map of Northeast Vietnam and location of the study area (Dovjikov et al., 1965); B-Geology and mineral map of the Pac Lang gold deposit (Hoang Van Quang et al., 1997)

The Pac Lang gold deposit is located at the western edge of the Song Hien zone, adjacent to the Bac Thai convexity complex. It is characterized by a deep depression that originated during the Middle Paleozoic and experienced significant tectonic activity in the Permian-Triassic period. As a result, the Mesozoic overlap may be associated with the intracontinental rift, which is connected to the late Permian-early Triassic mantle upwelling. The area primarily consists of terrigenous or terrigenous intercalated tufogen sedimentary rocks belonging to the Song Hien formation. In the northern region, there are additional carbonate and terrigenous sedimentary formations known as the Na Quan and Mia Le formations.

In the research area, gold ore bodies have various forms, including simple veins, complex veins, vein systems, lens-shaped bodies, stockwork bodies, and ore shoots.

The ore body displays zonation, often with gold-containing quartz veins. The zonation within the ore body progresses as follows: In the center lies a core of quartz, usually containing gold sulfides, surrounded by phyllites and sericite, infiltrated by sulfides. Beyond the core is the primary rock, heavily fractured and fissured, with some sections cross-cut by quartz veins, and with boundaries not always distinctly defined, occasionally existing only within the walls or pillars of the ore body, with some sulfide infiltration. The outermost part of the ore body consists of less altered primary rock.

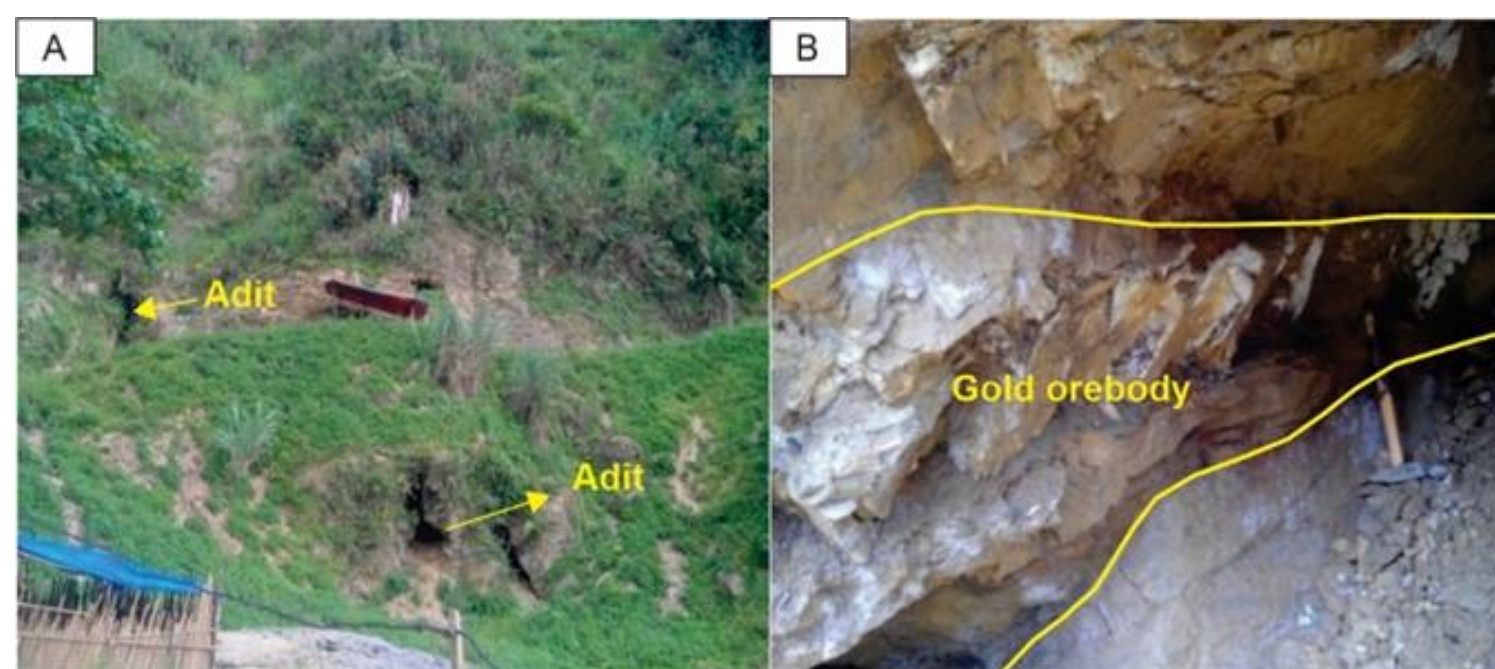


Figure 2. Gold ore bodies in the Khuoi Boc (PL.3009) (A) and Khuoi Kinh (PL.3003) (B) areas are in the form of veins (photo from Nguyen Van Dat et al., 2017)

Methods

1. Assessment of ore body's size, morphology, and localization
2. Assessment of the denudation rate

Calculating the ore body's denudation coefficient by the formula proposed by Beue and Grigoryan (1975) as follows:

$$K_z = \frac{Ag \times Pb \times Zn}{Cu \times Co \times Bi}$$

In which: K_z is the denudation coefficient; Ag, Pb, Zn, Cu, Co, Bi are elemental contents of Ag, Pb, Zn, Cu, Co, and Bi (ppm); $K_z < 0.1$ under the ore-forming zone; $0.1 \leq K_z \leq 10,000$ in the ore-forming zone; $K_z > 10,000$ on the ore-forming zone.

The calculation results indicate that the ore bodies in the gold deposit have relatively high development prospects, reaching 175.93m on average. Some ore bodies have a depth of 200-300m such as KK1, KB1, KB3, KB4c, MN3, and TH1.

Conclusion

The ore mineralization at the Pac Lang gold deposit can be classified into three main zones: The gold-quartz-pyrite-poor sulfide zone; the gold-quartz-polymetallic sulfide zone, and the gold-quartz-arsenopyrite and pyrite zone.

The calculation results indicate that the depth range of gold ore formation in the deposit is approximately 623 meters. Based on the morphology of gold ore bodies and the average size of ore bodies in the Pac Lang gold deposit, the forecasted existence depth is estimated to be around 175.93 meters.

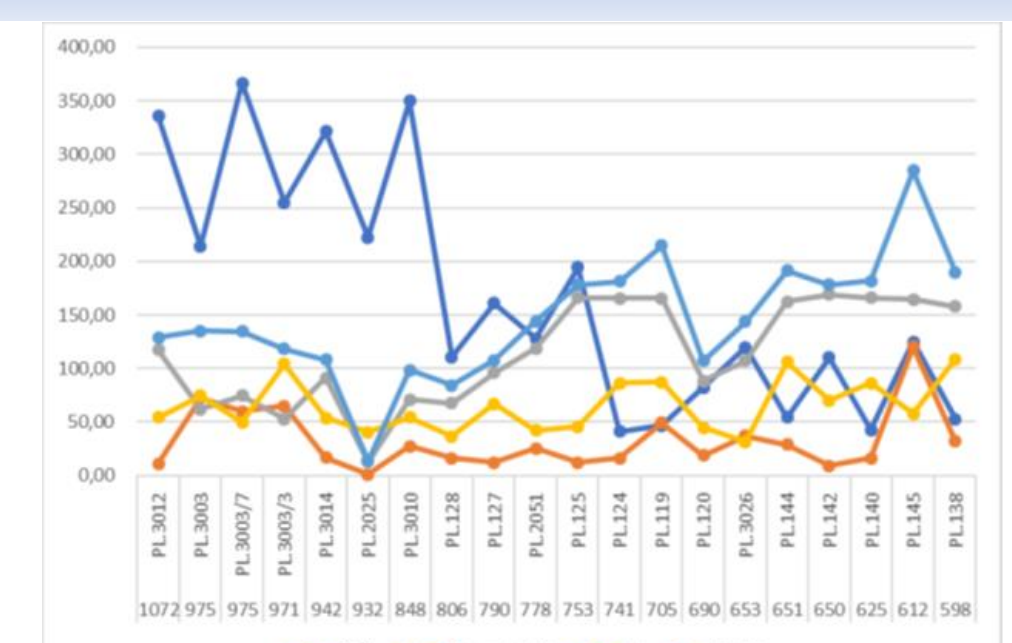
The denudation coefficient K_z for the gold ore in the deposit is calculated to be 11.78. This denudation coefficient suggests a moderate to strong denudation rate and places the deposit in the ore-forming zone, with the denudation depth estimated to be around 200-350 meters.

The study suggests the possibility of hidden gold ore deposits at even greater depths, potentially reaching depths of up to -5 kilometers.

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Results and Discussion



No.	Area	Ore bodies	Length in the strike direction (m)	Height in the dip direction (m)	Order No.	Existence depth
1	Khuoi	KK1	182.80	109.68	2	219.36
2	Kinh	KK2	143.60	86.16	2	172.32
3		KB1	194.50	116.70	2	233.40
4		KB2	143.20	85.92	2	171.84
5		KB3	255.10	153.06	2	306.12
6		KB4a	142.70	85.62	2	171.24
7	Khuoi	KB4b	143.30	85.98	2	171.96
8	Boc	KB4c	206.30	123.78	2	247.56
9		KB5	81.00	48.60	2	97.20
10		KB6	82.90	49.74	2	99.48
11		KB7	110.30	66.18	2	132.36
12		KB8	106.50	63.90	2	127.80
13		MN1	132.00	79.20	2	158.40
14		MN2	112.50	67.50	2	135.00
15		MN3	168.90	101.34	2	202.68
16		MN4	81.50	48.90	2	97.80
17		MN5	230.00	138.00	2	276.00
18		MN6	163.30	97.98	2	195.96
19		TH1	207.20	124.32	2	248.64
20		TH2	89.00	53.40	2	106.80
21		TH3	87.00	52.20	2	104.40
22		TH4	161.70	97.02	2	194.04
Average			146.60	87.96	2	175.93

