Journal of N.G.S. Vol. 7., 1991 Special issue 31-39

PRIMARY GOLD MINERALIZATION IN THE PRE-CAMBRIAN AND LOWER PALEOZOIC ROCKS, LUNGRI KHOLA REGION, ROLPA DISTRICT.

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ABSTRACT

Primary gold mineralization occurring in the Lungri Khola region is observed in the Pre-Cambrian green schist facies and Lower Paleozoic micaceous marble and limestone. The Pre-Cambrian green schist facies comprising mainly of sericite and chloritic quartzite, chlorite schist, quartz-chlorite schist, chloritic phyllite and schistose pebble beds include a discontinuous auriferous zone which persists laterally for about 30 km extension from the Gajul khola in the west to the upper reaches of Gam khola in the east. The auriferous host rocks are found confined close to the contact with the overlying Lower Paleozoic carbonates. Eight distinct auriferous hosts are encountered in the Pre-Cambrian green schists facies. Occurrence of auriferous host in the Lower Paleozoic limestone and marble is rather irregular and insignificant. So far minor quartz-carbonate veins have indicated the presence of gold. Finely disseminated gold with minor amount of pyrite, chalcopyrite and rarely arsenopyrite occurs in the above hosts. Visible gold ranging from 0.08 to 2 mm dimension has been recovered. Gold content of upto 6.7 gm/ton has been recorded but in general they show 0.1 gm/ton gold which is significantly 30 to 60 times higher in magnitude than the background value. Depending upon the type of the hosts, three possible models, namely (1) volcanogenic (2) hydrothermal and (3) syn-sedimentary, could be suggested for the origin of the primary gold mineralization which has later undergone remobilisation after the initial deposition.

INTRODUCTION

Placer gold of commonly less than 0.5 mm to sub-microscopic size, and rarely approaching to a large nugget weighing 30 gm are known to occur in the recent high-flood gravels and river bed materials which exist along the courses of Lungri, Phagam, Gam and Bojyang kholas (refer map-1). In dry season, the local people actively pan the recent river sediments and recover gold successfully. Gold winning practice was started in the early nineteenth century; however, no written records are available. Unlike the placer gold occurrence in other parts of the country, here it is found in a small catchment area.

Presence of placer gold in Lungri Khola area was first reported in 1972 (Tschering). Subsequent geological investigations carried out by Kansakar, (1982) and Paikada (1983) also reported its existence. Systematic exploration in this region (Joshi, 1985) guided to establish the primary source of placer gold, which is the first of its kind in the Kingdom of Nepal.

Evidence of mining activities for gold recovery from the in-situ source (bed rock) is not known. The area contains extensive old working of the past mining activities for copper and iron. A few such old excavations show primary gold association but it is not known whether the early miners were also aware of in-situ gold mineralization.

Annual production of gold from placer deposit is likely to be 1 kg and a total of about 25 to 50 kg of gold is believed to have been extracted so far.

REGIONAL GEOLOGY

The Jaljala Nappe (Kansakar, 1982) exposed for an average 15 km width forms a synclinorium in the present area. It includes NNW-SSE trending Jelbang, Telkhola and Mirul Formations (Refer map no 2 and 2a). The Jelbang Formation representing the lowermost member is exposed only in the southern limb of the synclinorium. It contains widely varied pelitic rocks such as micaceous quartzite, mica-schists, carbonaceous schist, chlorite schist and schistose pebble beds with occasional porphyroblastic gneiss and psammatic gneiss, which show Upper Pre-Cambrian to Lower Paleozoic age.

The Lower Paleozoic Telkhola Formation comprising of crystalline limestone, marble, calc-schist and quartzite overlies the Jelbang Formation.

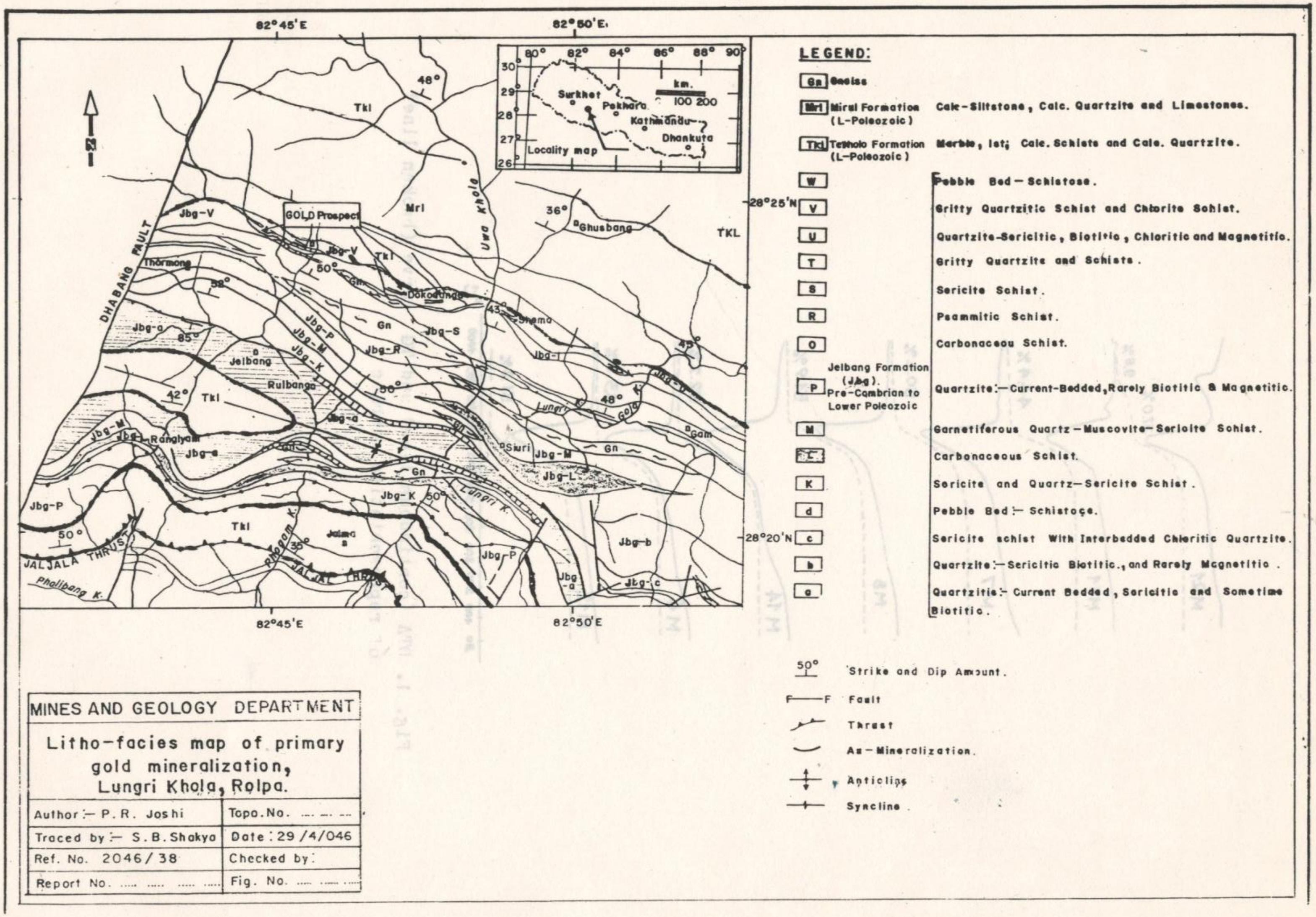
The Lower Paleozoic Mirul Formation is the youngest member of the Jaljala Nappe. It includes chiefly calcareous siltstone, quartzite and limestone.

MINERALIZATION

Occurrence of primary gold mineralization is known in the Pre-Cambrian green schist facies rocks and Lower Paleozoic micaceous marble and limestone (Refer figure 2a). Auriferous zones are mainly persistent in (1) the northern contact zone of Jelbang and Telkhola Formations and (2) the Telkhola Formation occurring along the Jaljala Thrust. Minor auriferous zones are also likely to exist in other stratigraphic positions of the Telkhola Formation but they have not yet been established.

The Pre-Cambrian green schist facies confined along the northern contact of Jelbang and Telkhola Formations include a discontinuous auriferous zone which has persisted laterally for about 30 km from the Gajul khola in the west to the upper reaches of Gam khola in the east. It comprises mainly of sericitic and chloritic quartzite, chlorite schist and quartz chlorite schist with the association of minor porphyroblastic gneiss, hydrothermal carbonate, massive magnetite and quartz bodies.

Surface mineralization in the Telkhola Formation is likely to be irregular and lower grade in comparision to auriferous zones in the green schist facies. Distribution and grade of such auriferous zones have not been fully defined. From the result of placer gold examination, possibilities on the occurrence of prospective surface mineralization could be expected in the catchment of the Khair and Gaja Kholas. A


82°45'E
82°50'E
N
Locality map
Surkhet
Pokhara
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km.
100 200
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Uwa Khola
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GOLD Prospect
DHABANG FAULT
Thormong
Dokodunga
Jbg-V
Jbg-P
Jbg-M
Jbg-K
Jbg-R
Jbg-S
Jbg-a
Jbg-L
Jbg-b
Jbg-c
Jelbang
Rulbanga
Ranglyam
Siuri
Gn
Lungri K.
Phagam K.
Phalibang K.
JALJALA THRUST
28°25'N
28°20'N
LEGEND:
Gn Gneiss
Mrl Mirsl Formation (L-Paleozoic) Calc-Siltstone, Calc. Quartzite and Limestones.
Tkl Tetholo Formation (L-Paleozoic) Marble, lst; Calc. Schists and Calc. Quartzite.
Jelbang Formation (Jbg). Pre-Cambrian to Lower Paleozoic
W Pebble Bed – Schistose.
V Gritty Quartzitic Schist and Chlorite Schist.
U Quartzite-Sericitic, Biotitic, Chloritic and Magnetitic.
T Gritty Quartzite and Schists.
S Sericite Schist.
R Psammitic Schist.
O Carbonaceou Schist.
P Quartzite:– Current-Bedded, Rarely Biotitic & Magnetitic.
M Garnetiferous Quartz – Muscovite – Sericite Schist.
L Carbonaceous Schist.
K Sericite and Quartz – Sericite Schist.
d Pebble Bed:– Schistose.
c Sericite schist With Interbedded Chloritic Quartzite.
b Quartzite:– Sericitic Biotitic., and Rarely Magnetitic.
a Quartzitic:– Current Bedded, Sericitic and Sometime Biotitic.
50° Strike and Dip Amount.
F—F Fault
Thrust
Au – Mineralization.
Anticline
Syncline.
MINES AND GEOLOGY DEPARTMENT
Litho-facies map of primary gold mineralization, Lungri Khola, Rolpa.
Author :– P. R. Joshi
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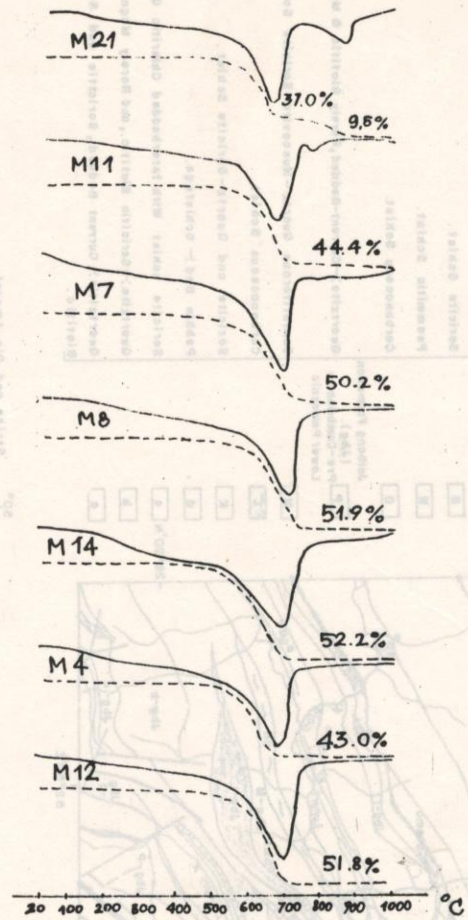


Fig. 1. DTA (continuous line) and TG curve (broken line) of representative samples

few quartz-carbonate floats delivered from Telkhola Formation have been found to have contained traces of gold.

Eight distint auriferous hosts are encountered in the Pre- Cambrian green schist facies and they have been tabulated below (Table -1, Figure -3).

NATURE OF GOLD

Free gold is rarely visible megascopically in the out-crops but gold grains of 0.08 to 0.2 mm dimension are usually observed in the concentrates of the crushed rocks. Although no gold is observed in polished sections examined so far, the presence of microscopic gold as well as preservation of rich auriferous zones with sizable nuggets cannot be ruled out.

Gold recovered from the in-situ mineralization exhibits pale yellow to bright yellow and reddish yellow, granular, flaky and sometime wedge-shaped. Purity test carried out on the two gold samples indicated fineness of 94.1 and 99.9%.

Besides free gold, electrum is also known in the hydrothermal carbonates. Although no silver has been identified from the in- situ source, a few samples resembling silvery colour have been detected from the placers.

Gold content in different hosts vary from below the detection limit (0.03 gm/ton to 6.7 gm/ton). Likewise, observed silver values range from 1 to 18 gm/ton. A majority of the auriferous hosts containing megascopically visible gold in the concentrate show gold and silver values of 0.1 to 0.3 gm/ton and 4 to 8 gm/ton respectively, as compared to the background concentration of 0.002 gm/ton Au and 0.08 gm/ton Ag in average in crustal rocks (Jensen and Bateman, 1981).

Traces of gold are also revealed in the rocks adjoining to such auriferous hosts. Gold values are usually found considerably elevated, about 10 to 15 times higher than the crustal background values.

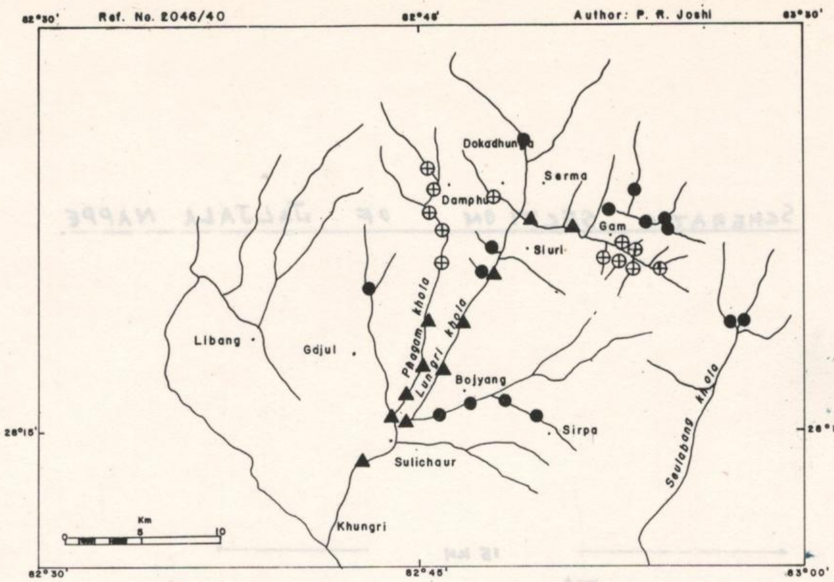
Among the known auriferous host rocks features such as quartzite, lode quartz and shear-zones contain significant amount of megascopically visible gold and their chemical analysis show 1.5 to 6.7 gm/ton Au.

DISCUSSION

As the in-situ gold mineralization belongs to widely varied hosts, gold might possibly have derived from different sources. Gold occurring in chlorite schist, quartz-chlorite schist, gneiss and massive magnetite bodies, could have been deposited under sub- marine hydrothermal exhalation with the dominance of volcanic activity as suggested by the presence of chlorite schist and gneiss which are the metamorphic products of intermediate mafic and rhyolite flows respectively.

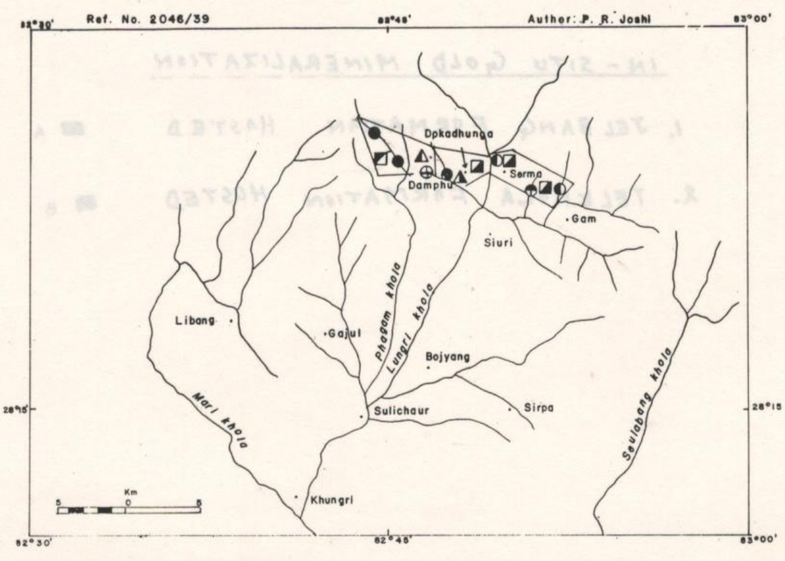
Table 1. CLASSIFICATION OF AURIFEROUS HOSTS

Type of host rock	Nature of host rock	Essential minerals	Accessory minerals	Dimension
1) Massive magnetite (hematite) ore body	Conformable, tight isoclinal folded, and rarely discordant and brecciated veins.	Magnetite	Hematite, chlorite, quartz, calcite, dolomite, ankerite, sericite, talc, chalcopyrite, pyrite and gold	0.5 to 5m x upto 100m.
2) Lode quartz	Concordant as well as discordant lenses and stock-work.	Quartz	Chlorite, sericite, biotite, epidote, tourmaline, magnetite, specularite, limonite, jarosite, malachite, azurite, chalcopyrite, pyrite and gold.	Individual quartz body up to 2m and stockwork upto 6m width.
3) Hydrothermal carbonate body	Usually conformable veins and lenses but rarely discordant ones.	Coarse grained and interlocked calcite and dolomite	Quartz, sericite, chlorite, barite, ankerite, magnetite, limonite, jarosite, malachite, azurite, pyrite, chalcopyrite, gold and electrum.	Upto 20m width and 110m length
4) Quartzite (a) magnetite rich,pyritised and occasionally pebbly quartzite	Current-bedded	Quartz	Sericite, chlorite, magnetite, hematite, malachite, azurite, and gold	up to 5m width
(b) Highly ferruginous and biotitic quartzite	Current-bedded	Quartz	Sericite, biotite, limonite hematite pyrite and gold	Usually 1 to 2m thick but upto 10m width
(c) Sericitic quartzite	Current-bedded	Quartz	Sericite, magnetite, feldspar, pyrite and gold	1 to 2m width.
(5) Chlorite schist and quartz-chlorite schist.	--	Quartz and chlorite	Magnetite, pyrite, chalcopyrite and gold	upto 4m width
6) Mylonite and gouze (shear-zone)	Parallel to the rock trend	Quartz, chlorite and sericite	Magnetite, chalcopyrite, pyrite malachite, azurite and gold	1.5 to 2m width
7) Altered limestone	--	Calcite, dolomite, quartz, chlorite and phologopite.	Magnetite, chalcopyrite, pyrite and gold	2 to 3m width
8) Gneiss	Conformable	K-feldspar, plagioclase, quartz, biotite and muscovite.	Chlorite, magnetite, barite and gold	up to 200m width



Map Showing Placer Gold Indications.

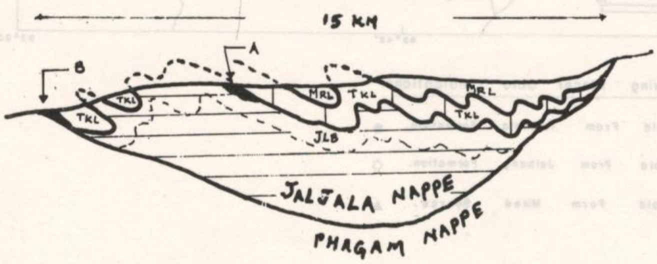
1. Placer Gold From Telkhola Formation. ●
2. Placer Gold From Jelbang Formation. ○
3. Placer Gold Form Mixed Source. ▲



Type of Hosts Showing in- Situ Au-Mineralization.

1. Massive Magnetite-(Hematite) ore 2. Quartz Body 3. Hydrothermal Carbonate 4. Magnetite Dominant And Occassionally Pebbly Quartzite 5 Chlorite Schist And Quartz Chlorite Schist ▲ 6. Weathered Gouze And Mylonite 7. Altered Lime-stone 8. Gneiss

SCHEMATIC SECTION OF JALJALA NAPPE



IN-SITU GOLD MINERALIZATION

1. JELBANG FORMATION HOSTED — A
2. TELKHOLA FORMATION HOSTED — B

Taking into account of the lithology of the host rocks, and associated sulphide minerals, the gold mineralization is comparable to the London-Virginia, gold deposit, a historically known "gold pyrite belt" in Virginia, which has produced a few tons to several thousand tons of gold. This deposit contains pyritic ferruginous quartzite and quartz-mica schist as hosts in association with chlorite schist and magnetite schist. The origin of such deposit has been suggested as submarine hydrothermal exhalation with volcanic activity (Margret Mangan et al, 1984).

Gold association in quartzite, including magnetite rich pyritic and pebbly beds could be syn-sedimentary, which is comparable to the Pre-Cambrian gold deposits enherent in quartz conglomerate and quartzite occuring in Jacobina of Brazil and Witwaterstrand of South Africa. Originally gold could have been deposited as disseminations of sub-microscopic to megascopic sizes and remobilization during subsequent metamorphism might have increased their grain size resulting in the recoverable gold.

Presence of gold in lode quartz, hydrothermal carbonate and shear-zone could be related to syntectonic hydrothermal activity which caused gold remobilization from the surrounding rocks, which originally had traces of gold.

ACKNOWLEDGEMENT

The author is extremely thankful to Mr. M. N. Rana, Director General, Dept. of Mines and Geology for the permission to use and publish the data from the Departmental unpublished reports

REFERENCES

Jensen, M. et al, (1981) - Economic Mineral Deposits, John Wiley and sons, New York, 535

Joshi, P.R. et al, (1984) - Drainage sediments and heavy concentrate survey, Lungri khola region, Rolpa, DMG (unpublished).

Joshi, P.R., (1986) - Geology of the Primary Gold Mineralization of Damphutara, Rolpa, DMG, (unpublished).

Kansakar, D. R., (1983) - Report of Geology of Khungrichaur- Rukum Region, Rolpa, DMG, (unpublished).

Margaret, Mangam et al, (1984) - Submarine exhalative gold mineralization at the London Virginia Mine, Buckingham Country, Virginia, Mineral Deposit, 19, 227-236.

Paikada, J., (1981) - Preliminary Investigation of Placer Gold in Lungri khola Region and its Tributaries, Rolpa, DMG, (unpublished).

Tschering, L. D., (1972) - Regional Geological Map of Rolpa, Piuthan and Baglung District, DMG (unpublished).