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Placer gold occurrences along the major rivers of Nepal Himalaya and their possible primary sources*

K. P. Kaphle, P. R. Joshi and H. R. Khan
Department of Mines and Geology, Lainchaur, Kathmandu, Nepal

ABSTRACT

Recent exploration in Lungri Khola area, Rolpa district, mid western Nepal helped to delineate a discontinuous 1.5 to 40 m thick and about 30 km long primary gold mineralization zone in the Precambrian greenschists and Lower Palaeozoic micaceous marbles of the Lesser Himalaya. The gold content in these lodes vary from 0.01 to 6.7 ppm.

In eastern Nepal occurrences of primary gold is recorded in quartz-biotite schist, amphibolite and pegmatite bodies in Sunmai and Bering Khola of Ilam district. Fine flakes of gold also occur in the pyritiferous quartz beds/lenses in chlorite-sericite phyllite and quartzite of Bamangaon polymetallic prospect, Dadeldhura district, far western Nepal. In this prospect the gold content is from 0.2 to 0.8 ppm, and one sample showed up to 14 ppm. Primary gold occurrences are also detected in few irregular quartz-pyrite veins and iron-copper sulphide bearing quartzite lying close to the amphibolite bodies. Some pyrite bearing radioactive quartzite beds in Banku Quartzite of Purchauni Crystalline Complex exposed at Boregad, Bangabagar, Baggoth and Jamari Gad area in Darchula and Baitadi districts, far western Nepal also contain gold. The gold content in the radioactive quartzite varies from 0.2 to 1.2 ppm and in some pyritiferous radioactive quartzite floats it reaches up to 5.06 ppm.

The primary gold appears to be of synsedimentary, hydrothermal and possibly volcanogenic in origin. Placer gold is derived from primary sources and deposited at favourable locations along the river flood plains. Further investigations in similar geological terrain may help to identify economically viable primary as well as placer gold deposits in the Nepal Himalaya.

INTRODUCTION

More than 6000 rivers and streams flow within the territory of Nepal. All the major rivers of Nepal originate from the Higher Himalayan region or Tibet and fed by the glaciers and glacier lakes. Most of them flow from north to south and pass through the Higher Himalaya, Lesser Himalaya and Sub Himalaya and finally join the Ganga River in India. On their way, these rivers erode the bed rocks in the catchment areas and scour the river banks and terraces. They transport a huge amount of eroded materials as detrital sediments and on their way deposit them along the flood plains. Deposition of these sediments have given rise to recent and old terraces along the course of these rivers.

Placer gold occurrences in some of the major rivers of Nepal are known since historic times. Bowman (1932) was the first to study these placer gold deposits. Further investigations were carried out by Chatterjee (1935) in Kali Gandaki; Welch (1955); O'Rourke (1959) and Manandhar (1961) in the Marodi Khola, Rapti Valley; Manandhar (1961,1965) and Singh (1964,1965) in Kali Gandaki, Burhi Gandaki, Trishuli River, Madi River and Modi Khola sections. They were successful to trace the placer gold in the river gravels. In almost all these cases, the deposits were found to be uneconomical for large scale mining. However, some of the results of panning in Burhi Gandaki near Arughat and Salyantar (Singh 1964,1965) and Kali Gandaki (Manandhar 1964,1966) were very promissing.

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Unfortunately, theese investigations were discontinued without any search for primary sources. Gold exploration works in Nepal has been generally nonsystematic and discontinuos. Studies were never adequately focused on the location of primary sources of placer gold.

Since 1981, Department of Mines and Geology (DMG) started some systematic reconnaissance type geological and geochemical exploration for gold. The first attempt was made in the Lungri Khola area, Rolpa district, mid-western Nepal and it was extended to Mahakali and Chamliya river sections in Baitadi, Darchula and Bajhang districts of far-western Nepal. As a result some potential areas for finding placer gold and their possible primary sources were identified.

GOLD EXPLORATION IN NEPAL

Placer gold is derived from the weathered and eroded auriferous quartz veins (lodes), quartz sulphide veins, auriferous polymetallic sulphide deposits and other primary sources. The formation of placer gold is the combined action of both mechanical and hydrogeochemical processes working in consort over long period of time (Boyle, 1969). Gravity is the force which plays the major role in the concentration of placer. Commonly high concentration takes place in the high flood plains specially in the inner bends of the meandering rivers.

Gravity separation is the principal method used to separate alluvial gold from the sediments. Even today conventional panning method using ordinary wooden or metallic pans are in use to win placer gold in Nepal. The experience has shown that such methods are useful mainly for coarse to medium size gold particles (i.e. +420 um). Generally very fine and flour gold get lost during such panning.

Gravity concentration using riffled sluices and accompanied by mercury amalgamation is still an important method used for gold extraction (Wenqin and Poling, 1983) which can also be applied in Nepal. But so far such a method has not been introduced in Nepal. The Bulk Leach Extractable Gold (BLEG), a cyanide leach technique useful for very fine gold extraction (Elliot and Towsey, 1989) is also not in use and may be difficult to introduce in Nepal due to high price of the chemicals and high risk of contamination in drinking and other sources of water causing health hazards. Mechanical suction dredging method is also another low cost high volume sediment washing method. It was tried during the preliminary evaluation of alluvial gold in Lungri Khola, but the method became unsuccessful because of the thick overburded of sediments (>3 m) and the presence of very coarse sediments with boulders up to 3 m in diameter.

Recent field investigations carried out in Mahakali River, Chamliya River and Jamari Gad river sediments in far western Nepal revealed that the gold concentration (of all sizes) in the river gravels is generally higher in the higher flood plains. Reworking and scouring of old river terraces and reconcentration of the heavy minerals in the sediments further downstream locally increase the amount of gold concentration. However, in general, the gold particles become much finer in size and the dilution with the sediment becomes higher as they travel farther away from the source.

The preliminary exploration and evaluation of alluvial gold in Lungri Khola (Paikara, 1983; Joshi,1984,1986) and Chamliya River (Kaphle and Khan, 1992) shows that the gold content in the gravels is about 100 to 3100 colours and 100 to 5000 colours/ton gravel (excluding boulders >25 cm size) respectively. In the same area, Paikara (1983) has reported as high as 7750 gold colours/m^3 gravel.

Since 1984 the Department of Mines and Geology has been working to identify the primary sources of these alluvial gold and delineate the targets for detail exploration. Rock samples from the outcrops (in situ sampling) of various rock types and float samples from the river course were collected during exploration. Such samples were crushed to 850 to 180 μm size fraction and gold content was determined by simple panning or by heavy liquid separation. Separation of fine gold from other heavy minerals were performed by amalgamation with mercury. The gold content in the rock/ore samples was confirmed by microscopic study. The quantitative analyses of the samples were done by Atomic Absorption Spectrophotometry. The results from the Chamliya River area show that some of the primary gold source contain 0.1 to 5.6 ppm gold (Kaphle and Khan,1994). In the Lungri Khola area the values are between 0.1 to 6.7 ppm gold (Joshi, 1992).

TYPES OF GOLD MINERALIZATION

Regional Geological mapping and reconnaissance geochemical prospecting in some selected parts of Lesser Himalaya have shown three major types of gold occurrences in Nepal. They are (i) Placer gold (ii) Primary vein type gold and (iii) Synsedimentary gold.

Placer Gold Occurrences

Among the placer gold occurrences (e.g. alluvial and eluvial) only the alluvial placers appear to be of importance in Nepal. Such placer gold occurs in the river basins either in the present flood plains or in the old river terraces. Since historic times alluvial gold has been the important source of gold in Nepal. But till date no modern mining methods have been introduced. After every monsoon floods, local people pan gold from the selected patches of the river beds using simple wooden or metallic pans. During the exploration the authors have recovered submicroscopic to 2.5 mm size gold in Chamliya River and up to 6 mm size in Lungri Khola area. Since 1983, Department of Mines and Geology has been conducting a systematic exploration and assessment of placer gold occurrences along the river channels (mainly in the higher flood plains) of Lungri Khola (66.5 km), Chamliya (about 100 km) and Mahakali rivers (about 100 km). Old terraces are not yet explored except for a few check sampling for the chemical analysis of gold content. Preliminary evaluation of placer gold was also carried out by systematic pitting in 0.23 km^2area in Lungri Khola. But the result is not encouraging. Some of the findings and other important known placer gold occurrences along the major rivers of Nepal are shortly described as below (Fig. 1).

Lungri Khola Area

Tshering (1972) reported placer gold occurrences in the Lungri Khola area of the Rolpa district. Later Paikara (1983) and Joshi (1984) conducted preliminary reconnaissance geochemical exploration along a total of 66.5 km long stretch of river channels (Gajul Khola-6 km, Phagam Khola -17 km, Lungri Khola -16 km, Gam Khola -7.5 km, Bhojyang Khola -10 km, Uma Khola -3 km, Jigribang Khola -4 km and Ghoseng Khola -3 km). Follow up geochemical exploration along 18.5 km long river channels in the Lungri Khola (9.5 km), Phagam Khola (6.5 km) and Gam Khola (2.5 km) was able to delineate some of the potential gold bearing gravel deposits (Fig. 2). Preliminary evaluation of some of these potential deposits in high flood plains were made by test pitting (mining). Sluice boxes, Puddle boxes and gold pans were used to concentrate the gold. From the preliminary evaluation data, 0.4 million cubic meter of proved reserve and 9 million cubic meter of possible reserve of gold bearing gravel has been calculated. The recovered gold particles are of submicroscopic to 6 mm size (Fig. 3). The gold rich gravel is expected to occur at 3 to 5 meter depth at the interface between the river sediments and the bed rocks. Few tests for extracting placer gold from the river beds by using dredging was performed. But the process was hindered by the presence of large boulders in the sediments. The gold content in the gravel varies from 100 to 3100 colours/ton gravel (Fig. 4).

Chamliya-Mahakali River Area

During the reconnaissance survey for alluvial gold in Chamliya River (Kaphle and Khan, 1992) and Mahakali River (Jnawali and Jha, 1993) in Baitadi and Darchula district of far western Nepal, more than 80% of the heavy concentrate samples collected from these rivers contained alluvial gold. The size of gold colours varies from fine dust to 2.5 mm and the numbers range from 50 to over 5000 colours/ton gravel. The gold content in the recent river sediments as well as in the old terraces of the Chamliya and Mahakali rivers are found to be less than 0.001 g to 1.56 g/t gravel. In the heavy concentrate samples it is up to 2900 g/t. On the basis of this survey two potential targets in Raktadi and Panjunaya along the Chamliya River section were identified and recommended for further follow up investigations and evaluation.

Kali Gandaki Region

Bowman (1932) did preliminary prospecting of alluvial gold from Tribeni Ghat to Ainselu Chaur and at Keladighat along the Kali Gandaki river and traced fine to medium size high quality placer gold

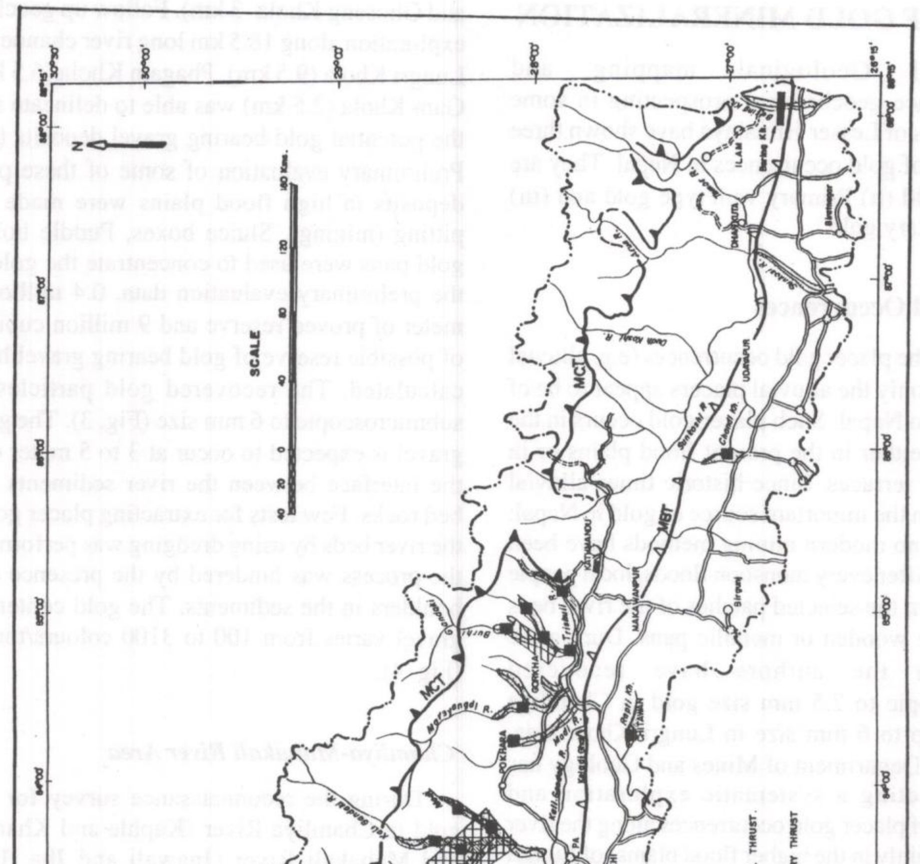

Fig. 1: Map showing gold ocurrences in the Nepal Himalaya.

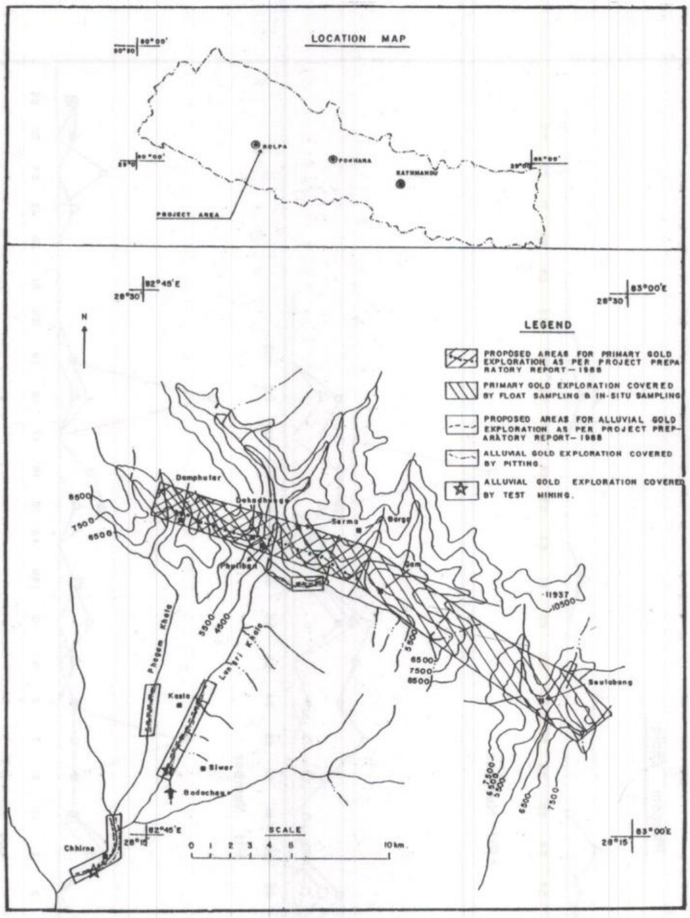

Fig. 2: Map showing the primary and alluvial gold exploration coverage in the Lungri Khola area.

(up to 1.3 g/ton gravel). He has also reported gold platinum alloy in Riri area. According to Chattarjee (1935), Hagen (1969) and Nanda (1966) placer gold occurs at various places along the Kali Gandaki River. Nadgir et al. (1966) traced few fine gold colours in Dana, Modipokhari and Riri sections along Kali Gandaki River and its tributaries. Few elluvial gold particles were also found in Dana area. Manandhar (1964) also reported fairly high concentration of gold in the gravels at Khaniaghat (Baglung) along the Kali Gandaki River. He believed that auriferous rock and quartz lodes exist in between Myagdi and Rahughat along the river. Upstream of Rahughat the gold content becomes negligible. The gold colours in Kali Gandaki are mainly fine grained and flaky to sub rounded in shape. The overall grade is low.

Burhi Gandaki-Trishuli River Area

Singh (1964) carried out preliminary investigations of placer gold in Burhi Gandaki, Trishuli and Modi Khola sections. Preliminary evaluation of alluvial gold from Benighat to Birkhu Khola (about 45 km upstream from Benighat) along Burhi Gandaki showed encouraging results in 26 localities. Follow up investigation has not been caried out as yet.

Modi Khola and Reu Khola (Rapti Valley)

The prospect area lies in the Siwalik Range in Chitwan district of central Nepal. Welch (1955) reported placer gold in Marodi Khola (Rapti Valley), 28 km south of Narayanghat. O'Rourke et al. (1958,1959) also examined placer gold in Marodi

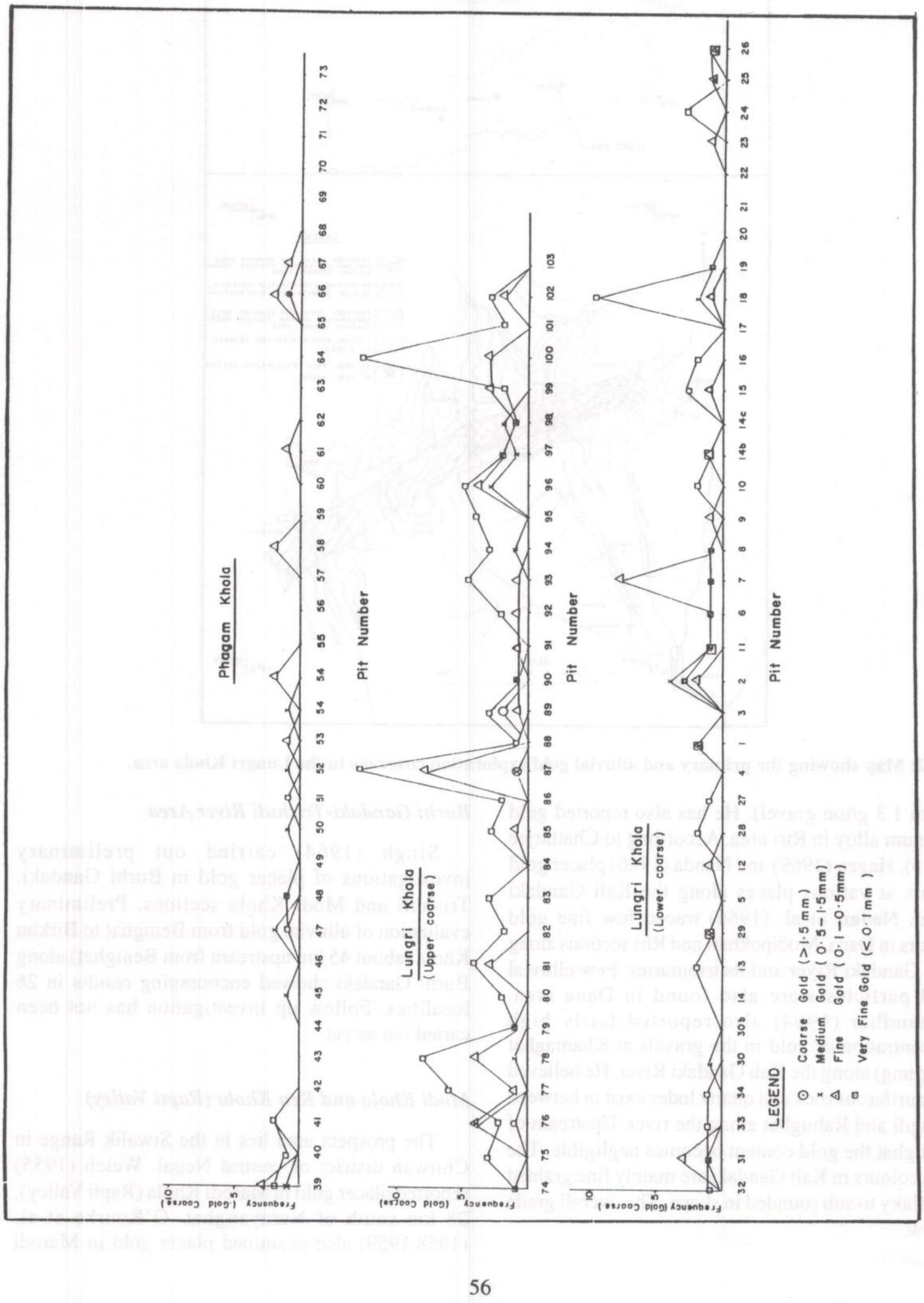

Fig. 3: Size based gold distribution profiles in Phagam Khola and Lungri Khola areas.

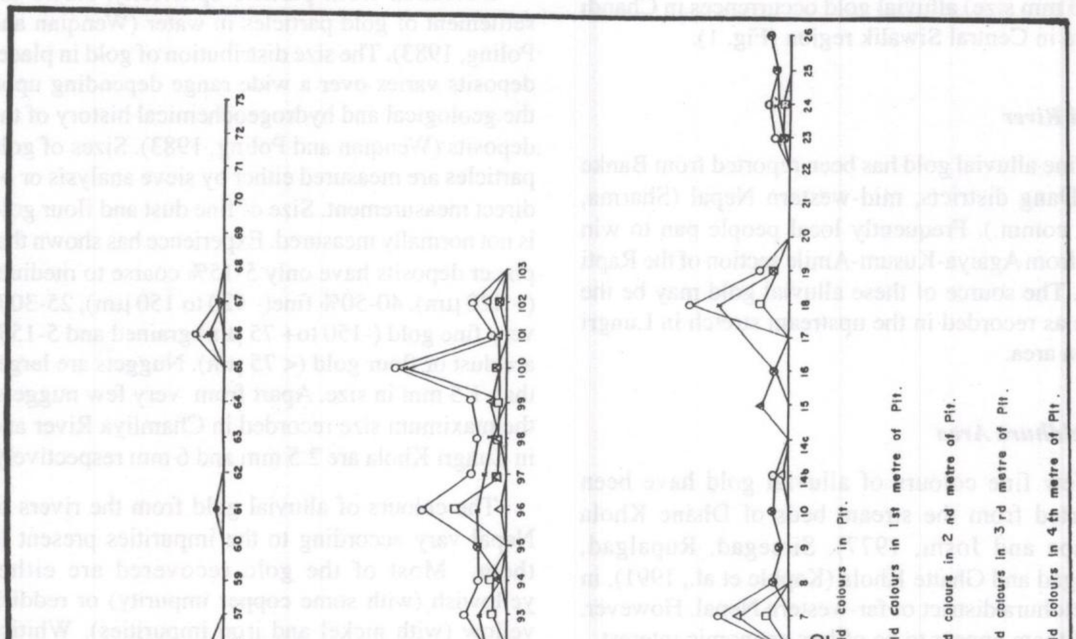

Fig. 4: Frequency based gold distribution profiles of Phagam Khola and Lungri Khola areas.

Khola and the surrounding areas. Some test pits were also dug but the deposit appeared uneconomic. Kaphle and Khan (1989) reported very few fine (up to 0.3 mm size) alluvial gold occurrences in Chandi Khola in Central Siwalik region (Fig. 1).

Rapti River

Fine alluvial gold has been reported from Banke and Dang districts, mid-western Nepal (Sharma, pers. comm.). Frequently local people pan to win gold from Agaiya-Kusum-Amile section of the Rapti river. The source of these alluvial gold may be the same as recorded in the upstream stretch in Lungri Khola area.

Dadeldhura Area

Few fine colours of alluvial gold have been reported from the stream beds of Dhane Khola (Thapa and Joshi, 1977), Sirsegad, Rupalgad, Damgad and Ghatte Khola (Kaphle et al., 1991), in Dadeldhura district of far-western Nepal. However, all of them appear to be of less economic interest.

Other Rivers

Placer gold occurrences have also been reported from Karnali River near Chisapani and Kuine sections (T.P.Ojha, personal comm.), Seti River in Accham, Doti and Bajhang districts, and Bheri River in Rukum and Surkhet districts. Similarly placer gold occurrences have also been recorded from Modi, Madi, Seti, Marshyangdi and Sunkoshi rivers. Systematic investigation for alluvial as well as primary gold sources in these areas are yet to be carried out.

Size, Shape, Colour and Fineness of Placer Gold

The shape and size analysis of the alluvial gold helps to ascertain the distance travelled by the gold particle from the source rock to the site of deposition. In general angular and flaky shape and coarser size indicate their near source where as rounded shape and finer size indicate the sources to be far away (few km to tens of km). Recent alluvial gold exploration in different parts of Nepal revealed that the shape of the gold particles are sub-rounded to well rounded and flaky (flattened).

Deviation from particle sphericity, slows the settlement of gold particles in water (Wenqian and Poling, 1983). The size distribution of gold in placer deposits varies over a wide range depending upon the geological and hydrogeochemical history of the deposits (Wenqian and Poling, 1983). Sizes of gold particles are measured either by sieve analysis or by direct measurement. Size of fine dust and flour gold is not normally measured. Experience has shown that placer deposits have only 5-15% coarse to medium (+ 420 μm), 40-50% fine(- 420 to 150 μm), 25-30% very fine gold (-150 to+ 75 μm) grained and 5-15% are dust or flour gold (< 75 μm). Nuggets are larger than 1.5 mm in size. Apart from very few nuggets, the maximum size recorded in Chamliya River and in Lungri Khola are 2.5 mm and 6 mm respectively.

The colours of alluvial gold from the rivers of Nepal vary according to the impurities present in them. Most of the gold recovered are either yellowish (with some copper impurity) or reddish yellow (with nickel and iron impurities). Whitish yellow gold (with silver impurity) are rare. From the fineness test it is known that smaller the size of the placer gold, the higher the fineness. Fineness value of the placer gold from Nepalese rivers are found to be between 500 and 999. Fineness of two placer gold samples from Lungri and Phagam Kholas showed 846 and 999 respectively (analysis carried out in East African Assay Laboratory, Joshi 1992).

Primary Gold Mineralization (Lode Gold)

Primary gold occurs either in quartz veins, quartz sulphide veins, quartz-carbonate veins or in polymetallic sulphide mineralized zones. They also occur in disseminated forms associated with pyrite, arsenopyrite, chalcopyrite, and pyrrhotite. They may present in the crystal lattice of iron, copper and other sulphide minerals as well. Some of the known primary gold occurrences (Fig. 1) are shortly described below.

Lungri Khola Area

The geological map of the Lungri Khola gold prospect area is shown in Fig. 5. The Lungri Khola

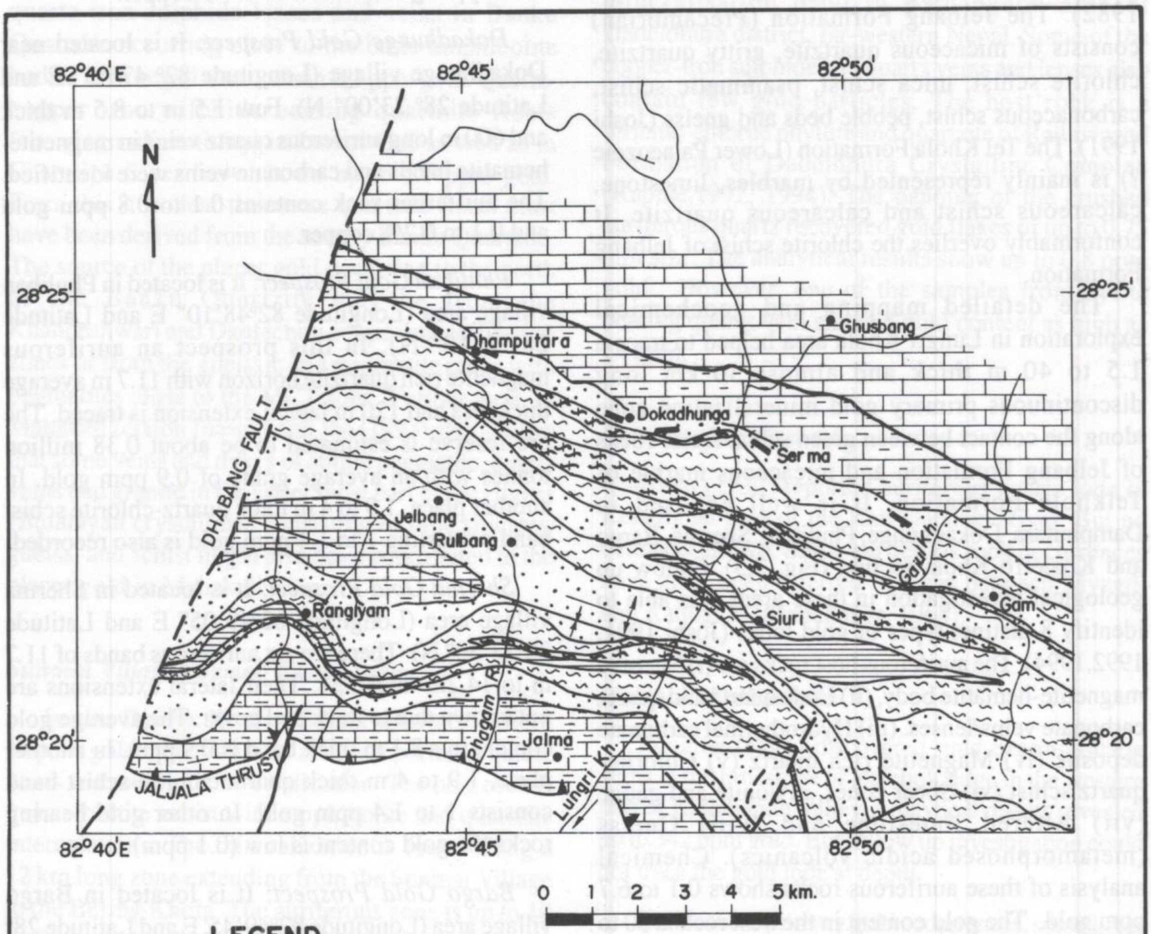

Fig. 5: Geological map of the Lungri Khola gold prospect, Rolpa district, far western Nepal. Legend: 1a. Gneiss; 1b. Quartzite, gritty qiartzitic schist and chlorite schist; 1c. Garnetiferous quartz-muscovite-schist, sericite schist and psammatic schist; 1d. Carbonaceous schist; 2. Tel Khola Formation; 3. Mirul Formation; 4. Strike and dip; 5. Fault; 6. Thrust; 7. Anticline; 8. Syncline; 9. Primary gold mineralization.

gold prespect lies in the Jelbang and Tel Khola formations of the Jaljala Synclinorium (Kansakar 1982). The Jelbang Formation (Precambrian) consists of micaceous quartzite, gritty quartzite, chlorite schist, mica schist, psammatic schist, carbonaceous schist, pebble beds and gneiss (Joshi 1991). The Tel Khola Formation (Lower Palaeozoic ?) is mainly represented by marbles, limestone, calcareous schist and calcareous quartzite. It conformably overlies the chlorite schist of Jelbang Formation.

The detailed mapping and geochemical exploration in Lungri Khola area helped to trace a 1.5 to 40 m thick and almost 30 km long discontinuous primary gold mineralization zone along the contact between green schist facies rocks of Jelbang Formation and micaceous marble of Telkhola Formation. It is well exposed in Damphutara, Dokadhunge, Phuliban, Sherma, Bargo and Khalerro Khola section (Fig. 2,5). Follow up geological investigation in these areas was able to identify 8 distinct types of gold lodes (Joshi 1991, 1992,1994). The auriferous host rocks are (i) Massive magnetite-hematite body, (ii) Lode quartz and quartz carbonate veins/lenses. (iii) Hydrothermal carbonate deposits (iv) Magnetite rich quartz (v) Chlorite-quartz schist (vi) Shear zones, mylonite and gauge (vii) Altered limestone and (viii) Gneiss (metamorphosed acidic volcanics). Chemical analysis of these auriferous rocks shows 0.1 to 6.7 ppm gold. The gold content in the host rock is 30 to 60 times higher than the background value of the surrounding rocks. Field investigations, microscopic studies and rock geochemistry of the host rocks have revealed the occurrence of low grade gold bearing auriferous rocks in Lungri Khola area. The native gold obtained from these lodes are bright yellow. They are flattened, flaky and wedge shaped with submicroscopic to 1 mm in size. Individual prospects are described below.

Damphutara Gold Prospect: It is located in Damphutara village area (Longitude 82°45'45" E and Latitude 28°24'15" N). Joshi (1992) has identified three auriferous bands of 1.2 to 3.5 m thickness. Chemical analysis of the ore samples revealed 1.05 to 1.7 ppm gold. Several trenches were dug across the mineralized bands. Seven auriferous bands of 1 to 31 m thickness and eight auriferous bands with 0.8 to 15.7 m thickness were traced. Probable ore reserve is calculated as 0.4 million tons ore with 0.1 to 0.3 ppm gold and 0.2 to 0.4% copper.

Dokadhunge Gold Prospect: It is located near Dokadhunge village (Longitude 82° 47'45" E and Latitude 28° 23'00" N). Few 1.5 m to 8.5 m thick and 600 m long auriferous quartz veins in magnetite-hematite bands and carbonate veins were identified. The auriferous rock contains 0.1 to 0.8 ppm gold and 0.1 to 0.2% copper.

Phuliban Gold Prospect: It is located in Phuliban village area (Longitude 82°48'10" E and Latitude 28°23'10" N). In this prospect an auriferous magnetite rich quartzite horizon with 11.7 m average thickness and 120 m lateral extension is traced. The ore reserve is estimated to be about 0.38 million tonnes with an average grade of 0.9 ppm gold. In another place, 1.9 to 4 m thick quartz-chlorite schist band consisting 1 to 1.4 ppm gold is also recorded.

Sherma Gold Prospect: It is located in Sherma village area (Longitude 82°49'05" E and Latitude 28°23'50" N). There are six auriferous bands of 11.7 m to 14.2m thickness. Their lateral extensions are not known due to thick soil cover. The average gold content in a 8.1 m thick band is 0.9 ppm. In another place, 1.9 to 4 m thick quartz chlorite-schist band consists 1 to 1.4 ppm gold. In other gold bearing rocks the gold content is low (0.1 ppm).

Bargo Gold Prospect: It is located in Bargo village area (Longitude 82°49'45' E and Latitude 28° 32'35" N). Only four auriferous quartzite bands of 0.9 m to 3 m thickness and containing 0.2 ppm gold are reported (Joshi, 1992). They contain low magnetite and copper iron sulphide minerals.

Khaleroo Khola Prospect: It is located in Khaleroo Khola area (Longitude 82°55'00" E and latitude 28°20'30" N). Joshi (1992) also reported lode quartz vein and hydrothermal carbonate from the limestone and calcareous schist. In situ mineralization has not been identified. But floats containing 0.2 to 3.25 ppm gold are reported.

Chamliya-Mahakali River Area

Very fine grained primary gold mineralization has also been reported in the quartzite and copper-iron sulphide bearing quartzite bands within Banku Quartzite of Purchaunni Crystalline Complex. These quartzites are radioactive. Some of the mineralized bands and lenses are exposed in Boregad, Bangabagar, Baggoth and Jamari Gad sections (Fig. 6). Analytical results of the samples from these outcrops revealed 0.2 to 1.2 ppm gold. Some other quartz-iron sulphide lenses and veins in Banku Quartzite occurring close to the basic amphibolite bodies in Boregad also contain 0.2 ppm gold. Quartz-copper iron sulphide bearing quartzite floats (showing radioactivity) in Jamari Gad as well as in Chamliya River have shown up to 5.6 ppm gold. From this it is clear that these quartzite floats must have been derived from the nearby Banku Quartzite. The source of the placer gold occurring to the north of the Banku Quartzite may be from the Khandeshwari and Danfechuli copper mineralization zones or from the gneissic and migmatite rocks with pegmatites close to the MCT zone. Further west, in Mahakali section Jnawali and Jha (1993) also believe that some veins and dykes of aplitic pegmatite, quartz veins and granite in the upper most part of the Higher Himalayan crystallines consisting of lime silicates, gneiss, and schist might also have contributed to the placer gold in Mahakali River.

Sunmai Village- Bering Khola Area

In the Bering Khola of Ilam district, Eastern Nepal a gold mineralization zone is reported in quartz veins with sulphide mineralization. The host rock is quartz-biotite schist with amphibolite and quartzite intercalations. The mineralization is found along a 12 km long zone extending from the Sunmai Village to the Bering Khola. The auriferous zone is up to 10 m thick and lies 200 m above the bering Khola pyrite deposit (Talalov, 1972). In Sunmai Khola it is exposed close to a water fall. In the host rock yellow gold flakes of 0.1 to 0.15 mm size are noted along the cracks of quartz. Other associated minerals are mainly arsenopyrite,pyrite and copper and rarely antimonite and bismuthinite. Chemical analyses of a few auriferous quartz vein samples and host rocks have shown 0.039 ppm gold. Gold content was also confirmed by heavy concentrate samples collected from selected quartz veins and the host rocks. Low sulphide gold mineralization is anticipated in this area.

Dadeldhura Area

Joshi (1982) and Kaphle (1982) reported 1 to 2 m thick few auriferous quartz lenses occurring in the uppermost part of the polymetallic sulphide mineralisation band in Bamangaon area of Dadeldhura district, far-western Nepal. Some of the copper-iron sulphide and quartz veins and lenses also contain few gold particles. The host rock is a sericitic-chlorite phyllite and quartzite of Raduwagad Formation of Dadeldhura Crystalline Complex (Kaphle,1992, 1994). The panning of the crushed auriferous quartz recovered gold flakes of up to 0.75 mm size. The analytical results show up to 0.8 ppm gold. However, one of the samples from pyrite bearing quartz vein showed gold content as high as 14 ppm.

Kali Gandaki Basin

Bowman (1932) reported auriferous quartz lode in Keladighat area of the Kali Gandaki River. But no details is known. Some auriferous rock occurrences have also been inferred in areas between Myagdi and Rahughat (Manandhar, 1964).

Halchok, Kathmandu

Jhingran (1941) discovered gold bearing quartz veins in the limestone of Halchok ridge in the western part of Kathmandu Valley. Analytical results revealed up to 342 ppm gold. But follow up investigation could not trace the gold lode at depth.

Beside these primary gold occurrences, some other gold bearing quartz-copper-iron sulphide ores (with few ppm gold) from Pandav Khani copper prospect (Baglung district) and Chhirling Khola copper prospect (Bhojpur district) have also been reported.

Synsedimentary Gold Mineralization

Siwalik Region

O'Rourke (1959) carried out heavy concentrate sampling of sandstone from Siwalik Formations in Marodi Khola section but could not trace any gold. However, some colours were found in Rau khola. From the Lower Siwalik rocks, Talalov (1972) reported the

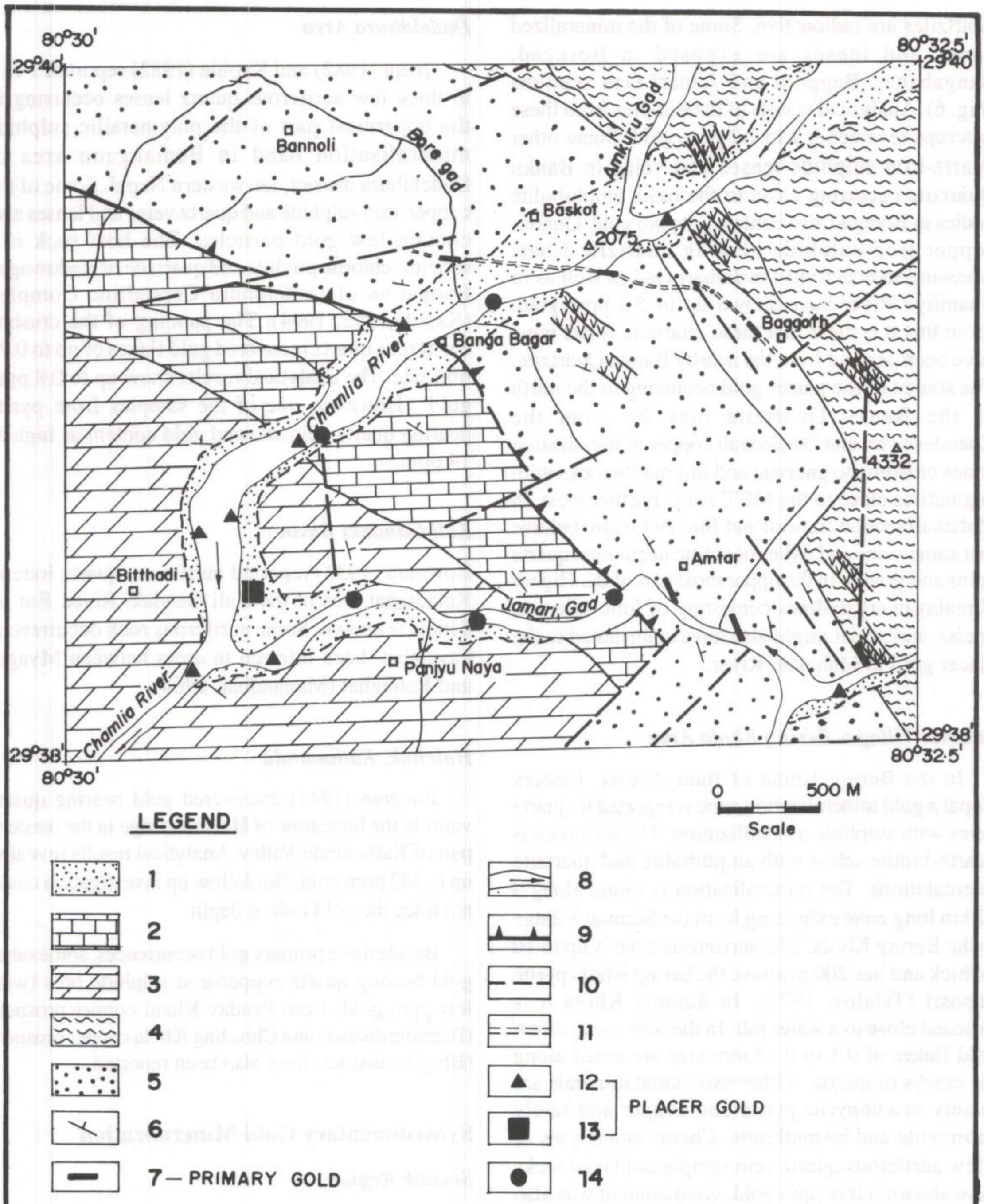

Fig. 6: Geological map of a part of Chamliya River and Jamari Gad area, Baitadi district, Far Western Nepal. Legend: 1. Quaternary Deposit; 2. Upper Malekhu Limestone; 3. Lower Malekhu Limestone; 4. Amkuru Phyllite; 5. Banku Quartzite; 6. Attitude of Beds; 7. Primary Gold; 8. River Channels; 9. Thrust; 10. Fault/Lineament; 11. Radioactive Quartzite; 12. & 13. Placer Gold; 14. Primary Gold.

presence of gold at Dubichaur (0.06 ppm gold) and Naganoli (0.015 ppm gold) villages, both lying to the north of Hetauda town. Kaphle and Khan (1989) also reported very few fine gold flakes from the conglomerate beds of Upper Siwaliks exposed in the westernmost tributaries of Chandi Khola, Makwanpur district, Central Nepal.

GENESIS OF GOLD

Disseminated primary gold occurrences in some quartzite and chlorite-mica schist in Lungri Khola, Chamliya and Sunmai-Bering Khola areas in Lesser Himalaya appear to be of syn-sedimentary origin. Possibly such gold have been deposited as ultra fine particles (as flour gold or dust gold). Later on they were chemically reworked and may have concentrated in particular horizons during diagenetic process. Subsequently when they got metamorphed secretion of gold ore shoots produced the lodes. It is also believed that the gold in quartz veins, quartz-sulphide veins, quartz-carbonate veins etc. are related to hydrothermal activity. In shear zones, however, they may be related to the syn-tectonic activity which is responsible for mobilising the gold from the source rocks. Occurrence of primary gold in quartzite and phyllite bands located close to the amphibolite bodies indicate that some of these basic rocks could also be the source for gold.

The placer gold occurrences in all the river beds and terraces described above are the result of weathering and erosion of the primary source rocks present in their catchment areas and the pay streaks are the result of gravity processes operating during the weathering and subsequent deposition. The placer gold occurrences in the rivers of the Siwaliks may be due to the reconcentration of the gold derived from the Siwalik rocks themselves (mainly from the Upper Siwalik pebble and boulder beds). These are the second cycle placer deposits.

CONCLUSIONS

A widespread occurrences of placer gold have been recorded along the channels and terraces of the major rivers of Nepal. A number of primary gold sources (auriferous zones) have also been identified in many parts of the Lesser Himalayan regions.

About 33 primary gold mineralization zones of 1.5 to 40 m thick and of few meters to hundreds of meters in length have been identified in different stratigraphic horizons in the Lungri Khola area. Individual auriferous bands (1.5 to 29 m thick) containing 0.1 to 6 ppm gold and 0.1 to 0.4% copper confirm the existence of a large tonnage but low grade/gold reserve. Selective small scale gold mining could be possible in some of the rich lodes in the Lungri Khola area. Further systematic gold exploration in the prospective areas may lead to the discovery of economically viable gold deposits in Nepal.

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