THE POTENTIAL FOR DISCOVERY OF ECONOMIC GOLD DEPOSITS IN SRI LANKA

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ABSTRACT

Historical records such as Mahawamsa and recent archeogeological observations indicate that gold was mined in large quantities in Sri Lanka during the ancient times. At present small quantities of gold are mined from alluvial placer accumulations. Present investigations show that significant quantities of alluvial gold occur in the zone lying between the gem-bearing gravel layer and the decomposed bed rock in the areas drained by Walawe Ganga and its tributaries such as Kiri-ibban wewa. In such zones, the gold content varies from place to place and concentrations up to 9g per tonne of sediment were observed. The gold grains show different morphological features and occur as dust, flakes and nuggets. Some grains contain 100% Au whereas others have lesser amounts with the balance being constituted of Ag, Cu and Mn.

The Walawe Ganga basin lies near the eastern boundary of the Precambrian Highland Complex rock terrain of Sri Lanka. The highest alluvial placer gold concentrations are found in zones of intense shearing and fracturing in the country rock which are commonly mineralized with sulphides and carbontes and intruded by quartz veins and pegmatites. The source of the gold in Walawe Ganga basin sediments appears to be young fracture controlled mineralization in the Highland Complex rocks.

Introduction

Various historical records (Mahawamsa, Thupawamsa) give evidence of gold mining in different parts of ancient Sri Lanka. One large scale gold mine has been in *Acaravittigama*, presently known as Kebithigollawa (Fig. 1). The native gold found in the mine had shapes varying from nuggets to dendritic form and sizes up to several centimetres in length. During the British rule of the country gold has been mined (Le Mesurier, 1893) from a vein like body in Ramboda (Fig. 1), which had a concentration of 28g per tonne of ore and also they found small quantities in the Nuwara Eliya area. Gold in small amounts has been reported (Ceylon Administrative Reports: Part IV, 1905) from the central, south-western and southern parts of the country. Recent geochemical analysis of stream sediment from central highlands (Ramakrishna, et al 1987) have shown relatively high gold concentrations. Some attempts have also been made to use the village names as a guide for gold occurrences (Karunaratne and Dissanayake 1990). The association of gold with heavy minerals in gem-bearing sediments from the Balangoda-Weligepola area (Fig. 1) was reported by Dissanayake and Nawaratne (1981), and Nawaratne and Wijeratne (1995).

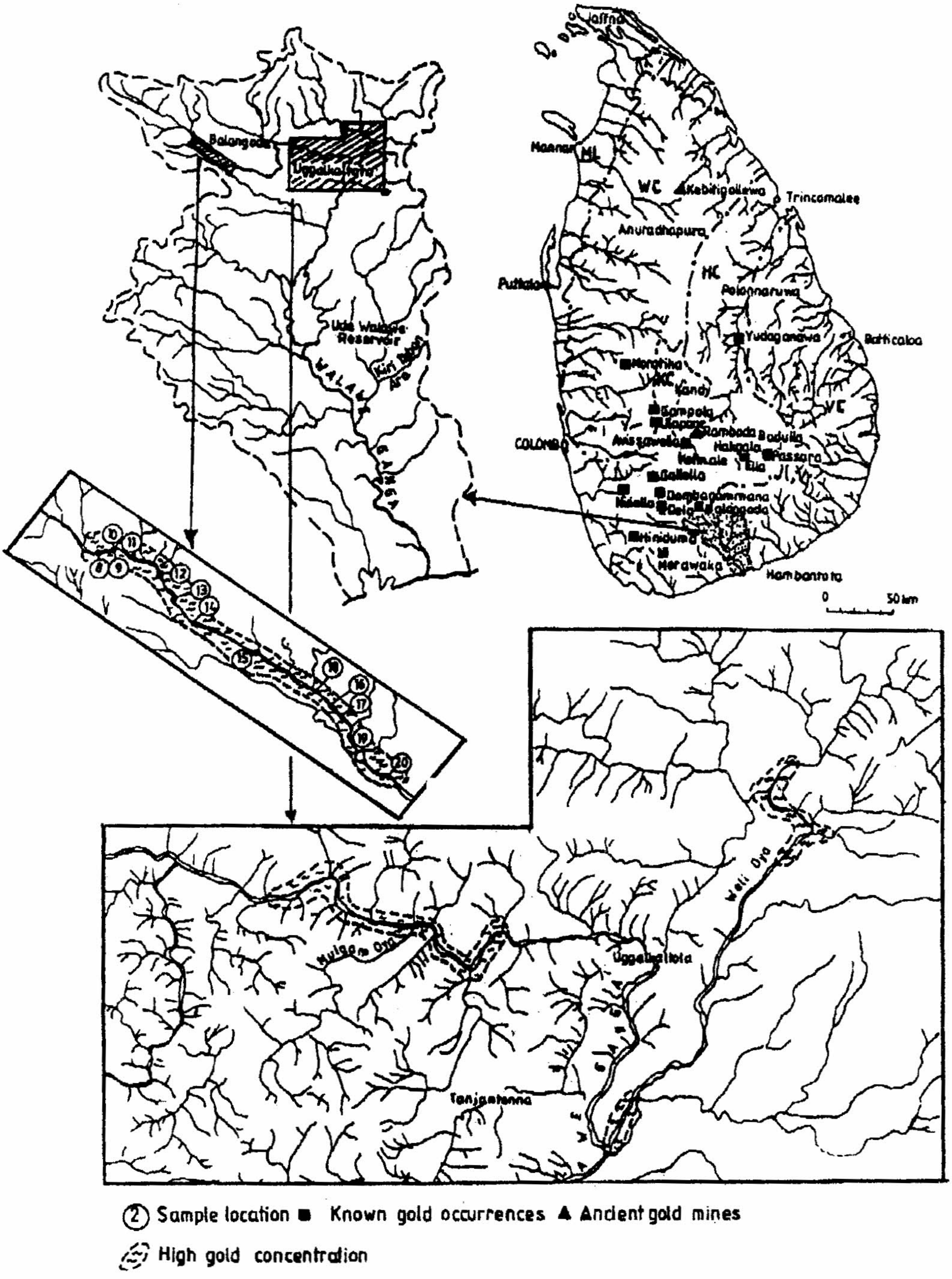

Fig. 1. The Walawe ganga basin of southern Sri Lanka showing areas of high gold concentration.

Currently, small amounts of placer gold are recovered by miners using traditional mining techniques specially developed for gem mining in rivers. Mammoties with long wooden handles are employed to recover both gemstones and gold by a process of dredging. This technique lets running water sort out and remove the lighter particles from the dredged river bed leaving a pile of heavy sediments and gravels. The gems and gold grains are hand picked or collected by panning the heavy sediments. From the flood plain sediments gold is recovered directly by panning. e.g. Kiri Ibban Ara/ Kiri Ibban Wewa (Fig. 1).

This paper reports the results of geological, sedimentological and geochemical and studies carried out in the Walawe Ganga basin of southern Sri Lanka (Fig. 1).

Geologic Setting

More than 90% of Sri Lanka is underlain by high-grade metamorphic rocks of Precambrian age and the rest is underlain by sedimentary rocks of Jurassic to Miocene age. The three major divisions of the Precambrian gneisses are known as Wanni Complex (WC), Highland Complex (HC) and Vijayan Complex (VC) (Cooray 1994) (Fig. 1).

The upper part of Walawe basin belongs to the HC and is underlain mainly by charnockites with occasional high garnetiferous varieties. The other major rock types in the basin include biotite (-garnet) gneiss, quartzite, crystalline limestone, assemblages of garnetiferous graphite gneiss, graphite bearing schists, graphite sillimanite-garnet gneiss etc. In the charnockitic rocks, pyrite occurs as an accessory mineral. Crystalline limestones are found interbedded with the other rocks or as plastically mobilized structures cross cutting the adjacent rocks.

Large and small scale intrusive rocks with compositions ranging from acidic to ultrabaic are common in the area. Pegmatitic intrusions, sometimes with well developed graphic texture and quartz veins vary from a few millimetres to several meters. Large intrusions of syenitic composition with big zircon crystals occur in the Walawe basin near Balangoda (Fig. 1). Mafic to ultramafic dykes occur at various locations. Significant amounts of pyrite, muscovite and carbonate minerals are found in the shears and fractures as secondary minerals. Wallrock alteration occurs associated with these mineralized fractures and are characterized by secondary minerals such as carbonates, hornblende and biotite. The quartz veins and pegmatites are associated occasionally with large crystals of garnet, sulphide minerals and radially arranged graphite.

Relatively young structural features such as ductile and brittle shears occur in the area at a high intensity. Some lineaments in the Walawe river basin runs for more than 20 km.

Gold and Other Minerals on the Stream Bed

The Walawe Ganga is rich in gemstones and has a long history of gem mining. The gemstones found in the gem-bearing gravel layers of the river include blue, white, pink and yellow sapphires, rubies, red and blue star sapphires and geuda, white beryl and aquamarine, alexandrite, cat's eyes and chrysoberyl with brownish shades, almandine, pyrope and grossularite, green, purplish and pink zircons, various shades of tourmaline and spinel, topaz, white-, purple/pink (amethysts), smoky quartz and quartz cat's eyes.

The heavy minerals are concentrated in the gem-bearing sediment layer. In the panned concentrates of the sediments from the gem-bearing layer, illuminate and garnet are the dominant minerals with rutile, monazite, tourmaline, corundum, zircon, diopside, apatite, spinel, pyrite and topaz occuring as accessories. Due to its high specific gravity gold in the forms of dust, nuggets and flakes has concentrated in the zone between the gem-bearing layer and the underlying decomposed rock.

Table I. Gold content in the sediments of the Walawe River (Sample locations are given in Fig. 1)

Location	Gold Content mg/kg	Location	Gold Content mg/kg	Location	Gold Content mg/kg
2	9.33	8	4.09	14	3.15
3	3.43	9	5.18	15	4.50
4	3.75	10	4.35	16	3.52
5	3.80	11	3.81	17	3.43
6	5.70	12	3.29	18	4.02
7	9.28	13	3.27	19	2.76

The values >2 mg/kg are given in the Table I. The other locations on Fig. 1 gave values between 0.5 to 2 mg/kg.

Characteristics of Gold Grains

Gold grains ranging from < 0.5 mm up to about 7 mm in length were recovered from the Walawe Ganga and some of the grains were more than 1g in weight. Grain morphology was studied under reflected light using the petrological microscope. More detailed observations were made using the Electron Probe Micro Analysis (EPMA). Some grains are angular in shape but show corrugations perhaps due to attrition. Others grains are nuggets with depressions of various shapes and partially rounded outlines. The grains with rounded outlines and corrugations and depressions may have a longer history in the sediment than those with sharp edges. The gold grains with angular outlines indicate little or no transportation since their release from the source rock and also they are not far from the sites of primary mineralization.

Electron Probe Micro Analysis (EPMA) and Energy Dispersive Analysis of X-Rays (EDAX) confirmed the mineral and chemical composition of the grains. All the measured grains gave perfect X-Ray diffractograms indicating that the grains are not amorphous. The analysis also showed that the silver content of individual grains varies from about <1% to >35%. The grains with angular outlines gave high values for silver which is characteristic of natural gold-silver alloys (Boyle, 1979). Table II shows some chemical compositions of gold grains.

Table II. Composition of gold grains

Sample No.	Au %	Ag %	Cu %	Mn %
LFB1.2	97.90	1.31	0.23	0.55
RSB12	99.24	0.10		0.65
RSB17	62.06	35.06	2.48	0.40
SGB01	63.45	29.57	6.98	
GMB1	99.34	0.66		
GMB2	99.50			0.50
GMB3	100.0			
WO/5	97.65	0.95		
WO/7	96.30	1.70		
WG/11	98.20	0.70		
WG/18	98.65	0.85		

Discussion and Conclusion

The study shows that gold occurs in varying amounts in the sediments of the Walawe Ganga. The rocks in the zones of gold occurrences in the river are within the areas of highly deformed rocks of the highland complex.

The distribution of angularity of gold grains along the course of the river is irregular suggesting that gold grains have been added to the river sediment at different locations. This indicates several sites of mineralization.

A peculiar relationship occurs between the composition and the morphology of gold grains. This can be easily seen in the angular grains with high silver contents. Shed gold grains with low silver contents could indicate that natural gold grains in the source rocks had low silver content or original high silver was leached out as a function of the time being in the river sediments. This is evidenced by the grains that have higher silver contents in the core portions than that in peripheral zones. The difference in the silver content may also be indicative of several sites of gold mineralization.

The sites of high gold concentration are in a zone of intensive deformation with closely distributed shears and fractures some of which extend over several tens of kilometres. Alteration minerals (Davies, et al 1979) such as sulphides, carbonates, quartz, biotite, garnet and hornblende on the walls of these fractures and shears give evidence for fracture filling mineralization. In addition pegmatitic intrusions which are sometimes associated with quartz veins and large mica mineralizations and sometimes rich in topaz also indicative of active pegmatitic and hydrothermal phases. These mineralizations and associated quartz veins are the possible source of placer gold in the Walawe river basin. This area is lying in the most southern part of a zone recognized as a mineralized belt (Munasinghe and Dissanayake 1979). The research is being continued on gold mineralization in Sri Lanka as economical quantities of gold could occur in the rocks of such zones.

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