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GOLD-QUARTZ-SULPHIDE REEFS OF MANGALUR, GULBARGA DISTRICT, KARNATAKA

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GOLD-QUARTZ-SULPHIDE reefs of Mangalur deposit are situated within the metabasic volcanic rocks in the south central part (near Mukangavi) of the Mangalur greenstone belt (figure 1). Exploration by the Geological Survey of India (GSI) and development of the mine by Hutti Gold Mines during recent years have resulted in establishing a sizable gold ore reserve of 70,000 metric tons of an average grade of

3 g/ton of gold¹. The mine was reopened in 1981 and developed by Hutti Gold Mines Co. Ltd.

The investigated area is characterized mainly by different variants of metavolcanic rocks such as coarse-grained amphibolite, banded amphibolite and schistose amphibolite. The rock types are involved in deformation which is evident from minor structures. Gold mineralization occurs within the metavolcanic rocks which were tholeiitic basalts regionally metamorphosed under medium to low-grade greenschist facies. There exists a geochemical similarity of these Archaean gold-bearing metabasic volcanic rocks of Mangalur with the oceanic tholeiites generated at marginal basin tectonic environment². The parent rocks have undergone some fractionation and appear to be derived from melts generated by 10 to 25% melting of the mantle.

The Mangalur gold deposit includes two gold-quartz-sulphide reefs. The main reef is almost N-S and dips at a steep angle 80° due west. This reef extends over a strike length of 350 m with an average width of 3 m. There is a shaft on the reef namely, Holman shaft. The mining depth is about 190 m in the main reef. Another gold-bearing quartz-sulphide reef is delineated over a strike length of 190 m with a width of 2–2.5 m. This reef runs nearly parallel to the main reef. However, this reef is not mined. The distance between the two reefs varies from 35 to 40 m. The reefs occur within shear zones. The host metabasic volcanic rocks in the shear zones are chloritized, biotitized and carbonatized. The reefs are conformable to the regional trend of the greenstone belt, showing bifurcation at places.

Gold-quartz-sulphide reefs of Mangalur deposit are characterized by the presence of disseminated streaks and grains of sulphides in the schistose amphibolites associated with thin quartz veins parallel to schistosity and abundant biotite, chlorite, sericite and carbonates (ankerite + calcite) indicating wall-rock alterations suggestive of the broad mechanism underlying gold mineralization in the area. Gold-bearing quartz is present in the form of parallel and/or enechelon bands, veins, lenses and stringers emplaced parallel to sub-parallel to the schistosity of amphibolite. Observations of quartz bodies underground reveal that gold-bearing quartz veins are controlled by linearly extending shear zones and based on their morphology and internal structure, they can be classified as mineralized zones. Most of the reefs are localized where the schist of the shear zones has been highly dragged and contorted particularly at gentle flexures in strike

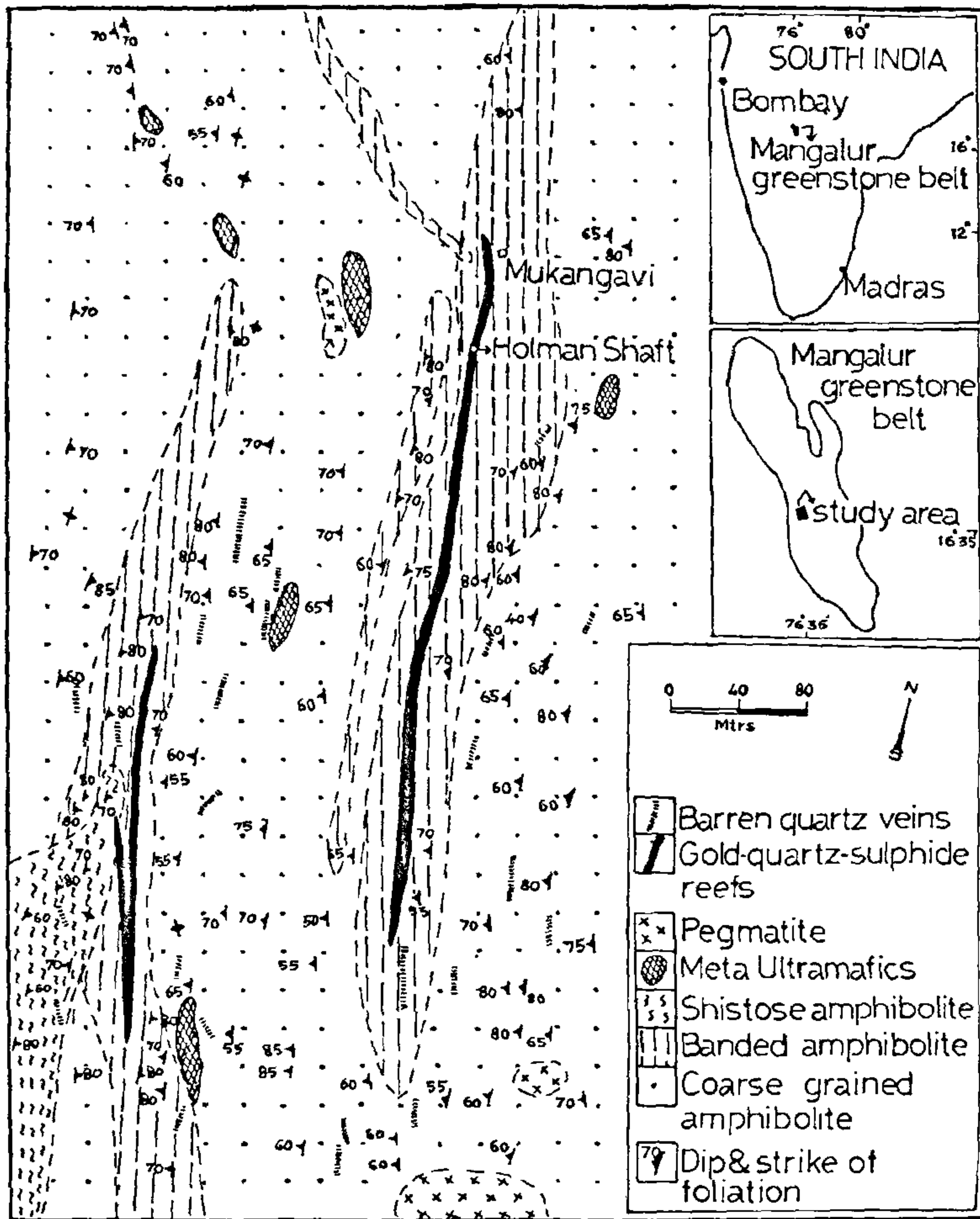


Figure 1. Geological map of Mangalur gold deposit.

and dip. In a few places quartz stringers and lenses occur within the shear zones which show little contortion and no observable relationship to any internal structural features. These lenses have probably formed in open dilatant zones that are localized by flexures or other features in the walls of the shear zones. Intense deformation and boudinage of gold-quartz veins are related to dynamometamorphic events associated with the last stage of folding, faulting and metamorphism. Gold-bearing quartz varies in colour from grey, blue to bluish black and

in structure from cryptocrystalline to coarse-grained. Thin section study reveals the presence of banded textures, corroded boundaries and the presence of sulphides and relic amphiboles. These are the characteristic features of gold-bearing quartz of Mangalur reefs. Gold-quartz veins are characteristically enveloped by alteration zones of schistose rocks derived from the original metabasic wall-rocks. Mineral associations found in the alteration zones represent a complete sequence of metasomatic alteration. Studies of these rocks reveal a

sequence of alteration zones viz. sericite-biotite-chlorite schist \pm carbonates (ankerite + calcite) at the immediate contacts of the gold-quartz veins followed by biotite-chlorite schist, chlorite-biotite schist, tremolite-chlorite schist. The dominant sulphide phase is pyrrhotite-pyrite assemblage with little amount of arsenopyrite, chalcopyrite and sphalerite. Gold occurs only in the native state. Occasionally, it occurs in spectacular visible form.

Chemical changes of major elements in the alteration zones of gold-quartz-sulphide reefs of Mangalur are characteristically marked by appreciable gain of K_2O (3.65%) and volatile contents (LOI = 10.12%), and loss of Na_2O (0.28%) and SiO_2 (34.48%) towards the gold-quartz veins as compared to their regional background values in the least altered amphibolites of Mangalur greenstone belt (K_2O = 0.33%, LOI = 2.38%, Na_2O = 2.54% and SiO_2 = 51.05%²). Many of the trace elements like Ag, As, Mn, Cu, Zr, Sb, Co, Ni, Pb, V and Y show gradual enrichment towards the gold-quartz veins of the reefs. Reefs analyse higher concentrations of elements like Ti (480 ppm), Ni (32 ppm), Cu (44 ppm), Mo (10 ppm), Zn (38 ppm), Cr (120 ppm), Ba (40 ppm) and Rb (47 ppm). The presence of such trace elements and relic host amphiboles in quartz veins reveals the important role 'metasomatic processes' played in the formation of these gold-quartz veins.

Mineralogical and geochemical features of gold-quartz-sulphide reefs of Mangalur deposit have shown that the gold and other gangue elements initially present in the basic volcanic rocks were mobilized by metamorphically derived hydrothermal solutions and concentrated in suitable tectonic structures and chemical traps during metamorphic overprinting to form the gold-quartz-sulphide reefs.

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EFFECT OF INCREASING CO_2 CONCENTRATION ON PHOTOSYNTHESIS AND PHOTORESPIRATION IN WHEAT LEAF

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GROWTH rates of plants under laboratory conditions can be accelerated by enriching the air with CO_2 . This increase in the growth rate is mainly due to the increase in the rate of CO_2 fixation. It has been reported¹ that in some plants, having C_3 carbon metabolism, the rate of photosynthesis is doubled by doubling the level of atmospheric CO_2 . By increasing the CO_2 level photorespiration becomes insignificant and thereby photosynthesis increases to a maximum². The present investigation reports the level of enhancement in photosynthesis and the changes in the products of photorespiration due to the CO_2 enrichment on wheat leaf.

Wheat plants (winter wheat cv. Augusta) were grown in a growth cabinet under $1000 \mu E m^{-2} sec^{-1}$ at $20^\circ C$. When the plants were 20-day-old, the third fully expanded leaf was excised and dipped into water before placing in a photosynthetic chamber (112 ml capacity). The leaf was then exposed to light ($800 \mu E m^{-2} sec^{-1}$) from one side and to an atmosphere of air with different CO_2 concentrations. The concentrations of 100, 340, 600, 1000, 3,400 and 10,000 ppm were employed in the present work. The desired level of CO_2 was generated in a 5 gallon reservoir by acidifying a known amount of $CaCO_3$. The enriched air from the reservoir was supplied to the photosynthetic chamber by displacing the air. The leaf was initially preincubated with the desired level of CO_2 for 30 min by flushing it with 0.5 l/min of the gas from the reservoir³. After this photosynthetic pretreatment, the leaf was exposed to $^{14}CO_2$ by releasing it from $Ba^{14}CO_3$ from the side arm of the chamber. The added $^{14}CO_2$ did not significantly change the total CO_2 concentration. After 5 min of incubation, the leaf was killed by boiling it in 80% (v/v) ethanol for 10 min, reextracted in boiling water. The radioactivity of the combined extract was counted in a liquid scintillation counter. An aliquot of the extract was run for two-dimensional paper chromatography and the labelled products were identified using a co-chromatograph³. The radioactivity was counted after eluting the spots by boiling ethanol.