ABSTRACT

India is known to have about 700 gold prospects and occurrences spread over 13 states of the country. About 90 prospects among the 700 have resources which have the potential to deliver mineable gold reserves. About 491 tons of gold resources are known to exist in these deposits/prospects besides 167 tons of reserves. Potential exists in the known geological tracts of the country to identify an additional 1000 tons of gold.

India is bestowed with numerous gold prospects, like world class examples of Kolar Gold Fields, Hutti Gold Fields and Gadag Gold Fields. Fortunately, all of these gold deposits are located within Karnataka, emphasising the fact that, Karnataka is the prime state for gold production. Apart from these world class gold deposits, several other gold prospects were identified and exploration activities are under progress. It is vital to re-establish India as a prime gold producer in the world and hence it is necessary for exploring additional gold prospects. Sandur Schist Belt is well known for its gold occurrences. Vasudev, et al., (1994); Radhakrishna (1996) and Naqvi, et al. (1996) have reported numerous gold occurrences from Copper Mountain, Lingadahalli, Taranagar and Joga area. Joga area has indicated presence of gold with the abundance of sulfidic Banded Iron Formations. Manikyamba, et al., (1997) have reported 2.9g/t gold value from Joga area. These facts have created an inspiration to take up research work on the area.

Mineral assemblages formed during hydrothermal alteration reflect the geochemical composition of ore-forming fluids. Gold is mainly transported in solution as Au-Cl and Au-S complexes. The change of physicochemical conditions such as temperature, pressure, oxygen fugacity, and sulfur fugacity are effective mechanisms for gold precipitation. Gold tends to be concentrated in the vapour phase of fluids at high temperatures and pressures. Au-As and Au-Sb associations are common in gold deposits. Native antimony and/or arsenic or native gold assemblages may precipitate from hydrothermal fluids with low sulfur fugacity. Hydrothermal fluids forming epithermal gold deposits are Au-saturated in most cases.

The Archaean greenstone-granite terranes constitute more than 70% of the continental crust in many Cratons of the world. They are generally composed of granitoid gneisses that occupy large areas interspersed with small linear supracrustal belts referred to as
greenstone belts. Various geological, geochemical and geophysical studies on these greenstone-granite terranes have contributed significantly to our understanding on the formation and evolution of the Earth’s crust during the Archaean. Precise information about the age of formation of the granitoids and metavolcanics of the granite-greenstone terranes and timing of metamorphism, deformation and associated gold mineralization would give a better understanding of Archaean crustal evolution and metallogeny.

The Dharwar craton in peninsular India is composed of vast volumes of granitoid rocks represented by tonalite-trondhjemite-granodiorite (TTG) gneisses, granodiorites, quartz-diorites, monzodiorites and granititic plutons. A sinistral shear zone running roughly north-south divides the Dharwar craton into western and eastern blocks. While the western Dharwar craton is characterized by the presence of schist belts of large areal extents, the eastern Dharwar craton is characterized by the presence of relatively narrow and smaller schist belts. A major phase of granitoid gneisses surrounding the schist belts of the western Dharwar craton are older than the schist belt rocks themselves and are considered to form the basement. But in the eastern Dharwar craton the granitoid rocks are either intrusive or in tectonic contact with the schist belt rocks.

Convergent margin magmatic associations are dominated by tholeiitic to calc-alkaline basalts compositionally similar to recent intraoceanic arcs. As well, Boninitic flows sourced in extremely depleted mantle are present, and the association of arc basalts with Mg-andesites-Nb enriched basalts-adakites documented from Cenozoic arcs characterized by subduction of young (<20 Ma), hot, oceanic lithosphere. Consequently, Cenozoic style “hot” subduction was operating in the Neoarchaean. These diverse volcanic associations were assembled to give composite terranes in a subduction-accretion orogen at c2.7 Ga, coevally with a global accretionary orogen at c2.7 Ga, and associated orogenic gold mineralization.

Gold deposits of the eastern greenstone belts are comparable to those of the younger greenstone belts of Canada, Zimbabwe and Australia where the mineralization is associated with quartz carbonate veins often in iron rich metabasic rocks. The gold was emplaced as hydrothermal fluids, derived from early komatiitic and tholeiitic magmas, and injected into suitable dialatent structures.
Greenstone hosted quartz carbonate vein deposits are structurally controlled, complex epigenetic deposits that are hosted in deformed and metamorphosed terranes. They consist of simple to complex networks of gold bearing, laminated quartz carbonate fault fill veins in moderately to steeply dipping, compressional brittle-ductile shear zones and faults, with locally associated extensional veins and hydrothermal breccias. They are dominantly hosted by mafic metamorphic rocks of greenschist to locally lower amphibolites facies. These deposits are typically associated with iron carbonate alteration. The relative timing of mineralization is syn to late deformation and typically post peak greenschist facies or syn peak amphibolites facies metamorphism. They are formed from low salinity, H$_2$O-CO$_2$-rich hydrothermal fluids with typically anomalous concentrations of CH$_4$, N$_2$, K and S. Gold is mainly confined to quartz carbonate vein networks but may also be present in significant amounts within iron rich sulphidized wall rock. Greenstone hosted quartz carbonate vein deposits are distributed along major compressional to tanspressional crustal scale fault zones in deformed greenstone terranes of all ages, but are more abundant and significant, in terms of total gold content, in Archaean terranes.

Several well known gold mines are located in the Hutti, Kolar and Ramagiri schist belts of the eastern Dharwar craton. These schist belts are mainly composed of pillowed metabasalts, felsic volcanics, polymictic conglomerates, phyllites, grits, minor sediments and banded iron formations. The surrounding granitoid rocks are predominantly granodiorites, quartz-diorites, monzodiorites and granites.

Joga granite is referred as Closepet granite/Juvenile granite (post tectonic), emplaced into the schist belt during 2.4 Ga (Bhaskar Rao et al., 1992). Joga granite is porphyritic in nature, both grey and pink varieties are common. Granitic outcrops consist of Mafic Magmatic Enclaves (MME).

Joga Banded Iron Formations (BIF) are narrow bands occurring within metabasalts, the band width varies from few cms to few meters up to a maximum of 15 meters. BIF runs parallel to the regional trend of approximately N70°E–S70°W with an exceptional trend of NW-SE. The banded iron formations are of hydrothermal origin and found deposited on the shallow marine shelf environment as justified by their association with carbonates (Ankerite, Dolomite etc.)
The metavolcanic lithounits consists of basic metavolcanic rocks like metabasalts and felsic volcanic rocks like rhyolites. These metabasalts are the prominent lithounits covering more than 70% of the study area. Metabasalts are predominantly of basaltic composition with rare occurrence of Picrobasalt. The metabasalts are exhibiting pillow structures prominently, suggesting a sub marine environment of deposition near volcanic vent. The metabasalt are tholeiitic in nature and derived in intra arc terrain settings.