Gold Deposits: A Brief Review

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Abstract: Gold has been the immutable love of mankind for the past 5000 years for its special properties like resistance to chemical reactions, high conductivity, ductility, and natural beauty. It has been serving as the international monetary standard since the 19th century. The alluring metal is exploited from various types of deposits and this paper enumerates a brief review on general characteristics of gold deposits in which gold is the principal metal.

Keywords: Gold deposits, Orogenic, Placer, Epithermal, Calin-type, Intrusions related.

Gold in Earth

Gold is a siderophile element and the majority of the Earth's gold partitioned into core during the formation of the Earth (Wood et al., 2006; Frimmel, 2008). Calculated amount of gold that resides in the mantle after core formation should be less than 10^{-4} times that of the average chondritic abundance whereas the actual concentration in the depleted mantle is less than 150 times the chondritic abundance (Holzheid et al., 2000; Robb, 2005). The extra amount of gold in the mantle may be explained by the addition of gold to the earliest mantle by the shower of meteoritic material which took place after core formation (Kleine, 2011; Willbold et al., 2011). Later, gold was introduced to the crust during the differentiation of the mantle and the present-day crustal abundance of gold is around 1-2 ppb (Fyfe and Kerrich, 1982; Walshe and Cleverly, 2009; Dill, 2010).

The enrichment of the metal in relatively small parts of the crust is achieved by different ore-forming processes in order to form a minable deposit. In nature, generally gold occurs as native grains or as electrum (i.e. a natural alloy of Au and Ag with more than 20% of Ag). Besides, gold can form alloys with Cu, PGE, Hg, Pb, Sn, Sb, and Bi, however, such alloys are rare (Hough et al., 2009). There are some minerals where gold is a part of the chemical composition such as tellurides (calaverite, krennerite, sylvanite, hessite, petzite, nagyagite) and selenides (Boyle, 1987). Pyrite, arsenian-pyrite, and arsenopyrite may contain invisible gold in their crystal lattices, and the amount of Au substituted in the crystal lattice is facilitated by arsenic (Cook and Chryssoulis, 1990; Reich et al., 2005). Arsenic present in the crystal structure of these minerals forms the $(AsS)^{3-}$ anion pairs creating a charge balance that can be met by the incorporation of a trivalent atom like Au^{3+} replacing the divalent iron (Cook and Chryssoulis, 1990; den Besten et al., 1999). Gold remains invisible in the crystal lattice of pyrite if the Au/As molar ratio is less than 0.02. Nanoparticles of gold may be formed in pyrite, if Au/As molar ratio is more than 0.02 and can be observed by High-Resolution Transmission Electron Microscopy (Palenik et al., 2004; Reich et al., 2005).

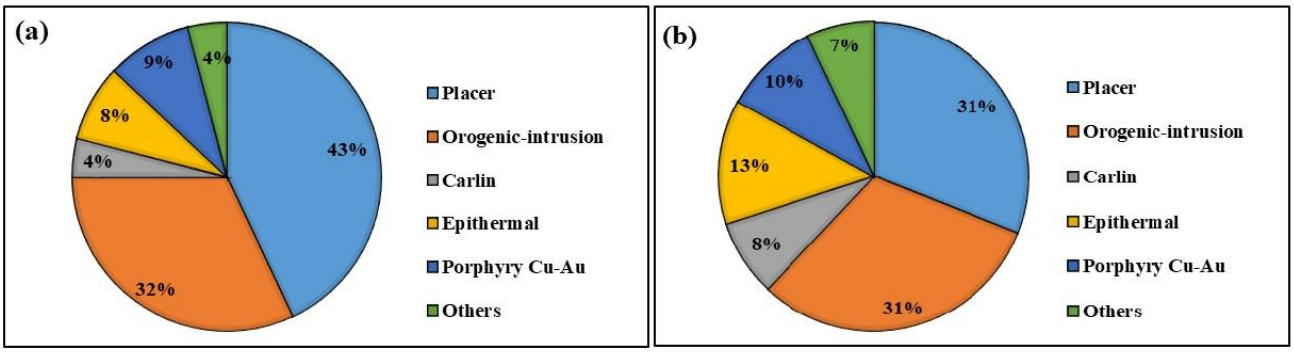

Fig. 1. Percentage of global gold production from different types of gold deposits; (a) past production and (b) production in 1984-2006 (after Frimmel, 2008).

Gold Deposits

Gold is extracted as principal metal and also as a by-product from several types of deposits, hence the gold deposits can broadly be divided into two categories. Firstly, the deposits in which gold is extracted as the principal metal include (i) Placer deposits, (ii) Orogenic gold deposits, (iii) Epithermal deposits, (iv) Carlin-type-deposits, and (v) Intrusion related gold deposits. A significant amount of global gold production comes from these deposits with placer deposits at the top followed by orogenic gold deposits (Fig. 1; Fontaine et al., 2017). Secondly, the deposits which are known for gold as a by-product such as (i) Volcanic Hosted Massive Sulphide (VHMS) deposits, (ii) Porphyry Cu (-Au) deposits, (iii) Ni-Cu sulphide deposits associated with mafic and ultramafic rocks, and (iv) gold associated with laterite. The average grade of gold in the majority of the VHMS deposits is less than 2 g/t, but few deposits having an average gold grade of 2 to 20 g/t also occur (Mercier-Langevin et al., 2011). A significant proportion of total gold production has come from VHMS ores in counties like Canada, Sweden and Australia. Gold concentration in Porphyry Cu (-Au) deposits varies from less than 0.05 g/t to more than 1 g/t with an average of around 0.05 g/t (Ulrich et al., 1999). The Ni-Cu sulphide deposits of the Sudbury igneous complex have an estimated average gold grade of around 0.08 g/t (Mishra, 2000). However, the contribution of these deposits is very less (~10 %) towards the global production of yellow metal (Frimmel, 2008).

Placer Gold Deposits

Placer gold deposits are formed by the mechanical concentration of gold grains in alluvial, eluvial, and marine sediments. Since gold is chemically stable at the temperature and oxygen fugacity conditions prevailing near Earth's surface, it is transported as a detrital particle. The high specific gravity of native grains (i.e. 19.3 to 15.6 depending on the Ag content) is the crucial parameter for mechanical concentration in placers (Boyle, 1987). Most of the placer gold deposits are associated with alluvial placers and the placers are composed of loose, unconsolidated to semi-consolidated gravels and sands (Misra, 2000). Placer gold deposits associated with eluvial placers are not uncommon. The most characteristic features of placer deposits are (i) gold grains with high fineness, generally greater than 850 [fineness= {(wt% Au) / (wt% Au + wt% Ag)}*1000] and (ii) occurrence of large gold nuggets. The high fineness of the gold may be due to the relatively high solubility and mobility of silver in supergene fluid before the transportation from source (Freyssinet et al., 2005; Desborough, 1970; Grant et al., 1991). The gold nuggets are naturally formed pieces of gold either weighing >1g or measuring > 4 mm and the origin (whether chemical or detrital) of the large nuggets in placer deposits is debatable (Hough et al., 2009). The placer gold deposits can broadly be divided into Paleo-placer deposits of Archean and Paleoproterozoic age (viz. Conglomerate hosted gold-uranium deposits of Witwatersrand Basin, South Africa) and Young Placer deposits (viz. Cariboo, Canada; Sierra, USA; Victoria, Australia) those formed mostly during the Tertiary and Quaternary age. The origin of conglomerate-hosted gold mineralization in the gold deposits of Witwatersrand Basin is dubious, and the placer model (Hallbauer and Utter, 1977; Kirk et al., 2002), modified placer model (Robb and Meyer, 1995; Frimmel, 1997) and hydrothermal model (Barnicoat, 1997; Phillips and Powell, 2011) have been proposed to explain the formation of gold mineralization. Lately, Heinrich (2015) proposed a model suggesting that the sulphurous volcanic gases released from large volcanic eruptions during Archean created acid rain which facilitated the dissolution and transportation of gold in surface water as sulphur complexes. Precipitation of gold took place due to the chemical reduction of dissolved gold when it came in contact with organic materials in the Witwatersrand Basin.

Orogenic Gold Deposits

Orogenic gold deposits are of considerable importance in terms of the world's gold production (Fig. 1). This type of deposits have also been referred as "Orogenic lode gold", "Mesothermal gold", "Gold only", "Lode gold" and "Greenstone hosted gold" deposits in literature (Groves et al., 1998; Goldfarb et al., 2001; Misra, 2000). Orogenic gold deposits are formed in both Archean and Phanerozoic Eons, and have close temporal and spatial association with major orogenic events (Goldfarb et al., 2001; Xu et al., 2016). Irrespective of their temporal and spatial distribution throughout the world, these deposits bear commonalities in some geological aspects that make them different from other types of gold deposits. The orogenic gold deposits exhibit common features with reference to host rocks, tectonic setting, vertical extent, temperature of mineralization, mineralogy/hydrothermal alteration, composition of ore fluids, and metal/element association (Fyfe and Kerrich, 1982; Groves et al., 1998; Goldfarb et al., 2001). Host rocks are highly variable, ranging from metamorphosed felsic-mafic igneous rock to chemical-clastic sedimentary rocks (Groves and Foster, 1991; Misra, 2000). Metamorphosed mafic volcanic and intrusive rocks are the dominant host rocks in most of the deposits and deposits hosted in these rocks contribute a major portion of gold production from this type of deposits. However, iron-rich rocks (such as tholeiitic basalt and Banded Iron Formations) are more suitable chemical traps for the deposition of gold (Mikucki, 1998; Phillips and Groves, 1983; Williams-Jones et al., 2009). The metamorphic condition of host rocks varies from sub-greenschist to granulite facies, but large and numerous deposits are associated with rocks of the greenschist facies domain (Kerrich and Cassidy, 1994;

Gebre-Mariam et al., 1995; McCuaig and Kerrich, 1998). Age of mineralization and characteristic hydrothermal alteration proportionate to the metamorphic P-T conditions indicate that gold mineralization in such deposits is an integral part of the metamorphism of host rocks (Kerrich and Cassidy, 1994; Eilu et al., 1999).

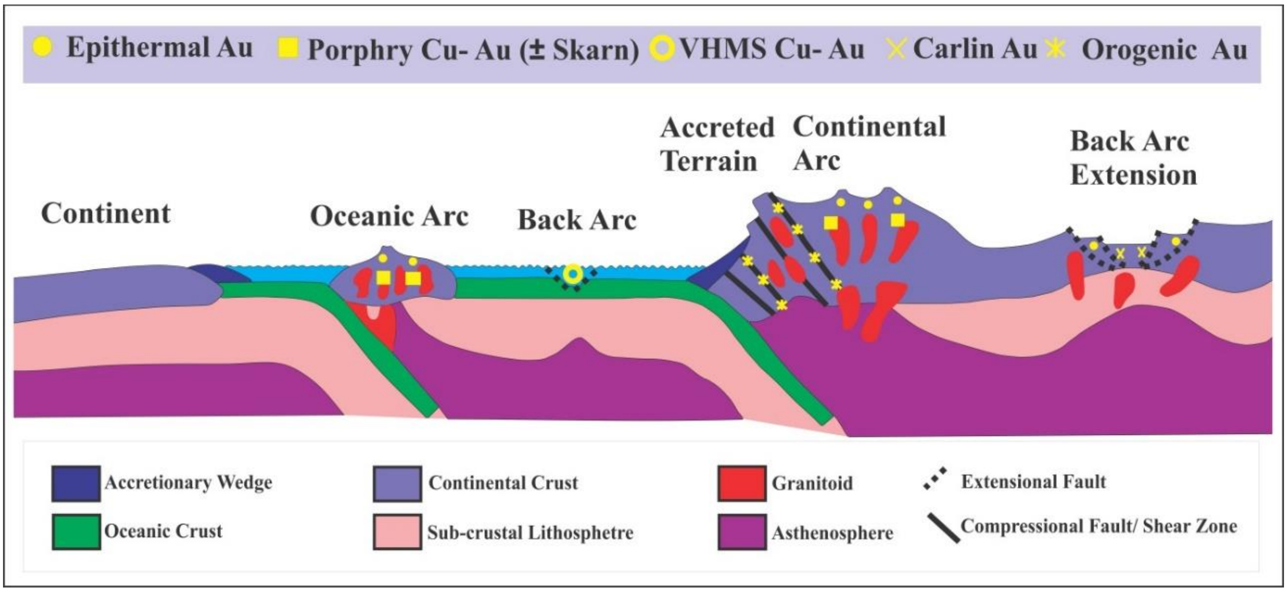

Fig. 2. Tectonic settings of gold-rich epigenetic mineral deposits. Epithermal veins and gold-rich porphyry and skarn deposits, form in the shallow (≤5 km) parts of both island and continental arcs in compressional through extensional regimes. The epithermal veins, as well as the sedimentary rock-hosted type Carlin ores, also are emplaced in shallow regions of back-arc crustal thinning and extension. In contrast, Orogenic gold on this diagram are emplaced during compressional to transpressional regimes and throughout much of the upper crust, in deformed accretionary belts adjacent to continental magmatic arcs (Groves et al., 1998).

Orogenic gold deposits have a spatial and temporal association with the orogenic belts (accretion and/or collision) that formed as a result of convergent tectonics (Groves et al., 1998; Goldfarb et al., 2001). Accretionary and collisional orogens are two end-member types and represent the initial and final stages of a continuous orogenic process. The gold-bearing mineralized zones are formed during the compressional and/or transpressional tectono-thermal events in the accreted terrains adjacent to the continental margins (Fig. 2). Generally, the deposits are proximal to first-order structures or regional scale deformation zones (Groves and Foster, 1991; McCuaig and Kerrich, 1998). Mineralization is restricted to the second or third-order structure of the regional scale deformation zones. The structures that host the mineralization include (i) brittle fault to ductile shear zones (low to high angle) with reverse-, strike- and oblique-slip movements, (ii) fracture arrays, stockwork networks, or breccia zones, and (iii) fold hinges and associated reverse faults mostly in turbidite and/or BIF hosted deposits (Eilu et al., 1999). The mineralized structures exhibit characteristics of the entire spectrum from brittle to ductile deformation and can be divided into brittle, ductile, and brittle-ductile transition (Colvine et al., 1988). However, the majority of the gold-bearing structures are transitional between brittle and ductile. Various styles of ore-bearing structures with respect to metamorphic conditions in the case of orogenic gold deposits have been given in detail by Witt (1993). In general, structural styles of mineralization varies from brittle structures in sub-greenschist facies domains to ductile structures in upper amphibolite and granulite facies domains through brittle-ductile structure in intermediate metamorphic domains (Gebre-Mariam et al.,1993; Groves, 1993). However, the structural styles of the gold-bearing zones are also controlled by the rheology of the host rocks (Hodgson, 1989; Eilu et al., 1999). The texture of the quartz veins shows commensurate variations with respect to the metamorphic grade i.e. from plumose, comb, and vug filling at lower grade through massive or laminated with partial annealing textures at intermediate grades to coarse-grained granoblastic textures at the higher metamorphic grades (Groves, 1993).

The vertical extent of mineralization in orogenic gold deposits range from <6 km to 20 km of crustal depth (Fig. 3) and the entire spectrum of crustal depth may not be present in a single deposit (Groves et al., 1998). Hence, the deposits can be classified as epizonal (<6 km), mesozonal (6-12km), and hypozonal (> 12km) based on the depth of formation (Gebre-Mariam et al., 1995; Groves et al., 1998). The estimated pressure and temperature of mineralization vary from <1 kbar to ~7 kbar and 180 ºC to 700 ºC, respectively (Groves, 1993;

Hagemann and Brown, 1996; Ridley et al., 1996). However, in most of the deposits mineralization is restricted to pressure and temperature ranges of 1 to 2.5 kbar and ~300 ºC to ~475 ºC, respectively which corresponds to the mesothermal or mesozonal conditions (Gebre-Mariam et al., 1995; Ridley and Diamond, 2000).

The vein mineralogy is quartz-dominant with ≤ 3–5% sulphide minerals mainly Fe-sulphides and ≤ 5–15% carbonate minerals (Groves et al., 1998). Albite, white mica or fuchsite, chlorite, scheelite and tourmaline are in veins of greenschist facies domain. In amphibolite facies domain, the gangue minerals in vein include amphibole, diopside, biotite/phlogopite, tourmaline or even garnet (Eilu et al., 1999). Hydrothermal alterations in these deposits are characterized by the addition of SiO_2, K, CO_2, S, H_2O, and LILE (Large Ion Lithophile Elements) to the wall rocks in the ore zone (Groves, 1993; Groves et al., 1998; McCuaig and Kerrich, 1998; Eilu et al., 1999). The common types of hydrothermal alteration associated with gold mineralization are chloritization, sericitization, carbonatization, silicification, and sulfidation. The alteration zones commonly exhibit lateral variations in mineralogy and can be described as proximal, intermediate, and distal zones with increasing distance from the center of the ore zone. The lateral extent of the alteration zone may vary from a few centimeters to 1-2 km and have a positive correlation with the size of the deposit. The tendency of lateral extension of hydrothermal alteration is more in the lower metamorphic facies domain than the higher metamorphic facies domain. Besides, the mineralogy in each zone (i.e. proximal, intermediate, and distal) varies with the metamorphic grade depending on the mineralogy-chemistry of the host rocks. Details of the variations of mineralogy in different zones with respect to metamorphic grade and host rock have been given in Eilu et al. (1999). Pyrite, pyrrhotite, and arsenopyrite are the dominant Fe-sulphide minerals in both veins and the alteration zone. The metasedimentary rock-hosted deposits contain more arsenopyrite, in contrast to pyrite and pyrrhotite are more in deposits hosted by metamorphosed igneous rocks (Eilu et al., 1999). Sulphide minerals show a broadly complementary trend from S-rich assemblages dominated by pyrite ± arsenopyrite ± pyrrhotite at low metamorphic grades, through pyrrhotite ± arsenopyrite dominated assemblages, to pyrrhotite-arsenopyrite ± loellingite assemblages at high metamorphic grade (Groves, 1993; Eilu et al., 1999). Tellurides, stibnite, tetrahedrite, and sulfosalts are commonly found in deposits formed in low metamorphic grades (Groves, 1993). Gold is found in both veins and altered wall rocks as native grains, electrum, inclusions in the sulphide minerals, and invisible lattice gold in pyrite and arsenopyrite.

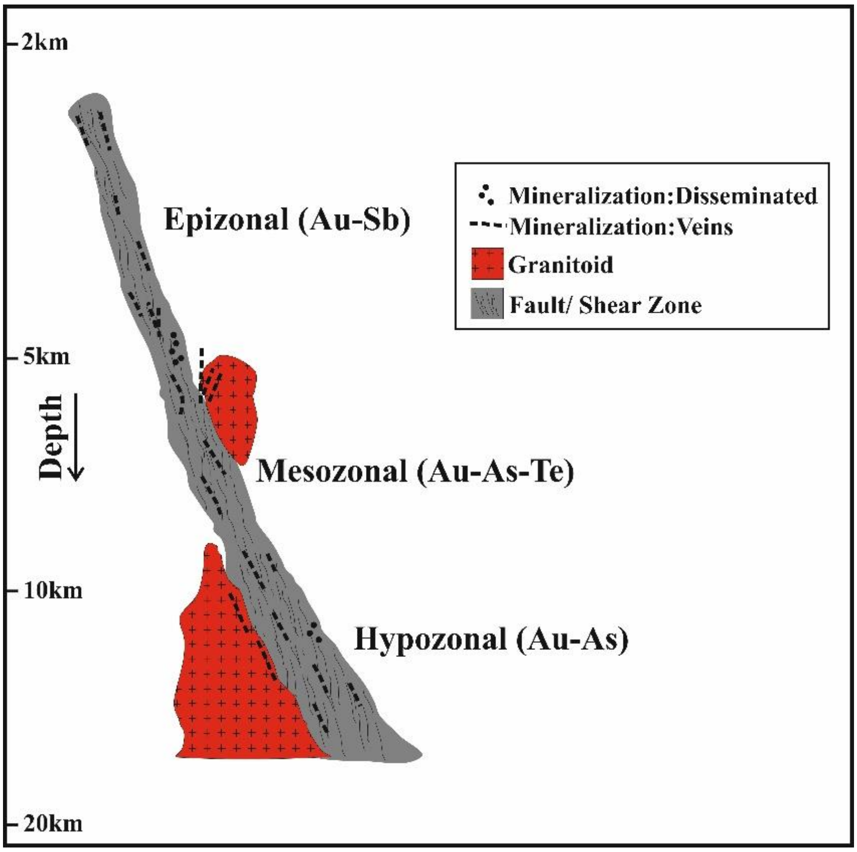

Fig. 3. Schematic representation of crustal depths of formation of orogenic gold deposits and classification based on the depth of formation (modified after Goldfarb et al., 2005).

The orogenic gold deposits have extreme enrichment of Au relative to other metals (viz. Cu, Pb, Zn) which are commonly associated with Au in other types of gold deposits such as porphyry Au-Cu deposits, epithermal deposits and Au-rich VMS deposits (Groves and Foster, 1991). In addition to Au, the orogenic deposits are enriched in certain precious and rare metals such as Ag, As, W, Sb, Bi, Te, and B in variable combinations without significant enrichment of the Cu, Pb, and Zn (Fyfe and Kerrich, 1982; Groves et al., 2003; Goldfarb and Groves, 2015). Such an association of metals/elements is quite distinct from the rest of the deposits and this unique feature has been attributed to the selective scavenging capacity of the ore fluids (Fyfe and Kerrich, 1982).

The inferences obtained from mineral assemblages and fluid inclusion studies indicate that major components of hydrothermal fluid in orogenic gold deposits are H_2O and CO_2 with a minor amount of CH_4 and N_2 (Phillips and Groves., 1983; Mikucki and Ridley, 1993; Ridley and Diamond, 2000; Goldfarb and Groves, 2015). Such ore fluids are low to moderate saline and the values of salinity range from 1 to 15 wt% NaCl equivalent with most of the values restricted between 3 and 7 wt% NaCl equivalent (Ridley and Diamond, 2000). The low saline aqueous-carbonic ore fluid contains a considerable amount of CO_2 compared to other types of gold deposits and in most of the deposits, the restricted range of XCO_2 is 0.1 to 0.25 (Groves, 1993; Ridley and Diamond, 2000). The fluids are near neutral to weakly alkaline with oxidation potential ranging from reducing to moderately oxidizing (Ridley et al., 1996). The pH and oxidation potential of the fluids approximately remain constant throughout the entire range of pressure and temperature conditions of mineralization (Mikucki and Ridley, 1993; Ridley et al., 1996).

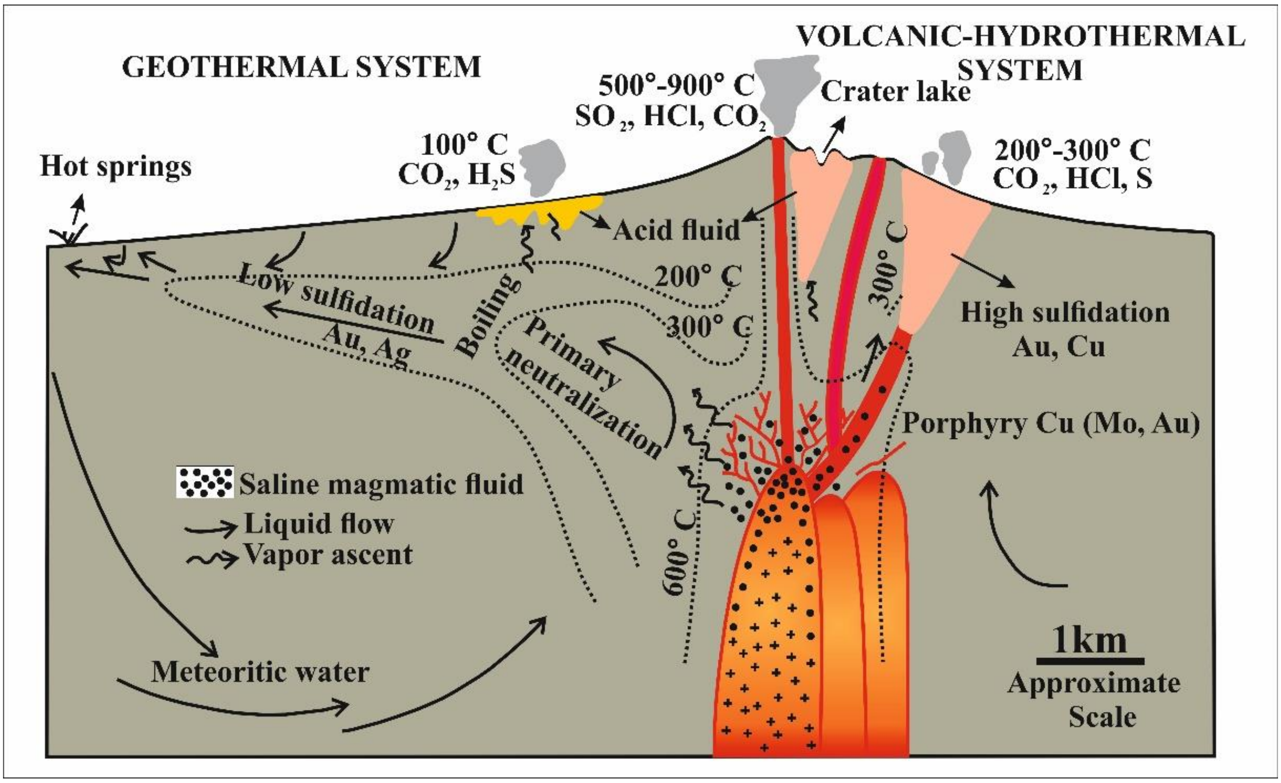

Fig. 4. Schematic representation of geothermal and volcanic hydrothermal systems, and associated low-sulphidation and high-sulphidation deposits, respectively (modified after Hedenquist et al., 2000).

Epithermal Gold Deposits

Epithermal gold deposits are formed at relatively shallow levels of crust from near subsurface to 1.5-2km depth within a temperature range of<150 to ~300 ºC (White and Hedenquist, 1995). The styles of gold mineralization in such deposits are manifested in the form of veins and disseminations mostly in volcanic and sedimentary rocks (Taylor, 2007). Alteration mineral assemblages, occurrences, textures, and to some extent the associated elements form the basis of the division of these deposits into two end-member types, such as low-sulphidation and high-sulphidation (White and Hedenquist, 1995; Andre-Mayer et al., 2002). The terms have been used based on the sulphidation state of sulphide mineral assemblages associated with respective deposits (Hedenquist et al., 2000). Similar to the geothermal system, near-neutral pH and reduced fluids dominantly of meteoric origin form low-sulphidation state of sulphide minerals in the case of low suphidation type deposits. But, relatively high-sulphidation state minerals are associated with high sulphidation type deposits that owe their origin to acidic and oxidized fluids derived from an oxidized magma in a volcanic hydrothermal system (Fig. 4). Pyrite-pyrrhotite-arsenopyrite and high Fe-sphalerite are the sulphide minerals present in low sulphidation end member deposits in contrast to pyrite-enargite-luzonite-covellite in high sulphidation end member (Hedenquist et al., 2000). Besides, the high-sulphidation type deposits have high sulphide content than the low-sulphidation type deposits (Taylor, 2007). The low-sulphidation type deposits are characterized by quartz-adularia-calcite veins with adularia, sericite and illite as alteration products in the ore zone. Hence, the low-sulphidation type has been referred to as the adularia-sericite type. High-sulphidation type deposits chiefly contain alunite and kaolinite as altered products in the ore zone, hence referred to as alunite-kaolinite type (Hedenquist et al., 2000; Taylor, 2007). Crustiform bands of chalcedony, bladed quartz, and open space filling are the dominant textures in low-sulphidation type deposits whereas textures in high-sulphidation type deposits are dominated by massive and vuggy quartz. Both types of epithermal gold deposits have anomalously high Au, Ag, As, Sb, Hg, Sb, and Pb. However, Cu, Bi, Mo, Sn, Te dominates in the high-sulphidation type deposits and, Zn, Se, and K predominate in the low sulphidation type deposits (White and Hedenquist, 1995). Mineralization in low-sulphidation type deposits postdate the formation of host rocks, but in the case of high-sulphidation type deposits mineralization takes place shortly after or synchronous with the emplacement of host rock. Gold occurs as native grain, electrum, and lattice-bound gold in pyrite. Epithermal deposits associated with alkaline volcanic rocks may contain significant amounts of telluride minerals such as calaverite, krennerite, sylvanite, and montbrayite (Misra, 2000). These deposits are known for the production of Ag and base metals besides gold. These deposits formed at shallow levels of crust and hence are more vulnerable to erosion and mostly found in younger volcanic rocks of the Cenozoic era (Taylor, 2007; Frimmel, 2008).

Carlin-type Gold Deposits

Carlin-type deposits are sedimentary rock-hosted disseminated gold deposits named after the Carlin deposit of Nevada that was first discovered in 1961 (Berger and Bagby, 1991; Cline et al., 2005). Later several Carlin-type gold deposits were discovered in western North America and southern China (Berger and Bagby, 1991; Liu et al., 1994; Rui-Zhong et al., 2002; Zhou et al., 2002; Cline et al, 2005). Studies on Carlin-type deposits of western North America and southern China indicate that marine sedimentary rocks of the Cambrian to Triassic age are the host rocks (Berger and Bagby, 1991). However, the most favorable host rocks are very finely laminated, carbonaceous silty carbonates, and carbonate-bearing siltstones and shales. The overthrust terrains related to continental margin tectonics are a favorable site for such deposits (Berger and Bagby, 1991). The mineralizing fluids could have migrated through high-angled faults and the breccia formed due to faulting may be the crucial component for localization of ore. Mineralization hardly extends far from the mappable fractures. Dissolution of carbonate minerals and precipitation of silica is a common and characteristic feature of Carlin-type deposits (Berger and Bagby, 1991). Silicification during the entire span of hydrothermal activity can be distinguished as pre-ore, ore-stage, and post-ore based on the textures of the deposited silica. The addition of silica during the main stage of ore formation is manifested by quartz veins and silicified breccia. Generally, gold occurs as (i) extremely fine native grains (mostly 1-5 µm) and electrum, (ii) nanoparticles in pyrite, and (iv) thin coating or film on pyrite. Argillic alteration and introduction/ mobilization of carbonacoues material include common types of alteration associated with the gold mineralization in such deposits. Pyrite is the dominant sulphide mineral associated with the gold mineralization event. The presence of marcasite is common and arsenopyrite is rarely found. Post-ore sulphide minerals mainly constitute realgar with a subordinate amount of orpiment, cinnabar, and stibnite. Anomalous concentration of As, Sb, Hg, and W is commonly associated with gold mineralization and the concentration of base metals is consistently low. Low saline (<5 wt% equivalent), moderate temperature (200-300 ºC), and CO_2 bearing (< 4 mole %) fluids were responsible for gold mineralization (Cline et al., 2005). The ore fluids were having a sufficient amount of H_2S to transport gold as bi-sulphide complex. The depth of ore deposition ranges from 0.3 km to 8 km as inferred by fluid inclusions, apatite fission-track modeling, jasperoid textures, and geologic reconstructions (Cline et al., 2005). The lack of suitable minerals to date is a major cause of debate on the timing of mineralization of Carlin types of deposits. The geochronological ages reported so far are late-Jurassic to late-Tertiary (Hofstra and Cline, 2000). Almost all the Carlin-type gold deposits have spatial and temporal association with felsic intrusive rocks and several workers (Sillitoe, 1991; Berger and Bagby, 1991) argued for the contribution of heat and hydrothermal fluids by these intrusive bodies. The models that have been proposed for the genesis of Carlin types deposits are the Meteoric water model (Emsbo et al., 2003), the Epizonal intrusion model (Cunningham et al., 2004), and (iii)

Deeply sourced ore fluid model (Seedorff, 1991). However, each model has its own lacuna and none of these models can be applied to a single deposit solely (Cline et al., 2005). Isotopic evidence supports different sources for different components of the ore system in a single deposit. Hence, Kesler (2005) categorized the hydrothermal system of Carlin-type deposits as a "Mystery Hydrothermal System".

Intrusion Related Gold Deposits

Gold deposits having spatial and genetic association with igneous intrusive rocks (mostly in epizonal environments) are termed as intrusion-related gold deposits. Although in some instances gold is a by-product in such deposits, viz. porphyry Cu (-Au) deposit, are exclusive in this context. Sillitoe (1991) classified the deposits into (i) porphyry-type gold deposits having similar geological attributes of porphyry copper and/or molybdenum-type deposits, (ii) Non-porphyry type gold deposits with stockwork/disseminated style of gold mineralization, (iii) Skarn and non-skarn replacement gold deposits in the carbonate host rock, (iv) Stockwork, disseminated and replacement deposits in the non-carbonate host rock, (v) Breccia hosted gold deposits and (vi) Veins type deposits in both intrusions and wall rocks. According to Hart et al. (2002), intrusion-related gold deposits can be of three broad types based on the spatial relation to the associated intrusions such as intrusion-hosted, proximal deposits, and distal deposits. The tectonic environment in which the intrusion-related gold deposits form can vary within a single province with time and space. Various types of tectonic environments such as back-arc, foreland fold-thrust, collisions, post-collisional and magmatic arcs have been proposed (Lang and Baker, 2001). Subduction-related accretionary to collisional orogens are the most favorable environment for the formation of such deposits as concluded by Goldfarb et al. (2000). Generally, the intrusion-related gold deposits are genetically linked with reduced, metaluminous, sub-alkalic, I-type intrusions of intermediate to felsic composition having characteristics similar to that of between the ilmenite and magnetite series magma (Thomson et al., 1999; Goldfarb et al., 2000; Lang and Baker, 2001). The intrusion-hosted and proximal deposits exhibit common characteristics alterations that include feldspathic, silicic, greisen, calc-silicate, and advanced argillic with a metal assemblage that variably includes Au with anomalous Bi, W, As, Mo, Te, and/or S (Goldfarb et al., 2000; Lang and Baker, 2001). Fluids dominantly of magmatic origin having high salinity and an appreciable amount of CO_2 have been ascribed as the ore fluids in most of the deposits (Sillitoe, 1991). The temperature and pressure range of gold precipitation vary from <200 ºC to > 600 ºC and <0.5 kbar to >3 kbar, respectively (Lang and Baker, 2001). However, the diverse kind of tectono-magmatic setting, metal association, fluid chemistry, and wall rock alteration makes these deposits poorly understood, defined, and recognized.

Summary and Conclusions

- There are several types of gold deposits and these deposits can be categorized into two broad types (i) deposits in which gold is the principal metal and (ii) deposits from which gold is obtained as a by-product. The major deposit types in which gold is the principal metal are placer gold deposits, orogenic gold deposits, epithermal gold deposits, carlin-type gold deposits, and intrusion-related gold deposits.
- Gold mineralization in different deposits has distinct metal associations, hydrothermal alteration patterns, temperature and depth of formation, and nature and composition of ore fluids.
- These deposits are formed in distinct geological settings. There can be a spatial association of different types of gold deposits in a terrain. However, the events of gold mineralization in each deposit type are associated with different geological processes related to the crustal evolution of the terrain.

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