Carlin-Type Gold Deposits in Qinling and Some Related Problems *

ZHANG FUXIN (张复新), ZONG JINGTING (宗静婷),
(Department of Geology, Northwest University, Xi'an 710069, China)
AND MA JIANQIN (马建秦)
(Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550002, China)

Abstract: The sediment-hosted disseminated gold deposits in the Qinling region are of sedimentation-slight-metamorphic origin superimposed by hydrothermal reworking at moderate-low temperatures and are well comparable with the typical Carlin gold deposits in the United States. In view of the confusing concept concerning the “sediment-hosted” and “Carlin-type” gold deposits, the authors propose that the term “sediment-hosted gold deposit” should be used in a broad sense which encompasses at least the four subtypes, i.e., the Carlin type, the metamorphic fine clastic type, the hydrothermal sedimentary type and the vein type. In other words, the “Carlin-type” should not be used as a synonym for “sediment-hosted” but is recommended as a subtype under the general category of “sediment-hosted gold deposits”.

Key words: Carlin-type gold deposits; sediment-hosted gold deposits; mineralization character; genetic mechanism of mineralization; Mt. Qinling

Since the discovery of the Carlin deposit in the 1960's, a belt of Carlin deposits extending over one thousand kilometers has been delineated in the West United States. This was followed shortly later in China by the discovery of quite a number of major disseminated gold deposits at the southwest and northwest margins of the Yangtze Block. These deposits constitute the two “Gold Triangles” in Southwest (Yunnan-Guizhou-Guangxi) and Northwest (Shaanxi-Gansu-Sichuan) China. Thus, two major regions of the Carlin-type gold deposits are known in the world, each of which consists of more than 40 Carlin deposits with some of them being very large in size. The Carlin-type gold deposits have also become a heat target of extensive exploration in many other parts of the world. However, some confusion exists in the understanding of the geological characters of the Carlin-type which causes ambiguities in the classification with some similar deposits (such as the turbidite type and the sediment-hosted type) improperly included into the type of Carlin deposits. Clarifications are proposed in this paper in the light of our studies on the Carlin-type deposits in the Qinling region.

The Carlin-Type Gold Deposits vs. Sediment-Hosted Gold Deposits

The Carlin-type gold deposits—conceptions

At present, geologists are not yet in agreement on the definition of the Carlin-type gold deposits. Romberger (1986) considered that Carlin deposits resulted from hydrothermal events, with invisible gold dispersed in economic concentrations in the hosts of various compositions. Generally, gold occurs as sub-microscopic or microscopic particles in disseminated or
veinlet-disseminated ores. The sediment hosts are variable in age, but the mineralization is most likely related to thermal events during the Tertiary period.

Tu Guangzhi drew much attention to the following distinctions of the Carlin-type gold deposits: (1) they are mostly hosted in Phanerozoic carbonate and fine clastic formations which show little sign of metamorphism; (2) the deposits are always found in or near Hg-Sb belts or their extensions; (3) the size of gold is mainly in micron or sub-micron range; (4) principal ore minerals are As-bearing pyrite, arsenopyrite, stibnite, realgar and orpiment, characterized by the association of As-Sb-Hg-T1-Ba-Au among which some are highly vaporizable; and (5) the Carlin-type gold deposits have many characteristics in common with typical strata-bound disseminated epithermal deposits.

Also, the Carlin-type deposits are visualized from other standpoints by different authors. For example, as held by Boyle (1984), they are just disseminated ores in chemically favorable sediments and were called by some others (Yang Weihua et al., 1997) “sediment-hosted gold deposits” which should include, in their proper sense, all the gold deposits in fine-clastic rocks, and carbonate or siliceous rocks that have not been metamorphosed.

It is not surprising that no consensus has yet been reached among geologists in this respect in view of the complex nature of the Carlin deposits. In the authors’ opinion, however, the following characteristics of the Carlin deposits should not be neglected: (1) the Carlin-type deposits are developed in sedimentary rocks along continental margins or in transitional zones between continental blocks; (2) wall-rock alterations are poorly developed in the Carlin-type deposits and no sharp boundary can be recognized between the orebodies and host rocks; (3) the ore metal association of Au-As-Sb-Hg-Tl-Ba is characteristic, among which As is particularly closely related with gold and most of them are characteristic of hydrothermal mineralization at moderate to low temperatures; (4) gold occurs as microscopic or submicroscopic particles in close association with As-bearing sulfides (As-pyrite, arsenopyrite, enargite, realgar and orpiment); (5) the deposits occur in clusters in areas flanked by regional fault systems which often control the evolution of sedimentary basins; and (6) syngenetic fault systems may have played an important role in the evolution of the sedimentary series which are generally highly variable in lithology.

The series of Carlin-type gold deposits in the Qinling sedimentary province

The characteristics of the Carlin-type gold deposits in the Qinling sedimentary province are presented in Table 1.

As may be seen, the Qinling Carlin-type deposits are comparable with those in the United States in geological background, host rocks, gold occurrence and some characters of deposit geology and geochemistry, but differ apparently from them in the age of host rocks, relations with magmatism, ore metal assemblage and some other features. On the basis of ore-metal associations, the Qinling Carlin-type gold deposits can be divided into four subtypes, i.e., the Au-As-Sb-Hg type (the Jinlongshan type), the Au-As-Cu-Ba type (the Ertaizi type), the Au-As-(Sb)-(Hg) type (the Pangjiahe type), and the Au-As-(U) type (the Liba type). These subtypes constitute a series of the Carlin-type gold deposits in the region.

Genesis of the Carlin-type gold deposits

The genesis of the Carlin-type deposits is also a subject of hot debate. They are classified as epithermal deposits in sediment hosts by some authors (Radtke et al., 1980; Romberger et al., 1986; Nesbitt, 1988; Shalton et al., ?), considering that gold was extracted from sur-