Types and distribution of silver ore deposits in China

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Abstract. Silver is generally recovered as a by- and co-product along with Au, Pb, Zn, Cu, Sb, Bi, Hg, Sn and W from polymetallic and gold mines in China. Chinese silver deposits can be classified into five principal types according to host rocks. These types and their host rocks are: (1) marine volcanic-sedimentary rocks hosting (1a) massive sulfide Pb-Zn-(Cu)-Ag ores and (1b) stratiform Ag-(Au) ores; (2) continental volcanic-sedimentary rocks containing (2a) various polymetallic-silver veins and/or stockworks, and (2b) Ag-(Au) veins in pyroclastic rocks; (3) rocks affected by metasomatic processes including (3a) complex Sn-polymetallic-Ag ores, (3b) Pb-Zn-(Cu)-Ag skarns, (3c) associated W-Ag quartz veins and/or skarns, and (3d) Ag-(Au) zones and veins in altered carbonate rocks; (4) metamorphic-intrusive rocks, principally Ag-(Au) veins in sheared and brecciated metamorphic rocks; and (5) sedimentary rocks including (5a) stratiform Pb-Zn-Ag ores in carbonate rocks, (5b) Ag-V mantos in black shales, and (5c) Cu-(Ag) layers in red sandstones. A sixth grouping includes gossans. The tectonic settings, geological features, and temporal and spatial distribution of these different types of silver occurrences indicate that silver mineralization reflects to a great extent the evolution of tectonic environments in China throughout geological time. Type 1 is generally developed in association with several fold belts from the Caledonian to Yanshanian orogens, while types 2, 3 and 4 correlate with rejuvenation of the eastern China continent during the Mesozoic period. The three subgroups of type 5 are recognized in different stages and various sedimentary and diagenetic environments during the development of paraplatforms and fold belts. Type 6 results from recent weathering of existing sulfide ores or protores.

The silver mining history of China can be traced back at least as early as the Zhou Dynasty (about 1100–256 B.C.) (Xia et al. 1979; Guo 1991). Several old smelter remains and ancient workings were found in places such as Yinshan, Jiangxi Province and Guiyang, Hunan Province. These districts were documented in local chronicles as famous lead-zinc-silver producers in the Tang Dynasty (618–907 A.D.), and in the Song Dynasty (960–1279 A.D.), respectively, when silver was used as a currency standard, as well as jewelry and ornaments (Xia et al. 1979).

In the present mineral industry of China, silver is recovered mainly as a by- or co-product from polymetallic and gold ores. However, several primary silver ore deposits have been discovered, explored and mined since the 1980s, such as Poshan (Chen and Zhou 1984) and Huangchengshan (Xiao 1991), Henan Province, Shanmen, Jilin Province (Tian and Shao 1991), Nioujuan, Hebei Province (Xu 1990, unpub.), and Huijajian, Jiangxi Province (He 1990, unpub.; Xu et al. 1993). Intensive efforts for a more comprehensive understanding of the geology, mineralogy and geochemistry of different types of silver mineralization have been undertaken in China during the last decade, forming the basis of prospecting for and assessment of silver resources.

This paper presents a basic introduction to the different types of Chinese silver deposits and discusses their geological settings, main geological characteristics, distributions in space and time, and economic significance. The present work belongs to a portion of a project started in 1990, organized by the Ministry of Geology and Mineral Resources of China (MGMRC), and funded by the Chinese National Nonferrous Company (CNNC).

Geological outline of China

The major tectonic units of China are schematically outlined after Huang et al. (1980) and simplified in Fig. 1. The oldest massif, named the North China (or Sino-Korea) paraplatform, possesses an Archean to early Proterozoic basement composed of various crystalline rocks including metamorphic complexes, migmatites and intrusives, isotopically dated as early as 3.3–3.5 Ga (Jahn et al. 1987; Liu et al. 1989). The cover consists of mid-Proterozoic to Mesozoic sedimentary rocks,
types of silver deposits

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5a 5b 5c ~ 6•

0 360 720km

Fig. 1. Distribution of silver-polymetallic deposits of China related to tectonic settings; tectonic divisions are after and simplified from Huang et al., 1980. The numbered deposits: 1–29 are listed in Table 2; 30 Bamao; 31 Manhantu-Xiaokouhuaying; 32 Zhijiadi; 33 Tongshanling; 34 Kangjiawan; 35 Xinmin; 36 Yaogangxian; 37 Jiaoli; 38 Shanhu; 39 Jinshan and Zhongsu; 40 Zhanggongling; 41 Shijingchong; 42 Qixiashan; 43 Xiangjialing; 44 Zhangjialu; 45 Qibaoshan; 46 Xianggang

comprising clastic and carbonate rocks, and coal-bearing shales (Kuo 1978).

The Talimu platform to the west and the Yangtze paraplatform to the south are two major blocks underlain by early Proterozoic basements. The Talimu platform is largely covered by a vast desert of Cenozoic sediments with exposed crystalline gneisses in marginal areas (Huang et al. 1980). The basement of the Yangtze paraplatform is composed of flysch to flyschoid clastic rocks, folded and metamorphosed into phyllites and slate, locally with spilitic-keratophyre and ultra-basic volcanic rocks in the lower part (Kuo 1978). The komatiites from the lower portion of the Yangtze basement are dated at 2219 Ma (Mao et al. 1990). The sediment cover ranges from tillite, phosphorite and black shales to various clastic and carbonate rocks, with ages from the late Proterozoic to the Mesozoic (Kuo 1978; Huang et al. 1980).

Adjacent to these older, rigid blocks are several foldbelts of the Caledonian, Hercynian, Indosinian, Yanshanian and Himalayan orogens (Fig. 1). They are composed mainly of thick marine volcanic-sedimentary rocks and are intensively folded, deformed, faulted and to a variable degree metamorphosed. These fold belts are believed to be ancient subduction or collision zones (Li 1980). The ancient Qinling trough between the North China and the Yangtze paraplatforms was finally closed and converged during the late Triassic (Wang et al. 1982), when most of eastern China was assembled into a continent (Kuo 1978).

During the Yanshanian orogen the east China continent was reactivated with extensive development of volcanic basins, grabens, shear zones, fault mountains and granitic intrusions, referred to as the so called “platform rejuvenation” (Chen 1960; Huang et al. 1980).

The nature of the south China foldbelt, including the Nanling Mountain area, remains unclear. For many years it was considered a Caledonian orogen, joined to the Yangtze paraplatform after the Devonian (Huang et al. 1980). However it was recently argued by Hsu et al. (1988) to be a Mesozoic orogen called Huanan (south China)