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Deportment of gold in major types of gold ores and its importance in economic geology

Jing Li* and Joe Zhou

Xiamen Zijin Technology of Mining and Metallurgy Limited, China, Xiamen, Fujian Province, China, *e-mail, jing.li.mineralogy@qq.com

Most ore deposit studies of gold ores focus on the tectonics, structure, alteration, and sulfidation. Direct and quantitative study on the occurrence of gold is limited. Due to the low concentrations of gold, it was not easy to acquire representative gold mineral samples for gold mineralogical study. A comprehensive and quantitative gold mineralogical approach named “gold deportment study” was developed by the authors and has been broadly applied in the processing industry for more than ten years, and this has played a significant role in the economic evaluation of gold projects involving most of the economic gold ores and gold-bearing material. We summarize the gold deportment of different ore types based on results acquired by ourselves and other researchers, indicating the key role of gold mineralogy in economic evaluation of gold deposits. Furthermore, the gold deportment is closely related to the genesis of the deposit and can provide important information on the mineralization process.

Mineralogically, gold can be classified into three forms based on its occurrence: microscopic gold, submicroscopic gold, or surface gold. Microscopic gold, also known as visible gold, comprises all gold minerals such as gold alloys, gold tellurides, gold sulfides, gold selenides, gold sulphotellurides, and gold sulphoselenides. Gold that is invisible under optical and scanning electron microscopes is referred to as submicroscopic gold (or invisible gold) and is the major form of gold in refractory gold ores such as Carlin-type gold deposits, some epithermal gold deposits, and volcanogenic massive sulfide (VMS) deposits. Surface gold is gold that was adsorbed onto the surface of other minerals, such as carbonaceous material and iron oxide. Each form of the gold requires a specific processing flowsheet which determines the project capital expenditure and operating costs, and needs to be investigated during the economic geology and resource evaluation stages.

In epithermal and orogenic gold deposits, gold often occurs as discrete grains in quartz veins, lodes, or stockworks, although some disseminated gold may be present. If the ore contains high concentrations of tellurium, antimony, or bismuth, then gold tellurides, aurostibite, and maldonite may occur. In porphyry copper-gold and IOCG deposits, gold occurs as coarse and fine particles and is often associated with pyrite, copper sulfides, and iron oxides. Generally speaking, gold in these ores is free-milling and can be extracted using gravity, floatation, cyanidation, or a combination of these techniques. Gold in the Carlin-type (and other sedimentary rock-hosted) gold deposits differs from gold in other deposit types in its invisibility and association with sulfide minerals (particularly pyrite and arsenopyrite) and carbonaceous material. To extract gold from refractory gold ores such as Carlin-type ores and gold telluride ores, the ore needs to be finely ground and pre-oxidation is often required.

A comprehensive gold deportment study procedure can provide important information including gold speciation and association, which can be directly used for the study of gold mineralization and economic evaluation of gold deposits.