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Metallogenic Characteristics of the Major Type Deposits in Southeast Asia

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1 Introduction

The Southeast Asia is endowed with a diversity of mineral resources(Khin Zaw et al., 2014). Tin, copper, nickel, bauxite, chromium and potash resources are widely distributed in the Southeast Asia, show considerable economic significance, have obvious complementarity to China, and is paid wide attention by Chinese geologists and mining industry in recent years. Although the exploration and development degree of mineral resources in Southeast Asia is very low, studies show that the Southeast Asia will be one of the most important metal suppliers and resource bases in the world in the coming years(Cobbing et al., 1986; Yokart et al., 2003; Khin Zaw et al., 2014). With the discovery of several world-class mineral deposits, the reopening of a number of old mines and the improvement of exploration technical level, the metallogenic studies and mineral exploration have attracted increasing attention among the international mining communities. In carrying out the idea of “two types of mining markets and two kinds of mineral resources” in China, the Southeast Asia will be one of the best choices. Although the Southeast Asia is still frontier area for exploration and mining, the present activity of exploration is very promising. For the purpose of clear understanding of the crust evolution and regional metallogeny, this introductory paper provides a summary of the geological features and temporal–spatial distribution regularities of the major type deposits of Southeast Asia. Meanwhile, the regional geological and tectonic setting and ore -forming processes have also been discussed. The purpose of this study is to fill the knowledge gap of our understanding of the metallogeny of the Southeast Asia. To better find new mineral deposits in the Southeast Asia, we should conduct more detailed researches both on regional metallogeny and on individual mineral deposits.

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2 Regional Geologial and Tectonic Setting

Mainland Southeast Asia is located at the zone of convergence between the Asia, India-Australia, and Philippine sea-Pacific Plates (Metcalfe, 2002, 2011a,b, 2013). The present day Southeast Asia is the result of more than 400 millon years of continental rifted away from the northwestern Gondwana margin at different feriond in the Phanerozoic which led to the Palaeo-Tethys, Meso-Tethys and Neotethyan-Tethys were opened and sequently destroyed, and continental fragments subduction, collision, convergenec and accretion(Searle et al., 2012; Sone et al., 2008). Mainland Southeast Asia consists of a complex continental fragments, volcanic arcs/backarc basins, and suture zones. The major continental fragments include Indochina, Sibumasu, West Myanmar terranes, Sukhothai terrane, Inthanon terrane and Sumatra which were derived from the southern Gondwana supercontinent.

During the whole history process of the Gondwana supercontinent break-up and the subsequent Mainland Southeast Asia amalgamation, most of the continental fragments that now make up Southeast Asia have occurred long-term various subduction-accretion, arc-continent collision, continent-continent collision and interactions, and resulted in the mutiple orogenic evevts, magmatism, tectonism, and metamorphism which have generated many mineralized fold belts at the most of the continental fragments margins. Throught the evolution process from Gondwana supercontinent break-up to the present-day Mainland Southeast Asia fromed, long-term multiple tectonic-magmatic-metamorphic-hydrothermal interactions have occurred among these Mainland Southeast Asia continental fragments and created superior metallogenic gelogical conditons for a wide variety of mineral resources.

The major types of deposits in Southeast Asia inciude

porphyry type copper (gold-molydenum) deposits, orogenic type gold deposits, skarn type copper-gold deposits, epithermal type gold-silver deposits and other deposits types such as intrusion-related gold deposits, VHMS, MVT, SEDEX, IOCG, granitoid-related tungsten-tin deposits, REE deposits and potash deposits(Yokart et al., 2003).

3 Metallogenic Characteristics of Major Type Deposits

3.1 Porphyry type copper(gold- molydenum) deposits

Major porphyry type copper (gold-molydenum) deposits are found in Sumatra Islands, Philippine Islands and Myanmar such as Grasberg super-large copper-gold, Tangse copper-molydenum, Tengkereng and Beutong copper–gold-molydenum deposits. Among these major porphyr type copper (gold- molydenum) deposits, the Grasberg super-large copper-gold deposit is fairly well studied, and is hosted in the Pliocene Grasberg complex. Most of the porphyr type copper (gold- molydenum) deposits in Southeast Asia are hosted in the Miocene porphyritic dioritic intrusion, and mineraled in Cenozoic.

3.2 Skarn type copper(gold) deposits

Major skarn type copper (gold) deposits are mainly distributed in the Truong Son fold belts in Laos and Loei fold belts in Thailand and along the Tam Ky-Phouc Son suture zone in central Vietnam. These skarn type copper (gold) deposits in Southeast Asia are divided into oxidized- and reduced copper (gold) deposits. The Major skarn type deposits include Phu Khan copper (gold) (northern Laos), Puthep porphyry-related iron-copper (gold) deposit (northern Thailand) and Phu Thap Fah gold deposit (northeastern Thailand).

3.3 Epithermal type gold-silver deposits

Major epithermal type gold-silver deposits are found in the Loei fold belts in Thailand, Truong Son fold belts in Laos, and in Sumatra Islands such as Chatree gold-silver deposit(central Thailand), Monywa copper (gold) deposit (central Myanmar), Martabe gold deposit (northwestern Sumatra), Miwah gold deposit (Sumatra) and Wang Yai prospect (central Thailand).

3.4 Laterite type nickel deposits

The laterite type nickel deposits in Southeast Asia are mainly distributed in Sumatra Islands in Indonesia and Philippine Islands such as the Rio Tuba large nickel deposit in Palawan island in Philippine and the Kolonodale nickel deposit in Sulawesi island in Indonesia. Kolonodale nickel deposit is a typical laterite type nickel deposit in Southeast Asia, and is hosted laterite weathering profile of ultramafic rocks. The ore-bearing profile of Kolonodale nickel deposit can divided into four vertical layers: the red ferric oxide layer, the yellow clay layer, the sage green ore layer and the regolith profile. The ore-forming process of Kolonodale nickel deposit can divided into three stages: the sparolite stage, the laterite stage and the secondary enrichrnment stage(Fu et al., 2010).

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