XU Deru, ZHOU Yueqiang, SHAN Qiang, NIE Fengjun, HOU Maozhou, WU Chuanjun, FU Yangrong, WANG Zhilin and ZHANG Xiaowen, 2014. Gold Mineralization in Hainan Province of South China: Geological Characteristics, Geodynamic Settings, and Ore-deposit Types. *Acta Geologica Sinica* (English Edition), 88(supp. 2): 815-816.

Gold Mineralization in Hainan Province of South China: Geological Characteristics, Geodynamic Settings, and Ore-deposit Types

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Abundant gold ore deposits and occurrences with metallogenic epoch predominantly at the Mesozoic are sited in Hainan Province, South China (Fig. 1), and occupy proven metal gold reserves of more than 143 t. They are hosted mostly by the low- to middle-grade volcano-clastic sedimentary rocks of the Mesoproterozoic, Silurian and Permian ages, with minor presence within the Cretaceous continental clastics or volcanics. The ore modes mainly include auriferous quartz veins, altered mylonites, and altered cataclasites that were developed along a group of NE-, NNW- and NWW-trending shear fracture zones, and NW- to NNW-trending intra- or interformational detachment fault belts which were associated with folding, shearing and/or transpressional to transtensional deformation. In combination with the tectonic development and magmatic activities, the ore geologies, fluid inclusion geochemistries, C-H-O-S-(Pb) isotopes and the geochronologies consistently indicate that at least there are two ore deposit-types for gold deposition in Hainan Island, i.e. the orogenic-type and the intrusion-related (Groves et al., 1998, 2003).

The predominant, orogenic gold mineralization which produced more than 95% of Au metal reserves in Hainan Island occurred at the Early Mesozoic of ca. 225 Ma age dated by Ar-Ar, K-Ar and Re-Os methods. This ore deposit-type represented by the large-scale Baolun, the Gezhen-type (inclduign Bumo, Erjia, Datian, Baoban, Hongquan, and Tuwaishan), and the Wangxia deposits generally is hosted by the metamorphosed rocks of various ages and related intimately to brittle-ductile shearing. These deposits with native gold as main gold minerals also contain a midddle-temperature, CO_2-rich (mainly 4.8-16.8 mol %), low-salinity (generally 3-10.5 wt.% $NaCl_{eq.}$) and near neutral (pH=~7) ore fluid component of $H_2O + CO_2 + CH_4$. The sulfide volume is low (<5%) whereas the Au/Ag ratios (generally >8%) and gold fineness are high. Linked to the petrographical and geochemical features of the Late Paleozoic to Early Mesozoic (ca. 300-200 Ma) granitoids, the orogenic gold mineralization will be considered to have occurred in a transitional post-orogenic to post-orogenic extensional setting in response to South China Indosinian orogeny leading to closure of the Paleotethys Ocean. The ore modes, ore fluid compositions, and mineralizing temperature and pressure conditions, however, suggest that the orogenic gold likely contains two subtypes, i.e. the *mesozonal* represented by the lode gold ores and the *epizonal* by disseminated, altered mylonite- and cataclasite ores. They represent end-members of a crustal continuum of orogenic gold emplacement. Moreover, an involvement of magmatic waters into the ore fluids as implied by abundant Bi-As-Te-Mo-S phases overgrown synchronously with the gold minerals especially in the high-grade Baolun deposit cannot be ruled out.

The Fuwen Au-dominated Au-Ag ore deposit which is hosted by the Early Cretaceous continental clastics is interpreted as a high-sulfide, intrusion-related deposit and likely occurred at the late Cretaceous. This deposit has some characteristic features as lode gold-dominated ore, high gold grade (average 28-95 g/t Au), extremely high sulfide volume (>50%), Au-dominated Au-Ag-Cu-Pb-Zn metal association, and small amounts of altered minerals

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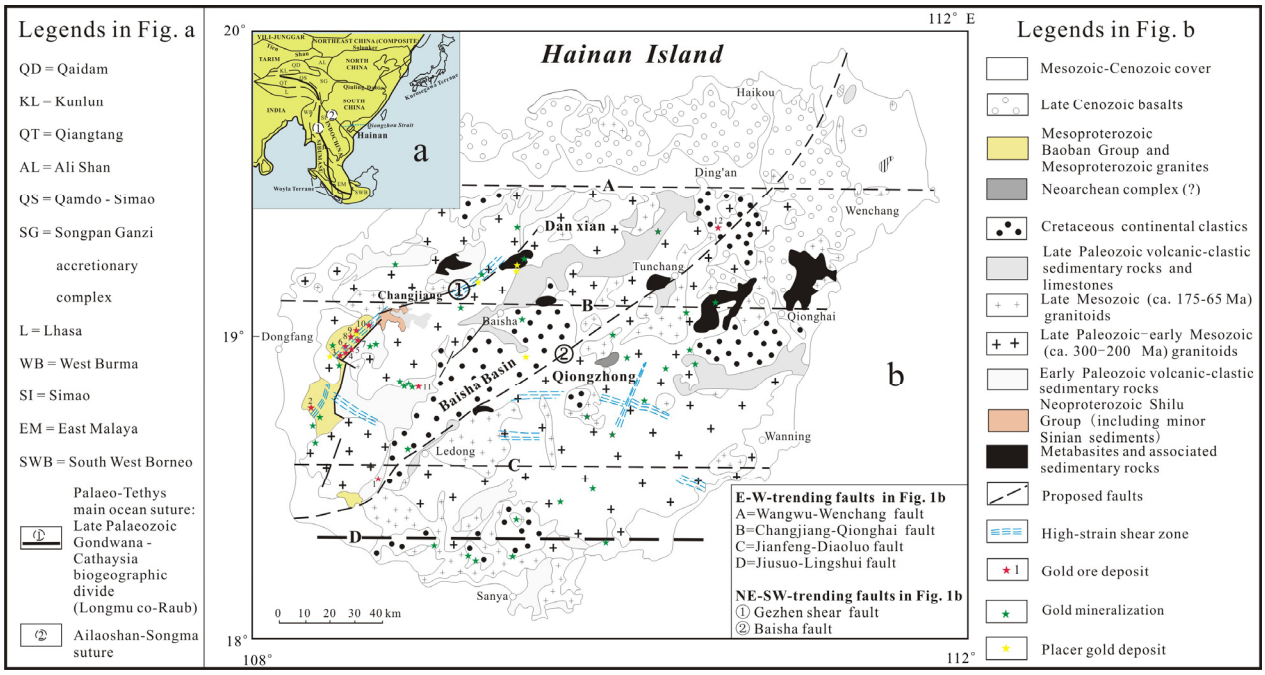

Fig. 1. (a) Location map (modified from Metcalfe, 2013) and (b) simplified map showing the main stratigraphic and magmatic units, and gold ore deposits and occurrences in the Hainan Island, south China (modified from Xu et al., 2013). In Fig. b, representative ore deposits and mines include 1= large-scale Baolun deposit, 2= Bumo deposit, 3=Hongfumenling mine of Erjia deposit, 4= Fengshuishan mine of Erjia deposit, 5= Beiniu mine of Erjia deposit, 6= Datian deposit, 7= Baoban deposit, 8= Hongquan and 9= Hongquan 18 deposit, 10= Tuwaishan deposit, 11= Wangxia deposit, 12= Fuwen deposit.

pyrite, quartz, sericite, chlorite and calcite. The rare isotopic data of O-H-S-Pb as well as its occurrence mainly in the interformational detachment fault belts and minor within the late Early Cretaceous (ca. 100 Ma by LA-ICP-MS) adakite-like granitoids suggest that the Fuwen deposit had an intimate genetic link to the arc-related extension-type magmatism due to asthenosphere upwelling caused by the roll-back of the subducted Paleopacific plate beneath South China continent.

Collectively, the gold mineralization in Hainan Island was associated closely with the host rocks of various ages, and the Late Paleozoic to Mesozoic tectonic development and related granitic magmatism. The depositional mechanism for gold, especially for the high-grade deposits, however, is still unclear and needs to be preciously elucidated.

Acknowledgements

This paper is funded by the State Key Fundamental Program (2012CB416806) and the Chinese Ministry of Land and Resources (1212011220710). Great thanks are given to senior engineers Chen Mulong and He Yusheng from Hainan Bureau of Geology, and senior engineers Liu Yongtang and Gao Peng, and engineer Wang Liguo from Shandong Gold Mining Co., LTD, for their supports during the regional geological survey and mining work. A particular thank is given to Profs. Niu Hecai, Zhang Hu, and Yu Xueyuan for their constructive suggestions to this paper.

Keywords: Orogenic-type gold ore deposit; intrusion-related gold ore deposit; Mesozoic mineralizing event; Hainan Province of South China

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