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# Biogeochemical characteristics of the Hetai goldfield, Guangdong Province, China

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**Abstract**

In the Hetai goldfield, Guangdong Province, China, samples including rocks, soils and leaves of four plants (*Pinus massoniana*, *Rhodomyrms tomenlosa*, *D. linearis* var. *dichotoma* and *Embelia laeta*) collected from the gold mineralization zone and the background area were analyzed for Au, Ag, Cu, Pb, Zn, Hg, As and physiological parameters. The objective of this investigation is to study the geochemical and biogeochemical characteristics of studied plants, aiming at biogeochemical methods in Au exploration. The goldfield region shows geochemical and biogeochemical anomalies. Abundances of Au in rocks, soils, plants and the leaf pigments in the mineralized area are much higher than those in the surrounding region. The plants display unhealthy physiological and ecological characteristics in the Hetai goldfield area. The cell structures of the goldfield plants were anomalous and aberrant, and there were many nano-metal particles diffused in mitochondria and chloroplasts. Macro- and microscopic evidences of the vegetation in the goldfield areas are distinctly different from the background regions. The strongly anomalies in responses to Au are profound in further geochemical and botanic exploration studies.


*Keywords:* Hetai goldfield; Biogeochemical characteristics; Cell structures

## 1. Introduction

Metallic ore deposits have played an important role in the development of technology and economy of the human society since early in the history of mankind. The highly industrialized contemporary society requires an increase in metallic mineral supplies. Thus, it is a priority to increase our activities of exploration and exploitation of these ore deposits. Geochemical and biogeochemical methods have been widely used for mineral exploration as existing mines become depleted in recent years. Brooks et al. (1995) published a detail review of biogeochemistry and described its application in mineral exploration. Voicu and Bardoux (2002) studied the geochemical behavior of Omai gold mine and presented a potentially useful tool for geochemical exploration in tropical terrains. Zeynep

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Özdemir (2003) proposed that *Pinus. brutia* can be used as a biogeochemical sample medium to detect concealed deposits of Zn and Fe. Fernandez-Turiel et al. (2003) has found three plant species, which can be considered suitable for biogeochemical exploration of tin mineralization in American arid regions. Some studies have shown that some microorganisms may also indicate the presence of buried deposits (Parduhn et al., 1985; Parduhn, 1991). Xu (1990, 1996) have studied the application of biogeochemistry to mineral prospecting in the Maanshan iron deposits of Anhui, the Yunfu pyrite and iron ore deposit of Guangdong, the Zn deposit of Xingjiang and the Qinling gold deposit belt in China. Research in exploration geochemistry has led to the use of vegetation as a sample medium in search for chemical anomalies that indicate mineralization. A number of studies have shown that plant sampling is a quick, inexpensive and effective geochemical exploration method, especially for Au exploration (Kovalevskii and Kovalevskaya, 1989; Busche, 1989; Cohen et al., 1987; Lintern et al., 1997; Rogers and Dunn, 1993).

The current study assessed the geochemical and biogeochemical characteristics of the Hetai goldfield, Guangdong Province, China. It established the usefulness of biogeochemistry as an aid in Au exploration and investigated the aberrant effect on botanic cell tissue. The aim of this work is to provide macro- and microscopic evidence of background and anomalous values for studies on Au exploration and to assist in defining targets for mineral exploration.

## 2. Study area

Hetai, the largest goldfield in South China is located in the Yunkai metamorphic terrane, which crops out over a broad region of western Guangdong and southeastern Guangxi Provinces (N 23°17′30″–N 23°20′00″, E 112°15′00″–E 112°22′00″. Fig. 1) with a district area of approximately 45 km$^2$. The gold deposit is in the northeastern sector of the northeast–southwest-oriented Wuchuan–Sihui fracture zone, one of a series of well-defined crustal-scale discontinuities in South China. There are two major intrusive bodies in the Hetai district. One is the Yunlougang granodiorite, occupying a large portion of the area in the northwest. The other is the Wuchun porphyritic granite, which is located in the northeast of the district. There are two ore types, namely the alteration mylonite type and the vein type. Rocks hosting the ores are silicified and sericitized, and the main gangue minerals in the lodes are quartz and sericite. Sulfide and Au ores were superimposed on the lenticular structures, producing disseminated and veinlet ores with mainly chalcopyrite, pyrite, pyrrhotite and native gold assemblages (Duan et al., 1992; Zhang et al., 2001). The vein type is found within dilation areas and usually parallel to the major ore body. Most soil types of the study area were classified as latosols, developed on schists and granite. Soil profiles vary greatly in thickness throughout the region from a few centimeters to over a meter as a result of topography. The pH of the soils varies from 4.4 to

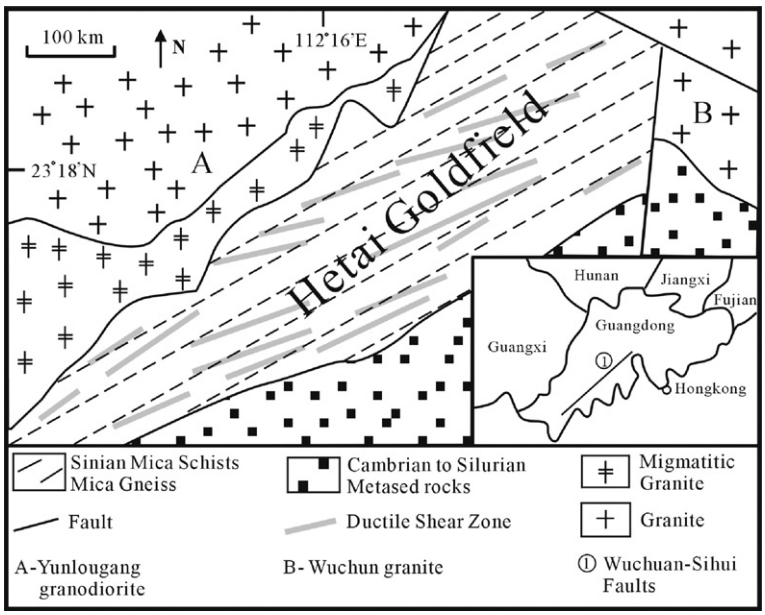


Fig. 1. Generalized geologic map of the Hetai goldfield.