Journal of Asian Earth Sciences 113 (2015) 1235–1252

Contents lists available at ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

Origin of the disseminated magnetite pyroxenite in the Tieshanmiao-type iron deposits in the Wuyang region of Henan Province, China

Tong Yao [a,b], Hou-Min Li [a,*], Wen-Jun Li [c], Li-Xing Li [a], Chuang Zhao [a,b]

[a] MLR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing 100037, China
[b] Faculty of Geosciences and Resources, China University of Geosciences, Beijing 100083, China
[c] Key Laboratory of Mineral Resources, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China

ARTICLE INFO

Article history:
Received 12 October 2014
Received in revised form 24 March 2015
Accepted 30 March 2015
Available online 23 April 2015

Keywords:
Banded pyroxene–magnetite quartzite
Disseminated magnetite pyroxenite
Iron deposits
North China Craton
Tieshanmiao

ABSTRACT

The Tieshanmiao-type iron deposits in the southern North China Craton comprise two types of ores: banded pyroxene–magnetite quartzite (BMQ) and disseminated magnetite pyroxenite (DMP). Whether the quartz-poor DMP represents metamorphosed iron-bearing ultramafic rocks or chemical sedimentary rocks is still unclear. Pyroxene compositions in the DMP are low in Al_2O_3 and TiO_2, which are similar to those from the BMQ and altered marble and pyroxenite. However, the compositions are different from those in the metamorphosed ultramafic rocks. The DMP and BMQ also show similar major element contents, with dominant SiO_2, total Fe_2O_3, CaO, MgO but low contents of Al_2O_3, TiO_2, MnO, Na_2O, K_2O, indicating a similar source through submarine chemical precipitation with little input from terrestrial or volcanic materials. The BMQ, DMP and magnetite separates from these rocks exhibit seawater-like signatures of REE patterns with LREE depletion, positive La, Gd and Y anomalies and high Y/Ho ratios, indicating that seawater participated in the formation of the iron ores. Combined with strong positive Eu anomalies, we infer that the deposition of the BMQ and DMP was mainly controlled by the mixing of seawater with hydrothermal fluids. The lack of negative Ce anomalies of the DMP, BMQ and magnetite separates indicate an anoxic marine environment. The DMP is rich in carbonate but relatively poor in silica and the BMQ is rich in silica but poor in carbonate. The protoliths of the DMP and BMQ in the Tieshanmiao-type iron deposits are inferred to be quartz–carbonate iron-bearing formations which underwent subsequent metamorphism.

1. Introduction

Precambrian banded iron formation (BIF) are iron-rich (TFe > 15%) marine sedimentary rocks which are composed of iron oxides (magnetite and hematite) and gangue minerals (James, 1954). Based on the difference in depositional environments and coeval rock assemblages, Gross (1965, 1980) divided the Precambrian BIFs into Algoma-type and Superior-type (or Hamersley-type). In China, the BIF-related iron ores constitute the most important type of iron deposits (Zhai and Santosh, 2013; Zhang et al., 2014). These deposits are composed of low-grade and coarse-grained magnetite ores which were formed during metamorphism and deformation (Zhou, 1987; Yao et al., 1993; Shen et al., 2005; Li et al., 2010, 2011). The BIF-related iron deposits in China are mainly distributed in the Anshan-Benxi (in Liaoning Province) and eastern Hebei (in Hebei Province) in the northern part of the North China Craton (NCC) (Li et al., 2012a,b, 2015a; Zhang et al., 2012, 2014; Shen, 2012), and the ores show well-developed banded structures. The ore types are mainly banded magnetite quartzite, with only minor amounts of amphibole, pyroxene, or chlorite (Li et al., 2014a, 2015b,c).

The Wuyang Tieshanmiao-type iron deposits, located at the southern part of the North China Craton (NCC), are hosted in the metamorphosed iron formation in the Neoarchean Taihua Group. Previous studies suggest that the Tieshanmiao-type iron deposits belong to Algoma-type, which have undergone amphibolite–granulite facies metamorphism (Yu et al., 1981; Wang et al., 2006; Luo, 2009; Lan et al., 2013; Li et al., 2013; Liu et al., 2014). The Tieshanmiao-type iron deposits have two types of ores: one is banded pyroxene–magnetite quartzite (BMQ), and the other is disseminated magnetite pyroxenite (DMP). The BMQ is similar to the BIF in the Anshan-Benxi and eastern Hebei areas. However, DMP is markedly different from the BMQ, and is mainly composed of

* Corresponding author.
E-mail address: lihoumin2002@163.com (H.-M. Li).

http://dx.doi.org/10.1016/j.jseaes.2015.03.050
1367-9120/

pyroxene and magnetite, with only minor or no quartz. The protolith of the DMP remains elusive. In this study, we attempt to characterize the ore deposit geology and geochemical features of the Tieshanmiao-type iron deposits with a view to investigate the genesis of the DMP.

2. Geological background

North China, South China and Tarim Cratons constitute the main tectonic framework of mainland China (Fig. 1). The North China Craton (NCC) is the largest and oldest craton in China (Zhao et al.,

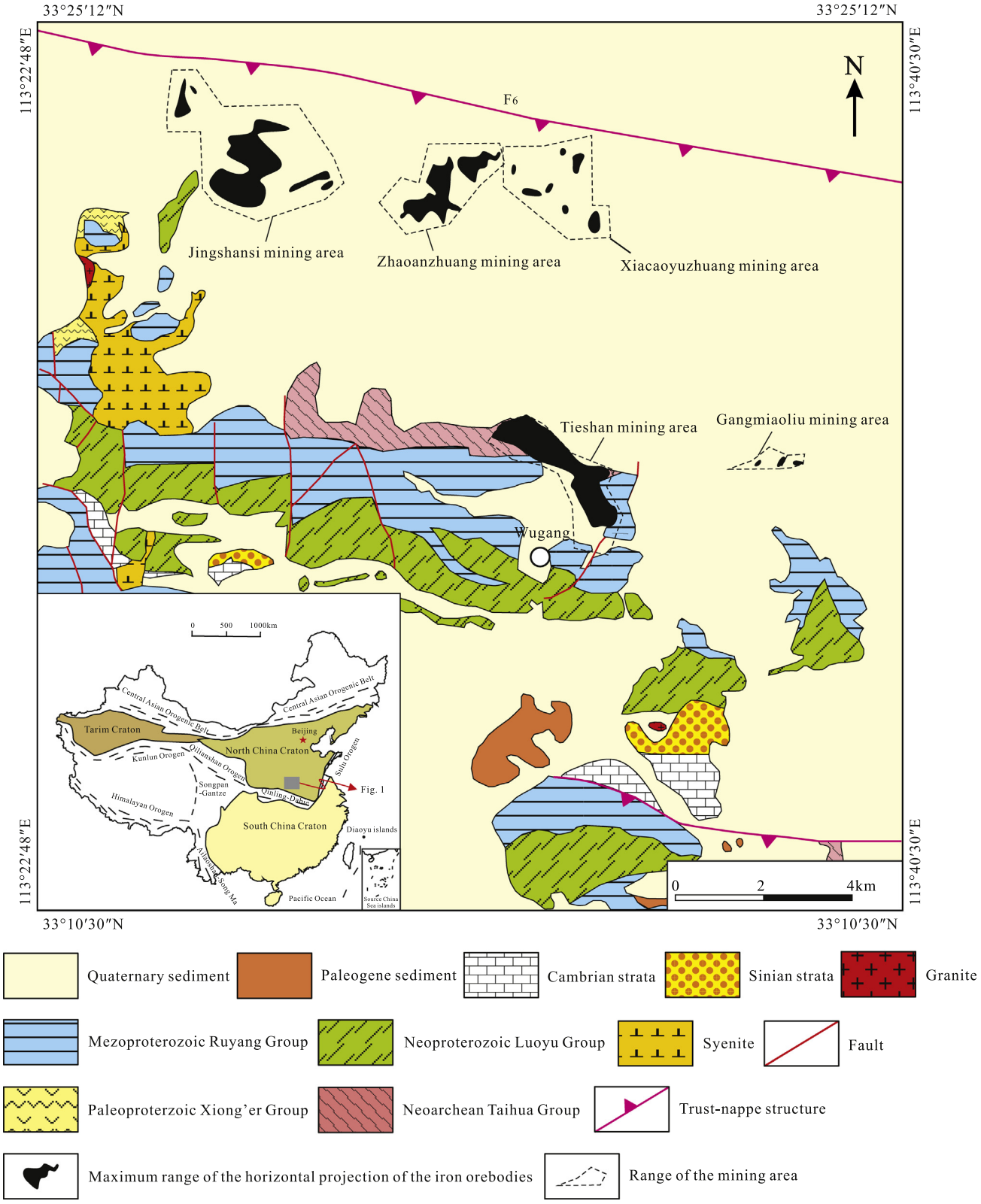

Fig. 1. Geological map showing the distribution of the iron deposits in the Wuyang region, Henan Province, China (modified after Han (2010) and Li (2012)). The schematic tectonic map of China is after Zhao et al. (2001).