

赣南印支期中硫化型浅成低温热液银矿床的发现和意义*

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摘要 近年, 在中国赣南的会昌县年坑地区新发现一浅成低温热液银矿床, 其矿体赋存在隐爆角砾岩筒内, 隐爆角砾岩的胶结物由富锰碳酸盐类矿物(含锰白云石-菱锰矿-含锰方解石)-石英-白云母-含银硫盐(黝铜矿-硫银锑矿)-硫化物(辉银矿-方铅矿-半透明闪锌矿和黄铁矿)-自然银组成, 成矿具有中硫化型特征。年代学研究表明, 年坑银矿床形成于三叠纪(印支期), 是华南地区首例印支期中硫化型的浅成低温热液矿床。对该矿的成矿时代和成矿特征的详细研究, 指示华南地区具有寻找印支期同类型浅成低温热液银矿及相关斑岩铜或锡矿床的潜力。

关键词 地球化学; 浅成低温热液银矿床; 中硫化型; 印支期; 成矿年代学

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Significance and discovery of Indosinian intermediate sulfidation epithermal Ag deposit in the southern Jiangxi Province

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Abstract

Recently, a new epithermal Ag deposit was discovered in the Niankeng area of the southern Jiangxi Province, South China. The Niankeng Ag deposit is hosted in a breccia pipe, which was cemented by the manganese-rich carbonate species (Mn-dolomite-kutnohorite-rhodochrosite-Mn-calcite)-quartz-muscovite-Ag-bearing sulfosalt (tetrahedrite-argyrodite)-sulfide (argentite-galena-translucent sphalerite-pyrite)-natural silver. The deposit is characterized by intermediate sulfidation. According to geochronologic studies, the Niankeng Ag deposit was formed in the Triassic (Indosinian), and is the first discovered and reported intermediate sulfidation epithermal Ag deposit in the South China. Studies of the mineralization ages and ore characteristics of the Niankeng Ag deposit are conducive to explore the Indosinian intermediate sulfidation epithermal Ag deposits and related porphyry Mo and Sn deposits in the South China.

Key words: geochemistry, epithermal Ag deposit, intermediate sulfidation, Indosinian, metallogenic chronology

浅成低温热液矿床富含巨量金银资源, 又可以作为找矿标志(Sillitoe et al., 2003; Mao et al., 2011), 与斑岩铜钼矿床形成一个连续的成矿系统, 可以互故受到广泛关注。浅成低温热液矿床的分类方案较

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多,其中,采用较多的是Hedenquist(1987)的分类根据矿石特征、矿物组合和硫价态将其分为低硫化型和高硫化型矿床。有学者将低硫化型矿床中一类具有高的Ag/Au比值、富含银硫盐(黝铜矿)和脉石矿物发育富锰碳酸盐类矿物的矿床定义为中硫化型矿床(Hedenquist et al., 2000)。相比于高硫化型和低硫化型矿床,目前报道的中硫化型浅成低温热液矿床的数量和研究程度均较低(宋国学等, 2018; Wang et al., 2019)。

中国赣南地区是全球范围内重要的钨多金属产地之一(Mao et al., 1996; 2013; 2019; 毛景文等, 2007; 2020; Wu et al., 2018; 2019a; 2019b; 祝红丽等, 2020),其东南部位于南岭和武夷山交汇部位的会昌地区,发育一系列隐爆角砾岩筒-斑岩成矿系统,并常常伴随着锡和铜成矿作用,如岩背锡矿(熊小林等, 1994; 李鸿莉等, 2007; 余长发等, 2013)、红山铜矿(苏慧敏等, 2010)、青龙山铜矿(侯珊珊等, 2018)等。年坑矿床是由江西省地质

矿产开发总公司近年在会昌县新发现的一个浅成低温热液(发育在隐爆角砾岩筒内)银矿床。研究表明会昌地区的隐爆角砾岩筒-斑岩成矿系统的锡和铜矿的形成时代为白垩纪(苏慧敏等, 2010),但是对年坑这类发育在隐爆角砾岩筒内的银矿尚未有研究。

赣南会昌年坑银矿体主要赋存在隐爆角砾岩筒内(图1),现已勘查到的银资源量308 t,达到中型,银品位60~194 g/t,并伴生一定量的锌资源。作者通过野外调查和室内研究,将该矿床定为中硫化型浅成低温热液矿床,具体依据如下:①产在陆相火山-次火山岩带内;②在次火山岩顶部发育隐爆角砾岩筒;③该隐爆角砾岩筒的胶结物主要由富锰碳酸盐类矿物(含锰白云石-锰白云石-菱锰矿-含锰方解石)-石英-白云母-含银硫盐(黝铜矿-硫银锗矿)-硫化物(辉银矿、方铅矿、半透明闪锌矿和黄铁矿)-自然银组成(图2)。初步地质勘探表明,年坑银矿的隐爆角砾岩筒垂向延伸超过1000 m,超过大部分浅成低温

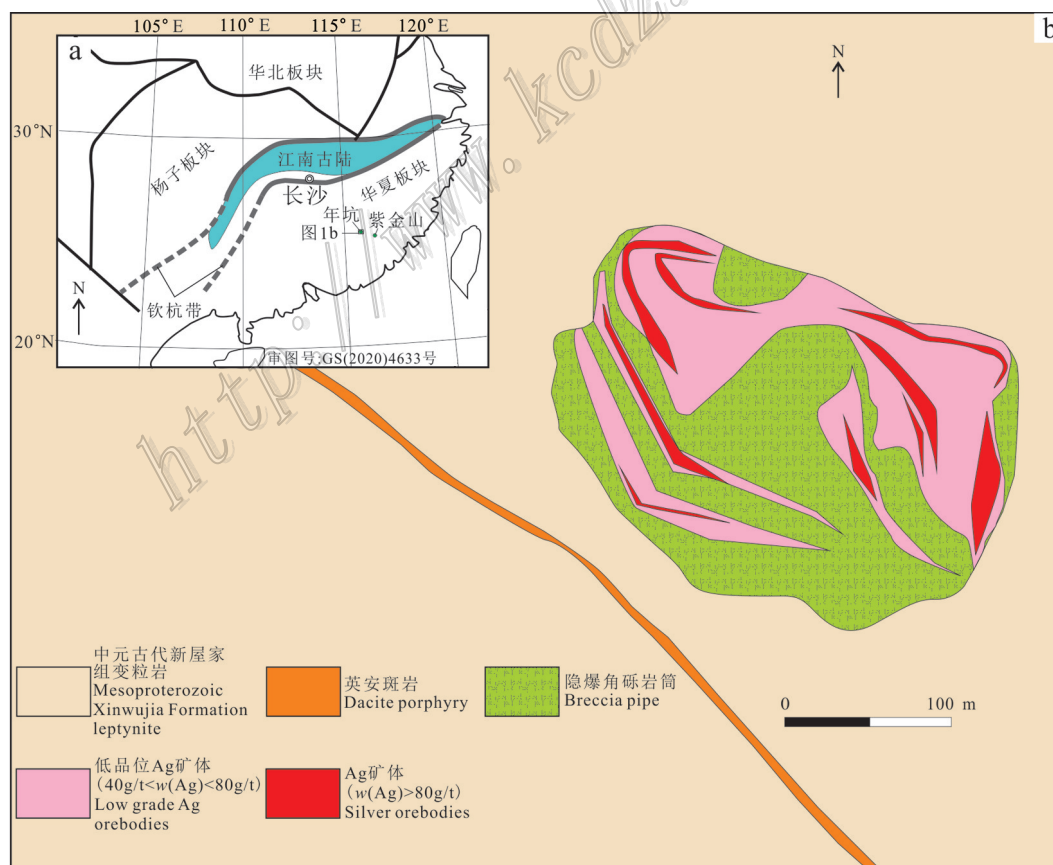


图1 江西年坑银矿床构造位置(a)地质图(b)

Fig. 1 Tectonic location (a) and geological map (b) of the Niankeng Ag deposit from Jiangxi Province

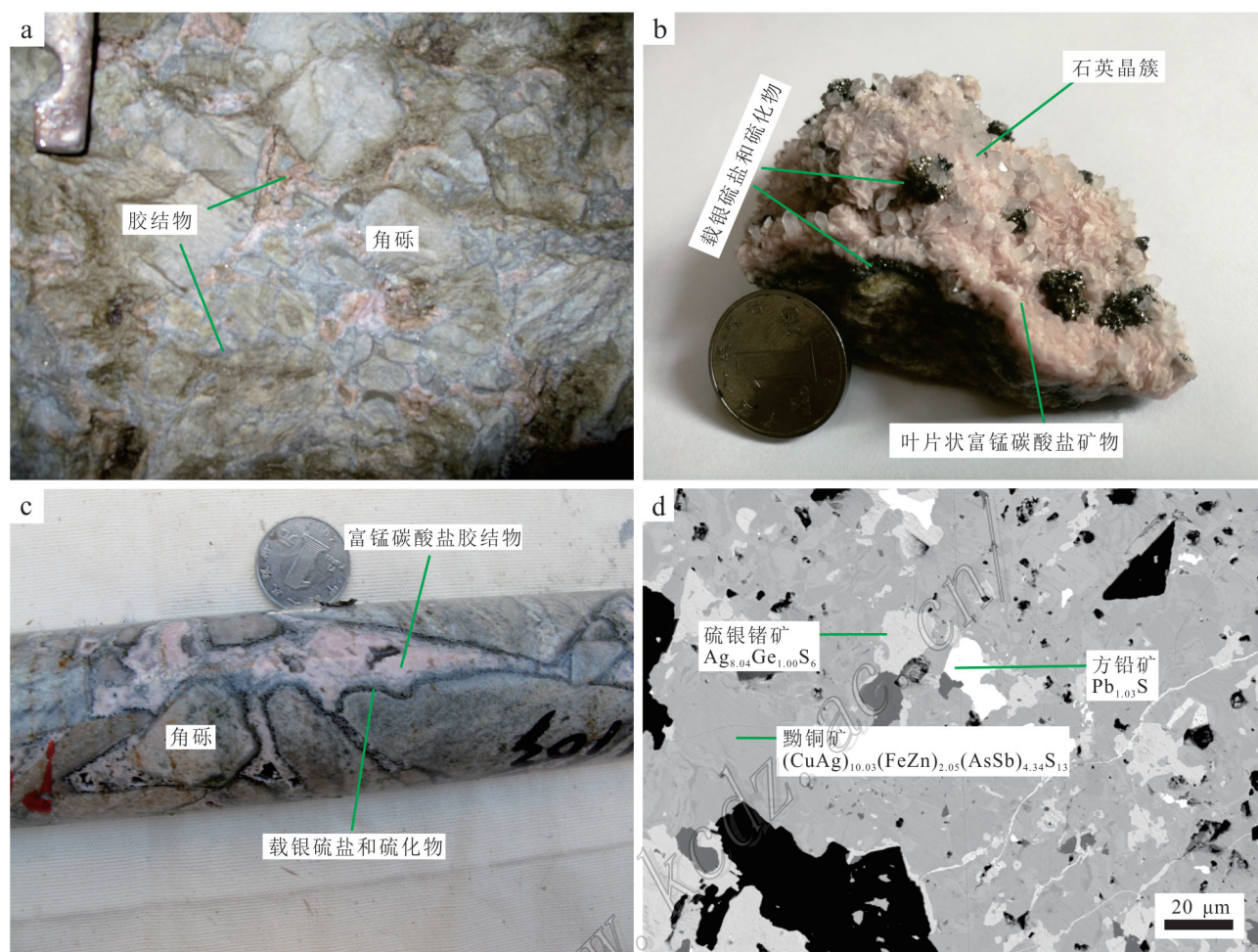


图2 江西年坑Ag矿床矿石特征和矿物组成

a. 巷道内观测到的由富锰碳酸盐类—载银硫盐/硫化物胶结的隐爆角砾岩筒; b. 叶片状富锰碳酸盐矿物和石英晶簇, 发育纹层状或浸染状载银硫盐/硫化物; c. 富锰碳酸盐矿物—载银硫盐/硫化物矿物胶结的隐爆角砾岩筒的岩芯照片; d. 矿石矿物显微照片, 主要由黝铜矿—硫银锗矿—方铅矿组成

Fig. 2 Characteristics and photograph of ores and minerals from the Niankeng Ag deposit, Jiangxi Province

a. Photograph of local breccia pipe cemented by the manganese-rich carbonates-Ag-bearing sulfosalts/sulfides, observed in the tunnel; b. Bladed carbonate minerals and quartz clusters, and development of banded or disseminated Ag-bearing sulfosalts/sulfides; c. Core photograph of the breccia pipe cemented by the manganese-rich carbonates-Ag-bearing sulfosalts/sulfides; d. Microscopic photograph of ores, mainly composed of tetrahedrite-argyrodite-galena

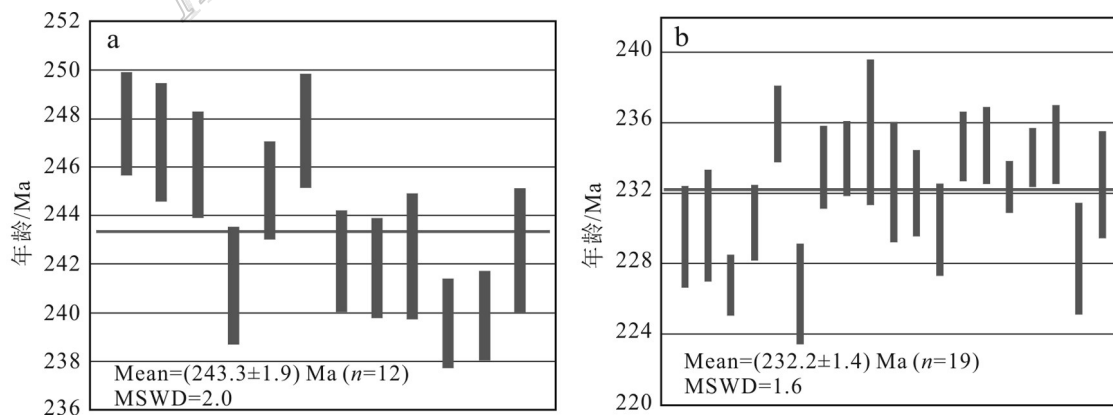


图3 江西年坑花岗斑岩(a)和辉绿岩(b)锆石U-Pb加权平均年龄

Fig. 3 Weighted mean ages of zircons from the granite porphyry (a) and diabase (b) in the Niankeng deposit, Jiangxi Province

热液(隐爆角砾岩筒)系统在垂向上的延伸长度。

作者获得年坑隐爆角砾岩筒底部的花岗斑岩角砾的 LA-ICP-MS 锆石 U-Pb 加权平均年龄为 (243.3 ± 1.9) Ma (MSWD=2.0) (图 3a); 切穿引爆角砾岩筒的辉绿岩脉的 LA-ICP-MS 锆石 U-Pb 加权平均年龄为 (232.2 ± 1.5) Ma (MSWD=1.6) (图 3b); 引爆角砾岩筒中胶结物中白云母的 Ar^{40} - Ar^{39} 同位素坪年龄为 (234.6 ± 2.2) Ma (MSWD=1.34) (未发表资料)。这些数据表明年坑银矿床形成于三叠纪。结合已有资料表明,该矿是华南地区目前发现的首例印支期的中硫化型浅成低温热液中矿床。据此,作者认为赣南会昌地区斑岩-引爆角砾岩筒成矿系统包括 2 期:① 三叠纪中硫化型浅成低温热液银矿;② 白垩纪斑岩-浅成低温热液(铜锡金银)成矿系统。年坑矿床的发现暗示在赣南地区具有寻找印支期斑岩-浅成低温热液钼银或锡银成矿系统的潜力。

根据 Wang 等 (2019) 的统计分析表明,全球范围内的中硫化型矿床大多形成于新生代,特别是分布在环太平洋成矿域的矿床。此外,环太平洋成矿域,中亚成矿域和特提斯-喜马拉雅成矿域,也发育若干中生代和古生代的中硫化型矿床。这一现象表明和斑岩型矿床类似,中硫化型浅成低温热液矿床形成时处在地表浅部,大部分经历抬升、风化和剥蚀已经消失,即越古老的浅成低温热液矿床越难保存下来。年坑银矿的发现表明赣南地区保存有中生代的中硫化型银矿。但是,上述成矿域中已报道的中硫化型矿床主要形成于侏罗纪和白垩纪,而年坑银矿床是目前勘查到鲜有的形成于三叠纪并保存较好的中硫化型银矿床。中硫化型浅成低温热液 Ag 矿床易由拉张地区的还原性的 S 型岩浆产生,如玻利维亚 Ag 矿带,与还原性的富钛铁矿的火山岩/侵入岩相关;也有部分由氧化的 I 型岩浆形成。在拉张环境下,中硫化型浅成低温热液矿床具有高的 Ag/Au 比值 (Wang et al., 2019)。年坑中硫化型银矿床具有 Ag/Au 值 >60 , 表明该中硫化型矿床很可能形成伸展的背景。伸展背景下的中硫化型银矿深部或周边常常伴随斑岩型钼或锡矿化(床),如中国东北的双尖子山 (Zhai et al., 2020)、玻利维亚的 Cerro Rico de Potosi (Rice et al., 2005) 以及阿根廷的 Pirquitas (Slater et al., 2021) 等。因此,对于赣南地区出现印支期的中硫化型浅成低温热液银矿床深部是否发育斑岩钼或锡矿化? 以

及矿床本身的成矿规模、成矿规律、成矿机理等,有待开展进一步研究和勘探工作。

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