doi: 10.12029/gc2019Z108

论文引用格式：贺根文，于长琦，李伟，刘孝斌，周兴华. 2019. 赣南于都金银多金属矿整装勘查区 1∶50 000 银坑幅矿产地质图数据集[J].中国地质，46(S1):66−74.

数据集引用格式：贺根文；于长琦；李伟；刘孝斌；周兴华. 赣南于都金银多金属矿整装勘查区 1∶50 000 银坑幅矿产地质图数据集(V1).江西省地质矿产勘查开发局赣南地质调查大队 [创建机构]，2016. 全国地质资料馆 [传播机构], 2019-06-30. 10.23650/data.C.2019.P7; http://dcc.ngac.org.cn/geologicalData/rest/geologicalData/geologicalDataDetail/49f332621e345f16920e51810203226b

收稿日期：2019-03-08
改回日期：2019-06-15

基金项目：中国地质调查局地质调查项目“整装勘查区找矿预测与技术应用示范”子项目（121201004000160910-13）资助。

赣南于都金银多金属矿整装勘查区 1∶50 000 银坑幅矿产地质图数据集

贺根文　于长琦　李伟　刘孝斌　周兴华

(江西省地质矿产勘查开发局赣南地质调查大队，江西 赣州 341000)

摘要：本数据集综合应用岩性−构造−矿化蚀变专项填图、遥感、物探、化探、钻探等多种方法进行数据采集，完成路线调查长度 520.65 km，采集水系沉积物样品 2 047 件，遥感数据解译面积 461 km^2，化学分析样 167 件。重点对燕山早期成矿岩浆岩、含矿建造、控岩控矿构造，以及矿化蚀变标志等进行了调查划分，明确区内银金多金属矿主要成矿地质体为燕山早期花岗闪长岩，控岩控矿构造为北东向逆冲断裂及其次级裂隙。在此基础上，编制了 1∶50 000 银坑幅建造构造图，利用数字化填图系统（DGSS）创建了区内矿产地质图数据库，全面汇编了重要建造构造、地质界线、断裂、岩浆岩等图层属性库；完善了银坑式中低温岩浆期后热液矿床找矿预测模型，突出了区内矿产与建造构造之间的成因联系。

关键词：于都整装勘查区；银坑幅；矿产地质图数据集；金银多金属矿；1∶50 000

数据服务系统网址：http://dcc.cgs.gov.cn

1 引言

赣南地区素有“世界钨都”、“稀土王国”的美誉，一直以来，以特有的石英脉型钨矿和风化壳离子吸附型稀土矿为其找矿重点。江西于都银坑−宁都青塘矿集区是赣南成矿地质条件较为特殊的区域，位于南岭成矿带与武夷成矿带的交汇部位，属雩山成矿带北部于都−宁都坳陷带内，是南岭成矿带东段的重要有色贵多金属矿集区之一。区内同时发现了多种贵金属和钨多金属两类矿床 (郭娜欣等, 2015；赵正等，2017)，分布有牛形坝银铅锌矿、老虎头铅锌矿、狮吼山硫铁钨矿、画眉坳钨铍矿、留龙金矿等多个中小型以上规模矿床。2013 年，为加快推进找矿突破战略行动，原国土资源部将“于都银坑−宁都青塘金银多金属矿区”列入全国第三批整装勘查区，统一部署并落实相关地质工作。近年来，通过整装勘查，分别在银、金、铅锌矿找矿方面取得重大进展，资源

第一作者简介：贺根文，男，1988 年生，工程师，硕士研究生，长期从事矿产勘查和矿产调查工作；Email：429056423@qq.com。

量有了显著增加。

区内出露地层主要有新元古代青白口系、南华系、震旦系，早古生代寒武系，晚古生代泥盆系、石炭系、二叠系，中生代侏罗系、白垩系，以及新生代第四系。可划分为青白口系–寒武系褶皱基底、泥盆系–二叠系褶皱盖层和中生代陆相碎屑岩盖层（局部有火山岩）三个构造层，各构造层之间呈角度不整合或断层接触，分别代表华南地区加里东、印支和燕山三次重要的构造事件。岩浆活动强烈，具有多阶段、多期次侵入的特点，可划分为加里东期、印支期和燕山期 3 期。加里东期岩体有鹅婆、长潭、白石坑 3 处岩体，岩性有黑云母花岗岩、石英闪长岩两类。印支期岩体位于整装勘查区西南部，代表性岩体有古嶂黑云母花岗岩。受环太平洋板块俯冲影响，区内燕山期经历了强烈的伸展减薄作用（毛景文等，2008；赵希林等，2012），岩体十分发育，分布于整装勘查区中部和西北部，包括江背、高山角、茶山迳岩体等，主要岩性有黑云母花岗岩、花岗闪长岩等，与区内的 W、Pb、Zn、Cu、Ag、Au 等矿化关系最为密切（王登红等，2012；赵正等，2012）。区内经历了强烈的构造变形（徐先兵等，2009），北东向和北

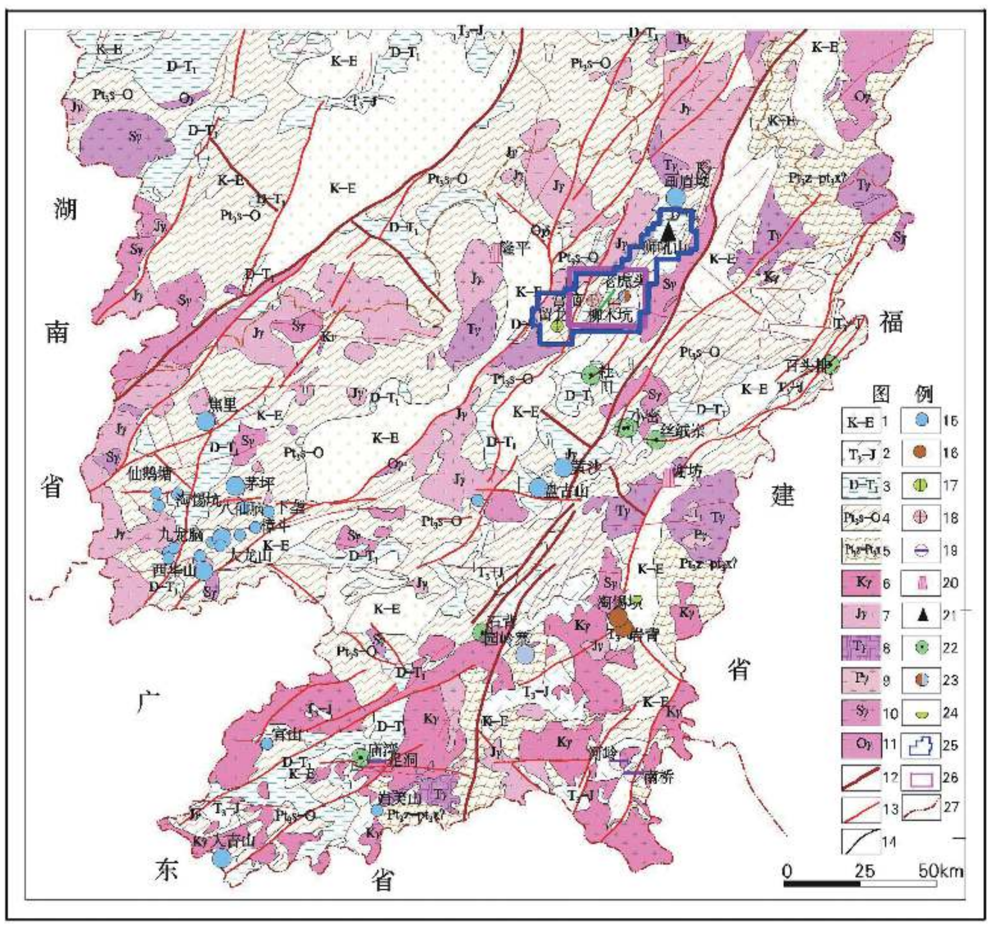

图 1　赣南地区地质矿产简图

1—白垩纪–第四纪沉积物；2—三叠纪–侏罗纪沉积物；3—泥盆纪–三叠纪沉积物；4—青白口纪–奥陶纪浅变质岩；5—中元古代变质基底；6—白垩纪岩浆岩；7—侏罗纪岩浆岩；8—三叠纪岩浆岩；9—二叠纪岩浆岩；10—志留纪酸性岩；11—奥陶纪岩浆岩；12—深大断裂；13—断层；14—地质界线；15—钨矿床 (图例大小与矿床规模有关)；16—锡矿床；17—金矿床；18—银矿床；19—稀土矿产；20—萤石矿产；21—硫铁矿床；22—锰矿床；23—铅锌矿床；24—膏盐矿床；25—银坑–青塘整装勘查区范围；26—银坑幅工作区范围；27—省界

西向两组断裂相互交叉，以北东向断裂为主。区域性鹰潭–定南深断裂呈北北东向穿过全区，表现为多期次活动的叠瓦式推覆作用，造成基底地层呈飞帽式岩片叠覆于褶皱盖层、断陷盆地之上，并广泛发育次级断裂–裂隙系统，成为区内中生代岩浆侵入、贵多金属成矿的引擎（曾载淋，2012）。

银坑幅（G50E011007）位于银坑–青塘整装勘查区中部（图 1），主要找矿方向为破碎带蚀变岩型金银多金属矿，已经发现有牛形坝–柳木坑、葛坳、小庄、桥子坑、鑫龙大中小型等多个金银铅锌矿产（图 2），分布集中、数量多，形成了赣南地区最为重要的贵多金属矿产资源地（曾载淋，2012）。但是，图幅内未系统开展过 1∶50 000 矿产地质调查工作，部分地区矿产调查工作程度较低，对含矿建造、成矿岩浆岩及控矿构造特征未开展系统调查研究，成矿规律总结不足，制约区内找矿突破的实现。2016—2018 年，中国地质调查局发展研究中心在区内部署 1∶50 000 矿产地质调查与找矿预测子项目，查明了区域成矿地质条件和矿产资源特征、总结了贵多金属矿产区域成矿规律、评价了区域资源潜力，提高了区内矿产地质调查程度和研究水平，提升了区内矿产地质工作服务资源安全、经济社会发展、生态文明建设的能力。

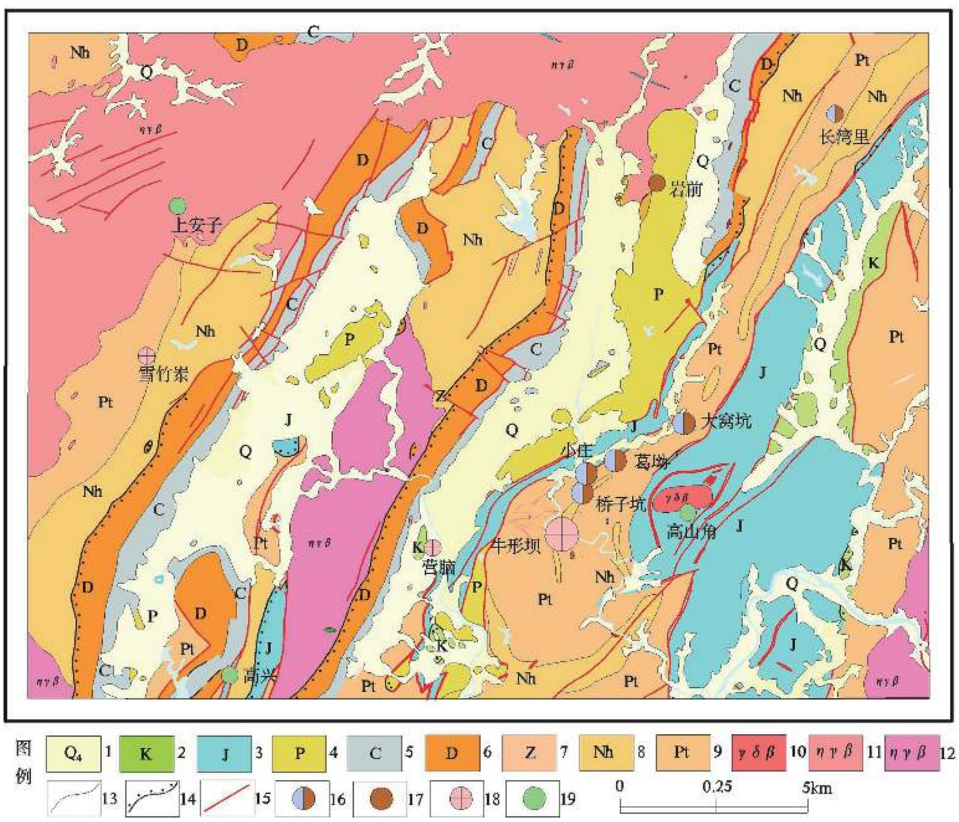

图 2　赣南于都 1∶50 000 银坑幅矿产地质简图

1—第四系；2—白垩系地层；3—侏罗系地层；4—二叠纪地层；5—石炭纪地层；6—泥盆纪地层；7—震旦纪地层；8—南华纪地层；9—青白口纪地层；10—高山角花岗闪长岩体；11—江背黑云母花岗岩体；12—长潭黑云母花岗岩体；13—整合地质界线；14—不整合地质界线；15—断层；16—铅锌矿床；17—钨矿床；18—银矿床；19—铜矿床

赣南于都整装勘查区 1∶50 000 银坑幅矿产地质图数据集基本信息简表如表 1。

表 1 数据库（集）元数据简表

条目	描述
数据库（集）名称	赣南于都金银多金属矿整装勘查区1∶50 000银坑幅矿产地质图数据集
数据库（集）作者	贺根文，江西省地质矿产勘查开发局赣南地质调查大队 于长琦，江西省地质矿产勘查开发局赣南地质调查大队 李　伟，江西省地质矿产勘查开发局赣南地质调查大队 刘孝滨，江西省地质矿产勘查开发局赣南地质调查大队 周兴华，江西省地质矿产勘查开发局赣南地质调查大队
数据时间范围	2016—2018
地理区域	江西省赣州市，东经115°30′~115°45′，北纬26°10′~26°20′
数据格式	*.wp，*.wl，*.wt，*.docx
数据量	59.5 MB
数据服务系统网址	http://dcc.cgs.gov.cn
基金项目	中国地质调查局地质调查项目“整装勘查区找矿预测与技术应用示范”子项目（121201004000160910-13）资助
语种	中文
数据库（集）组成	该数据集主要由矿产地质图（MapGIS格式）及矿产信息卡片（Word格式）组成。矿产地质图主要由主图、综合柱状图、镶图、地质构造格架剖面图、成矿区带图及图例组成。镶图包括牛形坝银金矿和狮吼山矽卡岩型硫铁多金属矿2个典型矿床的平面图和剖面图；图例包括构造、蚀变矿化、岩脉、矿产图例；修饰内容主要包括责任表、中国地质调查局局徽及图幅索引。银坑幅矿产信息卡片汇编了图幅内主要的矿床、矿点情况，包括金属矿产、能源矿产和非金属矿产，共16个矿区的基本矿产地质信息。

2　数据采集和处理方法

2.1　基础数据采集

本次工作按照中国地质调查局《1∶50 000 矿产地质调查工作指南（试行）》(中地调函 [2016]117 号）要求，以“三位一体”勘查区找矿技术理论为指导，开展矿产地质调查与找矿预测工作。综合应用了岩性–构造–矿化蚀变专项填图、遥感、物探、化探、钻探等多种方法进行数据采集，利用 GIS 软件进行原始数据整理和成果图件编制。原始数据采集过程中采用坐标系统为：1954 年北京坐标系，1985 年国家高程基准；后期按国家相关要求，对成果图件进行了坐标系转换，统一使用国家 2000 坐标系。其中，1∶50 000 矿产地质专项填图采用 DGSS 数字化填图系统，完成路线调查长度 520.65 km，重点对燕山早期成矿岩浆岩、含矿建造、控岩控矿构造及矿化蚀变标志等成矿要素进行了调查划分，编制了 1∶50 000 含矿建造构造图，认为青白口系库里组浅变质沉凝灰岩为区内 Au、Ag 矿化的重要围岩建造，具壳幔混染特征的花岗闪长岩为贵多金属矿区的成矿地质体，与矿（化）体时空关系密切；成矿作用主要受青塘–银坑叠瓦状逆冲推覆构造带的控制，赋矿构造为近东西向张性断裂；伴随的主要蚀变类型为硅化、绿泥石化、碳酸盐化、黄铁绢英岩化等，矿石矿物主要为方铅矿、闪锌矿、黄铜矿、黄铁矿等。同时，完成了 1∶50 000 水系沉积物测量面积 461 km^2，采集样品 2 047 件，遥感地质解译面积 461 km^2，按要求编制了相关成果图件，优选并评价了物化探综合异常。

2.2　矿产数据采集

全面收集了图幅内已有矿产资料，资料来源包括矿区勘查报告、矿产卡片、区调报告等，并对典型矿床、重要矿（化）点进行了矿产检查。同时选择重要的物探、化探、

遥感异常开展了综合检查工作，主要采用地面高精度磁法剖面、土壤剖面、汞气剖面等物化探测量手段，配合大比例尺专项填图及剖面测量，新发现矿（化）点 10 处（表 2）；针对重要的矿化线索，采集化学分析样 167 件。从成矿地质特征、矿化特征、找矿标志和资源潜力等方面综合矿产信息，共填写金属、非金属和能源矿产信息卡片 16 处（具体见数据集附件）。

表 2　赣南银坑式中低温岩浆期后热液型银金多金属矿预测要素表

预测要素			描述内容	分类
成矿地质背景	大地构造位置		武夷隆起西缘，宁都–南城拗陷断束南端和信丰–于都拗陷褶束交接部位的青塘–银坑拗陷带	重要
	区域成矿带		雩山隆褶带W–Ag–Pb–Zn–Au–Sn成矿亚带	重要
	岩浆岩带		于山岩浆岩褶隆带	重要
	成矿时代		燕山早期	重要
矿床特征	成矿地质体		燕山早期的花岗闪长斑岩、花岗闪长岩	必要
	含矿建造		中新元古代浅变质沉火山碎屑岩建造	重要
	成矿构造及结构面		破碎蚀变岩型银铅锌矿主要受青塘–于都银坑叠瓦状逆冲推覆构造带的控制，由一系列北北东向呈“S”状延伸的叠瓦状逆冲断裂组成。赋矿构造为近东西向张性断裂。	重要
	成矿作用特征	矿体特征	矿体以似层状、透镜状产出为主，沿走向及倾斜方向上具膨大缩小、分支复合及尖灭再现等现象，产状较陡。	重要
		矿物组合	主要矿石矿物为方铅矿、黄铁矿、闪锌矿、黄铜矿、自然金等；脉石矿物为石英、方解石等。	必要
		主金属元素	Pb、Zn、Cu、Au、Ag	次要
		矿床分带性	靠近江背花岗岩为W、Mo等中高温矿化组合，靠近高山角岩体为Pb、Zn、Ag、Au等中低温矿化组合。	重要
		蚀变类型	以硅化为主，次为黄铁矿化、绢云母化、绿泥石化及碳酸盐化	重要
	成矿模式		岩浆期后中低温热液脉型银金铅锌（铜）矿床	重要
物化遥综合信息	化探异常		Au、Ag、Pb、Zn、As等元素水系沉积物化探异常，汞气异常。	重要
	物探异常		岩体位于负重力异常区，高磁异常；矿体位于正低磁异常。	重要
	遥感异常		环形、弧形构造，羟基、铁染异常明显	重要

2.3　找矿预测模型建立

运用叶天竺研究员提出地“三位一体”勘查区找矿预测理论（叶天竺等, 2014，2017），从成矿地质体、成矿构造及结构面和成矿作用特征标志等方面，对银坑式中低温岩浆期后热液型矿床，选择牛形坝大型银金多金属矿区、老虎头铅锌矿区等进行典型矿床研究。从控矿要素及矿床特征上分析，认为银坑矿田存在牛形坝式、高山角式和老虎头式等“一体多型”的特点。其中，牛形坝式破碎带蚀变岩型银金多金属矿床（体）成矿地质体为燕山早期花岗闪长（斑）岩；成矿构造与成矿结构面主要为推覆构造及与其配套形成的一系列断裂—裂隙群；成矿作用标志研究表明，区内矿床成矿流体来源于岩浆水或深部流体，铅主要为幔源，硫为热液硫，蚀变主要为硅化、绿泥石化、绢英岩化、黄铁矿化等。采取的技术手段包括岩矿鉴定、主微量元素地球化学分析、锆石 U–Pb 测年、稳定同位素测试等，目的在于从宏观和微观综合解构成矿作用过程。结合物探化探异常分析结果，银金多金属矿体具有低极化率、高电阻率及中等磁化率特征，

化探异常表现为 Au、As、Ag 等中低温元素组合异常，土壤中气汞量测量常具有高的 Hg 含量（一般>500 ng/m^3）。由此，建立了中低温岩浆期后热液型银金多金属矿床的找矿预测模型（图 3）。

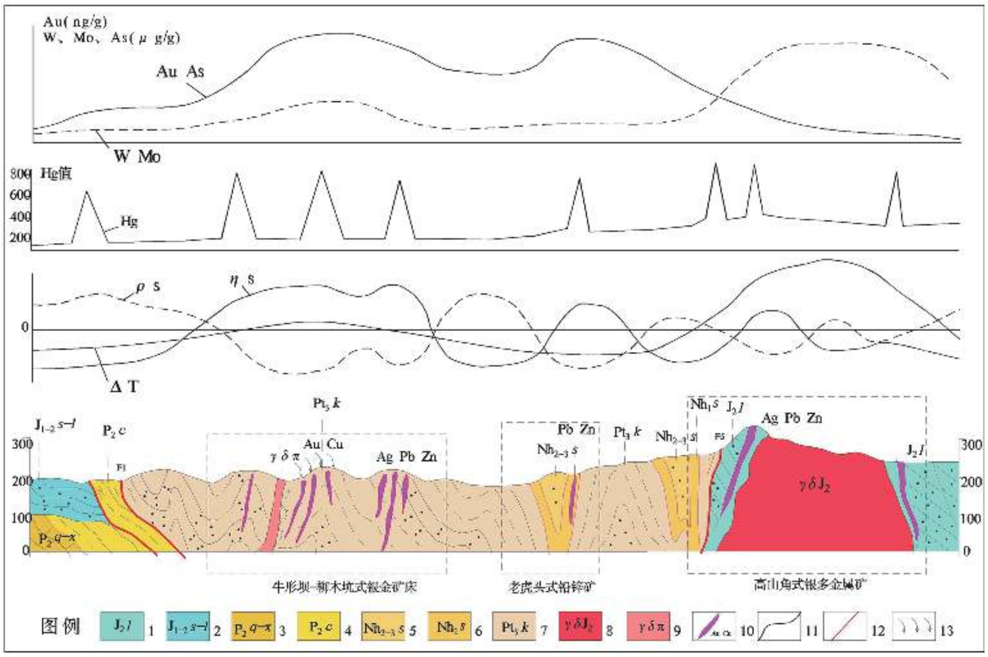

图 3　赣南银坑式中低温岩浆期后热液型银金多金属矿找矿预测模型

1—侏罗系罗坳组；2—侏罗系水北组-罗坳组；3—二叠系栖霞组-小江边组；4—二叠系车头组；5—南华系沙坝黄组；6—南华系上施组；7—青白口系库里组；8—中侏罗世花岗闪长岩；9—花岗闪长斑岩脉；10—各类矿脉；11—地质界线；12—断裂；13—流体迁移

3　数据内容评述

银坑幅矿产地质图数据集包括 1∶50 000 矿产地质图数据库和 16 份矿产信息卡片。图形数据库包括矿产地质图主图和一系列镶图，主图以含矿建造构造图为底图进行编制，镶图包括综合柱状图、典型矿床平（剖）面图、地质构造格架剖面图、成矿区带图及图例等。采用的坐标系：椭球参数为 2000 国家大地坐标系，投影类型为高斯-克吕格投影，平面直角坐标系。矿产信息卡片汇编了银坑幅内主要矿床或矿点，包括金属矿产、非金属矿产和能源矿产。

“建造构造图层属性表”（表 3）包含如下内容：地质体面实体标识号（由工作区类型、图幅号和数据编号组成）、地质体面实体类型代码、地质体面实体名称、地质体面实体时代、建造大类、建造类型、岩石组合、大地构造环境。

表 3　银坑幅矿产地质图建造-构造图层属性表

序号	数据项名称	标准编码	数据类型	实例
1	地质体面实体标识号	Feature_Id	字符串	AG50E011007000000035
2	地质体面实体类型代码（地质代码）	Feature_Type	字符串	$Pt_3^{1b}k^2$
3	地质体面实体名称	Geobody_Name	字符串	青白口系库里组二段
4	地质体面实体时代	Geobody_Era	字符串	Pt_3
5	建造大类	Formation	字符串	变质岩建造

续表 3

序号	数据项名称	标准编码	数据类型	实例
6	建造类型	Metallogenic	字符串	变质粉屑沉凝灰岩变质建造
7	岩石组合	Combination	字符串	变质粉屑沉凝灰岩
8	大地构造环境	Structural_Env	字符串	大地构造位置处于武夷块体与罗霄块体的交接带上

“地质界线属性表”（表 4）包含如下内容：要素标识号、地质界线（接触）代码、地质界线类型、界线左侧地质体代号、界线右侧地质体代号、界面走向、界面倾向、界面倾角。

表 4　银坑幅矿产地质图地质界线属性表

序号	数据项名称	标准编码	数据类型	实例
1	要素标识号	Feature_Id	字符串	AG50E011007000001818
2	地质界线（接触）代码	Feature_Type	字符串	F5
3	地质界线类型	Boundary_Name	字符串	断层接触
4	界线左侧地质体代号	Left_Boundary_Code	字符串	$Pt_3{}^{1b}k^2$
5	界线右侧地质体代号	Right_Boundary_Code	字符串	J_2l^2
6	界面走向	Strike	整数型	19
7	界面倾向	Dip_Direction	整数型	109
8	界面倾角	Dip_Angle	整数型	72

“断裂属性表”（表 5）包含如下内容：要素分类代码、断层类型（地质代码）、断层名称、断层编号、断层性质、断层上盘地质体代号、断层下盘地质体代号、断层破碎带宽度、断层走向、断层倾向、断层面倾角、估计断距、断层形成时代、活动期次。

表 5　银坑幅矿产地质图断裂构造属性表

序号	数据项名称	标准编码	数据类型	实例
1	要素分类代码	Feature_Type	字符串	F1
2	断层类型（地质代码）	Fault_Type	字符串	F1
3	断层名称	Fault_Name	字符串	牛形坝–岩前断层F1
4	断层编号	Fault_Code	字符串	G50E011007F1
5	断层性质	Fault_Character	字符串	逆冲断层
6	断层上盘地质体代号	Fault_Up_Body	字符串	$Nh_1s,J_2l^2,Pt_3{}^{1b}k^2,D_2y,P_3l,P_2c$
7	断层下盘地质体代号	Fault_Bottom_Body	字符串	$D_{2\text{-}3}z\text{-}D_3zd,Pt_3{}^{1b}k^2,J_2l^2,Nh_1s$
8	断层破碎带宽度	Fault_Wide	字符串	20~30m
9	断层走向	Fault_Strike	整数型	26
10	断层倾向	Fault_Dip	整数型	58
11	断层面倾角	Fault_Dip_Angle	整数型	116
12	估计断距	Fault_Distance	浮点型	1 000m
13	断层形成时代	Era	字符串	燕山期
14	活动期次	Movement_Period	字符串	燕山期

“矿产地属性表”（表 6）包含如下内容：要素标识号、矿种代码、矿种名称、共生矿、伴生矿、矿产地数、矿石品位、规模、成矿时代、矿产地名、矿化类型、成因类型。

表 6 银坑幅矿产地质图矿产地属性表

序号	数据项名称	标准编码	数据类型	实例
1	要素标识号	Feature_Id	字符串	AG50E011007000000007
2	矿种代码	Feature_Type	字符串	2202、2007、2008、2201、2006
3	矿种名称	Commodities_Name	字符串	Ag、Pb、Zn、Au、Cu
4	共生矿	Paragenic_Ore	字符串	Ag、Pb、Zn
5	伴生矿	Associated_Ore	字符串	Au、Cu
6	矿产地数	Ore_Sums	整数型	1
7	矿石品位	Ore_Grade	字符串	Au2.3g/t、Ag160g/t、Pb+Zn7%、Cu0.3%
8	规模	Deposite_Size	字符串	大型银矿床、中型金矿床
9	成矿时代	Metallogenetic_Epoch	字符串	燕山早期
10	矿产地名	Placename	字符串	牛形坝金银多金属矿
11	矿化类型	Genesis_Types	字符串	破碎蚀变岩型
12	成因类型	Industrial_Types	字符串	中低温岩浆期后热液

“侵入岩建造属性表”（表 7）包含如下内容：要素标识号、岩体填图单位名称、岩体填图单位符号、岩石名称、岩石颜色、岩石结构、岩石构造、主要矿物及含量、次要矿物及含量、与围岩接触关系、形成时代、含矿性。

表 7 银坑幅矿产地质图侵入岩建造图层属性表

序号	数据项名称	标准编码	数据类型	实例
1	要素标识号	Feature_Id	字符串	AG50E011007000000001
2	岩体填图单位名称	Intru_Body_Name	字符串	岽下山岩体
3	岩体填图单位符号	Intru_Body_Code	字符串	$\eta\gamma\beta J_3^D$
4	岩石名称	Rock_Name	字符串	中细粒斑状黑云母二长花岗岩
5	岩石颜色	Color	字符串	浅肉红色
6	岩石结构	Rock_Texture	字符串	中细粒似斑状结构
7	岩石构造	Rock_Structure	字符串	块状构造
8	主要矿物及含量	Primary_Mineral	字符串	石英35%，钾长石30%，斜长石30%
9	次要矿物及含量	Secondary_Mineral	字符串	黑云母5%
10	与围岩接触关系	Contact_Relation	字符串	侵入接触
11	形成时代	Era	字符串	燕山期
12	含矿性	Commodities	字符串	W、Sn

4 数据质量控制和评估

本次工作严格按照中国地质调查局《1∶50 000 矿产地质调查工作指南（试行）》（中地调函 [2016]117 号）执行，物化探专项工作亦严格执行国家和行业制定的标准及规范，如《地球化学普查规范（1∶50 000）》（DZ/T 0011–2015）、《地面高精度磁测技术规程》（DZ/T0071–93）等，保证了资料的可靠性。按照设计要求，全部或超额完成了设计工作量，实现了目标任务，确保了工作精度。2018 年 7 月，二级项目组织

专家对银坑幅矿调工作进行了野外验收，本次工作获得了专家的一致好评，经评议后顺利通过验收。。

项目野外实施过程中，按照《中国地质调查局地质调查项目管理制度》（2012 年版）相关要求，严格执行“三级质量检查制度”。其中，原始资料自检、互检比例均为 100%，项目组检查比例大于 50%，质检组抽查比例大于 20%，保证了资料数据的质量。样品测试分析均在符合资质要求的实验室进行，分析过程进行了内外部监控，分析质量符合要求。

5 结论

赣南于都金银多金属矿整装勘查区 1：50 000 银坑幅矿产地质图数据集以“三位一体”勘查区找矿预测理论为指导，按照《1：50 000 矿产地质调查工作指南（试行）》（中地调函 [2016]117 号）要求，综合利用矿产地质专项填图、遥感、物探、化探等技术手段，完成了区内矿产调查及找矿预测工作，圈定了 2 处找矿远景区和 3 处找矿靶区。本次工作重点划分了区内含矿建造、成矿岩浆岩、控矿构造和矿化蚀变标志等，突出了矿产地质调查特色，归纳总结了区内控矿要素及成矿规律；完善了燕山早期银坑式银金多金属矿床找矿预测模型，明确该类型矿床成矿地质体为燕山早期花岗闪长岩类，控岩控矿构造为北东向逆冲推覆断裂及其次级裂隙组，蚀变类型主要为硅化、黄铁绢英岩化、碳酸盐化等，为中低温岩浆期后热液脉型矿床。

参考文献

郭娜欣, 陈毓川, 赵正, 吕晓强, 刘珍, 陈郑辉, 曾载淋, 李江东, 张凤荣. 2015. 南岭科学钻中与两种岩浆岩有关的矿床成矿系列−年代学、地球化学、Hf 同位素证据 [J]. 地球学报, 36(6): 742−754.

毛景文, 谢桂青, 郭春丽, 袁顺达, 程彦博, 陈毓川. 2008. 华南地区中生代主要金属矿床时空分布规律和成矿环境 [J]. 高校地质学报, 14(4): 510−526.

王登红, 秦燕, 陈振宇, 侯可军. 2012. 赣南部分岩体的锆石铀−铅同位素年代学研究及其对成岩成矿机制的再认识 [J]. 岩矿测试, 31(4): 699−704.

徐先兵, 张岳桥, 贾东, 舒良树, 王瑞瑞. 2009. 华南早中生代大地构造过程 [J]. 中国地质, 36(3): 573−593.

叶天竺, 韦昌山, 王玉往, 等. 2014. 勘查区找矿预测理论与方法 (总论)[M]. 北京:地质出版社.

叶天竺, 吕志成, 庞振山, 等. 2017. 勘查区找矿预测理论与方法 (各论)[M]. 北京:地质出版社.

曾载淋. 2012. 南岭东段银坑地区主要金属矿产成矿规律研究与深部找矿探索 [D]. 北京: 中国地质科学院博士学位论文: 1–189.

赵希林, 刘凯, 毛建仁, 叶海敏. 2012. 华南燕山早期晚阶段两类花岗质岩体与成矿作用：以赣南−闽西南地区为例 [J]. 中国地质, 39(4): 871−886.

赵正, 陈毓川, 曾载淋, 郭娜欣, 陈郑辉. 2017. 江西银坑 W-Ag-Au 多金属矿田成矿规律与找矿方向: 兼论华南两个成矿系列叠加问题 [J]. 地学前缘, 24(5): 54−61.

赵正, 陈毓川, 陈郑辉, 王登红, 曾载淋, 赵斌, 张家菁. 2012. 赣南银坑矿田高山角花岗闪长岩 SHRIMP U-Pb 定年及其与成矿的关系 [J]. 岩矿测试, 31(3): 536−542.

Received: 08-03-2019
Accepted: 15-06-2019

Fund Project:
China Geological Survey Project "Demonstration Sub-project for Prospecting Prediction and Technical Application in Integrated Exploration Areas" (121201004000160910-13).

doi: 10.12029/gc2019Z108

Article Citation: He Genwen, Yu Changqi, Li Wei, Liu Xiaobin, Zhou Xinghua. 2019. The 1∶50 000 Mineral Geological Map Dataset of the Yinkeng Map-sheet, Yudu Au-Ag Multi-metal Ore Integrated Area, South Jiangxi[J]. Geology in China, 46(S1):87−99.

Dataset Citation: He Genwen; Yu Changqi; Li Wei; Liu Xiaobin; Zhou Xinghua. The 1∶50 000 Mineral Geological Map Dataset of the Yinkeng Map-sheet, Yudu Au-Ag Multi-metal Ore Integrated Area, South Jiangxi(V1). Gannan Geological Party, JBED GMR[producer], 2016. National Geological Archives of China [distributor], 2019-06-30. 10.23650/data.C.2019.P7; http://dcc.ngac.org.cn/geologicalData/rest/geologicalData/geologicalDataDetail/b912ea9bc14a51278ed9f93d155228f9

The 1∶50 000 Mineral Geological Map Dataset of the Yinkeng Map-sheet, Yudu Au-Ag Multi-metal Ore Integrated Area, South Jiangxi

HE Genwen, YU Changqi, LI Wei, LIU Xiaobin, ZHOU Xinghua

(*Gannan Geological Party*, *JBED GMR*, *Ganzhou* 341000, *China*)

Abstract: In order to develop this dataset, data were acquired comprehensively by using multiple methods such as mapping which is specific for lithology, structures and mineralized alterations, remote-sensing, geophysical/geochemical and drilling exploration. A route of 520.65 km was surveyed, with 2 047 stream sediment samples and 167 chemical analytical samples collected, and 461 km^2 area interpreted based on remote-sensing data. Emphasis was placed on survey and division of early-Yanshanian metallogenic magmatite, ore-bearing formations, rock-control and ore-control structures, and mineralized alteration marks etc., so that it could be verified that the main metallogenic geological bodies for Au-Ag multi-metal ores within the area were early-Yanshanian granodiorite and that the rock-control and ore-control formations were a NE-strike thrust fault and its secondary fissures. Building on this, the 1∶ 50 000 formation and tectonic map of the Yinkeng Map-sheet was compiled, the mineral geological map dataset was established by using a digital mapping system (DGSS), a map layer property database on key formations & tectonics, geological boundaries, fractures and magmatite etc. was comprehensively compiled; the prospecting prediction model for Yinkeng-style mid-low temperature post-magmatic hydrothermal deposits in the area was improved, highlighting the causal relationship between deposits and the formations or structures in the area.

Key words: Yudu integrated survey area; Yinkeng map-sheet; Mineral geological map dataset; Au-Ag multi-metal ore; 1∶50 000

Data service system URL: http://dcc.cgs.gov.cn

About the first author: HE Genwen, male, born in 1988, engineer, master, engaged in mineral prospecting and survey; Email: 429056423@qq.com.

1 Introduction

South Jiangxi is renowned as the "Tungsten Capital of the World" and the "Kingdom of Rare Earth" in which the prospecting focus has consistently been on unique quartz-vein W ores and weathered-crust ion-adsorption rare earth ores. The ore-concentrated area from Yinkeng, Yudu to Qingtang, Ningdu, both in Jiangxi, an area with very particular metallogenic geological conditions in Sough Jiangxi, is located in the intersection of the Nanling and Wuyi metallogenic zones, and within the Yudu–Ningdu depression zone in the north of the Yu-mountain metallogenic zone, one of the important nonferrous precious multi-metal ore concentrated areas in the north part of the Nanling metallogenic zone. Meanwhile, within the area, multiple precious metal deposits and tungsten multi-metal deposits were discovered (Guo NX et al., 2015; Zhao Z et al., 2017), where there were multiple deposits at small and medium scale or above, including the Niuxingba Ag-Pb-Zn deposit, the Laohutou Pb-Zn deposit, the Shihoushan S-Fe-W deposit, the Huameiao W-Be deposit and the Liulong Au depeosits. In 2013, in order to accelerate the implementation of the strategic action of breakthrough in prospecting, the previous Ministry of Land and Resources listed the Yudu Yinkeng–Ningdu Qingtang Au-Ag Multi-metal Ore Area in the 3rd batch of national integrated survey areas to make unified arrangement and promote their geological work. In recent years, with integrated survey, significant progress has been made in prospecting of Ag, Au, Pb-Zn ores, with resources increasing considerably.

Within the area, the outcropped strata are mainly the Neoproterozoic Qingbaikou system, the Nanhua system, the Sinian system, the early-Paleozoic-era Cambrian system, the late-Paleozoic-era Devonian-system, the Carboniferous system, the Permian system, the Mesozoic-era Jurassic system, the Cretaceous system and the Cenozoic-era Quaternary system. The strata can be divided into three tectonic layers: the Qingbaikou-system–Cambrian-system fold basement, the Devonian-system–Permian-system fold capping and the Mesozoic-era continental-facies clasolite-capping (locally, there is volcanic rock), and angular unconformable or fault contacts exist between these tectonic layers, representing 3 critical tectonic events respectively in South China, i.e. Caledonian, Indo-Chinese and Yanshan. There are intense magma activities, characterized by intrusion in multiple stages and multiple periods, which can be divided into three periods: Caledonian period, Indo-Chinese period, and Yanshanian. The Caledonian-period rock mass include Epo, Changtan and Baihsikeng rock masses, and their lithologies are biotite granite and quartz diorite. The Indo-Chinese-period rock mass lies in the southwest of the integrated survey area, and its representative lithology is biotite granite at Guzhang. Influenced by subduction of the circum-Pacific plate in the area, the Yanshanian experienced strong extension and thinning (Mao JW et al., 2008; Zhao XL et al., 2012), rock masses are highly developed and distributed in the mid and northwest of the integrated survey area, including the Jiangbei, Gaoshangjiao and Chashanjing rock masses etc., mainly consisting of biotite granite and granodiorite etc. lithologies, mostly tied to the mineralization of W, Pb, Zn, Cu, Ag and Au etc. in the area (Wang DH et al., 2012; Zhao Z et al., 2012). The area went through strong tectonic deformation (Xu XB et al., 2009), the NE-strike and NW-strike faults cross each other and there are mainly NE-strike faults. The regional Yingtan–Dingnan deep fault passes across the region in a NNE strike, in the form of imbricated overturn in multiple periods, leading basement strata to overly the fold-capping and the graben basin in the form of the klippen and having widely-developed secondary fault–fissure systems, becoming engines of Mesozoic-era magma intrusion and precious multi-metal metallogeny in the area (Zeng ZL, 2012).

In the Yinkeng map-sheet (G50E011007), which is located in the middle of the Yinkeng–Qingtang integrated survey area (Fig. 1), the focus in prospecting is on altered types of Au-Ag multi-metal ores in crushed zones, and a number of large/medium/small Au-Ag-Pb-Zn deposits have been found there, including Niuxingba–Liumukeng, Geao, Xiaozhuang, Qiaozikeng and Xinlong etc. (Fig. 2), distributed in clusters, and it is one of the most important precious multi-

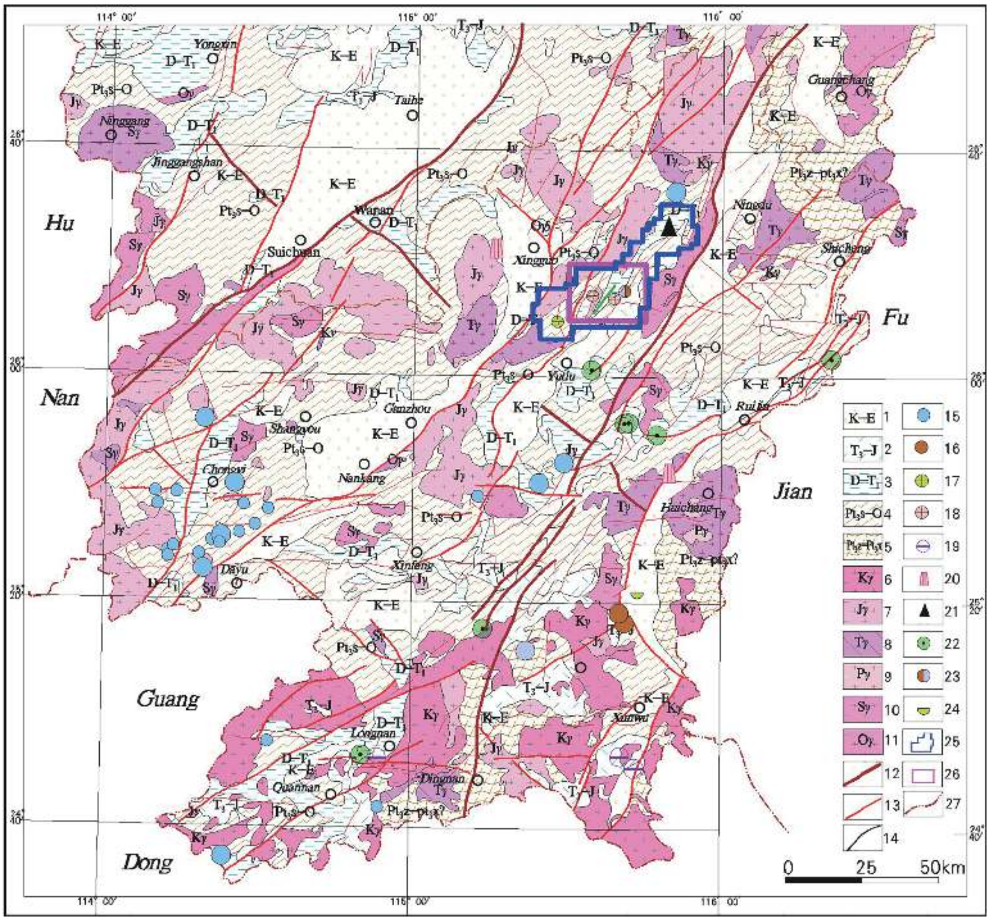

Fig. 1 Sketch showing geological and mineral features in South Jiangxi

1–Cretaceous period – Quaternary period sediment; 2–Triassic period – Jurassic period sediment; 3–Devonian period – Triassic period sediment; 4–Qingbaikou-period – Ordovician period epimetamorphic rock; 5–Mid-Proterozoic-era metamorphic basement; 6–Cretaceous period magmatite; 7–Jurassic magmatite; 8–Triassic period magmatite; 9–Permian period magmatite; 10–Silurian period acidic rock; 11–Ordovician period magmatite; 12–Deep major fracture; 13–Fault; 14–Geological boundary; 15–W deposit (legend size is related to the size of the deposit); 16–Sn deposit; 17–Au deposit; 18–Ag deposit; 19–Rare earth deposit; 20–Fluorite deposit; 21–Pyrite deposit; 22–Mn deposit; 23–Pb-Zn deposit; 24–Gypsiferous salt deposit; 25–Survey Range of the Yinkeng–Qingtang integrated survey area; 26–Range of the Yinkeng-map-sheet working area; 27–Provincial border metal mineral resource areas in South Jiangxi (Zeng ZL, 2012). However, in the map-sheet area, the 1：50 000 mineral geological survey has never been done, the mineral survey was incomplete in some places, its ore-bearing formations and features of metallogenic magmatite and ore-control structure have not ever been systematically surveyed and researched, and metallogenic regularities were not summarized enough to make breakthroughs in prospecting in the area. In the period 2016—2018, the CGS Development and Research Center launched the 1：50 000 Mineral Geological Survey and Prospecting Prediction Sub-project in the area, which made clear the metallogenic geological conditions and features of mineral resources in the region, summarized the precious multi-metal ore's regional metallogenic regularities, evaluated the resource potential in the area, so improved the mineral geological survey and research and enhanced the ability of mineral geological work in the area to serve resource security, economic and social development, and the construction of ecological civilization.

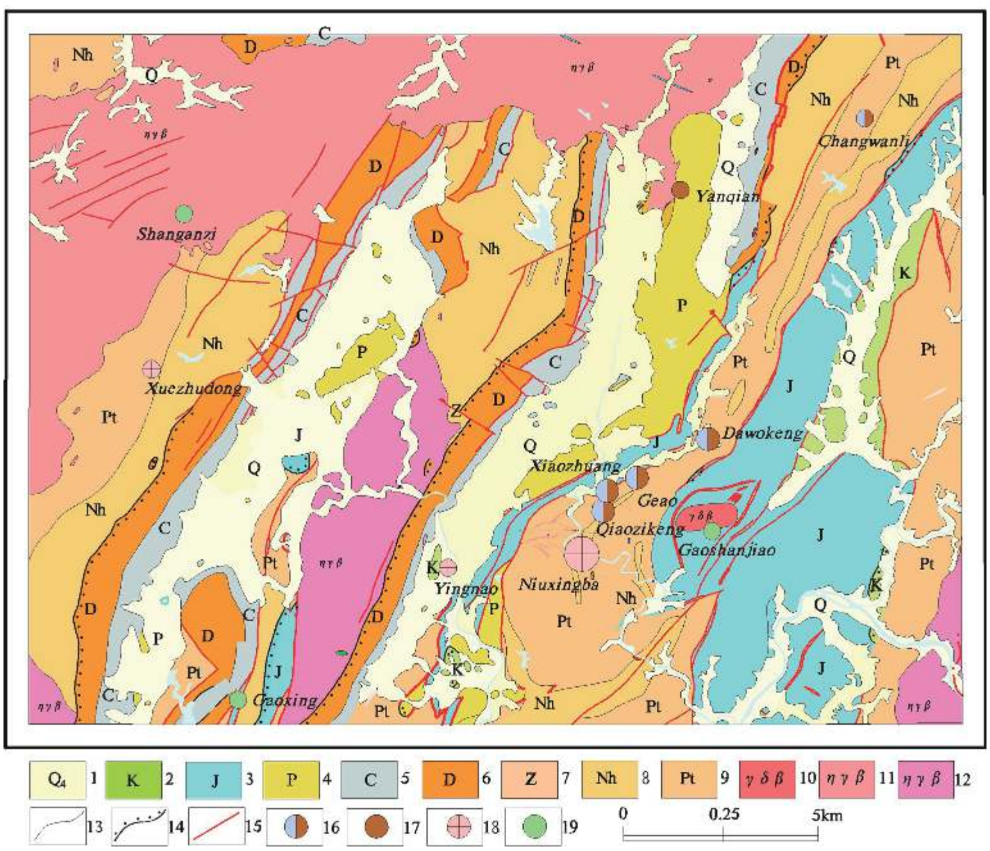

Fig. 2 1:50 000 mineral geological map of the Yinkeng Map-sheet, Yudu, South Jiangxi

1–Quaternary; 2–Cretaceous system stratum; 3– Jurassic system stratum; 4– Permian period stratum; 5– Carboniferous period stratum; 6– Devonian period stratum; 7–Sinian period stratum; 8–Nanhua period stratum; 9– Qingbaikou period stratum; 10– Gaoshanjiao granodiorite rock mass; 11–Jiangbei biotite granite rock mass; 12–Changtan biotite granite rock mass; 13– Conformable geological boundary; 14–Unconformable geological boundary; 15– Fault; 16– Pb-Zn deposit; 17–W deposit; 18–Ag deposit; 19–Cu deposit

Metadata table of the 1：50 000 Mineral Geological Map Dataset of the Yinkeng Map-sheet, Yudu Integrated Area, South Jiangxi, is shown in Table 1.

Table 1 Metadata Table of Database (Dataset)

Items	Description
Database(dataset) name	1∶50 000 Mineral Geological Map Dataset of the Yinkeng Map-sheet, Yudu Au-Ag Multi-metal Ore Integrated Area, South Jiangxi
Database(dataset) authors	He Genwen, Gannan Geological Party, JBED GMR Yu Changqi, Gannan Geological Party, JBED GMR Li Wei, Gannan Geological Party, JBED GMR Liu Xiaobin, Gannan Geological Party, JBED GMR Zhou Xinghua, Gannan Geological Party, JBED GMR
Data acquision time	2016—2018
Geographic area	Ganzhou City, Jiangxi Province; East Longitude: 115°30′ ~ 115°45′; North Latitude: 26°10′ ~ 26°20′
Data format	*.wp, *.wl, *.wt, *.docx
Data size	59.5 MB
Data service system URL	http://dcc.cgs.gov.cn
Fund project	China Geological Survey Project "Demonstration Sub-project for Prospecting Prediction and Technical Application in Integrated Survey Areas" (121201004000160910-13).
Language	Chinese
Database(dataset) composition	The dataset mainly consists of the mineral geological maps (MapGIS) and mineral information cards (Word). The mineral geological maps mainly include master maps, overall histograms, mosaic maps, geological tectonic framework profiles, metallogenic zone/belt maps and legends. Mosaic maps include plans and profiles of 2 typical deposits, Niuxingbao Au deposit and Shihoushan skarn-type ferrous-sulfide multi-metal deposit; legends include those for tectonic, altered mineralization, vein and minerals; decorations mainly include the responsibility matrix, CGS logo and map-sheet index. The Yinkeng-map-sheet information cards contain basic mineral geological information in 16 mining areas such as primary deposits and mineral occurrences in the map sheet, including metal, energy and non-metal minerals.

2 Method for Data Acquisition and Processing

2.1 Basic Data Acquisition

For this project, mineral geological survey and prospecting prediction were carried out in accordance with CGS's Guidance to *1∶50 000 Mineral Geological Survey (Interim)* (CGS No. [2016]117) and under the instructions of technical theory on prospecting of "trinity" survey areas. Data were acquired comprehensively by using multiple methods such as mapping specific to lithology-structure-mineralized alterations, remote-sensing, geophysical/ geochemical and drilling exploration, and the software GIS was used to collate original data and compile results maps. In the process of the original data acquisition, the coordinate systems used were: the 1954 Beijing coordinate system and the 1985 national elevation reference; later, results maps were converted for their coordinate systems as per applicable national requirements, and the 2000 state coordinate system was used in all maps. Among these, the 1∶50 000 mineral geological specific mapping was done using the digital mapping system DGSS, and 520.65 km long routes are surveyed, with emphasis being placed on survey and division of early-Yanshanian metallogenic magmatite, ore-bearing formations, rock-control and ore-control structures, and mineralized alteration marks etc., thus compiling the 1∶50 000 ore-bearing formation tectonic map; it is believed in the area that the epimetamorphic tuffite of the Qingbaikou-system Kuli Formation is an important Au-Ag-mineralized wall-rock formation, and that granodiorite characterized by crust-mantle mixing is a metallogenic geological body in the precious multi-metal ore area, having close temporal and spatial relationships to mineral (mineralized) bodies; metallogenesis is mainly controlled by the Qingtang - Yinkeng imbricated reverse-thrust nappe tectonic zone, and the ore-occurrence structure is a nearly EW-strike extension fracture; types of primarily associated alterations are silicification, chloritization, carbonatization and beresitization etc. and ores are mainly galena, sphalerite, chalcopyrite and pyrite etc. Meanwhile, a 461 km^2 area was measured for 1∶50 000 stream sediments. 2 047 samples were collected, the 461 km^2 area was geologically interpreted based on remote-sensing, results maps were plotted and anomalies from geophysical and geochemical exploration were optimally selected and assessed.

2.2 Mineral Data Acquisition

Existing mineral information on the map sheet were collected overall, with the sources including mine area exploration reports, mineral cards and regional survey reports etc. and typical deposits and important mineral (mineralization) points were checked for minerals there. Meanwhile, overall inspections were done by selecting important anomalies from geophysical and geochemical exploration and remote-sensing, and by using primarily geochemical and geophysical survey means such as ground high-precision magnetic profiling, soil profiling and mercury-vapour profiling, complete with large-scale specific mapping and profile measurement, resulting in 10 new mineral (mineralized) points found (Table 2); aiming at important mineralization signs, 167 samples were collected for chemical analysis. By combining mineral information in terms of metallogenic geological features, mineralization features, prospecting marks and resource potential etc., 16 information cards on metallic, non-metallic and energy minerals were completed (see the attachment to the dataset for details).

Table 2 Elements for the prediction of the low- and medium-temperature post-magma-period hydrothermal-solution-type Au-Ag multi-metal ores in the style of Yinkeng, South Jiangxi

Element for prediction		Description	Classification
Metallogenic geological background	Geotectonic location	Qingtang-Yinkeng depression zone, in the western margin of the Wuyi uplift, at the intersection of the south end of the Ningdu-Nancheng depression fault bundle and the Xinfeng-Yudu depression fold	important
	Regional metallogenic zone	W−Ag−Pb−Zn−Au−Sn metallogenic sub-zone of the Yu-mountain uplift fold zone	important
	Magmatite zone	Yushan magmatite fold-uplift zone	important
	Mineralogenetic epoch	Early Yanshanian	important
Deposit feature	Metallogenic geological body	early-Yanshanian granodiorite porphyry, and granodiorite	necessary

Continued table 2

Element for prediction			Description	Classification
Deposit feature	Ore-bearing formation		mid-Neoproterozoic epimetamorphic sed-volcanic pyroclastic rock formation	important
	Metallogenic tectonic and structural place		Broken-altered-rock-type Ag-Pb-Zn deposit is mainly under control of the Qingtan-Yudu Yinkeng imbricated reverse-thrust napped structural zone, and is composed of a series of imbricated reverse-thrust fractures which extend with NNE strike in the shape of a letter ‘S’. Its ore-occurrence structure is the nearly EW extension fracture.	important
	Features of metallogenesis	Features of mineral bodies	Most mineral bodies are bedded and lentoid, there are phenomena such as expansion and contraction, branching and then combination, or thinning-out and recurrence in their strike and their slant direction, with steeper altitude.	important
		Ore combination	Ores are mainly galena, pyrite, sphalerite, chalcopyrite and native gold etc; gangue ores are quartz and calcite etc.	necessary
		Main metal elements	Pb. Zn. Cu. Au. Ag	secondary
		Deposit zonation	Near the Jiangbei granite are mid-and-high temperature mineralization combinations of W and Mo etc. while near the Gaoshanjiao rock mass are mid-and low-temperature mineralization combinations of Pb, Zn, Ag and Au.	important
		Alteration type	Primarily silicification, secondarily pyritization, sericitization, chloritization and carbonatization	important
	Metallogenic mode		Post-magma-period, mid- and low-temperature hydrothermal-solution-type Ag-Au-Pb(-Cu) deposit	important
Combined information from geochemical and geophysical exploration and remote-sensing	Anomaly from geochemical exploration		Anomaly from stream sediments of elements such as Au, Ag, Pb, Zn and As from geochemical and geophysical exploration, and anomaly in mercury-vapour.	important
	Anomaly from geophysical exploration		Rock mass is located in a negative-gravity anomaly region, with a high magnetic anomaly; the mineral body is located in the positive low-magnetic anomaly area.	important
	Anomaly from remote-sensing		Structure in the shape of ring and arc, with a clear hydroxyl and iron-stained anomaly.	important

2.3 Building the Prospecting Prediction Model

By applying the "trinity" survey area prospecting prediction theory advanced by research fellow Ye Tianzhu (Ye TZ et al., 2014, 2017), from low-and-mid-temperature post-magma period hydrothermal solution deposits, the large Ag-Au multi-metal mining area Niuxingba and the Pb-Zn mine area Laohutou etc. were selected as typical deposits and researched in terms of their metallogenic geological body, metallogenic structure, and characteristic marks of structural plane and metallogenesis etc. By analyzing ore-control elements and deposit features, it was considered that the Yinkeng ore field has the feature of "multiple types at one single place" such as Niuxingba-style, Gaoshanjiao-style and Laohutou-style etc., Of these, for Niuxingba-pattern crushed-zone alteration-type Au-Ag metal-metal deposits (ore bodies), their metallogenic geological body is early-Yanshan granodiorite (granodiorite-porphyry); the metallogenic tectonic and metallogenic structural plane is mainly nappe structure and a series of associated fracture-fissure groups; research on metallogenic marks indicates that the metallogenic fluids in the deposit in the area stem from magmatic water or deep fluids, lead is mainly mantle source, sulfur is hydrothermal sulfur, and alterations mainly include silicification, chloritization, beresitization and pyritization etc. The techniques applied include identification of rocks and minerals, primary trace-element geochemical analysis, Zircon U−Pb dating, stable isotope testing etc. for the purpose of microscopic and macroscopic overall deconstruction of the metallogenic process. By combining the results from the analysis of anomalies from geochemical exploration, Ag-Au multi-metal ore bodies are characterized by low polarizability, high electrical resistivity and medium magnetic susceptibility, anomalies from geochemical exploration are anomalies of combinations of low- and medium-temperature elements such as Au, As, Ag, and a high Ha content is measured in soil through mercury-vapour measurement (>500 ng/m^3 on average). As a result, the prospection prediction model for low- and medium-temperature post-magma-period hydrothermal-solution-type Au-Ag multi-metal deposits was constructed (Fig. 3).

3 Review of Data Content

Mineral Geological Map Dataset of the Yinkeng Map-sheet comprises a 1：50 000 mineral geological map database and 16 mineral information cards. The map database includes the mineral master maps which were compiled using the ore-bearing formation tectonic map as a base map and a set of mosaic maps which include overall histograms, typical deposit plans (profiles), geological tectonic framework profiles, metallogenic zone/belt maps and legends. Coordinate system used: 2 000 national geodetic coordinates system for ellipsoidal parameters, the project type is Gauss-Kruger Projection, rectangular plane coordinate system. The mineral information cards involve principal deposits or mineral points in the Yinkeng map-sheet, including metal, energy and non-metal minerals.

The "Property table of formation tectonic map layers" (Table 3) contains: the mark number of the geological body's planar map layer (comprising the type of working area, the map-sheet number and data number), type code, name and era of geological body's planar map layer, formation category, formation type, rock combination and geotectonic setting.

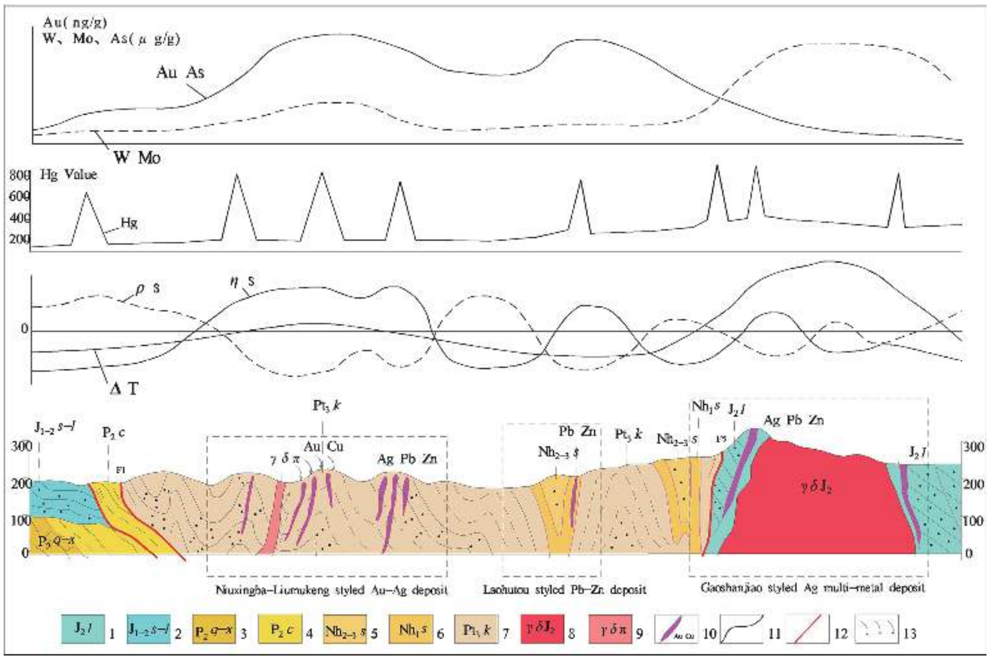

Fig. 3 Prospection prediction model for low- and medium-temperature post-magma-period hydrothermal-solution-type Au-Ag multi-metal deposits in the style of Yinkeng, South Jiangxi

1−Jurassic system Luoao Formation; 2−Jurassic system Shuibei Formation-Luoao Formation; 3−Permian system Qixia Formation-Xiaojiangbian Formation; 4−Permian system Chetou Formation; 5−Nanhua system Shabahuang Formation; 6−Nanhua system Shangshi Formation; 7−Qingbaikou system Kuli Formation; 8−mid-Jurassic epoch granodiorite; 9−Granodiorite porphyry vein; 10−Various ore veins; 11−Geological boundary; 12−fracture; 13−Fluid migration

Table 3 Property table of formation - tectonic map layer in mineral geological map of the Yinkeng map-sheet

No.	Name of data item	Standard code	Data category	Real example
1	Mark number of geological body's planar map layer	Feature_Id	Character string	AG50E011007000000035
2	Type code of geological body's planar map layer (geological code)	Feature_Type	Character string	$Pt_3^{1b}k^2$
3	Name of geological body's planar map layer	Geobody_Name	Character string	Member #2 of the Qingbaikou-system Kuli Formation
4	Era of geological body's planar map layer	Geobody_Era	Character string	Pt_3
5	Formation category	Formation	Character string	Metamorphic rock formation
6	Formation type	Metallogenic	Character string	Metamorphic powder tuffite metamorphic formation
7	Rock combination	Combination	Character string	Metamorphic powder tuffite
8	Geotectonic setting	Structural_Env	Character string	Regarding its geotectonic location, it is located at the connecting zone between the Wuyi and Luoxiao blocks.

The "geological boundary property table" (Table 4) contains: element identification number, geological boundary (contact) code, geological boundary type, codes of geological body to the right and left of the boundary, the strike, dip and dip angle of the interface.

Table 4　Geological boundary property table of the mineral geological map of the Yinkeng map-sheet

No.	Name of data item	Standard code	Data category	Real example
1	Element identification number	Feature_Id	Character string	AG50E011007000001818
2	Geological boundary (contact) code	Feature_Type	Character string	F5
3	Geological boundary type	Boundary_Name	Character string	Fault contact
4	Code of geological body to the left of the boundary	Left_Boundary_Code	Character string	$Pt_3^{1b}k^2$
5	Code of geological body to the right of the boundary	Right_Boundary_Code	Character string	J_2l^2
6	Interface strike	Strike	Integer	19
7	Interface dip	Dip_Direction	Integer	109
8	Interface dip angle	Dip_Angle	Integer	72

The “fracture property table” (Table 5) contains: element classification code, fault type (geological code)/name/code/property, codes of geological body overlying and underlying the fault, width of crushed zone of the fault, fault strike/dip/dip angle, estimated fault displacement, era of fault generation and movement periods.

Table 5　Fracture property table of the mineral geological map of the Yinkeng map-sheet

No.	Name of data item	Standard code	Data category	Real example
1	Element classification code	Feature_Type	Character string	F1
2	Fault type (geological code)	Fault_Type	Character string	F1
3	Fault name	Fault_Name	Character string	Niuxingba－Yanqian fault F1
4	Fault code	Fault_Code	Character string	G50E011007F1
5	Fault property	Fault_Character	Character string	Thrust fault fault
6	Code of geological body overlying the fault	Fault_Up_Body	Character string	Nh_1s,J_2l^2,$Pt_3^{1b}k^2$,D_2y,P_3l,P_2c
7	Code of geological body underlying the fault	Fault_Bottom_Body	Character string	$D_{2\text{-}3}z$-D_3zd,$Pt_3^{1b}k^2$,J_2l^2,Nh_1s
8	Width of crushed zone of fault	Fault_Wide	Character string	20 ~ 30 m
9	Fault strike	Fault_Strike	Integer	26
10	Fault dip	Fault_Dip	Integer	58
11	Fault dip angle	Fault_Dip_Angle	Integer	116
12	Estimated fault displacement	Fault_Distance	Floating-point type	1 000 m
13	Era of fault generation	Era	Character string	Yanshanian
14	Movement periods	Movement_Period	Character string	Yanshanian

The “deposit site property table” (Table 6) contains: element identification number, ore code and name, paragenic ore, associated ore, number of deposit sites, ore grade, scale, metallogenic era, deposit site name, mineralization type and genesis type.

Table 6 Deposit site property table of the mineral geological map of the Yinkeng map-sheet

No.	Name of data item	Standard code	Data category	Real example
1	Element identification number	Feature_Id	Character string	AG50E011007000000007
2	Ore type code	Feature_Type	Character string	2202, 2007, 2008, 2201, 2006
3	Ore name	Commodities_Name	Character string	Ag, Pb, Zn, Au, Cu
4	Paragenic ore	Paragenic_Ore	Character string	Ag, Pb, Zn
5	Associated ore	Associated_Ore	Character string	Au, Cu
6	Number of deposit sites	Ore_Sums	Integer	1
7	Ore grade	Ore_Grade	Character string	Au 2.3 g/t, Ag 160 g/t, Pb+Zn 7%, Cu 0.3%
8	Scale	Deposite_Size	Character string	Large Ag deposit, and medium Au deposit
9	Metallogenic epoch	Metallogenic_Epoch	Character string	Early Yanshanian
10	Deposit site name	Placename	Character string	Niuxingba Au-Ag multi-metal deposit
11	Mineralization types	Genesis_Types	Character string	Crushed altered rock
12	Genesis type	Industrial_Types	Character string	Low- and mid post-magma-period hydrothermal solution

The “intrusive rock formation property table” (Table 7) contains: element identification number, name and symbol of rock mass mapped, rock name/color/texture/structure, primary minerals and their content, secondary minerals and their content, contact relation with wall rock, generation era and ore-bearing potential.

Table 7 Intrusive rock formation property table of the mineral geological map of the Yinkeng map-sheet

No.	Name of data item	Standard code	Data category	Real example
1	Element identification number	Feature_Id	Character string	AG50E011007000000001
2	Name of rock mass mapped	Intru_Body_Name	Character string	Dongxiashan rock mass
3	Symbol of rock mass mapped	Intru_Body_Code	Character string	$\eta\gamma\beta J_3^D$
4	Rock name	Rock_Name	Character string	Medium/fine-grain porphyritic biotite monzonitic granite
5	Rock color	Color	Character string	Light pink
6	Rock texture	Rock_Texture	Character string	Medium/fine-grain porphyritic-like texture
7	Rock structure	Rock_Structure	Character string	Blocky structure
8	Primary mineral and content	Primary_Mineral	Character string	Quartz: 35%; K-feldspar: 30%; plagioclase: 30%
9	Secondary mineral and content	Secondary_Mineral	Character string	Biotite: 5%
10	Contact relation with wall rock	Contact_Relation	Character string	Intrusive contact
11	Generation era	Era	Character string	Yanshanian
12	Ore-bearing potential	Commodities	Character string	W, Sn

4 Data Quality Control and Assessment

To assure the credibility of the information, the project was implemented in strict accordance with CGS's Guidance for *1：50 000 Mineral Geological Survey (Interim)* (CGS No.[2016]117) and the specific work for geochemical and geophysical exploration was performed strictly in accordance with national and industrial standards and codes, for example, the DZ/T 0011−2015 Code for *Geochemical Reconnaissance Survey and DZ/T 0071−93 Technical Procedures for Ground-based High-precision Magnetic Survey*. According to design requirements, all the designed workload is completed or exceeded, and tasks and their goals are achieved, assuring the accuracy of the work. In July 2018, the Level 2 project arranged for experts to inspect the field-related work, and the project gained praise from all the experts and was well accepted.

The project team strictly followed the "Three-level Quality Inspection System" and applicable requirements in Rules for *Management Geological Project Management of the CGS* (2012) in the process of fieldwork. Meanwhile, the original information was 100% self-checked and mutually checked, inspected by the project team in more than 50% of cases and randomly inspected by the QC team in more than 20% of cases, thus ensuring the quality of information and data. All samples were tested and analyzed in the qualified labs under internal and external monitoring so that analytical quality met the requirements.

5 Conclusions

For the 1：50 000 Mineral Geological Map Dataset of the Yinkeng Map-sheet, Yudu Au-Ag Multi-metal Ore Integrated Area, South Jiangxi, the mineral survey and prospecting predictions were achieved, 2 prospecting prospective areas and 3 prospecting target areas were defined under the guidance of the "trinity" survey area prospecting prediction theory, in *accordance with CGS's Guidance to the 1：50 000 Mineral Geological Survey (Interim)* (CGS No.[2016]117), by applying technical means such as mineral geologicalmineralogically specific mapping, remote-sensing, geophysical and geochemical explorations. As an emphasis, the project divided ore-bearing formation, metallogenic magmatite, ore-control structure and mineralized alteration marks etc. in the area, highlighting the features of the mineral geological survey, generalizeing and summarizing ore-control elements and metallogenic regularities in the area; improving the prospecting prediction model on early-Yanshanian Yinkeng-styled Au-Ag multi-metal deposits, making it clear that the metallogenic geological body of such deposits was early-Yanshanian granodiorite, the rock-control and ore-control structure was NE-strike reverse-thrust nappe fracture and its secondary fissure group, alteration mainly was silicification, carbonatization and beresitization etc. which was a low- and mid-temperature post-magma-period hydrothermal-solution-type deposit.

References

Guo Naxin, Chen Yuchuan, Lv Xiaoqiang, Liu Zhen, Zeng Zailin, Li Jiangdong, Zhang Fengrong. 2015. Metallogenic Series Related to Two Types of Granitoid Exposed in the Nanling Scientific Drill Hole:

Evidence from Geochronology, Geochemistry and Hf Isotope[J]. Acta Geoscientica Sinica, 36(06): 742−754 (in Chinese with English abstract).

Mao Jingwen, Xie Guiqing, Guo Chunli, Yuan Shunda, Cheng Yanbo, Chen Yuchuan. 2008. Spatial-Temporal Distribution of Mesozoic Ore Deposits in South China and Their Metallogenic Settings[J]. Geological Journal of China Universities, 14(4): 510−526 (in Chinese with English abstract).

Wang Denghong, Qin Yan, Chen Zhenyu, Hou Kejun. 2012. U-Pb Isotopic Age and a Further Understanding of the Ore-forming Mechanism in Granite from the South Jiangxi Province[J]. Rock and Mineral Analysis, 31(04): 699−704 (in Chinese with English abstract).

Xu Xianbing, Zhang Yueqiao, Jia Dong, Shu Liangshu, Wang Ruirui. 2009. Early Mesozoic geotectonic process in South China[J]. Geology in China, 36(3): 573−593 (in Chinese with English abstract).

Ye Tianzhu, Lv Zhicheng, Pang Zhengshan,et al. 2017. Theory and method of prospecting prediction in exploration area (each theory)[M]. Beijing: geological publishing house (in Chinese).

Ye Tianzhu, Wei Changshan, Wang Yuwang, et al. 2014. Theory and method of prospecting prediction in exploration area (general theory)[M]. Beijing: geological publishing house (in Chinese).

Zeng Zailin. 2012. Study on metallogenic rules of major metal minerals and exploration of deep prospecting in Yinkeng area, east section of Nanling[D]. Beijing: Doctoral dissertation of Chinese academy of geological sciences: 1−189 (in Chinese with English abstract).

Zhao Xilin, Liu Kai, Mao Jianren, Ye Haimin. 2012. Metallogenesis of two types of late Early Yanshanian granitoids in South China: Case studies of south Jiangxi and southwest Fujian[J]. Geology in China, 39(4): 871−886 (in Chinese with English abstract).

Zhao Zheng, Chen Yuchuan, Chen Zhenghui, Wang Denghong, Zeng Zailin, Zhao Bin, Zhang Jiajing. 2012. SHRIMP U-Pb Dating of the Gaoshanjiao Granodiorite in the Yinkeng Ore-field of the South Jiangxi Region and Its Relations to Mineralization[J]. Rock and Mineral Analysis, 31(3): 536−542 (in Chinese with English abstract).

Zhao Zheng, Chen Yuchuan, Zeng Zailin, Guo Naxin, Chen Zhenghui. 2017. Jiangxi Yinkeng W-Ag-Au ore field's metallogenic regularity and prospecting direction: as well as the superposition of two metallogenic series in Southern China[J]. Earth Science Frontiers, 24(5): 54−61 (in Chinese with English abstract).