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1∶50 000 矿产地质图编制与数据库建设要求

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摘要：1∶50 000 固体矿产地质调查是保障国家能源资源安全的长期的基础性、公益性、战略性地质工作，是矿产勘查的重要基础和先导性工作，是国家地质调查与地球系统科学研究程度的重要指标，目的是摸清国家矿产资源家底、实现重大找矿突破或新发现、引导和拉动后续矿产勘查，在服务国家重大战略、社会发展和生态文明建设中发挥着重要的作用。2019 年中国地质调查局正式印发《固体矿产地质调查技术要求 (1∶50 000)》(DD2019–02)，创建了以成矿作用类型为主线、以成矿要素为对象、以预研究为基础、以矿产地质专项填图为核心、按成矿作用类型填 (编) 建造构造图的新方式和基于矿床模型综合地质信息预测方法的矿产资源潜力评价技术体系，建立了地质潜力、技术经济可行性和环境影响“三位一体”综合评价工作体系，为固体矿产地质调查及其成果表达指明方向，为支撑固体矿产勘查提供技术保障。其中 1∶50 000 矿产地质图是固体矿产地质调查核心成果图件，在此结合技术要求简要阐述 1∶50 000 矿产地质图编制与数据库建设要求。

关键词：1∶50 000；固体矿产勘查；矿产地质图；数据库；编图技术要求；地质调查工程

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1　引言

2004 年、2010 年，中国地质调查局相继印发了《战略性矿产远景调查技术要求 (试行)》(DD2004–04，2004 年 12 月印发执行) 和《矿产远景调查技术要求 (试行)》(2010 年 5 月印发)，在指导和规范战略性矿产远景调查专项、地质矿产调查评价专项中矿产地质调查项目的实施以及引领地方公益性地质调查工作中发挥了重要作用。当前，国家生态文明建设和能源资源安全保障等重大战略对矿产地质调查工作提出了新的更高的要求，中国地质调查局提出用科技创新改造、支撑和引领地质调查和加快推进服务方向、指导理论、发展动力 3 个根本性转变，为“矿产地质调查技术要求”修编指明了方向。

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中国地质调查局自 2016 年以来，深入总结汲取以往经验教训，学习借鉴美国、加拿大、澳大利亚等矿业发达国家的成功做法 (陈燕申等，2017；杜子图等，2014；刘凤山等，2009)，以地球系统科学为指导，运用勘查区找矿预测理论 (叶天竺等，2014，2017)，在试点工作基础上，探索新矿产地质调查工作模式，建立了以成矿有利地段为重点、不机械按网格平均布置工作的新模式，即通过预研究，确定主攻矿种和成矿作用类型，综合分析调查区物探、化探、遥感地质资料，圈定重点工作区和一般工作区。重点工作区就是重点部署区，一般占图幅面积的 1/3 ~ 1/4。针对重点工作区开展岩性、岩相、构造、蚀变专项填图 (不受比例尺限制)，确定成矿要素及其空间展布特征，结合物探、化探、遥感异常特征圈定找矿靶区，通过大比例尺矿产综合检查，确定找矿靶位，开展钻探工程验证。《固体矿产地质调查技术要求 (1：50 000)》(DD 2019–02) 规定了矿产地质图、成矿规律图、矿产预测图、资源环境综合信息图 4 类图件为矿产地质调查成果图件，其中矿产地质图为核心成果图件。在不同成矿作用类型矿产地质专项填图试点工作基础上，中国地质调查局组织编制了贵州盘信幅 (沉积成矿作用，刘健等，2020)、新疆红石幅 (火山–岩浆成矿作用，王丰丰等，2020)、甘肃花牛山幅 (岩浆成矿作用，王春女等，2019)、甘肃巴藏幅 (岩浆成矿作用，何进忠等，2020)、甘肃黄渚关幅 (沉积改造，贾祥祥等，2020)、吉林石人镇幅 (岩浆–变质成矿作用，王海建等，2020) 等矿产地质图 (1：50 000) 示范性成果图件，强化服务地质找矿作用和特色，切实推进地质填图与科学研究深度融合，起到了示范、指导和引领作用。

2　编图方法

矿产地质图是以建造构造图为底图，反映矿产地、矿 (化) 点类型、成因、规模以及其他矿产信息的一类客观性成果图件，是编制成矿规律图、矿产预测图和资源环境综合信息图的基础。图面坚持“三突出”和“三协调”原则，即突出主要含矿建造、控矿构造和矿化蚀变信息，协调主图与角图、平面与剖面以及主图内各要素之间的关系。

2.1　编图程序

编图工作应按照资料收集整理、地理底图修编、编图方案设计、图件编制、质量检查、审核校对、说明书编写等程序执行。

(1) 资料收集整理包括收集整理地理底图，综合整理预研究、野外地质调查、综合研究与专题研究、矿产资源潜力评价等阶段数据资料。

(2) 地理底图修编依据《国家基本比例尺地图图式 第 3 部分: 1：25 000 1：50 000 1：100 000 地形图图式》(GB/T 20257.3–2006))，采用《地质信息元数据标准》(DD 2006–05)、《数字地质图空间数据库标准》(DD 2006–06)、2000 国家大地坐标系、高斯–克吕格地图投影，适当简化地形要素。

(3) 结构布局包含主图、地质剖面图、综合柱状图、角图及整饰等内容。

(4) 质量检查时可应用地质云的地质调查智能空间平台。完成图件编制后，应根据原始资料对所编图件进行审核校对。编制图件的同时，按照数据库建设要求，进行图形库建设工作。

(5) 已有资料收集、数据推送、编图过程及质量检查等宜采用地质云的地质调查智能空间平台，全面反映矿产地质调查工作的综合化、信息化和体系化。图件编制采用 DGSS 或 MapGIS。

2.2 图面表达

图面内容包括主图、角图和图面整饰 3 部分内容 (图 1)。

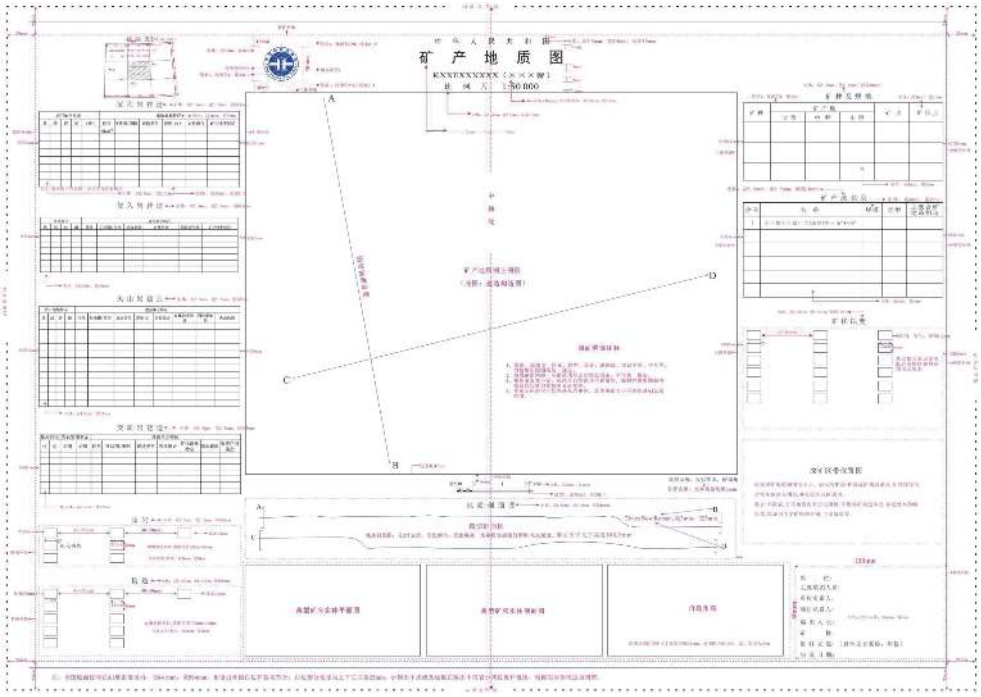

图 1 矿产地质图示例图例

(1) 主图包括地理信息底图图层、建造构造图层及矿产信息图层等，其中矿产信息图层包括矿产地、矿 (化) 点和矿化蚀变带等，矿化蚀变带应表示出其形状、范围、类型、矿物组合、蚀变强度。

必要的图层文件：地质界线、建造界线、建造花纹、断层、柱状图、地质剖面图、产状等。

(2) 角图包括沉积岩建造、侵入岩建造、变质岩建造、火山岩建造、脉岩、构造、底部角图、矿产图例、矿产地名录、矿化蚀变图例、成矿区 (带) 位置图。底部角图采用“3+*X*”表达方式。其中，“3”代表典型矿床 (区) 平面图、重要勘探线剖面图、地质剖面图；“*X*”代表创新性角图，如：典型矿床实体三维模型图、工作区沉积成矿期岩相古地理图、工作区“三位一体”空间结构模型图及其他创新性成果图件。

(3) 整饰部分包括主图内部分、主图外部分和其他整饰。主图内部分包括地质注记与建造花纹，指引线，断层倾向、倾角及断层性质，产状倾角，同位素注记，图切剖面位置，方里网等。主图外部分包括接图表、图例、建造柱状图、图切剖面、典型矿区图件、责任表等。其他整饰包括图名、比例尺、方里网注记、坐标参数、中国地质调查局局徽及其他。

2.3 地理信息底图编制

(1) 地理信息底图可继承实际材料图中的相应内容。

(2) 删去地形等高线及其注记要素，适当保留村庄、河流等地物标志，指示建造、构造、矿化蚀变等地理位置。

必要的图层文件包括：居民地、道路、水系、行政区划界线等要素，设置相应的

点 (.wt)、线 (.wl)、面 (.wp) 文件。

3 编图内容

3.1 建造构造底图

建造构造图反映调查区内沉积岩、火山岩、侵入岩、变质岩等各类建造以及褶皱、断裂等构造的地质特征、空间分布及相互关系，突出反映与成矿有关的各类建造、构造及相互关系。

3.1.1 编制流程

(1) 在预研究的基础上，初步划分填图单元，分析与成矿有关的构造类型及特征，编制建造构造草图。

(2) 测制建造构造剖面，厘定填图单元，研究成矿构造和成矿结构面，确定主要控矿构造。

(3) 以建造构造草图为基础，通过路线地质调查，宜应用 DGSS 系统对建造构造进行自动连图，按“V”字形法则连接建造和构造界线，填充建造花纹，标绘构造形迹及样式，编制形成建造构造图。

(4) 路线调查中如果发现新的与成矿有关的建造或构造，应对填图单元进行修改完善，补充相关图例。

3.1.2 建造的表达方式

主图区建造花纹和用色与柱状图应保持一致。建造花纹图例采用《区域地质图图例》(GB/T958−2015) 规定，用色依据《地质图用色标准及用色原则 (1：50 000)》(DZ/T0179−1997) 和全国矿产资源潜力评价成矿地质背景研究成果 (叶天竺等，2010)，特殊建造类型可自制表达样式，颜色、花纹等应与图内其他建造类型相协调，并在编图说明中给予说明。

以“岩性花纹+颜色”表达沉积岩建造、火山岩建造、侵入岩建造、变质岩建造，以“颜色”表达矿体、矿 (化) 体、脉岩等特殊地质体。

3.1.3 建造编码

建造编码由岩石名称代码和关系符组成，岩石名称代码依据《区域地质图图例》(GB/T958−2015)。关系代码有 2 种，一种表示“对等”或“互层”，用符号“-”连接，可用于各种建造；另一种表示夹层，用符号“>”连接，且量多的岩石类型在“>”之前，主要用于沉积岩建造、火山沉积岩建造和副变质岩建造。下面以沉积岩建造为例说明:

(1) 由 1 种岩性组成的沉积岩建造，直接用“岩石名称”编码，如石英砂岩建造，数据库中按岩石名称下属词直接填写代码“qsd”。

(2) 由 2 种岩性互层组成的沉积岩建造，用“岩石名称 1-岩石名称 2”编码，如“长石石英砂岩与粉砂岩互层建造”可表达为“fq-slt”，数据库填写 2 种岩性代码，中间用“-”连接。

(3) 由 2 种岩性组成的夹层建造，用“岩石名称 1>岩石名称 2”编码，如“长石石英砂岩夹粉砂岩建造”可表达为“fq>slt”，数据库填写 2 种岩性代码，中间用“>”连接，量多者在前。

(4) 由 3 种岩性互层组成的沉积岩建造，用“岩石名称 1-岩石名称 2-岩石名称 3”

编码，如“长石石英砂岩与粉砂岩和钙质泥岩互层建造”，可表达为“fq-slt-cam”，数据库填写 3 种岩性代码，中间用“-”连接。

(5) 由 3 种岩性构成，但 2 种为互层，另一种为夹层的沉积岩建造，用“岩石名称 1-岩石名称 2>岩石名称 3”编码，如“长石石英砂岩与粉砂岩互层夹钙质泥岩建造”可表达为“fq-slt>cam”，数据库填写 3 种岩性代码，互层用“-”连接，夹层用“>”连接。

3.1.4 构造表达方式

断裂构造：用对应的线型表达出断裂构造的性质和规模，突出表示区域性深大断裂、古断裂系统、同沉积断层等；同沉积构造常是沉积成矿类矿产形成 (特别是热水沉积、喷流 (溢) 沉积矿床、非岩浆热液矿床) 和富集的地带；根据断裂结构面和两盘岩层错动信息综合判断断层运动学特征，确认并按图例表达出断层性质。

褶皱构造：通过建造变化特征来体现；主图上不必添加褶皱轴迹。

3.2 角图

3.2.1 建造柱状图

(1) 沉积建造柱状图：包括年代地层单位 (系、统)、岩石地层单位 (群、组、段)、代号、柱状图/图例、建造类型、厚度 (m)、岩石组合、矿化蚀变特征等数据项，根据情况可加沉积相或亚相。

①“岩石地层单元”一栏，指建造所对应的沉积地层，用中文名称表达。如没有 (段)，可删除该列。

②“建造单元特征”一栏，以建造为单元阐述相关特征。

③代号的表示方法：以“Nh_2d^{1b}”(南华系中统大唐坡组第一岩性段 b 建造) 为例，其中“Nh_2d”代表南华纪中统大唐坡组，上角标数字“1”代表段，上角标小写字母“b”代表建造，a，b，c，d 代表不同建造；如在组内直接划分建造，无上角标数字，标示为“Nh_2d^{b}”；如组内只有一个建造，标示为“Nh_2d^{a}”；如段内只有一个建造，上角标数字和小写字母都不能省略，标示为“Nh_2d^{1a}”。

④柱状图/图例：按《地质图用色标准及用色原则 (1：50 000)》(DZ/T0179−1997) 上色，柱状图/图例的建造花纹和用色应与主图面相吻合；建造花纹反映地层岩性，含矿建造应标示所含主要矿种符号；颜色反映岩石形成的时代。

⑤建造类型：指建造名称。

⑥厚度 (m)：应标记沉积岩建造真实厚度，与实际厚度非比例关系。

⑦岩性组合：列出主要岩性，一般不超过 3 种；厚度小的夹层 (厚度<5 m) 若不具找矿意义不必列出。

⑧矿化蚀变特征：简述矿种和主要蚀变类型。

(2) 侵入岩建造柱状图：包括地质时代、建造单元特征 (代号、柱状图/图例、建造类型、岩性组合、同位素年龄、矿化蚀变特征)，可选填岩石成因类型、构造环境。

①“地质时代代号”的表示，代、纪、世、期。

②建造单元特征，以建造为单元阐述相关特征。

③代号用“岩石代号+时代”表示，如“$\gamma\beta K_1$”代表早白垩世黑云母花岗岩建造。

④柱状图/图例：按《地质图用色标准及用色原则 (1：50 000)》(DZ/T0179−1997) 上色，柱状图/图例的建造花纹和用色应与主图面相吻合。以不同颜色反映侵入体的时代；以建造花纹反映侵入体岩性，尽可能表达出岩石的结构构造特征；含矿建造应标示

所含主要矿种符号。

⑤建造类型：指建造名称。

⑥岩性组合：列出完整的岩石矿物学名称，包括颜色、结构、构造、特征矿物、基本名称等要素。

⑦同位素年龄：标明年龄值及测试方法。

⑧矿化蚀变特征：简述矿种和主要蚀变类型及相关特征。

(3) 火山岩建造柱状图：包括岩石地层单位、建造单元特征 (代号、柱状图/图例、建造类型、厚度、岩性组合、矿化蚀变特征、同位素年龄及火山机构)。

①“岩石地层单元”包括系、统、群、组。

②“建造单元特征”以建造为单元阐述其相关特征。

③代号的表示方法：以“K_1z^{3d}”(下白垩统张家口组第三岩性段 d 建造) 为例，其中“K_1z”代表下白垩统张家口组，上角标数字“3”代表段，上角标小写字母“d”代表建造，a，b，c，d 代表不同建造；如在组内直接划分建造，可省去上角标数字，标示为“K_1z^{d}”，如果组内只有一个建造，标示为“K_1z^{a}”；如段内只有一个建造，上角标数字和小写字母都不能省略。

④柱状图/图例：按《地质图用色标准及用色原则 (1：50 000)》(DZ/T0179−1997) 上色，柱状图/图例的建造花纹和用色应与主图面相吻合；以不同颜色反映火山岩时代，以建造花纹反映火山岩岩性及结构，含矿建造应标示所含主要矿种符号。

⑤建造类型：指建造名称。

⑥厚度 (m)：应标记火山岩建造真实厚度，与实际厚度非比例关系。

⑦岩性组合：列出主要岩性，一般不超过 3 种；厚度小的夹层 (厚度<5 m) 若不具找矿意义不必列出。

⑧矿化蚀变特征：简述矿种和主要蚀变类型及特征。

⑨同位素年龄：标明年龄值及测试方法。

⑩火山机构：填写主要火山机构类型，如：裂隙式火山机构、中心式火山机构、复式火山机构和岩穹构造。

(4) 变质岩建造柱状图：包括地质时代、岩石地层单位、建造单元特征 (建造类型、厚度、变质岩建造柱、岩石组合)、同位素年龄及测定方法、矿化蚀变、原岩建造、变质作用类型。

①地质时代包括代、纪。

②岩石填图单位包括岩群、岩组。

③建造单元特征，以建造为单元阐述相关特征。

④代号用“时代+岩组”表示，如“Ar_3t^{c}”代表新太古代晚期太平庄岩组 c 建造。

⑤柱状图/图例：按《地质图用色标准及用色原则 (1：50 000)》(DZ/T0179−1997) 上色，柱状图/图例的建造花纹和用色应与主图面相吻合。以建造花纹反映原岩建造类型，尽可能表达出岩石的结构构造特征；以颜色深浅反映岩石形成的时代，含矿建造应标示所含主要矿种符号。

⑥建造类型：指建造名称。

⑦岩性组合：列出主要岩性，一般不超过 3 种。

⑧矿化蚀变特征：简述矿种和主要蚀变类型及相关特征。

⑨原岩建造：指通过岩石组合、岩石地球化学、副矿物等特征恢复的原岩的岩石组合。

⑩变质作用类型：主要有埋深变质作用、区域低温动力变质作用、区域动力热流变质作用、区域中高温变质作用、接触变质作用、动力变质作用和洋底变质作用。

3.2.2 构造图例

表达图幅内的主要构造样式，如深大断裂、褶皱、正断层、逆断层、韧性剪切带等。

3.2.3 矿产地名录

数据项包括序号、矿产地名称、规模、类型及主要含矿建造构造，类型指矿产预测类型，参见《固体矿产地质调查技术要求 (1：50 000)》(DD2019−02)。

3.2.4 矿化蚀变

点状蚀变用符号表达，面状蚀变用点状符号和线共同表达，矿 (化) 点用对应矿产符号表达。

3.2.5 所属成矿区带位置

表示到 III 级至Ⅳ级成矿区 (带)。全国 III 级成矿区 (带) 划分标准参见陈毓川等（2010）所著《重要矿产和区域成矿规律研究技术要求》。Ⅳ级成矿区 (带) 参见省级矿产资源潜力评价相关成果资料。如遇各类保护区应以独立图层标示在区域内。图中应标示图幅所处位置、主要矿床位置及名称、重要城市等信息，要求内容简练、层次分明。不宜在角图中列表和增设图例区。

3.2.6 地质剖面图

一般应包括 2 ~ 3 条图切地质剖面，剖面位置的选择一般应垂直于主体构造走向。剖面应穿过典型矿床，尽量穿过主要矿产地、主要含矿建造和控矿构造。

3.2.7 典型矿床实体图

一般包括典型矿床实体平面图、实体剖面图、典型勘探线剖面图。典型矿床实体图宜采用与主图相同的图例。

3.2.8 责任签

责任签位置及样式见图 1。内容包括单位、主要填图人员、单位负责人、项目负责人、主要编图人员、审核、资料来源、编图日期等。

3.3 试点图幅图面内容表达

贵州盘信幅 (刘健等，2020)，内容以沉积成矿作用为主，以南华纪锰矿为主要研究对象，突出表现裂谷盆地古天然气锰矿成矿系统中渗漏喷溢中心相、过渡相、边缘相和隆起区盖帽白云岩的建造特征，选择构造岩相古地理图作为角图。

甘肃黄渚关幅 (贾祥祥等，2020)，内容以沉积成矿作用为主，研究对象为碎屑喷流沉积型矿床，其成矿局限于同生断裂控制的断陷滞留盆地，重点表现泥盆纪沉积相，选择岩相古地理图作为角图，此外，成矿涉及岩浆期后热液的改造，新增构造纲要角图对改造成矿的矿产的最终定位具有重要意义。

甘肃花牛山幅 (王春女等，2019)，内容以岩浆成矿作用为主，成矿与三叠纪正长花岗岩和二长花岗岩密切相关，重点表现花岗岩建造特征，选择侵入岩岩性岩相构造图作为角图。

甘肃巴藏幅 (何进忠等，2020)，内容以岩浆热液作用为主，主要形成中低温热液型、远成低温热液型矿床，其成矿岩体多为隐伏，但赋矿沉积建造具有硅钙组合的特

点，重点在主图区表现硅钙化蚀变特征。同时，选择综合岩性构造图作为角图。

新疆红石幅 (王丰丰等，2020)，以火山成矿地质作用为主，主要形成海相火山喷流沉积型矿床及陆相次火山热液型矿床。重点研究及突出表达的为火山机构及其伴生的裂隙、次火山岩及伴生的火山建造，次火山岩与沉积岩的接触界面等。角图选择火山岩岩性岩相构造图。

吉林石人镇幅 (王海建等，2020)，内容以变质成矿作用为主，太古宙斜长角闪岩建造、老岭群角砾状白云质大理岩建造和青白口系石英砂岩建造接触部位均是重点研究部位，选择区域变质建造构造图作为角图。

3.4 编图中几点注意事项

(1) 与成矿有关、图面宽度小于 50 m 的建造应放大表示。

(2) 对于沉积岩建造和变质岩建造，建造花纹的走向应与建造界线变化相一致，花纹的颜色应以不掩盖建造界线为前提。互层及复理石建造以各岩性层交互出现的方式表示。

(3) 夹层以主要岩性建造花纹中间绘制的不同岩性花纹表示。

(4) 如遇与火山成矿作用有关的区域应标绘出火山口范围。

(5) 接触变质岩以点、线方式勾绘接触变质带；动力变质岩与断裂同步勾绘。

(6) 确定与成矿无关的岩脉可不表达。

4 数据库建设

数据库建设主要包括图层（表 1）与数据库部分。

数据表主要包括：

(1) 建造构造图层数据表 (表 2)。

(2) 地质界线数据表 (表 3)。

表 1 图层信息表

	图层编号及名称	具体图层名称	空间特性	数据表	备注
1	地理图层	主要行政境界图层	线	无	直接引用数字填图背景图层
		主要居民点地图层	点	无	
		主要面状水系图层	面	无	
		主要线状水系图层	线	无	
		主要地理标注图层	点	无	
2	建造构造图层	建造构造图层	面	有	根据地质体面实体(_GeoPolygon.wp)编制
		地质(界)线	线	有	根据地质(界)线(_GeoLine.wl)编制
		构造变形带图层	面	有	根据(_TECOZONE.wp)编制
		褶皱图层	线	有	本次新增(_FOLD.wt)
		断裂图层	线	有	由地质界线中提取后，根据_FAULT挂接属性
		产状要素图层	点	有	引用_ATTITUDE.wt图层
		重要钻孔图层	点	有	引用_DRILLHOLE.wt图层
		化石样点图层	点	有	引用_FOSSIL.wt图层
		同位素年龄图层	点	有	引用_ISOTOPE.wt图层

续表 1

图层编号及名称	具体图层名称		空间特性	数据表	备注
3	矿产地图层		点	有	引用_MINERAL_PNT.wt图层
4	整饰图层	主图内部分	地质注记与建造花纹	点	无	根据a_GEOPOLYGON.wt图层编制建造花纹
			指引线	线	无	a_GEOPOLYGON.wl
			断层倾向、倾角及断层性质	点	无	a_GEOLINE.wt
			产状倾角	点	无	a_ATTITUDE.wt
			同位素注记	点	无	a_ISOTOPE.wt
			图切剖面	线、点	无	a_PROFILE.wl a_PROFILE.wt
			方里网	线	无	FRAME.wl
		主图外部分	接图表	点、线、面	无	MAP_SHEET.wt MAP_SHEET.wl MAP_SHEET.wp
			图例	点、线、面	无	LEGEND.wt LEGEND.wl LEGEND.wp
			建造柱状图	点、线、面	无	COLUMNAR_SECTION.wt COLUMNAR_SECTION.wl COLUMNAR_SECTION.wp
			图切剖面	点、线、面	无	CUTTING_PROFILE.wt CUTTING_PROFILE.wl CUTTING_PROFILE.wp
			典型矿区图件	点、线、面	无	TYPICALDEPOSITS.wt TYPICALDEPOSITS.wl TYPICALDEPOSITS.wp
			责任表	点	无	DUTY_TABLE.wt
			图外其他整饰	点、线、面	无	图名、比例尺、方里网注记、局徽及其他 OTHERMODIFY.wt OTHERMODIFY.wl OTHERMODIFY.wp

(3) 构造变形带数据表 (表 4)。

(4) 断裂数据表 (表 5)。

(5) 褶皱数据表 (表 6)。

(6) 化石采样点数据表 (表 7)。

(7) 同位素年龄数据表 (表 8)。

(8) 产状要素数据表 (表 9)。

(9) 重要钻孔数据表 (表 10)。

(10) 矿产地数据表。

①表达三位 (矿种、规模、类型) 一体，建议采用 1：250 000 矿产资源潜力评价矿产子图，在现有系统库中进行补充。

②属性结构: 引用数字填图_MINERAL_PNT.wt 成果。

③矿产地图层数据表 (表 11)。

表 2　建造构造图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
地质体面实体标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
地质体面实体类型代码(地质代码)	*Feature_Type	Character	30		M			引用地质体面实体(_GEOPOLYGON.wp)属性内容
地质体面实体名称	Geobody_Name	Character	50		M			
地质体面实体时代	Geobody_Era	Character	20		M			
建造大类	Formation	Character	10		M			填写沉积岩建造、侵入岩建造、火山岩建造、变质岩建造等大类(汉字名称)
建造类型	Metallogenic	Character	60		M			填写与建造大类相对应的建造类型(汉字名称)
岩石组合	Combination	Character	100		M			填写岩石自然共生组合(汉字名称)
大地构造环境	Structural_Env	Character	100		M			填写所处大地构造单元名称(汉字名称)
地质体面实体下限年龄值	Geobody_Age1	Double	10.2		O			引用地质体面实体(_GEOPOLYGON.wp)属性内容
地质体面实体上限年龄值	Geobody_Age2	Double	10.2		O			
子类型标识	Subtype	Integer	4		O			

表 3　地质界线图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
地质界线(接触)代码	*Feature_Type	Character	30		M			
地质界线类型	Boundary_Name	Character	50		M			
界线左侧地质体代号	Left_Boundary_Code	Character	30		M			引用地质(界)线(_GeoLine.wl)属性内容
界线右侧地质体代号	Right_Boundary_Code	Character	30		M			
界面走向	Strike	Integer	3		O			
界面倾向	Dip_Direction	Integer	3		O			
界面倾角	Dip_Angle	Integer	2		O			
子类型标识	Subtype	Integer	4		O			

5　结论

(1) 矿产地质图编制本着“继承、发展、改革、创新”的思想，以填、编图结合的

表 4　构造变形带图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
变形带代码	*Feature_Type	Character	30		M			
变形带类型名称	Deformation_Name	Character	60		M			
变形带岩石名称	Defor_Rockname	Character	60		M			
变形带组构特征	Fabric_Character	Character	250		M			引用(_TECOZONE.wp)属性内容
变形力学特征	Mechanics	Character	250		M			
形成时代	Ear	Character	100		M			
活动期次	Movement_Period	Character	200		M			
含矿性	Commodities	Character	120		O			
子类型标识	Subtype	Integer	4		O			

表 5　断裂图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素分类代码	*Feature_Type	Character	30		NOTNULL			
断层类型(地质代码)	Fault_Type	Character	30		M			
断层名称	Fault_Name	Character	80		M			
断层编号	Fault_Code	Character	30		M			
断层性质	Fault_Character	Character	250		M			
断层上盘地质体代号	Fault_Up_Body	Character	30		M			
断层下盘地质体代号	Fault_Bottom_Body	Character	30		M			引用_FAULT数据表属性内容
断层破碎带宽度	Fault_Wide	Character	80		O			
断层走向	Fault_Strike	Integer	3		O			
断层倾向	Fault_Dip	Integer	3		O			
断层面倾角	Fault_Dip_Angle	Integer	2		O			
估计断距	Fault_Distance	Float	10.2		M			
断层形成时代	Era	Character	30		O			
活动期次	Movement_Period	Character	100		O			
子类型标识	Subtype	Integer	4		O			

方式开展，创新图面表达方式，突出表达该区主要成矿地质体、成矿构造与成矿结构面、成矿作用特征标志，全面客观表达成矿作用与地质找矿特色，是中国地质调查局新一轮矿产地质调查与找矿预测项目的工作指南。

(2) 角图辅助解读主图作用更加突出，角图全面反映该图幅内含矿建造类型、时代及特征。典型矿床系列图件为该地区下一步找矿工作提供科学依据。

表 6　褶皱图层数据表

序号	数据项名称	数据项代码	数据类型	存储长度	小数位数	约束条件	默认值/初始值	值域	值单位	数据项填写规定	数据项词语定义或描述(即数据项词条定义或描述)
1	图元编号	CHFCAC	C	6		NOT NULL				按十进制数字码、从“000001”开始顺序填写	图元编号是空间数据库(未汇总的)连结图形与属性的关键字，在两者中必须保持一致，按顺序码编写，主要省级用
2	褶皱名称	GZCAB	C	40		O				填写通用的褶皱名称	填写图幅内褶皱的汉字名称
3	褶皱类型	GZCE	C	20		M				填写褶皱类型	根据褶皱形态将褶皱大致划分为背斜(背形)、向斜(向形)、倒转褶皱、平卧褶皱和倾竖褶皱等褶皱类型(源自潜力评价数据项下属词分册GZCE)
4	褶皱形态	GZCDD	C	20		O				填写褶皱形态	填写长轴、短轴、卵形等褶皱形态(源自潜力评价数据项下属词分册GZCD)
5	枢纽倾伏向	GZCCBE	C	7		O			度	填写褶皱枢纽的倾伏向	
6	枢纽倾伏角	GZCCBF	C	5		O			度	填写褶皱枢纽的倾伏角	
7	轴面倾向	GZCCAE	C	7		O			度	填写褶皱轴面的倾向	
8	轴面倾角	GZCCAF	C	5		O			度	填写褶皱轴面的倾角	
9	卷入褶皱的地层	GZCFA	C	20		O				填写地层的时代、岩性和变质程度	
10	形成时代	GZEKG	C	15		M				填写褶皱形成年代	根据卷入地层及与其他构造的关系判断褶皱的形成时间

(3) 客观、科学、合理的矿产地质图和详尽的空间数据信息为成矿规律图、矿产预测图和资源环境综合信息图的编制提供保障，为区域找矿预测提供基础信息。

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表 7　化石采样点图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
化石样品编号	Sample_Code	Character	20		O			
化石所属生物门类	*Feature_Type	Character	50		M			
化石属或种名	Genus_Species	Character	50		M			引用_FOSSIL.wt图层属性内容
化石产出层位	Bed	Character	50		M			
含化石地层单位代号	Lithostrat_Unit	Character	20		M			
化石时代	Era	Character	40		M			
子类型标识	Subtype	Integer	4		O			

表 8　同位素年龄图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
样品编号	Sample_Code	Character	30		M			
样品名称	Sample_Name	Character	50		M			
年龄测定方法	Measuring_Kinds	Character	60		M			
测定年龄	Age	Character	100		M			引用_ISOTOPE.wt图层属性内容
被测定出地质体单位及代号	Geobody_Code	Character	30		M			
测定分析单位	Unit	Character	50		M			
测定分析日期	Date	Character	8		YYYYMMDD			
子类型标识	Subtype	Integer	4		O			

表 9　产状要素图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
产状类型名称代码	*Feature_Type	Character	30		M			
产状类型名称	Attitude_Name	Character	40		M			引用_ATTITUDE.wt属性内容
走向	Strike	Integer	3		M			
倾向	Dip_Direction	Integer	3		M			
倾角	Dip_Angle	Integer	2		M			
子类型标识	Subtype	Integer	4		O			

表 10　重要钻孔图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
钻孔编号	Zk_Code	Character	30		M			
钻孔深度	Zk_Depth	Float	10.2		M			
基岩或目的层孔深	Rock_Depth	Float	10.2		M			
基岩或目的层岩性	Rock_Type	Character	200		O			
基岩或目的层时代	Base_Bed_Era	Character	50		O			引用(_Drillhole)图层属性内容
松散沉积层的年代	Loose_Lay_Era	Character	30		O			
松散沉积层的分层厚度	Loose_Lay_Thickness	Float	10.2		O			
松散沉积层的岩性	Loose_Lay_Lithology	Character	255		O			
子类型标识	Subtype	Integer	4		O			
主键名称Feature_Id，Zk_Code索引键名称Zk_Code								

表 11　矿产地图层数据表

数据项名称	标准编码	数据类型	数据存储长度	数据显示长度	约束条件	默认值/初始值	值域范围	数据项描述
要素标识号	*Feature_Id	Character	20		NOTNULL			
原编码	Source_Id	Character	30		O			
矿种代码	*Feature_Type	Character	50		M			
矿种名称	Commodities_Name	Character	60		M			
共生矿	Paragenic_Ore	Character	100		M			
伴生矿	Associated_Ore	Character	80		M			
矿产地数	Ore_Sums	Integer	3		O			引用_MINERAL_PNT.WT图层属性内容
矿石品位	Ore_Grade	Character	100		M			
规模	Deposite_Size	Character	100		M			
成矿时代	Metallogenetic_Epoch	Character	30		M			
矿产地名	Placename	Character	60		M			
矿化类型	Genesis_Types	Character	200		O			
成因类型	Industrial_Types	Character	200		O			
子类型标识	1 SUBTYPE	Integer	4		O			

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Requirements of Map Compilation and Database Building of 1∶50 000 Mineral Geological Maps

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Abstract: 1∶50 000 solid mineral geological surveys are long-term basic, public-spirited, and strategic geological work that guarantee national energy and resource security. They serve as both an important foundation and forerunner of mineral exploration and an important index of national geological surveys and earth system science research. Their purpose is to ascertain national mineral reserves, achieve significant breakthroughs in prospecting or make new discoveries, and guide and drive subsequent mineral exploration. Meanwhile, they play an important role in serving major strategies, social development, and ecological civilization construction. In 2019, the China Geological Survey officially issued the *Technical Requirement of* 1∶50 000 *Solid Mineral Geological Survey* (DD 2019-02), creating a new mineral geological survey method by mapping (compiling) suite-tectonic maps according to mineralization types and taking mineralization types as the thread, metallogenic factors as the objects, pre-research as the base, and mineral and geology-specific mapping as the core. Meanwhile, a mineral resources potential evaluation technical system and a "trinity" assessment system were also established. The former is based on the comprehensive geological information prediction of deposit models and the later integrates the assessment of geological potential, technical and economic feasibility, and environmental impact. All these guide solid mineral geological surveys and the expression of survey results and provide technical support for solid mineral exploration. Among them, the 1∶50 000 mineral geological maps serve as the core result maps of solid mineral geological surveys. This paper focuses on a brief description of the requirements of map compilation and database building of 1∶50 000 mineral geological maps based on the *Technical Requirement of* 1∶50 000 *Solid Mineral Geological Survey* (DD 2019-02).

Key words: 1∶50 000; solid mineral geological exploration; mineral geological map; database; technical requirements of map compilation; geological survey engineering

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

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1 Introduction

The China Geological Survey issued the *Technical Requirement of Strategic Mineral Prospect Survey* (*Trial*; DD 2004–04) (issued and implemented in December 2004) and the *Technical Requirement of Mineral Prospect Survey (Trial)* (issued in May 2010), respectively in 2004 and 2010. Both of them have played an important role in guiding and normalizing geological and mineral surveys specific to strategic mineral resources and the implementation of mineral geological surveys in the assessment specific to geological and mineral surveys. Besides, they also play a crucial role in leading local public-spirited geological surveys. However, the current major national strategies such as ecological construction and energy and resource security have put forward new and higher requirements of mineral geological surveys. To this end, the China Geological Survey has proposed reforming, supporting, and leading geological surveys with scientific and technological innovations and accelerating the fundamental transformation in service direction, guiding theories, and development driving force of geological surveys. This has pointed out the direction for the revision of the technical requirements of mineral geological surveys.

Since 2016, the China Geological Survey has learned lessons and summarized experience from the past and learned the successful and effective practices of developed countries in mining such as the United States, Canada, and Australia (Chen YS et al., 2017; Du ZT et al., 2014; Liu FS et al., 2009). Based on this, it has explored new mineral geological survey modes by applying prospecting prediction theory of exploration areas (Ye TZ al., 2014, 2017) on the basis of pilot work and under the guidance of earth system science. As a result, it has established a new work mode focusing on favorable metallogenic sections instead of mechanical average deployment according to grids. The details of the new work mode are as follows. Key and minor survey sites are delineated according to main mineral types and mineralization types determined by pre-research and on the basis of the comprehensive analysis of geophysical, geochemical, and remote sensing data of survey areas. The key survey sites serve as the main deployment area of geological surveys and cover 1/3–1/4 of a map sheet in general. In this case, mapping specific to lithology, lithofacies, structure, and alteration is carried out (not limited by scale) to determine metallogenic factors and their spatial distribution characteristics. Then prospecting target areas are delineated in combination with geophysical, geochemical and remote sensing data. Finally, the prospecting target sites are determined through large-scale comprehensive mineral inspection and then are verified through drilling engineering. As stipulated in the *Technical Requirement of* 1∶50 000 *Solid Mineral Geological Survey* (DD 2019-02), the maps of mineral geological survey results consist of mineral geological maps, metallogenic regularity maps, mineral prediction maps, and comprehensive information maps of resources and environment, among which the mineral geological maps serve as core maps. According to the pilot work of mineral and geology-specific mapping of different metallization types, the China Geological Survey has organized to compile demonstrative mineral geological maps of Panxin map sheet in Guizhou Province (sedimentary mineralization, Liu J et al., 2020), Hongshi map sheet in Xinjiang

(volcanic−magmatic mineralization, Wang FF et al., 2020), Huaniushan map sheet in Gansu Province (magmatic mineralization, Wang CN et al., 2019), Bazang map sheet in Gansu Province (magmatic mineralization, He JZ et al., 2020), Huangzhuguan map sheet in Gansu Province (sedimentary transformation, Jia XX et al., 2020), and Shiren Town map sheet in Jilin Province (magmatic-metamorphic mineralization, Wang HJ et al., 2020). The compilation of these maps (1∶50 000) strengthens the role and characteristics of mineral geological surveys in serving geological prospecting and has practically promoted the deep integration of geological mapping and scientific research, thus setting examples for future mineral geological surveys.

2 Map Compilation Methods

Mineral geological maps are a kind of maps that objectively reflect the information such as the types, genesis, and scale of mineral deposits and ore occurrence (mineralized points), with suite-tectonic maps as their base maps. They serve as the base for compilation of metallogenic regularity maps, mineral prediction maps, and comprehensive information maps of resources and environment. They are prepared by following the principles of highlighting the information of main ore-bearing suites, ore-controlling structures, and mineralized alteration and coordinating the relationships between the master map and corner maps; plane and sections, and among various factors in the master map.

2.1 Map Compilation Procedures

Map compilation procedures mainly consist of data collection, revision of geographic base map, design of compilation scheme, map compilation, quality inspection, audit and proofreading, and preparation of map manuals.

(1) Data collection includes the collection of geographic base maps and the data of various stages such as pre-research, field geological surveys, comprehensive research and special research, and mineral resources potential evaluation.

(2) Geographic base maps are revised according to the *Cartographic Symbols for National Fundamental Scale Maps—Part 3: Specifications for Cartographic Symbols* 1∶25 000, 1∶50 000 & 1∶100 000 *Topographic Maps* (GB/T 20257.3-2006), *Geological Information Metadata Standard* (DD 2006-05), and *Digital Geological Map Spatial Database Standard* (DD 2006-06), with the National Geodetic Coordinate System 2000 and Gauss-Kruger projection being adopted and topographic elements being properly simplified.

(3) Structural layout of a mineral geological map consists of a master map, geological sections, comprehensive histograms, corner maps, and map decorations.

(4) Quality inspection can be conducted using the AiSpace for GS (a geological survey intelligent space) on the Geocloud. The completed maps should be audited and proofread according to primary data. Meanwhile, during map compilation, graphics library should be built according to relevant requirements.

(5) The data collection, data push, compilation, and quality inspection should be conducted using the AiSpace for GS on the Geocloud to fully reflect the integration,

informatization, and systematization of mineral geological surveys. Maps should be compiled using DGSS or MapGIS.

2.2 Contents on Map Surface

The contents on map surface include three parts, namely a master map, corner maps, and map decorations (Fig. 1).

(1) The master map includes the map layers of geographic base map, suite-tectonic map, and mineral information map. Among them, the map layer of mineral information consists of mineral deposits, ore occurrence (mineralized points), and mineralized alteration zones. For the mineralized alteration zones, their shapes, scope, types, mineral associations, and alteration intensity should be expressed.

Necessary map layer files: the files of geological boundaries, suite boundaries, suite patterns, faults, histograms, geological sections, and attitude.

(2) Corner maps cover the suites of sedimentary rock, intrusive rock, metamorphic rock, and volcanic rock; vein rock; structures; bottom corner maps; mineral legends; mineral deposit list; mineralized alteration legends, and maps of metallogenic zone/belt locations. Among them, the bottom corner maps are presented by adopting the means "3+X", where, "3" denotes a plan of typical deposits (areas), a section of an important exploration line, and a geological section; "X" represents an innovative corner map, such as a 3D map of a typical deposit entity, a palaeogeographic map of the lithofacies in a sedimentary metallogenic stage of the survey site, or a "trinity" spatial structure model map of the survey site and other maps of innovative achievements.

(3) The map decorations include the decorations inside and outside a master map and other decorations. The decorations inside a master map include geological annotations; suite

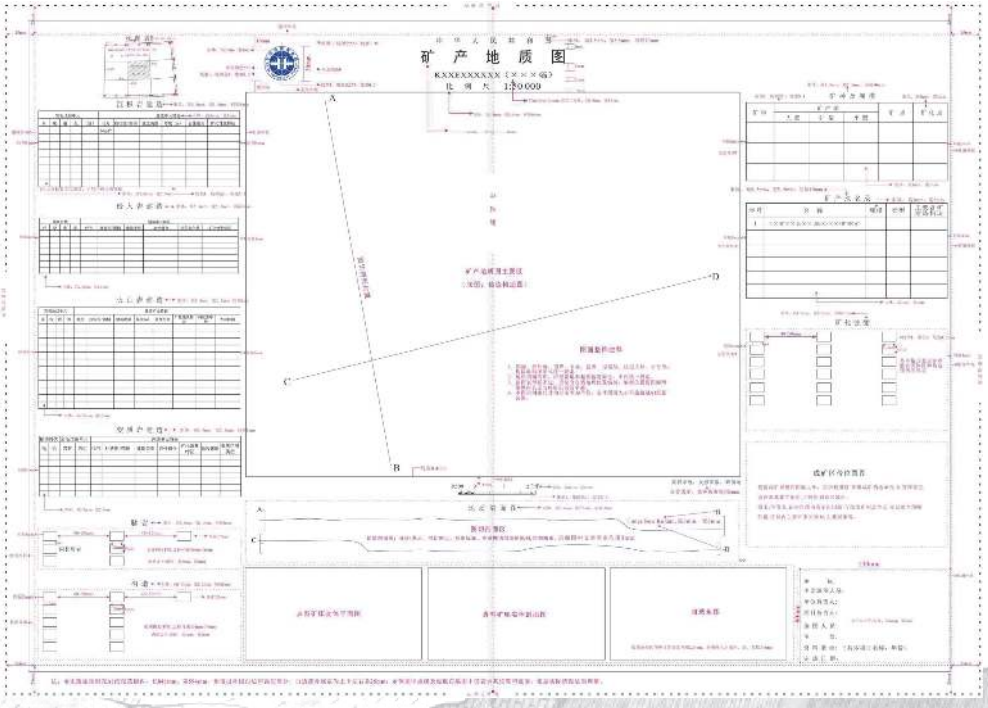

Fig. 1 Legends of an example of mineral geological maps

patterns; geologic leader lines; the dips, dip angles, and nature of faults; dip angles of attitude; isotopic annotations; positions of cross-sections, and kilometer grids. The decorations outside a master map include index maps, legends, suite histograms, cross-sections, maps of typical deposits, and responsibility tables. Other decorations include map titles, scale, kilometer grid notes, coordinate parameters, and the logo of the China Geological Survey and others.

2.3 Compilation of a Geographic Base Map

(1) Inherit corresponding contents from draft data maps.

(2) Delete the topographic contour lines and their annotation elements, properly reserve the surface feature indicators such as villages and rivers, and indicate the geographical locations of suites, structures, mineralized alteration, etc.

Necessary map layer files cover residential areas, roads, streams, and administrative division boundaries. Corresponding files of points (.wt), lines (.wl), and polygons (.wp) are established.

3 Map Compilation

3.1 A Suite-tectonic Base Map

A suite-tectonic map is used to reflect the geological characteristics, spatial distribution, and interrelationships of various suites (i.e., the suites of sedimentary rocks, volcanic rocks, intrusive rocks, and metamorphic rocks) and structures (i.e., folds and faults) in a survey site, especially the suites and structures related to mineralization and their interrelationships.

3.1.1 Compilation Process

(1) Preliminarily divide mapping units based on pre-research, analyze the types and characteristics of the structures related to mineralization, and compile suite-tectonic draft maps.

(2) Measure suite-tectonic sections, ascertain mapping units, research metallogenic structures and metallogenic structural planes, and determine main ore-controlling structures.

(3) Apply DGSS system to automatically form the outline of suites and structures based on suite-tectonic draft maps and through geological route surveys. Connect the boundaries of suites and structures following the V-shaped rule, fill in suite patterns, and plot features and styles of structures. In this way, a suite-tectonic map can be formed.

(4) Where new suites or structures related to mineralization are discovered during route surveys, the mapping units should be modified and improved and relevant legends should be supplemented.

3.1.2 Presentation of Suites

The patterns and colors of suites in a master map shall be consistent with those in the histograms. The former shall meet the requirements of the *Geological Legends Used for Regional Geological Maps* (GB/T 958-2015). The later shall meet the requirements of the *Standards and Principles of Colors Used for Geological Maps* (1∶50 000) (DZ/T 0179-1997) and the metallogenic geological background study results involved in national mineral resources potential evaluation (Ye TZ et al., 2010). Special types of suites can be presented in a

customized style, and their colors and patterns shall be coordinated with other types of suites in the map. Meanwhile, all these shall be explained in a compilation manual.

The suites of sedimentary rocks, volcanic rocks, intrusive rocks, and metamorphic rocks shall be presented with "lithologic patterns + colors", and special geologic blocks such as ore bodies, mineralized bodies, and vein rocks shall be presented with colors.

3.1.3 Codes of Suites

The code of a suite is composed of the codes of rock names and relation codes. The codes of rock names shall follow the *Geological Legends Used in Regional Geological Maps* (GB/T958-2015). There are two types of relation codes. One of them represents an "equivalent" or "alternating-layer" relation, with "-" as the connection symbol. They can be used for various suites. The other type of relation codes denotes interbeds. Their connection symbols is ">", with the rock type of a larger amount being placed before ">". They are mainly used for sedimentary rock suites, volcanic sedimentary rock suites, and parametamorphic rock suites. The examples of the codes of sedimentary rock suites are described as follows.

(1) A sedimentary rock suite consisting of one rock type is directly coded with the rock name. For example, as for a quartz sandstone suite, the code "qsd" is directly filled in the subordinate word of the rock name in the database.

(2) A sedimentary rock suite consisting of two lithologic types of alternating layers is coded with "rock name 1-rock name 2". For example, an alternating layer suite consisting of feldspathic quartz sandstone and siltstone can be expressed as "fq-slt". In the database, two lithologic codes connected with "-" are filled for this kind of suites in the database.

(3) An interbed suite consisting of two rock types is coded with "rock name 1>rock name 2". For example, a suite of feldspar quartz sandstone interbedded with siltstone can be expressed as "fq>slt". In the database, two lithological codes connected with ">" are filled for this kind of suites, with the code of the rock in a larger amount being placed before ">".

(4) A sedimentary rock suite consisting of three lithologic types of alternating layers is coded with "rock name 1-rock name 2-rock name 3". For example, an alternating layer suite consisting of feldspar quartz sandstone, siltstone, and calcareous mudstone can be expressed as "fq-slt-cam". In the database, the three lithologic codes connected with "-" are filled for this kind of suites.

(5) A sedimentary rock suite, which composed of three lithology, consisting of two alternating layers and one interbed can be coded with "rock name 1-rock name2>rock name 3". For example, a suite consisting of feldspar quartz sandstone and siltstone alternating layers interbedded with calcareous mudstone can be expressed as " fq-slt>cam". In the database, three rock codes are filled for this kind of suite, with the codes of two alternating layers being connected with "-" and then the code of the interbed being connected with ">".

3.1.4 Presentation of Structures

Fault structures: express the properties and scale of fault structures with corresponding line types, highlighting regional deep faults, ancient fault systems, and synsedimentary faults; synsedimentary structures tend to be the areas where sedimentary minerals (especially

hydrothermal deposits, exhalative/eruption sedimentary deposits, and non-magmatic hydrothermal deposits) are formed and rich; comprehensively judge the kinematic characteristics of faults based on the fault structural planes and the relative displacement of the rock layers on the hanging wall and foot wall of faults, and confirm and present fault properties according to the legends.

Fold structures: reflected by the variation characteristics of suites. It is unnecessary to add axial traces of folds on a master map.

3.2 Corner Maps

3.2.1 Suite Histograms

(1) A histogram of a sedimentary rock suite: including chronostratigraphic units (system and series), lithostratigraphic units (group, formation, and member), code, histogram/legends, suite type, thickness (m), rock associations, mineralized alteration characteristics, and other data items. Sedimentary facies or subfacies can be added if needed.

① The column "Lithostratigraphic unit": referring to the sedimentary stratum corresponding to the suite, which is expressed in Chinese. This column can be deleted where there are no members.

② The column "Suite unit characteristics": describing relevant characteristics by suite units.

③ Code: taking "Nh_2d^{1b}" (the suite *b* in the first member of Middle Nanhuan Datangpo Formation) as an example. "Nh_2d" represents the Middle Nanhuan Datangpo Formation, the superscript number "1" represents the member, and the superscript lowercase letter "b" represents the suite (a, b, c, and d denoting different suites). Where the formation is directly divided into suites, the suite is coded "Nh_2d^{b}", without superscript number. Where there is only one suite in the formation, the suite is coded "Nh_2d^{a}". Where there is only one suite in the member, neither the superscript number nor the lowercase letter can be omitted and the suite is coded "Nh_2d^{1a}".

④ Histogram/legends: coloring the histogram/legends in accordance with the *Standard and Principle of Coloring in Geological Map* (1∶50 000) (DZ/T 0179-1997), with the patterns and colors of the suite in the histogram/legends being consistent with those in the master map. The suite patterns reflect stratigraphic lithology (the symbols of main mineral types shall be marked for ore-bearing suites), and the suite colors reflect the formation eras of rocks.

⑤ Suite type: referring to the suite name.

⑥ Thickness (m): the true thickness of the sedimentary rock suite, instead of the proportion to the true thickness.

⑦ A lithologic association: listing main lithology, generally not more than three types. It is unnecessary to list the thin interbeds (< 5 m) that have no prospecting significance.

⑧ Mineralized alteration characteristics: briefly describing mineral types and main alteration types.

(2) A histogram of an intrusive rock suite: including geological age, characteristics of suite units (codes, histogram/legends, suite types, lithologic associations, isotopic ages, and

mineralized alteration characteristics), and optional rock genetic types and tectonic environment.

① Geological age codes: expressed with eras, periods, epochs, and stages.

② The column "Suite unit characteristics": describing relevant characteristics by suite units.

③ Code: expressed with "rock code + era". For example, "$\gamma\beta K_1$" represents Early Cretaceous biotite granite suite.

④ Histogram/legends: coloring histogram/legends in accordance with the *Standard and Principle of Coloring in Geological Map* (1∶50 000) (DZ/T 0179-1997), with the patterns and colors of the suite in the histogram/legends being consistent with those in the master map. The eras of intrusions are expressed with different colors. The lithology of intrusions is expressed with formation patterns, with the structural and textural characteristics of the intrusions being expressed as far as possible. The symbols of main mineral types shall be marked for ore-bearing suites.

⑤ Suite type: referring to the suite name.

⑥ A lithologic association: listing complete petromineralogical names including colors, texture, structures, characteristic minerals, and basic names.

⑦ Isotopic ages: marking isotopic ages and dating methods.

⑧ Mineralized alteration characteristics: briefly describing mineral types as well as main alteration types and their characteristics.

(3) A histogram of a volcanic rock suite: including lithostratigraphic units and characteristics of suite units (codes, histogram/legends, suite types, thickness, lithologic associations, mineralized alteration characteristics, isotopic ages, and volcanic edifices).

① The column "Lithostratigraphic unit": including system, series, group, and formation.

② The column "Suite unit characteristics": describing relevant characteristics by suite units.

③ Code: taking "K_1z^{3d}" (the suite *d* in the third member of Lower Cretaceous Zhangjiakou Formation) as an example. "K_1z" represents the Lower Cretaceous Zhangjiakou Formation, the superscript number "3" represents the member, and the superscript lowercase letter "d" represents the suite (a, b, c, and d denoting different suites). Where the formation is directly divided into suites, the superscript number can be omitted and the suite can be coded "K_1z^{d}". Where there is only one suite in the formation, the suite is coded "K_1z^{a} ". Where there is only one suite in the member, neither the superscript number nor the lowercase letter can be omitted.

④ Histogram/legends: coloring the histogram/legends in accordance with the *Standard and Principle of Coloring in Geological Map* (1∶50 000) (DZ/T 0179-1997), with the patterns and colors of the suite in the histogram/legends being consistent with those in the master map. The eras of the volcanic rocks are expressed with different colors, the lithology and texture of volcanic rocks are expressed with formation patterns, and the symbols of main mineral types shall be marked for ore-bearing suites.

⑤ Suite type: referring to the suite name.

⑥ Thickness (m): the true thickness of the volcanic rock suite, instead of the proportion to the true thickness.

⑦ A lithologic association: listing main lithology, generally not more than three types. It is unnecessary to list the thin interbeds (< 5m) that have no prospecting significance.

⑧ Mineralized alteration characteristics: briefly describing mineral types as well as main alteration types and their characteristics.

⑨ Isotopic ages: marking isotopic ages and dating methods.

⑩ Volcanic edifices: filling in main types of volcanic edifices, such as fissural volcanic edifices, central volcanic edifices, composite volcanic edifices, and dome.

(4) A histogram of a metamorphic rock suite: including geological ages, lithostratigraphic units, suite unit characteristics (suite type, thickness, metamorphic rock suite histogram, and rock associations), isotopic ages and dating methods, mineralized alteration, protolith suites, and metamorphism types.

① Geological ages: including eras and periods.

② Rock mapping units: including groups and formations.

③ The column "Suite unit characteristics": describing relevant characteristics by suite units.

④ Code: expressed with "era + formation". For example, "Ar_3t^c" represents the suite *c* of Late Neoproterozoic Taipingzhuang Formation.

⑤ Histogram/legends: coloring histogram/legends in accordance with the *Standard and Principle of Coloring in Geological Map* (1∶50 000) (DZ/T 0179-1997), with the patterns and colors of the suite in the histogram/legends being consistent with those in the master map. The types of protolith suites are expressed with suite patterns, with the structure and texture characteristics of metamorphic rocks being expressed as far as possible. The formation eras of metamorphic rocks are expressed with different colors. The symbols of main mineral types shall be marked for ore-bearing suites.

⑥ Suite type: referring to the suite name.

⑦ A lithologic association: listing main lithology, generally not more than three types.

⑧ Mineralized alteration characteristics: briefly describing mineral types as well as main alteration types and their characteristics.

⑨ A protolith suite: referring to a rock association of protolith recovered based on the characteristics such as rock associations, petrogeochemistry, and accessory minerals.

⑩ Metamorphism types: mainly including burial metamorphism, regional low-temperature dynamic metamorphism, regional dynamic hydrothermal metamorphism, regional medium-high temperature metamorphism, contact metamorphism, dynamic metamorphism, and ocean-floor metamorphism.

3.2.2 Legends of Structures

Legends of structures are used to express main structural styles in a map sheet, such as deep faults, folds, normal faults, reverse faults, and ductile shear zones.

3.2.3 List of Mineral Deposits

The data items of a mineral deposit include serial number, name, scale, type, and main ore-bearing structures. Among them, the type refers to the type of mineral prediction. Refer to the *Technical Requirement of* 1∶50 000 *Solid Mineral Geological Survey* (DD 2019-02) for details.

3.2.4 Mineralized Alteration

Spotted alternation is expressed with symbols, planner alteration is expressed with spotted symbols along with lines, and ore occurrence (a mineralized point) is expressed with mineral symbols.

3.2.5 Locations of Metallogenic Zones (Belts)

The metallogenic zones (belts) refer to the grade III−IV metallogenic zones (belts) that a survey site belongs to. The classification criteria of grade III metallogenic zones (belts) across China are described in the *Technical Requirements of Research on Important Minerals and Regional Metallogenic Regularity* authored by Chen YC et al. (2010). Grade IV metallogenic zones (belts) are stated in relevant results of provincial mineral resources potential evaluation. Various conservation areas, if any, should be marked in the form of independent map layers. The information such as the location of the map sheet, the locations and names of the main mineral deposits, and important cities shall be marked in the corner maps of the metallogenic zones (belts) in a concise and stratified way. Tables and legend areas should not be additionally set in these corner maps.

3.2.6 Geological Sections

In general, 2−3 geological sections that are perpendicular to the strike of the major structural features of a survey area shall be included. They shall run through typical deposits and as many main mineral localities, main ore-bearing suites, and ore-controlling structures as possible.

3.2.7 Entity Maps of Typical Deposits

The entity maps of typical deposits generally include the entity planes, entity sections, and typical exploration line sections of typical deposits. The legends in the master map should be adopted in these maps.

3.2.8 Map Responsibility Signatures

See Fig. 1 for the position and style of map responsibility signatures. Map signatures include the organization undertaking map preparation, major mapping personnel, person in charge of the organization, project manager, main personnel responsible for map compilation, audit panel, data source, and map compilation date.

3.3 Contents on Maps of Trial Map Sheets

The mineral geological map of Panxin map sheet in Guizhou Province (Liu J et al., 2020): focusing on sedimentary mineralization of Nanhuan manganese deposits; highlighting the characteristics of the suites in uplift areas in the metallogenic system of ancient natural gas and manganese deposits in rift basins, including the suites of leakage-eruption central facies, transitional facies, and marginal facies as well as cap dolomite suites. The palaeogeographical

map of tectonolithofacies is selected as a corner map.

The mineral geological map of Huangzhuguan map sheet in Gansu Province (Jia XX et al., 2020): focusing on sedimentary mineralization. The mineralization of the clastic sedimentary exhalative (SEDEX) deposits in the map sheet is limited to the faulted−artesian basins controlled by syngenetic faults, and thus the Devonian sedimentary facies is presented as a priority. The palaeogeography map of lithofacies is selected as a corner map. In addition, the mineralization involves postmagmatic hydrothermal transformation, and thus the newly added structural outline corner map is of great significance for the final positioning of the minerals formed from transformation.

The mineral geological map of Huaniushan map sheet in Gansu Province (Wang CN et al., 2019): focusing on magmatic mineralization. The mineralization in this map sheet is closely related to Triassic syenogranite and thus the characteristics of granite suites are highlighted. The lithologic and lithofacies structural map of intrusions is selected as a corner map.

The mineral geological map of Bazang map sheet in Gansu Province (He JZ et al., 2020): focusing on magmatic-hydrothermal process. The deposits formed in this map sheet mainly include medium-low temperature hydrothermal deposits and low-temperature telethermal deposits. Most of them have concealed ore-forming rock masses but their ore-hosting sedimentary suites show the characteristics of Si-Ca associations. Therefore, the characteristics of calcified and silicified alteration are mainly presented in the master map. Meanwhile, the comprehensive lithologic structural map is selected as a corner map.

The mineral geological map of Hongshi map sheet in Xinjiang (Wang FF et al., 2020): focusing on volcanic mineralization. The deposits formed in this map sheet mainly include marine volcanic exhalative sedimentary deposits and continental subvolcanic hydrothermal deposits. Therefore, the contents on the mineral geological map mainly include volcanic edifices; the associated fractures, subvolcanic rocks, and associated volcanic formations of the volcanic edifices, and the contact interfaces between subvolcanic rocks and sedimentary rocks. The lithologic and lithofacies structural map of the volcanic rocks is selected as a corner map.

The mineral geological map of Shiren Town map sheet in Jilin (Wang HJ et al., 2020): focusing on metamorphic mineralization of all parts where Archean amphibolite suite and the brecciaous dolomitic marble suite of Laoling Group contact with Qingbaikouan quartz sandstone suite. The regional metamorphic suite-tectonic map is selected as a corner map.

3.4 Cautions for Map Compilation

(1) The suites that are related to mineralization and less than 50 m wide shall be presented by amplification.

(2) For sedimentary rock suites and metamorphic rock suites, the strike of suite patterns shall be consistent with the change of suite boundaries and the pattern colors shall not hide the suite boundaries. Alternating layer suites and flysch suites are expressed in the form of alternative presentation of their lithologic layers.

(3) Interbeds shall be expressed with different lithologic patterns plotted between the

patterns of main lithologic suites.

(4) In the case of areas related to volcanic mineralization, the crater range shall be plotted.

(5) In the case of contact metamorphic rocks, the contact metamorphic belts shall be delineated using points and lines. Meanwhile, the dynamometamorphic rocks shall be delineated synchronously with faults.

(6) The dikes that are confirmed to be irrelevant to mineralization may not be presented.

4 Database Building

Database building mainly involves map layers (Table 1) and databases.

The data tables mainly include:

(1) Data table of suite-tectonic map layer (Table 2).

(2) Data table of geological boundaries (Table 3).

(3) Data table of structural deformation zones (Table 4).

Table 1 Data table of map layer information

Map layer no. and name		Specific map layer name	Spatial characteristics	Data table	Remarks
1	Geographic map layer	Map layer of major administrative boundaries/borders	Line	None	Directly referring to the background layer of the digital mapping system
		Map layer of major residential areas	Point	None	
		Map layer of major planar streams	Polygon	None	
		Map layer of major linear streams	Line	None	
		Map layer of major geographical annotations	Point	None	
2	Suite-tectonic map layer	Suite-tectonic map layer	Polygon	Available	Prepared based on geological polygon entity file (_GeoPolygon.wp)
		Geological (boundary) line	Line	Available	Prepared based on geological line entity file (_GeoLine.wl)
		Tectonic deformation zone map layer	Polygon	Available	Prepared based on (_TECOZONE.wp)
		Fold map layer	Line	Available	(_FOLD.wt) is newly added
		Fault map layer	Line	Available	Correlating attributes according to _FAULT after extracting faults from geological boundaries
		Attitude element map layer	Point	Available	Referring to the map layer _ATTITUDE.wt
		Map layer of important boreholes	Point	Available	Referring to the map layer _DRILLHOLE.wt
		Fossil sampling point layer	Point	Available	Referring to the map layer _FOSSIL.wt
		Isotopic age layer	Point	Available	Referring to the map layer _ISOTOPE.wt
3	Mineral map layer		Point	Available	Referring to the map layer _MINERAL_PNT.wt

Continued table 1

Map layer no. and name		Specific map layer name		Spatial characteristics	Data table	Remarks
4	Decoration map layer	Decorations inside the master map	Geological annotation and suite pattern	Point	None	Compiling formation patterns based on a_GEOPOLYGON.wt layer
			Leader line	Line	None	a_GEOPOLYGON.wl
			Dip, dip angle, and property of a fault	Point	None	a_GEOLINE.wt
			Dip angle of occurrence	Point	None	a_ATTITUDE.wt
			Isotope annotation	Point	None	a_ISOTOPE.wt
			Cross-section	Line and point	None	a_PROFILE.wla_PROFILE.wt
			Kilometer grid	Line	None	FRAME.wl
		Decorations outside the master map	Index map	Point, line, and polygon	None	MAP_SHEET.wtMAP_SHEET.wlMAP_SHEET.wp
			Legend	Point, line, and polygon	None	LEGEND.wtLEGEND.wlLEGEND.wp
			Suite histogram	Point, line, and polygon	None	COLUMNAR_SECTION.wt COLUMNAR_SECTION.wl COLUMNAR_SECTION.wp
			Cross-section	Point, line, and polygon	None	CUTTING_PROFILE.wtCUTTING_PROFILE.wlCUTTING_PROFILE.wp
			Typical mining area map	Point, line, and polygon	None	TYPICALDEPOSITS.wtTYPICALDEPOSITS.wlTYPICALDEPOSITS.wp
			Duty table	Points	None	DUTY_TABLE.wt
			Others	Point, line, and polygon	None	Map title, scale, kilometer grid annotation, logo of the China Geological Survey, etc.OTHERMODIFY.wtOTHERMODIFY.wlOTHERMODIFY.wp

(4) Data table of faults (Table 5).

(5) Data table of folds (Table 6).

(6) Data table of fossil sampling points (Table 7).

(7) Data table of isotopic ages (Table 8).

(8) Data table of attitude features (Table 9).

(9) Data table of important boreholes (Table 10).

(10) Data table of mineral deposits

① Adopting trinity expression (mineral type, scale, and type of mineral deposits). It is suggested to use 1∶250 000 mineral resource potential evaluation sub-map and make supplementation in existing system database.

②Attribute structure: referring to the digital mapping results of _MINERAL_PNT.wt.

③Data table of mineral deposit map layer (Table 11).

Table 2 Data table of suite-tectonic map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/initial value	Value range	Description
ID of a geological polygon entity	*Feature_Id	Character	20		NOTNULL			
Original ID	Source_Id	Character	30		0			
Type code of a geological polygon entity (geological code)	*Feature_Type	Character	30		M			Referring to the attributes of geological polygon entities (_GEOPOLYGON.wp)
Name of a geological polygon entity	Geobody_Name	Character	50		M			
Era of a geological polygon entity	Geobody_Era	Character	20		M			
Suite category	Formation	Character	10		M			Filling in suite categories such as sedimentary rock suite, intrusive rock suite, volcanic rock suite, or metamorphic rock suite (in Chinese characters)
Suite type	Metallogenic	Character	60		M			Filling in the suite type corresponding to the suite category (name in Chinese)
Lithologic association	Combination	Character	100		M			Filling in natural paragenetic associations of rocks (name in Chinese)
Geotectonic environment	Structural_Env	Character	100		M			Filling in the name of the geotectonic unit (name in Chinese)
Lower age limit of a geological polygon entity	Geobody_Age1	Double	10.2		O			Referring to the attributes of geological polygon entities (_GEOPOLYGON.wp)
Upper age limit of a geological polygon entity	Geobody_Age2	Double	10.2		O			
Subtype ID	Subtype	Integer	4		O			

Table 3 Data table of geological boundary map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Original ID	Source_Id	Character	30		O			
Geological boundary (contact) code	*Feature_Type	Character	30		M			
Geological boundary type	Boundary_Name	Character	50		M			
Code of the geologic block on the left side of a boundary	Left_Boundary_Code	Character	30		M			Referring to the attributes of geological (boundaries) lines (_GeoLine.wl)
Code of the geologic block on the right side of a boundary	Right_Boundary_Code	Character	30		M			
Interface strike	Strike	Integer	3		O			
Interface dip	Dip_Direction	Integer	3		O			
Interface dip angle	Dip_Angle	Integer	2		O			
Subtype ID	Subtype	Integer	4		O			

Table 4 Data table of structural deformation zone map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Original ID	Source_Id	Character30		O				
Deformation zone code	*Feature_Type	Character	30		M			
Deformation zone name	Deformation_Name	Character	60		M			
Rock name of a deformation zone	Defor_Rockname	Character	60		M			
Fabric characteristics of a deformation zone	Fabric_Character	Character	250		M			Referring to the attributes of (_TECOZONE.wp)
Mechanical characteristics of deformation	Mechanics	Character	250		M			
Formation era	Ear	Character	100		M			
Active stage	Movement_Period	Character	200		M			
Ore-bearing features	Commodities	Character	120		O			
Subtype ID	Subtype	Integer	4		O			

Table 5 Data table of fault map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/Initial value	Value range	Description
Feature type code	*Feature_Type	Character	30		NOTNULL			
Fault type (geological code)	Fault_Type	Character	30		M			
Fault name	Fault_Name	Character	80		M			
Fault code	Fault_Code	Character	30		M			
Fault characteristics	Fault_Character	Character	250		M			
Codes of geologic blocks on the hanging wall of a fault	Fault_Up_Body	Character	30		M			
Code of geologic blocks on the foot wall of a fault	Fault_Bottom_Body	Character	30		M			Referring to the attributes of the data table _FAULT
Width of a fault fracture zone	Fault_Wide	Character	80		O			
Fault strike	Fault_Strike	Integer	3		O			
Fault dip	Fault_Dip	Integer	3		O			
Fault dip angle	Fault_Dip_Angle	Integer	2		O			
Estimated fault throw	Fault_Distance	Float	10.2		M			
Formation era	Era	Character	30		O			
Active stage	Movement_Period	Character	100		O			
Subtype ID	Subtype	Integer	4		O			

Table 6 Data table of fold map layer

Serial no.	Date item	Code	Data type	Storage length	Decimal digits	Constraint	Default value/ initial value	Value range	Unit	Stipulation of filling	Definition or description of data item
1	Primitive code	CHFCAC	C	6		NOTNULL				Filling with the decimal numbers in order, starting from "000001"	Primitive codes are keywords linking graphics and attributes in spatial database (not summarized). Therefore, it must be consistent between graphics and attributes and coded according to sequence codes. They are mainly used at a provincial level.
2	Fold name	GZCAB	C	40		O				Filling in universal fold name	Filling in the Chinese name of a fold in a map sheet
3	Fold type	GZCE	C	20		M				Filling in fold type	Folds are roughly classified into anticlines, synclines, inverted folds, recumbent folds, and plunging folds according to their morphology(sourced from subordinate word volume GZCE of potential evaluation data items)
4	Fold morphology	GZCDD	C	20		O				Filling in fold morphology	Filling in the fold morphology such as long axis, short axis, and ovate(sourced from subordinate word volume GZCD of potential evaluation data items)
5	Fold hinge plunge direction	GZCCBE	C	7		O			Degree (°)	Filling in the plunge direction of a fold hinge	
6	Fold hinge plunge angle	GZCCBF	C	5		O			Degree (°)	Filling in the dip angle of a fold hinge	
7	Axial plane dip	GZCCAE	C	7		O			Degree (°)	Filling in the dip of a fold axial plane	
8	Axial plane dip angle	GZCCAF	C	5		O			Degree (°)	Filling in the dip angle of a fold axial plane	
9	Strata involved in a fold	GZCFA	C	20		O				Filling in the era, lithology, and metamorphic degree of strata	
10	Formation era	GZEKG	C	15		M				Filling formation era of a fold	Judging the formation era of a fold according to the involved strata and the relationship between the involved strata and other structures

Table 7 Data table of fossil sampling points

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/ Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Original code	Source_Id	Character	30		O			
Fossil sample ID	Sample_Code	Character	20		O			
Biological category	*Feature_Type	Character	50		M			
Fossil genus or species	Genus_Species	Character	50		M			Referring to the attributes of _FOSSIL.wt
Fossil horizon	Bed	Character	50		M			
Code of fossil-bearing stratigraphic unit	Lithostrat_Unit	Character	20		M			
Fossil era	Era	Character	40		M			
Subtype ID	Subtype	Integer	4		O			

Table 8 Data table of isotopic age map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/ Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Original code	Source_Id	Character	30		O			
Sample code	Sample_Code	Character	30		M			
Sample name	Sample_Name	Character	50		M			
Dating method	Measuring_Kinds	Character	60		M			Referring to the attributes of _ISOTOPE.wt
Dated age	Age	Character	100		M			
Dated geologic block unit and code	Geobody_Code	Character	30		M			
Dating organization	Unit	Character	50		M			
Dating date	Date	Character	8		YYYYMMDD			
Subtype ID	Subtype	Integer	4		O			

Table 9 Data table of attitude feature map sheet

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/ Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Source code	Source_Id	Character	30		O			
Attitude type code	*Feature_Type	Character	30		M			
Attitude type name	Attitude_Name	Character	40		M			Referring to the attributes of _ATTITUDE.wt
Strike	Strike	Integer	3		M			
Dip direction	Dip_Direction	Integer	3		M			
Dip angle	Dip_Angle	Integer	2		M			
Subtype ID	Subtype	Integer	4		O			

Table 10 Data table of important borehole map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/ Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Original code	Source_Id	Character	30		O			
Borehole code	Zk_Code	Character	30		M			
Borehole depth	Zk_Depth	Float	10.2		M			
Borehole depth in bedrock or target stratum	Rock_Depth	Float	10.2		M			
Lithology of bedrock or target stratum	Rock_Type	Character	200		O			Referring to the attributes of (_Drillhole)
Era of bedrock or target stratum	Base_Bed_Era	Character	50		O			
Era of loose sediment layer	Loose_Lay_Era	Character	30		O			
Thickness of loose sediments	Loose_Lay_Thickness	Float	10.2		O			
Lithology of loose sediments	Loose_Lay_Lithology	Character	255		O			
Subtype ID	Subtype	Integer	4		O			

Primary key name: Feature_Id; Index key name: Zk_Code

Table 11 Data table of mineral deposit map layer

Data item	Standard code	Data type	Storage length	Display length	Constraint	Default value/ Initial value	Value range	Description
Feature ID	*Feature_Id	Character	20		NOTNULL			
Source code	Source_Id	Character	30		O			
Mineral type code	*Feature_Type	Character	50		M			
Mineral type name	Commodities_Name	Character	60		M			
Paragenetic ore	Paragenic_Ore	Character	100		M			
Associated ore	Associated_Ore	Character	80		M			
Mineral deposit number	Ore_Sums	Integer	3		O			Referring to the attributes of _MINERAL_PNT.WT
Ore grade	Ore_Grade	Character	100		M			
Deposit scale	Deposite_Size	Character	100		M			
Metallogenetic epoch	Metallogenetic_Epoch	Character	30		M			
Name of mineral deposit	Placename	Character	60		M			
Mineralization type	Genesis_Types	Character	200		O			
Genesis type	Industrial_Types	Character	200		O			
Subtype ID	1 SUBTYPE	Integer	4		O			

5 Conclusions

(1) The mineral geological maps are prepared by mapping along with map compilation based on the philosophy of "inheritance, development, reform, and innovation." This aim to innovate the presentation of the contents on a map surface, highlight the main metallogenic geologic blocks, metallogenic structures and structural planes, characteristics and indicators of mineralization, and comprehensively and objectively express the characteristics of mineralization and geological prospecting. This serves as a guide for a new round of mineral geological survey and prospecting prediction projects initiated by the China Geological Survey.

(2) Corner maps play a more prominent role in interpreting the master map. They comprehensively reflect the types, eras and characteristics of ore-bearing suites in a map sheet. The map series of typical deposits provide scientific bases for further prospecting.

(3) Objective, scientific, and reasonable mineral geological maps and detailed spatial data provide support for the preparation of metallogenic regularity maps, mineral prediction maps, and comprehensive information maps of resources and environment and provide basic information for regional prospecting prediction.

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