Application of High-Precision Magnetic Method in Geological Mapping of Shallow Coverage Area in Inner Mongolia

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ABSTRACT

To meet the needs of the national economy, a new round of special geological mapping has been in full swing. Compared to in bedrock area, geological mapping in shallow coverage area is more dependent on the methods of geophysical and geochemical exploration. High-precision magnetic measurement is a relatively economical and applicable method. This article combined with the project “1:50000 mapping pilot in shallow coverage area of desert grassland in Central and Eastern Inner Mongolia”, in turn discussed the advantages and disadvantages of high-precision magnetic measurement in the project, aimed to share the experience of mapping.

INTRODUCTION

For geological survey in shallow coverage area, the traditional methods [4][5][6][10][16][17], such as route geological survey, section geological survey, large scale geological survey and so on, have been unable to collect the necessary field geological material (rock characteristics, rock assemblage characteristics, spatial distribution status and so on). To complete the task of
geological survey in shallow coverage area, it must be supported by geophysical exploration[1], geochemical exploration[13][15][18][19], drilling exploration[8], remote sensing[7][21] and other methods. In this paper, we analyzed the role of high-precision magnetic measurement in geological mapping of shallow coverage area in Inner Mongolia, with the aim of sharing the experience of mapping.

REGIONAL GEOLOGICAL BACKGROUND

The study area is located in the north and south splicing, suture zone (south) of the Siberian plate and the North China plate and in west of the Pacific plate[12][14][20] (Figure1). The ore-forming geological background and metallogenic geological conditions in the study area are advantageous and have very good prospecting potential.

![Tectonic location and regional geological map of the study area](image)

Figure1. Tectonic location and regional geological map of the study area (according to geological map of 1:200,000)
1-Holocene, 2-Pleistocene, 3-Paleogene, 4-Cretaceous, 5-Jurassic, 6-Triassic, 7-Permian, 8-Carboniferous, 9-Silurian, 10-Ordovician, 11-Precambrian, 12-Chalk Jurassic granitic porphyry, 13-Jurassic granitic porphyry, 14-Jurassic granite, 15-Jurassic granodiorite, 16-Permian granodiorite, 17-Geographical location.
The stratum exposed in the study area from old to new is: the oldest stratum is ordocivian, which is composed of marble inclusion schist and intermediate-basic pyroclastic rocks. Silurian is a set of intermediate-acid pyroclastic rocks intercalated with intermediate intrusive rocks. The rocks are generally metamorphic and strongly deformed. Permian is dominated by intermediate-basic pyroclastic rocks and contains a small amount of sedimentary pyroclastic rocks. Jurassic is composed of two set of rocks, which are intermediate and intermediate-acid pyroclastic rocks. Cenozoic era is composed of vast loose deposits, and its distribution area is the 2/3 largest in the study area.

Intrusive rocks in the study area are mainly composed of two stage magmatic rocks: the Permian granodiorite, mainly distributed in the eastern part of the study area, was not observed contact with other mapping units, presumably intruded into the Silurian and Permian, and was covered by Quaternary. The Jurassic granite distributed in the central and western part of the study area, intruded into the Permian granodiorite and Jurassic, maybe intruded into Silurian and covered by Quaternary.

In the study area, these linear structure, whose obvious characteristics are strike near west-east and north-east[14], mostly are blind fault. Comparatively, the characteristics of those near north-west are not obvious. There is volcanic mechanism with caldera in Permian and Jurassic[9;2]; Silurian widely have penetrative cleavage, whose characteristics are strike near west-east, maybe associated with dynamic metamorphism.

INTERPRETATION OF HIGH-PRECISION MAGNETIC MEASUREMENT ABNORMAL MAP

After collected and analyzed the results of 1:5 million scale mineral survey of Inner Mongolia Geological Engineering Co., Ltd and 1:5 million scale area high-precision magnetic measurement of Inner Mongolia Tenth Geological Mineral Exploration and Development Co., Ltd. (Figure 1c), magnetic anomaly characteristics are as follows: the quiet low value field indicates the distribution of Silurian metamorphic rocks and Cretaceous sedimentary rocks; the wave field indicates the distribution of Permian and Jurassic volcanic rocks and their intrusive rocks.

APPLICATION

Blind Intrusive Rocks Area

The northern part of the study area is covered by a large area of Aeolian sand, surface geological survey has been unable to carry out normal work, drilling tools[8] do not have the conditions of construction (large, medium and small vehicle
mechanical equipment can not enter the Aeolian desert area, feed water and other required supplement of construction not local materials. The use of special means to enter the cost is huge). Therefore, high-precision magnetic principle highlights its advantages.

What we can see in Figure 1d is as follows: The M&N two points in ΔT contour map (upper left) are very similar at the magnetic anomaly characteristics, presumably for the same lithological characteristics, but it is not known its spatial distribution; In geological map (upper right) are covered by aeolian sand, and the lithology of M point can be considered as the Permian granodiorite. In remote sensing interpretation map (lower left) can not determine its lithological characteristics, but according to the regional characteristics can determine that they are located in both sides of the north-west strike slip fault, whose strike slip distance is about 10km. In other words, two points should be in the same position before the fault activity; Bedrock geological map (lower right) is a combination of the above three kinds of picture content, through assumption get the bed rock after stripped off the Quaternary. We can get that the lithology of the M,N two points both are the Permian granodiorite, the intrusive outline can be roughly circled with the magnetic anomaly characteristics, and two points moved at a distance of 10km by the north-west strike slip fault.

Figure 1c. Plot of ΔT contour in study area
1- quoted from Inner Mongolia Geological Engineering Co., Ltd. 1: 5 million mine transfer results, 2- Inner Mongolia tenth geological and mineral exploration and development limited liability company 1: 50000 area of high precision magnetic measurement results.
Volcanic Rock Area (Volcanic Mechanism)

The aeolian loess coverage area is very vast in the study area. There is only a small area distributed intermediate volcanic rock near SiLeng mountain, as shown in Figure 1e. Compared ΔT contour map (left) with geological map (middle), the results of high-precision magnetic measurement show a large amount of bedrock lithology information, overall show that magnetic field intensity had a little fluctuation range and distributed jumping and disorderly. Though the comprehensive analysis and summary of the block in ΔT contour map and geological map, can get bedrock geological map of e block after stripped off the Quaternary.

It can be seen from Figure 1e, the oldest basement is Ordovician (the main lithology is marble and intermediate-basic volcanic rock). During the Mesozoic
period, the Pacific plate rotationally extruded westward, there developed a large number of intermediate-basic volcanic rock. The e block is characterized by the development of intermediate volcanic rock covering the Ordovician with angular unconformity. Early Cretaceous, a large number of granite intruded from Northwest. The early Cretaceous granite and the Jurassic andesitic breccias tuff are intrusive contact.

**Course Clastic Rock Area**

In the southwest corner of the study area, there are a small amount bedrock outcrops of the Cretaceous Jiufotang Formation[11], whose lithology is gray-green tuffaceous sandstone, sandstone-conglomerate and shale. The Cretaceous Jiufotang Formation and the Silurian Badangshan Formation were covered by the Pleistocene loess, as shown in Figure 1f.

In ΔT contour map (left), the results of high-precision magnetic measurement show more information of bedrock lithology, overall show that magnetic field intensity had a little fluctuation range and distributed disorderly. Compared with the geological map can see that there is no greater correlation; and compared with the bedrock geological map, there is no law to follow.

It can be seen from Figure 1f and Figure 2 that the Permian Elitu Formation is covered above the Silurian and the Cretaceous Jiufotang Formation overlies on the Permian and the Silurian with angular unconformity. A set of irregularly distributed conglomerate, whose gravel components is andesite, in the base of the Cretaceous Jiufotang Formation.

According to Figure 1f and Figure 2, it is considered that the applying of high-precision magnetic measurement is not effective in sedimentary rock area, especially in coarse clastic rock area. Mainly because the results of the high-precision magnetic measurement reflect the lithological and magnetic characteristics of clastic bedrock, rather than the geological characteristics (or hypothetical magnetic characteristics) of the clastic rock itself.

![ΔT contour map (left), geological map (middle), bedrock geological map (right)](image)

(Cited from the stage results of eastern Inner Mongolia desert grassland shallow coverage area 1: 50000 mapping pilot).
CONCLUSIONS

In shallow coverage area of desert grassland in Central and Eastern Inner Mongolia, high-precision magnetic measurement method has the following characteristics:

I. In the intrusive rock mapping area (especially the blind concealed intrusive body area), it is effective in directing geological mapping.

II. In the volcanic rock mapping area (especially volcanic mechanism area), it can plays an important role in indication.

III. In the clastic rock mapping area (especially the coarse clastic rock area), its guidance of geological mapping is ineffective.

REFERENCES


