Simple analysis the Characteristics of Petrography and Principal element zone of Hadamengou Gold Deposit, Inner Mongolia

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Abstract. The petrographic study of the piedmont potassic belt indicates that the rocks in the piedmont potassic belt of Hadamengou gold deposit are mainly composed of potassic feldspar, plagioclase and quartz, which are distributed in a scattered form, and the rock fragmentation structure is widely developed. The study of element geochemistry and other aspects shows that the rocks in the piedmont potassified zone are mainly composed of potassium feldspar, plagioclase and quartz, followed by a small amount of sericite, epidote and kaolin. The main elements mainly contain high K₂O and low Na₂O, and the K₂O/Na₂O ratio is higher than 2, all of which belong to the hyperpotassium series rocks.

1. Introduction
The piedmont potassic belt refers to the brick-red vein geologic body occurring in the tectonic platform, and potassic is one of the alteration types most closely related to the mineralization of Hadamengou gold deposit [1]. The ore bodies mainly occur in the kali-feldspathic alteration rocks, or in the quartz vein at the center of the kali-feldspathic alteration rocks, and the veins are densely distributed, but none of them cross the piedmont potassic belt [2]. The piedmont potassic belt is closely related to ore veins, so this paper studies the piedmont potassic belt in hadamengou gold ore area in terms of petrography and geochemistry, discusses the relationship between the trace elements and rare earth elements in the potassic belt and the alteration of potassic, and gets some new understanding of the piedmont potassic belt. The brick red potassium alteration makes the Hadamengou deposit a unique type of gold deposit. Therefore, a detailed study of the Hadamengou piedmont potassium belt will provide more scientific basis and theoretical support for further discussion of the relationship between the Hadamengou piedmont potassium belt and ore veins.

2. Geological survey
Hadamengou gold deposit is located 15km west of Baotou City, Inner Mongolia, starting from Meigengou in the west and reaching Hadamengou in the east, and bounded by Wulashan mountain front fault in the south. The ore belt is 20km in length from east to west and 6km in width from north to south [3,4], tectonically located in the middle section of Yinshan uplift in the west section of North China platform margin and the middle section of Inner Mongolia axis. The strata in the area are mainly composed of the Neoarchaean Wulashan Group, Paleoproterozoic Sertenshan Group and
Middle Proterozoic Jaertai Group metamorphic rocks, and the main rock types are amphibolitic plagioclase gneiss, plagioclase amphibolite, neoglass gneiss, neoglass plagioclase gneiss and so on. The structure in the area is complex, and the fold and fault structures are well developed. The Wulashan anticline is distributed in an east-west direction, and the mining area is located in the core of the compound reversed anticline. There are two main faults: the first is the piedmont fault (Baotou-Hohhot fault), the overall trend of which turns from east-west to NE-direction; The second is the Houshan fault (Linhe-Jining fault), trending NEE.

3. Characteristics of piedmont potassium zone

3.1. Geological characteristics
Hadamengou gold deposit in Inner Mongolia is an area where potassic feldspathic alteration is very developed. The field survey found that the rocks in the potassified zone were red and maroon on the whole and distributed in a zonal pattern along the faults, with a length of up to 7-8km and a width of about 10m. The trend of potassified belt is nearly EW, which is basically the same as that of the northern vein, and shows a small Angle intersection trend with the vein in the east of the mining area [5]. The piedmont potassified zone is nearly vertical in surface occurrence, and its Angle gradually slows down as it extends deeper, and the whole zone dips northward. However, the occurrence of the vein is opposite to that of the potassified belt, showing the characteristics of a southward dip. The piedmontane potassified belt meets the vein in depth, and the vein is cut off in the middle of the piedmontane by extending deeper [3]. The overall fragmentation of the potassium zone is strong, with common pegmatitic masses and residual gynrite. The veinule specularite is relatively developed, with a vein width of a few millimeters, basically consistent with the occurrence of the main vein body.

3.2. Geological characteristics
Inner Mongolia hadad gate ditch potassium piedmont belt of rock is mainly composed of potassium feldspar, plagioclase, quartz (Fig. 1a), the second contains a small amount of sericite, epidote, kaolin, etc; Potassium feldspar granularity is coarse, semi-idiomorphoid - other-shaped granular, the size is generally 1-2mm, a small part of 0.2-1mm (fine), part of 2-4mm (middle), disorderly distribution, fresh and clean surface, common lattice twin-crystal, sodium stripes (Figure 1E); The granularity of plagioclase is slightly smaller than that of potassium feldspar, presenting an idiomorphic plate-shaped or semi-idiomorphic other-shaped granular appearance and scattered distribution. It is common to have lamellar twin-crystal and sodium carbonate composite twin-crystal (Fig. 1b, Fig. 1D), and is often metasomized by potassium feldspar, partially presenting as pseudomorphic (Fig. 1e). Quartz particle size is generally between 0.2-0.5mm, some of which can reach 0.5-1mm, and only a small amount of which is between 0.1-0.2mm. It is usually scattered and interstitial, with obvious wavy extinction (Fig. 1b). The biotite illusion appears in the rock sample, which is metasomatism formed by chlorite, sericite, potassium feldspar or iron. The diameter is about 0.2-0.5mm, and some parts are 0.1-0.2mm, with a scattered distribution (Fig. 1C). In addition, rock fragmentation structures are widely developed (Fig. 1f). According to the petrological and mineralogical appraisal, the protolith of this potassic zone may be quartz syenite or quartz monzonite diorite, which is destroyed by tectonic movement, resulting in strong cataclastic fracture, and formed by hydrothermal alteration in the later period.
3.3. Geological characteristics

The analysis data of major elements of rock samples from the piedmont potassified zone of Hadamen Valley are listed in Table 1. Contain SiO$_2$, Al$_2$O$_3$, CaO, Fe$_2$O$_3$, FeO, K$_2$O, MgO, MnO, Na$_2$O, P$_2$O$_5$, TiO$_2$, CO$_2$, H$_2$O, and so on. K$_2$O content is 9.73-15.07%, with an average of 12.39%; Na$_2$O content was 0.20-1.26%, with an average value of 0.47%; Fe$_2$O$_3$ content is 2.24-8.88%, with an average of 4.97%; The content of Al$_2$O$_3$ is 12.64-16.56%, with an average of 14.42%.

| Sample No. | HD01   | HD02   | HD04   | HD06   | HD08   | HD10   | HD11   | Average |
|------------|--------|--------|--------|--------|--------|--------|--------|---------|
| SiO$_2$    | 59.09  | 68.85  | 56.75  | 53.24  | 54.58  | 55.32  | 58.55  | 58.05   |
| Al$_2$O$_3$| 13.54  | 12.64  | 13.32  | 13.84  | 15.43  | 15.62  | 16.56  | 14.42   |
| CaO        | 3.74   | 1.71   | 5.47   | 4.54   | 5.39   | 5.98   | 0.16   | 3.86    |
| Fe$_2$O$_3$| 5.66   | 2.51   | 5.25   | 8.88   | 3.44   | 2.24   | 6.79   | 4.97    |
| FeO        | 0.22   | 0.43   | 0.32   | 0.50   | 0.32   | 0.41   | 0.29   | 0.36    |
K₂O  12.29  10.37  11.46  9.73  13.67  14.13  15.07  12.39  
MgO  0.08  0.09  0.15  0.36  0.20  0.17  0.06  0.16  
MnO  0.14  0.10  0.10  0.43  0.09  0.13  0.08  0.47  
Na₂O 0.20  0.79  0.30  1.26  0.25  0.23  0.24  0.09  
P₂O₅ 0.45  0.11  0.44  0.80  0.75  0.15  0.05  0.39  
TiO₂ 0.78  0.12  0.88  1.37  0.90  0.08  0.70  0.69  
LOI  3.56  1.92  5.05  4.58  4.48  5.31  1.34  3.75  
Total 99.75  99.64  99.49  99.20  99.50  99.69  99.89  99.59  
K₂O/Na₂O 61.45  13.13  38.20  54.68  61.43  62.79  42.77  
SiO₂/Al₂O₃ 4.36  5.45  4.26  3.85  3.54  3.54  4.08  
Al₂O₃/Fe₂O₃ 2.39  5.04  2.54  1.56  4.49  6.97  2.44  3.63  
K₂O/Al₂O₃ 0.91  0.82  0.86  0.70  0.89  0.90  0.91  0.86  

In general, the samples studied have a high K₂O content (9.73-15.07%) and a relatively low Na₂O content (0.20-1.26%), and the K₂O/Na₂O ratio of the samples is higher than 2, all of which are superpotassic series rocks. By Foley (1987) [6] for super potassic rock CaO-SiO₂ classification diagram, the study of the samples between I classes and class III (figure 4), higher K₂O/Al₂O₃ ratio (0.70-0.91) showed I class of potassic rock characteristics, but are generally lower content of TiO₂ (table 1), indicate that they should belong to III class super potassic rock, so the samples have I ultra high potassic rock K₂O/Al₂O₃ ratio and III ultra low potassic rock characteristics of TiO₂ content [7]. With the increase of K₂O content in this sample, the corresponding Al₂O₃ content increased gradually, showing a positive linear correlation, while the SiO₂ content did not change regularly (Fig. 3a and Fig. 3b).The ratio of SiO₂/Al₂O₃ in the 7 samples is less than 5 except HD02, which indicates that the degree of desilication and enrichment of aluminum in the brick red potassium zone is relatively large. The ratio of Al₂O₃/Fe₂O₃ ranges from 1.56 to 6.97, indicating that the piedmont potassified zone has a strong ability of desilication and aluminum enrichment.

Fig 2. Classification diagram of CaO-SiO₂
Fig 3. The covariant relationship of major elements of piedmont potassic alteration zone, Inner Mongolia

4. Discuss
Hadamengou gold deposit in Inner Mongolia is a part of Wulashan gold field, which is a super-large gold field characterized by extensive potassium feldspar mineralization\(^3\). The most characteristic of the mining area is the brick-red piedmont potassified zone. In the front part of this paper, some characteristics of the potassified zone, including the location of production, the overall trend of the potassified zone, the extension and width of the potassified zone, have been introduced in detail. On the profile, the potassified zone is nearly upright in occurrence, gradually slows down in depth, and dips northward as a whole. At depth, it meets with the ore veins and cuts them off\(^3\). So the potassified zone is closely related to the formation of ore veins.

Potassium is rich in potassium fluid metasomatism of rock, piedmont geochemical characteristics of potassium belt is extremely obvious, with containing high K content and distinguish other geological mining area, and shows that it has the rich supply of potassium to pledge, the mine of birch back rock mass stretch at the bottom of the mining area, a huge rock branches may reflect the potassium to pledge from the radiant back rock mass related hydrothermal activity. Potassium belt through petrography observation in this area is obviously formed from the original rock crushing, alteration, and through the predecessors' work, found that potassium belt is overall and northern veins direction are consistent, and in the deep vein and the trend of the intersection, generally control the distribution of the vein, potassium metasomatism can be divided into two categories, diagenesis and potassic alteration metasomatic, though, these two kinds of situation is favorable for mineralization, but potassic hydrothermal alteration rock more mineralization and prospecting significance, therefore, that potassium piedmont belt for potassic hydrothermal alteration rock.

Effect of cycle times on mechanical properties of Ni-Ti alloy wire: In order to understand the mechanical properties of the wire under cyclic loading, the two types of alloy wire were tested under cyclic loading with equal strain amplitude, respectively. The strain amplitude was set at 2%, 3% and 5%. In order to make an effective comparison, the hysteretic curves of smooth alloy wire and stranded wire with strain amplitude of 5% are selected for comparison (as shown in figure 6).

As can be seen from FIG. 2.7, the hysteretic curve of the two kinds of silk gradually becomes smooth as the number of cycles increases. The upper yield platform of the two shape memory alloy wires is basically unchanged after the number of cycles exceeds 20, while the lower yield platform has been stabilized after the number of cycles exceeds 5, and the smooth ni-ti alloy wire is higher than the lower yield platform of the ni-ti alloy wires. For the ni-ti alloy stranded wire, when the strain is less than 0.5%, the stress increase is not obvious, while the smooth ni-ti alloy wire does not appear such
phenomenon. The reason is that there is a certain gap between the single wires that make up the ni-ti stranded wire, and the initial strain results in the error of the initial strain.

5. conclusion
The petrographic analysis of the potassified belt in Hadamengou Mountain shows that the rocks in the potassified belt are mainly composed of potassified feldspar, plagioclase and quartz. The minerals are mostly semi-idiomorphic and heteromorphic, and the potassified feldspar is often metasomatic plagioclase to form a pseudomorphic appearance. The rock fragmentation is intense, and the fractures are filled with minerals such as calcite, which reflects that the rock has gone through the process of fragmentation and alteration.

The content of K$_2$O is high (9.73-15.07%) and the content of Na$_2$O is low in the potassium zone, which is characterized by a series of superpotassium rocks. With the increase of K$_2$O content, the content of Al$_2$O$_3$ and SiO$_2$ showed a positive linear correlation, indicating that the content of Al$_2$O$_3$ and SiO$_2$ in the potassification zone increased with the increase of potassification intensity.

In summary, it is considered that the piedmont potassium mineralization zone in Hadamenggou gold deposit in Inner Mongolia is a fault formed by tectonic movement, and then the potassium metamorphic fluid moves up along the structural weak zone and is formed by alteration.

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