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The characteristics of geological and altered rocks of Caijiaying Pb-Zn-Ag ore deposit

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Abstract: The Caijiaying Pb-Zn-Ag ore deposit locates at the northwest of Hebei Province, inner margin of northern to North China Craton and it is a large moderate temperature hydrothermal vein filled metasomatism deposit. It is mainly composed of five ore belts and always with buried vein ore body and occurred in the hornblende-biotite-plagioclase granulite of Hongqiyingzi Group, lower Proterozoic, and a few of ore body occurred in volcaniclastic rock of later Jurassic. The occurrence of stratum in the ore district is reversal monocline with north dipping. There is exposed pyrogranite-porphyry, quartz porphyry which has close relation with mineralization. The metallogenesis of Caijiaying Pb-Zn-Ag ore deposit is the product of the identity structural-thermal event between the turn of stronger structural system and magma fluid metallization initiated by extensional process during in Mesozoic era in the eastern of North China Craton.

The Caijiaying Pb-Zn-Ag ore deposit is duplex vein type and the main ore minerals as follows: marmatite, Fe-bearing sphalerite, sphalerite, galena, chalcopyrite and minor gold and silver- bearing minerals etc. There are many periods of wall rock alteration, but no obvious space zoning and the main type is green rock with characteristic minerals assemblage of epidote- actinolite-chlorite-carbonate. There are different altered rocks developed such as pyrite sericite quartz rock and sericitization. The sequence of wall rock alteration as follows: epidote- actinolite- chlorite; carbonate- sericite quartz rock-silicification, then later carbonate.

There exist positive dependency relation between the $Fe^{2+}+Al^{IV}$and Fe/(Fe+Mg) value of the chlorite in the hydrothermal deposit and there are obvious different ratio value in chlorite in different deposit (ore district). There are obvious different of Al^{IV} and Al^{VI} value of chlorite in Caijiaying deposit and it demonstrates that this deposit has absolute property. The types of chlorite are medium amount of iron and brunsvigite and seldom Fe-rich chamosite in Caijiaying. The changes of chemical composition of chlorite depend on the forming environment such as temperature, pressure, acidity etc. The different types of chlorites in Caijiaying show the acid forming environment. There exist positive dependency relations among frequency difference of vibration zone in infra-red spectrum, iron amount and mineralizing degree in thuringite of Caijiaying.

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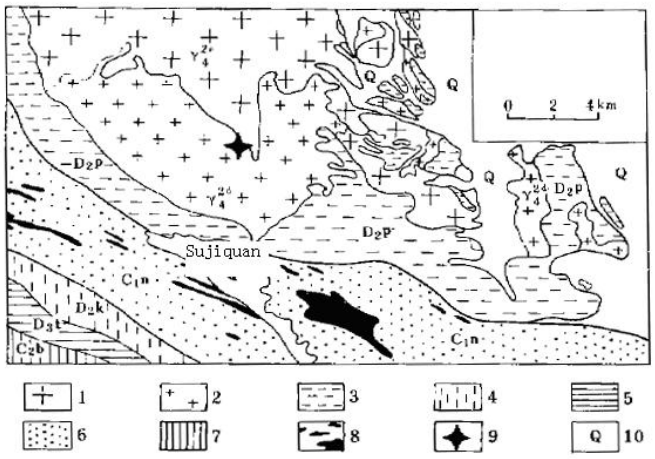
Introduction

The Caijiaying Pb-Zn-Ag ore deposit locates at the northwest of Hebei Province, inner margin of northern to North China Craton (Figure 1), it is a super-large zinc deposit in the world and the Ag resource can reach to large type. There are many scientists researched the ore genesis from many aspects, the main genesis as follows: moderate-temperature hydrothermal vein filled metasomatism deposit (Huang D H etc.1991), ancient emanation exhalation-hot water sedimentary metamorphism-hydrothermal superimposition (Yang M Z, 2000), fluid evolution consistently (Wang L J, 2003). The metallogenesis of Caijiaying Pb-Zn-Ag ore deposit is the product of the identity structural-thermal event between the turn of stronger structural system and magma fluid metallization initiated by extensional process during in Mesozoic era in the eastern of North China Craton. But, the characteristics of alteration rock in the deposit have not been studied in detail.

Figure 1. Geological sketch map of the graphite ore-field in Sujiquan



1.arfvedsonite granite 2. biotitic granite; 3.tuff, sandstone, siltstone containing jasperite; 4. fine sandstone and feldspathic sandstone; 5. sandy conglomerate containing fine sandstone; 6. siltstone feldspathic sandstone, tuff, sandy slate containing carboniferous shale. 7. tuff conglomerate, rhyolitic porphyry, tuff sandstone, conglomerate; 8. ultra-basic rocks; 9. graphite ore deposit; 10. Quaternary.

Geological characteristics of the deposit

Stratum

The Caijiaying deposit located in the north of regional NEE tensional shear zone, the 10°20°fault in the district controlled the extension of Pb-Zn-Ag ore body and there are NW post mineralizing faults cutting the ore body. There is exposed pyrogranite-porphyry (141Ma), quartz porphyry (119 Ma) (Rui Z Y) which has close relation with mineralization. There are ancient Proterozoic (Pt) stratum exposed in the ore district, they are composed of hornblende-biotite-plageclase granulite of Hongqiyingzi Group (1825Ma) (Wang L J, etc. 2003), but the others thought its age belong to new Archean based on the Sm-Nd isotope age (Wang Q C etc. 2004). There are acid tuff and tuff breccia of upper Jurassic covered on it uncomfortably. Lithology of all above stratum is sillimanite-plageclase granulite, hornblende granulite and hornblende- plageclase granulite, and there are marble and graphite light colour granulite, they belong to amphibolite facies.

Distribution of ore body

It is mainly composed of five ore belts and always with buried vein ore body and the Ag-Pb-Zn mineralizing are vary in the No. 2, 3, 5 ore belts and with large extension. The trending of the No.3 vein is NWW (280°290°) and dipping S, dip angle 60°65°it occurred in the hornblende-plageclase granulite and biotite-plageclase granulite. The length of the ore body 1500m, widths 500~1500 m (exposed at 1000~1500m level) and the ore type is chlorite-sphalerite. The No.5 ore belt is composed of more than 20 ore bodies, with trending of the vein is 280°and dipping NWW , dip angle 65°the thickness of the single ore body is 115m extending to 1800m and extending depth 300500m. The No.2 ore belt is composed of 3 ore bodies, with width 200m, extending to 400500m and extending depth 1500 2000m.

Types of ore and mineralizing periods

The Caijiaying Pb-Zn-Ag ore deposit is duplex vein type and the main ore minerals as follows: marmatite, Fe-bearing sphalerite, sphalerite, galena, chalcopyrite and minor gold and silver-bearing minerals, etc. They can be divided into five mineralizing periods for the Caijiaying Pb-Zn-Ag deposit: (i) wall-rock metasomatism period: arsenopyrite; (ii) pyrite- kroeberite- sphalerite period; (iii) natural gold-galena- pyrite period; (iv) Ag-bearing galena- argentite-Ag-Cu-S-Sb mineral period; (v) natural silver-pyrite-calcite period.

Mechanism and resources of mineralization

The characteristics of quartz inclusions in each mineralizing period and homogeneous temperature results show that the ratio of gas to liquid was 25%10% and the inclusion types from gas CO_2 to liquid inclusion. The temperature results by inclusion homogeneous demonstrates that the temperature during mineralizing was 130180°C.The liquid phase components of quartz inclusion and calculation of forming physical chemistry parameters show that F^-,Cl^-,SO_42^- and Na^+ are riched in liquid componentsand N_2,CO_2 and H_2O are rich in gas phase components, the mineralizing physical chemistry parameters are pressure is 780 Pa, pH= 7.057.50, Eh=-0.69-0.74 and salinity (NaCl) eq= 48.08% 52.3%. There are two sorts of resources for the mineralizing matter based on the geological occurrence, the matter components of ore and the analysis results of Pb-Pb isotope; (1) the metamorphic medium-basic, medium-acidic volcanic rocks of Hongqiyingzi Group, ancient Proterozoic(Pt); (2) fluid came from lower crust-mantle. In summary, the Caijiaying Pb-Zn-Ag deposit is ancient eruption gas-hydrothermal sedimentary metamorphic-hydrothermal superimposed.

The characteristics of the altered rocks

There are many stages of wall rock alteration and the main type is green rock with characteristic minerals assemblage of epidote- actinolite-chlorite-carbonate. There are different altered rocks developed such as pyrite sericite quartz rock and sericitization. The sequence of wall rock alteration as follows: epidote- actinolite- chlorite; carbonate- sericite quartz rock-silicification, then later carbonate. There exists alteration zone from wall rock to ore body: chlorite→actinolite→pyrite sericite quartz rock; and there are follow altered rock zoning for the biotite-plageclase granulite: fading biotite →hydromica→pyrite sericite quartz rock→silicification. The petrochemical equilibrium calculation of each alteration rocks (Table 1) shows that the mineralizing fluids enter wall rock along the fault structure and the following components such as SiO_2, Fe_2O_3, K_2O,Na_2O and H_2O were added, but the components such as Al_2O_3, TiO_2, FeO, CaO, MgO were leaching loss. The main alteration minerals are chlorite and mica, in order to research the relation between the alteration and mineralization, the characteristics of these two minerals have been studied in detail. Many analytic methods such as electron probe analysis, X-ray diffraction, differential analysis, IR spectrum have been used.

Table 1. Petrochemical equilibrium calculation of alteration rocks in Caijiaying Pb-Zn-Ag deposit

oxidate	**biotite-plage-clase amphib-olite**				**actino-lite**					**pyrite sericite quartz rock**				
	wt%	cation molecule	unit cell	ion num-ber	wB%	cation mole-cule	ion num-ber	carry out numbers of unit cell	carry out num-bers of ion	wt%	cation molecule	ion number	carry out numbers of unit cell	carry out numbers of ion
SiO2	51	850	850	466.8	59.48	991.33	991.33	487.71	20.91	57.23	953.83	953.83	471.61	4.81
Al2O3	16.24	159.22	318.44	174.88	16.57	162.45	324.9	159.84	-15.04	8.27	81.08	162.16	80.18	-94.7
TiO2	1.66	20.8	20.8	11.42	0.66	8.27	8.27	4.07	-7.35	0.51	6.39	6.39	3.16	-8.26
Fe2O3	4.5	28.19	56.39	30.97	6.55	41.04	82.08	40.38	9.41	9.17	57.46	114.91	56.82	25.85
FeO	6.14	85.51	85.51	46.96	1.17	16.29	16.29	8.01	-38.95	1.55	21.59	21.59	10.67	-36.29
CaO	5.87	104.82	104.82	57.56	0.8	14.29	14.29	7.03	-50.53	2.59	46.25	46.25	22.87	-34.69
MgO	3.56	88.56	88.56	48.64	1.18	29.36	29.36	14.44	-34.2	2.11	52.49	52.49	25.95	-22.69
K2O	4.14	43.59	87.9	48.27	4.84	51.38	102.76	50.56	2.29	3.82	40.55	81.1	40.1	-8.17
Na2O	2.9	46.82	91.2	50.09	0.15	2.43	4.85	2.39	-47.7	2.35	37.96	75.93	37.54	-12.55
P2O5	1.18	8.32	16.64	9.14	1.58	11.14	22.28	10.96	1.82	3.39	23.89	47.78	23.62	14.48
MnO	0.15	2.12	2.12	1.16	0.06	0.84	0.84	0.41	-0.75	0.11	1.55	1.55	0.77	-0.39
CO2	1.22	27.73	27.73	15.23	0.54	12.28	12.28	6.04	-9.19	2.85	64.78	64.78	32.03	16.8
H2O+	1.27	70.56	141.11	77.49	6.26	347.78	695.56	342.2	264.71	8.97	498.33	996.67	492.79	415.3

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Chlorite

Chemical component

Based on the electron probe analysis from 18 chlorite samples, the crystal chemical formula have been calculated and then ploting them on the genesis figure, they can be divided into following type: the main type is brunsvigite, the others are prochlorite, chamosite and diabantite. The typical characteristics of chlorites in the Caijiaying deposit are iron rich higher than the general hydrothermal poly metal deposits.

IR spectrum

The analytic results of IR spectrum for chlorites listed in Table 2). Two stronger dilation vibration zone of OH^- located at near 35563538cm^{-1} and 34273390cm^{-1}, at the same time, dilation vibration zone of SiOSi(Al) is a very stronger single peak with lower and mostly at near 990cm^{-1}. According to the classification by Menka (Ying Y P, 1982), the chlorites in Caijiaying deposit can be classified as two types, and most of them are thuringite, the others are ripidolite. The other OH^- dilation vibrated frequency locates between 34303390cm^{-1}; a few samples are ripidolite whose librated zone of OH^- locates at 3560cm^{-1}, 3425cm^{-1} and bend librated at near 655cm^{-1}.

Table 2. The vibration frequency of infrared spectra of chlorite in the Caijiaying mineral district (cm^{-1})

No.	sample position	ν_{OH}	ν_{M-OH}	$\nu_{Si-O-Si(Al)}$	$\sigma_{Si-O-Si(Al)}$	name
1	Zk315-30	35,533,415	665,623	996,816		thuringite
2	Zk317-3	35,483,391	666,619(sh)	995		thuringite
3	Zk317-3	35,483,391	666,619(sh)	995		thuringite
4	Zk315-27	35,463,397	656,626	984	748	thuringite
5	Zk307-18	35,423,391	666,626	985	808,751	thuringite
6	Zk307-18	35,383,397	666,625	990	775	thuringite
7	Zk307-18	35,403,391	666,628	991	771	thuringite
8	Zk307-24	35,523,379	666,630	992	751	thuringite
9	Zk317-3	35,513,427	670,625			thuringite
10	stratumG3	35,553,417	669,636	988	829	thuringite
11	stratumG4	35,413,403	670,629	990	796,749	thuringite
12	Zk315-23	35,583,435	650	994	743	ripidolite
13	Zk311-21	361,635,433,441	662	990	815,764	ripidolite
14	Xiaobazi bore drill	3560	630	994		ripidolite
15	Zk315-23	35,963,296	662	1006	772	chlorite

Differential analysis

The results of differential analysis of chlorites in the deposit listed in Table 3 . Most of chlorites have two decalescence valley, located at the range 500600^oC and 600 700 ^oC or 700800 ^oC. Based on the classification principle on the structural decompose by Werner Smyktar Kloss, the chlorites in the ore field are maily ripidolite, brunsvigite and some chlorite with deaquation and prochlorite. All

those characteristics are consistent with the conclusion that chlorite often belong to brunsvigite in the Pb-Zn deposit (Ye D N, 1984).

Table 3. The breakdown temperature of chlorite structure and nomenclature

structural decompose temperature ºC	name
580,710	ripidolite - brunsvigite
575,690	ripidolite
580,715,760	ripidolite?brunsvigite
580,743	ripidolite?brunsvigite
550	ripidolite
525,830	ripidolite, Zn-bearing penninite
520,640	ripidolite
672	chlorite with deaquation
575,780	ripidolite,prochlorite
575,755	ripidolite,Zn-bearing penninite
570,720	ripidolite?brunsvigite
540,760	ripidolite, prochlorite
570,690	ripidolite

X-ray diffraction analysis

According to the data of x-ray diffraction analysis on chlorites, the d(001), d(002),d(060) can be obtained, on the basis of these information, the atom numbers of Fe^{2+}, Fe^{3+}, Mg^{2+} and Si^{4+} in chlorites can be calculated and then plotting the results on the figure provided by Brown B E, 1962, the poly type of chlorites in Caijiaying deposit are I_{ba}, I_{bb} and II_{bb} (Table 4).

Table 4. X-ray diffraction analyses of chlorite in Caijiaying(x0.1nm)

No.	d(002)	d(060)	poly type
1	6.9919	1.4968	I_{bb}
2	7.3022	1.5395	I_{ba}
3	7.2544	1.5607	I_{bb}
4	7.0139	1.545	II_{bb}
5	6.9699	1.545	I_{ba}
6	6.9699	1.545	I_{ba}
7	7.0251	1.5465	I_{bb}
8	6.9699	1.5465	II_{bb}
9	6.9157	1.5488	II_{bb}
10	7.3132	1.5465	II_{bb}
11	7.1725	1.5371	II_{bb}

Potassium mica

Chemical composition

Sericite is one of the main wall rock alterations in Caijiaying deposit. The experiments was finished at electron probe room of geology department, Beijing University, the results of two main ore belts and stratum are listed in Table 5 , it shows that the K_2O is very high, so they can be named as potassium mica. The metal oxide amounts are follows: w SiO_2 (wt%) 43.20%52.69%, w (K_2O) 6.49%10.63%, w (MgO) 0.98%-2.39%, w (FeO) 1.56%8.77%, w ($Al_2$03) 30.47%37.41% and minor Na_2O, MnO_2, TiO_2. Accepted chemical computation method (Xiao P, 2001), the potassium mica chemical formula are calculated and results listed in Table 6 .

Table 5. Chemical composition of potash mica analyse by electronic probe

No.	sample position	K_2O	Na_2O	CaO	MgO	TiO_2	Al_2O_3	MnO	SiO_2	FeO	Total
1	V ore belt	10.63	0.07	0.08	1.02	0	31.43	0	47.51	1.69	92.52
2	V ore belt	6.49	0.05	0.17	2.39	0	30.89	0	52.69	1.97	94.59
3	III ore belt	7.78	0.16	0.02	4.03	0.03	30.46	0.26	43.2	8.77	94.89
4	III ore belt	9.44	0.3	0.06	1.02	0	30.37	0.04	51.79	1.72	94.76
5	III ore belt	8.17	0.1	0	1.47	0.07	35.05	0.04	49.89	1.56	96.36
6	V ore belt	8.42	0.32	0.04	0.98	0.23	37.41	0.02	44.93	2.27	95.08

Table 6. Calculated crystal chemical formula (potash mica)

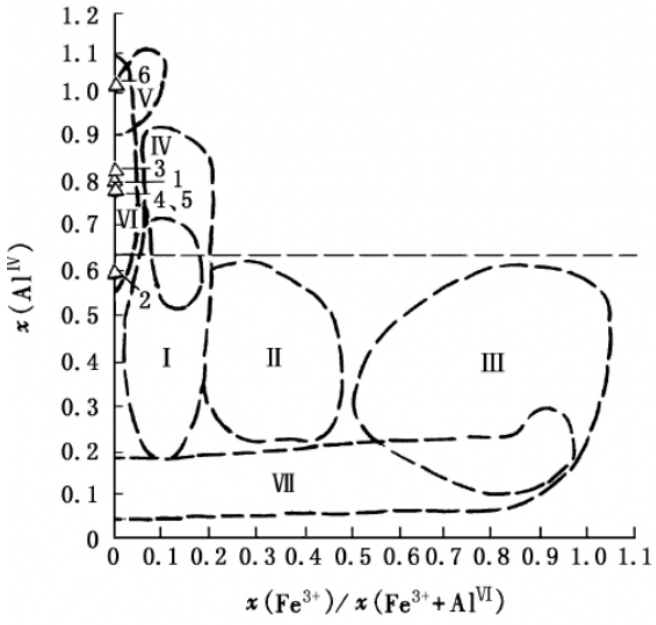
No.	crystal chemical formula
1	$K_{0.89}(Al^{VI}_{1.71}Mg_{0.12}Fe^{2+}_{0.08})_{1.91}[(Si_{3.20}Al^{IV}_{0.71})_{4.00}O_{10}](OH)_2$
2	$K_{0.54}(Al^{VI}_{1.65}Mg_{0.23}Fe^{2+}_{0.11})_{1.99}[(Si_{3.36}Al^{IV}_{0.64})_{4.00}O_{10}](OH)_2$
3	$K0.58(Al^{VI}_{1.38}Mg_{0.22}Fe^{2+}_{0.43})_{2.03}[(Si_{3.18}Al^{IV}_{0.82})_{4.00}O_{10}](OH)_2$
4	$K_{0.80}(Al^{VI}_{1.79}Mg_{0.12}Fe^{2+}_{0.08})_{1.97}[(Si_{3.21}Al^{IV}_{0.79})_{4.00}O_{10}](OH)_2$
5	$K_{0.70}(Al^{VI}_{1.84}Mg_{0.13}Fe^{2+}_{0.08})_{2.07}[(Si_{3.21}Al^{IV}_{0.79})_{4.00}O_{10}](OH)_2$
6	$(K_{0.71}Na_{0.08})0.79(Al^{VI}_{1.84}Fe^{3+}_{0.08}Mg_{0.08})_{2.00}[(Si_{2.99}Al^{IV}_{1.01})_{4.00}O_{10}](OH)_2$

In order to discuss the composition variation of potassium mica, we researched from several aspects:

(i) Genesis diagram

Put the data of $x(Al^{IV})$, $x(Fe^{3+})/x(Fe^{3+}+Al^{IV})$ and x from Table 6 on the genesis diagram, all the potash mica fell in the hompgeneity multiple facial hydrothermal area of 1 Md, lM, 2M, $2M_1$, $2M_2$, 3T. This demonstrates that potassium mica is hydrothermal genesis.

Figure 2. Characteristics of crystal chemistry of dioctahedron sericites in different genesis



IIII. Diagenesis – initial epigenesis 1 Md-1 M polyphase of sedimentary mica; I. Al illite area; II. evaporation of illite; III_1 glauconite; IV. $1M_2$ M_1 polyphase of mica in deep epigenesis belt ;V. metamorphic belt of mica; .1 Md, 1M, $2M_1$, $2M_2$ and 3T polyphase hydrothermal mica; VII. 1 pictoamesite areaafter A T Kososyvier and B.A. Deliz,1975

(ii) The relation of K and Na in potassium

The K ion number of potassium mica in Caijiaying ore body changes between 0.54 and 0.89, but Na ion number is 0. Though the K ion number of potassium mica in the stratum of Datongying Formation is 0.71 which is near to the ore body, the Na is 0.08 which is different from the ore body. The reason is that Na is carried out in the rock when hydrothermal alteration occurred.

(iii) The relation of Mg and Si in potassium mica

The Mg ion number of potassium mica in Caijiaying ore body changes between 0.12 and 0.23, all Si ion number are higher than 3.00 and range from 3.18 to 3.41, they belong to silicon poly mica. But the Mg ion number in stratum is lower and Si ion number equal to 2.99 which similar to silicon poly mica.

(iv) The Al occupy position in potassium mica

The Al^{IV} and Al^{VI} in the tetrahedron position of the potassium mica in the ore body are 0.64-0.82 and 1.38-1.84, but the numbers that of stratum is 1.01 and 1.84 respectively. The reason may be that Al^{VI} was carried out during hydrothermal alteration.

(v) The relation among Al, Fe, Mg in octahedron position

Plotting the Al, Fe and Mg atom numbers in octahedron position of potassium mica on the Al-Fe-Mg diagram, w(FeO),w(MgO) of sample No. 3 are the highest, 4.03% and 8.77% respectively, Fe, Mg atom numbers are 0.43 and 0.22. It demonstrates there is positive relation between Mg and Fe in octahedron position of potassium mica, w(Mg) and w(Fe) are higher, so the Al^{VI} is lower. The other samples locate in a small area. All these characteristics show that w(A1), w(Mg) and w(Fe) are similar in potassium mica.

Differential analysis

The nine samples of potassium mica in the deposit have been analyzed at differential analysis room of geology department, Beijing University. The structural decompose of potassium mica range from 615–860°C and most of them at 620-750°C. Based on the classification principle on the structural decompose, the potassium mica in the ore field are mainly 1M, 1M-$2M_1$ and $2M_1$ poly type. The species of potassium mica can be named as sericite, hydromuscovite, hydromuscovite-sericite. The weight loss amount of potassium mica is different from 5% to 9.25%, these results are consistent with the fugitive constituent analyzed by electron probe analysis from 3.46% to 7.42%.

X-ray diffraction

Ten samples of potassium mica in the deposit have been analyzed by x-ray diffraction. The experiment was finished at X-ray room of geology department, Beijing University. The crystal indexes of potassium mica are calculated and compare with the standard data by Ye D N (1984). There are different d(060) in different poly type potassium mica, the d(060) of dioctahedral and trioctahedral are 0.1480 0.1510 nm and 0.15300.1557 nm respectively. There are poly type of potassium mica 1M, 1M + $2M_1$, $2M_1$, $2M_1$ + 3T in the Caijiaying deposit (Table 7) and this result consistent with differential analysis. At the same time, there are some relation between the poly type of potassium mica and depth which they locate, and 1M poly type can be seen at 1432.6 m reflecting that the depth is shallow. But the $2M_1$ poly type formed at deep, 13611153.0 m, 1M +2M, poly type formed at 1361 and 1302 m.

Table 7. Results of x-ray diffraction potash mica

No.	Sample location	elevation /m	poly type
1	V ore belt	1433	1M
2	V ore belt	1361	$2M_1$
3	V ore belt	1361	1M+$2M_1$
4	III ore belt	1357	$2M_1$
5	V ore belt	1317	$2M_1$
6	V ore belt	1302	1M+$2M_1$
7	V ore belt	1230	$2M_1$
8	III ore belt	1153	$2M_1$
9	III ore belt	1128	$2M_1$
10	III ore belt	1121	$2M_1$+3T

Discussion

There exists positive linear correlation between Fe^{2+} +Al^{IV} and Fe/(Fe^{+}Mg) in the chlorites from hydrothermal poly metal deposits and the ratios are different ore districts. The values of Al^{IV} and Al^{VI} of the chlorites in Caijiaying Pb-Zn-Ag deposit are distinguished from the other types of deposits and this demonstrates that this is uniqueness. The chemical composition of chlorites is controlled by the forming environments such as temperature, pressure and acidity, etc. The acidity has affected the composition of minerals during the medium temperature hydrothermal

deposits. According to the replacement principle of acid and alkali by Korzhinskii, it is favor to acid components to replace the alkali on the condition of acidity increasing of the solution. The coordination numbers of Fe^{2+} and Mg^{2+} in chlorites are usually six and thus they often replace each other. The chlorites formed in relative acid environment when Fe replaces Mg; otherwise, it formed alkali environment when Mg replaces Fe. The characteristics of chlorites in Caijiaying are that they are brunsvigite demonstrating they formed in acid environment.

The characteristics of mica is higher K_2O and typical series of potassium mica, this is seldom seen at the same genesis of Pb-Zn deoposit. The data of $X(Al^{IV})$-$X(Fe^{3+})/X(Fe^{3+} + Al^{VI})$ reflects that it is hydrothermal genesis.

The difference in chemical composition of stratum and ore body and shows in the correlation of Mg, Si and octahedral. But there is no difference of Fe, Mg and Al in octahedral potassium mica. The potassium mica can came from hydrothermal alteration by albite, plageclase feldspar, potash feldspar from the optical microscope obseravation. Silicication of companied with potassium mica, and pyrite to form pyrite- sericite-quartz rock which have close relation with mineralization.

There are poly types of potassium mica 1M, 1M + $2M_1$, $2M_1$, $2M_1$ + 3T in the Caijiaying deposit and 1Md exists in the peripheral area. At the same time, there are some relation between the poly type of potassium mica and depth which they locate, and 1M poly type can be seen at 1432.6 m reflecting that the depth is shallow. But the $2M_1$ poly type formed at deep, 13611153.0 m, 1M + 2M, poly type formed at 1361 and 1302m. This conclusion is consistent with viewpoint of Ye D N (1984) that the mica class is octahedron in Pb-Zn deposit. Pyrite sericite quartz rock in the wall rock alteration has close relation with mineralization in silver deposit and illite-hydromuscovite alteration played the second role in mineralization (Xiao P, 2001). It has very important significance to look for the same genesis deposit in the world that using the regularity that the poly type of potassium mica change with the depth.

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