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The Occurrence of Useful Components in Platinum-Palladium Deposit in the Great Dyke, Zimbabwe

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1 Introduction

Research on the mineralogy of platinum-group minerals (PGM) in the platinum-palladium deposits hosted by the Great Dyke of Zimbabwe is very limited. Our study of the occurrence of PGM provides a mineralogical basis for understanding the genesis of the ores and also for ore beneficiation. The core samples were collected in boreholes of Hartley mine and we assay the samples using scanning electron microscope (QUANTA-600).

2 Occurrence of Platinum-Group Mineral Series

Platinum-group elements (platinum, palladium, ruthenium, rhodium, osmium and iridium) occur as discrete minerals; and coexist with sulfides containing iron, copper, nickel and cobalt in many mineral facies.

Platinum-group minerals can be broadly classified into nine types, namely, sulfide-arsenides, nickel sulfides, sulfides, bismuth tellurides, arsenides, tin compounds, antimonides, iron compounds and natural platinum classes. The number of subclass of platinum-group minerals has reached more than 20.

The series of platinum-group minerals in Hartley mine are listed in Table 1.

3 Occurrence of Other Associated Components

In the PGE ores, other useful associated elements are copper, nickel, cobalt and gold. Copper, nickel and cobalt mainly occur in the sulphides chalcopyrite, pentlandite and cobaltite, respectively. Gold mainly occurs as minerals like electrum.

The element composition of principal metallic sulfides

Table 1 Platinum-group mineral series

Compound type	Platinum-group mineral	Chemical formula
Natural element	Native platinum (Fig. 1)	Pt
Iron compounds	Platina (Fig. 2)	Pt ₄ Fe-Pt ₂ Fe
Sulfide	Cooperite	PtS
Nickel sulfide	Laurite	RuS ₂
Arsenide	Braggite	PtAs ₂
Sulfide-Arsenide	Sperrylite (Fig. 3)	PtAsS
	Platarsite	RhAsS
	Hollingworthite	IrAsS
Tin compounds	Rustenburgite	(Pt,Pd) ₃ Sn
Antimonide	Atokite	(Pd,Pt) ₃ Sn
	Stibiopalladinite	Pd _{5+x} Sb _{2-x} x=0.05
	Maslovite	PtBiTe
Bismuth telluride compounds	Moncheite	(Pt,Pd)(Te,Bi) ₂
	Michenerite	PdBiTe
	Kotulskite	Pd(Te,Bi)
	Biteplapalladite	(Pd,Pt)(Te,Bi) ₂

Table 2 Element Contents of Principal Metallic Sulfides

Mineral name	Average Content of Element (%)				
	Cu	Ni	Co	Fe	S
Pyrrhotite	0.15	0.42	0.005	56.56	41.56
Pentlandite	0.43	33.58	1.097	27.95	36.37
Chalcopyrite	31.59	0.29	0.03	29.20	37.88
Marcasite	0.14	0.66	0.00	44.06	54.41
Nickel-bearing Pyrite	0.20	5.14	0.55	35.38	57.98
Sphalerite	0.50	0.15	0.18	6.81	36.63
Cobaltite	As 35.86	3.95	28.60	3.79	27.81
Cobalt-bearing Gersdorffite	As 33.88	23.82	6.05	5.83	30.41

Table 3 Compositional data for electrum

Element	Au (%)	Ag (%)	Note
Content Range	64.46~ 86.88	13.12~ 35.54	18 samples
Average Value	74.48	25.02	

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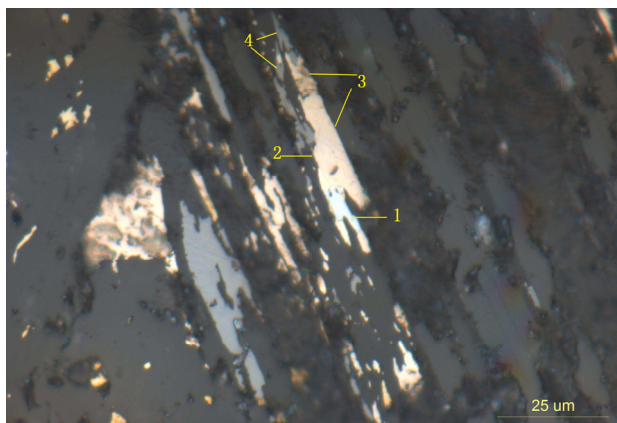


Fig. 1. Assemblage of native platinum (1), chalcopyrite(2), pyrrhotite (3) and ilmenite (4). Reflected light image

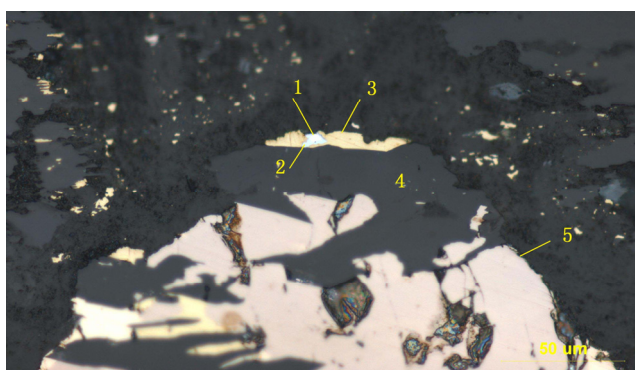


Fig. 2. Assemblage of platina (1), native platinum (2), chalcopyrite (3), pyroxene (4) and pyrrhotite (5). Reflected light image

and electrum is given in Tables 1 and 2, respectively.

Table 2 shows that Pyrrhotite contains trace amount of Ni with the average content of 0.42%. Pentlandite contains more cobalt (mean content of 1.097%) and nickel (mean content of 5.14%). Cobalt-bearing gersdorffite contains 6.05% cobalt, making it a valuable host of that element.

Table 3 shows that electrum contains more gold than silver. The average content is 74.48% Au and 25.02% Ag.

4 Conclusions

(1) Platinum-group elements occur as discrete minerals;

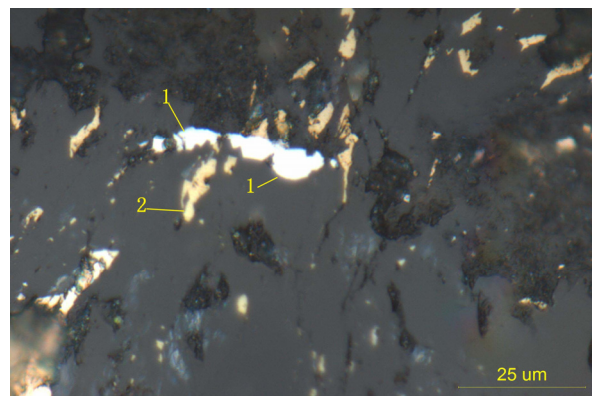


Fig. 3. Assemblage of sperrylite (1) and chalcopyrite (2). Reflected light image

and coexist mainly with pyrrhotite, pentlandite, chalcopyrite and pyrite.

(2) Copper, nickel and cobalt mainly occur in the chalcopyrite, pentlandite and cobaltite respectively.

(3) Gold mainly occurs as minerals like electrum.

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