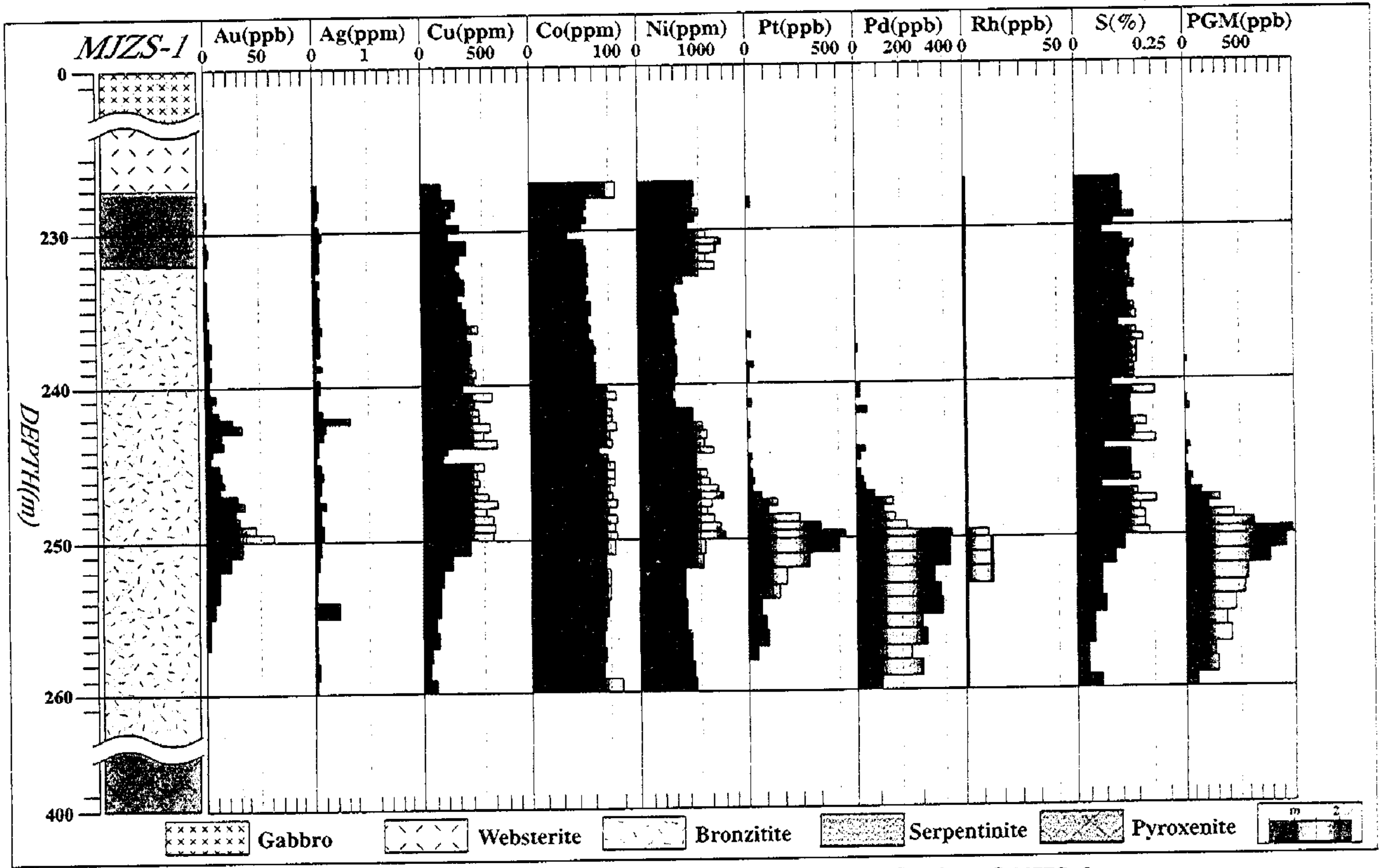

Fig.II-5-10 Log showing of Chemical analysis of MJZS-1

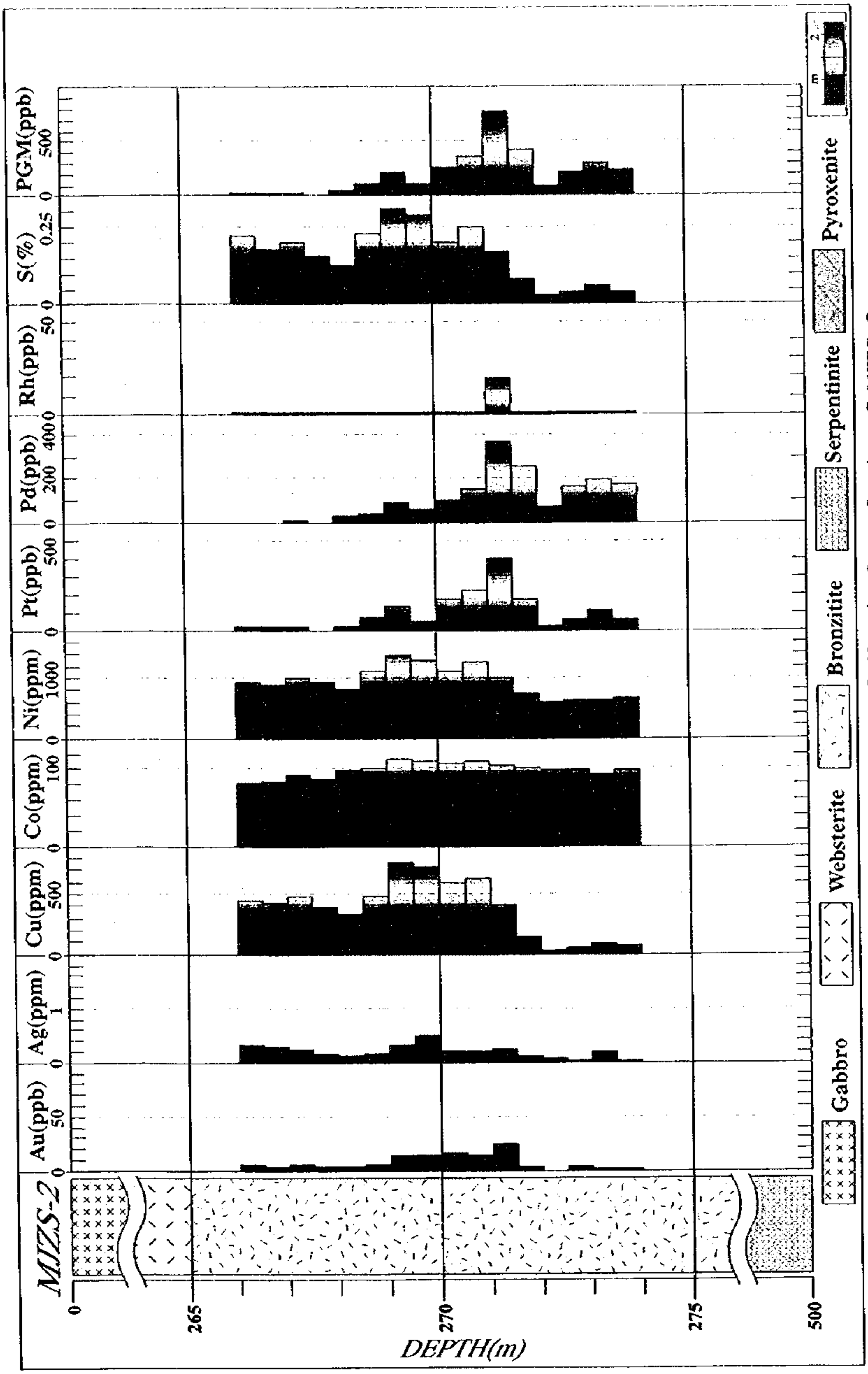

Fig.II-5-11 Log showing of Chemical analysis of MJZS-2

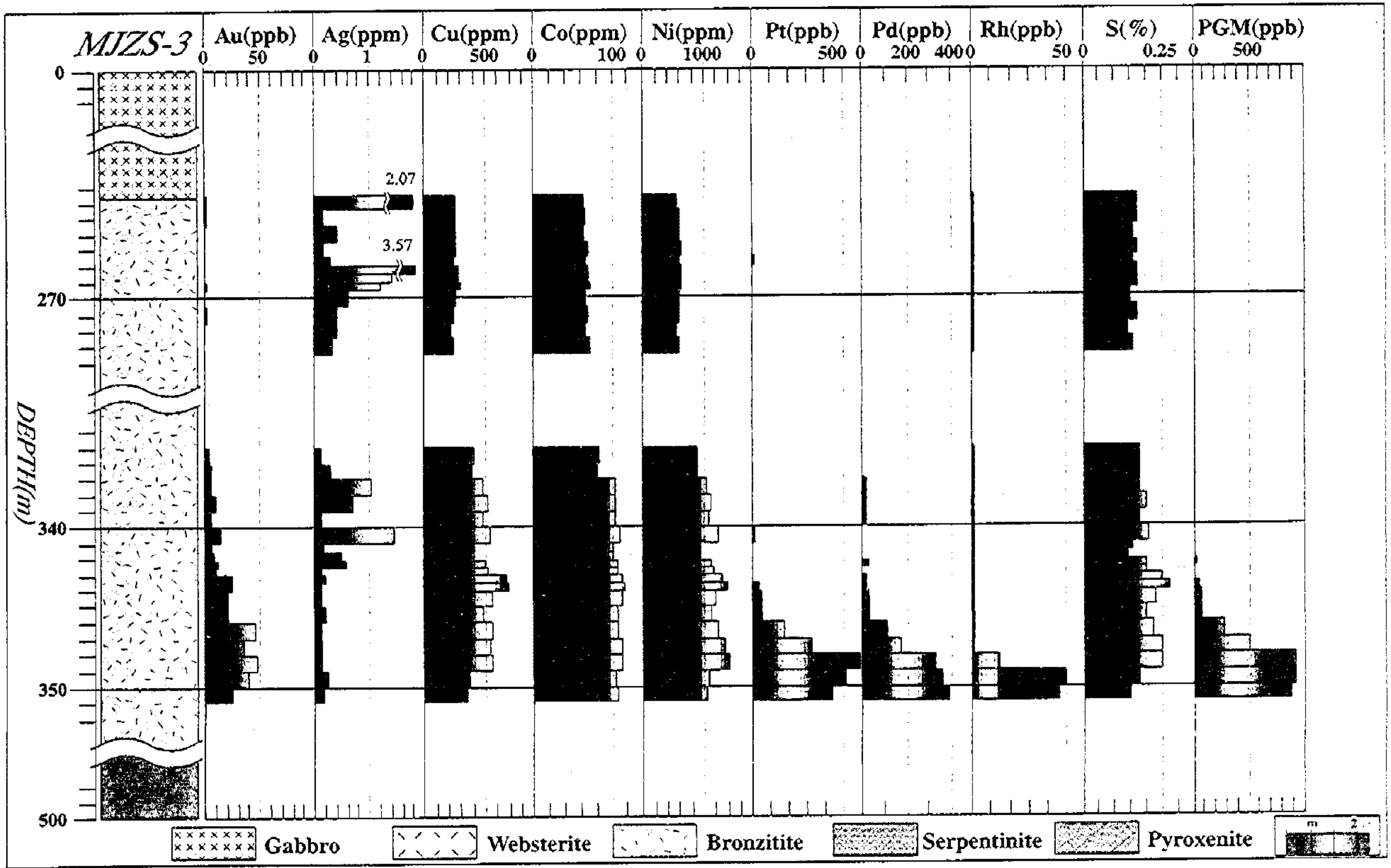

Fig.II-5-12 Log showing of Chemical analysis of MJZS-3

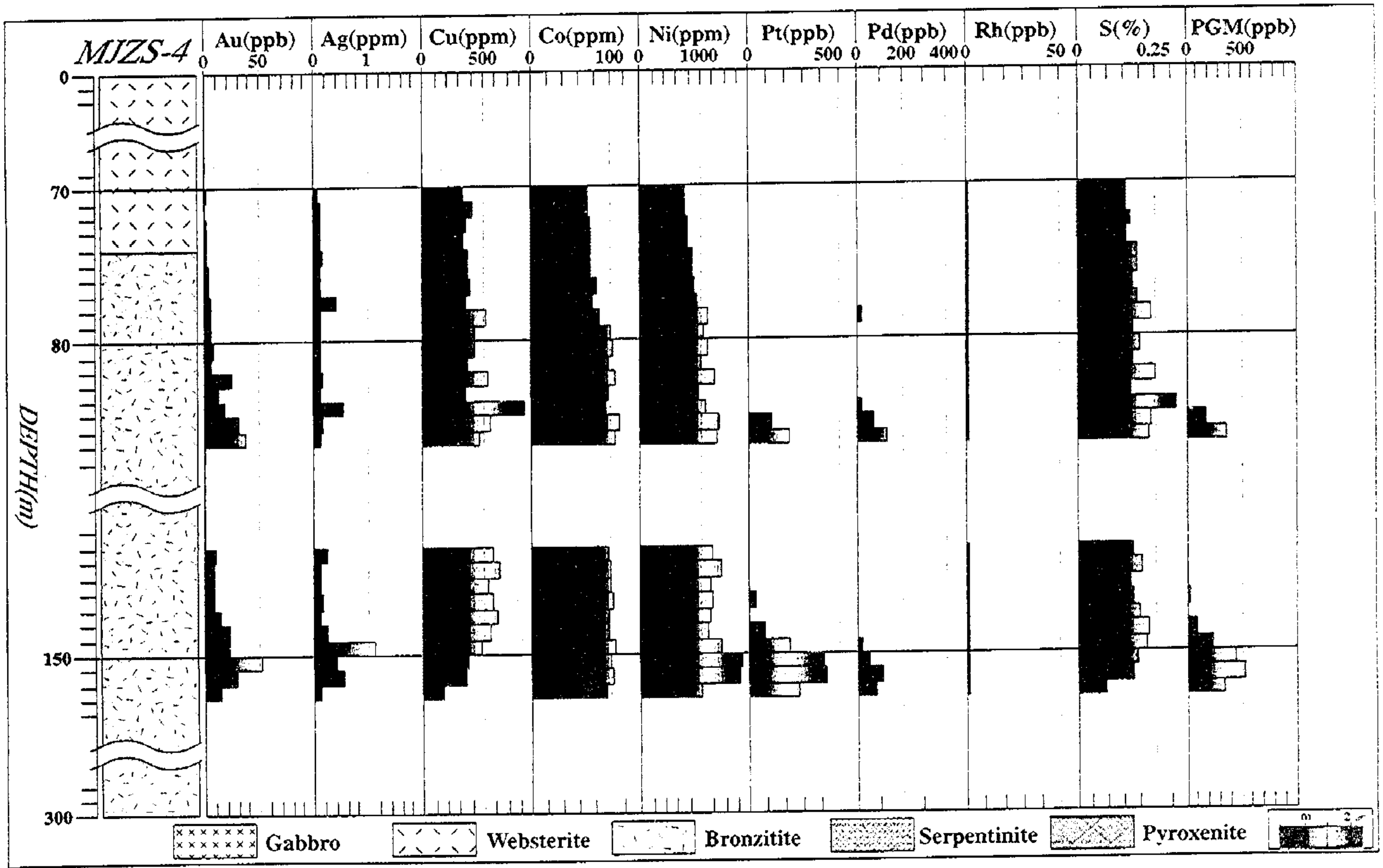

Fig.II-5-13 Log showing of Chemical analysis of MJZS-4

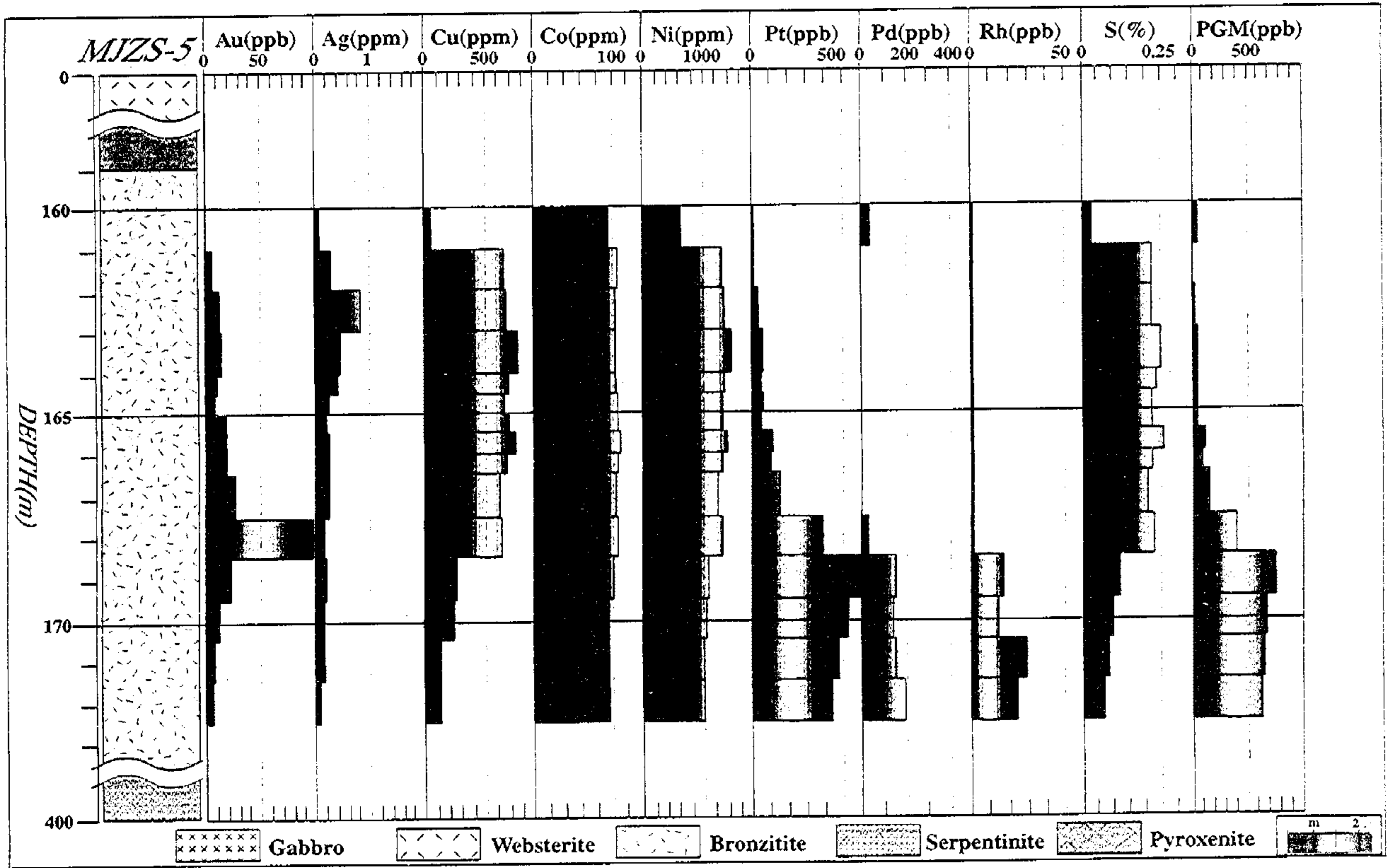

Fig.II-5-14 Log showing of Chemical analysis of MJZS-5

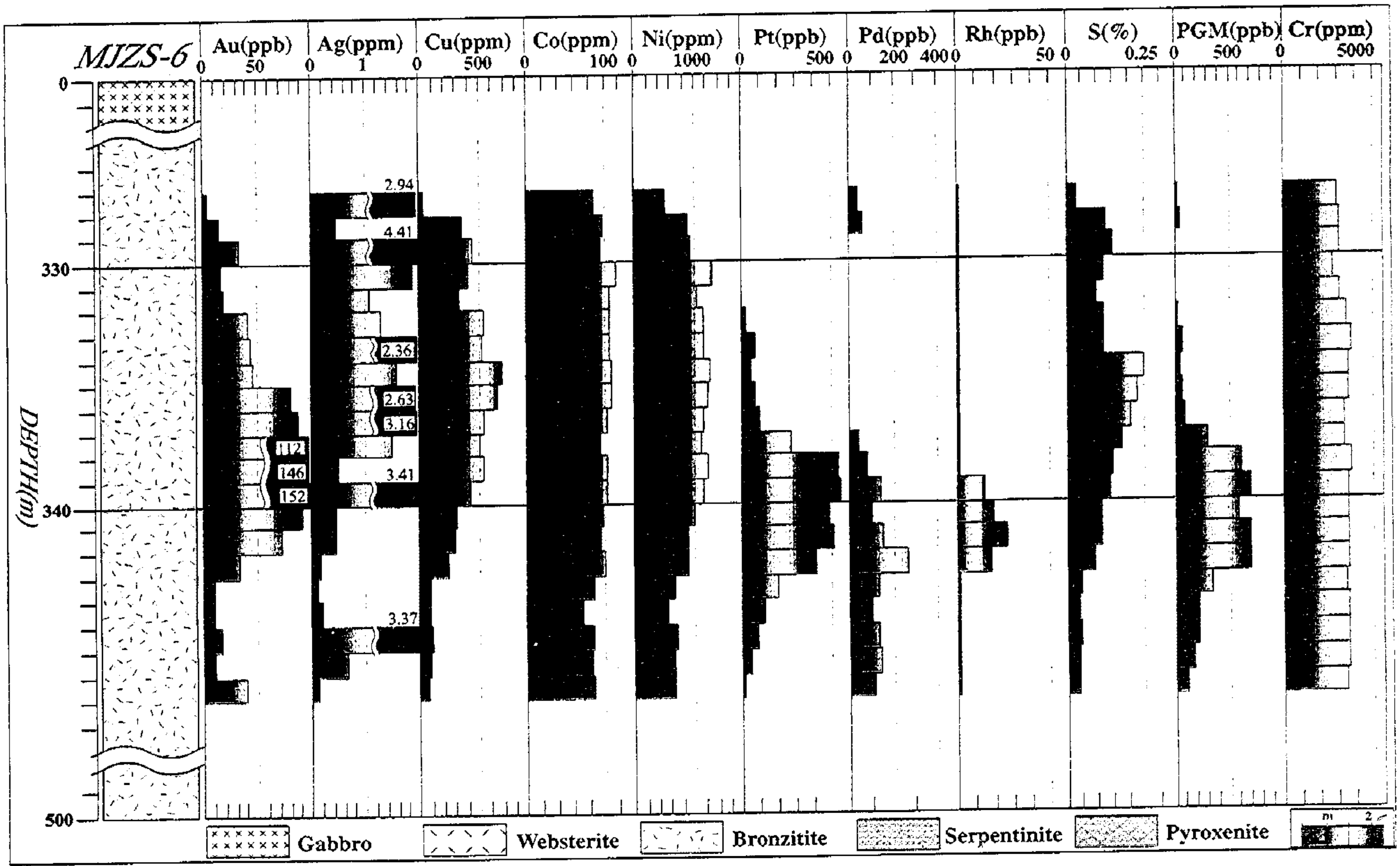

Fig.II-5-15 Log showing of Chemical analysis of MJZS-6

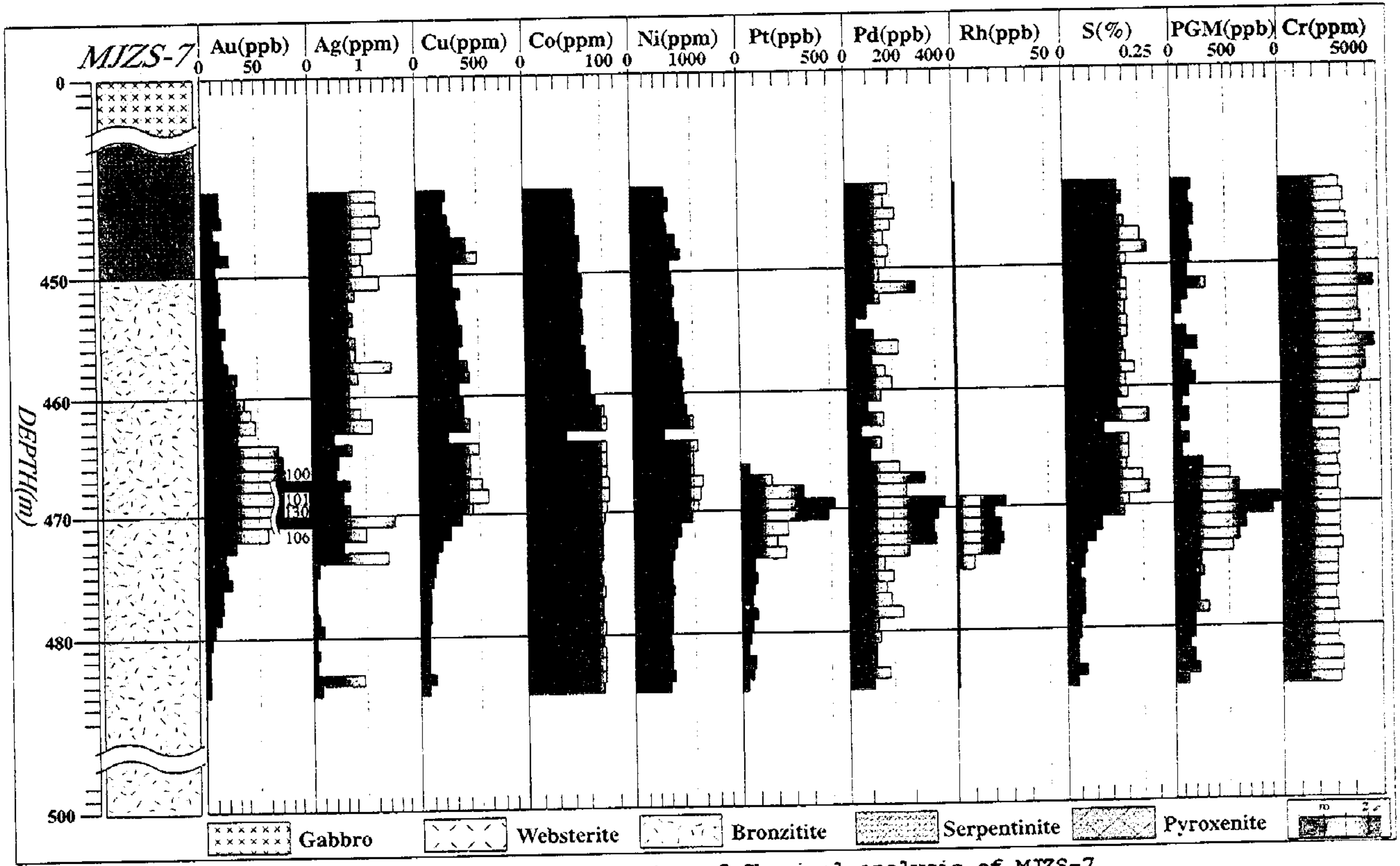

Fig.II-5-16 Log showing of Chemical analysis of MJZS-7

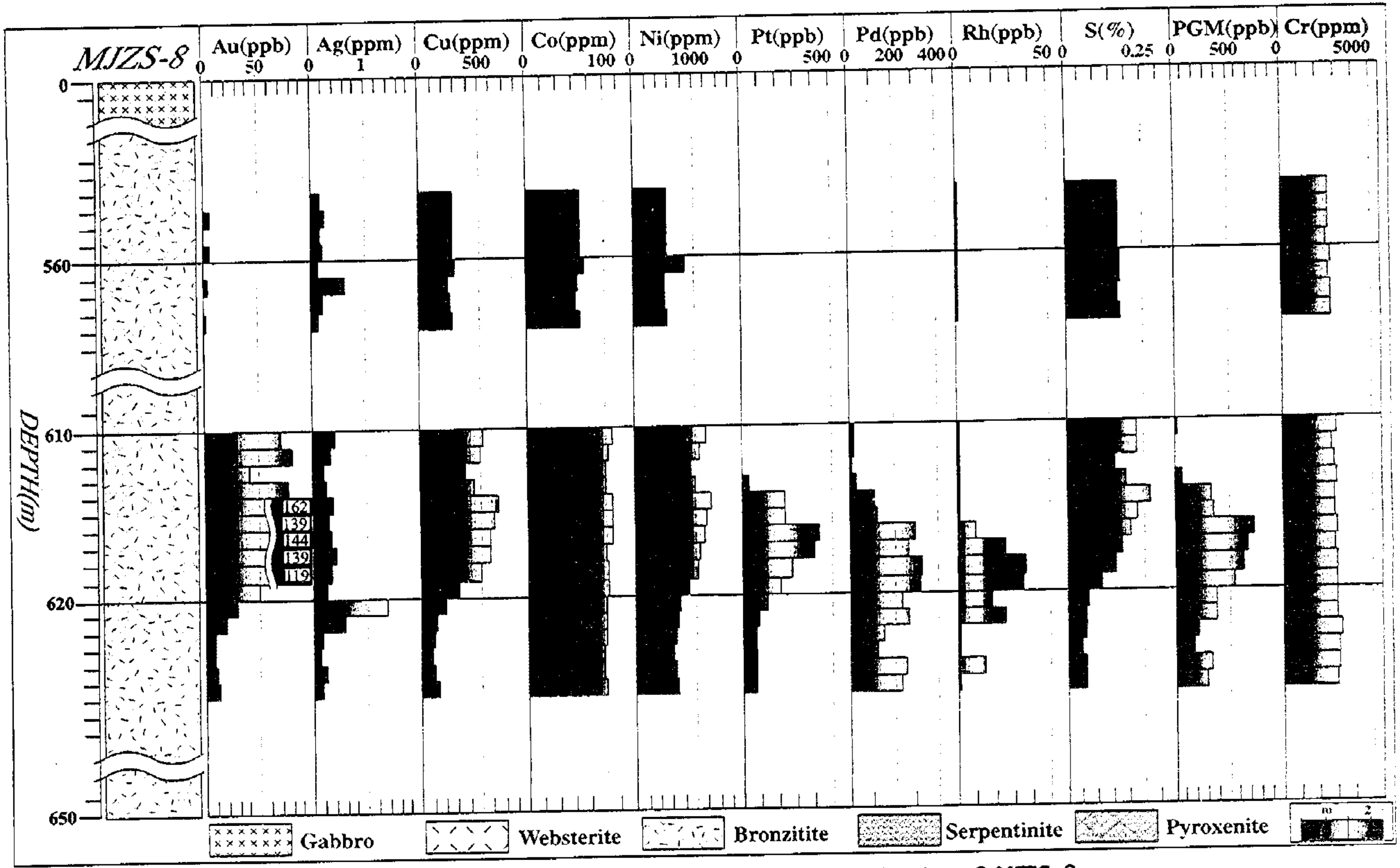

Fig.II-5-17 Log showing of Chemical analysis of MJZS-8

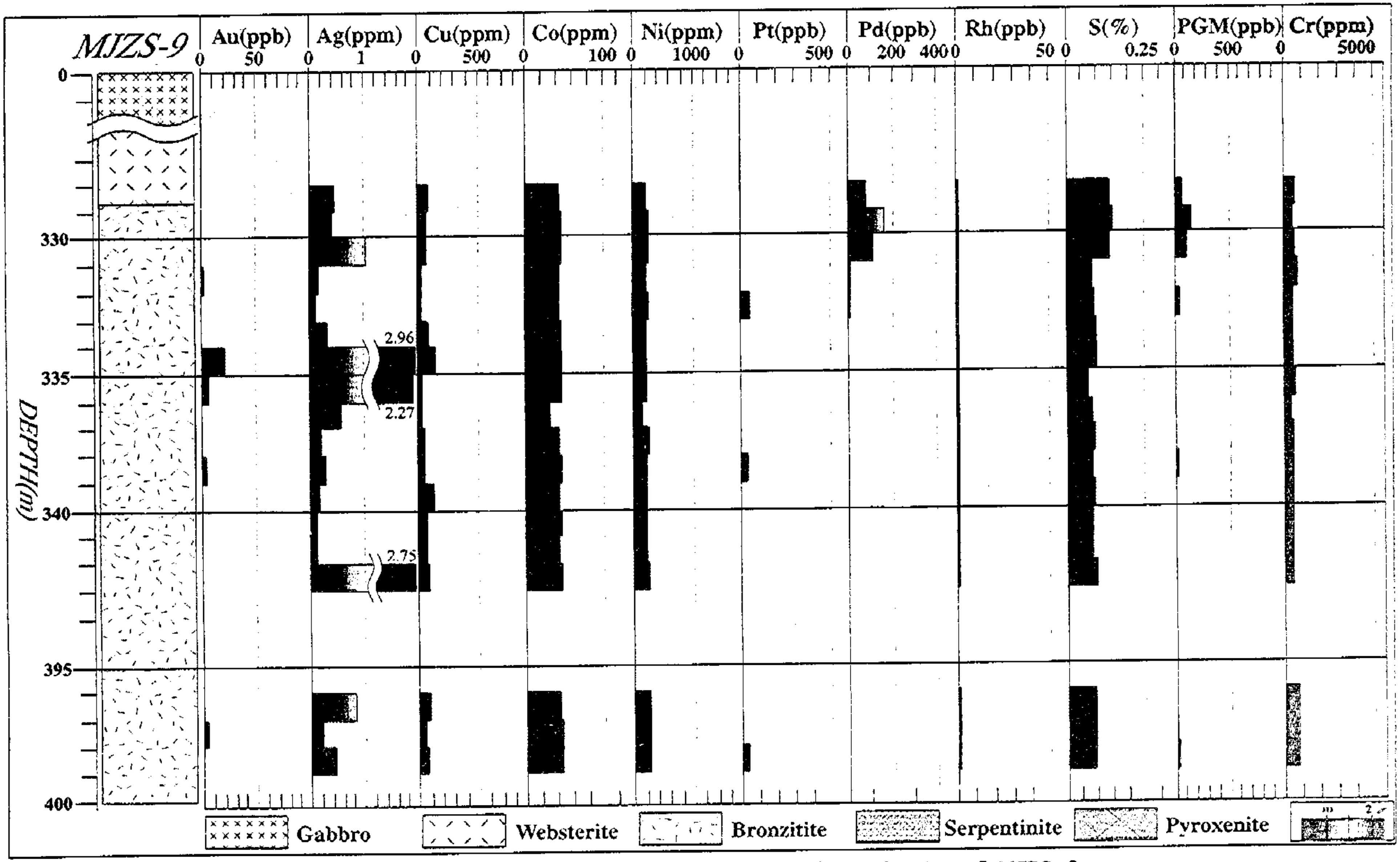

Fig.II-5-18 Log showing of Chemical analysis of MJZS-9

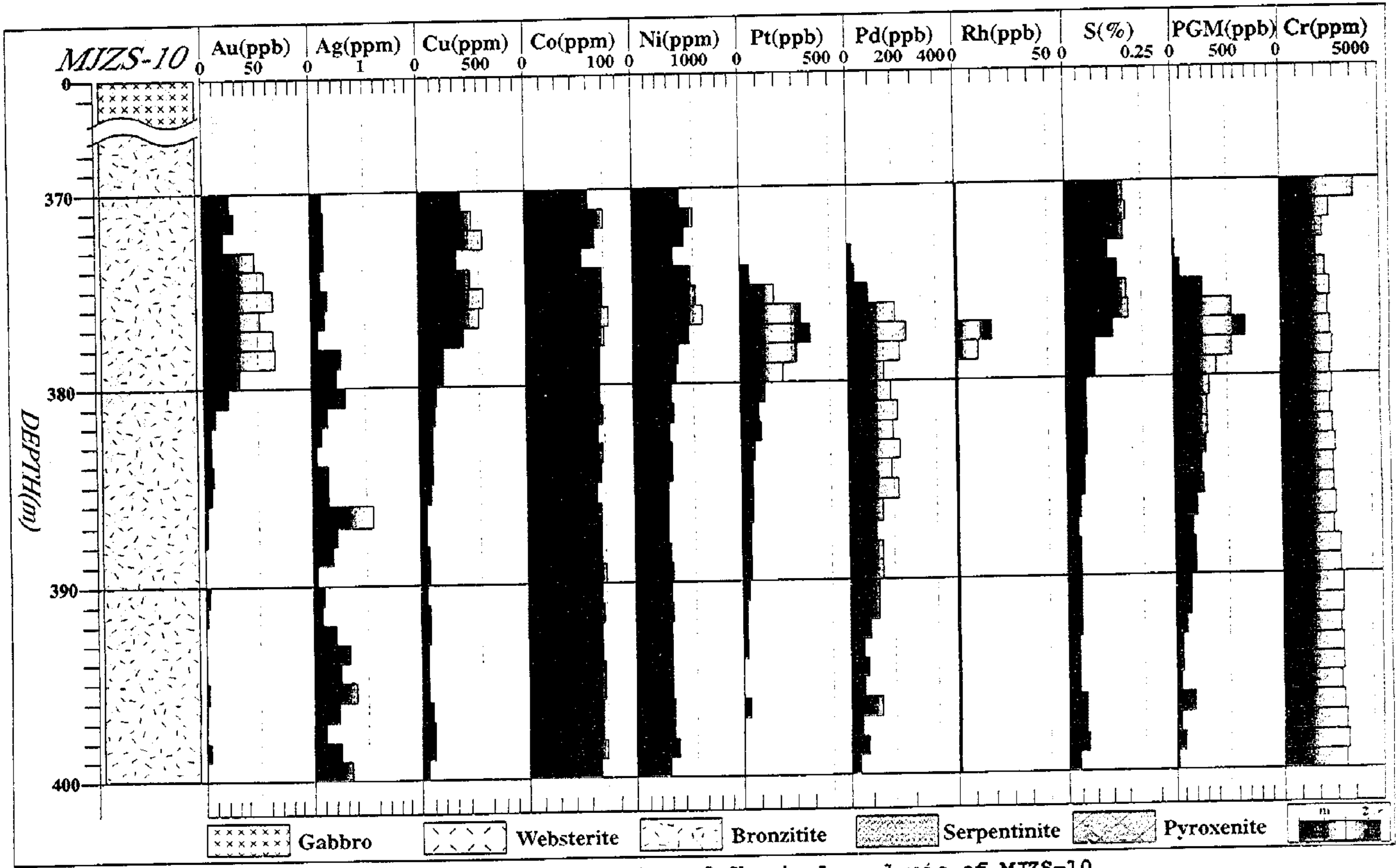

Fig.II-5-19 Log showing of Chemical analysis of MJZS-10

gold and platinum group elements. Copper and sulphur have similar distribution from and characteristically decrease their content from where platinum group elements distribute to lower portion. Cobalt and Nickel have similar gentle distribution form and a wide distribution peak is formed in the upper part from where platinum group elements distribute. Chrome has about same content through mineralization zone.

The results of microscopic observations of polished sections of ores are shown in Table II-5-3.

Main Mineral assemblage in this area is pyrrhotite - pentlandite - chalcopyrite, A small quantity of pyrite and marcasite which are closely accompanied by main ore minerals or are observed as exsolution products. An extremely small quantity of mackinawite, talnakhite, bornite, valleriite, sphalerite and chromite are also recognized.

A quantity of ore minerals are pyrrhotite > pentlandite > chalcopyrite.

Pyrrhotite shows irregular shape 0.05 to 0.2mm size and is observed closely assembled with pentlandite and chalcopyrite.

Pentlandite shows granular or irregular shape 0.05 to 0.2mm size and is observed closely assembled with pyrrhotite and chalcopyrite or replaced a boundary of gangue minerals.

Chalcopyrite shows irregular shape 0.05 to 0.5mm size and is observed closely assembled with pentlandite and pyrrhotite.

Pyrite shows 0.01 to 0.08mm size and is observed wrapped by the pentlandite and pyrrhotite.

Marcasite is observed replacing pentlandite and pyrite.

Sphalerite is accompanied with pentlandite and pyrrhotite.

Bornite is observed as a foliated exsolution products in the chalcopyrite.

An extremely small quantity of talnakhite which shows granular shape 0.005 to 0.02mm size and accompanied with the pyrrhotite is observed.

Mackinawite shows 0.01 to 0.03mm size and is observed as a foliated exsolution products in the chalcopyrite.

Valleriite shows irregular shape 0.01 to 0.02mm size and is observed an extremely small quantity in gangue minerals.

Chromite shows granular shape 0.05 to 0.2mm and scattered as small quantities in gangue minerals.

EPMA quantitative analysis was carried out for typical ore samples. platinum group minerals were defined in two samples and analyzed point are total 7 points. Results of this analysis are shown in Table II-5-4.

Table II-5-3 Results of the microscopic observations of polished section of ore samples

Number	Sample name	Rock name defined by microscopic obervation	Location: Drill number	Location: Depth(m)	Sulphides: Pyrite	Sulphides: Marcasite	Sulphides: Pyrrhotite	Sulphides: Pentlandite	Sulphides: Chalcopyrite	Sulphides: Bornite	Sulphides: Mackinawite	Sulphides: Talnakhite	Sulphides: Valleriite	Sulphides: Sphalerite	PGM: Moncheite	PGM: Sperrilite	Oxides: Magnetite	Oxides: Chromite	Others: Quartz	Others: Carbonates	Others: Other minerals	Texture
1	P-1	Bronzitite	MJZS-3	289.20			◎	○	○		·	·										disseminate, exsolution
2	P-2	Bronzitite	MJZS-3	341.10	·	△	◎	○	○					·				·				disseminate, exsolution, micrograghic
3	P-3	Bronzitite	MJZS-5	164.80			◎	○	○					·								disseminate
4	P-4	Bronzitite	MJZS-5	165.70			◎	○	○	·		·										disseminate, exsolution
5	P-5	Bronzitite	MJZS-2	269.60		△	◎	○	○				·									disseminate, exsolution, micrograghic
6	P-6	Bronzitite	MJZS-2	270.30	·	△	◎	○	○													disseminate, exsolution, micrograghic
7	P-7	Bronzitite	MJZS-2	271.60		△	◎	○	○													disseminate, micrograghic
8	P-8	Bronzitite	MJZS-1	230.80			○	·	·													disseminate
9	P-9	Bronzitite	MJZS-1	232.20			·	·	·					·								disseminate
10	P-10	Bronzitite	MJZS-1	232.70			△	△	△		·			·			·					disseminate, exsolution
11	P-11	Bronzitite	MJZS-1	243.30		△	◎	○	○													disseminate
12	P-12	Bronzitite	MJZS-4	70.70			◎	○	○													disseminate
13	P-13	Bronzitite	MJZS-4	82.15			◎	○	○													disseminate, exsolution
14	P-14	Bronzitite	MJZS-4	148.75		△	◎	○	○					·								disseminate, exsolution
15	PS-1	Olivin-Websterite	MJZS-7	468.50	·		◎	○	△						·							disseminate
16	PS-2	Olivin-Websterite	MJZS-7	469.50	·		◎	◎	○													disseminate
17	PS-3	Olivin-Websterite	MJZS-7	470.50			◎	◎	△													disseminate
18	PS-4	Olivin-Websterite	MJZS-7	471.50	·		○	○	○													disseminate
19	PS-5	Olivin-Websterite	MJZS-7	472.50			◎	◎	△													disseminate
20	PS-6	Olivin-Websterite	MJZS-6	338.50			◎	△	△													disseminate
21	PS-7	Olivin-Websterite	MJZS-6	339.50			◎	○	△													disseminate
22	PS-8	Olivin-Websterite	MJZS-6	341.50	·		◎	○	△						·	·						disseminate
23	PS-9	Olivin-Websterite	MJZS-6	342.50			○	○	○													disseminate
24	PS-10	Websterite	MJZS-8	616.50	·		◎	○	△													disseminate
25	PS-11	Olivin-Websterite	MJZS-8	617.50	△		◎	○	△													disseminate
26	PS-12	Olivin-Websterite	MJZS-8	618.50	△		○	○	○													disseminate
27	PS-13	Orthopyroxenite	MJZS-10	377.50	△		◎	◎	○													disseminate

※ ◎ : abundance ○ : common △ : minor · : rare

Table II-5-4. Results of EPMA quantitative analysis

Sample No.	Ps-1	Ps-1	Ps-1	Ps-8	Ps-8	Ps-8	Ps-8
mineral name	moncheite	moncheite	moncheite	sperrylite	sperrylite	moncheite	moncheite
size (μm)	29 * 22	29 * 22	29 * 22	9 * 6	9 * 6	15 * 12	15 * 12
weight %							
Pt	30.11	30.50	29.76	57.15	55.21	39.05	38.75
Pd	6.64	6.74	6.76	-	-	-	-
Bi	16.49	16.11	16.38	-	-	24.63	16.13
Te	46.17	45.93	46.87	-	-	35.65	44.32
As	-		-	42.60	43.75	-	-
Total	99.42	99.28	99.77	99.75	98.96	99.33	99.20
atomic ratio							
Pt	0.235	0.238	0.231	0.340	0.326	0.335	0.319
Pd	0.095	0.097	0.096	-	-	-	-
Bi	0.120	0.117	0.118	-	-	0.197	0.124
Te	0.550	0.548	0.555	-	-	0.468	0.557
As	-	-	-	0.660	0.674	-	-
Sum	1.000	1.000	1.000	1.000	1.000	1.000	1.000

-: below detection limits

Analyses conditions

X-ray take-off angle	52.5
Acc. voltage	20 kV
sample current	10 nA on MgO
standard materials	pure metal for Pt, Pd, Bi, Te GaAs for As
characteristic X-ray	Pt Mα, Pd Lα, Bi Lα, Te Lα, As Lα

*) PS-1: MJZS-7, 468.50m
PS-8: MJZS-6, 341.50m

Moncheite{(Pt,Pd)(Te,Bi)2} and Sperrylite{(Pt,Rh)(As,Sb,S)2} were observed as a platinum group ore minerals in microscopic observation and EPMA analysis. These minerals show irregular shape with 10 30 μm size and exist in boundary between pentlandite and chalcopyrite or sulphide minerals and cumulus mineral (orthopyroxene).

Previous work points out that merenskyite (PdTe2) and holligworthite (RhAs2) are observed as other platinum group minerals (E.P.O.645) (M.D.Prendergast and A.H.Wilson, 1989).

5-3 Considerations

Exploration work in this area was carried out by UNION CARBIDE (E.P.O.193) and CLUFF (E.P.O.654), mineralization zone of platinum group elements were encountered.

Trough Phase II and III survey, Mineralization of PGM was encountered by all drill holes. It is considered that PGM occur in upper most of bronzitite zone and this area may have a continuous mineralization zone similar to other platinum mining areas along the Great Dyke.

As the result of this survey, summary of mineralization in this area is shown in Fig.II-5-20.

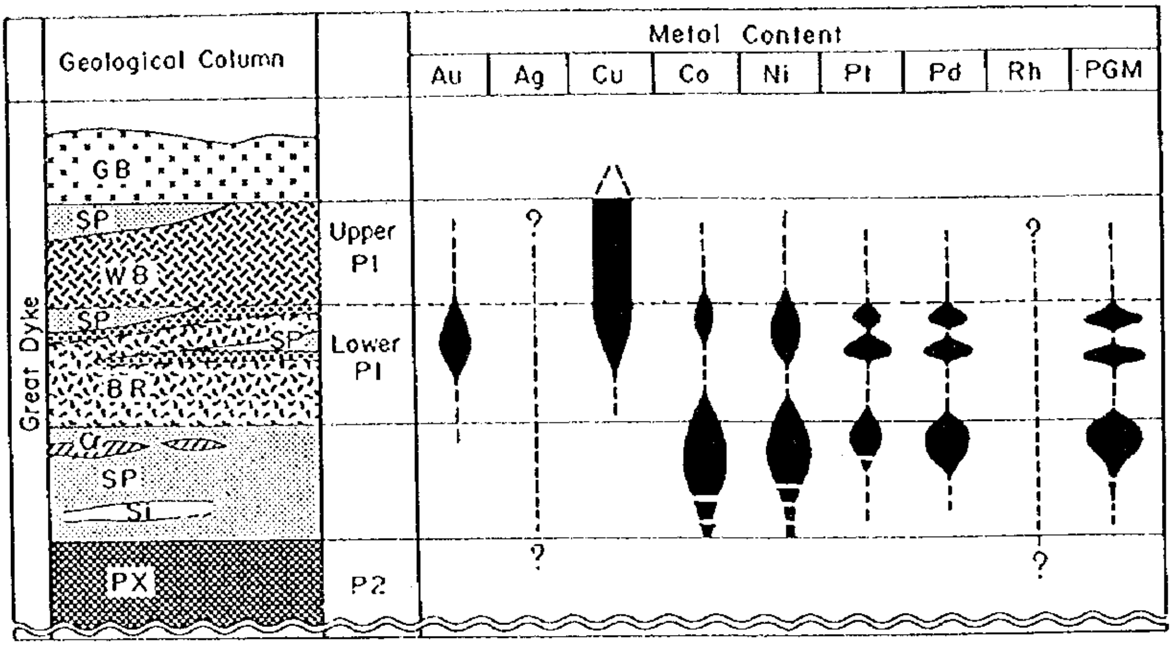

Fig.II-5-20 Summary of the mineralization

Moncheite and Sperrylite are observed as a PGM minerals, they are closely assemblaged with sulphide minerals like a pyrrhotite, Pentlandite, chalcopyrite, etc., and occur especially boundary portion between pentlandite and chalcopyrite or sulphide minerals and cumulus minerals.

Host rock of mineralization is the bronzitite which include large quantities of orthopyroxene in the field, however, it is olivin websterite lithologically because it include some amount of clinopyrixene and olivin under the microscopic observation.

Distribution zone of PGM situate in the lowest portion of sulphide mineralization zone, these concentration peak does not always situate at the same place. Regarding to difference between both concentration zone of sulphides and PGM, the tendency of decreasing of clinopyroxene is recognized in the PGM mineralization zone by microscopic observation however it is difficult to decide its boundary by naked eye.

Through Phase II and III survey, maximum thickness of sulphide mineralization zone is 42m(MJZS-7) but maximum metal content of PGM is about 1 g/t. On the other hand, the Hartley Mine which developed recently published their ore reserves and grading as follows (Introducing Hartley Platinum, Zimbabwe : BHP Joint Venture with Delta Gold N. L.).

Reserves	:	50.9 million tonnes (proven and probable)	
Grading	:	2.64 g/t Platinum	1.8 g/t Palladium
		0.21 g/t Rhodium	0.47 g/t Golg
		0.17 % Nickel	0.14 % Copper
Another	:	116 million tonnes of resource has been identified from diamond drilling	

Snake Head area is generally low grade of PGM compared with the Hartley Mine, it is considered that the grade of concentration of PGM may be low in this survey area, and in addition, this area is under poor infrastructure, some difficulty may exist to develop a new mine at present.

Previous works are pointing out following things.

Great Dyke has a ship bottom structure in transverse direction, cyclic units of each formation decrease their thickness in both rim portion and increase their thickness in axial portion (Allan H. Wilson and Marian Tredoux 1990). The form and thickness of mineralization zone are about similar at all platinum mining area in Great Dyke (M.D.Prendargast and Reid R. Keays 1989). In the case of rim portion of Great Dyke, MSZ decrease the thickness(2.3m) shows high metal content, and mineralization zone of PGM become about 1.5m in MSZ, in the case of axial potion, MSZ shows comparatively low grade and become more than 20m thickness (M.D.Prendargast and A.H.wilson 1989).

It may be consider that the result of drilling is reflecting the characteristics of Great Dyke as the reason why the metal content is comparatively low.

Chapter 6 Considerations of the Survey Results

6-1 Controls on Mineralization Related to the Geological Structure and Characteristics of the Mineralization

The Great Dyke is a layered basic intrusion, whose PGM, Ni, and Co ore deposits are reported to occur mainly in the P1 layer just under the gabbroic rocks.

Same mineralized zone was recognized in the Mimosa Mining area of Wedza complex, The Unki area of the Selukwe complex, and the Zinka, Selous, Hartley mining area of the Hartley complex.

Upper gabbroic rocks are widely distribute in the center portion of the survey area. Rock facies move to lower peridotite(dunite, harzburgite) pass through multi layered pyroxenite.

The sulphide mineralization which can be observed with naked eye mainly occur in the P1 layer of the upper most pyroxenite layer. Chromite occur mainly in the lower pyroxenite layer.

Sulphide minerals in the mineralized zone consist of pyrrhotite, pentlandite, chalcopyrite as essential minerals and the pyrite, magnetite, chromite as a accessory minerals. Small quantities of violarite, millerite, goethite occurring as secondary minerals were also recognized.

Layering in the western block shows a N-S to NE-SW direction of strike and E to SE direction of dip, whereas the layering in the central block shows a N-S direction of strike and E direction of dip in the northern portion and W direction of dip in the southern portion. The layering in the eastern block shows a N-S to NE-SW direction of strike and W to NW direction of dip.

These layering can be pursued in the field.

6-2 Relationship between Geochemical Anomaly and the Mineralization

(1) Metal concentration and geological position

Gold, platinum, and palladium show a narrow continuous distribution, confined to the middle portion of the P1 layer. Platinum and palladium were also partially detected in the serpentinite layer, below P1 pyroxenite.

Silver and rhodium show low grade and wide a distribution, not corresponding to geology. Silver has no correlation with other elements, suggesting that it has a different condition of concentration compared to these elements. Distribution of the population of Rhodium is difficult because samples shown above the detectable limit are very few.

Copper is divided into 2 clear different populations, continuously concentrated in upper portion of P1 layer. Sulphide dissemination which correspond to high copper concentrated zone is recognized in the field, therefore, copper concentrated zone suggest to existence of mineralization.

Cobalt and nickel show a clear and continuous zone high concentration in the lower portion of P1 layer and lower serpentinite layer. The distribution of cobalt and nickel seem to reflect the geology.

(2) Comparison of each geochemical survey area

As regard gold and PGM elements, the area expected to high concentration of metals is the WS area, followed by the northeastern portion of the WN area and northern portion of CB area. though the southwestern portion of the WN area is divided into small area by faulting, local metal concentration are recognized. Southern portion of the CB area shows weak metal concentrations, distribution of concentrations become patchy. EN and ES areas show no concentration.

6-3 Relationship between Geophysical Anomaly and the Mineralization

The characteristics of high chargeability anomalies in this area is not accompanied by low resistivity distribution.

As a result of physical property tests, it was proved that the sample which has sulphide content are in the order of 1.0mV/V to 2.5mV/V and do not show a great deal of contrast with the host rock. This probably results from minor quantities of sulphide. On the other hand, Serpentinite with chromite($FeCr_2O_4$) shows high chargeability(50mV/V), and also shows high resistivity(over 500 W×m). Difference was found between this sample and other rocks in chargeability.

As a result of 2-D simulation analysis, it was estimated that the anomaly in the western part of area result from polarizable body which correspond to Serpentinite. And it was also estimated that the anomaly at the deep part between stations No.6 and No.10 on E, H, I, J, K, L, M, N survey lines result from polarizable body which correspond to the deeper part of Serpentinite or the basal part of Pyroxenite(P1).

The relationship between grade of sulphide and chargeability can not be decided because of the variety of resistivity of host rock or connection between each sulphide minerals. But it can be stated that it is difficult to find out low-grade sulphide target(under %-order) by IP survey.

6-4 Results of drilling and mineralization

Trough Phase II and III survey, Mineralization of PGM was encountered by all drill holes. It is considered that PGM occur in upper most of bronzitite zone and this area may have a continuous mineralization zone similar to other platinum mining areas along the Great Dyke.

A summary of the sulphide mineralization zone of each hole which can be observed by the naked eye are as follows.

Hole No.	Depth(m)	Mineralization	Main Suiphides
MJZS-1	226.00～260.00	disseminate	Po, Pn, Cp, Py,
MJZS-2	266.00～274.00	disseminate	Po, Pn, Cp, Py,
MJZS-3	263.50～273.50	disseminate	Po, Pn, Cp, Py,
MJZS-3	355.00～351.00	disseminate	Po, Pn, Cp, Py,
MJZS-4	70.00～ 87.00	disseminate	Po, Pn, Cp, Py,
MJZS-4	143.00～153.00	disseminate	Po, Pn, Cp, Py,
MJZS-5	160.00～172.50	disseminate	Po, Pn, Cp, Py,
MJZS-6	327.00～348.00	disseminate	Po, Pn, Cp, Py,
MJZS-7	443.00～485.00	disseminate	Po, Pn, Cp, Py,
MJZS-8	556.00～564.00	disseminate	Po, Pn, Cp, Py,
MJZS-8	610.00～626.00	disseminate	Po, Pn, Cp, Py,
MJZS-9	331.00～343.00	disseminate	Po, Pn, Cp, Py,
MJZS-9	396.00～399.00	disseminate	Po, Pn, Cp, Py,
MJZS-10	370.00～400.50	disseminate	Po, Pn, Cp, Py,

Metal content of the platinum group elements in the sulphide mineralization zone is as follows.

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-1	249.00～249.50	396	228	--	624
MJZS-1	249.50～250.00	533	434	12	979
MJZS-1	250.00～251.00	490	425	15	930
MJZS-1	251.00～252.00	336	421	15	772
MJZS-2	271.00～271.50	389	374	19	782
MJZS-3	348.00～349.00	583	331	14	928
MJZS-3	349.00～350.00	510	355	51	916
MJZS-3	350.00～351.00	438	394	47	924
MJZS-4	151.00～152.00	426	111	--	537
MJZS-4	152.00～153.00	270	81	--	451
MJZS-5	168.50～169.50	598	147	17	762
MJZS-5	169.50～170.50	518	138	15	671
MJZS-5	170.50～171.50	467	152	29	648
MJZS-5	171.50～172.50	431	188	24	643
MJZS-6	338.00～339.00	534	79	--	613
MJZS-6	339.00～340.00	541	145	15	701

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-6	341.00~342.00	511	154	27	692
MJZS-7	468.00~469.00	339	266	--	605
MJZS-7	469.00~470.00	514	442	27	983
MJZS-7	470.00~471.00	486	412	20	918
MJZS-7	471.00~472.00	256	394	24	673
MJZS-7	472.00~473.00	195	398	25	619
MJZS-8	616.00~617.00	423	301	10	734
MJZS-8	617.00~618.00	392	264	26	682
MJZS-8	618.00~619.00	274	332	37	643
MJZS-10	376.00~377.00	329	214	--	543
MJZS-10	377.00~378.00	384	271	19	675
MJZS-10	378.00~379.00	304	238	12	553

6-5 Potential of ore deposits

Through Phase II and III survey, maximum thickness of sulphide mineralization zone is 42m(MJZS-7) but maximum metal content of PGM is about 1 g/t. On the other hand, the Hartley Mine which developed recently published their ore reserves and grading as follows

Reserves	:	50.9 million tonnes (proven and probable)	
Grading	:	2.64 g/t Platinum	1.8 g/t Palladium
		0.21 g/t Rhodium	0.47 g/t Golg
		0.17 % Nickel	0.14 % Copper

Snake Head area is generally low grade of PGM compared with the Hartley Mine, it is considered that the grade of concentration of PGM may be low in this survey area, and in addition, this area is under poor infrastructure, some difficulty may exist to develop a new mine at present.

Part III Conclusion and recommendation

Part III Conclusion and Recommendation

Chapter 1 Conclusion

The Snake Head area is the expected area where a high potential for existence of Platinum group metals deposit. The survey was carry out in order to explore for new deposits through 3 years.

The literature search(150km^2), the geological survey, the geochemical survey(22.25km^2) and geophysical survey(total line length 32km) were carried out as the Phase I of this project. Drillings were carried out as the Phase II and III of this project.

Results of this survey are summarized below.

Summary of the survey.

Literature search	Geological map, previous work report, papers etc.
Geological survey	Area 150km2, route length 68.3km
Geochemical survey	Area 22.25km2, samples 1,366
Geophysical IP survey	Survey lines 16, total length 32km
Drilling	10 holes, total length 2,500.74m
Others	Laboratory test

As the result of the literature search and the geological survey, upper gabbroic rocks are widely distribute in the center portion of the survey area. Rock facies move to lower peridotite(dunite, harzburgite) pass through multi layered pyroxenite.

The sulphide mineralization which can be observed with naked eye mainly occur in the P1 layer of the upper most pyroxenite layer. These layering can be pursued in the field.

As the result of the geochemical survey, the mineralization zone of the PGM corresponds well to the concentrate zone of platinum group elements of the drilling survey. The geochemical survey using rock samples is useful for the platinum exploration.

As the result of the geophysical survey, the result of the geophysical IP survey do not show a clear correspondence against the mineralization zones obtained by drillings. The reason may be that the why the sulphide content in the mineralized zone is few, and a clear difference of chargeability between mineralized rock and country rock does not show.

As the result of drillings, Mineralization of PGM was encountered by all drill holes. It is considered that PGM occur in upper most of bronzitite zone and this area may have a continuous mineralization zone.

Metal content of the platinum group elements in the sulphide mineralization zone is as follows.

Hole No.	Depth(m)	Pt(ppb)	Pd(ppb)	Rh(ppb)	PGM(ppb)
MJZS-1	249.50~250.00	533	434	12	979
MJZS-1	250.00~251.00	490	425	15	930
MJZS-2	271.00~271.50	389	374	19	782
MJZS-3	348.00~349.00	583	331	14	928
MJZS-3	349.00~350.00	510	355	51	916
MJZS-4	151.00~152.00	426	111	--	537
MJZS-5	168.50~169.50	598	147	17	762
MJZS-5	169.50~170.50	518	138	15	671
MJZS-6	339.00~340.00	541	145	15	701
MJZS-6	341.00~342.00	511	154	27	692
MJZS-7	469.00~470.00	514	442	27	983
MJZS-7	470.00~471.00	486	412	20	918
MJZS-8	616.00~617.00	423	301	10	734
MJZS-8	617.00~618.00	392	264	26	682
MJZS-10	377.00~378.00	384	271	19	675

Moncheite and Sperrylite are observed as a PGM minerals, they are closely assemblaged with sulphide minerals like a pyrrhotite, Pentlandite, chalcopyrite, etc., and occur especially boundary portion between pentlandite and chalcopyrite or sulphide minerals and cumulus minerals.

However, through Phase II and III survey, maximum thickness of sulphide mineralization zone is 42m(MJZS-7) but maximum metal content of PGM is about 1 g/t. On the other hand, the Hartley Mine which developed recently published their ore reserves and grading as follows

Reserves : 50.9 million tonnes (proven and probable)
Grading : 2.64 g/t Pt 1.8 g/t Pd 0.21 g/t Rh 0.47 g/t Au

Snake Head area is generally low grade of PGM compared with the Hartley Mine, it is considered that the grade of concentration of PGM may be low in this survey area, it could not be attained to discover the new ore deposit that can expect to develop at present.

Chapter 2 Recommendation for the future

According to conclusions obtained through the survey results the method of the survey for the future is proposed as follows.

(1) Further drilling survey must be carried out in the north-eastern portion of the WN area and the northern portion of the CB area in order to study the probability of the existence of the platinum ore deposit.

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