North Fiji Basin magma sources is directly influenced by two sources of the surrounding active or dead subduction zones and the regional oceanic island basalt, and a mixing of the above to sources and N-MORB controlled the magma genesis. The eruption age of the both basalts from the West and East Areas seem to be similar, however, these differences of chemical character occur between the two basalts collected from close locations of the West and East Areas in the Triple Junction Area. The characteristic chemical futures depending on the geological unit, such as basalts of footwall, stockwork zone and on the surface, were not observed.

3-3-6 Mineralization of the Area

For understanding and evaluation of the mineralization of the area, ore microscopy of polished thin section, assaying, X-ray diffraction analyses and geochemical consideration were conducted.

3-3-6-1 Ore Microscopy

A total of 25 polished thin sections were prepared for microscopic work. The list of the samples for microscopic work together with the samples of assaying is given in Table3-3-6-1. The summaries, photographs and descriptions of the ore microscopy are, respectively, given in Table3-3-6-2, Appendices 10 and 11.

The studied samples are mound, fragment of chimney, veins of the stockwork zone and hyaloclastite. The sequences of crystallization estimated by microscopic observations are given in Figure 3-3-6-1.

The most of the massive sulfide samples constituting the mound are collected in the West Area. They mainly consist of pyrite and calcopyrite associated by marcasite and sphalerite, and coveline and bornite are rarely observed. The gangue minerals are barite, chalcedony quartz, smectite and goethite. The chalcopyrite tends to be abundante in the samples of less marcasite. While, sphalerite tends to be abundante in marcasite-rich samples. Three types of pyrite with different textures occur: dendritic pyrite, colloform-framboidal pyrite and isolated euhedral pyrite grains. Among them the dendritic pyrite precipitated at the first stage followed by colloform-framboidal pyrite. Similar to pyrite, two types of marcasite, dendritic and colloform-framboidal, are observed, and a close association of these marcasites with the pyrite of dendritic and colloform-framboidal texture suggests a simultaneous crystallization of these two minerals. Calcopyrite usually occurs surrounding pyrite and marcasite, and it coexists with sphalerite. This suggests a simultaneous precipitation of chalcopyrite and sphalerite after the precipitation of pyrite and marcasite with dendritic and

Table 3-3-6-1 Sample List of Polished Thin Section and Ore Assay

Area	Ore Showing	Hole No.	Polished thin section	Assay	Core Barrel No. : position	Type of Ore	Remarks
West Area	W1	01SFBMS12		AS01	No.1 : 0-50cm	massive sulfide	cp, py, porous ore
			PL01		No.1 : 15cm	massive sulfide	cp, py, porous ore
	W3	01SFBMS08		AS01	No.1 : 0-96cm	massive sulfide	cp, py
			PL01		No.1 : 50cm	massive sulfide	cp>py
			PL02		No.1 : 60cm	massive sulfide	black ore cp, py, sph
				AS02	No.2 : 0-26cm	massive sulfide	cp-py
			PL03		No.2 : 5cm	massive sulfide	cp rich, framboidal texture
			PL04		No.2 : 10cm	massive sulfide	black part, cp, py dissemination
			PL05		No.3 : 25cm	massive sulfide	py rich part
				AS03	No.3 : 0-50cm	massive sulfide	py, cp
			PL06		No.4 : 30-35cm	altered hyaloclastite	py dissemination, footwall
		01SFBMS24		AS01	No.1 : 0-55cm	massive sulfide	py, cp
			PL01		No.1 : 20cm	massive sulfide	py, cp
				AS02	No.2 : 0-28cm	massive sulfide	cp, py
			PL02		No.2 : 20cm	massive sulfide	cp, py
				AS03	No.3 : 0-28cm	massive sulfide	cp, py
			PL03		No.3 : 20cm	massive sulfide	cp, py part and black matrix
				AS04	No.4 : 0-15cm	massive sulfide	cp, py, fragments
				AS05	No.5 : 0-20cm	massive sulfide	py, cp
			PL04		No.5 : 0-20cm	massive sulfide	py, cp, sph, mainly gray matrix
			PL05	AS06	No.6 : 20-35cm	altered hyaloclastite	cp, py dissemination, footwall
	W4	01SFBMS09	PL01		No.2 : 40cm	vein in basalt	stockwork zone, py dissemination
	W6	01SFBMS10		AS01	No.1 : 5-13cm	massive sulfide	black ore composed of Cp and Py
				AS02	No.2 : 0-40cm	massive sulfide	cp, py rich part with black matrix
			PL01		No.2 : 20cm	massive sulfide	unclear boundary between py>cp part and matrix
			PL02		No.2 : 30cm	massive sulfide	cp>py patch
			PL03		No.2 : 35cm	massive sulfide	cp>py patch and matrix
		01SFBMS26		AS01	No.1 : 0-25cm	massive sulfide	py, cp
			PL01		No.1 : 20cm	massive sulfide	py, cp
	W7	01SFBMS06	PL01		No.3 : 13cm	vein in basalt	vein with py and cp, in stockwork zone, width 5mm
				AS01	No.3 : 23-26cm	vein in basalt	vein with py and cp, in stockwork zone, width 5mm
East Area	E1	01SFBMS14	PL01	AS01	sample except BMS hole	fragment of massive sulfide	cp, py, sph
	E4	01SFBMS20	PL01	AS01	No.1 : 8-15cm	black oxides	porous black oxidized sample composed of py, cp
			PL02	AS02	sample except BMS hole	fragment of massive sulfide	py, cp, sph, Sample A, ϕ 20cm
			PL03	AS03	sample except BMS hole	fragment of massive sulfide	py, cp, sph, Sample B, ϕ 20cm
	E12	01SFBMS23	PL01	AS01	No.1 : 0-10cm	massive sulfide	py, cp, sph
	E13	01SFBMS17	PL01	AS01	No.1 : 0-26cm	fragment of massive sulfide	cp, py, sph
	E13	01SFLC17	PL01	AS01	0-10cm	fragment of massive sulfide	py, cp, sph, ϕ 10cm

py: Pyrite, cp: Chalcopyrite, sph: Sphalerite

Table 3-3-6-2 Results of Microscopic Observation of Polished Thin Sections (West Area:1/2)

Area	Ore Showing	Hole No.	Sample No.	Type of Ore	Ore mineral									Gangue mineral					Remarks
					Pyrite	Marcasite	Chalcopyrite	Sphalerite	Wurtzite	Covelline	Bornite	Chalcocite	Nickelite	Barite	Quartz	Glass	Goethite	Smectite	
West Area	W1	01SFBMS12	PL01	Massive sulfide (MD)	◎	·	○	·		×					·				medium size grain, compacted massive sulfide (Py-Cp) ore.
	W3	01SFBMS08	PL01	Massive sulfide (MD)	◎	·	◎									·		×	Py : 2 stages of minelarization (dendritic→colloform), Cp : replacing Py and fossil
			PL02	Massive sulfide (MD)	◎		◎									·		△	Py : 2 stage of minelarization (dendritic→colloform), Cp : replacing Py, partly coexist with Py
			PL03	Massive sulfide (MD)	·		◎								△			?	Cp rich, grain size varies in certain direction. Coarse grained part is porous.
			PL04	Massive sulfide (MD)	○	·	○	·						·	·	·	·	·	fragments of Py and Cp, reworked ore, tiny veins of Sph are found in Py and Cp grains.
			PL05	Massive sulfide (MD)	◎	○	△	×					?			·		×	Py : 2 stages of minelarization (dendritic→colloform), partly crushed to fragment
			PL06	altered hyaloclastite	◎										○	·	×	×	detrital sandstone including Py. grain size of Py is variably.
		01SFBMS24	PL01	Massive sulfide (MD)	◎	△	◎	△							·			×	massive sulfide (Py-Cp) ore with prominent layering。
			PL02	Massive sulfide (MD)	◎	·	◎	△							·			·	massive sulfide (Py-Cp) ore
			PL03	Massive sulfide (MD)	◎	△	○	×		·				△		△	·		detrital tuffaceous rock including the fragments of sulfide, the formation of sulfide is variably
			PL04	Massive sulfide (MD)	◎	·	×	×							◎				strongly silicified rock including Py
			PL05	altered hyaloclastite	◎	·	△	·							△		·	×	sulfide ore consisting of fragments, fragments of silicified rock and basalt lava are included.
	W4	01SFBMS09	PL01	vein within Basalt (ST)	·	◎	×	·						△		△		·	country rock is glassy basalt disseminated by marcasite.
	W6	01SFBMS10	PL01	Massive sulfide (MD)	◎		·	·		×				○		△	·	·	consists of sulfide minerals with colloform texture.
			PL02	Massive sulfide (MD)	○	·	◎	×		×				·	×	·			massive sulfide ore, partially fine Py and Cp with colloform texture are covered by Ba
			PL03	Massive sulfide (MD)	◎	·	○	×		·	·			·	×	·		·	massive and layering sulfide (Cp-Py) ore
		01SFBMS26	PL01	Massive sulfide (MD)	○	◎	×	×							△			·	layered sulfide ore with Mc-Py.
	W7	01SFBMS06	PL01	vein in Basalt (ST)	◎	△									○		○	○	Py with framboidal or colloform texture in brecciated basalt

MD : mound, CM : fragment of chimney, ST : stockwork zone

◎ : abundant ○ : common △ : poor · : rare × : trace

Py : Pyrite, Cp : Chalcopyrite, Sph : Sphalerite, Mc : Marcasite, Wu : Wurtzite, Ba : Barite

Table3-3-6-2 Results of Microscopic Observation of Polished Thin Sections (East Area : 2/2)

Area	Ore Showing	Hole No.	Sample No.	Type of Ore	Ore mineral									Gangue mineral					Remarks
					Pyrite	Marcasite	Chalcopyrite	Sphalerite	Wurtzite	Covelline	Bornite	Chalcocite	Nickelite	Barite	Quartz	Glass	Goethite	Smectite	
East Area	E1	01SFBMS14	PL01	Massive sulfide (CM)	◎	△	△	·		×					·				Layered Py-Cp-Sph ore. Py has colloform or stromatolite texture.
	E4	01SFBMS20	PL01	Black oxide ore (MD)	○		·	△		×		×		·		·	·	·	Tuffaceous sulfide disseminated ore consists of fragments
			PL02	Massive sulfide (CM)	◎	◎	△	△		×					·		×	·	Massive sulfide ore with variable grain size
			PL03	Massive sulfide (CM)	◎	◎	○	△							·			×	Layered massive sulfide ore.
	E12	01SFBMS23	PL01	Massive sulfide (MD)	○	◎	△	·	·						·			·	Sulfide minerals are covered by chalcedony Quartz.
	E13	01SFBMS17	PL01	Massive sulfide (CM)	·	◎	×	◎	△						·				Mc-Sp h massive ore with chalcedony matrix
		01SFLC17	PL01	Massive sulfide (CM)	·	△	◎	×							·		×	·	Massive Cp ore with variable grain size grain

MD : mound, CM : fragment of chimney, ST : stockwork zone

◎ : abundant ○ : common △ : poor · : rare × : trace

Py : Pyrite, Cp : Chalcopyrite, Sph : Sphalerite, Mc : Marcasite, Wu : Wurtzite, Ba : Barite

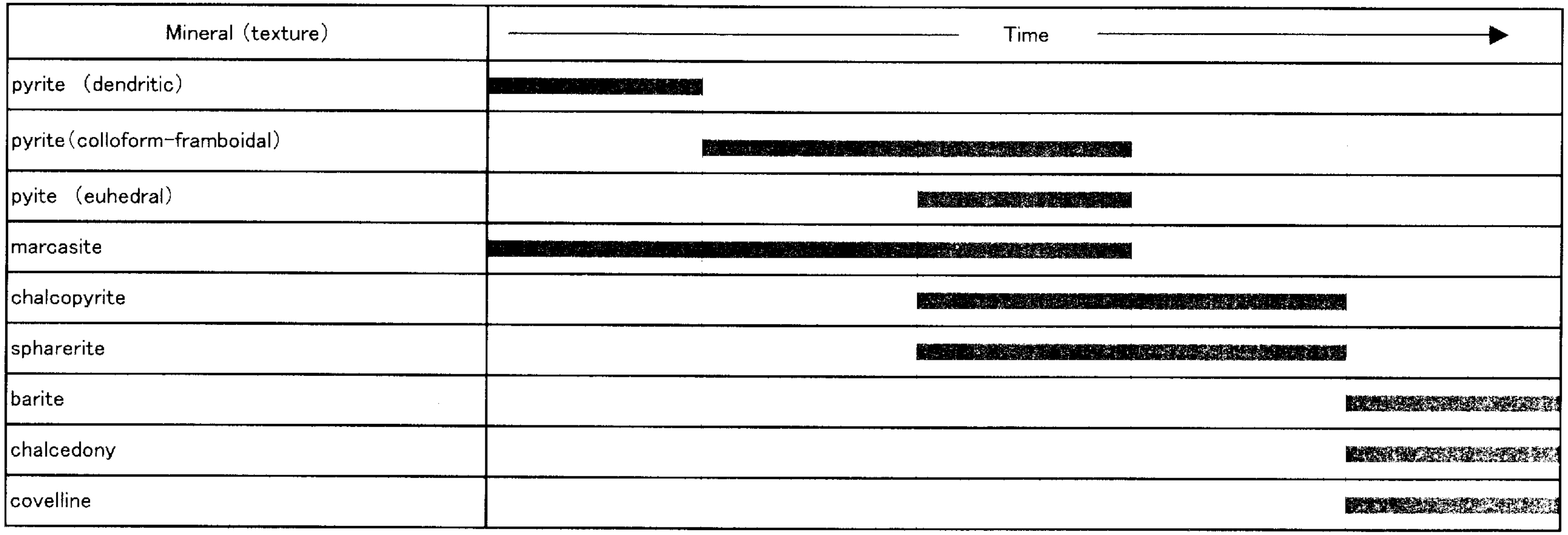


Figure 3-3-6-1 Sequence of Crystalization

colloform-framboidal textures. Coveline occurs along the cleavages of and surrounding the calcopyrite grains, and barite and chalcedony quartz, precipitated at the latest stage, occur interstitially. The sequences of ore minerals precipitation in the Triple Junction Area is similar to those of the White Lady Site reported by Bendel et al. (1993). The some of the massive sulfide samples, 01SFBMS08PL04, 01SFBMS10PL01 and 01SFBMS24PL03, show a clastic texture consisting of fragments such as massive sulfide, pyrite, calcopyrite and volcanic glass. This suggests that tectonic and erosion events during or after formation of the mounds.

The massive sulfide samples of chimney fragments are collected only from the East Area. Marcasite, calcopyrite, pyrite and sphalerite are main constituents of the massive sulfide of the chimney and they are associated by coveline and wurtzite. The gangue minerals of the are quartz, goethite and smectite. Compared with the massive sulfide of the mound collected from the West Area, the amounts of the marcasite and sphalerite are more in the chimney fragments. The sequences of ore mineral participation in chimney fragments are similar to those of the mound samples. Pyrite and marcasite of colloform-framboidal textures precipitated at the first stage, followed by euhedral pyrite. These phases are surrounded by calcopyrite and sphalerite simultaneously precipitated with calcopyrite.

Two altered hyaloclastite samples from the same mound (Ore Showing W3) show different mineral assemblages. Pyrite is the only sulfide mineral in 01SFBMS08PL06, while an assemblage of pyrite-calcopyrite-marcasite-sphalerite occurs in 01SFBMS24PL05. The sulfide veins in the basalt of the stockwok zone consist of mainly marcasite and associated by sphalerite, chalcopyrite and barite in 01SFBMS09PL01 and pyrite, marcasite and quartz in 01SFBMS06PL01.

3-3-6-2 Grade of ore samples

Ore assaying was conducted for 21 samples. The results and analytical methods are given in Table 3-3-6-3 and Appendix 9. The massive sulfide samples for assaying were taken along the whole length of drill core. Since the core recovery of this survey is not good, thickness of the massive sulfide was estimated from the observations of drilling operation and the drill core. The estimated thickness of the massive sulfide is given in Table 3-3-6-3. The average grades of ore in the Triple Junction Area are given in Table 3-3-6-4, together with average grades of ores of typical sea floor hydrothermal mineralization sites in the world.

The assayed samples consist of massive sulfide of mound, fragments of chimney, altered hyaloclastite of alteration zone and veins in the basalt of stockwork

Table 3-3-6-3 Results of Ore Assay

	Ore Showing	Hole No.	Sample No.	Type of Ore	Core Barrel No. : position	Thickness of Ore Body (estimated)	Cu %	Ni %	Co %	Fe %	As %	S %	Pb %	Zn %	Au g/t	Ag g/t
West Area	W1	01SFBMS12	AS01	massive sulfide (MD)	No.1: 0-49cm	215cm	2.70	<0.005	0.014	36.4	0.01	53.10	0.02	0.53	0.36	20.0
	W3	01SFBMS08	AS01	massive sulfide (MD)	No.1 : 0-96cm	165cm	15.00	<0.005	0.058	25.7	0.01	33.50	0.01	0.16	0.61	11.6
			AS02	massive sulfide (MD)	No.2 : 0-26cm	219cm	5.96	<0.005	0.062	28.0	0.01	39.20	0.04	0.53	0.78	20.8
			AS03	massive sulfide (MD)	No.3 : 0-50cm	212cm	1.99	<0.005	0.074	35.1	0.02	48.70	0.04	1.69	1.82	34.4
		01SFBMS24	AS01	massive sulfide (MD)	No.1 : 0-55cm	132cm	5.84	<0.005	0.030	30.9	0.01	42.70	0.01	0.72	0.96	34.8
			AS02	massive sulfide (MD)	No.2 : 0-28cm	28cm	13.40	<0.005	0.028	30.8	<0.01	42.10	0.01	0.64	0.62	35.2
			AS03	massive sulfide (MD)	No.3 : 0-28cm	220cm	8.45	<0.005	0.026	26.3	<0.01	35.50	0.02	0.50	0.75	25.2
			AS04	massive sulfide (MD)	No.4 : 0-15cm	216cm	9.33	<0.005	0.026	26.9	<0.01	34.30	0.01	0.18	0.52	34.8
			AS05	massive sulfide (MD)	No.5 : 0-20cm	166cm	1.06	<0.005	0.028	27.1	<0.01	33.40	0.01	0.17	0.17	5.6
			AS06	altered hyaloclastite	No.6 : 20-35cm	-	4.57	<0.005	0.034	31.2	<0.01	37.50	0.01	0.46	0.30	16.6
	W6	01SFBMS10	AS01	massive sulfide (MD)	No.1 : 5-13cm	96cm	13.50	<0.005	0.124	25.2	0.02	36.00	0.03	0.24	0.39	8.2
			AS02	massive sulfide (MD)	No.2 : 0-40cm	40cm	17.15	<0.005	0.052	20.1	0.01	29.00	0.02	0.46	0.35	11.8
		01SFBMS26	AS01	massive sulfide (MD)	No.3 : 0-25cm	25cm	0.24	<0.005	<.002	28.6	0.03	38.30	0.14	1.24	4.53	90.8
	W7	01SFBMS06	AS01	vein in basalt (ST)	No.3 : 23-26cm	-	0.28	<0.005	0.002	10.6	0.01	12.35	0.01	0.15	0.15	7.0
East Area	E1	01SFBMS14	AS01	massive sulfide (CM)	sample attached to BMS body	φ11cm	1.16	<0.005	0.002	29.9	0.03	40.10	0.06	3.12	2.70	75.0
	E4	01SFBMS20	AS01	massive sulfide (MD)	No.1 : 8-15cm	80cm	2.01	<0.005	<.002	10.4	0.02	17.35	0.26	8.17	1.69	210.0
			AS02	massive sulfide (CM)	sample attached to BMS body	φ20cm	3.48	<0.005	0.048	29.7	0.01	39.10	0.04	4.39	1.45	84.4
			AS03	massive sulfide (CM)	sample attached to BMS body	φ20cm	2.95	<0.005	0.066	28.1	0.01	37.50	0.03	3.29	1.00	60.2
	E12	01SFBMS23	AS01	massive sulfide (MD)	No.1 : 0-10cm	10cm	1.28	<0.005	<.002	26.3	0.01	32.20	0.07	2.28	1.62	62.2
	E13	01SFBMS17	AS01	massive sulfide (CM)	No.1 : 0-26cm	φ20cm	7.21	<0.005	0.006	24.5	0.02	35.70	0.06	4.84	2.93	99.4
		01SFLC17	AS01	massive sulfide (CM)	0-10cm	φ10cm	5.38	<0.005	0.024	33.3	<0.01	39.00	0.03	0.22	1.07	37.0

MD : Mound, CM : Fragment of Chimney, ST : Stockwork zone

Table 3-3-6-4 Average of Ore Grade

	Ore Showing	Hole No.	Type of Ore	Number of Samples	Thickness of Ore Body	Cu %	Ni %	Co %	Fe %	As %	S %	Pb %	Zn %	Au g/t	Ag g/t
West Area	W1	01SFBMS12	mound	1	215cm	2.70	<0.005	0.014	36.4	0.01	53.10	0.02	0.53	0.36	20.0
West Area	W3	01SFBMS08	mound	3	596cm	7.05	<0.005	0.065	29.9	0.01	41.00	0.03	0.84	1.10	23.1
West Area	W3	01SFBMS24	mound	5	762cm	6.82	<0.005	0.027	27.6	<0.01	36.19	0.01	0.38	0.59	25.7
West Area	W3		alteration zone	1	-	4.57	<0.005	0.034	31.2	<0.01	37.50	0.01	0.46	0.30	16.6
West Area	W3	Average of W3		8	679cm	6.93	<0.005	0.050	28.75	<0.01	38.60	0.02	0.61	0.85	24.39
West Area	W 6	01SFBMS10	mound	2	136cm	14.57	<0.005	0.103	23.7	0.02	33.94	0.03	0.30	0.38	9.3
West Area	W 6	01SFBMS26	mound	1	25cm	0.24	<0.005	<.002	28.6	0.03	38.30	0.14	1.24	4.53	90.8
West Area	W7	01SFBMS06	stockwork zone	1	-	0.28	<0.005	0.002	10.6	0.01	12.35	0.01	0.15	0.15	7.0
East Area	E1	01SFBMS14	fragment of chimney	1	φ11cm	1.16	<0.005	0.002	29.9	0.03	40.10	0.06	3.12	2.70	75.0
East Area	E4	01SFBMS20	mound	1	80cm	2.01	<0.005	<.002	10.4	0.02	17.35	0.26	8.17	1.69	210.0
East Area	E4		fragment of chimney	2	φ20cm	3.22	<0.005	0.057	28.9	0.01	38.30	0.04	3.84	1.23	72.3
East Area	E12	01SFBMS23	mound	1	10cm	1.28	<0.005	<.002	26.3	0.01	32.20	0.07	2.28	1.62	62.2
East Area	E13	01SFBMS17/LC17	fragment of chimney	2	φ10 - 20cm	6.30	<0.005	0.015	28.9	0.02	37.35	0.05	2.53	2.00	68.2

Average grade (After Iizasa et al. (1999))

		Number of Samples	Thickness of Ore Body	Cu %	Ni %	Co %	Fe %	As %	S %	Pb %	Zn %	Au g/t	Ag g/t
Arc front	Sunrise deposit, Myojin knoll	37		5.5			10.5			2.27	21.9	20.0	1213
	Suiyou seamount	11		11.9			14.6			0.77	20.6	27.7	190
Back arc Basin	Izena caldron	14		2.0			10.3			11.49	20.9	4.7	2806
	Lau basin	46		5.2			10.6			0.38	21.6	3.8	178
Mid-oceanic Ridge, slow spreading	TAG	31		7.8			24.0			0.04	11.1	2.9	80
	Snake Pit	36		9.2			34.4			0.05	6.2	2.0	87
Mid-oceanic Ridge, intermediate to fast spreading	Explorer	48		3.4			26.8			0.11	5.0	0.8	124
	Axial seamount	16		0.3			4.9			0.36	18.8	4.7	175
	East Pacific Rise, 13°N	6		6.0			23.0			0.08	14.8	1.2	80
	Galapagos	17		4.7			28.7			0.01	0.8	0.1	17
Average Kuroko deposit		-		1.5			15.0			1.00	3.0	0.5	50

zone.

The massive sulfides of mound collected from the West Area show a wide range of Cu, varying from less than 1.0 % to 17.1%. Varying Cu grade even at the same location, from 1.99% to 15.00% at 01SFBMS08 and from 1.06% to 15.00% at 01SFBMS24, suggests a considerable vertical variation of the massive sulfide of mound. Reflecting the high abundance of pyrite and marcasite in the massive sulfide, Fe and S are generally high, ranging, respectively, from 20.1% to 35.1% and from 29.00% to 53.10%. Pb, varying from 0.01% to 0.14%, is low. Zn ranges from 0.16% to 1.69%, and it seems to have close relations with Au and Ag. In accordance with Zn values, Au and Ag change their values proportionally, from 0.15g/t to 4.53g/t and from 4.6g/t to 90.8g/t.

The assayed samples in the East Area consist of two mound samples and five fragments of chimney. Although Cu is slightly low in the former compared with latter, there is no clear differences in grade of other elements between them. Compared with the samples of the West Area, the samples of the East Area have low Cu, ranging from 1.16% to 5.38%. Zn, Au and Ag, each of which, respectively, ranging from 0.22% to 8.17%, 1.00g/t to 2.93g/t and 37.0g/t to 210.0g/t, are high in the samples of the East Area These differences of the assay results between two areas are considered to be due to the facts that only mound samples were collected in the West Area and the samples of East Area consist of mainly chimney samples with some mound samples collected at only shallow level. According to the study of White Lady and Pere Lachaise sites (Bendel et al., 1993), the mound is filled by Cu rich ore covered by Zn-Fe rich ore and fragments of chimney on the surface. The constitution of the mounds in the Triple Junction Area seems to be similar to that of White Lady and Pere Lachaise sites. By the drilling of this survey, only Cu rich ore of the mound was collected in the West Area, while in the East Area, only Zn-Fe rich ore of the surface was collected.

The altered hyaloclastite of the footwall shows relatively high Cu grade of 4.57%. Cu and Zn of less than 1.0% were obtained from the vein of the stockwork zone.

As shown in Table 3-3-6-4, in the Ore Showing W3, massive sulfides of similar ore grade were obtained with lengths of 596cm and 762cm, respectively at 01SFBMS08 and 01SFBMS24. The average grades of the two sites are Cu6.93%, Zn0.61%, Au0.85g/t and Ag24.39g/t, and the mound of the Ore Showing W3 is expected to be composed of massive sulfide with these grades. By comparison with typical sea floor hydrothermal mineralization sites elsewhere in the world, the massive sulfide of the Ore Showing W3 have similar ore grade to that of the Midoceanic Ridge with high Cu and Fe, low Pb, Au and Ag. The ore samples of the Lau Basin, one of the backarc basin close to the North Fiji Basin, show lower Fe and higher Zu, Au and Ag compared to the massive sulfide of

Ore Showing W3.

3-3-6-3 X-ray Diffraction Analyses

The alteration related to the mineralization of the Triple Junction Area was studied by the X-ray diffraction analyses of 23 samples. The results of X-ray diffraction analyses and its analytical method are given in Table 3-3-6-5 and Appendix 9.

The samples of X-ray diffraction analyses consist of massive sulfide (mound and fragments of chimney), altered hyaloclastite, basalt of the stockwork zone and basalt on the surface. The identified minerals are quartz, plagioclase, clay minerals, mordenite, barite and sulfides.

Quartz was identified from six samples of the altered hyaloclastite. Smectite, mixed layers of chlorite/smctite chlorite, sepiolite and kaoline are clay minerals identified by the X-ray diffraction. Among them, mixed layers of chlorite/smectite, and chlorite are only found in the altered hyaloclasite with quartz. Pyrite occurs in all the samples.

Based on the identified minerals, the samples are classified into three alteration zones given below.

Zone I-a: The assemblage of mordenite and smectite characterizes this zone and it occurs in the peripheral area of the alteration zone. Some of the altered hyaloclastite belong to this zone.

Zone I-b: This zone is characterized by an association of quartz with either chlorite or mixed layers of chlorite/smectite. Most of the altered hyaloclastite samples belong to this zone.

Zone II: This zone corresponds to the center of the mineralization consisting of sulfides, such as pyrite, calcopyrite and sphalerite with an association of barite.

All of the altered hyaloclastite belong to either Zone I-a or Zone I-b. Among them, the samples belonging to Zone I-a were collected at the edge of mound (01SFBMS27XD01, 01SFBMS27XD02) or away from the massive sulfide (01SFBMS10XD03). While, the altered hyaloclastite of Zone I-b occurs directly beneath or at the vicinity of the massive sulfides.

In the Triple Junction Area, two alteration zones of different degree were identified surrounding the ore body of the massive sulfide. Zone I-b occurs close to the massive sulfide and Zone I-a occurs outside of Zone I-b. Barite occurs in the ore body

Table3-3-6-5 Results of X-ray Diffraction

Area	Ore Showing	Hole No.	Sample No.	Type of Ore or Rock	Geological Unit	Silica Minerals			Feldspar	Clay Mineral						Zeolite	Sulphate Mineral			Other Mineral							Alteration Zone
						Quartz	Cristobalite	Tridymite	Feldspar	Smectite	Sericite/Smectite	Chlorite/Smectite	Chlorite	Sericite	Kaolinite	Mordenite	Gypsum	Anhydrite	Barite	Marcasite	Pyrite	Chalcopyrite	Sphalerite	Galena	Sepiolite	Volcanic Glass	
West Area	W1	01SFBMS12	XD01	Massive Sulfide	Mound																13	2					ZoneII
West Area	W1	01SFBMS12	XD02	Altered Hyaloclastite	Alteration Zone	1			3				1								1				2	o	Zone I-b
West Area	W3	01SFBMS08	XD01	Massive Sulfide	Mound															2	3	21					Zone II
West Area	W3	01SFBMS08	XD02	Altered Hyaloclastite	Alteration Zone	20							1								7						Zone I-b
West Area	W3	01SFBMS24	XD01	Massive Sulfide	Mound																7	13					Zone II
West Area	W3	01SFBMS24	XD02	Altered Hyaloclastite	Alteration Zone	1							1							3	15	1					Zone I-b
West Area	W4	01SFBMS27	XD01	Altered Hyaloclastite	Alteration Zone				3							1					1				3		Zone I-a
West Area	W4	01SFBMS27	XD02	Altered Hyaloclastite	Alteration Zone					3						1				1	1						Zone I-a
West Area	W6	01SFBMS10	XD01	Massive Sulfide	Mound														2		4	6					Zone II
West Area	W6	01SFBMS10	XD02	Altered Hyaloclastite	Alteration Zone										1						6				2		Zone I-b
West Area	W6	01SFBMS10	XD03	Altered Hyaloclastite	Alteration Zone	2			1	o		5									2				2		Zone I-a
West Area	W6	01SFBMS26	XD01	Basalt	Beneath Ore Body				2												2					o	Zone I-b
West Area	W7	01SFBMS06	XD01	Vein within Basalt	Stockwork Zone														3		7						Zone II
West Area	W7	01SFBMS06	XD02	Altered Hyaloclastite	Alteration Zone	4						3															Zone I-b
West Area	W7	01SFBMS06	XD03	Altered Hyaloclastite	Alteration Zone	13			0			3															Zone I-b
West Area	W7	01SFBMS06	XD04	Altered Hyaloclastite	Alteration Zone				4			2									0						Zone I-b
East Area	E1	01SFBMS14	XD01	Altered Hyaloclastite	Alteration Zone				6												1				3		Zone I-b
East Area	E1	01SFBMS14	XD02	Altered Hyaloclastite	Alteration Zone								1													o	Zone I-b
East Area	E4	01SFBMS20	XD01	Massive Sulfide	Mound														5		2		10				Zone II
East Area	E4	01SFBMS20	XD02	Massive Sulfide	Fragments of Chimney														2	3	2	7	10				Zone II
East Area	E11	01SFBMS18	XD01	Altered Hyaloclastite	Alteration Zone				6												1				3		Zone I-b
East Area	E11	01SFBMS18	XD02	Altered Hyaloclastite	Alteration Zone				9												0				2		Zone I-b
East Area	E13	01SFBMS17	XD01	Massive Sulfide	Fragments of Chimney															14	4		7				Zone II

and veins of the srockwork zone.

3-3-6-4 Geochemical Considerations of the Miineralization

For understanding the geochemical characteristics related to the mineralization, chemical analyses were conducted for typical samples of each geological unit. The results of the chemical analyses and analytical method are given in Table 3-3-6-6 and Appendix 9. The statistical figures of each geological unit and correlation coefficients are given in Tables 3-3-6-7 and 3-3-6-8.

The chemical analyses were conducted for a total of 41 samples. They are unconsolidated sediments (3 samples), relatively fresh basalt (12 samples), basalt of the stockwork zone (3 samples), altered hyaloclastite (15 samples), massive sulfide of the chimney fragments (3 samples) and massive sulfide of mound (5 samples).

Among the three samples of unconsolidated sediments, reddish brown clay (01SFBMS21CM01) collected at the vicinity of mound seems to show the chemical characteristics affected by the mineralization. Compared to other two samples, it is enriched by metallic elements, such as Au, Co, Cu, Hg, Fe, Mn, Mo, Pb, Sb associated by high contents of As, Ba, K and P.

Since two types of relatively fresh basalts, ones collected on the surface and the others beneath the massive sulfides, show a similar chemical composition, they were treated as one geological unit of the basalt. The chemical compositions other than the basalt were divided by the average chemical composition of the basalt and the chemical compositions relative to the basalt are shown in Figure 3-3-6-2. Compared to the basalt, the basalts of the stockwok zone and altered hyaloclastite of the alteration zone are rich in Au, Ag, As, Bi, Cd, Co, Cu, Fe, Hg, Mo, Pb, Sb, W and Zn. This suggests that these elements were enriched by the mineralization. While, compared to the basalt, Al, Be, Ca, K, Mn, Na, P and Sr are less in the basalts of the stockwok zone and altered hyaloclastite of the alteration zone, suggesting a possible subtraction of theses elements by the mineralization.

Among the massive sulfide samples, Au, Ag, Cd, Hg, Pb, Sb and Zn are higher in the fragments of chimney compared to the mound samples and Bi, Cu, Mo and W are lower in the fragments of chimney, showing that the massive sulfide of chimney and the mound.have different chemical characteristics. This is, also, seen in the correlation coefficient. Two groups of elements with high correlation coefficient were obtained as shown below.

A. Cu-Co-Fe-Mo

Table 3-3-6-6 Results of Geochemical Analysis (1/2)

	Ore Showing	Hole No.	Sample No.	Type of Ore or Rocks	Geological Unit	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg
						ppb	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppb
West Area	W1	01SFBMS12	CM01	Massive Sulfide	Mound	240	23.30	0.04	141.0	72.0	0.05	0.70	0.03	16.70	91.7	173	25700.0	>25.0	410
			CM02	Altered Hyaloclastite	Alteration Zone	10	4.34	8.59	4.6	164.5	1.50	0.67	2.30	0.38	27.7	227	5390.0	3.96	80
			CM03	Basalt	Footwall	<5	1.76	8.76	4.0	45.5	0.35	0.05	6.90	5.30	44.8	182	870.0	6.83	50
	W3	01SFBMS08	CM01	Massive Sulfide	Mound	570	12.15	0.68	58.2	5.5	0.15	0.01	0.08	5.38	576.0	44	122500.0	>25.0	510
			CM02	Massive Sulfide	Mound	1580	35.30	<0.01	163.0	68.5	<0.05	0.07	0.03	57.20	464.0	128	15600.0	>25.0	2420
			CM03	Altered Hyaloclastite	Alteration Zone	105	1.44	6.78	8.6	100.0	0.25	0.01	5.20	4.40	42.7	151	612.0	10.05	350
		01SFBMS24	CM01	Massive Sulfide	Mound	685	37.40	0.44	241.0	195.5	0.15	0.32	0.04	56.60	280.0	83	79700.0	>25.0	350
			CM02	Altered Hyaloclastite	Alteration Zone	280	17.15	1.46	122.5	44.0	0.05	0.90	0.05	17.10	379.0	363	45400.0	>25.0	560
	W4	01SFBMS09	CM01	Basalt	Stockwork Zone	70	1.32	4.81	32.0	39.0	0.15	1.38	0.27	1.40	143.2	168	796.0	15.90	260
		01SFBMS27	CM01	Altered Hyaloclastite	Alteration Zone	975	18.65	1.47	57.6	23.5	0.20	0.80	0.68	4.24	10.9	82	293.0	10.90	7250
			CM02	Altered Hyaloclastite	Alteration Zone	10	3.14	7.58	2.2	1644.5	0.75	0.41	1.25	2.44	34.4	114	155.8	7.44	50
			CM03	Altered Hyaloclastite	Alteration Zone	15	1.32	7.80	7.2	434.0	0.75	0.29	1.25	8.26	36.0	168	168.5	7.40	50
	W5	01SFBMS11	CM01	Basalt	Basalt of Surface	10	0.94	8.38	1.6	180.0	0.35	0.04	8.30	0.52	45.5	185	522.0	7.53	30
	W6	01SFBMS10	CM01	Massive Sulfide	Mound	635	20.80	0.32	64.6	32.5	<0.05	3.12	0.06	16.20	708.0	307	116500.0	18.55	2750
			CM02	Altered Hyaloclastite	Alteration Zone	120	3.26	7.90	42.4	60.0	0.20	1.54	0.44	182.00	77.8	223	4470.0	11.90	200
			CM03	Altered Hyaloclastite	Alteration Zone	15	1.18	9.48	7.6	145.0	0.25	0.23	1.40	15.25	64.0	172	370.0	9.76	100
		01SFBMS25	CM01	Clay	Surface	25	3.04	6.80	13.6	792.4	0.60	0.87	3.90	2.22	26.0	160	625.0	7.12	260
			CM02	Hyaloclastite	Surface	40	2.30	5.98	2.2	251.5	0.40	0.02	5.20	0.38	33.7	196	863.0	6.92	900
		01SFBMS26	CM01	Basalt	Footwall	120	5.20	5.61	19.0	135.5	0.95	0.43	3.50	4.60	20.5	136	240.0	7.41	610
	W7	01SFBMS06	CM01	Basalt	Stockwork Zone	30	1.64	6.98	3.4	87.0	0.65	0.05	4.40	2.84	34.8	193	654.0	7.91	480
			CM02	Altered Hyaloclastite	Alteration Zone	5	0.38	8.14	2.2	7.5	0.55	1.03	0.17	0.14	32.5	119	53.2	8.95	10
			CM03	Altered Hyaloclastite	Alteration Zone	10	0.26	7.77	2.2	8.0	0.30	2.73	0.89	0.44	33.5	126	57.8	7.32	<10
			CM04	Altered Hyaloclastite	Alteration Zone	25	0.56	8.31	2.8	37.0	0.20	0.60	1.85	6.04	33.7	129	1110.0	6.46	10
	W8	01SFBMS07	CM01	Basalt	Basalt of Surface	<5	0.30	8.40	1.2	41.0	0.45	0.13	7.70	0.20	41.5	181	113.7	7.68	<10
East Area	E1	01SFBMS14	CM01	Altered Hyaloclastite	Alteration Zone	55	3.34	8.89	2.2	525.4	0.55	1.73	2.60	138.50	33.7	70	5600.0	6.15	370
			CM02	Altered Hyaloclastite	Alteration Zone	10	1.68	8.79	6.4	68.0	1.00	1.05	1.20	0.60	22.4	75	677.0	9.42	<10
			CM03	Massive Sulfide	Fragments of Chimney	1980	61.70	0.09	492.0	95.5	<0.05	<0.01	0.06	94.80	36.8	107	12000.0	>25.0	3200
	E3	01SFBMS13	CM01	Clay	Surface	5	1.46	8.09	20.4	402.5	0.60	2.03	4.50	5.56	35.3	184	496.0	8.49	100
			CM02	Basalt	Basalt of Surface	<5	0.72	8.39	0.6	66.5	0.25	0.03	8.20	0.20	40.0	172	175.8	6.97	<10
	E4	01SFBMS20	CM01	Massive Sulfide	Fragments of Chimney	2220	160.00	0.30	199.0	124.5	0.10	0.12	0.10	367.00	397.0	67	29700.0	>25.0	9970
		01SFBMS21	CM01	Clay	Surface	235	2.46	5.34	121.0	1219.5	0.80	0.43	2.30	1.02	180.2	82	68600.0	14.60	430
			CM02	Basalt	Basalt of Surface	5	1.32	7.34	0.8	112.0	0.70	<0.01	7.00	0.44	38.7	72	478.0	7.53	70
	E8	01SFBMS15	CM01	Basalt	Basalt of Surface	<5	2.04	7.78	1.6	236.0	1.25	0.01	6.50	0.46	32.6	93	103.8	6.19	50
		01SFBMS16	CM01	Basalt	Basalt of Surface	10	1.32	8.36	2.8	341.0	1.30	0.02	5.60	0.92	32.7	82	149.7	5.51	90
	E11	01SFBMS18	CM01	Basalt	Basalt of Surface	<5	1.04	8.24	1.2	281.5	1.00	0.07	6.90	0.36	30.9	170	120.9	5.63	10
			CM02	Altered Hyaloclastite	Alteration Zone	15	1.08	8.38	13.0	377.5	0.70	0.08	3.40	3.92	46.6	181	671.0	6.21	80
			CM03	Altered Hyaloclastite	Alteration Zone	45	0.82	7.91	10.6	83.5	0.45	0.97	4.30	4.22	51.6	176	265.0	7.66	200
	E12	01SFBMS22	CM01	Basalt	Basalt of Surface	20	1.00	9.31	3.2	243.0	1.05	0.14	6.60	2.28	36.7	253	293.0	5.62	100
		01SFBMS23	CM01	Basalt	Stockwork Zone	30	1.50	7.60	5.4	175.5	0.90	<0.01	5.40	7.56	27.3	196	1140.0	5.54	110
	E13	01SFBMS19	CM01	Basalt	Basalt of Surface	<5	0.86	8.42	1.6	226.5	1.00	<0.01	6.80	0.36	31.4	169	154.3	5.32	30
		01SFLC17	CM01	Massive Sulfide	Fragments of Chimney	1550	50.70	0.18	78.2	46.5	0.10	<0.01	0.05	5.18	359.0	65	68200.0	>25.0	1080

Table 3-3-6-6 Results of Geochemical Analysis (2/2)

	Ore Showing	Hole No.	Sample No.	Type of Ore or Rocks	Geological Unit	K	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Ti	V	W	Zn
						%	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
West Area	W1	01SFBMS12	CM01	Massive Sulfide	Mound	<0.01	0.01	45	395.00	0.02	2.2	110	151.0	2.90	7.6	<0.01	17	2.4	3550
			CM02	Altered hyaloclastite	Alteration zone	0.35	2.15	480	14.30	1.18	42.6	210	24.0	0.60	352.0	1.10	425	15.5	442
			CM03	Basalt	Footwall	0.07	3.92	1195	13.70	2.16	58.3	640	8.0	0.35	139.5	0.92	322	0.4	1655
	W3	01SFBMS08	CM01	Massive Sulfide	Mound	0.02	0.04	95	549.00	0.07	2.0	130	138.5	4.80	4.4	<0.01	155	0.1	1205
			CM02	Massive Sulfide	Mound	0.01	0.01	100	82.88	0.03	3.8	100	283.0	7.80	11.4	<0.01	26	1.8	8330
			CM03	Altered hyaloclastite	Alteration zone	0.08	2.86	615	24.05	1.53	37.0	390	16.5	0.95	111.5	0.60	235	0.3	1190
		01SFBMS24	CM01	Massive Sulfide	Mound	0.05	0.04	75	158.25	0.08	3.0	130	131.5	6.20	14.6	<0.01	42	134.5	7450
			CM02	Altered hyaloclastite	Alteration zone	0.06	0.79	180	93.42	0.07	20.0	100	127.5	4.35	10.4	0.15	65	18.6	3810
	W4	01SFBMS09	CM01	Basalt	Stockwork zone	0.01	4.42	265	100.05	0.06	44.2	1080	22.5	1.00	9.2	0.85	156	6.1	266
		01SFBMS27	CM01	Altered hyaloclastite	Alteration zone	0.12	0.44	220	49.90	0.37	17.2	90	71.0	15.35	95.0	0.16	65	7.0	916
			CM02	Altered hyaloclastite	Alteration zone	0.22	7.05	1400	2.25	1.97	37.4	340	12.5	0.60	157.5	0.68	270	4.9	1255
			CM03	Altered hyaloclastite	Alteration zone	0.20	6.38	1130	4.30	1.87	53.9	600	40.5	1.20	146.0	0.96	328	1.3	2660
	W5	01SFBMS11	CM01	Basalt	Basalt of Surface	0.15	4.74	1410	3.65	1.93	45.6	450	4.0	0.50	114.0	0.71	284	0.2	158
	W6	01SFBMS10	CM01	Massive Sulfide	Mound	0.01	0.27	35	201.00	0.05	8.0	180	90.0	3.05	17.6	0.05	23	1.3	4550
			CM02	Altered hyaloclastite	Alteration zone	0.09	1.71	120	21.00	0.68	66.5	330	82.5	7.30	31.0	0.90	309	2.0	44300
			CM03	Altered hyaloclastite	Alteration zone	0.07	8.13	365	48.35	1.06	66.1	980	17.0	1.20	95.4	1.01	368	1.1	1710
		01SFBMS25	CM01	Clay	Surface	0.79	2.54	685	2.95	1.86	29.8	630	18.0	1.20	170.0	0.68	238	4.2	648
			CM02	Hyaloclastite	Surface	0.19	3.17	950	3.00	1.60	49.2	420	3.0	0.25	200.0	0.67	222	0.9	132
		01SFBMS26	CM01	Basalt	Footwall	0.41	2.07	685	10.75	1.37	29.6	480	55.0	2.15	110.5	0.56	174	10.9	838
	W7	01SFBMS06	CM01	Basalt	Stockwork zone	0.17	3.46	755	5.15	1.75	50.8	500	24.5	0.95	135.5	0.80	277	0.9	1225
			CM02	Altered hyaloclastite	Alteration zone	0.03	10.90	1005	2.60	0.35	41.2	120	5.5	0.50	14.6	0.71	251	0.9	964
			CM03	Altered hyaloclastite	Alteration zone	0.05	9.51	645	2.45	0.93	39.0	150	3.0	0.15	39.0	0.69	240	1.8	652
			CM04	Altered hyaloclastite	Alteration zone	0.06	8.52	235	4.75	1.49	47.6	440	5.5	0.30	74.6	0.87	291	1.2	1710
	W8	01SFBMS07	CM01	Basalt	Basalt of Surface	0.24	4.12	1320	1.05	2.11	70.0	660	1.0	0.05	144.5	0.95	299	0.2	98
East Area	E1	01SFBMS14	CM01	Altered hyaloclastite	Alteration zone	0.33	5.28	1320	7.40	2.11	30.8	1520	169.0	0.85	242.0	1.26	347	0.6	6600
			CM02	Altered hyaloclastite	Alteration zone	0.28	8.18	1010	3.55	1.15	48.6	2550	12.0	0.70	82.4	1.65	226	1.6	3060
			CM03	Massive Sulfide	Fragments of Chimney	0.04	0.03	315	166.45	0.05	3.2	110	652.0	22.70	7.4	<0.01	21	1.1	18400
	E3	01SFBMS13	CM01	Clay	Surface	0.64	4.04	1130	4.90	1.87	50.0	850	23.0	1.80	163.0	0.82	258	1.3	622
			CM02	Basalt	Basalt of Surface	0.12	4.57	1335	1.10	1.92	46.0	440	1.5	0.05	111.0	0.72	275	0.3	96
	E4	01SFBMS20	CM01	Massive Sulfide	Fragments of Chimney	0.06	0.06	175	262.00	0.09	3.6	180	294.0	47.20	16.2	0.01	42	7.3	77200
		01SFBMS21	CM01	Clay	Surface	1.12	1.20	9150	52.44	1.83	14.6	3970	300.0	4.45	330.0	0.28	301	5.5	612
			CM02	Basalt	Basalt of Surface	0.38	3.98	1265	1.70	2.20	43.6	870	3.5	0.15	168.0	0.99	289	0.3	184
	E8	01SFBMS15	CM01	Basalt	Basalt of Surface	0.73	3.24	1170	3.90	2.11	36.8	1690	4.0	0.35	260.0	1.37	268	0.9	290
		01SFBMS16	CM01	Basalt	Basalt of Surface	0.64	3.21	1065	4.95	2.20	48.8	1110	6.5	0.25	330.0	1.22	260	0.4	358
	E11	01SFBMS18	CM01	Basalt	Basalt of Surface	0.49	3.33	1030	2.15	2.09	67.2	1620	6.5	0.05	300.0	1.19	205	0.3	304
			CM02	Altered hyaloclastite	Alteration zone	0.12	5.90	765	4.25	1.56	67.0	600	21.0	0.85	113.0	0.95	281	5.3	2000
			CM03	Altered hyaloclastite	Alteration zone	0.10	5.52	675	12.95	1.65	54.7	430	18.0	0.85	128.0	0.69	251	117.0	1765
	E12	01SFBMS22	CM01	Basalt	Basalt of Surface	0.69	5.18	870	5.40	2.14	172.5	1340	4.5	0.40	306.0	1.09	209	0.8	852
		01SFBMS23	CM01	Basalt	Stockwork zone	0.31	3.40	1035	4.00	1.97	84.0	1370	20.5	0.40	299.0	1.15	208	0.5	2150
	E13	01SFBMS19	CM01	Basalt	Basalt of Surface	0.51	3.31	920	2.50	2.07	77.9	1500	3.0	0.35	292.0	1.25	204	1.3	120
		01SFLC17	CM01	Massive Sulfide	Fragments of Chimney	0.02	0.03	30	97.76	0.06	1.8	140	137.0	5.40	6.0	<0.01	38	1.2	2560

Table 3-3-6-7 Statistics of Geochemical Samples

Geological Unit		Au ppb	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Hg ppb
Clay	Max.	235.0	3.04	8.090	121.0	1219.5	0.800	2.03	4.50	5.56	180.2	184	68600.0	14.60	430
Surface	Min.	5.0	1.46	5.340	13.6	402.5	0.600	0.43	2.30	1.02	26.0	82	496.0	7.12	100
3 samples	Ave.	88.3	2.32	6.743	51.7	804.8	0.667	1.11	3.57	2.93	80.5	142	23240.3	10.07	263
	S. D	127.4	0.80	1.376	60.1	408.6	0.115	0.83	1.14	2.35	86.5	53	39282.7	3.98	165
Basalt	Max.	120.0	5.20	9.310	19.0	341.0	1.300	0.43	8.30	5.30	45.5	253	870.0	7.68	900
Footwall, Surface	Min.	2.5	0.30	5.610	0.6	41.0	0.250	0.01	3.50	0.20	20.5	72	103.8	5.32	5
12 samples	Ave.	18.3	1.57	7.914	3.3	180.0	0.754	0.08	6.60	1.34	35.8	158	340.4	6.60	163
	S. D	33.9	1.28	1.100	5.0	98.9	0.380	0.12	1.34	1.79	7.0	53	281.5	0.89	285
Basalt	Max.	70.0	1.64	7.600	32.0	175.5	0.900	1.38	5.40	7.56	143.2	196	1140.0	15.90	480
Stockwork zone	Min.	30.0	1.32	4.810	3.4	39.0	0.150	0.01	0.27	1.40	27.3	168	654.0	5.54	110
3 samples	Ave.	43.3	1.49	6.463	13.6	100.5	0.567	0.48	3.36	3.93	68.4	186	863.3	9.78	283
	S. D	23.1	0.16	1.465	16.0	69.2	0.382	0.78	2.72	3.22	64.9	15	249.9	5.43	186
Altered hyaloclastite	Max.	975.0	18.65	9.480	122.5	1644.5	1.500	2.73	5.20	182.00	379.0	363	45400.0	25.00	7250
Alteration Zone	Min.	5.0	0.26	1.460	2.2	7.5	0.050	0.01	0.05	0.14	10.9	70	53.2	3.96	5
15 samples	Ave.	113.0	3.91	7.283	19.5	248.2	0.513	0.87	1.80	25.86	61.8	158	4352.9	9.24	621
	S. D	249.2	5.82	2.445	32.7	419.6	0.383	0.71	1.51	55.41	89.3	75	11527.0	4.83	1841
Massive Sulfide	Max.	2220.0	160.00	0.300	492.0	124.5	0.100	0.12	0.10	367.00	397.0	107	68200.0	25.00	9970
Fragments of Chimney	Min.	1550.0	50.70	0.090	78.2	46.5	0.025	0.01	0.05	5.18	36.8	65	12000.0	25.00	1080
3 samples	Ave.	1916.7	90.80	0.190	256.4	88.8	0.075	0.04	0.07	155.66	264.3	80	36633.3	25.00	4750
	S. D	339.5	60.18	0.105	212.8	39.4	0.043	0.07	0.03	188.43	197.9	24	28734.4	0.00	4643
Massive Sulfide	Max.	1580.0	37.40	0.680	241.0	195.5	0.150	3.12	0.08	57.20	708.0	307	122500.0	25.00	2750
Mound	Min.	240.0	12.15	0.005	58.2	5.5	0.025	0.01	0.03	5.38	91.7	44	15600.0	18.55	350
5 samples	Ave.	742.0	25.79	0.297	133.6	74.8	0.080	0.84	0.05	30.42	423.9	147	72000.0	23.71	1288
	S. D	499.6	10.52	0.282	75.7	72.8	0.065	1.30	0.02	24.60	243.2	102	49785.6	2.88	1191

Geological Unit		K %	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P ppm	Pb ppm	Sb ppm	Sr ppm	Ti %	V ppm	W ppm	Zn ppm
Clay	Max.	1.120	4.04	9150	52.44	1.87	50.0	3970	300.0	4.45	330.0	0.82	301	5.5	648
Surface	Min.	0.640	1.20	685	2.95	1.83	14.6	630	18.0	1.20	163.0	0.28	238	1.3	612
3 samples	Ave.	0.850	2.59	3655	20.10	1.85	31.5	1817	113.7	2.48	221.0	0.59	266	3.7	627
	S. D	0.246	1.42	4764	28.03	0.02	17.8	1868	161.4	1.73	94.5	0.28	32	2.2	19
Basalt	Max.	0.730	5.18	1410	13.70	2.20	172.5	1690	55.0	2.15	330.0	1.37	322	10.9	1655
Footwall, Surface	Min.	0.070	2.07	685	1.05	1.37	29.6	420	1.0	0.05	110.5	0.56	174	0.2	96
12 samples	Ave.	0.385	3.74	1101	4.49	1.99	62.1	935	8.4	0.41	206.3	0.97	251	1.4	424
	S. D	0.231	0.85	219	3.92	0.26	37.5	493	14.8	0.57	85.7	0.26	46	3.0	470
Basalt	Max.	0.310	4.42	1035	100.05	1.97	84.0	1370	24.5	1.00	299.0	1.15	277	6.1	2150
Stockwork zone	Min.	0.010	3.40	265	4.00	0.06	44.2	500	20.5	0.40	9.2	0.80	156	0.5	266
3 samples	Ave.	0.163	3.76	685	36.40	1.26	59.7	983	22.5	0.78	147.9	0.93	214	2.5	1214
	S. D	0.150	0.57	390	55.13	1.05	21.3	443	2.0	0.33	145.3	0.19	61	3.1	942
Altered hyaloclastite	Max.	0.350	10.90	1400	93.42	2.11	67.0	2550	169.0	15.35	352.0	1.65	425	117.0	44300
Alteration Zone	Min.	0.030	0.44	120	2.25	0.07	17.2	90	3.0	0.15	10.4	0.15	65	0.3	442
15 samples	Ave.	0.144	5.55	678	19.70	1.20	44.6	590	41.7	2.38	112.8	0.83	263	11.9	4869
	S. D	0.106	3.30	420	25.73	0.62	15.5	661	49.6	4.05	89.6	0.38	98	29.6	11019
Massive Sulfide	Max.	0.060	0.06	315	262.00	0.09	3.6	180	652.0	47.20	16.2	0.01	42	7.3	77200
Fragments of Chimney	Min.	0.020	0.03	30	97.76	0.05	1.8	110	137.0	5.40	6.0	0.01	21	1.1	2560
3 samples	Ave.	0.040	0.04	173	175.40	0.07	2.9	143	361.0	25.10	9.9	0.01	34	3.2	32720
	S. D	0.020	0.02	143	82.49	0.02	0.9	35	264.0	21.00	5.5	0.00	11	3.6	39327
Massive Sulfide	Max.	0.050	0.27	100	549.00	0.08	8.0	180	283.0	7.80	17.6	0.05	155	134.5	8330
Mound	Min.	0.005	0.01	35	82.88	0.02	2.0	100	90.0	2.90	4.4	0.01	17	0.1	1205
5 samples	Ave.	0.019	0.07	70	277.23	0.05	3.8	130	158.8	4.95	11.1	0.01	53	28.0	5017
	S. D	0.018	0.11	29	190.70	0.03	2.5	31	73.1	2.09	5.3	0.02	58	59.5	2907

Max.: Maximum, Min.: Minimum, Ave. : Average, S.D.: Standard Deviation

Table 3-3-6-8 Correlation Coefficients

N=41

(yellow) : over 0.70
(gray) : over 0.40

	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Ti	V	W	Zn
Au	1.00																											
Ag	0.88	1.00																										
Al	−0.79	−0.65	1.00																									
As	0.78	0.65	−0.73	1.00																								
Ba	−0.18	−0.14	0.20	−0.08	1.00																							
Be	−0.51	−0.40	0.63	−0.46	0.33	1.00																						
Bi	−0.12	−0.12	−0.03	−0.10	−0.05	−0.21	1.00																					
Ca	−0.51	−0.41	0.63	−0.49	0.03	0.48	−0.40	1.00																				
Cd	0.60	0.80	−0.31	0.44	−0.07	−0.31	0.06	−0.33	1.00																			
Co	0.55	0.47	−0.74	0.35	−0.17	−0.51	0.20	−0.50	0.27	1.00																		
Cr	−0.31	−0.26	0.13	−0.17	−0.16	−0.04	0.26	0.14	−0.18	0.07	1.00																	
Cu	0.39	0.31	−0.68	0.36	−0.04	−0.39	0.17	−0.46	0.09	0.87	−0.05	1.00																
Fe	0.77	0.68	−0.89	0.77	−0.22	−0.61	−0.11	−0.61	0.40	0.69	−0.15	0.62	1.00															
Hg	0.78	0.82	−0.58	0.47	−0.15	−0.36	0.01	−0.36	0.67	0.36	−0.22	0.18	0.41	1.00														
K	−0.33	−0.28	0.39	−0.23	0.55	0.71	−0.11	0.45	−0.20	−0.32	−0.10	−0.16	−0.42	−0.23	1.00													
Mg	−0.59	−0.48	0.75	−0.55	0.10	0.27	0.18	0.17	−0.29	−0.54	−0.02	−0.54	−0.63	−0.44	−0.02	1.00												
Mn	−0.20	−0.20	0.21	−0.05	0.58	0.30	−0.09	0.20	−0.15	−0.14	−0.18	0.08	−0.24	−0.16	0.64	0.04	1.00											
Mo	0.48	0.48	−0.74	0.48	−0.21	−0.49	0.01	−0.51	0.28	0.67	−0.17	0.72	0.76	0.34	−0.36	−0.54	−0.21	1.00										
Na	−0.66	−0.54	0.82	−0.61	0.40	0.67	−0.27	0.84	−0.32	−0.65	0.03	−0.55	−0.79	−0.47	0.62	0.41	0.38	−0.66	1.00									
Ni	−0.56	−0.47	0.73	−0.52	0.00	0.50	−0.14	0.58	−0.24	−0.52	0.38	−0.53	−0.64	−0.40	0.31	0.49	0.02	−0.53	0.62	1.00								
P	−0.32	−0.28	0.39	−0.20	0.41	0.53	−0.08	0.29	−0.16	−0.24	−0.19	−0.08	−0.36	−0.26	0.73	0.16	0.76	−0.29	0.48	0.28	1.00							
Pb	0.79	0.63	−0.66	0.92	0.04	−0.40	−0.08	−0.48	0.50	0.36	−0.25	0.36	0.69	0.49	−0.12	−0.53	0.13	0.46	−0.51	−0.53	−0.04	1.00						
Sb	0.84	0.94	−0.57	0.65	−0.11	−0.37	−0.09	−0.40	0.83	0.34	−0.27	0.19	0.56	0.90	−0.22	−0.45	−0.13	0.42	−0.49	−0.40	−0.23	0.66	1.00					
Sr	−0.47	−0.40	0.60	−0.42	0.42	0.84	−0.26	0.63	−0.26	−0.48	0.04	−0.34	−0.62	−0.30	0.79	0.11	0.47	−0.49	0.79	0.53	0.61	−0.31	−0.35	1.00				
Ti	−0.71	−0.57	0.90	−0.66	0.09	0.73	−0.05	0.57	−0.26	−0.67	0.06	−0.65	−0.80	−0.51	0.41	0.63	0.08	−0.66	0.74	0.70	0.49	−0.61	−0.52	0.63	1.00			
V	−0.73	−0.61	0.90	−0.66	0.27	0.55	−0.05	0.48	−0.25	−0.61	0.05	−0.51	−0.79	−0.55	0.35	0.62	0.33	−0.59	0.74	0.51	0.35	−0.53	−0.51	0.56	0.75	1.00		
W	0.05	0.10	−0.18	0.23	−0.05	−0.12	0.03	−0.14	0.04	0.10	−0.04	0.21	0.21	−0.03	−0.15	−0.12	−0.09	0.07	−0.17	−0.14	−0.15	0.03	0.03	−0.14	−0.22	−0.17	1.00	
Zn	0.59	0.81	−0.31	0.42	−0.11	−0.30	0.02	−0.33	0.96	0.27	−0.12	0.09	0.39	0.68	−0.22	−0.30	−0.16	0.29	−0.36	−0.20	−0.19	0.45	0.85	−0.31	−0.28	−0.27	0.01	1.00
	Au	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Ti	V	W	Zn

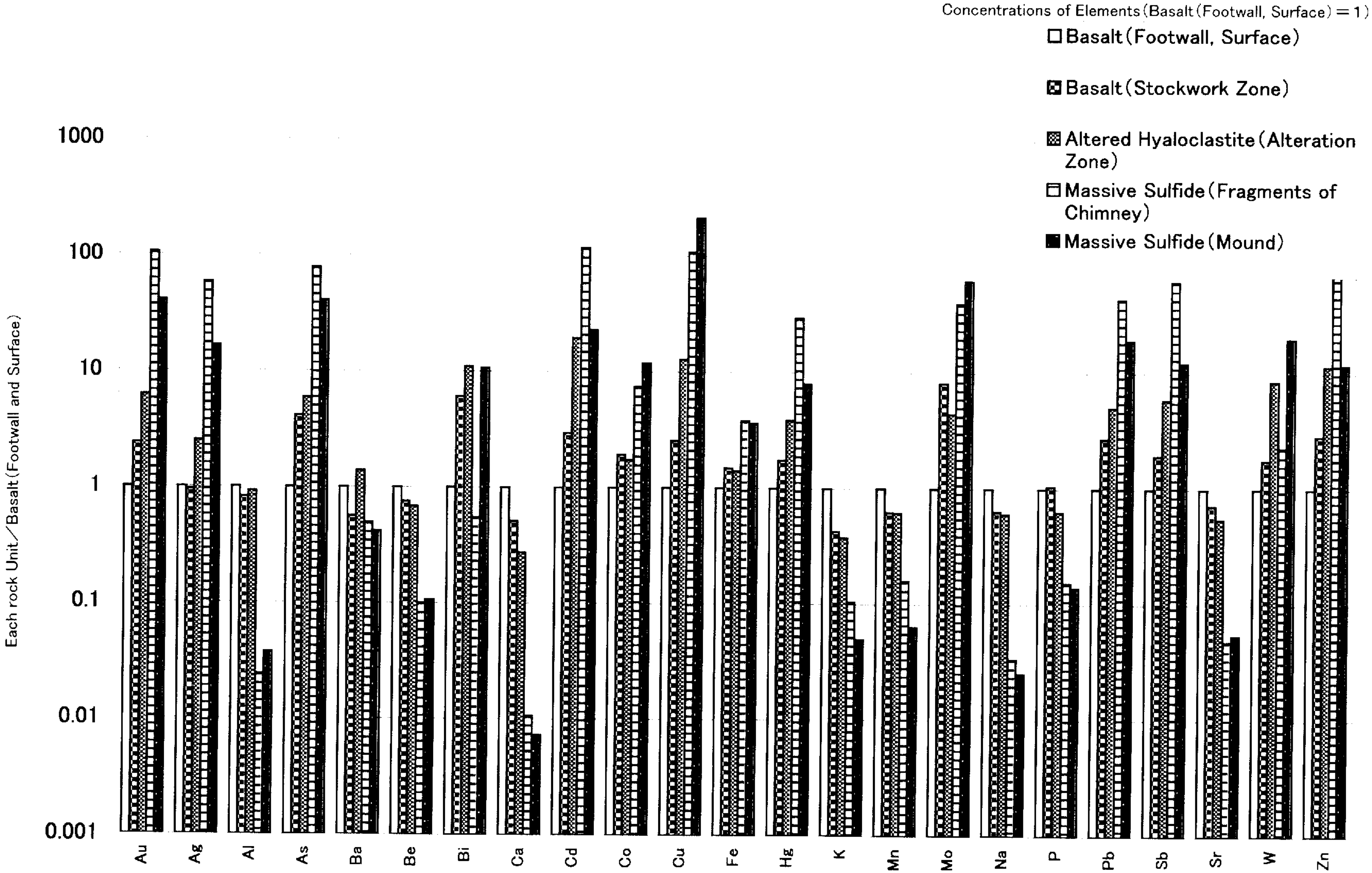


Figure 3-3-6-2 Concentrations of Elements Relative to Basalt

B. Au-Ag-As-Cd-Co-Fe-Hg-Pb-Sb-Zn

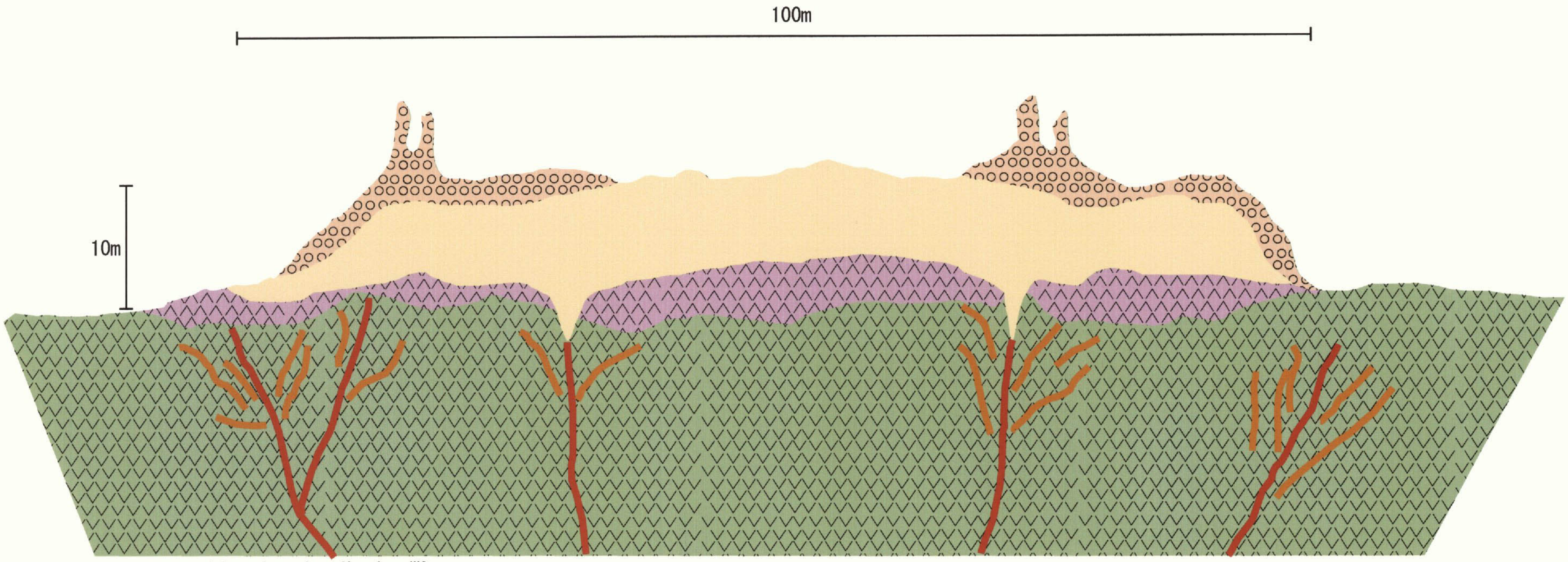
The elements of Group A characterize the mineralization of Cu-rich mound samples, while, those of Group B characterize the mineralization of Au-Ag-Zn rich chimney samples.

3-3-6-5 Characteristics of the Ore Showing

The schematic model of the ore showing in the Triple Junction Area was constructed mainly based on the Ore Showing W3 (Figure 3-3-6-3).

The relatively large mounds extending over an area of approximately 100m and rising 10m high from the surrounding sea floor occur in the Triple Junction Area. Chimneys of 3-5m high stand on the mound and they are surrounded by fragments of chimney and sulfide ore. After the formation of chimney at the first stage, the mound starts to build with accumulation of collapsed chimney and Zn-Au-Ag rich ore of Cu4.04%, Zn3.17%, Au1.83g/t and Ag71.20g/t is formed on the surface of the mound. This ore is formed by precipitation of marcasite, pyrite and sphalerite through mixing of hydrothermal fluid with seawater. As formation of the mound continues, Cu-rich massive sulfide of Cu6.93%, Zn0.61%, Au0.85% and Ag24.39% is formed in the core of the mound. This ore was formed by precipitation of mainly calcopyrite and pyrite at high temperature by isolation of hydrothermal fluid from seawater. At the drill sites of 01SFBMS08 and 01SFBMS24 in the Ore Showing W3, the Zu-Au-Ag rich ore was not confirmed and the Cu-rich ore seems to be exposed on the surface. From the both drill holes, the thickness of the Cu-rich ore is 6.0m to 7.5m. In the East Area, on the other hand, fragments of chimney and massive sulfide of the mound with only 80cm thick were collected. A part of Zn-Au-Ag ore of the surface was collected and Cu-rich ore beneath this was not hit by the drilling in the East Area. Because of the locations of mounds in the East Area being distributed on slop and of rough surface of the mounds, Cu-rich ore could not be hit by drilling.

The ore reserve of the Ore Showing W3 was estimated approximating ore body to be rectangular shape. As observed from BMS camera and the results of drilling, it has an extension of 100m in one direction and a thickness of 7m. The extension of the ore body perpendicular to the observed direction was assumed to be 30m. From the above figures, the ore reserve of the Ore Showing W3 is estimated to be 73,500t at specific gravity of 3.5. The observations of the sea floor by BMS and FDC suggest that there are at least seven mounds of similar size to Ore showing W3 in the Triple Junction Area.



Constructed based on Ore Showing W3

General photographs of chimney & mound

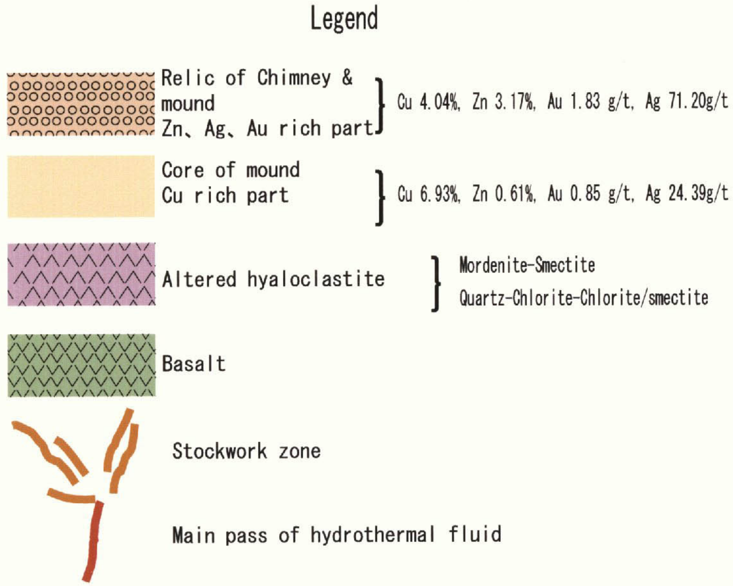


Figure 3-3-6-3 Schematic Model of the Ore Showing (North Fiji Basin)