3-2 Akmola area

Four diamond core drill holes, MJTA-6, -7, -8 and -9, with the total aggregated length of 1,038m, were placed in Akmola Area during the 3rd Year's Field Campaign. The detailed descriptions of the drill cores are presented in the drill hole columns, Plate 4 to 7 attached. The detailed results of the laboratory tests such as microscopic observations of thin and polished sections, X-ray diffraction analysis, homogenization temperature and salinity analysis of fluid inclusions, and chemical analysis of core samples, are also attached in Appendices-1, -2, -3, -4 and –6 respectively. Geology, alteration, mineralization and the laboratory test results for each hole are summarized below.

3-2-1 MJTA-6

Location: Akmola, 48° 28′ 44″ N, 68° 34′ 03″ E

Depth: 250m

Collar Inclination: 90°

<u>Core Observation</u>

0.0—3.0m: surface cover; brown sandy soil containing pebbles of weathered rocks with sizes of 3 to 10cm.

3.0—21.5m: oxidized zone; reddish to yellowish brown, weathered quartz porphyry. The rocks are silicified and contain hematiteand/or goethite as networks or dissemination, occasionally associated with quartz veinlets. Unsilicified plagioclase phenocrysts are partly argillized. The section between 19.6 and 21.5m is a transition from the oxidized to the primary zone.

21.5—63.0: medium to fine grained porphyritic granite; in which mafic minerals are altered to chlorite and plagioclase, to white clay minerals or occasionally to epidote. Numerous chlorite and minor quartz veinlets, most of which contain pyrite, are developed throughout the section. Pyrite dissemination is also observed but very minor in amount. The section between 45.3 and 51.9m is characterized by intense argillization and pyrite dissemination with weak silicification.

63.0—75.6m: vitric andesite dike; containing a minor amount of fine grained biotite phenocrysts with sizes less than 1mm. The rocks have undergone very weak chloritization.

75.6—83.4m: medium grained granite; intruded by a number of some 50cm thick dacite dikes with angles ranging from 15 to 75° against the core axis. Chloritization and white argillization, as well as pyrite dissemination, are observed in association with the granite. Mineralization and alteration in the dacite dikes are minimal.

83.4—91.6m: fine grained andesite dike; dark green, chloritized. Minor pyrite dissemination and quartz veinlets are associated.

91.6—139.4m: granite; chloritized and epidotized. Superimposition of silicification and weak argillization is observed in various parts of the section. Mafic minerals are altered to chlorite or partly to epidote, and feldsapars, to clay minerals or to sericite. Chlorite veinlets are uniformly observed throughout the section. Pyrite dissemination, 2 to 3% in volume, and quartz veinlets are well developed where silicification is notable.

139.4—152.2m: granite; intensely silicified. The section is characterized by abundant pyrite in forms of dissemination or veinlets and by a number of quartz veinlets. The original rock textures are completely obliterated due to intense silicification.

152.2—166.0m: porphyry; containing abundant plagioclase phenocrysts with sizes of 3 to 4mm. Mafic minerals and some feldspars are altered to chlorite and/or epidote, particularly where pyritic chlorite veinlets are developed. The section between 152.2 and 160.3m, being intensely silicified, is disseminated with abundant pyrite and contains numerous veinlets of pyrite and quartz. A minor amount of chalcopyrite is occasionally observed in association with quartz veinlets.

166.0—250.0m: medium grained granite; chloritized and weakly argillized. A number of chlorite veinlets are developed at intervals of several centimeters. In various sections, for examples, those from 185.7 to 194.5m and from 219.0 to 235.6, silicification overprints chloritization. Abundant disseminated pyrite(2—3% in volume) and a number of quartz veinlets are associated with silicification. Brecciated structures are also observed in part.

<u>Microscopic Observation of Thin Sections</u>

Some of the rocks, which have been called 'granite' based on megascopic observation in the field, are identified as adamellite according to the result of microscopic observation of thin sections of seven selected core samples. A representative mode of occurrences is described below;

- Silicified Adamellite(at 151.0m): Abundant quartz in veinlets and opaques(mostly pyrite) in dissemination are observed under microscope. The primary textures of the rock are obliterated due to development of these secondary minerals. Biotite is entirely altered to chlorite and epidote, and plagioclase, to sericite. Major rock forming minerals are presumed to be, judging from their pseudomorphs, plagioclase, K-feldspar, quartz and biotite with grain sizes of about 2mm.

X-ray Diffraction Analysis

Six core samples were collected from silicified portions and submitted for X-ray diffraction analysis. Chlorite and feldspars, together with quartz, sericite and pyrite, are idendified where silicification is minimal. Neither chlorite nor feldspar is present in the intensely silicified samples which contain abundant quartz, sericite and pyrite.

Microscopic Observation of Polished Sections

A total of seven polished sections, six intensely silicified samples disseminated with abundant pyrite and one weakly silicified sample including pyritic quartz networks, were prepared and observed under reflecting microscope. Common ore minerals observed under microscope are pyrite, chalcopyrite and goethite, as well as magnetite, galena and (?)bismuthinite in some polished sections. Two representative modes of occurrences are described below;

- MJTA-6-49.2(at 49.2m): The sample is intensely silicified and disseminated with abundant pyrite. Pyrite, subordinate chalcopyrite, galena and goethite are identified under microscope. Pyrite, euhedral to subhedral with the maximum grain size of 0.4mm, is disseminated in silicified groundmass. Chalcopyrite, galena and goethite occur as fine grain, anhedral crystals surrounding pyrite grains.
- MJTA-6-249.0(at 249.0m): The sample is weakly silicified and includes pyritic quartz networks. Pyrite, goethite, chalcopyrite and (?)bismuthinite, in descending order of the amount, are observed under microscope. Euhedral to subhedral crystals of pyrite, with the maximum grain size of 0.3mm, occur in association with quartz veinlets. Chalcopyrite and (?)bismuthinite are present as inclusions within pyrite. Goethite forms pseudomorphs after pyrite.

Assessment of Chemical Analysis

In order to assess the analytical result, individual assay runs are grouped into sections having common geochemical characteristics in terms of copper and molybdenum values principally in accordance with the same rules as adopted in the assessment of the chemical analysis in Zalturblak(see 3-1-1, (1). Assessment of Chemical Analysis).

The result of chemical analysis of core samples is summarized in Table II-2-1-4 below.

Table II-2-1-4 Summary of Assay Result (MJTA-6)

Interval(m)		Length	Cu(ppm)			Mo(ppm)			Remarks
From	To	(m)	Max.	Min.	Av.	Max.	Min.	Av.	
0.0	186.0	186.0	360.0	4.0	54.9	19.0	<2.0	0.2	Cu-Pb-Zn 49.0-50.0m, Au av. 181ppb, 144.0-148.0m
186.0	221.0	35.0	66.0	18.0	32.7	93.0	<2.0	9.8	
221.0	250.0	29.0	126.0	18.0	61.3	23.0	<2.0	11	

The geochemical features of MJTA-6 are summarized as follows;

a) There is virtually no significant increase in any of analyzed elements to 186.0m except for the 1m section from 49.0 to 50.0m which indicates 360.0, 839.6, 288.0 and 7.0ppm for Cu, Pb, Zn and Mo respectively. This section is characterized by development of drusy quartz veinlets in intensely chloritized and pyritized host rocks. The average of Au values in the 4m section between 144.0 and 148.0m is estimated at 181ppb with the maximum of 347ppb. However, no notable increase in any other elements is indicated in this section.
b) Mo values start picking up below 186.0m, contrasting to the above section in which most values are below the detection limit of 2.0ppm except 3 assays.
c) Mo values appear increasing towards the bottom of hole after 221.0m but not in great deal.
d) No copper value of any significance is indicated throughout the hole except for the 1m section mentioned in the above a).

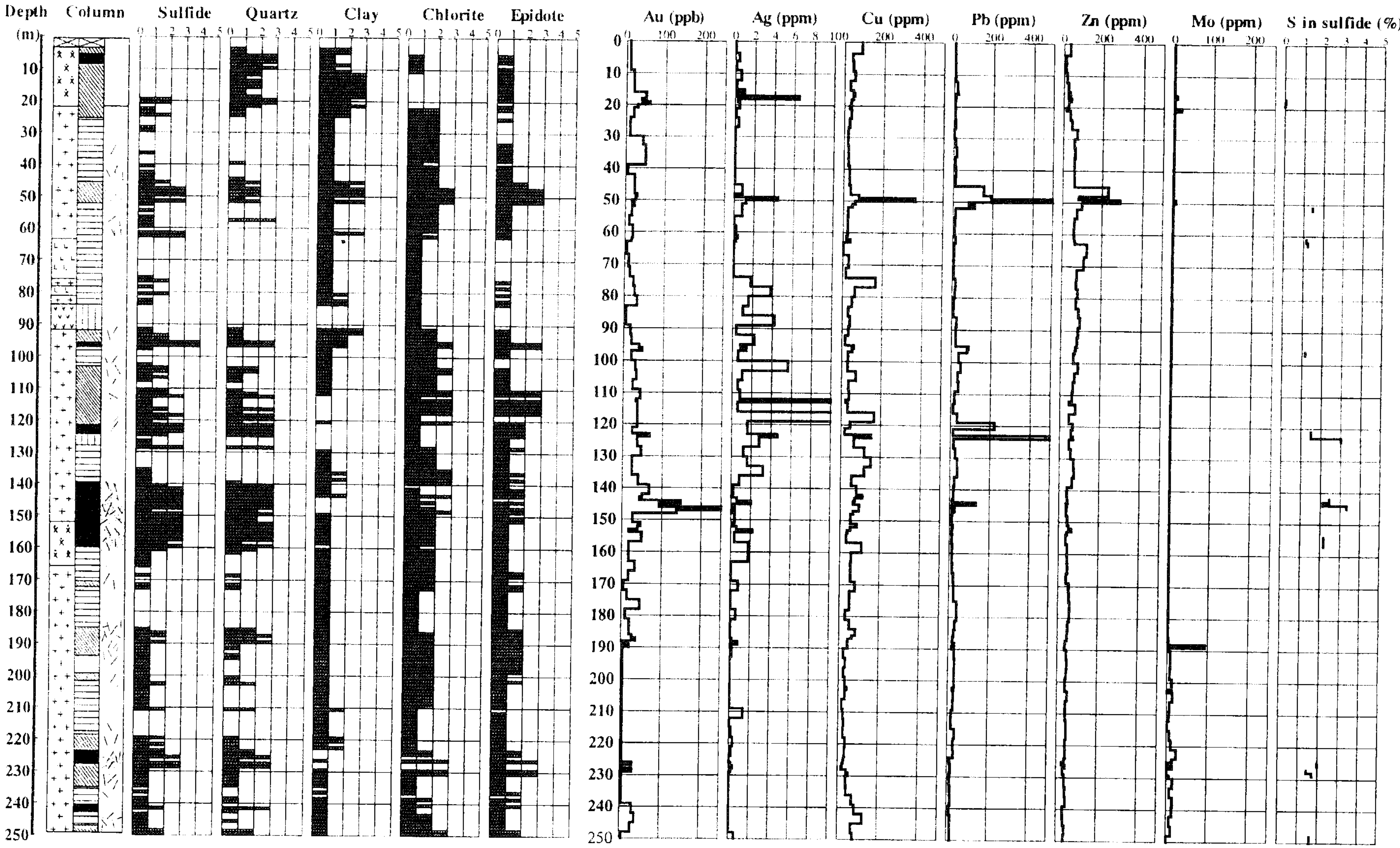

Figure Ⅱ-3-1-4 Alteration mineral assemblage and assay results of the drill core samples from MJTA-6

3-2-2 MJTA-7

Location: Akmola, 48° 49′ 30″ N, 68° 27′ 10″ E

Depth: 250m

Collar Inclination: 90°

<u>Core Observation</u>

0.0—8.0m: surface cover; yellowish brown sand.

8.0—21.4m: oxidized zone; brown, intensely weathered rocks from 8.0 to 15.5m and hornblende-biotite granodiorite heavily stained by iron oxides from 15.5 to 21.4m. Cores of the intensely weathered rocks are ground to pebble sizes.

21.4—111.5m hornblende-biotite granodiorite; pinkish green-gray. Numerous chlorite veinlets, at intervals of 0.5 to 3cm or forming networks in places, are developed throughout the section, as well as subordinate epidote and quartz veinlets. Pyrite is associated with these veinlets and its average content is estimated at 1% or less in volume. Hornblende and biotite are mostly altered to chlorite, and plagioclase, partly to clay minerals, while alkaline feldspars are subjected to minimal alteration. Several siliceous and argillaceous veins, with widths of several tens centimeters, are observed crosscutting at angles nearly perpendicular to the core axis. The siliceous veins are disseminated with abundant pyrite. The sections from 22.75 to 26.0m, from 43.3 to 44.9m and from 51.3 to 51.9m comprise porphyry dikes, which are subjected to similar alteration as observed in the host granodiorite.

111.5—113.0m: andesite dike; subjected to chloritization, pyritization and partly silicification. The dike intrudes with an angle of approximately 50° to the core axis.

113.0—201.5m: hornblende-biotite granite; pinkish green-gray. Numerous chlorite veinlets, at intervals of 1 to 3cm or forming networks in places, are developed throughout the section, as well as subordinate epidote and quartz veinlets. Pyrite is mainly contained in chlorite veinlets and its average content is estimated at 1% or less. Hornblende and biotite are mostly altered to chlorite, and a part of plagioclase, to clay minerals. Some sections, for lengths of 1 to 4m, are so intensely silicified or argillized that their original textures are completely obliterated.

201.5—236.7m: andesite dike; fine grained and chloritized. Veinlets of gray clay, pyrite and quartz are developed throughout the section. The section between 215 and 230m is intensely silcified and bleached due to argillization, and contains numerous pyrite veinlets.

236.7—250.0m: hornblende-biotite granite; chloritized. Hornblende and biotite are mostly altered to chlorite, and a part of plagioclase, to clay minerals. Chlorite and subordinate epidote veinlets are developed at intervals of 3 to 5cm. Pyrite is mostly associated with chlorite veinlets and occasionally with quartz veinlets. Some sections, with core lengths ranging from 2 to 4m, are intensely silicified or argillized.

Microscopic Observation of Thin Sections

The granite observed in the drill cores is determined as adamellite for its rock forming mineral composition according to the result of the microscopic obsevation of thin sections. A representative mode of occurrence is described below.

- Adamellite(at 188.2m): Major rock forming minerals are plagioclase, K-feldspar, quartz, common hornblende and biotite. Common hornblende and biotite are entirely altered to chlorite or epidote, and plagioclase, mostly to sericite. Opaque minerals, mostly pyrite, are also disseminated.

X-ray Diffraction Analysis

Six samples were collected from portions subjected to silicification and white argillization and submitted for X-ray diffraction analysis. The silicified samples contain quartz, sericite and pyrite, but neither chlorite nor epidote. Alteration minerals such as sericite, sericite/montmorillonite mixed layers, chlorite and pyrite are identiied in the argillized samples.

Microscopic Observation of Polished Sections

Two polished sections are prepared for the samples collected from argillized granite disseminated with pyrite.

- MJTA-7-124.0(at 124.0m): Pyrite, goethite and pyrrhotite, in descending order of the amount, are observed under microscope. Pyrite is disseminated as euhedral to subhedral crystals with the maximum grain size of 0.6mm. Pyrrhotite occurs as anhedral inclusions, with the maximum grain size of 50 micron, within pyrite. Goethite is formed on the periphery of pyrite crystals.
- MJTA-7-188.2(at 188.2m): Pyrite, goethite, chalcopyrite and galena, in descending order of the amount, are identified under microscope. Pyrite is observed as euhedral to subhedral crystals in association with quartz veinlets, while chalcopyrite and galena occur as anhedral inclusions, with the maximum grain size of 50 micron, within pyrite. Goethite forms anhedral crystals, with the maximum grain size of 0.1mm, within quartz veinlets.

Assessment of Chemical Analysis

The result of chemical analysis of core samples is summarized in Table II-2-1-5 below.

Table II-2-1-5 Summary of Assay Result (MJTA-7)

Interval(m) From	To	Length (m)	Cu(ppm) Max.	Min.	Av.	Mo(ppm) Max.	Min.	Av.	Remarks
0.0	36.2	36.2	98.0	16.0	33.8	25.0	2.0	6	
36.2	57.6	21.4	66.0	16.0	35.9	<2.0	<2.0	<2.0	
57.6	78.0	20.4	27.8	10.6	17.6	19.0	7.0	11.2	
78.0	116.0	38.0	67.4	22.6	32.1	<2.0	<2.0	<2.0	
116.0	191.0	75.0	120.0	15.4	37	40.0	<2.0	21.7	Slightly elevated Mo values, consistent
191.0	215.0	24.0	49.0	11.0	26.8	<2.0	<2.0	<2.0	
215.0	221.0	6.0	149.0	22.4	93.2	195.0	<2.0	37.8	Mo increases ass.w/high Pb
221.0	250.0	29.0	156.0	29.2	72.9	<2.0	<2.0	<2.0	

The geochemical features of MJTA-7 are summarized as follows;

a) Very weak Mo concentration is indicated in the top section to 36.2m by continuous low values above the detection limit and below the threshold of 10ppm(except 25 ppm of the bottom assay run).

b) Mo values are slightly elevated above the threshold value of 10ppm in the 20.4m section from 57.6 to78.0m.

c) No notable increase of values in any of the analyzed elements is indicated to 116.0m excluding the two sections as above mentioned.

d) Mo values in the 75.0m section from 116.0 to 191.0m are somewhat elevated and consistent. The average for this section is estimated at 21.7ppm, though the maximum is not particularly high at 40.0ppm.

e) The section below 191.0m to the bottom of hole is virtually unmineralized for any of the analyzed elements except for the 6m section between 215.0 and 221.0m, in which the average Pb value is estimated at 568.4ppm with the maximum of 1946.0ppm. In this section, a significant Mo value of 195.0ppm is indicated in the top 1m assay run, as well as moderate increase in Cu and Zn values in part. The mineralization is associated with intense silicification and argillization.

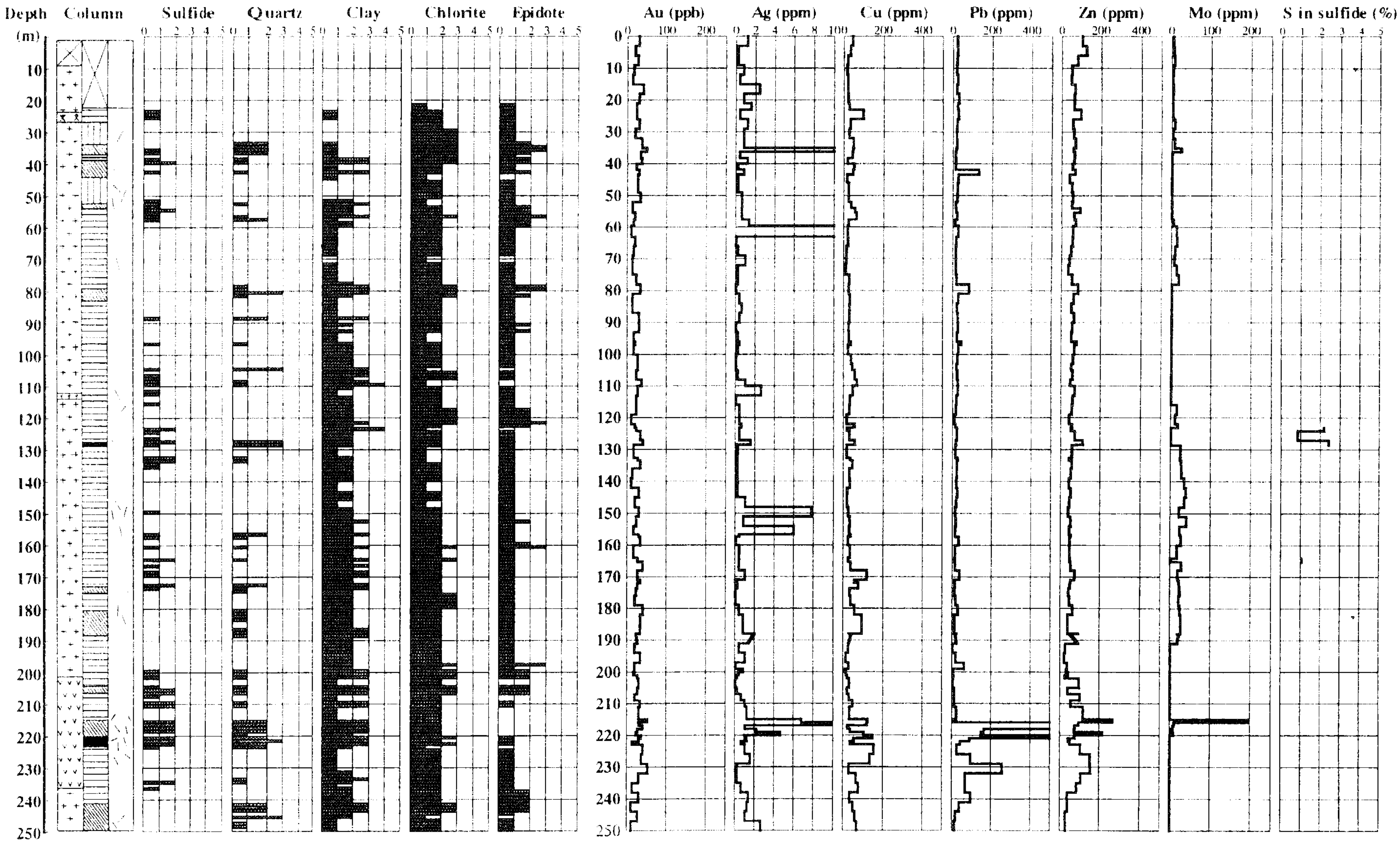

Figure II-3-1-5 Alteration mineral assemblage and assay results of the drill core samples from MJTA-7

3-2-2 MJTA-8

Location: Akmola, 48° 49′ 08″ N, 68° 26′ 25″ E

Depth: 250m

Collar Inclination: 90°

Core Observation

0.0—6.1m: surface cover; yellowish brown soil containing pebbles of intensely weathered rocks.

6.1—27.5m: weathered rhyolite; brownish light gray, containing plagioclase and a lesser amount of quartz phenocrysts with grain sizes of 3 to 6mm. The section between 21.8 to 27.5m is a transition from the oxidized to the primary zone and is weakly disseminated with pyrite.

27.5—114.7m: mainly porphyry; argillized and weakly silicified. Phenocrysts comprise plagioclase, with grain sizes of about 5mm, and lesser amounts of quartz, biotite and hornblende, and account for 50% in volume. Numerous veinlets of quartz, pyrite, clay and chlorite, in descending order of the abundance, are developed, often forming networks. The average content of pyrite is estimated at 1 to 2% in volume. A small amount of chalcopyrite is megascopically identified at the depths of 30.8m, around 56m and between 65.7 and 71.3m. Zones of intense silicification, with widths of 2 to 4m, are located at intervals of about 15m and present brecciated structures with development of quartz networks and abundant pyrite dissemination. The total content of sulfides is estimated at 2 to 4% in volume.

114.7—130.7m: zone of extremely intense silicification; with the original textures being completely destroyed due to silicification. Abundant pyrite is contained as dissemination or in forms of blebs and veinlets. The pyrite content is estimated at 2 to 4% in volume.

130.7—140.6m: porphyry; argillized and weakly silicified. Plagioclase phenocrysts and a greater part of groundmass are altered to clay minerals, with biotite and hornblende being replaced by chlorite. Veinlets of quartz and pyrite are developed at intervals of 2 to 5cm. Pyrite dissemination is generally weak.

140.6—165.0m: intensely silicified rocks; Veinlets of quartz and pyrite are highly developed, forming networks in the most part of the section. Pyrite is abundant also as dissemination. The section between 140.6 and 151.4m, where silicification is relatively weak, contains argillized plagioclase and chloritized mafic minerals. Clay minerals and chlorite almost completely disappear in the section below 151.4m due to extremely intense silicification and development of dense quartz networks and pyrite dissemination. The pyrite content is estimated at 3 to 5% in volume.

165.0—177.0m: porphyry; intensely argillized and chloritized, also intensely silicified in places. Quartz veinlets, carrying pyrite, are observed at intervals of 3 to 5cm. Pyrite dissemination is genarally weak.

177.0—185.8m: andesite dike; Phenocrysts of plagioclase, with grain sizes of 1 to 2mm, and of hornblende, with grain sizes of about 1mm, are altered to clay minerals and chlorite respectively. Clay veinlets are developed at intervals of 4 to 10cm. At 165.5m, a quartz vein carrying pyrite, with a thickness of 25cm, crosscuts the andesite dike at angle of 50° against the core axis.

185.8—192.0m: intensely silicified rocks; The rocks contain quartz veinlets at intervals of 0.5 to 1cm and disseminated with pyrite. The section between 190.0 and 192.0m is brecciated and silisified.

192.0—205.3m: rhyolite dike; porphyritic and subjected to intense chloritization and weak argillization. Quartz and epidote veinlets, carrying pyrite, are observed at intervals of 3 to 5cm.

205.3—214.4m: porphyry; chloritized and weakly argillized. Pyrite veinlets are developed at intervals of 2 to 5cm.

214.4—250.0m: porphyry; silicified. Mafic minerals are not silicified , though chloritized. Quartz and chlorite veinlets, carrying pyrite, are developed at intervals of 1 to 3cm or form networks. Clay and calcite veinlets are rarely observed. A minor amount of chalcopyrite is identified in the section between 214.4 and 219.0m.

Microscopic Observation of Thin Sections

According to the megascopic observation of drill cores, this hole consists mainly of porphyritic rocks, which are subjected to sericitization and silicification and contain abundant quartz networks, carrying pyrite, and a substantial amount of disseminated pyrite. Their original textures are completely obliterated where alteration, particularly silisification, is extremely intense. Descriptions of two thin sections are quoted below as for representative modes of occurrence under microscope.

- Intensely Altered Rock(at 157.0m): Original textures are extremely obliterated due to intense silicification and sericitization. Phenocrysts of plagioclase, being replaced by sericite, and of quartz are present in groundmass mainly comprising cryptocrystalline secondary quartz. The groundmass also contains small amounts of sericitized plagioclase, chloritized biotite and possible hornblende. Abundant opaque minerals, mostly pyrite, are observed as dissemination.
- Altered Quartz Porphyry(at 249.4m): The original porphyritic texture is well preserved although the rock is subjected to relatively weak silicification and

sericitization in comparison with those for the above sample. Phenocrysts of euhedral plagioclase, partly sericitized, and of subhedral quartz, are present in groundmass comprising sericitized plagioclase, quartz and chloritized biotite.

X-ray Diffraction Analysis

Four silicified and two white-argillized rock samples were collected and submitted for X-ray diffraction analysis. Common alteration minerals that are identified in both the silcified and argillized samples are quartz, sericite, chlorite and pyrite, while kaolinite is observed only in the argillized samples. A minor amount of primary feldspars is present in all the samples.

Microscopic Observation of Polished Sections

Ten polished sections of quartz porphyry, which was subjected to sericitization and silicification and contained abundant disseminated pyrite and quartz networks, were prepared and observed under reflecting microscope. Common ore minerals that are identified under microscope are pyrite, chalcopyrite, pyrrhotite and goethite. Some samples contain bornite, covellite, aikinite($PbCuBiS_3$), galena, molybdenite manetite and/or hematite in very minor amounts. Descriptions of three polished sections are presented below as for representative modes of occurrence.

- MJTA-8-86.0(at 86.0m): The sample is silicified and disseminated with pyrite. Pyrite, goethite, bornite, covellite and aikinite, in descending order of the amount, are identified under microscope. Pyrite is disseminated as subhedral crystals with the maximum grain size of 0.5mm. Bornite, covellite and aikinite occur as anhedral inclusions, with the maximum grain size of 20 microns, within pyrite. Anhedral goethite forms aggregates upto 60 microns in grain size, possibly after mafic minerals.
- MJTA-8-121.0(at 121.0m): The sample is silicified and contains abundant pyrite veinlets. Pyrite, goethite, molybdenite, galena and hematite, in descending order of the amount, are identified under microscope. Pyrite occurs as aggregates of euhedral to subhedral crystals, forming veinlets with a width of 1mm. Molybdenite is present as euhedral crystals, with sizes upto 50 microns, in close association with pyrite. Galena and hematie are contained within pyrite as inclusions with the maximum grain size of 40 microns. Goethite is disseminated alongside pyrite veinlets.
- MJTA-8-157.0(at 157.0m): The sample is silicified and contains abundant pyrite in veinlets or as dissemination. Abundant pyrite, subordinate goethite, chalcopyrite and galena are identified under microscope. Pyrite occurs as aggregates of euhedral to subhedral crystals, forming veinlets. Chalcopyrite and galena are present within pyrite, filling cleavages. Goethite is disseminated in close proximity to pyrite veinlets.

Assessment of Chemical Analysis

The result of chemical analysis of core samples is summarized in Table II-2-1-6 below.

Table II-2-1-6 Summary of Assay Result (MJTA-8)

Interval(m)		Length	Cu(ppm)			Mo(ppm)			Remarks
From	To	(m)	Max.	Min.	Av.	Max.	Min.	Av.	
0.0	18	18.0	235.8	43.4	117.0	44.0	7.0	22.0	
18	30.0	12.0	121.4	59.2	92.2	4.0	<2.0	2.8	Au max.110ppb, 18.0-22.0m
30.0	44.0	14.0	145.2	70.4	107.6	44.0	<2.0	21.3	Au max.127ppb. 41.6-42.6m
44.0	71.0	27.0	151.4	37.6	65.1	7.0	<2.0	2.0	
71.0	152.0	81.0	225.0	11.4	82.4	58.0	<2.0	24.6	Au max. 130ppb, 87.0-89.0m, sporadic Au>100ppt
152.0	219.0	67.0	249.4	39.2	108.9	2.0	<2.0	<2.0	Au max. 210ppb, 186.0-189.0m, sporadic Au>100
219.0	237.0	18.0	96.0	34.0	64.5	46.0	8.0	15.3	
237.0	250.0	13.0	101.0	59.0	78.7	2.0	<2.0	<2.0	

The geochemical features of MJTA-8 are summarized as follows;

a) Mo values are somewhat elevated in the 18 and 14m sections from 0.0 to 18.0m and from 30.0 m to 44.0m respectively. The increase in Mo values appears to be associated with moderate silicification and quartz networks.

b) Moderate increase in Mo values is also identified for the 81.0m section from 71.0 to 152.0m in association with moderate to intense silicification and pyritization. It is very difficult to identify molybdenite only with the aid of a magnifying glass due to its fine grained nature. The mineral is, however, observed under microscope, occurring as euhedral crystals with sizes upto 50 microns in close association with pyrite. This section, having a substatial interval, may form a part of a zone of molybdenum mineralization if not concentrated in a significant degree.

c) The section below 152.0m to the bottom of hole is mostly barren except for the 18.0m section between 219.0 and 237.0m which indicates slight increase in Mo values.

d) No significant increase is recorded for other elements than molybdenum, although occcasional kicks in Au and Cu values are observed in one or two consecutive assay runs. Under microscope, however, chalcopyrite is commonly identified. Galena is also not uncommon but less common than chalcopyrite.

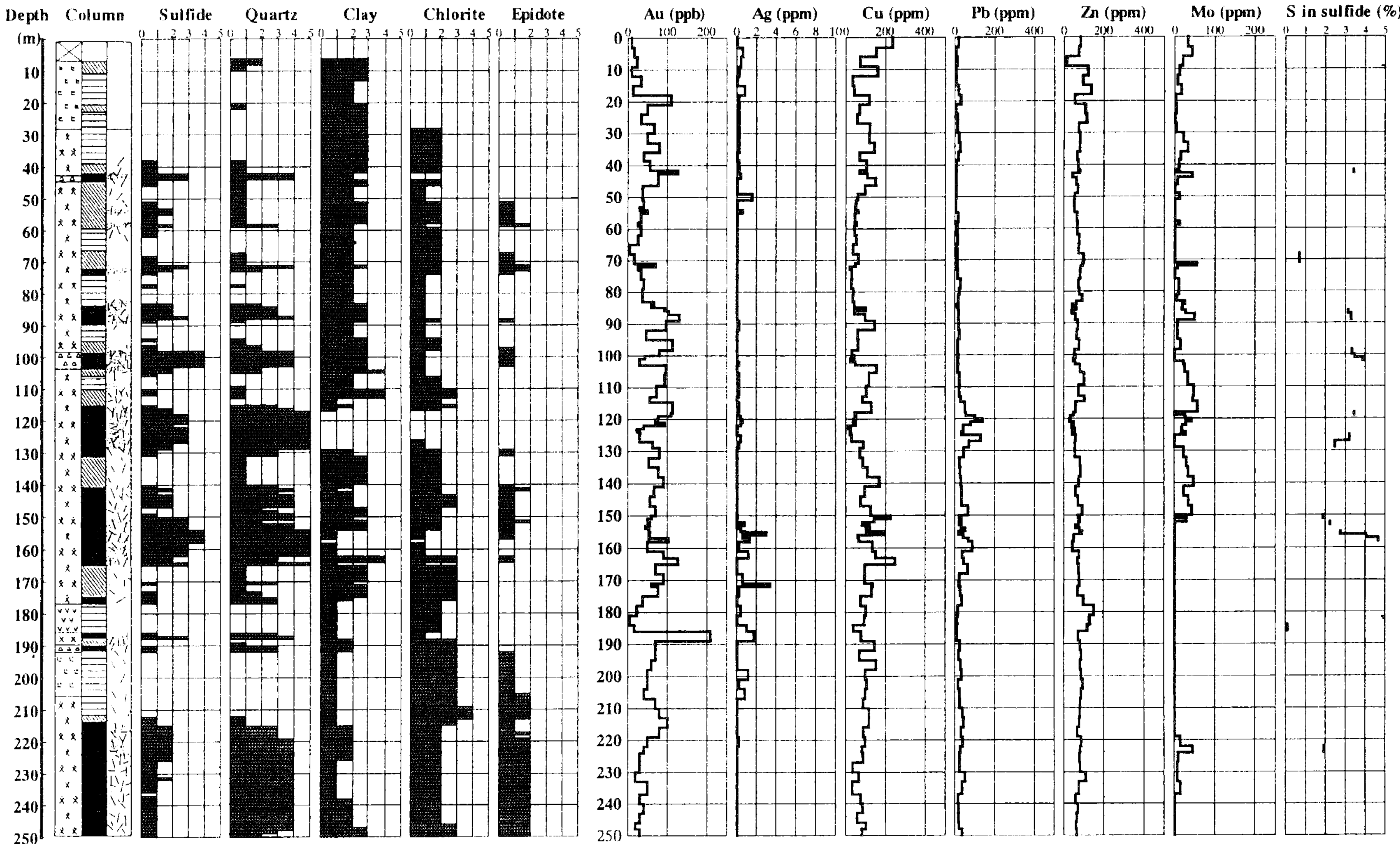

Figure Ⅱ-3-1-6 Alteration mineral assemblage and assay results of the drill core samples from MJTA-8

3-2-4 MJTA-9

Location: Akmola, 48° 48′ 59″ N, 68° 26′ 44″ E

Depth: 288m

Collar Inclination: 90°

Core Observation

0.0—11.2m: surface cover; reddish brown sandy soil containing pebbles of intensely weathered rocks to 8.6m and boulders of silicified rocks from 8.6 to 11.2m.

11.2—32.7m: oxidized zone; with abundant quartz-hematite networks and hematite veinlets and dissemination.

32.7—50.8m: mainly silicified rocks; with abundant quartz veinlets. The section between 32.7 and 36.5m is an oxide-primary transition zone. Pyrite dissemination is outstanding in the section below 41m. The overall pyrite content is estimated at 3 to 4% in volume.

50.8—81.7m: argillized rocks; with pyrite dissemination and networks. A minor amount of chalcopyrite is observed in the section between 74.7 and 77.0m. The overall sulfide content is estimated at 1 to 3% in volume.

81.7—122.5m: fine grained granite; silicified. Its original texture is obliterated due to silicification. Feldspars are altered to clay minerals or epidote, and hornblende and biotite, to chlorite and magnetite. Pyrite is abundant in veinlets, as dissemination or in association with quartz veinlets. A minor amount of chalcopyrite is also observed in places. The overall sulfide content is estimated at around 3% in volume. Judging from the crosscutting relationship of veins and veinlets, silicification, quartz veinlets and sulfide dissemination is considered to have been introduced after white-argillization, chloritization and epidotization. The section between 109.2 and 109.6 consists of silicified and brecciated rocks which are disseminated with abundant pyrite and minor chalcopyrite.

122.5—141.0m: medium to fine grained granite; intruded by porphyritic rhyolite dikes. Both granite and porphyritic rhyolite are subjected to intense chloritization as well as weak argillization and epidotization, and contain a fair amount of pyrite in veinlets and as dissemination. Feldspars in the granite are mostly altered to clay minerals, and mafic minerals, entirely to chlorite. Nevertheless, its original texture is relatively well preserved. Porphyritic rhyolite dikes, with thicknesses of 1 to 3m, crosscut the granite at 4 locations with angles of 55 to 60° against the core axis. The rhyolite contains abundant phenocrysts of plagioclase and quartz with grain sizes ranging from 2 to 5mm. The section between 123.0 and 125.0m comprises silicified and brecciated rocks which contain a fair amount of disseminated pyrite. The section comprises fine grained, silicified rocks which contain abundant pyrite veinlets. In these sections, the original textures of the rocks are completely obliterated. The overall pyrite content is estimated at 2 to 4% in volume.

141.0—157.9m: fine to medium grained granite; subjected to intense chloritization, weak epidotization and silicification. The rocks contain disseminated pyrite with the estimated content of 1 to 3% in volume and a number of chlorite, pyrite and quartz veinlets. The sections from 141.0 to 145.0m and from 152.2 to 154.3m consist of intensely silicified rocks in which a large amount of pyrite is present in veinlets or as dissemination.

157.9—169.0m: silicified rocks; gray-white. The original textures of the rocks are completely obliterated due to intense silicification. Pyrite occurs in forms of dissemination, blebs or veinlets. The overall pyrite content is estimated at 2 to 4% in volume. The sections from 158.7 to 159.0m and from 168.0 to 168.5m contain angular fragments with sizes of 2 to 5cm across.

169.0—182.5m: medium to fine grained granite; Feldspars are subjected to silicification and epidotization, and biotite and hornblende, to chloritization. Pyrite, in veinlets and as dissemination, and quartz veinlets are abundant. The overall pyrite content is estimated at around 2% in volume. The sections from 169.0 to 170.4m and from 181.5 to 182.5m consist of porphyritic rhyolite dikes, which are subjected to alteration similar, in nature and intensity, to that in the granite.

182.5—259.0m: fine to medium grained granite; subjected to silicification. A considerable amount of pyrite, with the estimated content of 3 to 4% in volume, is disseminated and veinlets-networks of quartz and chlorite are highly developed in the granite. Its original texture is completely obliterated in places due to extremely intense silicification and pyritization. Judging from the modes of occurrence of alteration minerals, silicification and quartz veining are considered to have been brought about later than chloritization, white-argillization and epidotization. Intensely silicified portions often present brecciated structures and contain a large amount of sulfides.

259.0—261.5m: fine grained andesite dike; intruding with a thickness of 1.8m at angles of 30 to 35° against the core axis. The andesite contains plagioclase phenocrysts with grain sizes of about 1mm and is subjected to weak chloritization.

261.5--288.0m: medium grained granite; subjected to chloritization, weak epidotization and intense silicfication in part. Where the grnite is intensely silicified, quartz networks are well developed and contain a small amount of molybdenite in part. The amount of pyrite dissemination is moderate and estimated at 1 to 2% in volume as a whole.

Microscopic Observation of Thin Sections

According to the megascopic observation of drill cores, this hole consists mainly of granite and porphyry, containing abundant disseminated pyrite and quartz networks, which are intruded by porphyritic rhyolite and intensely silicified breccia dikes. Dominant alteration is silicification and sericitization, and completely obliterates the original texture of rocks where it is intense.

- Altered Quartz Porphyry(at 45.7m): The original texture is obliterated due to intense silicification and sericitization. The porphyry contains phenocrysts of quartz and sericitized plagioclase in groundmass mainly comprising primary quartz, cryptocrystalline secondary quartz and sericitized plagioclase. A minor amount of chlorite and epidote, possibly formed after biotite and hornblende, are also included in the groundmass. Abundant opaque minerals, mostly pyrite, are characteristically disseminated throughout the microscopic visual field.
- Altered Rhyolite Porphyry or Porphyritic Dacite(at 170.0m): The original porphyritic texture is well preserved. Phenocrysts of euhedral plagioclase, partly sercitized, and of subhedral quartz are present in groundmass comprising sericite, chlorite and cryptocrystalline quartz. A large amount of opaque minerals, mainly pyrite, are disseminated throughout the microscopic visual field. This specimen is characterized by the small proportion of phenocrysts, estimated at 20 to30% in volume, and by the fine grained groundmass in comparison with dacite.

X-ray Diffraction Analysis

The section between 50.8 and 81.7m consists of gray argillized rocks and contains such alteration minerals as quartz, kaolinite, sericite, montmorillonite and sericite/montmorillonite mixed layers as the result of the X-ray diffraction analysis. Rocks deeper than 81.7m are generally subjected to silicification to variable degrees and contain quartz, sericite and chlorite as well as primary feldspars, where silicification is weak. No feldspar peak is observed in X-ray diffraction charts of samples collected in intensely silicified portions.

Microscopic Observation of Polished Sections

A total of 11 polished sections, nine of silcified rocks disseminated with abundant pyrite and two of quartz veins carrying pyrite and chalcopyrite, were prepared and observed under reflecting microscope. Major ore minerals observed under microscope are pyrite, chalcopyrite and goethite, accompanying minor pyrrhotite, bornite, covellite, galena, sphalerite and/or bismuthinite in some polished sections. Three representative modes of occurrence are described below.

- MJTA-9-136.0(at 136.0m): The sample was collected from a silicified rock containing abundant disseminated pyrite and quartz networks. Pyrite, chalcopyrite, goethite and bismuthinite, in descending order of the amount, are identified under microscope. Pyrite occurs as disseminated subhedral crystals with the maximum grain size of 8mm. Chalcopyrite and bismuthionite are included within pyrite crystals, with grain sizes upto 60 microns. Chalcopyrite also fills cleavages of pyrite crystals. Goethite is disseminated in close proximity of pyrite.
- MJTA-9-163.0(at 163.0m): The sample was collected from a silicified rock containing abundant pyrite in dissemination. Pyrite is the most dominated mineral, accompanied by minor chalcopyrite, bornite, covellite and goethite. Pyrite is disseminated with the maximum grain size of 1.5mm. Chalcopyrite occurs as anhedral crystals filling spaces between pyrite crystals. Bornite and covelline are included within pyrite crystals, with grain sizes upto 40 microns. Goethite is disseminated in close proximity of pyrite.
- MJTA-9-163.0(at 163.0m): The sample was collected from a quartz vein carrying pyrite and chalcopyrite. Chalcopyrite, pyrite, galena and sphalerite, in descending order of the amount, are identeified under microscope. Chalcopyrite and pyrite are abundant, with grain sizes ranging from 0.2 to 1mm. Galena occurs filling cleavages within pyrite or as inclusions within chalcopyrite. Sphalerite, with grain sizes of around 0.2, accompanies chalcopyrite and galena on its periphery, and also contains chalcopyrite inclusions with grain sizes of around several microns.

Assessment of Chemical Analysis

The result of chemical analysis of core samples is summarized in Table II-2-1-7below.

Table II-2-1-7 Summary of Assay Result (MJTA-9)

Interval(m)		Length	Cu(ppm)			Mo(ppm)			Remarks
From	to	(m)	Max.	Min.	Av.	Max.	Min.	Av.	
0.0	21.0	21.0	119.0	16.0	49.9	8.0	<2.0	1.1	
21.0	48.0	27.0	29.0	13.0	21.3	30.0	<2.0	14.4	
48.0	90.0	42.0	264.0	26.0	88.1	48.0	<2.0	10.9	
90.0	182.5	92.5	244.0	13.0	49.3	17.0	<2.0	1.3	
182.5	210.0	27.5	156.0	12.0	38.7	46.0	<2.0	18.5	Au max. 117ppb, 185.0-186.5m
210.0	248.0	38.0	87.0	16.0	48.2	913.0	22.0	445.5	Au max 3883ppb, 211.8-213.5m
248.0	281.5	33.5	157.0	28.0	76.6	61.0	11.0	37.7	
281.5	288.0	6.5	313.0	83.0	229	14.0	<2.0	5.0	Au max.207ppb, 283.7-286.0m

The geochemical features of MJTA-9 are summarized as follows;

a) Slight increase in Mo values is observed in the section between 21.0 and 90.0m, of which the upper 27.0m section includes a number of assay runs indicating values above the threshold of 10ppm and is characterized by intense silicification.

b) No significant value in any of analyzed elements is recorded for the 92.5m section from 90.0 to 182.5m except a few Cu and Mo values barely exceeding the thresholds, though silicification is generally moderate to intense throughout the section.

c) The 27.5m section between 182.5 and 210.0m includes a number of Mo values better than the threshold. This section, intensely silcified, appears to form the upper geochemical halo of the following 38.0m section which is significantly mineralized with molybdenite.

d) The average of Mo values is estimated at 445.5ppm for the section from 210.0 to 248.0m characterized by particularly intense quartz-sericite alteration. It is extremely difficult to identify molybdenite only by the aid of hand lens due to its very fine grained nature. Under microscope, molybdenite occurs as minute euhedral crystals with sizes upto 50 microns in close association with pyrite. Dusts of fine grained molybdenite, where contained in a sufficient amount, often give grayish colors to quartz veinlets or intensely silcified host rocks. An extraodinarily high Au value of 3883ppb is recorded in the assay run between211.8 and 213.5m but is considered to be of a nugget effect because of its isolated occurrence among neighboring background values.

e) The 33.5m section from 248.0 to 281.5m comprises Mo values significantly higher than the threshold and is consider to form the lower geochemical halo of the above mineralized section. Silicification of this section is moderate to intense except for a few short intervals.

f) The last 6.5m section includes a couple of assay runs indicating Cu values higher than the threshold. Chalcopyrite, accompanying minor galena and shalerite, is identified under microscope in a neighboring core sample.

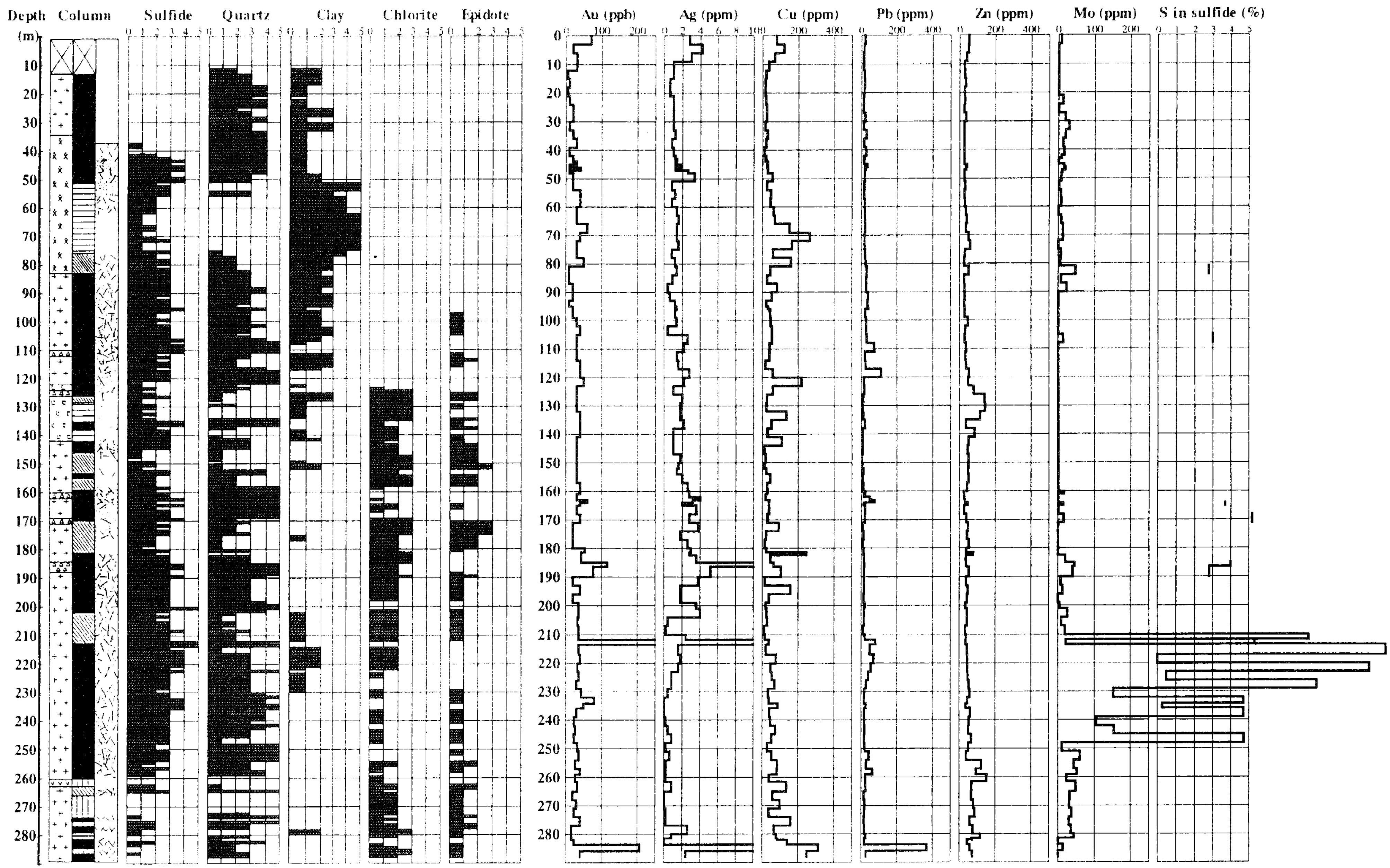

Figure Ⅱ-3-1-7 Alteration mineral assemblage and assay results of the drill core samples from MJTA-9

3-3 Whole rock chemical analysis

In this section, chemical characteristics of host rocks and intrusive bodies of West Aktau (2 samples), Western Zalturbulak (3 samples) and Akmola (3 samples) mineralization zone are described using the various figures. For reference, data from Qonyrat porphyry molybdenum copper deposit (Late Carboniferous deposit: Kudryavtsev, 1996), Bozhakol porphyry molybdenum copper deposit (Cambrian deposit: Kudryavtsev, 1996) and Koktenkol porphyry molybdenum Tungsten deposit (Late Carboniferous deposit: Mazurov1996) are also plotted on the same figures. The locations of deposits are shown in Figure I-3-1-1. The result of chemical analysis is shown in Appendix 8 of Phase III report of this project (JICA/MMAJ, 2000).

(1) AFM diagram (Figure II-3-1-1; Irvine and Baragar, 1971)

At first, the results of chemical analysis were plotted on the AFM diagram. From this diagram Igneous rocks from Terektinsky uplift area belong to calc-alkaline series. All host rocks of porphyry system except on a sample from Qonyrat deposit are plotted on the region of to calc-alkaline series.

(2) Granite series (magnetite series and ilmenite series, Figure II-3-3-2)

Three samples of the Western Zalturbulak plot near boundary of magnetite series and ilmenite series. One sample from Akmola plot at the border of magnetite series and ilmenite series and two samples in magnetite series field. All West Aktau samples plot within magnetite series field.

Most samples from Koktenkol show low $Fe^{3+}/Fe^{3+}+Fe^{2+}$ value and plot within ilmenite series region and all other samples from Qonyrat and Bozhakol deposit plots within magnetite series. According to the microscopic study, magnetite is observed in almost all samples from West Aktau and Western Zalturbulak. From Akmola, magnetite is observed in only a few samples although tens of samples are observed under the microscope.

(3) Granite series (I type and S type)

S type and I type granitoids of Chappell and White (1974) is considered to have relations to the magma generated from pelitic rocks and to the remelting magma of igneous rocks respectively. $Al_2O_3/(CaO+Na_2O+K_2O)$比 (1.1(molar ratio)>:S type、1.1<: I type) , $CaO/((Al_2O_3-Na_2O-K_2O)+CaO+(FeO+MgO))$ ratio (ACF diagram) are useful for discrimination of both type.

All samples from Terektinsky uplift area are I type in ACF diagram (Figure II-3-3-

3). Qonyrat and Bozshakol data plot in both field and two samples from Koktenkol plot in S type field. All other data plots in I type suite.

In Al_2O_3/CaO+ Na_2O + K_2O diagram (Figure II-3-3-4), all samples from Terektinsky uplift area are in I type suite. Qonyrat and Bozshakol data again plot in both field and one sample from Koktenkol plot in S type field. All other data plots in I type suite.

(4) K_2O / Na_2O (Figure II-3-3-5)

Samples from West Aktau are rich in K_2O compared with those from Western Zalturbulak and Akmola. Bozshakol samples are rich in K_2O and Koktenkol in Na_2O.

In summary, all rocks of Terektinsky uplift area are in calc alkaline and I type suite. The igenous rocks of West Aktau belong to magnetite series. The rocks from Western Zalturbulak plot at the border of magnetite series and ilmenite series. Two Akmola samples belong to magnetite series and one plots at the border of magnetite series and ilmenite series.

All host rocks of porphyry system except on a sample from Qonyrat deposit are plotted on the region of to calc-alkaline series. Qonyrat and Bozshakol data plot in both I and S type suite and belong to magnetite series. Koktenkol samples plot in ilmenite series suite and belong to both I type and S type.

Distinct difference of K_2O/ N Na_2O ratio occurs within igneous rocks of Terektinsky uplift area. Samples from West Aktau are poor in K_2O and seem to have genetic relationship to Bozshakol samples. The samples from Western Zalturbulak and Akmola are clearly high compared with those of West Aktau.

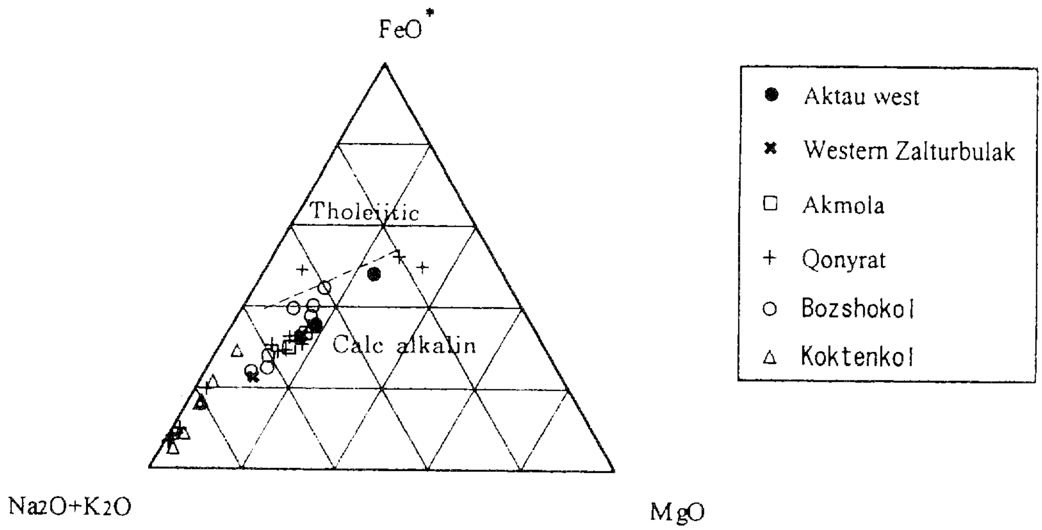

Figure II-3-3-1 Molar proportion of Na_2O+K_2O, FeO*(total iron) and MgO

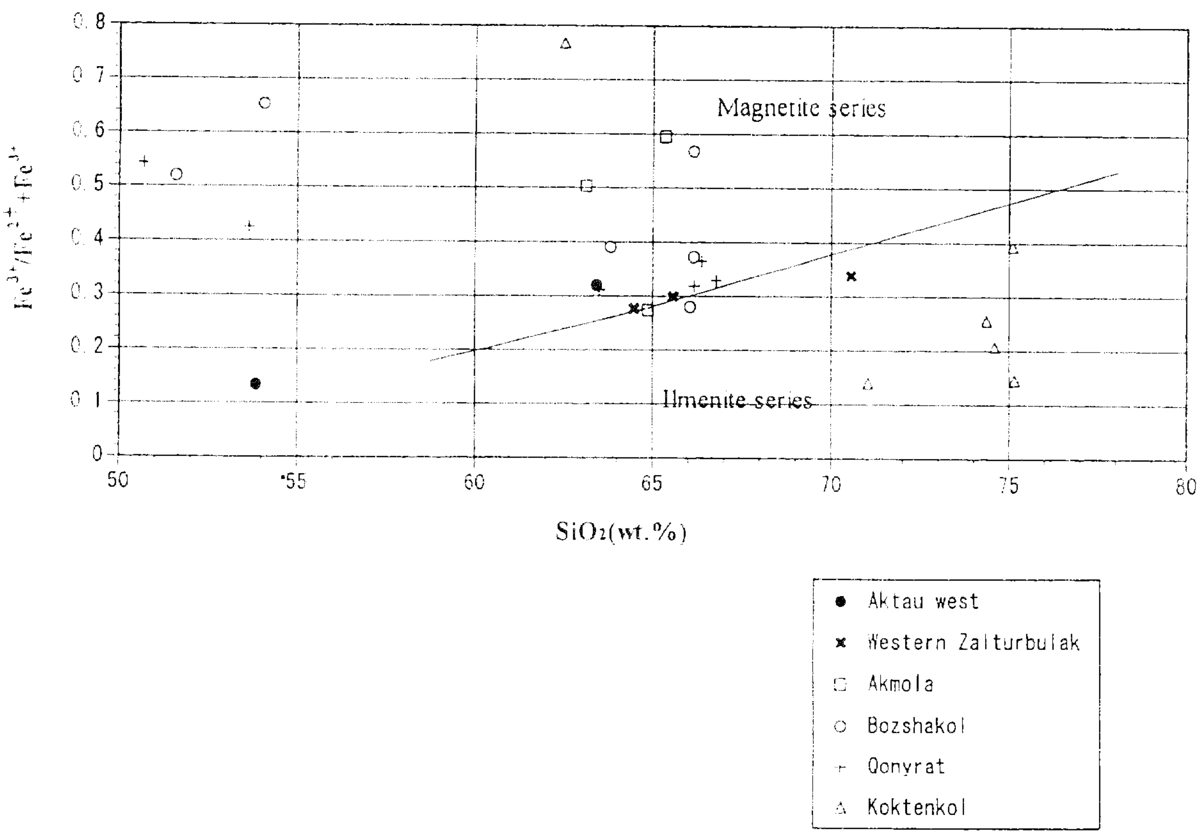

Figure II-3-3-2 $SiO_2/Fe^{3+}/Fe^{2+}+Fe^{3+}$ variation diagram

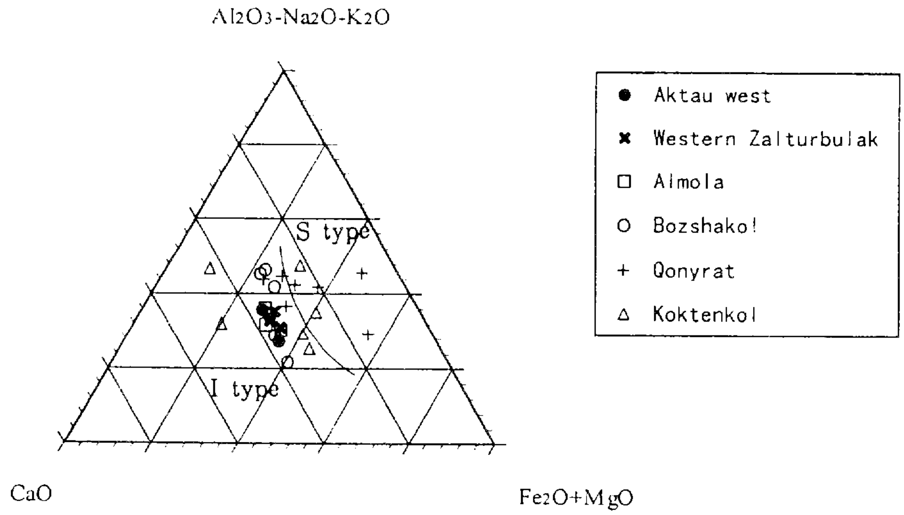

Figure II-3-3-3 Molar proportion of CaO, Al_2O_3-Na_2O-K_2O and Fe_2O+MgO

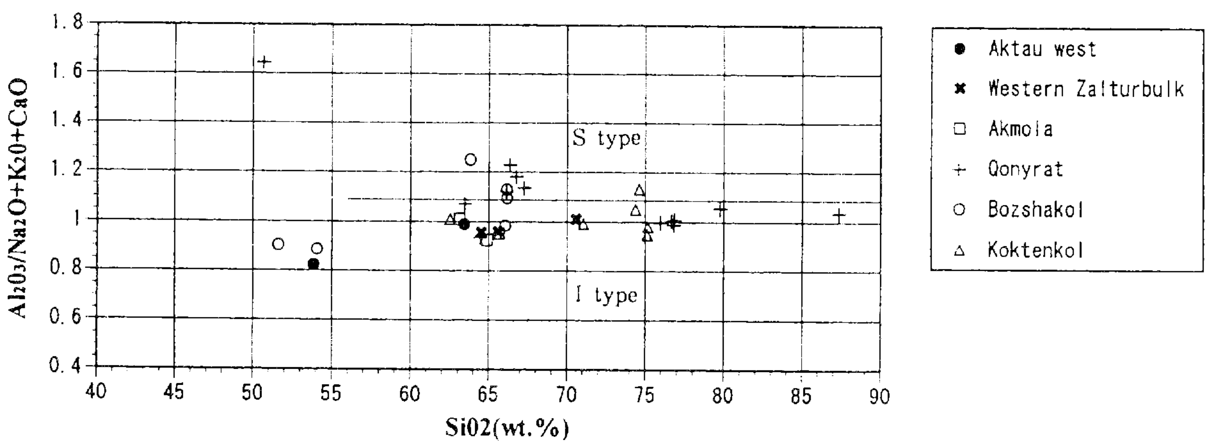

Figure II-3-3-4 $Al_2O_3/Na_2O+K_2O+CaO/SiO_2$ variation diagram

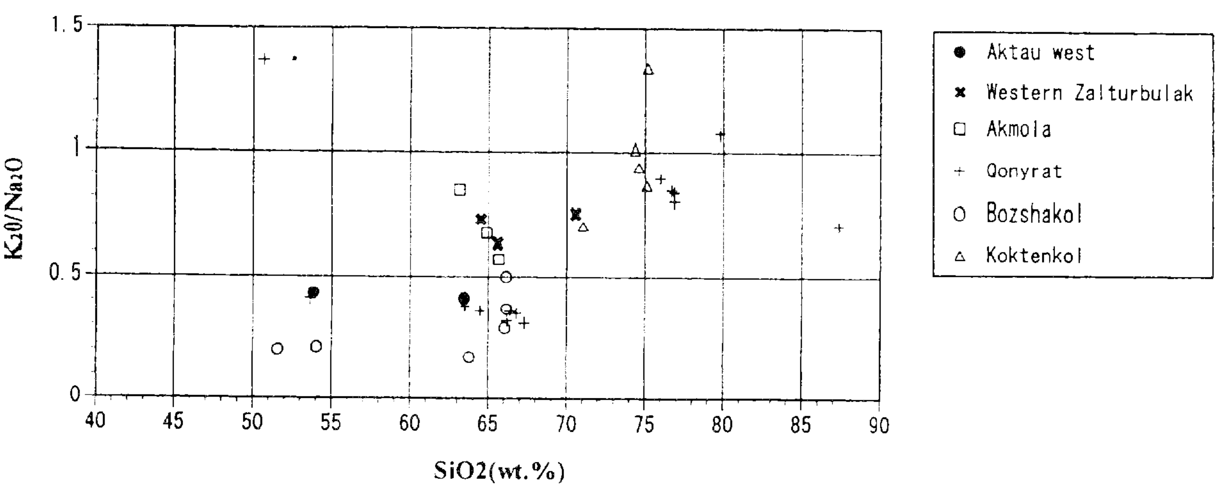

Figure II-3-3-5 $K_2O/Na_2O/SiO_2$ variation diagram