Chapter 3 Trench Investigation

3-1 Objectives

Six trenches, T1 to T6 with the aggregated length of 120m, were excavated along the creek at the west end of the F7 Ore Body and along the road leading to the F1 Fluorite Ore Body, in order to examine the continuation of the F7 Ore Body. The relative locations of the trenches, the wall sketches of the trenches, T1, T4 and T6, the sketches of the mineralized outcrops are presented in Figure II-3-1, Figures II-3-2(1) to (3), and Figures II-3-3 and –4 respectively.

3-2 Mineralization of the F3 Ore Body in its Western Part

The trenches T1 and T3 failed to expose the continuation of the mineralized outcrop along the creek as expected previously. The mineralization, in form a lens, possibly continues below the creek. The mineralization, exposed in the trench T1, is significant in fluorite concentration in the eastern half of the trench, adjoined with rare earth concentration to the west, and weakens towards the west end. This occurrence suggests that the mineralization is correlated to the mineralized outcrop along the road to the east, which is situated in the hanging wall side, rather than the continuation of the mineralized outcrop along the creek.

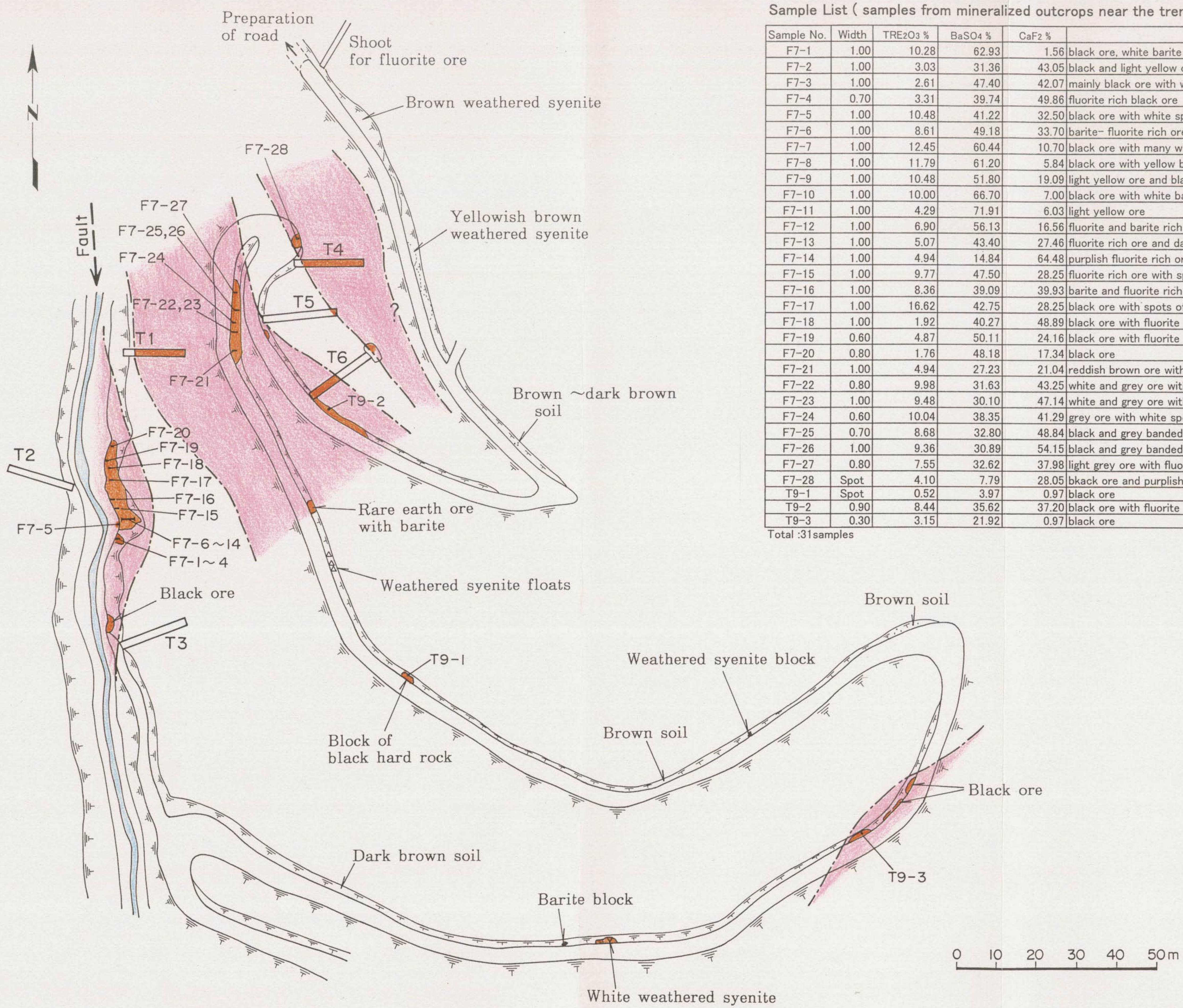
The trench, T2 was excavated with expectation to expose the western continuation of the mineralization along the creek, failed to prove the expectation. A N-S trending fault is, therefore, assumed along the creek, crosscutting the mineralization.

The expected continuation of the mineralized outcrop along the road was revealed in the trenches T1 and T6. It is interpreted that the mineralization exposed in the trench T4 and the east ends of the trenches T5 and T6 are situated in the hanging wall side of the mineralized outcrop along the road.

The investigation by the 6 trenches indicates that the west zone of the F7 Ore Body comprises three mineralized horizons, namely the mineralized outcrop along the creek, that along the road and the uppermost mineralized zone. The continuation of the mineralized outcrop along the creek is interpreted to be situated below the creek level both to the north and the south. The mineralized outcrop along the road and the uppermost zone of mineralization are expected to continue to the southeast. The elevation difference between the mineralized outcrop along the creek and the uppermost mineralized zone is estimated at approximately 55m, which warrants further exploration for the continuations of these mineralized horizons.

The assay results of the samples collected in a part of the trenches T1 and T4, where intensely weathered syenite are visually identified, are in the range from 3.11 to 7.29% RE_2O_3 (mostly 5 to 6%), from 9.65 to 25.10% $BaSO_4$ and from 1.25 to 5.51% CaF_2.

According to these assay results, there may be portions significantly mineralized with rare earths even where barite and/or fluorite mineralization is relatively weak. It is extremely difficult to visually identify rare earth mineralization in hand specimens or outcrops, which requires chemical analysis for identification of intensity of rare earth mineralization.

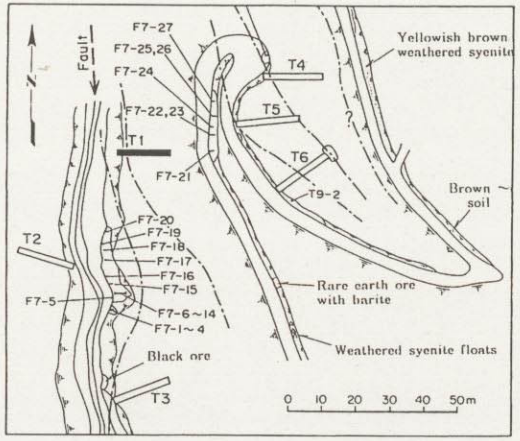


Sample List (samples from mineralized outcrops near the trench T1,T2,T3 and T4,T5,T6)

Sample No.	Width	TRE_2O_3 %	$BaSO_4$ %	CaF_2 %	Description
F7-1	1.00	10.28	62.93	1.56	black ore, white barite and light yellow bastnaesite
F7-2	1.00	3.03	31.36	43.05	black and light yellow ore with barite
F7-3	1.00	2.61	47.40	42.07	mainly black ore with white spots of barite
F7-4	0.70	3.31	39.74	49.86	fluorite rich black ore
F7-5	1.00	10.48	41.22	32.50	black ore with white spots of barite
F7-6	1.00	8.61	49.18	33.70	barite- fluorite rich ore
F7-7	1.00	12.45	60.44	10.70	black ore with many white spots of barite
F7-8	1.00	11.79	61.20	5.84	black ore with yellow bastnaesite
F7-9	1.00	10.48	51.80	19.09	light yellow ore and black ore
F7-10	1.00	10.00	66.70	7.00	black ore with white barite and a little fluorite
F7-11	1.00	4.29	71.91	6.03	light yellow ore
F7-12	1.00	6.90	56.13	16.56	fluorite and barite rich ore
F7-13	1.00	5.07	43.40	27.46	fluorite rich ore and dark brown ore
F7-14	1.00	4.94	14.84	64.48	purplish fluorite rich ore
F7-15	1.00	9.77	47.50	28.25	fluorite rich ore with spots of barite
F7-16	1.00	8.36	39.09	39.93	barite and fluorite rich ore
F7-17	1.00	16.62	42.75	28.25	black ore with spots of barite and yellow bastnaesite
F7-18	1.00	1.92	40.27	48.89	black ore with fluorite and spots of barite
F7-19	0.60	4.87	50.11	24.16	black ore with fluorite and white spots of barite
F7-20	0.80	1.76	48.18	17.34	black ore
F7-21	1.00	4.94	27.23	21.04	reddish brown ore with hematite
F7-22	0.80	9.98	31.63	43.25	white and grey ore with barite and fluorite
F7-23	1.00	9.48	30.10	47.14	white and grey ore with barite and fluorite
F7-24	0.60	10.04	38.35	41.29	grey ore with white spots of barite
F7-25	0.70	8.68	32.80	48.84	black and grey banded ore with white spots of barite
F7-26	1.00	9.36	30.89	54.15	black and grey banded ore with white spots of barite
F7-27	0.80	7.55	32.62	37.98	light grey ore with fluorite
F7-28	Spot	4.10	7.79	28.05	bkack ore and purplish grey fluorite rich ore
T9-1	Spot	0.52	3.97	0.97	black ore
T9-2	0.90	8.44	35.62	37.20	black ore with fluorite
T9-3	0.30	3.15	21.92	0.97	black ore

Total :31samples

Figure Ⅱ-3-1 Route map of the western part of F7 orebody



SAMPLE No.	TRE2O3 %	BaSO4 %	CaF2 %
T1-1	6.39	23.11	10.91
T1-2	7.35	26.59	18.58
T1-3	3.51	14.63	8.77
T1-4	4.39	18.30	14.05
T1-5	5.26	23.56	27.95
T1-6	7.27	25.62	37.50
T1-7	7.39	24.14	39.25
T1-8	7.23	24.58	24.35
T1-9	6.27	23.29	4.34
T1-10	6.96	24.75	3.62
T1-11	7.04	25.10	3.00
T1-12	7.29	24.92	5.36
T1-13	6.65	24.95	2.55
T1-14	6.00	21.40	1.99
T1-15	5.82	20.73	1.73
T1-16	3.11	16.83	1.25
T1-17	3.34	21.31	1.34
T1-18	1.42	11.72	4.54
T1-19	0.89	7.98	2.82
T1-20	0.88	8.11	29.08

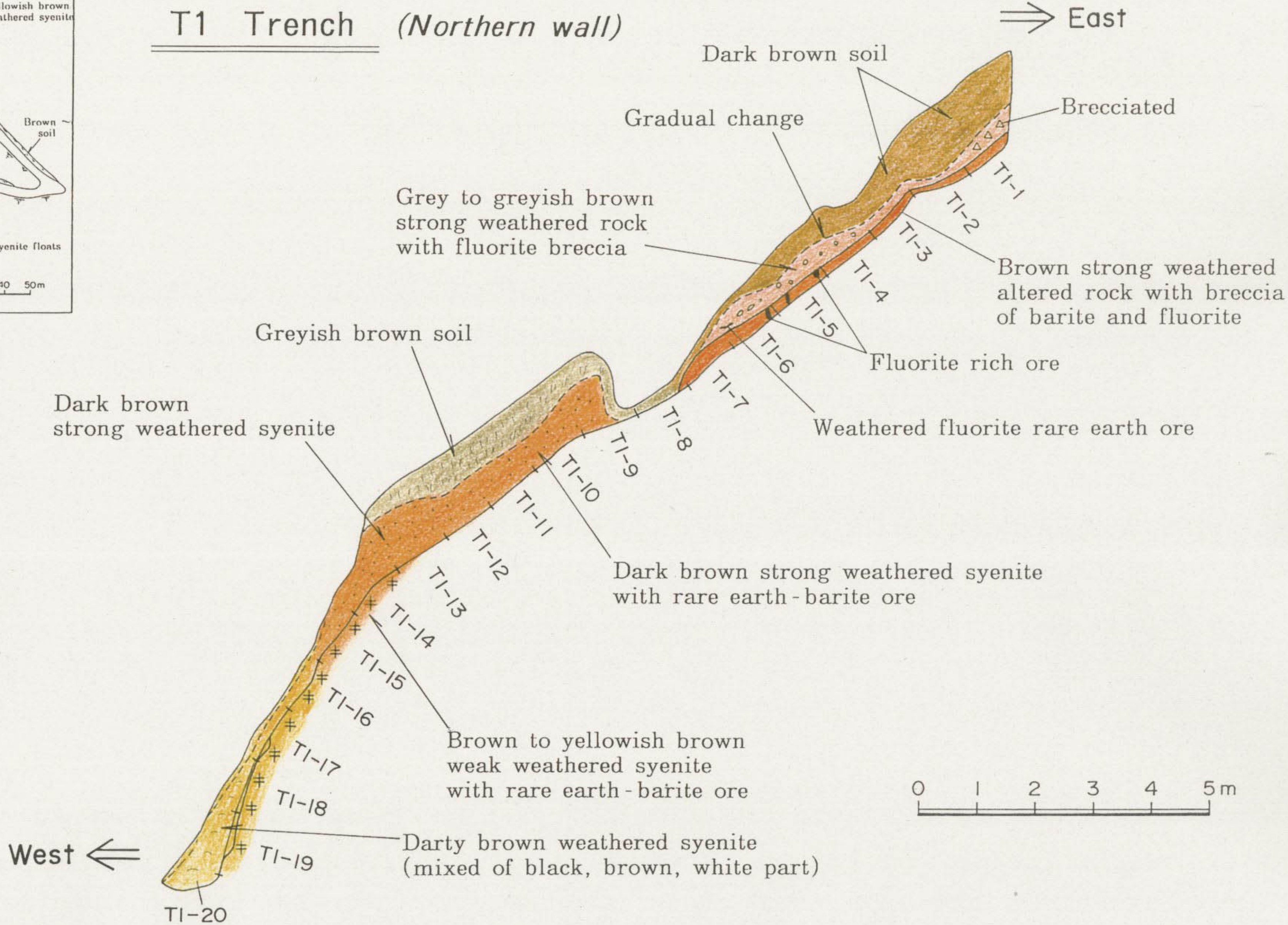


Figure II-3-2 (1) Sketch of the T1 trench

SAMPLE No.	TRE2O3 %	BaSO4 %	CaF2 %
T4-1	6.04	44.61	27.95
T4-2	6.48	22.28	21.27
T4-3	6.17	15.05	3.16
T4-4	5.50	11.83	4.05
T4-5	5.13	9.65	1.68
T4-6	6.36	10.09	1.48
T4-7	5.57	12.66	2.30
T4-8	5.02	14.34	4.21
T4-9	5.37	18.49	5.51
T4-10	5.25	11.66	1.58
T4-11	4.52	10.88	2.38
T4-12	5.38	12.82	1.77
T4-13	5.86	13.11	1.95
T4-14	5.41	13.01	2.61
T4-15	5.75	13.56	1.87
T4-16	6.00	13.18	2.05
T4-17	6.26	12.79	1.97
T4-18	4.68	11.45	1.54
T4-19	2.96	6.67	1.13
T4-20	2.31	6.09	1.09
TB4-1	6.37	25.65	35.96
TB4-2	6.30	16.50	53.63
TB4-3	6.24	18.60	50.34
TB4-4	6.11	9.44	38.22

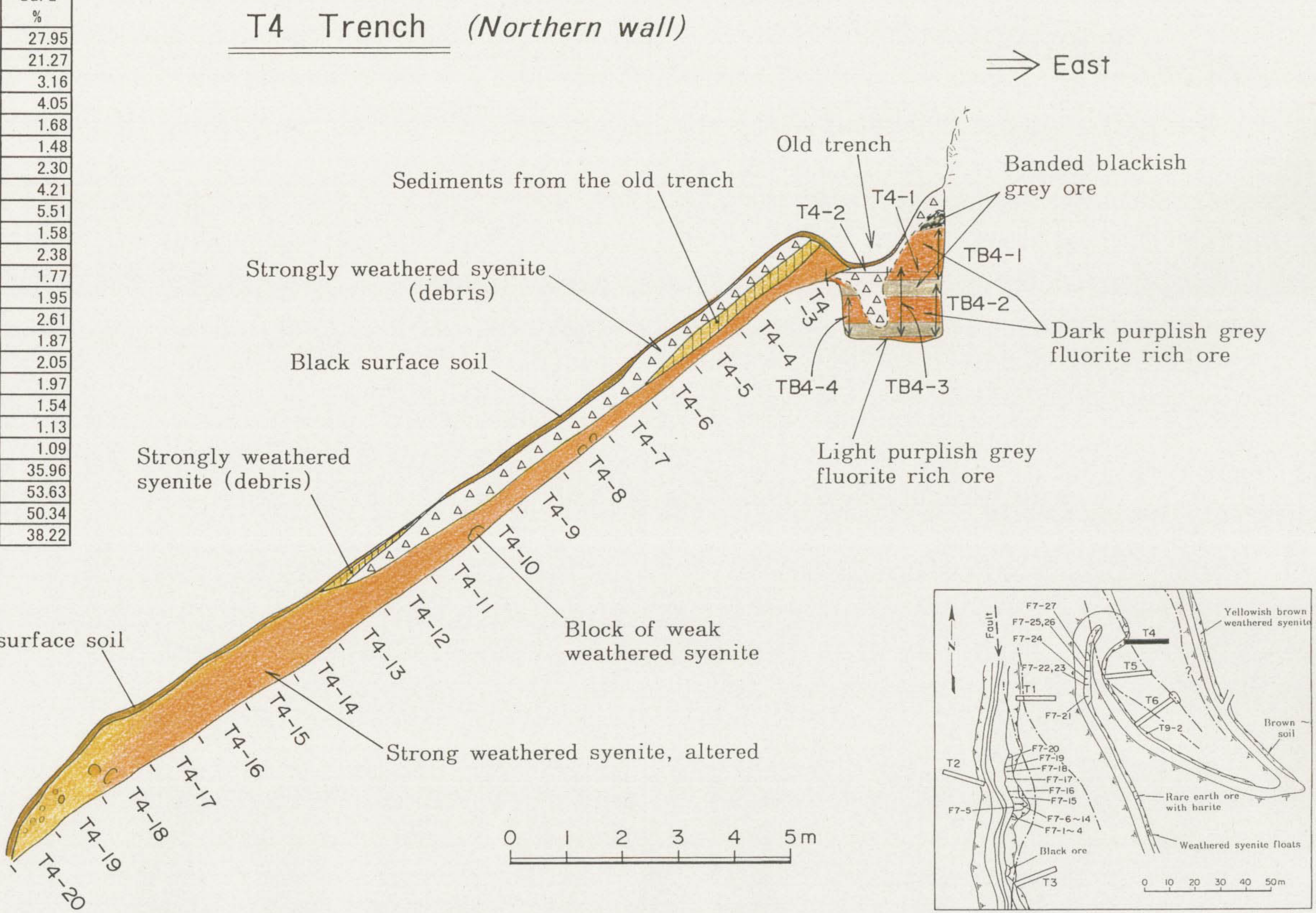
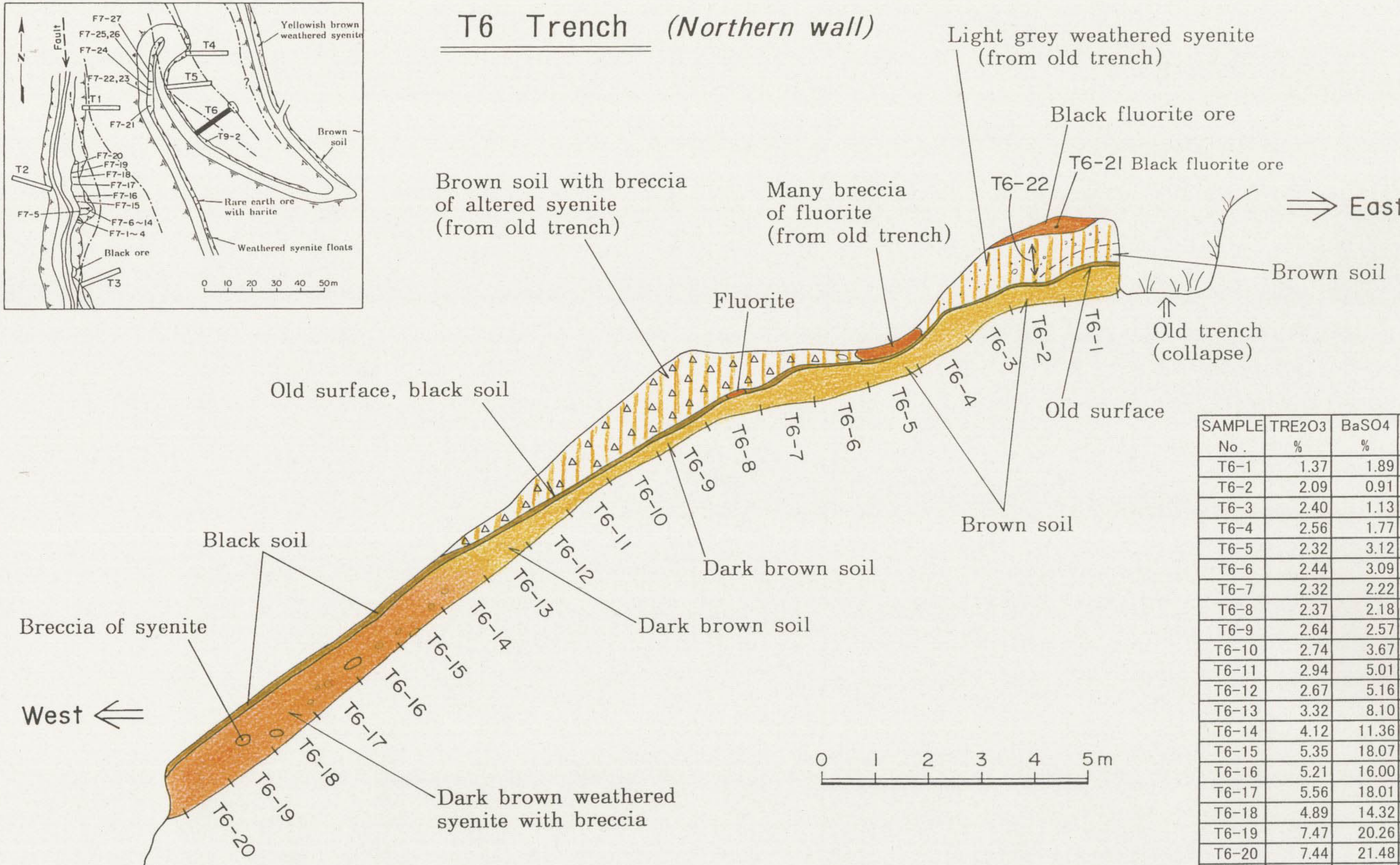
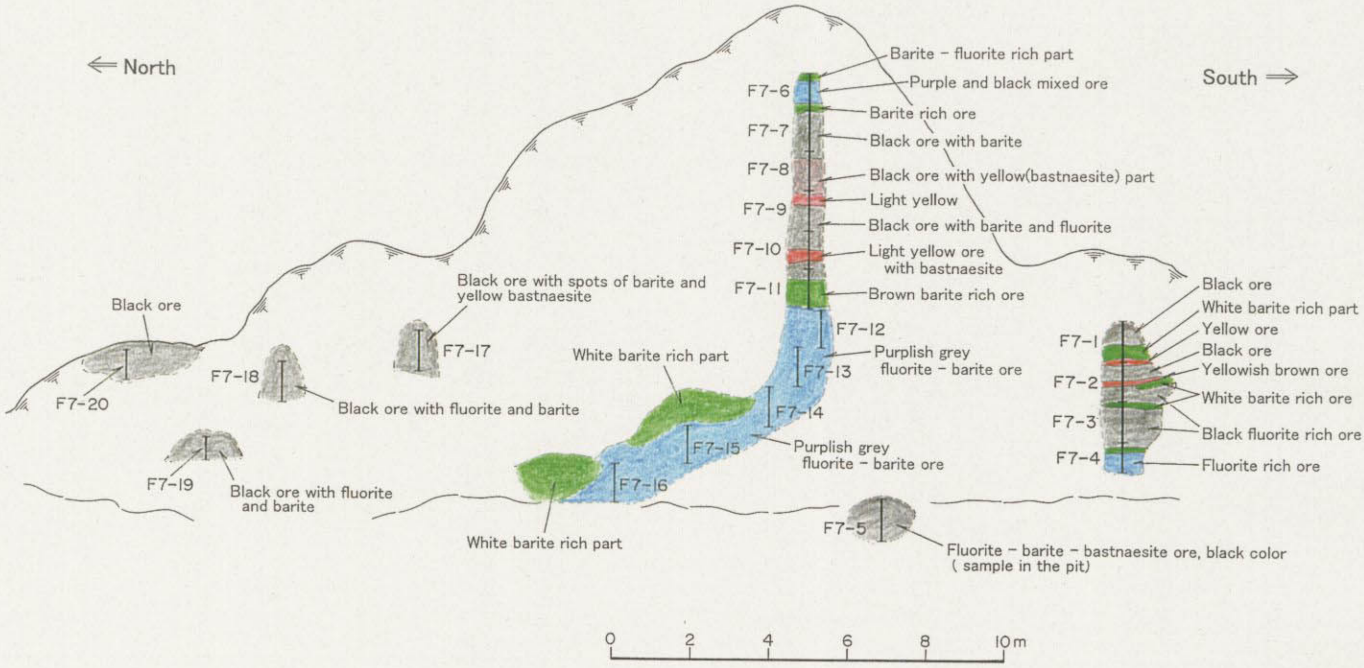


Figure II-3-2 (2) Sketch of the T4 trench



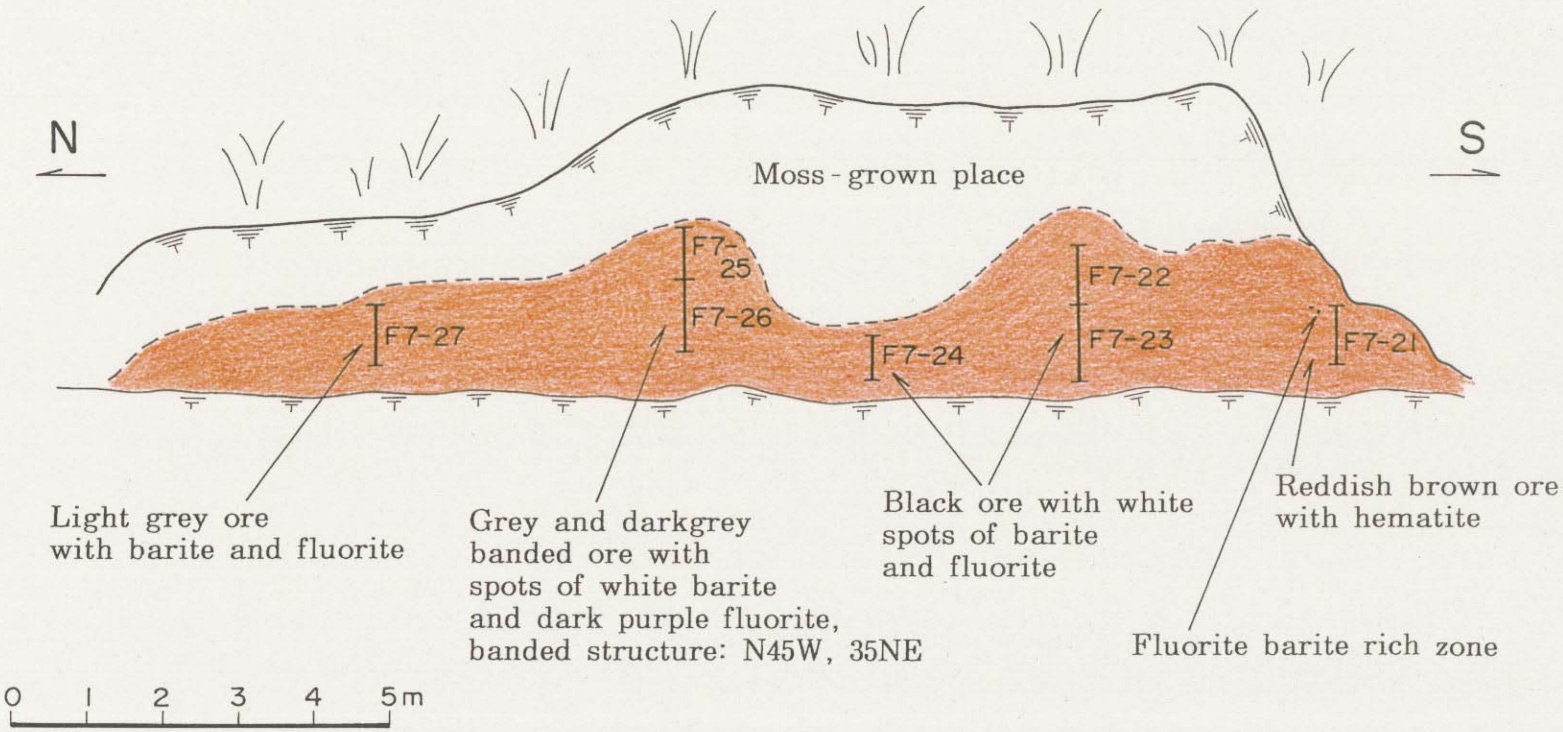
SAMPLE No.	TRE2O3 %	BaSO4 %	CaF2 %
T6-1	1.37	1.89	0.90
T6-2	2.09	0.91	0.88
T6-3	2.40	1.13	0.90
T6-4	2.56	1.77	0.99
T6-5	2.32	3.12	0.92
T6-6	2.44	3.09	1.03
T6-7	2.32	2.22	0.99
T6-8	2.37	2.18	1.03
T6-9	2.64	2.57	1.05
T6-10	2.74	3.67	1.15
T6-11	2.94	5.01	1.03
T6-12	2.67	5.16	1.05
T6-13	3.32	8.10	1.13
T6-14	4.12	11.36	1.29
T6-15	5.35	18.07	1.32
T6-16	5.21	16.00	1.50
T6-17	5.56	18.01	1.68
T6-18	4.89	14.32	1.56
T6-19	7.47	20.26	2.18
T6-20	7.44	21.48	1.91
T6-21	10.83	38.95	9.76
T6-22	1.46	4.51	0.78

Figure Ⅱ-3-2 (3) Sketch of the T6 trench



Sample No.	Width	TRE_2O_3 %	$BaSO_4$ %	CaF_2 %	Description
F7-1	1.00	10.28	62.93	1.56	black ore, white barite and light yellow bastnaesite
F7-2	1.00	3.03	31.36	43.05	black and light yellow ore with barite
F7-3	1.00	2.61	47.40	42.07	mainly black ore with white spots of barite
F7-4	0.70	3.31	39.74	49.86	fluorite rich black ore
F7-5	1.00	10.48	41.22	32.50	black ore with white spots of barite
F7-6	1.00	8.61	49.18	33.70	barite- fluorite rich ore
F7-7	1.00	12.45	60.44	10.70	black ore with many white spots of barite
F7-8	1.00	11.79	61.20	5.84	black ore with yellow bastnaesite
F7-9	1.00	10.48	51.80	19.09	light yellow ore and black ore
F7-10	1.00	10.00	66.70	7.00	black ore with white barite and a little fluorite
F7-11	1.00	4.29	71.91	6.03	light yellow ore
F7-12	1.00	6.90	56.13	16.56	fluorite and barite rich ore
F7-13	1.00	5.07	43.40	27.46	fluorite rich ore and dark brown ore
F7-14	1.00	4.94	14.84	64.48	purplish fluorite rich ore
F7-15	1.00	9.77	47.50	28.25	fluorite rich ore with spots of barite
F7-16	1.00	8.36	39.09	39.93	barite and fluorite rich ore
F7-17	1.00	16.62	42.75	28.25	black ore with spots of barite and yellow bastnaesite
F7-18	1.00	1.92	40.27	48.89	black ore with fluorite and spots of barite
F7-19	0.60	4.87	50.11	24.16	black ore with fluorite and white spots of barite
F7-20	0.80	1.76	48.18	17.34	black ore
Total	19.10				
Average	0.96	7.55	48.41	27.15	

Figure II-3-3 Sketch of the outcrop along the stream in the western part of F7 orebody



Assay results

Sample No.	Width	TRE_2O_3 %	$BaSO_4$ %	CaF_2 %	Description
F7-21	1.00	4.94	27.23	21.04	reddish brown ore with hematite
F7-22	0.80	9.98	31.63	43.25	white and grey ore with barite and fluorite
F7-23	1.00	9.48	30.10	47.14	white and grey ore with barite and fluorite
F7-24	0.60	10.04	38.35	41.29	grey ore with white spots of barite
F7-25	0.70	8.68	32.80	48.84	black and grey banded ore with white spots of barite
F7-26	1.00	9.36	30.89	54.15	black and grey banded ore with white spots of barite
F7-27	0.80	7.55	32.62	37.98	light grey ore with fluorite
Average	0.84	8.46	31.46	41.74	

Figure Ⅱ-3-4 Sketch of the outcrop along the road in the western part of F7 orebody

Chapter 4 Drilling Investigation

4-1 General

4-1-1 Objectives

The drilling investigation for the known mineralization of the Dong Pao F3 Ore Body was carried out in order to examine its geological and mineralogical characteristics and to verify the mineralization intensity of rare earth elements such as Cerium, Lanthanum and others.

The central to southeastern part of the F3 Ore Body was explored by a total of 16 drill holes with the aggregated length of 1,480m in the 1st Year Campaign. The western to northern part was drill-explored in the 2nd Year Campaign by 7 holes with the aggregated length of 820m. the hole locations are shown in Figure II-4-1. The hole particulars are presented in Table II-4-1 below.

Table II-4-1 Drilling Performance

	Hole Name	Depth (m)	Inclination (deg)
Phase 1	MJVD-1	80	90°
	MJVD-2	80	90°
	MJVD-3	80	90°
	MJVD-4	100	90°
	MJVD-5	100	90°
	MJVD-6	100	90°
	MJVD-7	100	90°
	MJVD-8	100	90°
	MJVD-9	100	90°
	MJVD-10	100	90°
	MJVD-11	100	90°
	MJVD-12	100	90°
	MJVD-13	80	90°
	MJVD-14	80	90°
	MJVD-15	80	90°
	MJVD-16	100	90°
	Sub total	1,480	-
Phase 2	MJVD-17	100	-90
	MJVD-18	130	-90
	MJVD-19	140	-90
	MJVD-20	120	-90
	MJVD-21	120	-90
	MJVD-22	110	-90
	MJVD-23	100	-90
	Sub total	820	
Ground total		**2,300**	-

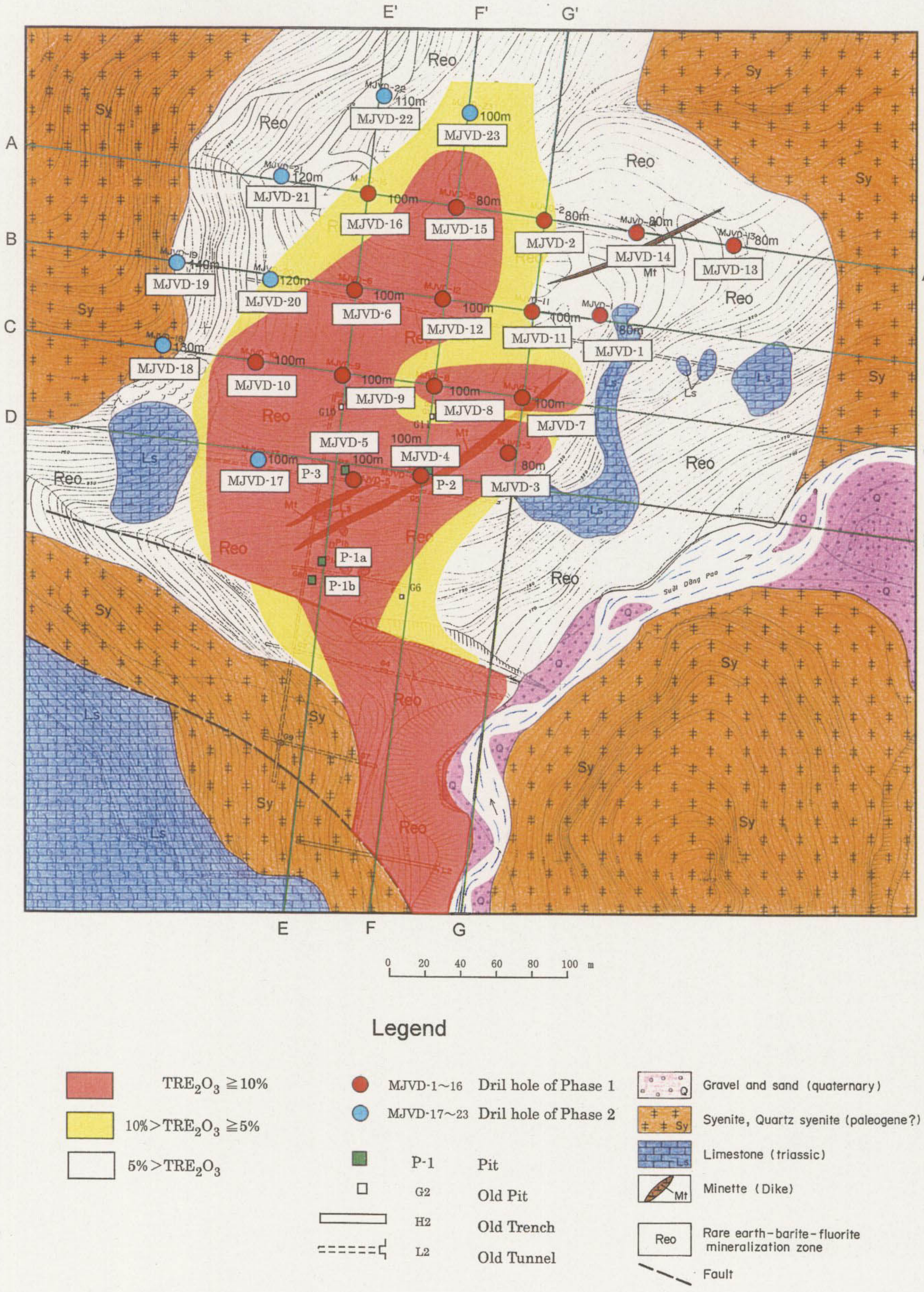


Figure Ⅱ-4-1 Location map of the drilling sites

4-1-2 Methodology

The recovered drill cores were observed and recorded in the geologic logs at a scale of 1 to 100 that were compiled to 1 to 200 scale hole profiles. The core samples were continuously collected at an interval of 1m and were quartered for chemical analysis. Selected core samples were submitted for laboratory tests such as microscopic observation of thin sections, X-ray diffraction analysis and so forth. The remaining core samples are now stored at the core storage at about 400m to the southwest of New Dong Pao.

4-2 Interpretation of the Drilling Result

4-2-1 Geology and Geological Structures

The mineralized zone including the F3 Ore Body is shown in plan in Figure II-4-1. The geology of the mineralized zone comprises limestone of the middle Triassic System and Palaeogene syenite intruded by minette dikes. The regional geological structures trend in the NW-SE direction, as typically indicated in the trend of the Song Da Tectonic province to which the Project Area belong. The major fault system crosscuts the limestone and the syenite in the southwestern part of the mineralized zone, striking in the NNW-SSE direction. The minette dikes presumably run in the NE-SW direction as shown in the geological cross-sections interpreted on the basis of the drilling result.

The rocks of the mineralized zone show the following mode of occurrences according to the results of the drilling and of the 1st Year Geological Prospecting.

- The limestone forms steep cliffs in the southwestern part and presents light gray, massive appearances.
- The syenite intrudes the Triassic limestone and extensively develops in the Project Area. It is intensely weathered and loose in the surface in general. The unmineralized syenite shows brown color when weathered, while the mineralized syenite is gray to black-gray in color. Numerous limestone blocks are included in the syenite. Their sizes are relatively large in the western and eastern part. The larger blocks of limestone are light gray to gray in color and fine grained, while the smaller blocks are turned into white to gray microcrystalline marble and are often mineralized. Sulfides are also disseminated in part.
- The minette forms small size dikes intruding the syenite. These dikes are also intensely weathered and loose, showing brown color. It characteristically contains phlogopite with sizes of 2 to 5 mm.
- Alluvium develops along the Dong Pao river, running to the southeast of the F3 Ore Body.

4-2-2 Ore Body

The contents of RE_2O_3, $BaSO_4$ and CaF_2 are calculated based on the assay results of core samples for the 23 holes, MJVD-1 through MJVD-23, totaling 2,300m, and are tabulated in the attached Apx. 6.

Based on the results of the drilling exploration for the 2-year period, 7 cross-sections, from A-A' to G-G', are prepared to demonstrate the geology and mineralization of the F3 Ore Body. Of these, the representative cross-sections, B-B', C-C', E-E' and F-F', are shown in Figures II-4-2 (1/4) to (4/4). The RE_2O_3, $BaSO_4$ and CaF_2 contents in the holes along these cross-sections are graphically illustrated in Figures II-4-3 (1/4) to (4/4).

The extent of the mineralization and alteration zone enclosing the F3 Ore Body is estimated about 300m wide in the east-west and about 500m long in the north-south, based on the results of the past exploration and of the geological and geochemical prospecting in the Current Project. The extent of the mineralization with the grades of 10% RE_2O_3 or better is estimated 150m wide in the east-west and 400m in the north-south as shown in Figure II-4-1.

4-2-3 Rare Earth Mineralization

Of the 16 holes drilled in the 1st Year Campaign, the 7 holes, MJVD-5, -6, -7, -9, -10, -12 and -15 encountered mineralization containing 10% RE_2O_3 or better, and the 5 holes, MJVD-2, -3, -4, -8 and -16, that containing 5 to 10% RE_2O_3. The remaining 4 holes intersected only low grade rare earth mineralization.

Of the 7 holes drilled in the 2nd Year Campaign, the hole MJVD-17 was the only one to have intersected mineralization containing 10% RE_2O_3 or better and the two holes, MJVD-21 and –23, that containing 5 to 10% RE_2O_3. The remaining 4 holes intersected long sections largely comprising limestone only with weak rare earth mineralization.

(1) Cross-sections of the Mineralized Zone

Along the E-W cross-sections, the mineralized zone is bounded by limestone blocks at the east and west ends, although the mineralization tends to become stronger westwards in part.

Along the N-S longitudinal sections (E-E' to G-G'), the mineralized zone, cropping out on the slope at the southern end, tends to weaken and narrow northwards. Along the longitudinal section F-F', however, the zone appears to be open to the north of the northern limit of the drilling grid, suggesting possible continuation to the F7 Ore Body. The limestone block at the west end that forms a steep cliff, is intersected by the hole MJVD-22 on the section E-E', indicating its northern continuation, and bounds the northern extension of the mineralized zone on this longitudinal section.

The F3 Ore Body, comprising the high grade center($RE_2O_3 \geq$ 10%) and the surrounding moderate grade periphery(10% > $RE_2O_3 \geq$ 5%), forms a irregularly shaped lens that is enclosed by extensive low grade mineralization with grade less than 5% RE_2O_3. The high grade intersections are tabulated in Table II-4-2.

Table II-4-2 High grade intersections of REO

Section No.	Drill Hole No.	Depth (m)	Thickness (m)	Content T-RE_2O_3(%)
A-A'	MJVD-15	63.00～77.00	14.00	10.90
B-B'	MJVD-6	63.00～87.00	24.00	14.20
	MJVD-12	46.00～91.00	45.00	10.82
C-C'	MJVD-10	44.00～96.00	52.00	10.44
	MJVD-9	64.00～88.00	24.00	10.59
	MJVD-7	39.00～55.00	16.00	11.72
D-D'	MJVD-5	0.00～25.00	25.00	11.00
	MJVD-17	11.00～38.00	27.00	10.09

(2) Plan of the Mineralized Zone

The lateral distribution of the high grade center and the moderate grade periphery is shown in Figure II-4-1. The distribution to the south of the cross-section D-D' is drawn based on the assay results of the past pit and tunnel samples to the depth of 30m from the surface. The high grade center distributes in an area approximately 150m wide and 400m long in plan.

(3) Statistical Analysis of the RE_2O_3 Contents

The histogram and the cumulative frequency distribution of the RE_2O_3 contents in the drill core samples are prepared and presented in Figure II-4-4.

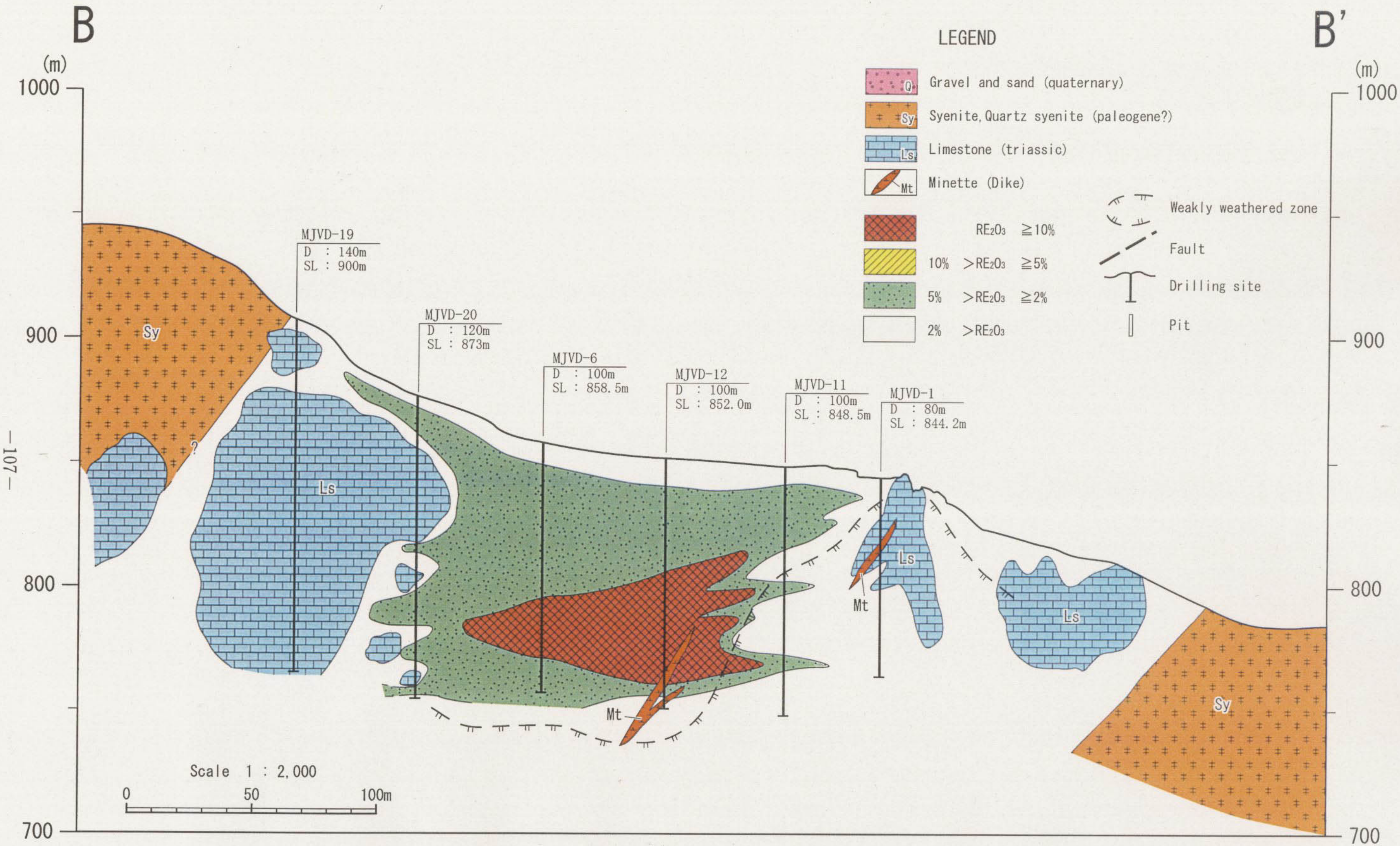


Figure II-4-2 (1/4) Geology-mineralization cross-section of F3 orebody (B-B')

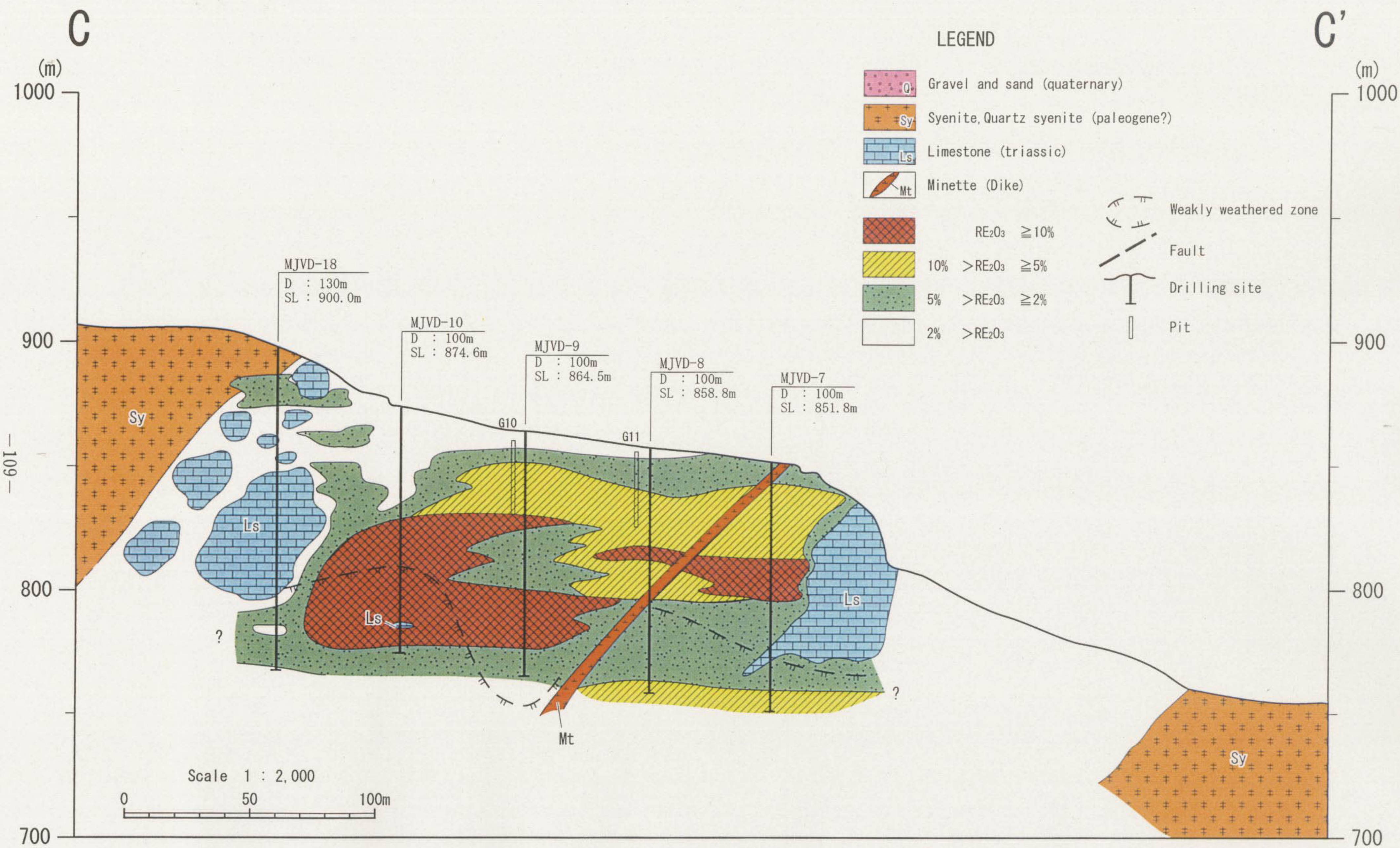


Figure Ⅱ-4-2 (2/4) Geology-mineralization cross-section of F3 orebody (C-C')

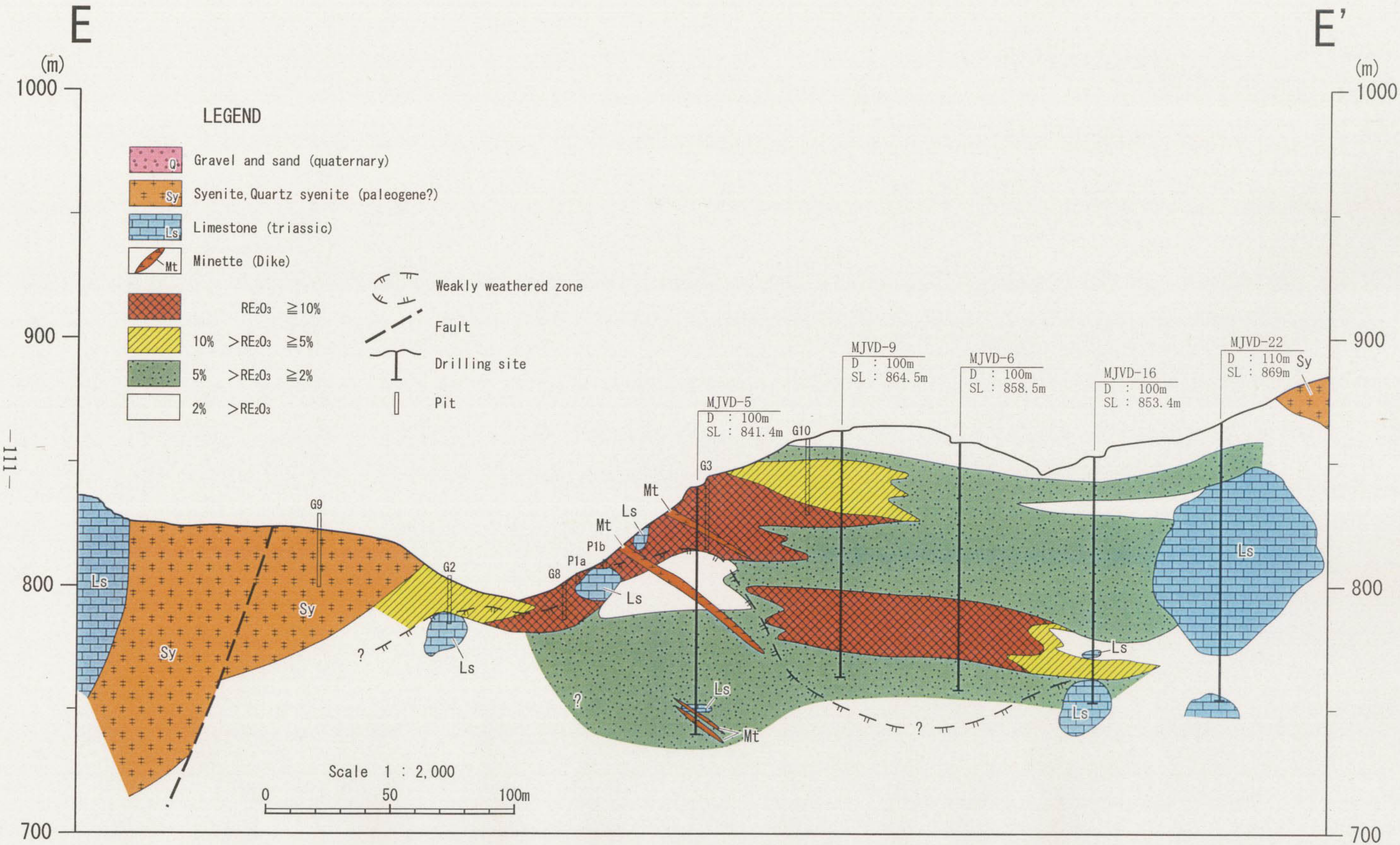


Figure Ⅱ-4-2 (3/4) Geology-mineralization cross-section of F3 orebody (E-E')

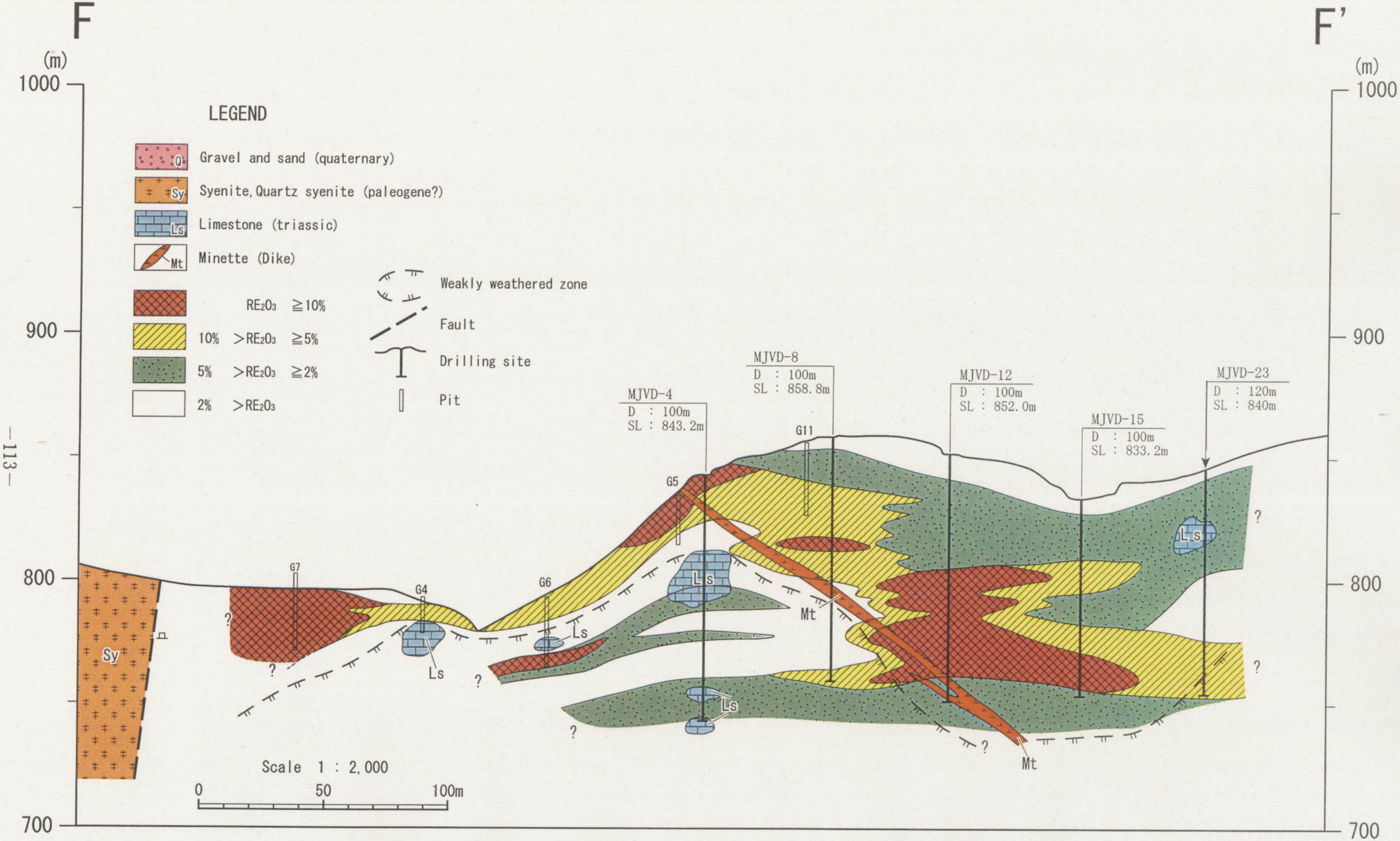


Figure Ⅱ-4-2 (4/4) Geology-mineralization cross-section of F3 orebody (F-F')

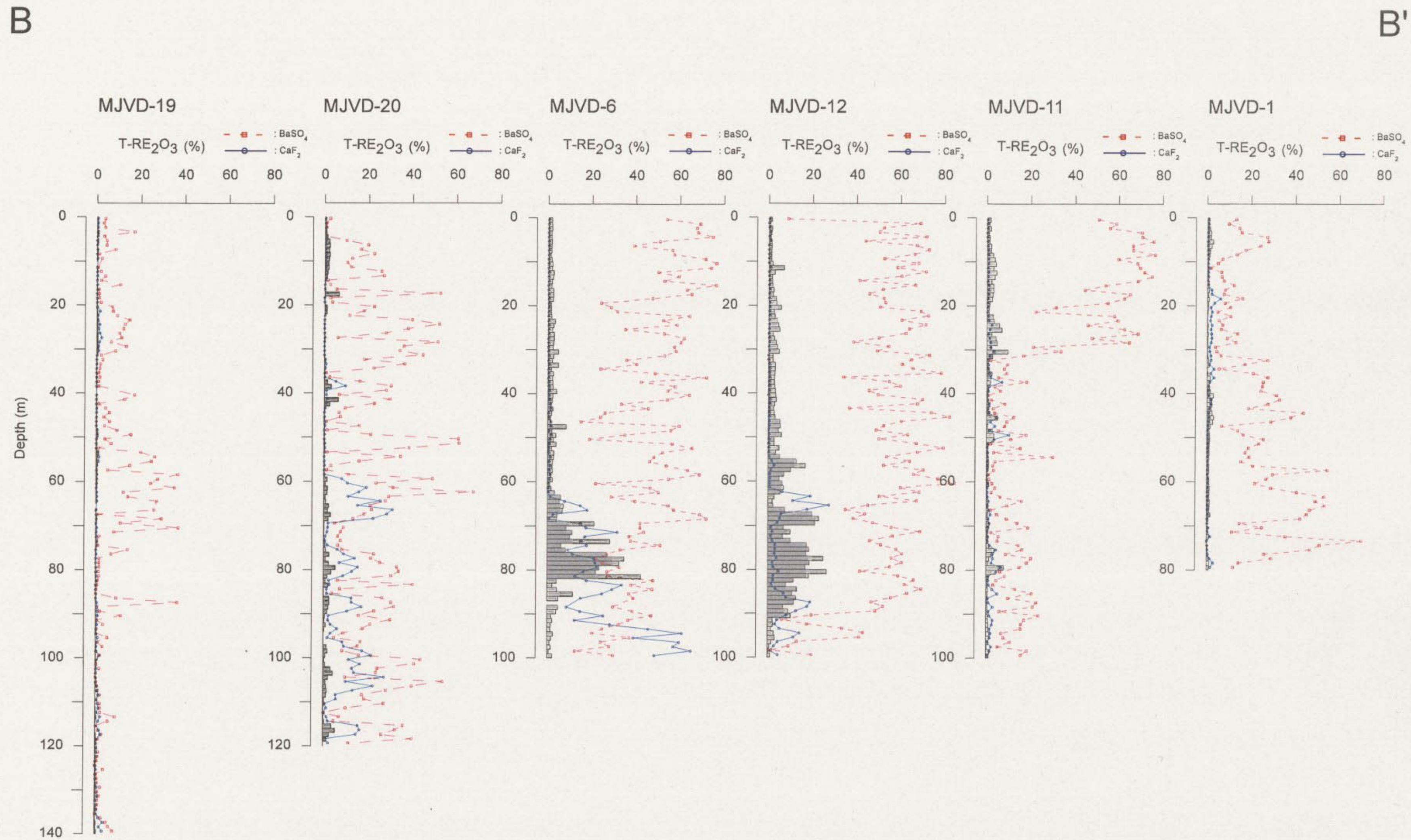


Figure Ⅱ-4-3 (1/4) Bar graphs for T-RE_2O_3, line graphs for CaF_2 and $BaSO_4$ (B-B')

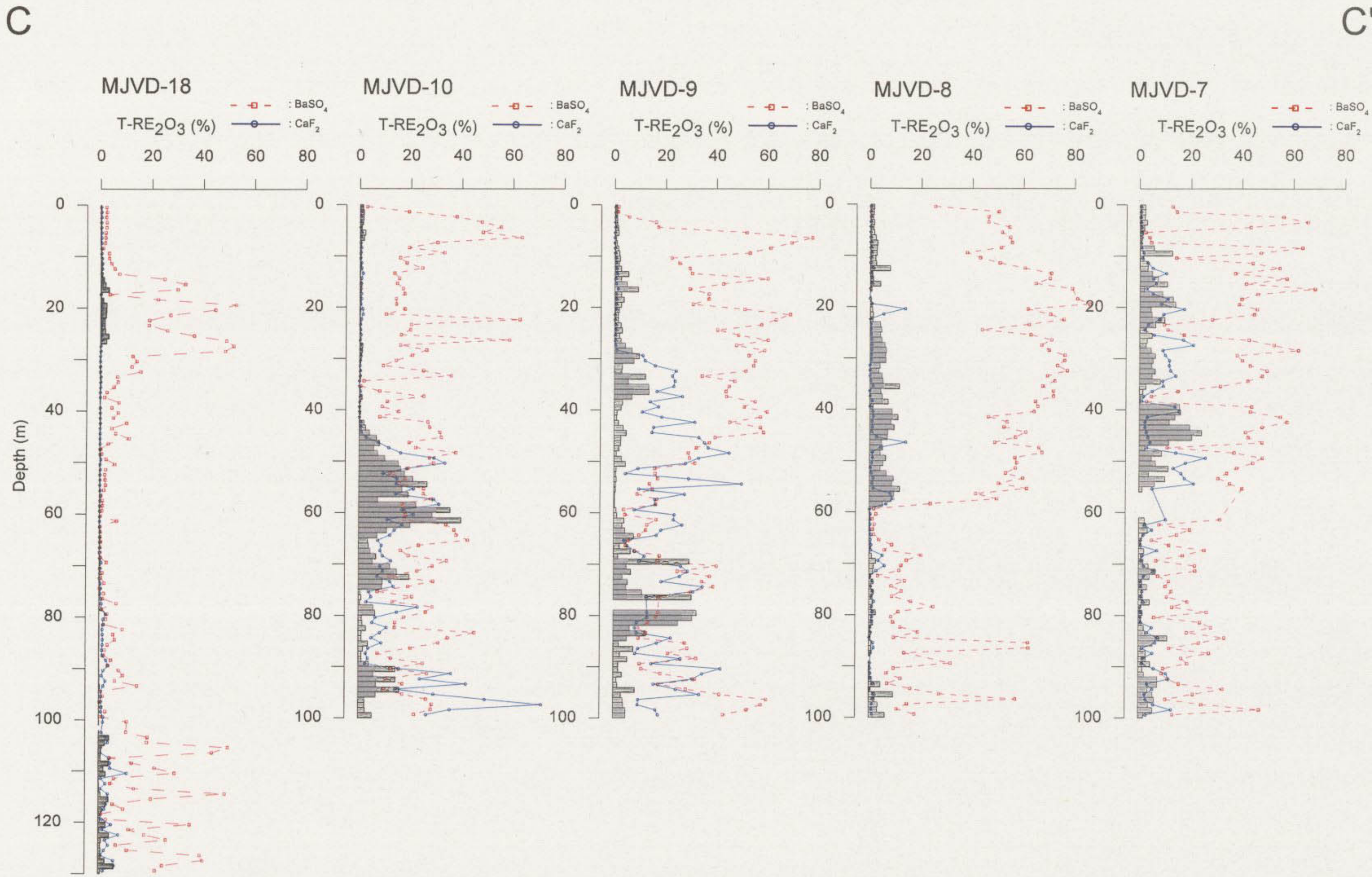


Figure Ⅱ-4-3 (2/4) Bar graphs for T-RE_2O_3, line graphs for CaF_2 and $BaSO_4$ (C-C')

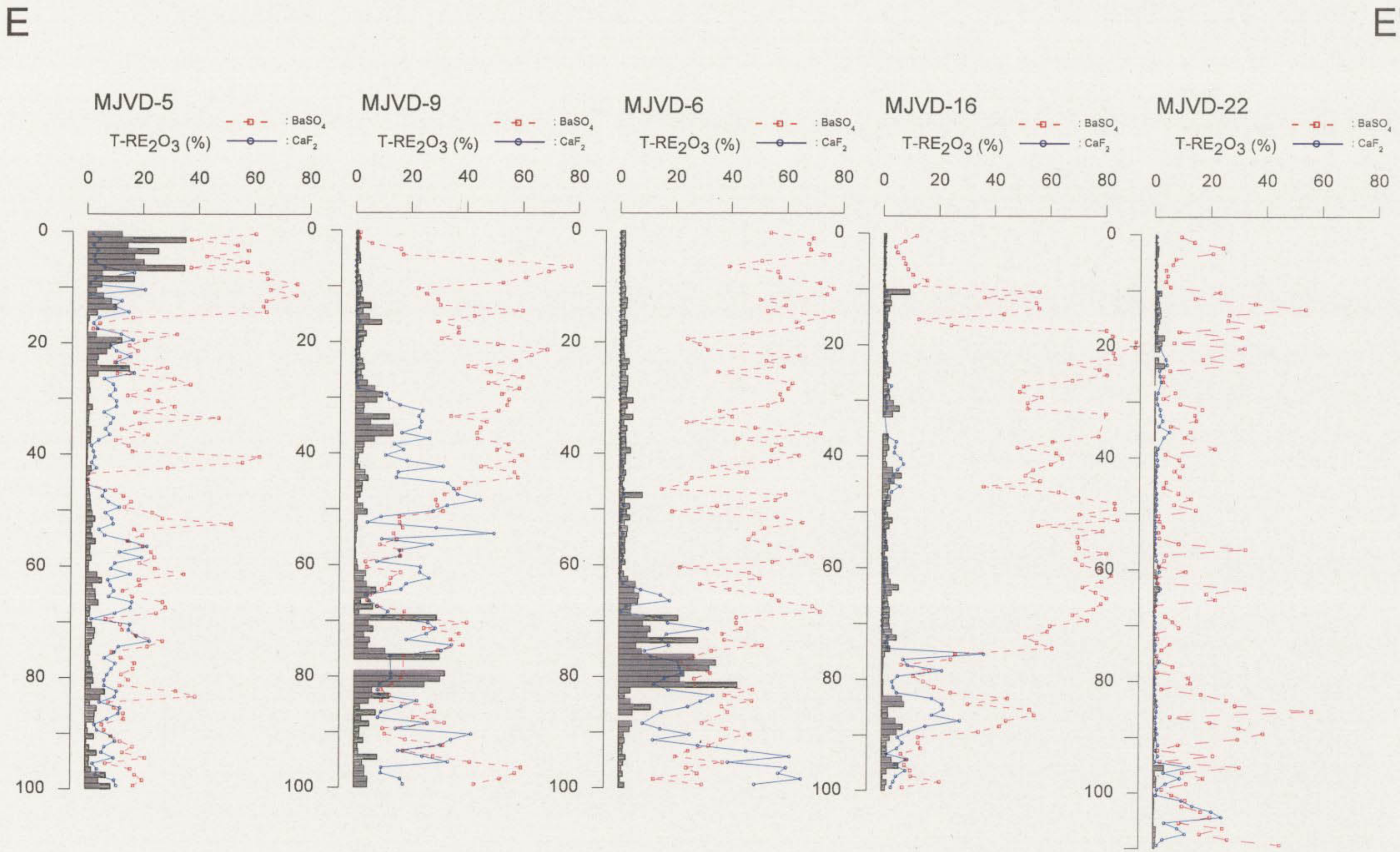


Figure Ⅱ-4-3 (3/4) Bar graphs for T-RE_2O_3, line graphs for CaF_2 and $BaSO_4$ (E-E')

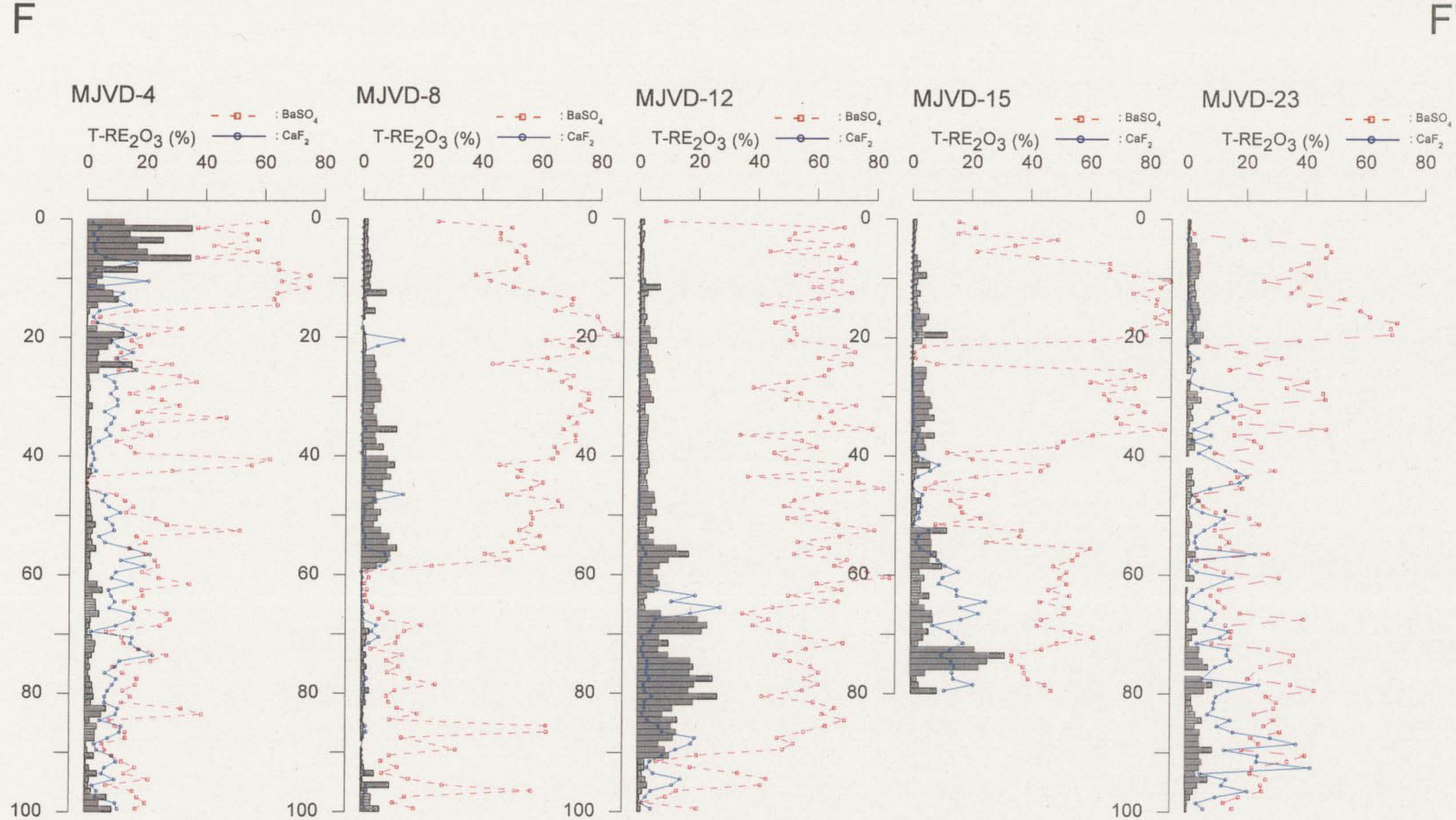


Figure Ⅱ-4-3 (4/4) Bar graphs for T-RE_2O_3, line graphs for CaF_2 and $BaSO_4$ (F-F')

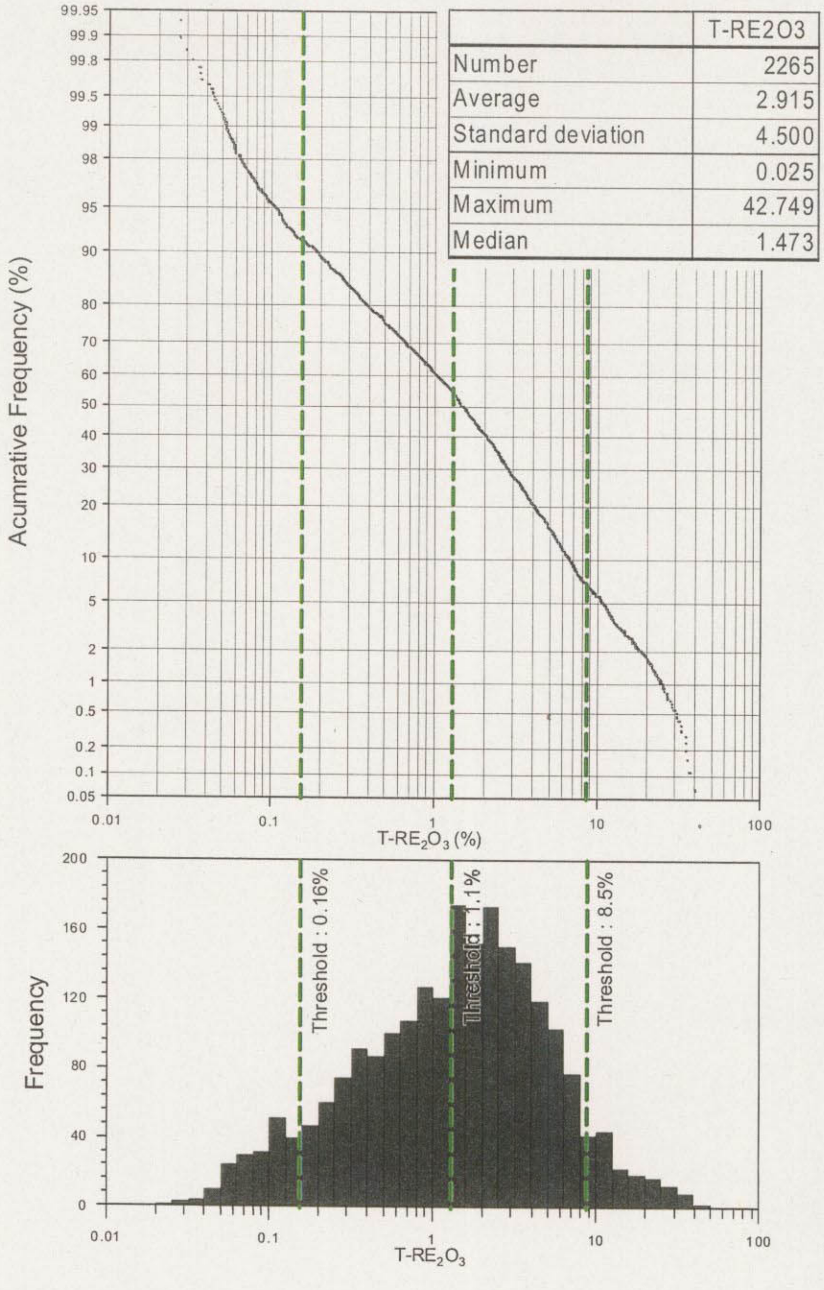


Figure II-4-4 Histogram and cumulative frequency diagram of T-RE$_2$O$_3$(%) of core

The RE_2O_3 content of the F3 Ore Body indicates a unimodal distribution and accordingly is linear in the cumulative frequency distribution. However, slight inflections are observed at 0.16%, 1.1% and 8.5% RE_2O_3. The intervals between these thresholds are compared for the mineralization characteristics as shown in Table II-4-3.

Table II-4-3 Classification of mineralization by thresholds of T-RE_2O_3(%) distribution

Threshold Intervals	Classification of Mineralization
$RE_2O_3 < 0.16\%$	unmineralized limestone
$0.16\% \leq RE_2O_3 < 1.1\%$	limestone and syenite slightly mineralized
$1.1\% \leq RE_2O_3 < 8.5\%$	weakly to moderately mineralized ores
$8.5\% \leq RE_2O_3$	intensely mineralized ores

4-2-4 Fluorite Mineralization

The holes MJVD-2, -5, -6, -7, -9, -10, -12 and –15, drilled in the 1st Year Campaign, and MJVD-17 and –23, drilled in the 2nd Year Campaign, intersected significant fluorite mineralization. The concentration of fluorite mineralization superimposes that of rare earth mineralization in plan. However, they differ from each other in cross-section and indicate no correlation to each other. Therefore, it is presumed that these two types of mineralization were formed in different stages.

The fluorite mineralization occurs as dissemination in syenite and as veinlets or dissemination in limestone. Fluorite intersections in drill holes are summarized in Table II-4-4.

Table II-4-4 Significant Fluorite Intersections in Drill Holes

Section No.	Drill Hole No.	Depth (m)	Thickness (m)	Content CaF_2 (%)
A-A'	MJVD-15	58.00 ～ 80.00	22.00	14.99
B-B'	MJVD-6	69.00～100.00	31.00	27.42
C-C'	MJVD-10	47.00～ 65.00	18.00	18.85
	Ditto	90.00～100.00	10.00	34.63
	MJVD-9	29.00～100.00	71.00	19.81
D-D'	MJVD-5	18.00～ 32.00	14.00	11.37
	Ditto	55.00～ 78.00	23.00	12.94
	Ditto	0.00～ 46.00	46.00	23.10
F-F'	MJVD-23	69.00～100.00	31.00	15.17

4-2-5 Barite Mineralization

The barite mineralization is considerable in the F3 Ore Body. A number of holes drilled in the 1st and 2nd Year Campaigns intersected high grade barite mineralization. However, the 4 holes, MJVD-18, -19, 21 and –22 drilled in the 2nd Year campaign, encountered long limestone sections and were weak in barite mineralization in comparison with other drill holes.

The concentration of barite mineralization extensively distributes beyond that of rare earth mineralization in plan. These types of mineralization indicate no agreement in their distributions in cross-section and no correlation to each other. The barite concentration tends to thicken from south to north and east to west, excluding the limestone portions, with increasing the degree of concentration. No correlation is observed between the barite and the fluorite mineralization. Significant mineralization that was intersected by the 4 holes drilled in the 1st Year Campaign is summarized in Table II-4-5.

Table II-4-5 Significant Barite Intersections in Drill Holes

Section No.	Drill Hole No.	Depth (m)	Thickness (m)	Content $BaSO_4$(%)
A-A'	MJVD-16	10.00～33.00	23.00	62.03
	Ditto	36.00～75.00	39.00	68.01
B-B'	MJVD-6	0.00～76.00	76.00	50.95
	MJVD-12	1.00～90.00	89.00	58.93
C-C'	MJVD-8	1.00～59.00	58.00	60.20

4-2-6 Mode of Mineral Occurrences and Mineralogy

(1) Mode of Mineral Occurrences

The ores of the F3 Ore Body are intensely weathered both in the drill cores and in surface outcrops, which makes it extremely difficult to distinguish minerals by visual observation of hand specimens. It is, however, possible to distinguish them by their colors and color tones.

An outcrop of the F3 ore Body is exposed along the road in the vicinity of the holes MJVD-3, -4, -5 and –17. The locations of the samples along the road, together with their assay results, are shown in Figures II-4-5 and –7. The sketches of the outcrop are presented in Figures II-4-6 and –8.

The ores of yellow to light yellow color, as seen in the sketches, are generally rich in bastnaesite indicating higher grades than 10% RE_2O_3. Black-gray ores are relatively low in rare earth contents. White portions indicate barite concentrations and purple portions are rich in fluorite. The bastnaesite, barite and fluorite concentrations form gently inclined lenses at different locations from each other in cross-section. This mode of occurrences suggests that these concentrations took place at different stages of a series of the mineralization process. The occurrences that are observed on this outcrop possibly represent the general mode of occurrences of the F3 Ore Body.

(2) Mineralogy

The ore minerals that were observed in the F3 Ore Body are bastnaesite, hydroxy-bastnaesite, synchysite, barite, fluorite and minor pyrite. The gangues observed include quartz, calcite, K-feldspar and minor phlogopite, illite, kaolinite, halloysite, smectite and boehmite.

Bastnaesite mainly occurs as fine grained crystals interstitially filling spaces between crystals of barite, fluorite, calcite and other minerals. In part, it forms veinlets crosscutting barite, fluorite and calcite crystals.

(3) Characteristics of Rare Earth Elements

The contents of rare earth elements in the selected drill core samples (9 samples) and the pit samples for the metallurgical testing are normalized with the chondrite standards in order to examine the characteristics of the rare earth elements occurring in F3 ore body. The chondrite standards used for the normalization are of the C1 chondrite (Evensen et al., 1978). The chondrite-normalized REE pattern is illustrated in Figure II-4-9, compared to those of bastnaesite from Mountain Pass and of monazite from Yoganup.

The drill core and the metallurgical test samples are higher in the proportion of light rare earths than in that of heavy rare earths, compared to the standard chondrite. The chondrite normalized REE patterns for these samples demonstrate excellent agreement with those of the Mountain Pass bastnaesite rather than with those of the Yoganup monazite which is proportionally high in light to medium rare earths. The characteristics of F3 ore body demonstrated in the REE patterns indicate, in combination with the results of the microscopic observation and the X-ray diffraction analysis, that bastnaesite is the main component of the rare earth mineralization.

4-3 Genetic Model of Rare Earth Ore Deposits

A proposed genetic model for the rare earth deposits in the Project Areas is presented in Figure II-4-10. The process of the formation of the rare earth deposits is, according to this model, interpreted as follows.

(1) Intrusion of Alkaline Magma

The Triassic limestone, interbedded shale and sandstone were subjected to the Alpine Orogenic Movement and broken into a number of blocks by major faults and fracture systems trending mostly in the NW-SE direction. In the early Palaeogene, intrusion of alkaline magmas initiated along the NW-SE trending fault systems at depth in the Dong Pao area. Limestone and other sedimentary rocks, as the alkaline magmas intruded, were collapsed and broken into fragments of various sizes which were taken into the magmas. The temperature and pressure were reduced as the magmas ascent and then crystallization of non-volatile matters took place, which led to formation of syenite bodies. Limestone fragments taken into the magmas became micro-crystalline due to heat from the magmas.

(2) Mineralization Stages

In the course of magmatic differentiation to form syenite, melt at the bottom of magmas was enriched in volatile matters and then in rare earth elements as the vapor pressure increased. The high-pressure and high-temperature vapor enriched in volatile matters migrated through cooling-joints, formed in the peripheries of syenite bodies or through fractures mechanically formed in surrounding limestone by intruding forces of the magmas. The peripheries of syenite bodies were auto-metamorphosed by the high pressure-temperature vapor. The high pressure-temperature vapor was cooled down to hydrothermal solution, mixing with meteoric water as it ascended, and precipitated rare earth minerals under favorable conditions.

The homogenization temperatures of fluid inclusions within quartz and fluorite range from 128 to 281 ℃ according to the measurement carried out during the current project. The temperature range suggests that the rare earth ore deposits in this area were formed under epithermal to mesothermal conditions.

The high grade portions of total rare earth, fluorite and barite indicate no apparent correlation to each other, which implies that the three types of mineralization were formed in different stages of the mineralization. However, their close relationship in space suggests that they were formed in a single sequence of the mineralization process.

Rare earth, fluorite and barite concentrations form relatively sizable lenses or lenticular bodies of irregular shapes within altered syenite bodies, while they tend to occur in limestone as veinlet networks or disseminations in narrow spaces.

(3) Present State of the Ore Deposit

The syenite body has been exposed on the surface as the limestone on the top was eroded out. Its present dimension is, though irregular in its shape, measured at approximately 4 km in the east-west and at 5 km in the north-south. The ore deposits are located in the northern, southern and western peripheries of the syenite body.

The genesis of the rare earth deposits in the Project Area is interpreted as above. The limestone blocks within the syenite body are micro-holocrystalline and often contain disseminations of sulfides such as pyrite, sphalerite and galena as observed in drill core samples. It may be possible to interpret these calcareous rock bodies as carbonatite. This report, however, prefers to interpret that they are the Triassic limestone taken into the syenite body as blocks or boulders.

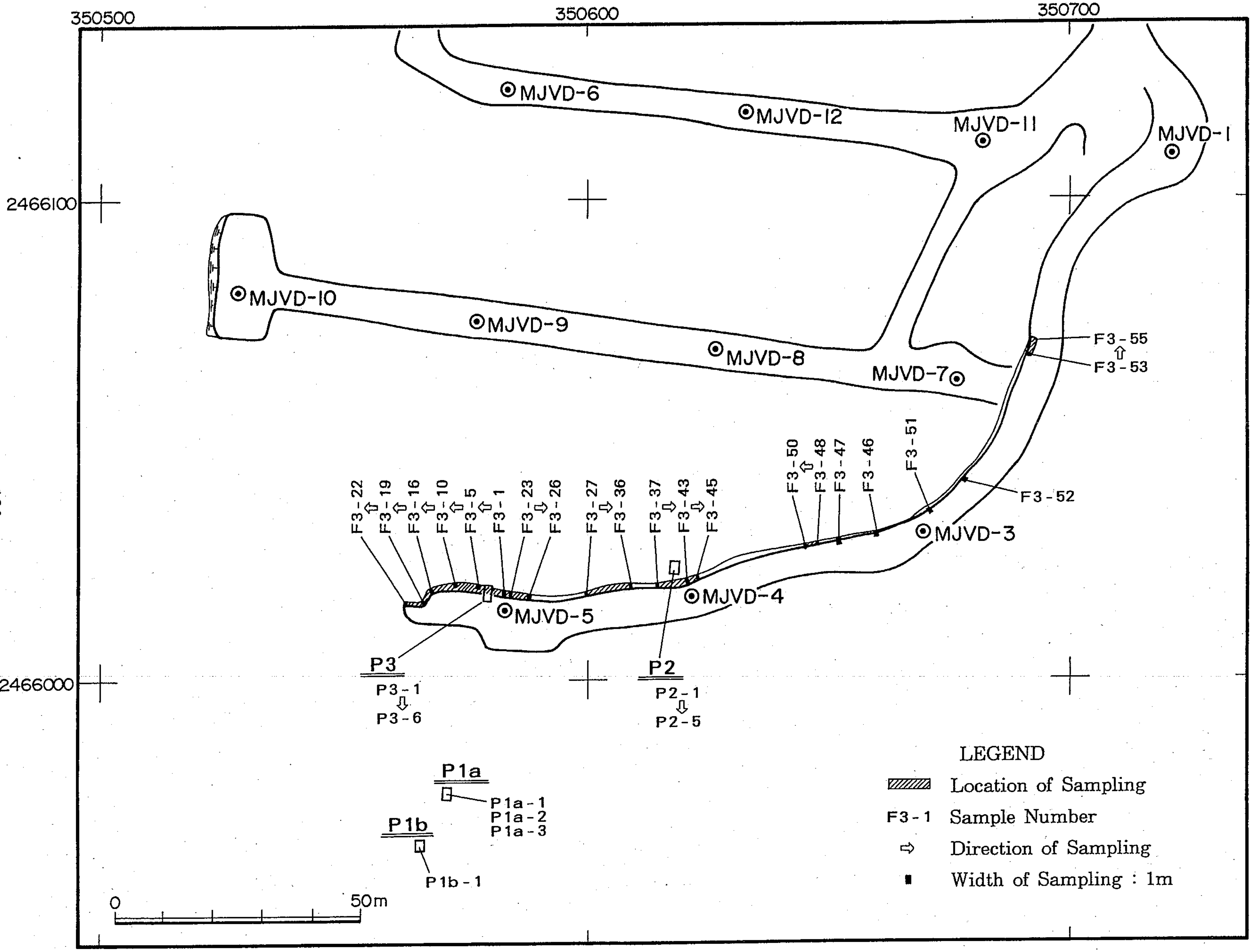
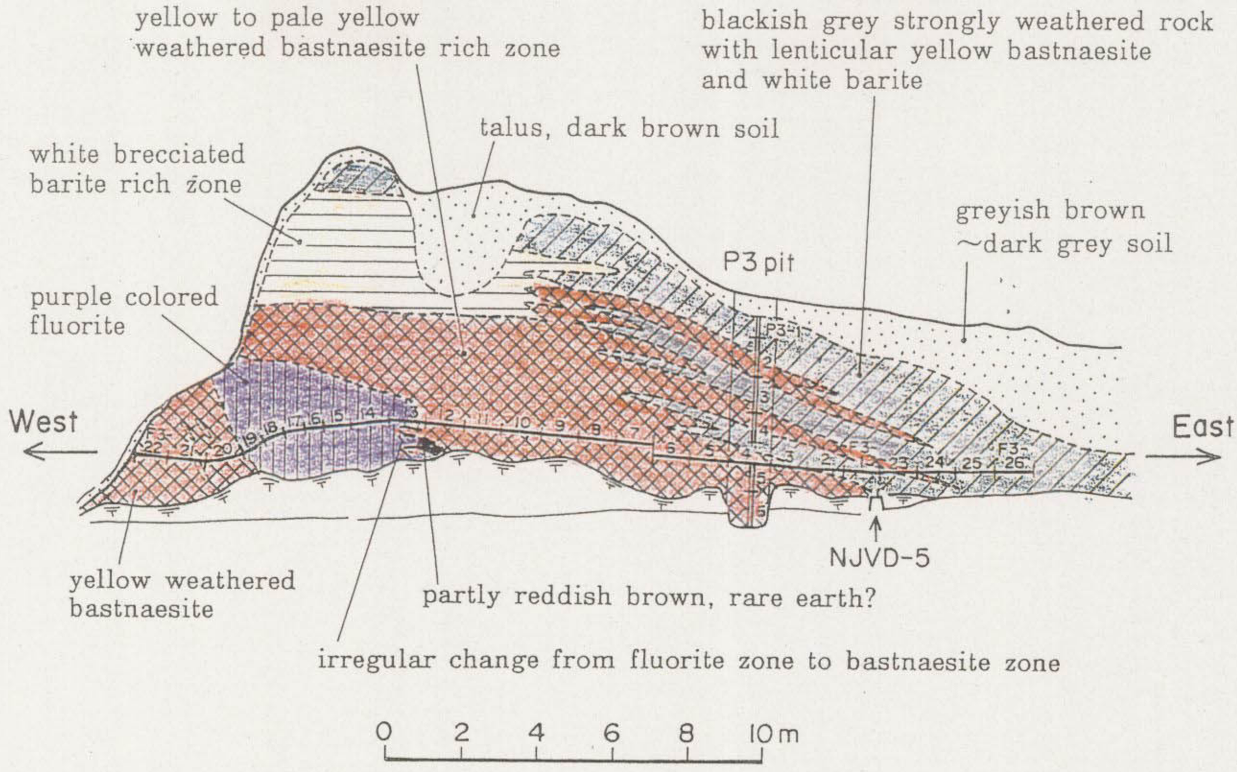


Figure II-4-5 The sample location and assay results of the outcrop in F3 ore body along the road

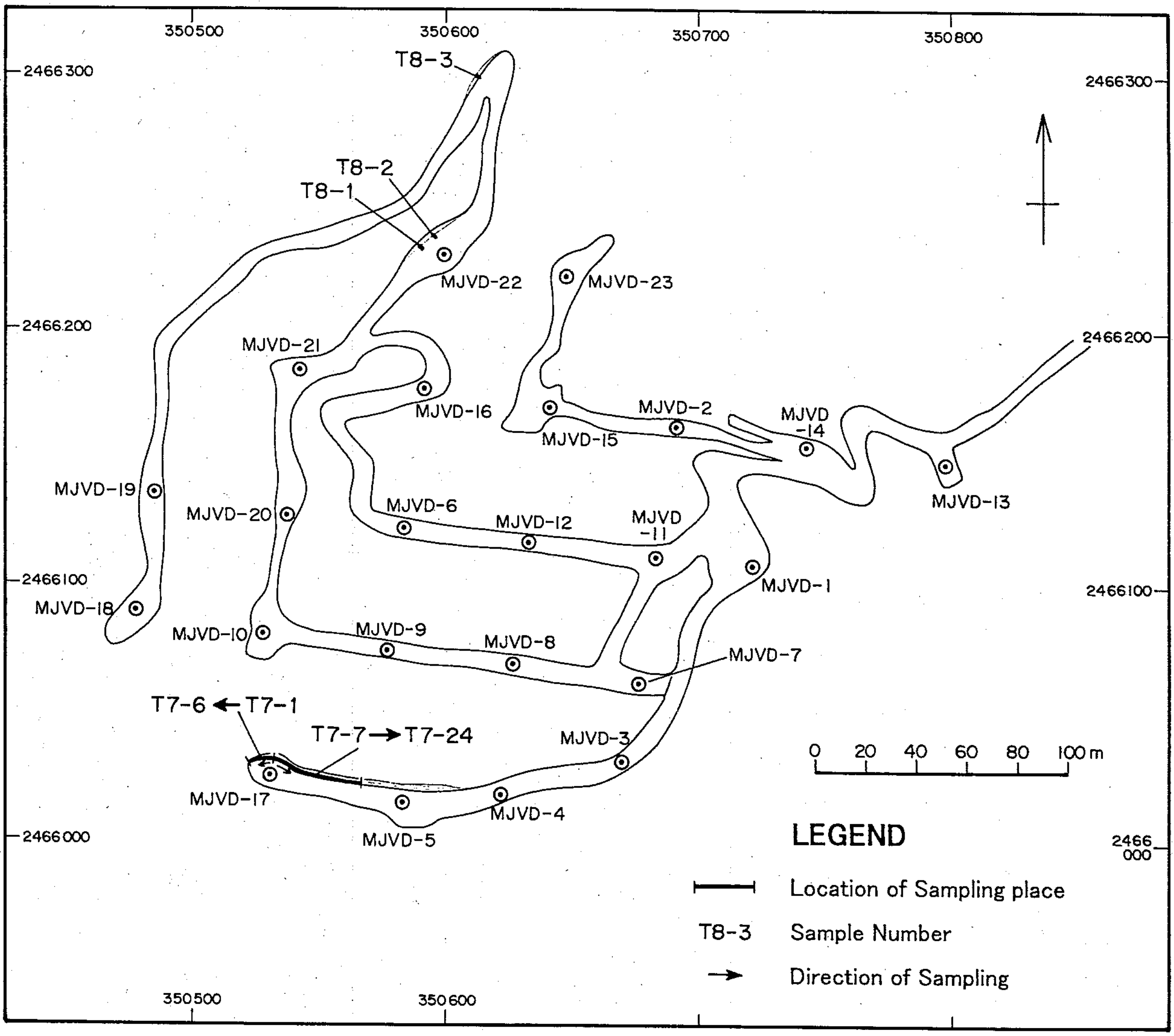
Sample No.	Width	Assay result (%)		
		T-RE_2O_3	$BaSO_4$	CaF_2
F3-1	1	4.10	64.07	0.39
F3-2	1	3.91	64.27	0.39
F3-3	1	7.27	64.11	0.39
F3-4	1	15.33	52.96	0.78
F3-5	1	3.44	61.40	0.39
F3-6	1	24.13	47.96	0.39
F3-7	1	14.15	59.47	0.39
F3-8	1	8.31	58.00	13.05
F3-9	1	22.25	39.02	4.29
F3-10	1	40.55	20.33	2.73
F3-11	1	56.28	16.87	1.17
F3-12	1	18.44	55.28	1.17
F3-13	1	6.39	57.77	14.03
F3-14	1	7.33	43.01	26.69
F3-15	1	2.92	17.02	65.84
F3-16	1	9.22	52.47	13.64
F3-17	1	8.45	37.54	24.35
F3-18	1	12.49	30.80	28.64
F3-19	1	7.79	15.12	64.09
F3-20	1	22.33	45.42	1.56
F3-21	1	33.94	42.10	0.97
F3-22	1	45.99	25.33	2.73
F3-23	1	3.91	64.52	0.195
F3-24	1	8.00	60.71	0.195
F3-25	1	7.88	67.05	0.195
F3-26	1	6.18	67.35	0.29
F3-27	1	7.15	68.03	0.97
F3-28	1	18.13	60.23	0.48
F3-29	1	29.05	49.48	0.58
F3-30	1	18.50	63.20	0.39
F3-31	1	29.83	49.79	0.58
F3-32	1	1.82	80.90	0.195
F3-33	1	7.17	65.99	0.195
F3-34	1	37.97	41.28	0.58
F3-35	1	39.61	39.89	0.49
F3-36	1	30.50	51.32	0.39
F3-37	1	0.37	90.81	0.19
F3-38	1	4.31	74.72	0.19
F3-39	1	5.20	65.14	0.19
F3-40	1	2.95	78.18	0.19
F3-41	1	8.83	70.26	0.39
F3-42	1	4.28	76.04	0.39
F3-43	1	4.26	78.52	0.29
F3-44	1	8.61	56.26	0.39
F3-45	1	1.53	74.05	0.19
F3-46	1	21.52	41.25	0.57
F3-47	1	0.10	31.50	3.90
F3-48	1	8.77	67.69	0.39
F3-49	1	16.58	57.06	0.37
F3-50	1	5.60	54.93	0.19
F3-51	1	10.48	67.09	0.39
F3-52	1	17.69	57.91	0.39
F3-53	1	3.59	58.98	0.19
F3-54	1	6.31	61.33	0.19
F3-55	1	6.79	60.44	0.19
Total		758.48	3022.22	282.98
Average		13.79	54.95	5.15

Sample No.	Width	Assay result (%)		
		T-RE_2O_3	$BaSO_4$	CaF_2
P1a-1	1	6.53	41.93	19.87
P1a-2	1	6.04	37.10	19.48
P1a-3	1	13.80	39.41	19.67
P1b-1	1	10.77	36.80	32.14
P2-1	0.4	2.59	58.22	0.19
P2-2	1	3.36	59.15	0.19
P2-3	1	4.00	65.10	0.19
P2-4	1	5.07	73.69	0.19
P2-5	1	5.74	78.98	0.39
P3-1	0.6	9.16	57.05	0.19
P3-2	1	12.13	61.01	0.19
P3-3	1	12.16	62.20	0.39
P3-4	1	15.40	54.35	0.19
P3-5	1	28.71	44.89	0.39
P3-6	1	2.61	79.66	0.19
Total		138.07	849.54	93.85
Average		9.20	56.64	6.26



Sample No.	Width	Assay result (%)			Description
		T-RE_2O_3	$BaSO_4$	CaF_2	
F3-1	1	4.10	64.07	0.39	black and grey mixed ore
F3-2	1	3.91	64.27	0.39	black and grey mixed ore
F3-3	1	7.27	64.11	0.39	black ore network
F3-4	1	15.33	52.96	0.78	yellow ore
F3-5	1	3.44	61.40	0.39	yellow >black ore
F3-6	1	24.13	47.96	0.39	black ore with yellow ore
F3-7	1	14.15	59.47	0.39	yellow ore
F3-8	1	8.31	58.00	13.05	yellow>>black ore
F3-9	1	22.25	39.02	4.29	yellow and black mixed ore
F3-10	1	40.55	20.33	2.73	mainly yellow ore
F3-11	1	56.28	16.87	1.17	mainly yellow ore
F3-12	1	18.44	55.28	1.17	mainly yellow ore
F3-13	1	6.39	57.77	14.03	yellow and black mixed ore
F3-14	1	7.33	43.01	26.69	fluorite>yellow =black ore
F3-15	1	2.92	17.02	65.84	fluorite>yellow ,partly grey
F3-16	1	9.22	52.47	13.64	fluorite>yellow ,partly grey
F3-17	1	8.45	37.54	24.35	fluorite>yellow ,partly grey
F3-18	1	12.49	30.80	28.64	fluorite>yellow =black ore
F3-19	1	7.79	15.12	64.09	fluorite rich ore
F3-20	1	22,33	45.42	1.56	yellow =black>fluorite ore
F3-21	1	33.94	42.10	0.97	yellow >>fluorite ore
F3-22	1	45.99	25.33	2.73	yellow >>fluorite ore
F3-23	1	3.91	64.52	0.195	black>>yellow ore
F3-24	1	8.00	60.71	0.195	black>>yellow ore
F3-25	1	7.88	67.05	0.195	black>>barite ore
F3-26	1	6.18	67.35	0.29	black ore with yellow ore
P3-1	0.6	9.16	57.05	0.19	dark brown ore
P3-2	1	12.13	61.01	0.19	dark grey ore
P3-3	1	12.16	62.20	0.39	grey and yellow mixed ore
P3-4	1	15.40	54.35	0.19	grey and yellow mixed ore
P3-5	1	28.71	44.89	0.39	yellowish grey ore
P3-6	1	2.61	79.66	0.19	yellow bastnaesite rich ore

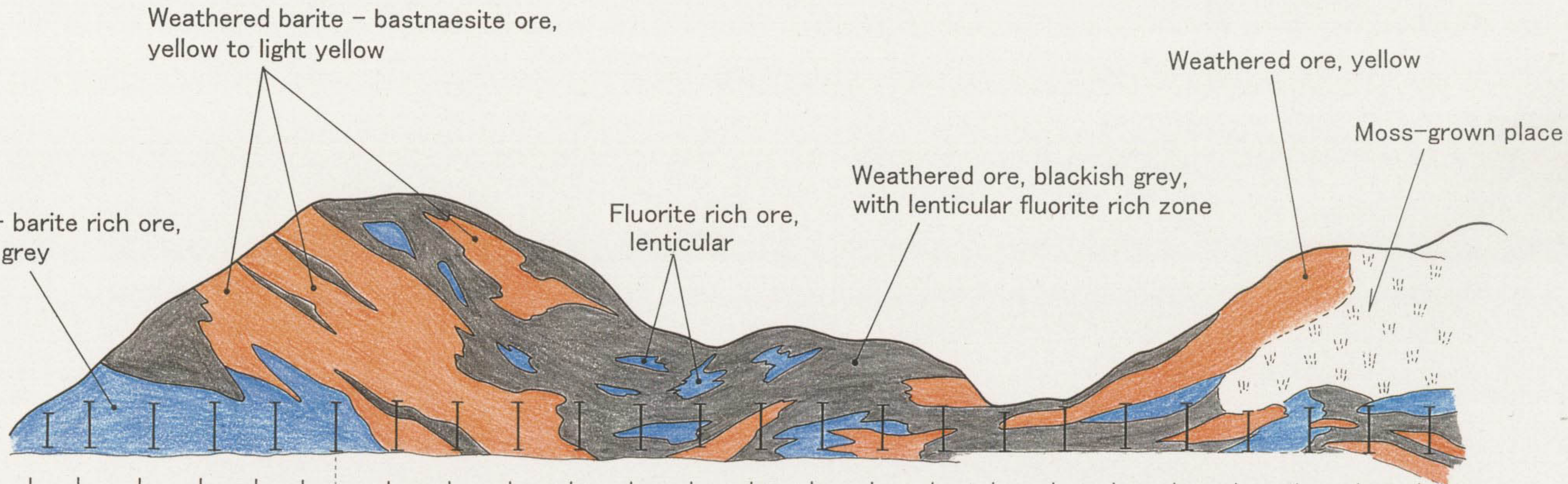
Figure Ⅱ-4-6 Sketch of the outcrop and assay results (Phase 1)



Sample No.	Width(m)	TRE2O3 %	BaSO4 %	CaF2 %	Description
T7-1	1.50	11.85	40.50	32.90	barite –fluorite – bastnaesite ore
T7-2	1.50	13.38	45.74	33.89	barite –fluorite – bastnaesite ore
T7-3	1.50	9.09	42.71	39.15	fluorite – barite–bastnaesite ore
T7-4	1.50	5.56	53.18	28.64	fluorite – barite–(bastnaesite) ore with black ore
T7-5	1.50	13.46	39.65	37.59	fluorite – barite–bastnaesite ore with black ore
T7-6	1.50	9.90	15.50	70.90	bastnaesite–fluorite ore
T7-7	1.50	9.64	64.32	9.54	light yellow barite–bastnaesite ore
T7-8	1.50	10.66	66.07	0.97	banded ore of bastnaesite and black ore
T7-9	1.50	10.31	57.00	1.36	mixed ore of brown, black and light yellow ore
T7-10	1.50	5.33	62.31	1.17	mainly black ore
T7-11	1.50	3.48	72.40	1.36	black ore with barite
T7-12	1.50	9.47	68.02	1.36	banded ore of black part and white barite rich part
T7-13	1.50	5.94	53.94	1.17	banded ore of black, yellowwhite and white part
T7-14	1.50	3.90	60.98	18.12	mixed ore of barite– fluorite ore
T7-15	1.50	17.17	51.10	1.56	mixed ore of bastnaesite–barite–fluorite
T7-16	1.50	18.78	43.72	1.17	mainly black ore with lenticular and breccia of bastnaesite
T7-17	1.20	23.46	39.06	1.56	mainly black ore with breccia (size of 2–10 cm)of bastnaesite
T7-18	1.50	29.00	30.49	3.50	banded ore of yellow bastnaesite and black ore
T7-19	1.50	8.59	28.26	37.20	banded ore of black ore, yellow barite–bastnaesite and fluorite
T7-20	1.50	10.43	51.90	12.27	banded ore of yellow bastnaesite,black ore,barite and fluorite
T7-21	1.20	12.34	38.02	29.99	banded ore of yellow bastnaesite,black ore,barite and fluorite
T7-22	1.50	6.81	41.72	30.97	banded ore of black ore, yellow barite–bastnaesite and fluorite
T7-23	1.50	22.42	43.04	13.05	upper part is banded ore, under part is bastnaesite rich ore
T7-24	1.50	14.65	48.04	12.85	upper part is banded ore, under part is fluorite rich ore
Average	1.50	11.90	48.24	17.59	

Sample No.	Width(m)	TRE2O3 %	BaSO4 %	CaF2 %	Description
T8-1	1.00	0.32	0.02	0.97	brown altered syenite with breccia
T8-2	1.20	1.27	74.68	0.97	black ore with barite
T8-3	0.90	1.98	12.12	1.17	black ore

Figure II-4-7 The sample location and assay results of the outcrop in F3 ore body along the road



No.	Width(m)	TRE_2O_3 %	$BaSO_4$ %	CaF_2 %
T7-6	1.50	9.90	15.50	70.90
T7-5	1.50	13.46	39.65	37.59
T7-4	1.50	5.56	53.18	28.64
T7-3	1.50	9.09	42.71	39.15
T7-2	1.50	13.38	45.74	33.89
T7-1	1.50	11.85	40.50	32.90
T7-7	1.50	9.64	64.32	9.54
T7-8	1.50	10.66	66.07	0.97
T7-9	1.50	10.31	57.00	1.36
T7-10	1.50	5.33	62.31	1.17
T7-11	1.50	3.48	72.40	1.36
T7-12	1.50	9.47	68.02	1.36
T7-13	1.50	5.94	53.94	1.17
T7-14	1.50	3.90	60.98	18.12
T7-15	1.50	17.17	51.10	1.56
T7-16	1.50	18.78	43.72	1.17
T7-17	1.20	23.46	39.06	1.56
T7-18	1.50	29.00	30.49	3.50
T7-19	1.50	8.59	28.26	37.20
T7-20	1.50	10.43	51.90	12.27
T7-21	1.20	12.34	38.02	29.99
T7-22	1.50	6.81	41.72	30.97
T7-23	1.50	22.42	43.04	13.05
T7-24	1.50	14.65	48.04	12.85

0 5 10 15 20 m

Figure Ⅱ-4-8 Sketch of the outcrop and assay results (Phase 2)

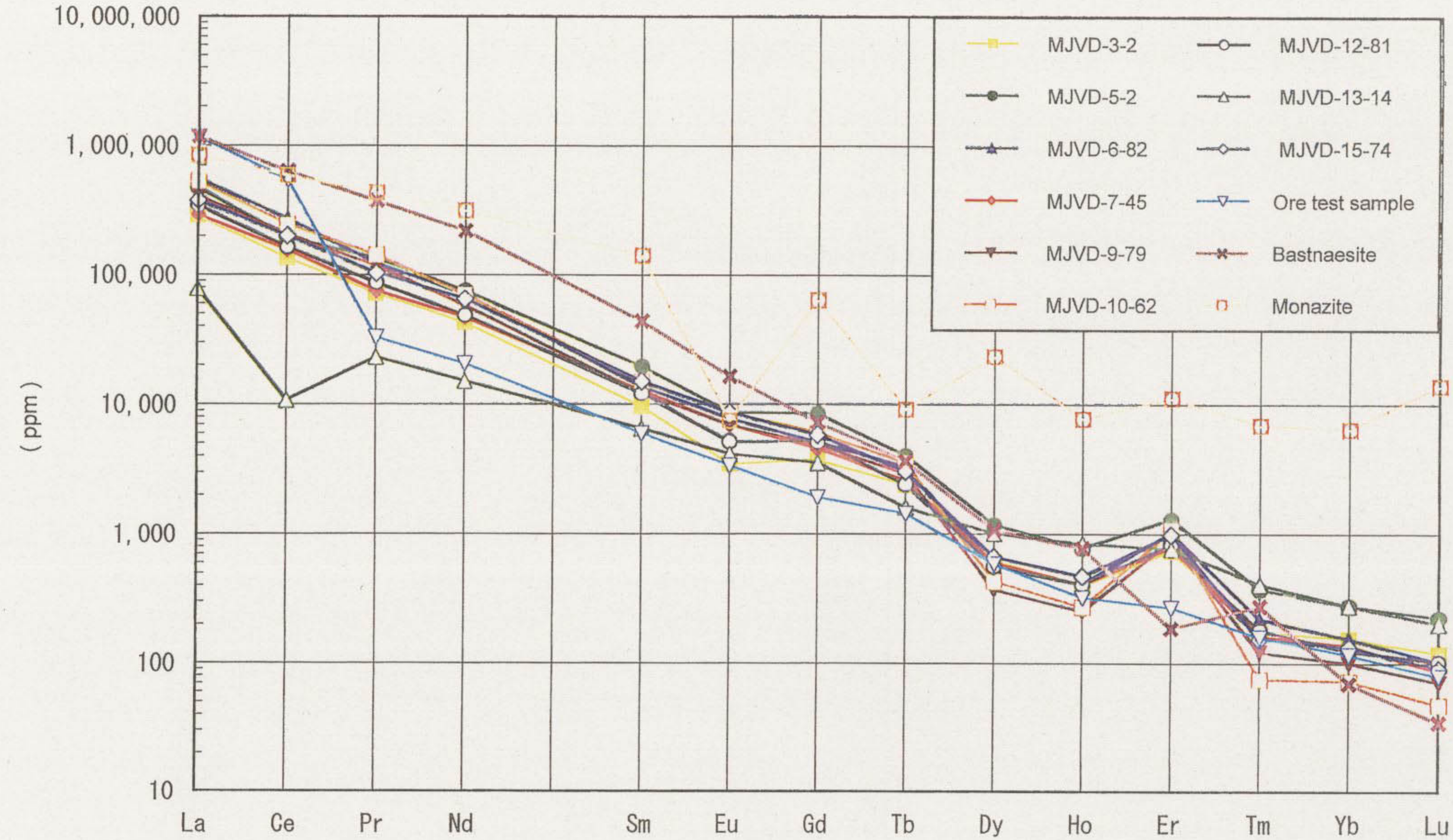


Figure Ⅱ-4-9 Chondrite-normalized REE distribution

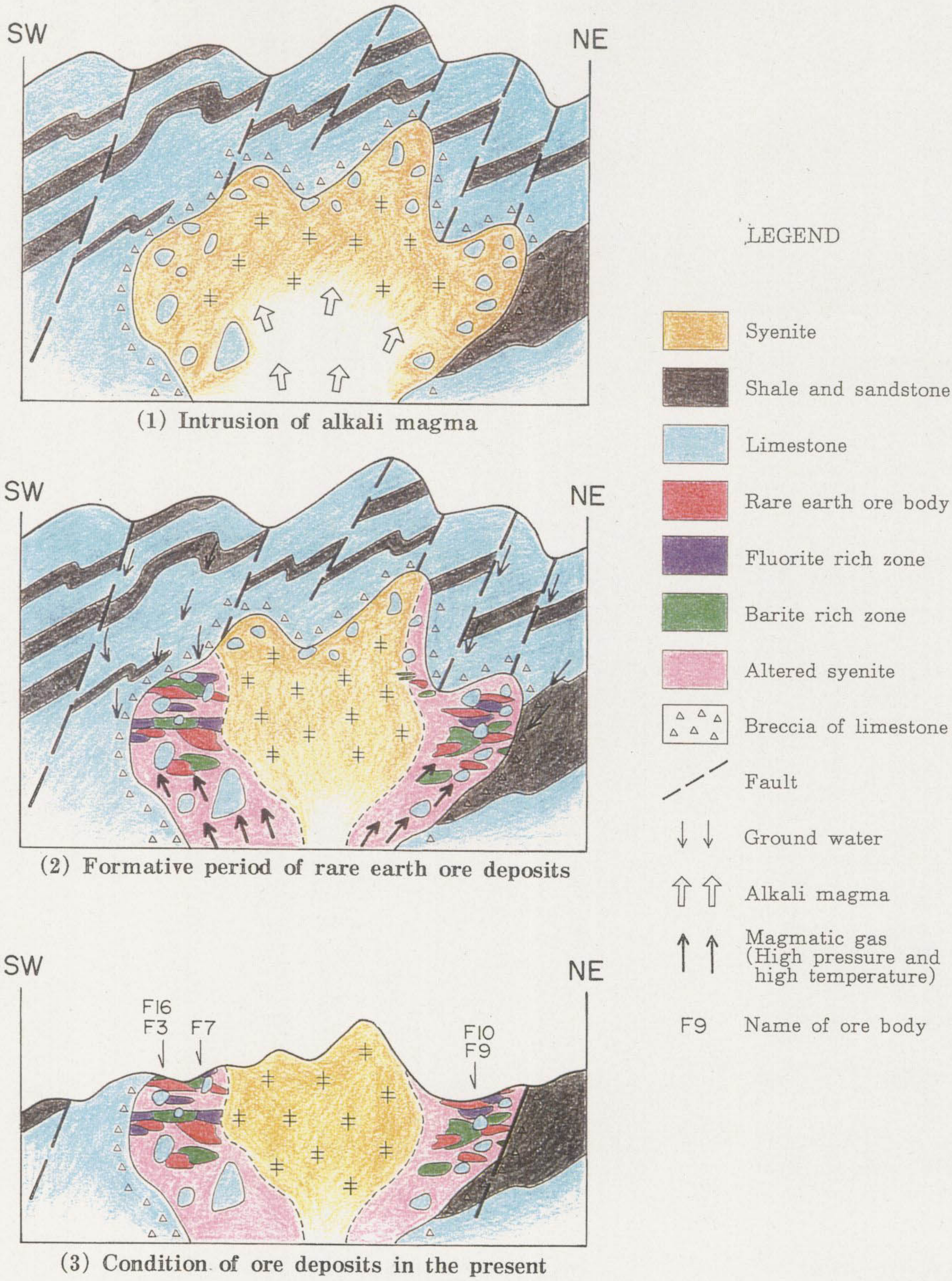


Figure II-4-10 A proposed genetic model for the rare earth deposits in the Dong Pao area