A CLASSIFICATION OF SEVERAL YAMATO-74 CHONDRITES

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Abstract: Six Yamato-74 chondritic meteorites have been classified, based on iron contents of olivines and orthopyroxenes in their small fragments. The results are as follows: Yamato-74193, -74498 and -74507 are H4-chondrites, Yamato-74367 and -74603 are L4-chondrites, and Yamato-74454 is L5-chondrite.

1. Introduction

The purpose of this study is to assist in the preparation of a catalogue of the Yamato meteorites collected in Antarctica in 1974, at the request of Dr. K. YANAI, curator of the National Institute of Polar Research. Small fragments (0.01–0.45 g) with crust of six Yamato-74 chondritic meteorites (Yamato-74193, -74367, -74454, -74498, -74507 and -74603) were supplied for their classification by electron microprobe analysis.

In spite of the scantiness of the supplied material, we have been required to specify both chemical group and petrologic type of the given chondritic meteorites. This work must have been done without a thin section for optical microscopic examination. Therefore, we cannot employed the established criteria (VAN SCHMUS and WOOD, 1967) for the classification of these chondritic meteorites. Instead, we have chosen a modified version of the classification proposed by YANAI *et al.* (1978).

The proposed classification method for chondritic meteorites is based on histograms of iron concentrations of olivines and orthopyroxenes in a given specimen. The chemical group is determined by the mean iron concentrations of the minerals, that is, by peak positions on the histograms and/or based on the relative abundance of metallic iron by visual examination. The petrologic type is determined by the following criteria:

(1) Type 3 should have no prominent peak in the histograms within the known range of iron concentrations of the minerals.

(2) Type 4 should have such peak but the range of iron concentrations extends outside the known range of the equilibrated chondrites.

(3) Types 5 and 6 should have iron concentrations of the minerals all within the known range of the equilibrated chondrites.

(4) Type 6 should have large enough plagioclase to be analyzed by electron microprobe in addition to condition (3).

Even if we adopt the simplified criteria for classification of the supplied specimens, we do not know whether these small fragments are representative of the main mass of the given chondritic meteorites. It should be noted that the classification given in this paper is undoubtedly a tentative one.

2. Experimental

Approximately 0.01 g fragments without crust were chipped from the given specimen and mounted in epoxy to make polished sections for microprobe analysis.

The quantitative chemical analyses of the polished sections were carried out with a system of computer-controlled electron probe X-ray micro-analyzer at Chemical Analysis Center of the University of Tsukuba. The system consists of a JEOL JXA-50A electron probe X-ray micro-analyzer with three channels of spectrometer and a DEC PDP-11 minicomputer having a 24 k word memory. This automation system has a specially designed interface between the micro-analyzer and the computer developed by ELIONIX and makes it possible to do quantitative micro-analysis rapidly and precisely.

The probe current of both the standard and the sample is checked in a Faraday cage every time prior to X-ray intensity measurement. The deviation from X, Y, Z point coordinates preselected for the analysis is corrected automatically with a high degree of precision ($\pm 5\ \mu$). The peak search of X-ray radiation is being conducted for every element both in the standard and in the sample. The output data from each X-ray counter and digital microammeter are transferred to the computer through the interface. The quantitative analysis of silicates is made by a programme introducing the corrections to calculate concentrations by the BENCE-ALBEE method (1968). The total system is controlled by a modified BASIC language, "EASS."

Measurements for each meteorite were made on more than 50 points randomly selected on the polished surface, under the conditions of accelerating voltage 15 kV, probe diameter $\sim 5\ \mu$m and sampling time 20 s. All of the output data on olivines and orthopyroxenes in the supplied specimen are cited in the following tables. The analytical results fall within the range of 96 to 102%.

3. Results

3.1. Yamato-74193

The supplied fragment of this meteorite is composed of chondrules, metallic Fe, crystals and fine-grained groundmass. The chemical compositions of the olivines and the orthopyroxenes are given in Table 1. Fig. 1 shows histograms of

Table 1a. Chemical compositions of olivines in Yamato-74193.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
SiO_2	40.19	39.87	40.00	39.99	40.04	38.83	40.07	38.05	38.48	38.58	36.67	39.09
Al_2O_3	0.00	0.00	0.11	0.00	0.00	0.00	00.0	0.01	0.00	0.00	0.02	0.02
TiO_2	0.00	0.00	0.02	0.01	0.00	0.00	00.0	0.00	0.00	0.00	0.01	0.04
Cr_2O_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
FeO	16.76	17.81	17.37	17.09	17.89	18.65	17.93	16.57	17.85	17.67	21.08	17.30
NiO	0.00	0.03	0.00	0.00	0.00	0.07	0.06	0.02	0.03	0.00	0.25	0.00
MnO	0.34	0.52	0.18	0.46	0.24	0.43	0.46	0.44	0.34	0.37	0.40	0.24
MgO	43.53	42.77	43.22	43.04	43.68	41.62	44.16	41.09	41.63	42.94	39.19	42.86
CaO	0.02	0.02	0.00	0.03	0.00	0.04	0.03	0.01	0.00	0.04	0.07	0.00
Na_2O	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	100.84	101.03	100.90	100.61	101.85	99.65	102.71	96.19	98.33	99.60	97.73	96.30
Fe/ Mg+ Fe	17.8	18.9	18.4	18.2	18.7	20.1	18.6	18.5	19.4	18.8	23.2	18.5

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
SiO_2	34.88	39.58	39.34	39.42	38.55	39.45	39.88	39.67	38.82	39.94	40.11	39.22
Al_2O_3	0.00	0.00	0.06	0.06	0.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00
TiO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Cr_2O_3	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00
FeO	23.10	16.62	18.46	18.56	17.13	17.21	17.16	17.72	19.91	17.67	16.59	16.22
NiO	0.08	0.02	0.05	0.07	0.03	0.00	0.00	0.02	0.07	0.00	0.07	0.00
MnO	0.23	0.16	0.23	0.26	0.33	0.41	0.54	0.37	0.54	0.51	0.44	0.45
MgO	37.93	43.29	40.49	42.17	42.75	43.47	43.26	42.97	41.82	43.89	43.75	43.17
CaO	0.08	0.00	0.05	0.00	0.02	0.02	0.02	0.02	0.03	0.05	0.03	0.00
Na_2O	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.30	99.69	98.68	100.54	98.89	100.56	100.89	100.78	101.20	102.06	101.06	99.06
Fe/ Mg+ Fe	25.5	17.7	20.4	19.8	18.4	18.2	18.2	18.8	21.1	18.4	17.5	17.4

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)
SiO_2	39.70	39.97	38.11	39.50	38.77	39.34	39.20	37.70	36.71	39.44	36.71	37.91	37.01
Al_2O_3	0.00	0.00	0.00	0.10	0.03	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.02
TiO_2	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cr_2O_3	0.00	0.00	0.00	0.00	0.07	0.02	0.07	0.01	0.00	0.00	0.00	0.00	0.10
FeO	17.55	18.06	17.01	18.03	17.00	16.30	15.98	18.96	21.71	14.90	18.55	17.49	17.45
NiO	0.00	0.12	0.00	0.02	0.02	0.05	0.08	0.20	0.12	0.03	0.00	0.00	0.00
MnO	0.40	0.47	0.26	0.34	0.41	0.27	0.38	0.29	0.45	0.44	0.41	0.26	0.54
MgO	43.06	43.53	41.26	42.35	43.35	42.77	42.97	42.18	39.90	43.00	41.18	41.60	40.90
CaO	0.05	0.02	0.00	0.03	0.03	0.00	0.00	0.03	0.00	0.04	0.02	0.02	0.02
Na_2O	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	100.76	102.17	96.65	100.37	99.69	98.75	98.79	99.37	98.89	97.85	96.88	97.28	96.04
Fe/ Mg+ Fe	18.6	18.9	18.8	19.3	18.0	17.6	17.3	20.1	23.4	16.3	20.2	19.1	19.3

the olivines and the orthopyroxenes of the fragment. The range of iron concentrations for the known equilibrated ordinary chondrites (H6, L6 and LL6) is indicated at the top of each figure. The positions of the peaks in the histograms indicate that this chondrite belongs to H group. The distribution pattern in the

Table 1b. Chemical compositions of orthopyroxenes in Yamato-74193.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
SiO_2	56.77	56.23	55.54	55.26	56.50	55.79	56.74	57.02	56.47	55.18	55.49	55.58	55.83
Al_2O_3	0.17	0.24	0.77	1.10	0.14	0.13	0.14	0.14	0.07	0.13	0.12	0.17	0.13
TiO_2	0.08	0.18	0.07	0.18	0.06	0.12	0.19	0.17	0.18	0.17	0.13	0.21	0.13
Cr_2O_3	0.03	0.08	0.03	0.00	0.00	0.02	0.00	0.00	0.04	0.06	0.19	0.13	0.10
FeO	11.11	11.70	12.82	10.96	10.84	11.76	10.83	10.93	10.88	11.27	11.54	11.77	11.23
NiO	0.05	0.00	0.07	0.15	0.06	0.13	0.00	0.00	0.08	0.08	0.03	0.04	0.01
MnO	0.59	0.33	0.39	0.44	0.57	0.41	0.34	0.55	0.25	0.58	0.50	0.57	0.50
MgO	30.63	30.61	29.64	28.85	30.95	30.51	31.56	30.85	30.04	30.95	31.23	30.36	30.75
CaO	0.72	0.54	0.66	0.74	0.68	0.60	0.60	0.66	0.74	0.60	0.53	0.73	0.55
Na_2O	0.00	0.02	0.01	0.04	0.06	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.02
K_2O	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	100.15	99.93	100.00	97.72	99.87	99.50	100.41	100.32	98.75	99.02	99.76	99.56	99.25
Fe/ Mg+ Fe	16.9	17.7	19.5	17.6	16.4	17.8	16.1	16.5	16.9	17.0	17.2	17.9	17.0

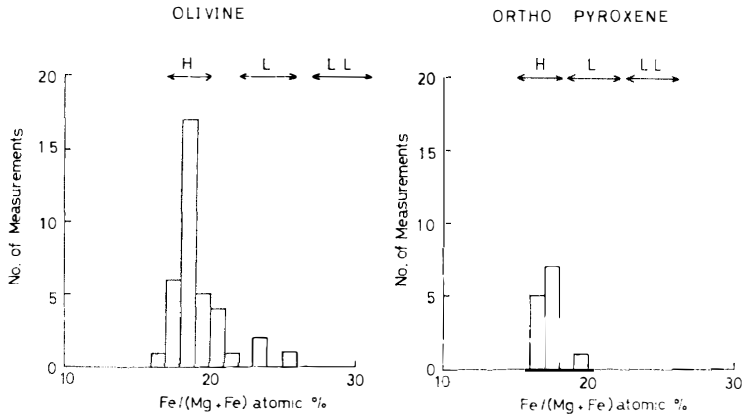

Fig. 1. Iron contents of olivines and orthopyroxenes in Yamato-74193 chondrite.

histograms suggests that petrologic type of this chondrite is 4. The range of iron concentrations extends outside the known range of the equilibrated H-chondrites. Yamato-74193 is classified as an H4-chondrite.

3.2. Yamato-74367

The fragment of this meteorite is composed mainly of chondrules, crystal agglomerate and metallic Fe. Groundmass is not much abundant in the fragment. The chemical compositions of the olivines and the orthopyroxenes are given in Table 2. Fig. 2 shows histograms of iron contents of the minerals. The positions of the peaks as well as the distribution patterns in the histograms indicate that Yamato-74367 belongs to L4-chondrite.

Table 2a. Chemical compositions of olivines in Yamato-74367.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SiO_2	40.40	37.53	38.94	37.84	37.11	37.59	38.21	36.39	37.03	38.44	37.00
Al_2O_3	0.00	0.01	0.14	0.02	0.00	0.00	0.00	0.00	0.08	0.00	0.00
TiO_2	0.00	0.00	0.00	0.00	0.03	0.02	0.04	0.00	0.00	0.00	0.00
Cr_2O_3	0.00	0.00	0.01	0.03	0.04	0.00	0.02	0.00	0.61	0.04	0.00
FeO	20.35	25.89	24.72	26.74	22.11	22.22	21.98	23.49	21.39	22.47	22.03
NiO	0.11	0.44	0.08	0.00	0.03	0.04	0.00	0.00	0.08	0.02	0.00
MnO	0.51	0.25	0.51	0.54	0.47	0.52	0.50	0.42	0.36	0.16	0.51
MgO	34.65	36.69	37.68	37.22	36.97	38.31	38.44	37.34	38.49	39.00	37.74
CaO	0.15	0.02	0.00	0.00	0.05	0.03	0.00	0.02	0.07	0.00	0.00
Na_2O	0.00	0.01	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.00	0.01
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.18	100.84	102.08	102.42	96.81	98.73	99.21	97.66	98.11	100.13	97.29
Fe/Mg+Fe	24.8	28.4	26.9	28.7	25.1	24.5	24.3	26.1	27.8	24.4	24.7

	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
SiO_2	34.83	38.91	37.66	37.68	36.64	38.18	36.42	38.29	36.54	35.10	38.73
Al_2O_3	0.07	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.03	0.07
TiO_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Cr_2O_3	0.38	0.01	0.01	0.01	0.17	0.05	0.01	0.00	0.00	0.03	0.01
FeO	27.02	22.69	22.28	22.97	22.21	23.40	22.83	22.46	22.09	26.69	23.71
NiO	0.10	0.01	0.00	0.00	0.08	0.00	0.13	0.00	0.06	0.29	0.00
MnO	0.05	0.49	0.38	0.40	0.32	0.53	0.50	0.47	0.22	0.40	0.51
MgO	35.87	38.03	36.81	37.75	37.00	38.39	37.60	37.22	37.48	36.25	38.20
CaO	0.05	0.03	0.02	0.02	0.01	0.01	0.00	0.03	0.00	0.00	0.02
Na_2O	0.00	0.00	0.02	0.02	0.04	0.00	0.00	0.00	0.02	0.04	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.32	100.17	97.18	98.85	96.47	100.56	97.51	98.47	96.42	98.83	101.25
Fe/Mg+Fe	29.7	25.1	25.3	25.4	25.2	25.5	25.4	25.3	24.9	29.2	25.8

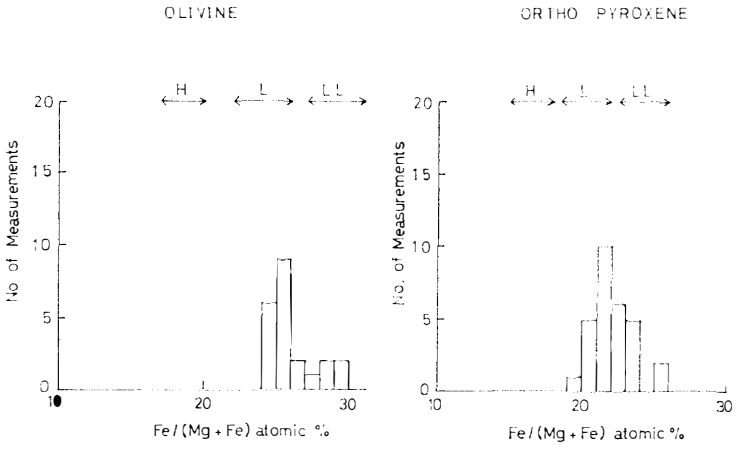

Fig. 2. Iron contents of olivenes and orthopyroxenes in Yamato-74367 chondrite.

Table 2b. Chemical compositions of orthopyroxenes in Yamato-74367.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO_2	55.03	54.47	56.37	57.38	56.46	57.28	54.20	55.71	54.97	54.09
Al_2O_3	0.16	0.05	0.06	0.11	0.16	0.19	0.17	0.12	0.19	0.22
TiO_2	0.04	0.09	0.08	0.05	0.14	0.19	0.15	0.14	0.19	0.17
Cr_2O_3	0.00	0.06	0.00	0.14	0.07	0.08	0.09	0.06	0.00	0.11
FeO	13.84	13.65	15.04	14.85	15.31	13.47	14.88	14.14	13.39	13.79
NiO	0.05	0.00	0.05	0.02	0.05	0.06	0.07	0.03	0.03	0.12
MnO	0.44	0.48	0.50	0.58	0.33	0.24	0.23	0.19	0.55	0.48
MgO	27.73	28.60	27.74	29.08	28.76	28.57	27.95	27.91	29.06	27.99
CaO	0.88	0.78	0.89	0.68	0.68	0.68	0.95	0.82	0.71	0.92
Na_2O	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.02
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.18	98.19	100.73	102.90	101.96	100.70	98.70	99.13	98.90	97.91
Fe/Mg+Fe	21.9	21.1	23.3	22.3	23.0	20.9	23.0	22.1	20.5	21.7
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
SiO_2	58.10	54.42	55.85	55.51	53.83	54.14	55.37	56.19	52.95	55.11
Al_2O_3	0.11	0.11	0.10	0.17	0.68	0.21	0.18	0.18	0.26	0.19
TiO_2	0.15	0.19	0.17	0.18	0.09	0.16	0.19	0.17	0.13	0.15
Cr_2O_3	0.00	0.09	0.07	0.08	0.21	0.03	0.15	0.11	0.07	0.06
FeO	13.55	12.78	13.75	14.36	13.57	14.29	13.26	14.06	16.21	13.81
NiO	0.00	0.10	0.04	0.00	0.03	0.21	0.07	0.05	0.00	0.00
MnO	0.56	0.48	0.41	0.51	0.27	0.52	0.46	0.26	0.51	0.18
MgO	30.00	28.76	28.35	28.17	27.12	27.82	28.05	28.26	27.01	28.73
CaO	0.63	1.21	0.86	0.79	0.67	0.83	0.76	0.70	0.73	0.78
Na_2O	0.02	0.03	0.04	0.00	0.00	0.01	0.01	0.00	0.02	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	103.12	98.16	99.64	99.77	96.47	98.22	98.50	99.98	97.89	99.01
Fe/Mg+Fe	20.2	19.9	21.4	22.2	21.9	22.4	21.0	21.8	25.2	21.2
	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	
SiO_2	54.65	54.51	53.09	55.10	55.02	55.29	55.80	54.60	55.16	
Al_2O_3	0.15	0.19	0.00	0.21	0.01	0.17	0.12	0.14	0.12	
TiO_2	0.13	0.16	0.13	0.23	0.21	0.09	0.12	0.16	0.17	
Cr_2O_3	0.07	0.00	0.18	0.17	0.11	0.00	0.00	0.08	0.17	
FeO	14.04	14.16	14.36	15.13	13.24	12.82	15.32	16.55	13.58	
NiO	0.00	0.06	0.00	0.08	0.17	0.11	0.00	0.06	0.00	
MnO	0.45	0.48	0.43	0.56	0.21	0.59	0.47	0.28	0.50	
MgO	28.07	28.23	27.31	27.58	28.10	27.94	28.82	27.22	28.61	
CaO	0.78	0.64	0.79	0.77	0.67	0.97	0.70	0.80	0.82	
Na_2O	0.00	0.04	0.04	0.00	0.04	0.00	0.04	0.04	0.02	
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Σ	98.34	98.47	96.33	99.83	97.78	97.71	101.39	99.93	98.59	
Fe/Mg+Fe	21.9	22.0	22.8	23.5	20.9	20.5	23.0	25.4	21.0	

3.3. Yamato-74454

The fragment of this meteorite is enriched in crystal agglomerate and metallic Fe grains and depleted in fine-grained groundmass. The chemical compositions of the olivines and the orthopyroxenes are given in Table 3. Fig. 3 shows histograms of iron contents of the olivines and the orthopyroxenes of the fragment. The position of the peaks indicate that this chondrite belongs to L group. The distribution pattern of the olivines suggests petrologic type 5–6, while the distribu-

Table 3a. Chemical compositions of olivines in Yamato-74454.

	(1)	(2)	(3)	(4)	(5)	(6)
SiO_2	37.39	38.36	40.01	37.50	38.91	38.81
Al_2O_3	0.00	0.00	0.00	0.02	0.03	0.03
TiO_2	0.01	0.00	0.00	0.00	0.00	0.00
Cr_2O_3	0.00	0.00	0.00	0.00	0.00	0.00
FeO	20.91	20.69	21.41	21.29	20.95	21.29
NiO	0.00	0.00	0.00	0.02	0.00	0.08
MnO	0.26	0.29	0.43	0.46	0.27	0.30
MgO	37.58	38.61	37.82	38.28	37.73	39.92
CaO	0.06	0.00	0.02	0.08	0.03	0.11
Na_2O	0.00	0.05	0.04	0.00	0.02	0.03
K_2O	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.21	98.06	99.73	97.65	97.94	100.57
Fe/Mg+Fe	23.8	23.1	24.1	23.8	23.7	23.0

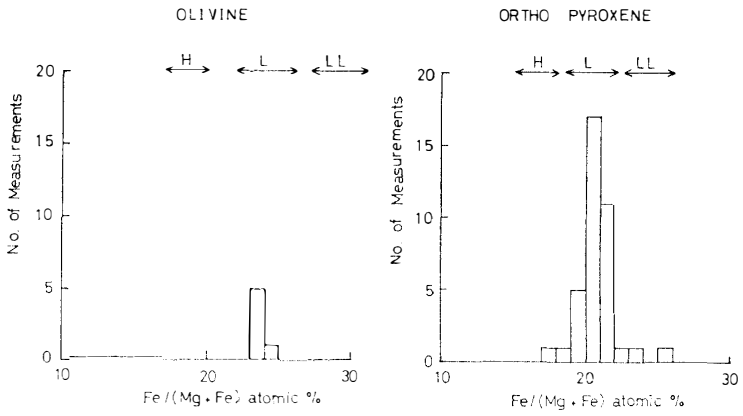

Fig. 3. Iron contents of olivenes and orthopyroxenes in Yamato-74454 chondrite.

tion pattern of the orthopyroxenes indicates petrologic type 4. Yamato-74454 is tentatively classified as an L5-chondrite.

3.4. Yamato-74498

The fragment of this meteorite is composed mainly of chondrules, metallic Fe granis and crystal agglomerate. Groundmass is not much abundant in the fragment. The chemical compositions of the olivines and the orthopyroxenes are given in Table 4. Histograms of iron contents of the olivines and the orthopyroxenes, as shown in Fig. 4, indicate that this meteorite belongs to H4-chondrite.

Table 3b. Chemical compositions of orthopyroxenes in Yamato-74454.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
SiO_2	54.43	54.95	54.73	55.70	55.41	55.26	54.53	55.69	55.67	55.36	55.76	55.31	56.01
Al_2O_3	0.15	0.17	0.21	0.35	0.16	0.15	0.16	0.16	0.07	0.13	0.00	0.11	0.15
TiO_2	0.16	0.03	0.24	0.20	0.17	0.15	0.11	0.18	0.15	0.13	0.18	0.08	0.13
Cr_2O_3	0.06	0.11	1.23	0.05	0.08	0.10	0.00	0.01	0.35	0.02	0.07	0.25	0.06
FeO	13.47	14.23	13.72	10.81	13.10	12.97	13.65	13.49	13.98	13.92	13.29	13.83	12.83
NiO	0.00	0.00	0.00	0.04	0.06	0.01	0.02	0.00	0.00	0.04	0.00	0.00	0.00
MnO	0.57	0.51	0.53	0.39	0.54	0.35	0.53	0.41	0.50	0.44	0.50	0.49	0.42
MgO	29.40	27.21	28.19	28.00	29.07	28.80	27.93	28.71	29.50	28.19	28.58	28.70	28.98
CaO	0.52	0.58	0.46	1.57	0.61	1.06	0.47	0.58	0.68	0.88	0.72	0.58	0.65
Na_2O	0.00	0.01	0.00	0.08	0.02	0.05	0.02	0.04	0.05	0.01	0.01	0.01	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.76	97.80	99.31	97.19	99.22	98.90	97.42	99.27	100.95	99.12	99.11	99.36	99.23
Fe/Mg+Fe	20.5	22.7	21.4	17.8	20.2	20.2	21.5	20.9	21.0	21.7	20.7	21.3	19.9

	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
SiO_2	54.82	55.77	54.77	52.80	51.69	55.91	55.99	55.14	55.75	55.30	54.90	54.55	52.30
Al_2O_3	0.15	0.09	0.15	0.14	0.11	0.13	0.12	0.14	0.16	0.02	0.14	0.07	0.16
TiO_2	0.17	0.14	0.16	0.18	0.11	0.17	0.16	0.16	0.13	0.17	0.18	0.14	0.08
Cr_2O_3	0.00	0.00	0.01	0.05	0.08	0.00	0.05	0.00	0.00	0.14	0.09	0.00	0.00
FeO	12.88	12.40	13.06	14.24	15.89	13.32	12.77	13.08	13.60	13.93	12.45	13.42	17.16
NiO	0.05	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
MnO	0.23	0.51	0.49	0.45	0.31	0.45	0.41	0.43	0.44	0.47	0.47	0.53	0.18
MgO	28.72	29.06	28.78	30.37	28.44	28.97	28.97	28.25	28.80	28.64	28.37	29.13	28.55
CaO	0.57	0.88	0.55	1.07	0.50	0.56	1.17	0.70	0.64	0.78	0.91	0.63	0.62
Na_2O	0.00	0.04	0.02	0.07	0.00	0.02	0.05	0.00	0.00	0.00	0.00	0.01	0.02
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	97.59	98.89	97.99	99.41	97.13	99.53	99.69	97.90	99.52	99.45	97.51	98.50	99.07
Fe/Mg+Fe	20.1	19.3	20.3	20.8	23.9	20.5	19.8	20.6	20.9	21.4	19.8	20.5	25.2

	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)
SiO_2	56.39	54.74	54.77	55.89	53.64	54.72	55.89	55.49	53.82	56.09	55.94	56.52
Al_2O_3	0.13	0.07	0.12	0.17	0.16	0.08	0.15	0.13	0.12	0.15	0.13	0.04
TiO_2	0.15	0.16	0.10	0.14	0.14	0.05	0.11	0.11	0.13	0.14	0.14	0.10
Cr_2O_3	0.00	0.05	0.08	0.05	0.06	0.07	0.07	0.05	0.00	0.00	0.14	0.04
FeO	13.33	13.09	11.95	12.63	13.69	13.30	14.03	13.45	13.91	13.63	13.03	14.04
NiO	0.00	0.05	0.06	0.00	0.08	0.00	0.00	0.00	0.03	0.03	0.00	0.16
MnO	0.20	0.51	0.47	0.54	0.46	0.32	0.33	0.53	0.43	0.40	0.25	0.37
MgO	29.29	27.91	29.27	29.20	28.34	27.54	28.54	29.25	29.92	28.70	29.23	29.61
CaO	0.58	0.80	0.66	0.61	0.69	0.55	0.64	0.84	0.48	0.72	0.57	0.59
Na_2O	0.01	0.02	0.00	0.02	0.01	0.00	0.00	0.02	0.00	0.03	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	100.08	97.40	97.48	99.25	97.27	96.63	99.76	99.87	98.84	99.89	99.43	101.47
Fe/Mg+Fe	20.3	20.8	18.6	19.5	21.3	21.3	21.6	20.5	20.7	21.0	20.0	21.0

Table 4a. Chemical compositions of olivines in Yamato-74498.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO_2	36.51	39.84	38.78	38.77	38.62	37.50	39.25	38.41	38.15	38.84
Al_2O_3	0.03	0.00	0.00	0.02	0.00	0.02	0.00	0.02	0.01	0.00
TiO_2	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.01	0.00	0.02
Cr_2O_3	0.01	0.00	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.00
FeO	21.24	15.99	17.13	16.78	17.09	19.41	16.00	17.55	17.36	16.60
NiO	0.19	0.00	0.00	0.08	0.07	0.19	0.00	0.00	0.08	0.08
MnO	0.42	0.35	0.42	0.40	0.31	0.30	0.47	0.25	0.57	0.47
MgO	38.63	43.37	42.54	42.01	41.53	41.75	42.76	42.43	41.25	42.31
CaO	0.01	0.01	0.02	0.00	0.02	0.00	0.02	0.02	0.00	0.00
Na_2O	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	97.04	99.55	98.90	98.09	97.66	99.19	98.55	98.69	97.42	98.32
Fe/Mg+Fe	23.6	17.1	18.4	18.3	18.8	20.7	17.3	18.8	19.1	18.0
	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
SiO_2	39.41	37.58	35.48	35.57	40.03	40.76	37.48	38.29	40.16	39.66
Al_2O_3	0.00	0.00	0.05	0.01	0.00	0.01	0.02	0.04	0.00	0.00
TiO_2	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
Cr_2O_3	0.03	0.00	0.05	0.00	0.01	0.00	0.00	0.06	0.00	0.00
FeO	16.20	16.45	20.08	21.04	16.36	17.09	19.89	18.44	16.24	16.87
NiO	0.01	0.08	0.07	0.07	0.00	0.05	0.04	0.11	0.00	0.00
MnO	0.51	0.56	0.47	0.37	0.16	0.43	0.25	0.43	0.47	0.47
MgO	43.57	42.92	40.37	39.51	42.90	44.31	41.25	38.88	42.81	42.99
CaO	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.01	0.00
Na_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.74	97.59	96.57	96.57	99.46	102.67	98.97	96.27	99.69	100.01
Fe/Mg+Fe	17.3	17.7	21.8	23.0	17.6	17.8	21.3	21.0	17.5	18.0

Table 4a (Continued).

	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)
SiO_2	38.91	38.58	36.34	38.84	39.43	38.87	37.18	38.43	39.22	39.05
Al_2O_3	0.12	0.02	0.03	0.14	0.02	0.01	0.05	0.00	0.00	0.00
TiO_2	0.02	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00
Cr_2O_3	0.00	0.09	0.00	1.17	0.00	0.01	0.02	0.00	0.00	0.00
FeO	20.51	18.23	21.79	17.32	16.97	18.91	17.54	16.36	16.62	17.58
NiO	0.03	0.02	0.15	0.00	0.05	0.00	0.00	0.00	0.00	0.00
MnO	0.44	0.38	0.19	0.59	0.54	0.44	0.51	0.21	0.47	0.46
MgO	39.04	43.24	39.10	43.06	42.89	42.14	42.45	43.09	42.50	42.56
CaO	0.04	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Na_2O	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.11	100.57	97.60	101.13	99.91	100.41	97.77	98.10	98.81	99.65
Fe/Mg+Fe	22.8	19.1	23.8	18.4	18.2	20.1	18.8	17.6	18.0	18.8
	(31)	(32)	(33)	(34)	(35)	(36)	(37)	(38)	(39)	(40)
SiO_2	39.24	39.52	39.01	38.19	39.43	40.28	38.90	38.97	38.54	38.62
Al_2O_3	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.01	0.00
TiO_2	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.01	0.00
Cr_2O_3	0.04	0.00	0.01	0.05	0.01	0.00	0.00	0.00	0.00	0.03
FeO	17.27	16.71	16.65	18.26	16.86	17.20	17.54	15.48	17.25	17.44
NiO	0.09	0.00	0.00	0.11	0.02	0.07	0.00	0.00	0.07	0.00
MnO	0.31	0.37	0.45	0.33	0.45	0.33	0.52	0.30	0.48	0.49
MgO	42.60	42.33	42.15	41.22	42.90	43.89	42.97	43.64	42.11	44.86
CaO	0.01	0.01	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Na_2O	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.56	98.96	98.30	98.17	99.67	101.81	99.95	98.39	98.47	101.44
Fe/Mg+Fe	18.5	18.1	18.1	19.9	18.0	18.0	18.6	16.6	18.6	17.9

Table 4b. Chemical compositions of orthopyroxenes in Yamato-74498.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
SiO_2	51.41	52.87	53.96	54.66	54.69	54.39	55.91	53.03	53.35	53.66	56.35	54.97
Al_2O_3	0.20	0.16	0.17	0.18	0.57	0.24	0.19	0.20	0.28	0.59	0.11	0.12
TiO_2	0.15	0.18	0.12	0.16	0.17	0.14	0.17	0.16	0.07	0.15	0.15	0.22
Cr_2O_3	0.11	0.06	0.03	0.12	0.06	0.00	0.05	0.08	1.47	0.00	0.02	0.10
FeO	15.83	14.29	11.87	21.61	11.74	13.55	12.10	10.95	14.21	14.42	11.01	13.67
NiO	0.07	0.08	0.12	0.08	0.00	0.05	0.10	0.00	0.18	0.12	0.05	0.00
MnO	0.30	0.49	0.29	0.56	0.58	0.29	0.22	0.54	0.49	0.31	0.56	0.41
MgO	27.81	28.00	30.03	30.19	29.18	29.96	29.57	30.30	28.78	28.89	30.71	30.12
CaO	0.67	0.63	0.61	0.71	0.68	1.36	0.69	0.73	0.59	0.57	0.77	0.54
Na_2O	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.02	0.01	0.02
Ka_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.55	96.79	97.20	99.27	97.67	99.98	99.00	96.02	99.44	98.73	99.74	100.17
Fe/Mg+Fe	24.2	22.3	18.1	19.0	18.4	20.2	18.7	16.9	21.7	21.9	16.8	20.3

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
SiO_2	54.80	54.46	53.64	55.31	54.69	56.00	57.02	56.28	56.99	57.11	54.89	56.96
Al_2O_3	0.17	0.18	0.11	0.20	0.14	0.10	0.12	0.13	0.11	0.14	0.19	0.02
TiO_2	0.18	0.16	0.03	0.19	0.19	0.11	0.18	0.17	0.13	0.14	0.12	0.04
Cr_2O_3	0.06	0.00	0.00	0.07	0.07	0.06	0.05	0.04	0.00	0.04	0.14	0.03
FeO	12.54	12.84	11.88	10.39	11.99	10.26	10.84	13.38	11.37	11.01	14.31	10.69
NiO	0.12	0.00	0.00	0.05	0.67	0.06	0.00	0.11	0.05	0.02	0.00	0.03
MnO	0.36	0.44	0.20	0.37	0.48	0.53	0.52	0.45	0.32	0.50	0.53	0.41
MgO	30.47	30.11	29.40	30.42	29.80	30.22	31.46	29.50	31.46	31.13	30.48	30.57
CaO	0.52	0.69	0.87	0.81	0.59	0.56	0.53	0.53	0.46	0.61	0.63	0.66
Na_2O	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00
Ka_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.23	98.90	96.15	97.81	98.62	97.90	100.72	100.59	100.91	100.72	101.29	99.41
Fe/Mg+Fe	18.8	19.3	18.5	16.1	18.4	16.0	16.2	20.3	16.9	16.5	20.8	16.4

	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)
SiO_2	55.48	52.35	56.79	56.79	53.33	56.67	55.18	55.73	57.04	58.79	57.36
Al_2O_3	0.17	0.19	0.14	0.14	0.18	0.00	0.20	0.22	0.20	0.20	0.17
TiO_2	0.17	0.15	0.07	0.07	0.13	0.09	0.18	0.19	0.17	0.18	0.15
Cr_2O_3	0.07	0.04	0.12	0.12	0.12	0.08	0.17	0.15	0.00	0.08	0.09
FeO	12.09	15.17	10.32	10.32	14.23	11.18	11.90	10.26	10.46	10.31	11.01
NiO	0.00	0.02	0.00	0.00	0.00	0.02	0.13	0.07	0.09	0.00	0.08
MnO	0.18	28.36	0.54	0.54	0.30	0.59	0.47	0.52	0.56	0.28	0.60
MgO	31.10	0.48	31.27	31.27	30.06	30.58	30.06	30.47	31.53	29.46	31.85
CaO	0.53	0.06	0.58	0.58	0.54	0.68	0.77	0.70	0.71	0.78	0.64
Na_2O	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.02	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	99.81	96.82	99.83	100.83	98.89	99.91	99.06	98.32	100.76	100.10	101.95
Fe/Mg+Fe	17.9	23.1	15.6	15.6	21.0	17.0	18.2	15.9	15.7	16.4	16.2

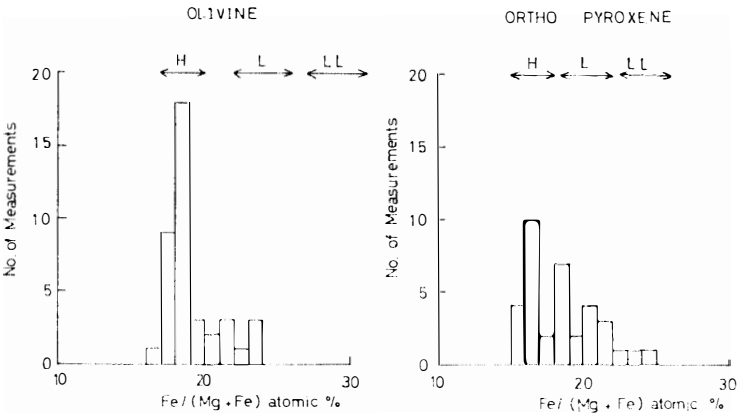

Fig. 4. Iron contents of olivines and orthopyroxenes in Yamato-74498 chondrite.

3.5. Yamato-74507

The fragment of this meteorite is composed of a metallic Fe grain, broken chondrules and crystal agglomerate, and depleted in groundmass. The chemical compositions of the olivines and the orthopyroxenes are given in Table 5. Histograms of iron contents of the olivines and the orthopyroxenes, as shown in Fig. 5, indicate that the meteorite is classified as an H4-chondrite.

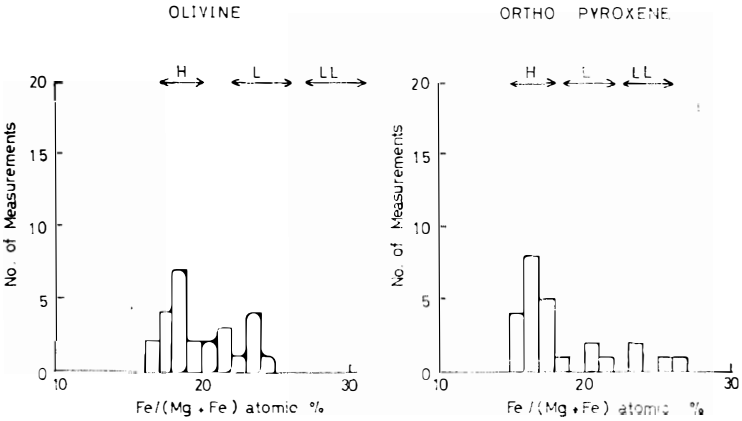

Fig. 5. Iron contents of olivines and orthopyroxenes in Yamato-74507 chondrite.

Table 5a. Chemical compositions of olivines in Yamato-74507.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO_2	35.18	39.08	40.59	37.80	37.60	38.33	38.63	38.32	37.53	39.36
Al_2O_3	0.00	0.02	0.96	0.01	0.01	0.00	0.06	0.03	0.04	0.04
TiO_2	0.01	0.02	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.02
Cr_2O_3	0.00	0.09	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00
FeO	21.63	18.59	15.91	17.69	19.40	15.12	17.22	16.83	20.82	16.48
NiO	0.48	0.00	0.00	0.08	0.20	0.00	0.02	0.12	0.19	0.00
MnO	0.36	0.46	0.47	0.28	0.37	0.56	0.46	0.54	0.44	0.22
MgO	38.84	42.87	39.85	42.59	41.29	42.24	42.23	42.23	41.20	42.58
CaO	0.05	0.01	0.88	0.02	0.09	0.05	0.04	0.06	0.05	0.03
Na_2O	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.55	101.14	98.66	98.47	98.97	96.32	98.68	98.20	100.27	98.73
Fe/(Mg+Fe)	23.8	19.6	18.3	18.9	20.9	16.7	18.6	18.3	22.1	17.8

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
SiO_2	37.81	34.91	34.50	35.52	40.84	39.61	36.84	37.44	36.66	40.61
Al_2O_3	0.02	0.48	0.06	0.05	0.02	0.00	0.00	0.00	0.02	0.00
TiO_2	0.00	0.01	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Cr_2O_3	0.00	0.10	0.05	0.00	0.03	0.00	0.03	0.03	0.02	0.02
FeO	19.30	21.08	21.62	22.13	17.06	17.53	22.63	19.36	17.64	16.24
NiO	0.18	0.43	0.13	0.38	0.00	0.00	0.22	0.09	0.04	0.05
MnO	0.54	0.34	0.33	0.18	0.45	0.59	0.39	0.29	0.43	0.21
MgO	40.35	39.27	39.58	39.23	43.47	43·93	39.79	40.34	43.49	44.35
CaO	0.02	0.02	0.05	0.24	0.03	0.02	0.03	0.04	0.00	0.00
Na_2O	0.00	0.00	0.00	0.00	0.03	0.02	0.02	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.22	96.64	96.34	97.76	101.93	101.68	99.95	97.59	98.30	101.48
Fe/(Mg+Fe)	21.2	23.1	23.5	24.0	18.0	18.3	24.2	21.2	18.5	17.0

	(21)	(22)	(23)	(24)	(25)	(26)
SiO_2	39.62	38.29	35.45	39.37	35.97	39.87
Al_2O_3	0.00	0.00	0.00	0.00	0.00	0.00
TiO_2	0.00	0.00	0.00	0.00	0.09	0.01
Cr_2O_3	0.00	0.00	0.00	0.02	4.29	0.01
FeO	16.23	17.46	20.67	16.16	18.60	15.75
NiO	0.00	0.10	0.24	0.00	0.18	0.08
MnO	0.33	0.37	0.37	0.37	0.32	0.44
MgO	42.74	41.64	39.42	43.99	40.83	43.52
CaO	0.01	0.01	0.00	0.03	0.06	0.02
Na_2O	0.00	0.00	0.00	0.00	0.02	0.02
K_2O	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.93	97.87	96.15	99.94	100.36	99.72
Fe/(Mg+Fe)	17.6	19.0	22.7	17.1	20.4	16.9

Table 5b. Chemical compositions of orthopyroxenes in Yamato-74507.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
SiO_2	53.29	55.36	56.39	55.63	57.02	55.97	56.29	53.18	57.04	57.05	52.37	51.11	56.09
Al_2O_3	0.01	0.00	0.09	0.11	0.17	0.00	0.00	0.05	0.13	0.03	0.18	0.12	0.08
TiO_2	0.12	0.03	0.15	0.05	0.17	0.05	0.19	0.14	0.18	0.17	0.10	0.00	0.05
Cr_2O_3	0.13	0.06	0.04	0.06	0.00	0.00	0.06	0.14	0.08	0.09	0.06	0.05	0.04
FeO	11.34	12.45	11.19	11.90	11.28	10.81	10.83	13.21	10.58	10.63	15.93	17.49	10.44
NiO	0.11	0.00	0.10	0.02	0.02	0.00	0.04	0.15	0.00	0.08	0.55	0.42	0.03
MnO	0.47	0.46	0.58	0.29	0.53	0.53	0.34	0.33	0.55	0.56	0.42	0.31	0.44
MgO	29.92	30.68	30.49	32.07	30.27	30.12	30.65	28.75	31.07	31.10	29.36	28.72	32.90
CaO	0.76	0.77	0.76	0.54	0.94	0.86	0.70	0.58	0.79	0.72	0.50	0.61	0.56
Na_2O	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.04	0.00	0.00	0.03
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.15	99.82	99.81	100.68	100.40	98.34	99.11	96.54	100.43	100.47	99.47	98.83	100.66
Fe/Mg+Fe	17.5	18.5	17.1	17.2	17.3	16.8	16.6	20.5	16.0	16.1	23.3	25.5	15.1

	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
SiO_2	54.16	51.29	57.44	56.88	56.60	54.58	54.70	54.94	52.22	57.10	55.44	56.20
Al_2O_3	0.15	0.15	0.21	0.20	0.23	0.19	0.04	0.00	0.20	0.00	0.00	0.81
TiO_2	0.07	0.08	0.17	0.12	0.07	0.05	0.16	0.17	0.15	0.14	0.14	0.00
Cr_2O_3	0.08	0.03	0.31	0.14	0.02	0.06	0.13	0.06	0.00	0.14	0.00	0.05
FeO	14.28	19.67	10.61	11.16	11.04	11.61	13.82	10.17	15.37	10.08	10.68	10.60
NiO	0.29	0.41	0.00	0.03	0.00	0.03	0.10	0.00	0.02	0.02	0.08	0.12
MnO	0.51	0.42	0.46	0.26	0.47	0.40	0.45	0.45	0.37	0.52	0.39	0.42
MgO	30.21	29.19	31.25	31.28	30.83	31.09	30.73	30.57	28.66	30.66	31.00	31.58
CaO	0.62	0.61	0.53	0.67	0.52	0.53	0.68	0.58	0.62	0.63	0.53	0.70
Na_2O	0.00	0.01	0.02	0.02	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	100.37	101.86	101.00	100.76	99.78	98.56	100.81	96.95	97.61	99.29	98.26	100.48
Fe/Mg+Fe	21.0	27.4	16.0	16.7	16.7	17.3	20.1	15.7	23.1	15.6	16.2	15.8

3.6. Yamato-74603

The fragment of this meteorite is composed mainly of equal amounts of chondrules and fine-grained groundmass. Metallic Fe grains are not abundant in the fragments. The chemical compositions of the olivines and the orthopyroxenes are given in Table 6. Fig. 6 shows histograms of iron contents of the olivines and the orthopyroxenes in the fragment. The iron contents of the orthopyroxenes fall within the range defined by the equilibrated L-chondrite, while the iron contents of the majority of the olivines fall in a hiatus between the known H6- and L6-chondrites. The distribution patterns of the minerals suggest that petrologic type is 4. Yamato-74603 is tentatively classified as an L4-chondrite.

Table 6a. Chemical Compositions of olivines in Yamato-74603.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SiO_2	37.44	39.05	37.47	37.87	40.05	38.51	39.48	38.64
Al_2O_3	0.07	0.00	0.01	0.33	0.04	0.00	0.03	0.00
TiO_2	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.03
Cr_2O_3	0.00	0.00	0.00	0.00	0.02	0.04	0.04	0.04
FeO	20.64	20.58	22.70	22.03	19.34	17.74	18.91	20.09
NiO	0.01	0.00	0.22	0.28	0.00	0.02	0.06	0.05
MnO	0.46	0.00	0.47	0.35	0.61	0.50	0.25	0.24
MgO	37.65	41.08	38.11	38.53	41.06	39.78	40.12	39.36
CaO	0.15	0.00	0.02	0.14	0.03	0.07	0.16	0.05
Na_2O	0.00	0.00	0.00	0.04	0.01	0.01	0.04	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	96.42	100.71	99.00	99.57	101.22	96.67	99.09	98.50
Fe/(Mg+Fe)	23.5	21.9	25.0	24.3	20.9	20.0	20.9	22.2

	(9)	(10)	(11)	(12)	(13)	(14)	(15)
SiO_2	40.84	39.89	40.88	39.53	38.79	38.90	38.28
Al_2O_3	0.75	0.01	0.00	0.28	0.00	0.05	0.00
TiO_2	0.00	0.02	0.01	0.00	0.02	0.15	0.00
Cr_2O_3	0.00	0.00	0.05	0.00	0.02	0.04	0.00
FeO	17.68	18.90	19.10	18.69	19.59	18.92	19.65
NiO	0.00	0.00	0.00	0.08	0.03	0.00	0.00
MnO	0.28	0.43	0.20	0.43	0.35	0.36	0.24
MgO	37.11	40.01	39.91	39.67	40.53	39.41	40.49
CaO	1.00	0.23	0.42	0.23	0.02	0.10	0.04
Na_2O	0.00	0.03	0.00	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	97.66	99.52	100.57	98.91	99.35	97.93	98.70
Fe/(Mg+Fe)	21.1	21.0	21.2	20.9	21.3	21.2	21.4

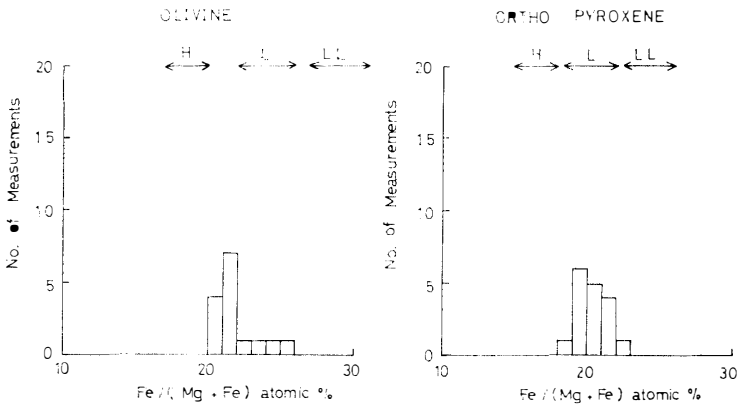

Fig. 6. Iron contents of olivines and orthopyroxenes in Yamato-74603 chondrite.

Table 6b. Chemical compositions of orthopyroxenes in Yamato-74603.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SiO_2	54.38	57.02	54.72	56.02	54.02	54.02	54.56	53.87	53.10
Al_2O_3	0.14	0.00	0.00	0.09	0.11	0.14	0.00	0.00	0.00
TiO_2	0.16	0.00	0.07	0.04	0.16	0.17	0.15	0.13	0.09
Cr_2O_3	0.05	0.00	0.10	0.06	0.03	0.00	0.00	0.10	0.00
FeO	13.78	12.24	13.36	12.95	12.78	13.24	13.27	13.52	14.06
NiO	0.17	0.00	0.11	0.00	0.05	0.00	0.01	0.00	0.42
MnO	0.34	0.00	0.20	0.40	0.31	0.41	0.49	0.46	0.55
MgO	28.71	29.66	31.60	30.00	28.43	28.11	28.54	28.35	28.61
CaO	0.31	0.00	0.37	0.52	0.57	0.51	0.50	0.51	0.45
Na_2O	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.04	98.92	100.53	100.08	96.46	96.62	97.52	96.96	97.28
Fe/(Mg+Fe)	21.2	18.8	19.2	19.5	20.1	20.9	20.7	21.1	21.6

	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
SiO_2	54.30	55.11	55.69	56.84	55.23	55.42	57.08	52.96
Al_2O_3	0.00	0.06	0.00	0.00	0.06	0.04	0.00	0.00
TiO_2	0.08	0.19	0.09	0.21	0.10	0.00	0.14	0.15
Cr_2O_3	0.09	0.00	0.06	0.12	0.00	0.04	0.00	0.00
FeO	13.73	13.12	15.54	13.11	12.45	12.28	12.72	14.05
NiO	0.05	0.40	0.32	0.03	0.07	0.00	0.03	0.24
MnO	0.51	0.51	0.46	0.51	0.15	0.39	0.31	0.61
MgO	29.34	29.29	29.66	29.77	28.72	28.40	30.29	28.48
CaO	0.54	0.69	0.59	0.56	0.59	0.55	0.58	0.68
Na_2O	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Σ	98.64	99.37	102.45	101.15	97.38	97.12	101.15	97.17
Fe/(Mg+Fe)	20.8	20.1	22.7	19.8	19.6	19.5	19.1	21.8

The results obtained in this study are summarized in Table 7.

Table 7. Mean compositions (Fe/Mg+Fe) of olivines and pyroxenes and standard deviations of their compositions in the Yamato-74 chondrites.

Sample No.	Olivine			Orthopyroxene			Remarks
	No. of measurements	Mean compositions	Standard deviation	No. of measurements	Mean compositions	Standard deviation	
Yamato-74193	37	19.12	1.79	13	17.27	0.87	H4
-74367	22	26.02	1.65	29	22.00	1.31	L4
-74454	6	23.58	0.44	38	20.78	1.27	L5
-74498	40	19.03	1.84	35	18.44	2.36	H4
-74507	26	19.91	2.47	25	18.36	3.32	H4
-74603	15	21.79	1.40	17	20.38	1.08	L4

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