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Mineral paragenesis and chemical compositions of the constituent minerals of jadeitites from the Osayama area in the Sangun metamorphic belt, southwest Japan

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Abstract

Jadeitites (OsaJd and OsaJd2) from the serpentinites of the Osayama ultramafic body in the Sangun metamorphic belt (Suo belt) are petrographically described. Wollastonite and albite are newly found in the jadeitite of OsaJd associated with jadeite, pectolite, grossular and analcite. Magnesiokatophorite has been found from the jadeitite of OsaJd2, and it is associated with jadeite, omphacite, diopside, phlogopite, rutile and titanite. The clinopyroxenes from the jadeitite (OsaJd2) are classified into jadeite, omphacite and diopside. The compositional gaps between jadeite and omphacite and omphacite and diopside have been revealed. Based on the textural relationship a successive formation of clinopyroxenes from jadeite through omphacite and up to diopside is recognized.

Ca-rich minerals such as diopside, wollastonite, pectolite and grossular occur along the cracks within the matrix of jadeites, suggesting later stage Ca-rich fluid infiltration and subsequent participation of such Ca-rich minerals.

Key word: Sangun, Renge, Osayama, serpentinite melange, tectonic block, jadeite, omphacite, diopside, wollastonite, katophorite

Introduction

Jadeitites often occur as block or enclave within serpentinite body or serpentinite melange. In the Renge belt of the Sangun high–P metamorphic belt (Nishimura, 1998), jadeitite blocks within the serpentinite bodies have been described from the Omi–Renge, Oya, Wakasa and Osayama areas.

The Osayama ultramafic body (Fig. 1) is emplaced into the low-grade schists of the Suo belt (Nishimura, 1998), and it consists mainly of harzburgite with small amounts of dunite and metagabbro, but major parts of the ultramafic rocks are serpentinized (Kobayashi et al., 1987; Nozaka and Shibata, 1994, 1995). A Cretaceous granitic body gave a contact metamorphism in the southwestern parts of the Osayama ultramafic body. The Osayama ultramafic body contains



Fig. 1. Location of the Osayama ultramafic body (after Shibata and Nishimura, 1989; Matsumoto and Sugita, 1980; Matsumoto et al., 1995). AS: Ashidachi body; YM: Yanomine body; OS: Osayama body; TG: Taguchi body.

tectonic blocks with diverse lithologies and sizes (10 cm-1.5 km across). The tectonic blocks within the serpentinite matrix include lawsonite-glaucophane schists, garnet glaucophane schists, pelitic schists, metagabbros, metadiabases, metadolerites and metasomatic rocks such as rodingite, albitite, omphacitite, tremolite rock and jadeitite (Watanabe, 1984; Watanabe et al., 1987; Kobayashi et al., 1987; Tsujimori and Takasu, 1994; Sakamoto and Takasu, 1996; Takasu and Sakamoto, 1996).

A vein-like jadeitite block with several meters in width within the serpentinites was discovered from the northeastern part of the Osayama ultramafic body (Fig. 2; Kobayashi et al., 1987). Rodingites also occur as veins and lenses in the serpentinites close to the jadeitite block. The jadeitites show milky white, light green and light blue in color. The jadeitites occurring in the interior parts of the vein-like block consist mainly of jadeite with minor grossular, analcite, prehnite, vesuvianite, natrolite, thomsonite, zircon, deweylite and stronalsite. The marginal parts of the block consist of grossular, chlorite, diopside and zircon (Kobayashi et al., 1987). Nozaka, T. of Okayama University (1988: personal communication) found pectolite from a loosed block of jadeitite close to the outcrop of jadeitite block described by Kobayashi et al. (1987). Tsujimori (1998) petrographically studied some loosed blocks of jadeitites, and

Jadeitites from the Osayama area



Fig. 2. Sample locality of the jadeitite blocks (after Kobayashi et al., 1987).

described omphacite, phlogopite and rutile in the jadeitites. Omphacite, analcite and phlogopite were regarded as secondary minerals.

In this paper, we describe jadeitites which were collected as loosed blocks occurring close to the original locality of jadeitite in the Osayama area (Fig. 2). Wollastonite, amphibole of the sodic-calcic group (Leake et al., 1997) and albite in jadeitites are newly described in this paper. We also show the chemical compositions of the constituent minerals of the jadeitite such as clinopyroxene, pectolite, wollastonite, phlogopite and sodic-calcic amphibole, and discuss the mineral paragenesis of the jadeitites in the Osayama ultramafic body.

Petrography of jadeitites from the Osayama area

Two jadeitite loosed blocks (OsaJd and OsaJd2) were collected close to the original locality of the jadeitite described by Kobayashi et al. (1987), and are petrographically described below. **1.** OsaJd

The jadeitite (OsaJd) is massive, and it consists mainly of jadeite with subordinate pectolite, wollastonite, grossular, analcite and albite.

Jadeite has no preferred orientation, and it is of subhedral to euhedral prismatic crystal with maximum length of c. 3 mm. The grain size of jadeite is different in different domains within the sample. Pectolite, grossular, analcite and albite occur along cracks and at the intestices of jadeite crystals. Wollastonite is participated along irregular cracks in the pectolite crystals (Fig. 3).

2. OsaJd2

The jadeitite (OsaJd2) is massive, and it consists mainly of jadeite and subordinate



Fig. 3. Elemental color map photo of Na, Fe, Ca and BEI. In the Ca map, wollastonite (white) occurs along the cracks through the pectolite grains (pink). Black parts consist of aggregate of jadeites.

amounts of omphacite and diopside, with accessory phlogopite, sodic-calcic amphibole, rutile and titanite. Diopside and sodic-calcic amphibole occur along the cracks in the matrix consisting mainly of jadeites.

Jadeite has no preferred orientation, and it is of subhedral to euhedral prismatic crystal with maximum length of c. 1 mm. Omphacite occurs at the interstice of jadeite grains and as inclusion in diopside. Diopside has two modes of occurrence, one being of subhedral to anhedral prismatic crystal (max. 2–3 mm in length) and the other being euhedral prismatic crystal (max. 0.7 mm in length) with no preferred orientation overgrowing on the matrix jadeites. Phlogopite is of subhedral to anhedral tiny crystal occurring along the cracks together with diopside and sodic-calcic amphibole. Rutile occurs as porphyroblast of subhedral to anhedral prismatic crystal (max. 5 mm in length). It is rimmed by aggregate of titanites.

Chemistry of the constitute minerals in jadeitites

Chemical compositions of minerals have been analysed by EPMA (JEOL JXA-8800M) in the Research Center for Coastal Lagoon Environments, Shimane University. The analyses were performed at 15 kV of accelerating voltage, 2×10^{-8} A of specimen current, and $3-5 \mu m$ of probe diameter, following the correction method of Bence and Albee (1968). The chemical composition of the minerals are shown in Tables 1 and 2.

1. clinopyroxenes

Clinopyroxenes in the sample of OsaJd are classified into jadeite composition ranging from $Jd_{94.5}$ to $Jd_{99.6}$. There is a compositional gap between $Jd_{95.1}$ and $Jd_{98.9}$ (Fig. 4). Aegirine and kosmochlor molecules are negligible.

Clinopyroxenes in the sample of OsaJd2 are chemically classified into three, i.e. jadeite, omphacite and diopside (Fig. 5). The jadeite group clinopyroxenes contain very low aegirine molecules (<0.5 mol.%), and the lower the jadeite molecule, the higher the aegirine molecule. Diopsidic clinopyroxenes have relatively high aegirine molecule up to c. 10 mol.%. Jadeitic clinopyroxenes have a compositional gap between Jd_{94.5} and Jd_{86.6}. There are also compositional gaps between jadeites and omphacites (Jd_{47.8-80.0}) and omphacites and diopsides (Jd_{12.2-27.9}). Clinapyroxenes in OsaJd2 contain negligible amounts of kosmochlor molecule.

Sample	OsaJd										
	717				719				823		
No.	1	3	4	5	2	10	11	13	1	2	4
SiO ₂	59.06	58.73	58.40	58.95	59.29	59.48	59.24	59.40	59.54	59.19	59.14
TiO ₂	0.02	0.06	0.14	0.00	0.01	0.01	0.00	0.03	0.00	0.00	0.00
Al_2O_3	25.41	23.90	23.47	24.98	25.00	25.14	25.03	24.90	25.39	25.06	25.22
FeO*	0.09	0.65	0.57	0.04	0.06	0.11	0.05	0.11	0.18	0.04	0.14
MnO	0.00	0.00	0.03	0.00	0.01	0.04	0.00	0.04	0.01	0.00	0.02
MgO	0.03	0.71	1.21	0.00	0.09	0.00	0.00	0.01	0.01	0.00	0.02
CaO	0.12	1.16	0.81	0.15	0.32	0.20	0.10	0.17	0.22	0.09	0.15
Na ₂ O	14.65	14.30	14.05	14.45	15.15	15.04	15.22	15.14	15.38	14.70	14.95
K ₂ O	0.06	0.04	0.37	0.03	0.01	0.04	0.04	0.04	0.03	0.04	0.04
Cr_2O_3	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01
Total	99.45	99.55	99.05	98.60	99.94	100.06	99.68	99.87	100.76	99.13	99.69
Si	1.996	1.996	1.996	2.007	1.999	2.001	2.001	2.003	1.993	2.006	1.997
Ti	0.001	0.002	0.004	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Al	1.012	0.957	0.945	1.002	0.993	0.997	0.996	0.990	1.001	1.000	1.003
Fe	0.003	0.018	0.016	0.001	0.002	0.003	0.001	0.003	0.005	0.001	0.004
Mn	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.001
Mg	0.002	0.036	0.062	0.000	0.005	0.000	0.000	0.001	0.000	0.000	0.001
Ca	0.004	0.042	0.030	0.005	0.012	0.007	0.004	0.006	0.008	0.003	0.005
Na	0.959	0.942	0.931	0.953	0.990	0.980	0.996	0.989	0.998	0.965	0.978
К	0.003	0.002	0.016	0.001	0.000	0.002	0.002	0.002	0.001	0.002	0.002
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Total	3.980	3.995	4.001	3.969	4.001	3.991	4.000	3.997	4.006	3.977	3.991
Jd	99.52	95.12	94.50	99.43	98.85	99.27	99.64	99.30	98.87	99.65	99.42
Aeg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00
Ko	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.02
Aug	0.45	4.88	5.50	0.57	1.15	0.73	0.36	0.62	0.77	0.35	0.56

Table 1 Chemical compositions of clinopyroxenes from the jadeitites.

* Total Fe as FeO

Jd: jadeite; Aeg; aegirine; Ko: kosmochlor; Aug: augite.

Sample	OsaJd	OsaJd2									
	823	717	_		_						
No.	14	2	3	4	7	10	11	12	13	14	15
SiO ₂	59.14	58.10	57.94	57.90	53.72	53.59	54.20	54.17	53.97	57.43	57.64
T_1O_2	0.00	0.12	0.11	0.20	0.26	0.30	0.11	0.31	0.36	0.04	0.10
Al_2O_3	24.76	24.24	21.05	20.78	0.61	1.08	0.79	1.28	1.16	20.38	19.89
FeO ⁷	0.16	0.30	0.65	0.89	4.52	5.14	5.58	5.55	5.81	0.99	0.75
MaO	0.00	0.00	2.68	0.02	1/ 02	14 80	14.46	13 63	12.84	2 28	2 70
CaO	0.62	0.69	3 64	3.70	22.95	21.93	22.73	22.01	22.03	4 27	4 99
Na ₂ O	15.19	14.17	12.86	12.59	1.37	1.76	1.20	1.90	1.61	12.22	11.93
K ₂ O	0.06	0.19	0.05	0.03	0.07	0.29	0.06	0.04	0.05	0.27	0.05
Cr_2O_3	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.27	0.03	0.00	0.02
Total	100.12	98.50	98.99	98.83	98.58	99.14	99.31	99.26	98.97	99.00	99.07
Si	1.995	1.991	1.996	1.999	2.002	1.991	2.009	2.008	2.007	1.987	1.991
Ti	0.000	0.003	0.003	0.005	0.007	0.008	0.003	0.009	0.010	0.001	0.003
Al	0.984	0.979	0.854	0.845	0.027	0.047	0.035	0.056	0.051	0.831	0.810
Fe	0.005	0.009	0.019	0.026	0.141	0.160	0.173	0.172	0.181	0.029	0.022
Mn	0.000	0.000	0.000	0.001	0.005	0.005	0.005	0.003	0.003	0.001	0.000
Mg	0.009	0.035	0.138	0.140	0.829	0.824	0.798	0.753	0.767	0.174	0.190
Ca	0.022	0.025	0.134	0.137	0.916	0.872	0.902	0.874	0.878	0.158	0.185
Na	0.993	0.941	0.858	0.842	0.099	0.127	0.086	0.136	0.116	0.819	0.799
к Сг	0.002	0.008	0.002	0.001	0.003	0.014	0.003	0.002	0.002	0.012	0.002
Total	4 010	3 991	4 004	3 996	4 029	4 048	4 015	4 021	4 016	4 012	4 003
Id	07.24	06 46	95.05	04.70		2.74	2 45	5.52	4.010	91.04	4.005
Ju	97.34	90.40	85.05 0.70	84.70	2.04	5.74 9.77	5.45	5.55 7 10	5.09	0 12	80.05
Ko	0.45	0.00	0.73	0.00	0.00	0.00	0.00	0.78	0.44	0.13	0.00
Aug	2.21	3 54	14 13	15 24	90.25	87.49	91 38	86 49	88 37	18.03	19.89
1148				13.21				00.12	00.57	10.05	17.07
Sample	OsaJd2										
Sample	OsaJd2 717		······································								
Sample No.	OsaJd2 717 16	17	18	19	22	23	24	25	26	27	28
Sample No. SiO ₂	OsaJd2 717 16 53.93	17 54.81	18	<u>19</u> 53.84	22 53.73	23 53.93	24 54.90	25 55.28	<u>26</u> 53.97	27 55.44	28 54.28
Sample No. SiO ₂ TiO ₂	OsaJd2 717 16 53.93 0.37	17 54.81 0.33	18 54.06 0.52	19 53.84 0.40	22 53.73 0.47	23 53.93 0.40	24 54.90 0.36	25 55.28 0.25	26 53.97 0.41	27 55.44 0.25	28 54.28 0.19
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃	OsaJd2 717 16 53.93 0.37 2.17	17 54.81 0.33 11.15	18 54.06 0.52 1.18	19 53.84 0.40 1.12	22 53.73 0.47 1.16	23 53.93 0.40 1.21	24 54.90 0.36 10.28	25 55.28 0.25 10.38	26 53.97 0.41 0.67	27 55.44 0.25 8.50	28 54.28 0.19 7.27
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO*	OsaJd2 717 16 53.93 0.37 2.17 4.66	17 54.81 0.33 11.15 2.12	18 54.06 0.52 1.18 4.77	19 53.84 0.40 1.12 4.80	22 53.73 0.47 1.16 4.13	23 53.93 0.40 1.21 4.46	24 54.90 0.36 10.28 2.37	25 55.28 0.25 10.38 2.29	26 53.97 0.41 0.67 4.75	27 55.44 0.25 8.50 2.60	28 54.28 0.19 7.27 2.96
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08	17 54.81 0.33 11.15 2.12 0.07	18 54.06 0.52 1.18 4.77 0.15	19 53.84 0.40 1.12 4.80 0.04	22 53.73 0.47 1.16 4.13 0.13	23 53.93 0.40 1.21 4.46 0.09	24 54.90 0.36 10.28 2.37 0.02	25 55.28 0.25 10.38 2.29 0.04	26 53.97 0.41 0.67 4.75 0.12	27 55.44 0.25 8.50 2.60 0.09	28 54.28 0.19 7.27 2.96 0.09
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CCO	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97	17 54.81 0.33 11.15 2.12 0.07 10.12	18 54.06 0.52 1.18 4.77 0.15 14.32	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70	22 53.73 0.47 1.16 4.13 0.13 14.96 22.5	23 53.93 0.40 1.21 4.46 0.09 14.66	24 54.90 0.36 10.28 2.37 0.02 10.53	25 55.28 0.25 10.38 2.29 0.04 10.19	26 53.97 0.41 0.67 4.75 0.12 14.87	27 55.44 0.25 8.50 2.60 0.09 11.30	28 54.28 0.19 7.27 2.96 0.09 12.55
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na O	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.25	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 2.06
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K-O	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MgO CaO Na ₂ O K ₂ O Cr.O ₂	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.00 98.58	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.05 98.83	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.048 0.48 98.83	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.00	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67 1.965 0.009	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.01	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84 1.999 0.011	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.007	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.01	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.00 98.58 2.000 0.010 0.095	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67 1.965 0.009 0.471	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.012	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.019	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.007 0.436	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.011 0.029	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.56 0.03 98.87 1.970 0.005 0.311
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67 1.965 0.009 0.471 0.064	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.014 0.014 0.052 0.148	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.01 98.69 1.994 0.013 0.013 0.128	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435 0.071	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.007 0.436 0.068	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 99.12 2.001 0.011 0.021 0.011	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.078	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.090
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67 1.965 0.009 0.471 0.064 0.002	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.014 0.052 0.04 0.052	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049 0.149 0.001	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004	23 53.93 0.40 1.21 4.46 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.003	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 98.83 1.970 0.010 0.435 0.071 0.001	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 99.50 1.971 0.007 0.436 0.001	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 99.12 2.001 0.011 0.029 0.147 0.004	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.003	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.03 98.87 1.970 0.005 0.311 0.000 0.003
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.45\\ 0.00\\ 98.67\\ \hline 1.965\\ 0.009\\ 0.471\\ 0.064\\ 0.002\\ 0.540\\ \end{array}$	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.014 0.052 0.148 0.005 0.791	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049 0.049 0.001 0.817	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004 0.827	23 53.93 0.40 1.21 4.46 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.003 0.810	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.43 98.83 1.970 0.010 0.435 0.071 0.001 0.563	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.007 0.436 0.001 0.541	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.011 0.029 0.147 0.029 0.147 0.0821	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.007 0.358 0.003	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.005 0.311 0.003 0.678
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.00\\ 98.67\\ 1.965\\ 0.009\\ 0.471\\ 0.064\\ 0.002\\ 0.540\\ 0.509\\ \end{array}$	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.014 0.052 0.148 0.005 0.791 0.870	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.849 0.011 0.817 0.864	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004 0.827 0.884	23 53.93 0.40 1.21 4.46 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.003 0.810 0.881	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.43 98.83 1.970 0.010 0.435 0.071 0.063 0.530	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.007 0.436 0.068 0.0068 0.0541 0.5541	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.011 0.029 0.147 0.029 0.147 0.029	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.078 0.0358 0.078 0.602	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.56 98.87 1.970 0.005 0.311 0.090 0.031 0.678 0.660
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.45\\ 0.00\\ 98.67\\ 1.965\\ 0.009\\ 0.45\\ 0.009\\ 0.471\\ 0.064\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ \end{array}$	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.052 0.148 0.005 0.791 0.870 0.136	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.049 0.041 0.041 0.041 0.041 0.04 0.04 0.04	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004 0.884 0.131	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.003 0.810 0.881 0.131	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435 0.071 0.001 0.633 0.530 0.420	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.036 0.436 0.068 0.001 0.561 0.561 0.562	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.013 0.029 0.147 0.004 0.290 0.004	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.078 0.003 0.602 0.624 0.341	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.090 0.003 0.660 0.278
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155 0.008	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.045\\ 0.00\\ 98.67\\ \hline 1.965\\ 0.009\\ 0.471\\ 0.064\\ 0.002\\ 0.540\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.021\\ \end{array}$	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.014 0.005 0.791 0.870 0.136 0.005	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.049 0.049 0.149 0.001 0.817 0.817 0.817 0.813 0.008	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004 0.827 0.827 0.827 0.827	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.003 0.810 0.881 0.131 0.002	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435 0.071 0.001 0.563 0.520 0.420	$\begin{array}{c} 25\\ 55.28\\ 0.25\\ 10.38\\ 2.29\\ 0.04\\ 10.19\\ 14.72\\ 6.24\\ 0.10\\ 0.01\\ 99.50\\ 1.971\\ 0.007\\ 0.436\\ 0.068\\ 0.001\\ 0.541\\ 0.684\\ 0.001\\ 0.541\\ 0.005\\ \end{array}$	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.011 0.029 0.147 0.004 0.821 0.004 0.821 0.004 0.001	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.078 0.003 0.602 0.602 0.602 0.341 0.011	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.090 0.003 0.678 0.660 0.278 0.026
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cl ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155 0.008 0.000	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.45\\ 0.00\\ 98.67\\ \hline 1.965\\ 0.009\\ 0.451\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.021\\ 0.000\\ \end{array}$	$\begin{array}{c} 18\\ 54.06\\ 0.52\\ 1.18\\ 4.77\\ 0.15\\ 14.32\\ 21.91\\ 1.89\\ 0.10\\ 0.03\\ 98.93\\ 2.004\\ 0.014\\ 0.05\\ 0.791\\ 0.791\\ 0.791\\ 0.791\\ 0.791\\ 0.705\\ 0.005\\ 0.001\\ \end{array}$	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049 0.149 0.001 0.817 0.817 0.813 0.008 0.000	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004 0.827 0.827 0.827 0.821	23 53.93 0.40 1.21 4.46 0.09 14.66 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.003 0.810 0.881 0.131 0.002 0.001	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435 0.071 0.001 0.563 0.530 0.420 0.022 0.001	$\begin{array}{c} 25\\ 55.28\\ 0.25\\ 10.38\\ 2.29\\ 0.04\\ 10.19\\ 14.72\\ 6.24\\ 0.10\\ 0.01\\ 99.50\\ 1.971\\ 0.007\\ 0.436\\ 0.001\\ 0.541\\ 0.541\\ 0.005\\ 0.000\\ \end{array}$	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 99.12 2.001 0.011 0.021 0.040 0.821 0.004 0.821 0.004 0.801 0.001	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.007 0.003 0.602 0.602 0.624 0.341 0.011 0.000	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.090 0.003 0.678 0.660 0.278 0.026 0.001
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr Total	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155 0.008 0.000 4.024	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.45\\ 0.00\\ 98.67\\ \hline 1.965\\ 0.009\\ 0.45\\ 0.009\\ 0.451\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.021\\ 0.000\\ 4.022\\ \hline \end{array}$	$\begin{array}{c} 18\\ 54.06\\ 0.52\\ 1.18\\ 4.77\\ 0.15\\ 14.32\\ 21.91\\ 1.89\\ 0.10\\ 0.03\\ 98.93\\ 2.004\\ 0.014\\ 0.052\\ 0.14\\ 0.052\\ 0.148\\ 0.005\\ 0.791\\ 0.870\\ 0.136\\ 0.005\\ 0.001\\ 4.026\\ \end{array}$	$\begin{array}{c} 19\\ 53.84\\ 0.40\\ 1.12\\ 4.80\\ 0.04\\ 14.76\\ 21.70\\ 1.85\\ 0.17\\ 0.01\\ 98.69\\ 2.001\\ 0.011\\ 0.011\\ 0.001\\ 0.149\\ 0.149\\ 0.001\\ 0.817\\ 0.864\\ 0.133\\ 0.008\\ 0.000\\ 4.033\\ \end{array}$	22 53.73 0.47 1.16 4.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.021 0.128 0.004 0.827 0.884 0.001 0.000 0.000 4.033	$\begin{array}{c} 23\\ 53.93\\ 0.40\\ 1.21\\ 4.46\\ 0.09\\ 14.66\\ 22.19\\ 1.83\\ 0.05\\ 0.02\\ 98.84\\ 1.999\\ 0.011\\ 0.053\\ 0.138\\ 0.003\\ 0.810\\ 0.881\\ 0.131\\ 0.002\\ 0.001\\ 4.029\\ \end{array}$	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435 0.071 0.001 0.563 0.530 0.420 0.022 0.001 4.023	$\begin{array}{c} 25\\ 55.28\\ 0.25\\ 10.38\\ 2.29\\ 0.04\\ 10.19\\ 14.72\\ 6.24\\ 0.10\\ 0.01\\ 99.50\\ 1.971\\ 0.007\\ 0.436\\ 0.001\\ 0.541\\ 0.562\\ 0.001\\ 0.541\\ 0.562\\ 0.001\\ 0.541\\ 0.005\\ 0.000\\ 4.022\\ \end{array}$	$\begin{array}{c} 26\\ 53.97\\ 0.41\\ 0.67\\ 4.75\\ 0.12\\ 14.87\\ 22.82\\ 1.45\\ 0.03\\ 99.12\\ 2.001\\ 0.011\\ 0.01\\ 0.01\\ 0.04\\ 0.821\\ 0.906\\ 0.104\\ 0.821\\ 0.906\\ 0.104\\ 0.001\\ 0.001\\ 4.026\\ \end{array}$	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.007 0.358 0.003 0.602 0.624 0.341 0.001 0.000 4.007	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.090 0.003 0.678 0.660 0.278 0.026 0.001 4.022
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr Total Jd	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155 0.008 0.000 4.024 9.45	17 54.81 0.33 11.15 2.12 0.07 10.12 13.27 6.35 0.45 0.00 98.67 1.965 0.009 0.471 0.064 0.002 0.540 0.509 0.441 0.021 0.000 4.022 43.74	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.014 0.052 0.791 0.870 0.136 0.005 0.001 4.026 5.13	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049 0.149 0.001 0.817 0.864 0.133 0.000 4.033 4.87	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.128 0.004 0.827 0.884 0.001 0.884 0.001 0.000 4.033 4.39	23 53.93 0.40 1.21 4.46 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.03 0.810 0.881 0.031 0.881 0.031 0.881 0.032 0.001 4.029 5.16	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 98.83 1.970 0.010 0.435 0.071 0.001 0.563 0.530 0.420 0.022 0.001 4.023 40.67	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 99.50 1.971 0.007 0.436 0.001 0.541 0.0562 0.431 0.005 4.022 40.47	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 99.12 2.001 0.011 0.011 0.029 0.147 0.004 0.821 0.906 0.104 0.001 4.026 2.90	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.007 0.358 0.003 0.602 0.624 0.341 0.001 0.000 4.007 34.30	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.03 98.87 1.970 0.005 0.311 0.005 0.311 0.003 0.678 0.026 0.0278 0.026 0.001 4.022 27.93
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr Total Jd Aeg	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155 0.008 0.000 4.024 9.45 6.03	$\begin{array}{r} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.45\\ 0.00\\ 98.67\\ \hline 1.965\\ 0.009\\ 0.471\\ 0.064\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.021\\ 0.000\\ 4.022\\ \hline 43.74\\ 0.54\\ \hline $	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.103 98.93 2.004 0.014 0.052 0.791 0.870 0.136 0.001 4.026 5.13 8.29	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.011 0.049 0.049 0.049 0.049 0.001 0.817 0.864 0.133 0.0864 0.133 0.000 4.033 4.87 8.33	22 53.73 0.47 1.16 4.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.084 0.004 0.827 0.884 0.131 0.000 4.033 4.39 8.47	23 53.93 0.40 1.21 4.46 22.19 1.83 0.05 0.02 98.84 1.999 0.011 0.053 0.138 0.03 0.810 0.881 0.131 0.002 0.001 4.029 5.16 7.76	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.43 0.05 98.83 1.970 0.010 0.435 0.071 0.001 0.563 0.530 0.420 0.022 0.001 4.023 40.67 1.38	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.007 0.436 0.068 0.001 0.541 0.562 0.431 0.0562 0.431 0.055 0.000 0.4022 40.47 2.38	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.011 0.029 0.147 0.004 0.821 0.906 0.104 0.001 0.001 0.001 0.001 4.026 2.90 7.33	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 0.358 0.003 0.602 0.624 0.341 0.001 0.000 4.007 34.30 0.00	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.005 0.311 0.090 0.003 0.678 0.660 0.278 0.660 0.278 0.626 0.002 4.022 27.93 0.00
Sample No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr Total Jd Aeg Ko	OsaJd2 717 16 53.93 0.37 2.17 4.66 0.08 13.97 21.08 2.16 0.16 0.00 98.58 2.000 0.010 0.095 0.144 0.003 0.772 0.837 0.155 0.008 0.000 4.024 9.45 6.03 0.000	$\begin{array}{c} 17\\ 54.81\\ 0.33\\ 11.15\\ 2.12\\ 0.07\\ 10.12\\ 13.27\\ 6.35\\ 0.09\\ 0.45\\ 0.009\\ 98.67\\ 1.965\\ 0.009\\ 0.45\\ 0.009\\ 0.471\\ 0.064\\ 0.002\\ 0.540\\ 0.509\\ 0.441\\ 0.021\\ 0.000\\ 4.022\\ 43.74\\ 0.54\\ 0.00\\ 5.54\\ 0.00\\ 5.54\\ 0.00\\ 5.55\\ 0.00\\ 5.55\\ 0.00\\ 0.00\\ 0.55\\ 0.00\\ 0.00\\ 0.55\\ 0.00\\ $	18 54.06 0.52 1.18 4.77 0.15 14.32 21.91 1.89 0.10 0.03 98.93 2.004 0.052 0.148 0.005 0.136 0.005 0.001 4.026 5.13 8.29 0.09	19 53.84 0.40 1.12 4.80 0.04 14.76 21.70 1.85 0.17 0.01 98.69 2.001 0.019 0.049 0.049 0.049 0.049 0.001 0.864 0.133 0.008 0.000 4.033 4.87 8.33 0.03	22 53.73 0.47 1.16 4.13 0.13 14.96 22.25 1.82 0.03 0.01 98.69 1.994 0.013 0.051 0.021 0.004 0.884 0.004 0.887 0.004 0.887 0.031 0.001	$\begin{array}{c} 23\\ 53.93\\ 0.40\\ 1.21\\ 4.46\\ 0.09\\ 14.66\\ 22.19\\ 1.83\\ 0.05\\ 0.02\\ 98.84\\ 1.999\\ 0.011\\ 0.053\\ 0.138\\ 0.003\\ 0.810\\ 0.810\\ 0.881\\ 0.003\\ 0.810\\ 0.881\\ 0.131\\ 0.002\\ 0.001\\ 4.029\\ 5.16\\ 7.76\\ 0.06\\ 0.66\\ 7.76\\ 0.06\\ 0.66\\ $	24 54.90 0.36 10.28 2.37 0.02 10.53 13.80 6.04 0.48 0.05 98.83 1.970 0.010 0.435 0.071 0.001 0.435 0.071 0.001 0.420 0.022 0.001 4.023 40.67 1.38 40.67	25 55.28 0.25 10.38 2.29 0.04 10.19 14.72 6.24 0.10 0.01 99.50 1.971 0.001 99.50 1.971 0.436 0.068 0.001 0.562 0.431 0.055 0.000 4.022 40.47 2.38 0.03	26 53.97 0.41 0.67 4.75 0.12 14.87 22.82 1.45 0.03 0.03 99.12 2.001 0.01 0.029 0.147 0.004 0.290 0.104 0.001 0.001 4.000 2.900 7.33 0.09	27 55.44 0.25 8.50 2.60 0.09 11.30 16.28 4.92 0.25 0.00 99.63 1.983 0.007 8.003 0.624 0.358 0.078 0.003 0.624 0.341 0.011 0.000 4.007 34.30 0.00 0.00	28 54.28 0.19 7.27 2.96 0.09 12.55 16.98 3.96 0.56 0.03 98.87 1.970 0.005 0.311 0.090 0.003 0.660 0.278 0.026 0.001 4.022 27.93 0.00 0.09

Table 1 (Continued)

Aug84.52* Total Fe as FeO

Table 1 (Continued)

	717										
No	29	31	32	40	41	12	13	44	45	17	18
- 50	52 61	57 79	52 07	52.96	55.04	54 22	54.94	54.94	55 57	55 50	55.01
TiO ₂	0.65	0.19	0.63	0.65	0.16	0.32	0.20	0.20	0.26	0.28	0.30
Al ₂ O ₃	1.21	21.44	1.63	0.87	8.87	1.33	8.54	8.54	10.83	8.14	8.22
FeO*	5.48	0.69	4.96	5.03	2.54	4.26	2.52	2.52	2.23	2.22	2.44
MnO	0.09	0.00	0.16	0.10	0.03	0.10	0.09	0.09	0.00	0.05	0.06
MgO	14.13	2.82	13.93	14.39	10.89	15.22	12.56	12.56	10.33	11.94	12.50
CaO	21.19	3.22	20.94	22.21	16.17	22.36	15.79	15.79	14.03	16.65	16.19
Na ₂ O	2.37	12.56	2.30	1.81	5.53	1.92	4.43	4.43	5.99	4.88	4.69
K ₂ O	0.05	0.32	0.07	0.06	0.07	0.08	0.83	0.83	0.34	0.28	0.51
Total	0.04	0.00	0.00	0.00	100.20	0.00	0.00	0.00	0.00	100.02	0.00
	1 007	1 020	2 005	2 001	1.007	1 002	1.00	1.00	1 072	1 000	1.000
51 Ti	0.018	0.005	2.005	2.001	1.98/	1.992	1.962	0.005	1.973	1.980	1.900
A]	0.018	0.005	0.071	0.018	0.371	0.009	0.005	0.005	0.007	0.342	0.008
Fe	0.171	0.020	0.154	0.156	0.075	0.131	0.075	0.075	0.066	0.066	0.073
Mn	0.003	0.000	0.005	0.003	0.001	0.003	0.003	0.003	0.000	0.002	0.002
Mg	0.784	0.145	0.771	0.796	0.576	0.831	0.669	0.669	0.546	0.634	0.665
Ca	0.845	0.119	0.833	0.883	0.615	0.878	0.605	0.605	0.534	0.635	0.620
Na	0.171	0.838	0.166	0.130	0.381	0.136	0.307	0.307	0.412	0.337	0.325
K	0.002	0.014	0.003	0.003	0.003	0.004	0.038	0.038	0.015	0.013	0.023
Cr	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	4.045	3.999	4.026	4.028	4.013	4.041	4.024	4.024	4.006	4.016	4.028
Jd	4.88	85.54	7.14	3.76	35.74	4.85	31.23	31.23	41.83	32.27	31.23
Aeg	11.83	0.00	9.42	9.09	2.19	8.60	0.00	0.00	0.00	1.47	1.31
KO Aug	0.12	0.00	0.00	0.00	62.07	0.00	68 77	0.00	0.00	0.03	0.00
Aug	65.17	14.40	03.44	87.15	02.07	- 80.33	08.77	00.77	38.17	00.24	07.40
Samn	de Osald2										
Samp	le OsaJd2 717										
Samp No.	de OsaJd2 717 49	51	52	53	54	55	56	58	59	60	
Samp No. SiO ₂	0saJd2 717 49 53.85	51	52 55.13	53	<u>54</u> 54.32	55	56 54.92	58	<u>59</u> 58.97	60 58.85	
Samp No. SiO ₂ TiO ₂	053Jd2 717 49 53.85 0.38	51 55.27 0.27	52 55.13 0.16	53 55.45 0.17	54 54.32 0.72	55 54.11 0.43	56 54.92 0.13	58 58.63 0.05	59 58.97 0.00	60 58.85 0.00	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃	le OsaJd2 717 49 53.85 0.38 1.39	51 55.27 0.27 9.83	52 55.13 0.16 10.99	53 55.45 0.17 11.65	54 54.32 0.72 2.87	55 54.11 0.43 1.04	56 54.92 0.13 7.95	58 58.63 0.05 24.84	59 58.97 0.00 25.07	60 58.85 0.00 25.06	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO*	le OsaJd2 717 49 53.85 0.38 1.39 6.42	51 55.27 0.27 9.83 2.01	52 55.13 0.16 10.99 2.26	53 55.45 0.17 11.65 2.47	54.32 0.72 2.87 4.25	55 54.11 0.43 1.04 4.79	56 54.92 0.13 7.95 2.47	58 58.63 0.05 24.84 0.14	59 58.97 0.00 25.07 0.10	60 58.85 0.00 25.06 0.08	
Samp No. SiO_2 TiO_2 Al_2O_3 FeO^* MnO	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15	51 55.27 0.27 9.83 2.01 0.07	52 55.13 0.16 10.99 2.26 0.06	53 55.45 0.17 11.65 2.47 0.07	54 54.32 0.72 2.87 4.25 0.12	55 54.11 0.43 1.04 4.79 0.18	56 54.92 0.13 7.95 2.47 0.08	58 58.63 0.05 24.84 0.14 0.00	59 58.97 0.00 25.07 0.10 0.00	60 58.85 0.00 25.06 0.08 0.04	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21 00	51 55.27 0.27 9.83 2.01 0.07 10.47	52 55.13 0.16 10.99 2.26 0.06 9.73	53 55.45 0.17 11.65 2.47 0.07 9.42	54 54.32 0.72 2.87 4.25 0.12 13.64	55 54.11 0.43 1.04 4.79 0.18 14.42	56 54.92 0.13 7.95 2.47 0.08 11.64	58 58.63 0.05 24.84 0.14 0.00 0.24	59 58.97 0.00 25.07 0.10 0.00 0.01	60 58.85 0.00 25.06 0.08 0.04 0.02	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5 7 4	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.08	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 2.01	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.42	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14 62	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O	le OsaJd2 717 49 53.85 0.38 6.42 0.15 13.66 21.06 2.12 0.10	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33 0.02	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O K ₂ O Cr.O ₂	le OsaJd2 717 49 53.85 0.38 6.42 0.15 13.66 21.06 2.12 0.10 0.04	51 55.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 0.07	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33 0.02 0.00	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17	51 55.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 0.07 99.09	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.34 0.00 98.84	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33 0.02 0.00 98.68	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO MgO CaO Na ₂ O Cr ₂ O ₃ Total Si	le OsaJd2 717 49 53,85 0.38 1.39 6.42 0.15 13,66 21.06 2.12 0.10 0.04 99.17 2.003	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.10 0.00 99.02 1.998	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 0.07 99.09 2.004	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983	58 58.63 0.05 24.84 0.14 0.24 0.43 14.33 0.02 0.00 98.68 1.998	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12 2.001	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005	54 54,32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 0.07 99.09 2.004 0.012	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.004	58 58.63 0.05 24.84 0.14 0.02 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001	59 58.97 0.00 25.07 0.10 0.00 0.01 99.12 2.001 0.000	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO [*] MnO MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487	54 54,32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 0.07 99.09 2.004 0.012 0.045	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.004 0.338	58 58.63 0.05 24.84 0.14 0.02 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997	59 58.97 0.00 25.07 0.10 0.00 0.01 99.12 2.001 0.000 1.002	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO CaO CaO Cr ₂ O ₃ Total Si Ti Al Fe	le OsaJd2 717 49 53.85 0.38 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.068	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487 0.073	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131	$\begin{array}{r} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ 2.004\\ 0.012\\ 0.045\\ 0.148\\ \end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.004 0.338 0.075	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.002	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn	le OsaJd2 717 49 53.85 0.38 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.468 0.002	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487 0.073 0.002	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004	$\begin{array}{r} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.04 0.00 98.84 1.983 0.004 0.338 0.075 0.002	58 58.63 0.05 24.84 0.14 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.002 0.001	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MngO CaO Na ₂ O CaO Na ₂ O CaO Na ₂ O CaO Si Total Si Ti Al Fe Mn Mn Mg	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002 0.558	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.004 0.463 0.002 0.519	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.497 0.073 0.002 0.497	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004 0.747	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 99.09 2.004 0.012 0.045 0.148 0.006 0.796	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.00 98.84 1.983 0.004 0.388 0.075 0.002 0.626	58 58.63 0.05 24.84 0.14 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.001 0.907	59 58.97 0.00 25.07 0.10 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.002 0.001 0.001	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MgO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.200 0.005 0.757 0.839	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002 0.558 0.584	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.004 0.463 0.004 0.463 0.002 0.519 0.539	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487 0.005 0.487 0.002 0.497 0.512	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.320 0.124 0.324 0.004 0.747 0.787	$\begin{array}{r} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ \hline 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.006\\ 0.796\\ 0.888\\ 0.015\\ 0.145\\ \hline 0.015\\ 0.006\\ 0$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.04 0.00 98.84 1.983 0.004 0.338 0.004 0.338 0.002 0.626 0.653	58 58.63 0.05 24.84 0.14 0.02 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.012 0.016	59 58.97 0.00 25.07 0.10 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.010	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.000 1.003 0.001 0.001 0.007	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na V	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757 0.839 0.153	$\begin{array}{r} 51\\ 55.27\\ 0.27\\ 9.83\\ 2.01\\ 0.07\\ 10.47\\ 15.25\\ 5.74\\ 0.15\\ 0.02\\ 99.08\\ 1.978\\ 0.007\\ 0.414\\ 0.060\\ 0.002\\ 0.558\\ 0.584\\ 0.398\\ 0.584\\ 0.398\\ 0.607\end{array}$	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.004 0.463 0.002 0.519 0.539 0.434 0.621	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 6.98 0.27 0.005 0.487 0.005 0.487 0.005 0.487 0.002 0.497 0.512 0.497	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004 0.747 0.787 0.787	$\begin{array}{c} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 99.09\\ \hline 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.115\\ 0.002\end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.004 0.338 0.004 0.338 0.002 0.626 0.653 0.310	58 58.63 0.05 24.84 0.14 0.02 0.00 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.012 0.016 0.945	59 58.97 0.00 25.07 0.10 0.00 1.028 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.010 0.010	60 58.85 0.00 25.06 0.08 0.02 0.20 14.76 0.05 0.00 1.005 0.000 1.003 0.000 1.003 0.001 0.001 0.001 0.007 0.001	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MgO CaO Na ₂ O K ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Ca Si Si Si Si Si Si Si Si Si Si Si Si Si	le OsaJd2 717 49 53,85 0.38 1.39 6.42 0.15 13,66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757 0.839 0.153 0.005	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002 0.558 0.584 0.398 0.007	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.008 0.004 0.463 0.068 0.002 0.519 0.539 0.434 0.000	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 9.98 0.27 0.005 0.487 0.005 0.487 0.002 0.497 0.512 0.512 0.479 0.012	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.020 0.124 0.747 0.787 0.214 0.050	$\begin{array}{r} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.115\\ 0.003\\ 0.002\\ \end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.004 98.84 0.004 0.338 0.004 0.338 0.004 0.338 0.002 0.623 0.653 0.310 0.016	58 58.63 0.05 24.84 0.14 0.02 0.02 0.02 0.00 98.68 0.001 0.997 0.004 0.001 0.012 0.016 0.946 0.001	59 58.97 0.00 25.07 0.10 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.010 0.001 0.003 0.003	60 58.85 0.00 25.06 0.08 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.002 0.001 0.001 0.001 0.007 0.971 0.002	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO CaO Na ₂ O CaO CaO CaO Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Ca Na K Cr Total	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757 0.839 0.153 0.005 0.001 4 034	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002 0.558 0.558 0.558 0.398 0.007 0.001 4.009	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.068 0.002 0.519 0.434 0.010 0.000 0.4012	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487 0.073 0.002 0.487 0.512 0.479 0.512 0.479	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004 0.121 0.004 0.787 0.214 0.005 0.000	$\begin{array}{r} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.115\\ 0.003\\ 0.002\\ 4.019\end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.005 98.84 1.983 0.007 5 0.002 0.653 0.310 0.016 0.000	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.097 0.004 0.000 0.012 0.016 0.946 0.946 0.946	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.010 0.001 0.001 0.003 0.000 0.961 0.003 0.000	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.002 0.001 0.001 0.007 0.971 0.002 0.002	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO CaO Na ₂ O CaO CaO CaO CaO Si Ti Al Fe Mn Mg Ca Si Ti Al Si Ti La Ca Si Ca CaO Si Si Si Si Si Si Si Si Si Si Si Si Si	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757 0.839 0.153 0.005 0.001 4.034	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002 0.558 0.584 0.398 0.007 0.001 4.009	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.434 0.068 0.002 0.519 0.434 0.010 0.000 4.010 0.000	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487 0.073 0.002 0.497 0.512 0.479 0.012 0.479 0.012 0.479	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004 0.747 0.747 0.214 0.005 0.000 4.005	55 54.11 0.43 1.04 4.79 0.18 14.42 22.38 1.60 0.07 0.07 99.09 2.004 0.012 0.045 0.148 0.006 0.796 0.888 0.115 0.003 0.002 4.019	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.004 0.338 0.004 0.338 0.075 0.002 0.626 0.6310 0.310 0.016 0.000 4.007	58 58.63 0.05 24.84 0.14 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.012 0.004 0.000 0.946 0.001 0.946 0.001 0.946 0.001 0.946 0.001 0.946 0.947 0.997 0.	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.001 0.003 0.000 0.961 0.003 0.000 3.981	60 58.85 0.00 25.06 0.08 0.04 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.002 0.001 0.001 0.001 0.001 0.001 0.001 0.002 0.000 3.986 0.04 0.04 0.05 0.00 0.05 0.00 0.05 0.00 0.05 0.00 0.00 0.00 0.05 0.00 0.00 0.00 0.05 0.00 0.0	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MgO CaO Na ₂ O CaO CaO CaO CaO CaO CaO CaO CaO CaO Ca	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757 0.839 0.153 0.005 0.001 4.034 6.05 9.00	51 55.27 0.27 9.83 2.01 0.07 10.47 15.25 5.74 0.15 0.02 99.08 1.978 0.007 0.414 0.060 0.002 0.558 0.584 0.398 0.007 0.001 4.009 39.32 0.51	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.403 0.068 0.002 0.519 0.434 0.010 0.000 4.012 43.48 0.00	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.085 0.497 0.073 0.002 0.497 0.512 0.073 0.02 0.497 0.512 0.497 0.512 0.429 0.012 0.000 4.032	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004 0.747 0.214 0.005 0.000 4.030 12.17 9.23	$\begin{array}{c} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ 2.004\\ 0.012\\ 0.045\\ 0.045\\ 0.045\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.115\\ 0.003\\ 0.002\\ 4.019\\ 4.53\\ 6.72\\ \end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.34 0.00 98.84 1.983 0.004 0.338 0.075 0.002 0.626 0.653 0.310 0.016 0.000 4.007 31.38 0.00	58 58.63 0.05 24.84 0.14 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.012 0.004 0.000 0.946 0.001 0.0946 0.001 0.0946 0.001 0.000 3.975 98.34 0.00	59 58.97 0.00 25.07 0.10 0.00 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.001 0.001 0.001 0.003 0.000 3.981 98.92 0.00	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.999 0.000 1.003 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.000 0.001 0.000 0.001 0.002 0.000 0.001 0.002 0.000 0.000 0.001 0.002 0.000 0.000 0.001 0.002 0.0000 0.00000 0.0000 0.0000 0.00000 0.00000 0.0000000 0.00000000	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MngO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr Total Jd Aeg Ko	le OsaJd2 717 49 53.85 0.38 1.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.061 0.200 0.005 0.757 0.839 0.153 0.005 0.001 4.034 6.05 9.000 0.12	$\begin{array}{c} 51\\ 55.27\\ 0.27\\ 9.83\\ 2.01\\ 0.07\\ 10.47\\ 15.25\\ 5.74\\ 0.15\\ 0.02\\ 99.08\\ 1.978\\ 0.007\\ 0.414\\ 0.060\\ 0.002\\ 0.558\\ 0.584\\ 0.398\\ 0.007\\ 0.001\\ 4.009\\ 39.32\\ 0.51\\ 0.06\end{array}$	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.004 0.463 0.002 0.519 0.539 0.434 0.010 0.000 4.012 43.48 0.000	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.497 0.073 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.512 0.002 0.497 0.075 0.005 0.045 0.072 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.075 0.072 0.072 0.075 0.075 0.0720 0.0720 0.0720000000000	54 54.32 0.72 2.87 4.25 0.12 13.64 19.98 3.01 0.11 0.00 99.02 1.998 0.020 0.124 0.131 0.004 0.747 0.787 0.214 0.005 0.000 4.030 12.17 9.23 0.00	$\begin{array}{c} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 99.09\\ \hline 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.115\\ 0.003\\ 0.002\\ 4.019\\ \hline 4.53\\ 6.72\\ 0.20\\ \hline \end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.00 98.84 1.983 0.004 0.388 0.075 0.002 0.626 0.653 0.310 0.016 0.000 4.007 31.38 0.00	58 58.63 0.05 24.84 0.14 0.00 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.012 0.016 0.901 0.001 0.001 0.001 0.001 0.000 3.975 98.34 0.00	59 58.97 0.00 25.07 0.10 0.01 0.28 14.62 0.06 0.01 99.12 2.001 0.000 1.002 0.003 0.000 0.001 0.001 0.001 0.000 0.001 0.000 3.981 98.92 0.000 0.03	60 58.85 0.00 25.06 0.08 0.04 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.099 0.000 1.003 0.002 0.001 0.001 0.001 0.001 0.007 0.001 0.000 1.999 0.000 1.999 0.000 1.999 0.000 1.999 0.000 1.999 0.000 1.909 0.000 1.909 0.000 1.909 0.000 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.000 1.999 0.000 0.001 0.001 0.001 0.0000 0.0000 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.00000 0.00000 0.00000 0.000000 0.00000000	
Samp No. SiO ₂ TiO ₂ Al ₂ O ₃ FeO* MnO CaO Na ₂ O Cr ₂ O ₃ Total Si Ti Al Fe Mn Mg Ca Na K Cr Total Jd Aeg Ko Que	le OsaJd2 717 49 53.85 0.38 0.38 0.39 6.42 0.15 13.66 21.06 2.12 0.10 0.04 99.17 2.003 0.011 0.200 0.005 0.757 0.839 0.153 0.005 0.001 4.034 6.05 9.00 0.12 84.83	$\begin{array}{c} 51\\ 55.27\\ 0.27\\ 9.83\\ 2.01\\ 0.07\\ 10.47\\ 15.25\\ 5.74\\ 0.15\\ 0.02\\ 99.08\\ \hline 1.978\\ 0.007\\ 0.414\\ 0.060\\ 0.002\\ 0.558\\ 0.584\\ 0.398\\ 0.007\\ 0.001\\ 4.009\\ \hline 39.32\\ 0.51\\ 0.06\\ 60.11\\ \hline \end{array}$	52 55.13 0.16 10.99 2.26 0.06 9.73 14.07 6.26 0.23 0.01 98.90 1.973 0.004 0.463 0.004 0.463 0.004 0.463 0.002 0.519 0.539 0.434 0.000 4.012 43.48 0.000 4.012	53 55.45 0.17 11.65 2.47 0.07 9.42 13.50 6.98 0.27 0.00 99.98 1.965 0.005 0.487 0.073 0.005 0.487 0.073 0.005 0.487 0.012 0.497 0.512 0.497 0.512 0.497 0.512 0.497 0.512 0.400 4.322	$\begin{array}{c} 54\\ 54.32\\ 0.72\\ 2.87\\ 4.25\\ 0.12\\ 13.64\\ 19.98\\ 3.01\\ 0.11\\ 0.00\\ 99.02\\ 1.998\\ 0.020\\ 0.124\\ 0.030\\ 0.124\\ 0.04\\ 0.747\\ 0.787\\ 0.214\\ 0.004\\ 0.747\\ 0.787\\ 0.214\\ 0.005\\ 0.000\\ 4.030\\ 12.17\\ 9.23\\ 0.005\\ 0.000\\ 78.60\\ \end{array}$	$\begin{array}{c} 55\\ 54.11\\ 0.43\\ 1.04\\ 4.79\\ 0.18\\ 14.42\\ 22.38\\ 1.60\\ 0.07\\ 0.07\\ 99.09\\ \hline 2.004\\ 0.012\\ 0.045\\ 0.148\\ 0.006\\ 0.796\\ 0.888\\ 0.115\\ 0.003\\ 0.002\\ 4.019\\ \hline 4.53\\ 6.72\\ 0.20\\ 88.55\\ \hline \end{array}$	56 54.92 0.13 7.95 2.47 0.08 11.64 16.88 4.43 0.00 98.84 1.983 0.004 0.338 0.004 0.338 0.004 0.338 0.002 0.626 0.653 0.310 0.016 0.000 4.007 31.38 0.00 0.000	58 58.63 0.05 24.84 0.14 0.02 0.24 0.43 14.33 0.02 0.00 98.68 1.998 0.001 0.997 0.004 0.000 0.012 0.016 0.001 0.000 0.001 0.001 0.000 3.975 98.34 0.00 0.000 1.66	$\begin{array}{c} 59\\ 58.97\\ 0.00\\ 25.07\\ 0.10\\ 0.00\\ 1.02\\ 8\\ 14.62\\ 0.06\\ 0.01\\ 99.12\\ 2.001\\ 0.000\\ 1.002\\ 0.003\\ 0.000\\ 0.001\\ 0.010\\ 0.961\\ 0.000\\ 3.981\\ 98.92\\ 0.00\\ 0.03\\ 1.05\\ \end{array}$	60 58.85 0.00 25.06 0.08 0.02 0.20 14.76 0.05 0.00 99.06 1.999 0.000 1.003 0.000 1.003 0.001 0.001 0.001 0.001 0.001 0.000 3.986 99.26 0.00 0.00 0.07 4.76	

* Total Fe as FeO

	OsaJd										
mineral	pectolite						wo				
No.	8	9	10	11	12	16	17	18	19	20	21
SiO ₂	54.30	53.98	53.77	54.43	54.05	54.24	51.16	51.75	51.35	52.65	51.16
TiO_2	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.00	0.00	0.01
Al_2O_3	0.02	0.00	0.00	0.68	0.01	0.03	0.62	0.01	0.02	1.88	0.01
FeO*	0.03	0.07	0.05	0.11	0.06	0.09	0.03	0.09	0.05	0.14	0.24
MnO	0.06	0.08	0.00	0.08	0.10	0.00	0.05	0.02	0.04	0.10	0.08
MgO	0.04	0.04	0.00	0.04	0.01	0.05	0.04	0.02	0.04	0.05	0.02
CaO	33.90	33.84	33.83	33.10	33.89	33.76	46.67	48.21	48.12	44.00	47.57
Na ₂ O	9.23	8.95	9.14	9.55	9.36	9.34	0.05	0.01	0.01	0.47	0.10
K_2O	0.03	0.04	0.01	0.04	0.05	0.01	0.03	0.06	0.04	0.83	0.05
Cr_2O_3	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Total	97.62	97.02	96.80	98.03	97.51	97.54	98.66	100.19	99.67	100.12	99.27
O =	8.5	8.5	8.5	8.5	8.5	8.5	6	6	6	6	6
Si	2.996	2.997	2.994	2.985	2.990	2.995	1.998	1.999	1.995	2.012	1.997
Ti	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000
Al	0.002	0.000	0.000	0.044	0.000	0.002	0.028	0.000	0.001	0.085	0.000
Fe	0.001	0.003	0.002	0.005	0.003	0.004	0.001	0.003	0.002	0.004	0.008
Mn	0.003	0.004	0.000	0.004	0.005	0.000	0.002	0.001	0.001	0.003	0.003
Mg	0.003	0.003	0.000	0.003	0.000	0.004	0.003	0.001	0.002	0.003	0.001
Ca	2.003	2.012	2.017	1.944	2.008	1.997	1.952	1.994	2.002	1.801	1.988
Na	0.987	0.963	0.986	1.015	1.003	0.999	0.003	0.001	0.000	0.034	0.008
К	0.002	0.003	0.001	0.003	0.003	0.001	0.002	0.003	0.002	0.041	0.003
Cr	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Total	5.997	5.986	6.000	6.003	6.012	6.003	3.989	4.003	4.005	3.983	4.009

Table 2 Chemical compositions of pectolite, wollastonite, phlogopite and amphibole.

	OsaJd2			
	phlogopite		amp	
	717		717	
No.	36	39	38	46
SiO_2	42.76	41.33	52.59	53.40
TiO_2	0.08	0.00	0.25	0.25
Al_2O_3	12.88	14.06	7.52	7.80
FeO*	3.53	2.74	3.07	2.63
MnO	0.02	0.00	0.00	0.04
MgO	24.43	25.54	19.87	17.11
CaO	0.65	0.12	6.59	9.09
Na_2O	1.22	0.89	7.23	5.79
K_2O	9.16	9.85	0.50	0.75
Cr_2O_3	0.00	0.00	0.00	0.00
Total	94.73	94.53	97.62	96.86
0=	22	22	23	23
Si	6.050	5.862	7.313	7.466
Ti	0.009	0.000	0.026	0.026
Al	2.147	2.350	1.232	1.285
Fe	0.418	0.325	0.357	0.307
Mn	0.002	0.000	0.000	0.005
Mg	5.149	5.396	4.116	3.563
Ca	0.098	0.018	0.981	1.361
Na	0.334	0.254	1.948	1.569
к	1.653	1.781	0.089	0.134
Cr	0.000	0.000	0.000	0.000
Total	15.860	15.986	16.062	15.716

* Total Fe as FeO

Wo: wollastonite; amp: amphibole.

Jadeitites from the Osayama area



Fig. 4. Chemical composition of clinopyroxenes from the jadeitite (OsaJd). Aeg.: aegirine; Aug: augite; Jd: jadeite.



Fig. 5. Chemical composition of clinopyroxenes from the jadeitite (OsaJd2). Aeg.: aegirine; Aug: augite; Jd: jadeite.

2. Pectolite

Pectolites in the jadeitite, OsaJd, show the chemical composition close to the ideal composition, $Ca_2NaH[SiO_3]_3$ (Table 2). Al, Fe, Mn and Mg in the pectolites are negligible.

3. Wollastonite

Wollastonites in the jadeitite, OsaJd, show the chemical composition of the ideal formula of wollastonite. They contain very low Fe and Mn (Table 2).

4. Phlogopite

Phlogopites in the jadeitite, OsaJd2, range in Mg/(Mg+Fe) between 0.92 and 0.94. Na/ (Na+K) is 0.12-0.17 (Table 2).

5. Sodic-calcic amphibole

Sodic-calcic amphiboles occur in the jadeitite of OsaJd2, and they are classified into magnesiokatophorite (Leake et al., 1997). Mg/(Mg+Fe) is high with 0.92, and Ca ranges from 0.98 to 1.36 (O = 23).

Conclusions

(1) Two loosed blocks of jadeitite form the Osayama area in the Sangun metamorphic belt have been described. Wollastonite and albite are newly described in the jadeitite (OsaJd) associated with jadeite, pectolite, grossular, and analcite. Magnesiokatophorite has been described from the jadeitite (OsaJd2), and it is associated with jadeite, omphacite, diopside, phlogopite, rutile and titanite.

(2) The clinopyroxenes from the jadeitite (OsaJd) are classified into jadeite, omphacite and diopside. The compositional ranges of the gaps between jadeite and omphacite and omphacite and diopside have been revealed. Based on the textural relationship a successive formation of clinopyroxenes from jadeite through omphacite and up to diopside is recognized.

(3) Relatively Ca-rich minerals such as diopside, wollastonite, pectolite and grossular occur along the cracks within the matrix consisting mainly of jadeites, suggesting later stage Carich fluid infiltration and subsequent participation of such Ca-rich minerals.

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日本語要旨

三郡変成帯大佐山地域産ひすい輝石岩の 構成鉱物の共生関係と化学組成

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三郡変成帯(周防帯)中の大佐山超苦鉄質岩体に由来すると考えられるひすい輝石岩転石 (OsaJd と OsaJd2)の記載岩石学的研究と,構成鉱物の化学組成の分析を行った. OsaJd の ひすい輝石岩からは珪灰石と曹長石がひすい輝石,ペクトライト,グロシュラー,方フッ石 とともに見いだされた. OsaJd2からはマグネシオカタフォライトがひすい輝石,オンファ ス輝石,透輝石,金雲母,ルチル,チタナイトとともに共生するのが見つかった. OsaJd2 の単斜輝石はひすい輝石,オンファス輝石,透輝石で,それぞれの間の組成はギャップとな っている. 組織より,ひすい輝石が最初で,その後オンファス輝石,最後に透輝石が形成さ れたことがわかる.

透輝石, 珪灰石, ペクトライト, グロシュラーなどのカルシウムに富む鉱物は, ひすい輝 石集合体からなるマトリックス中の割れ目に沿って形成されており, ひすい輝石岩が形成さ れた後のカルシウムに富む流体の浸透によって, これらの鉱物が形成されたと考えられる.