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**Study of Dioritic Intrusion and Pyroxenitic and Andesitic Xenoliths
from SW of Sorkh Shad (NE of Isfahan Province)**

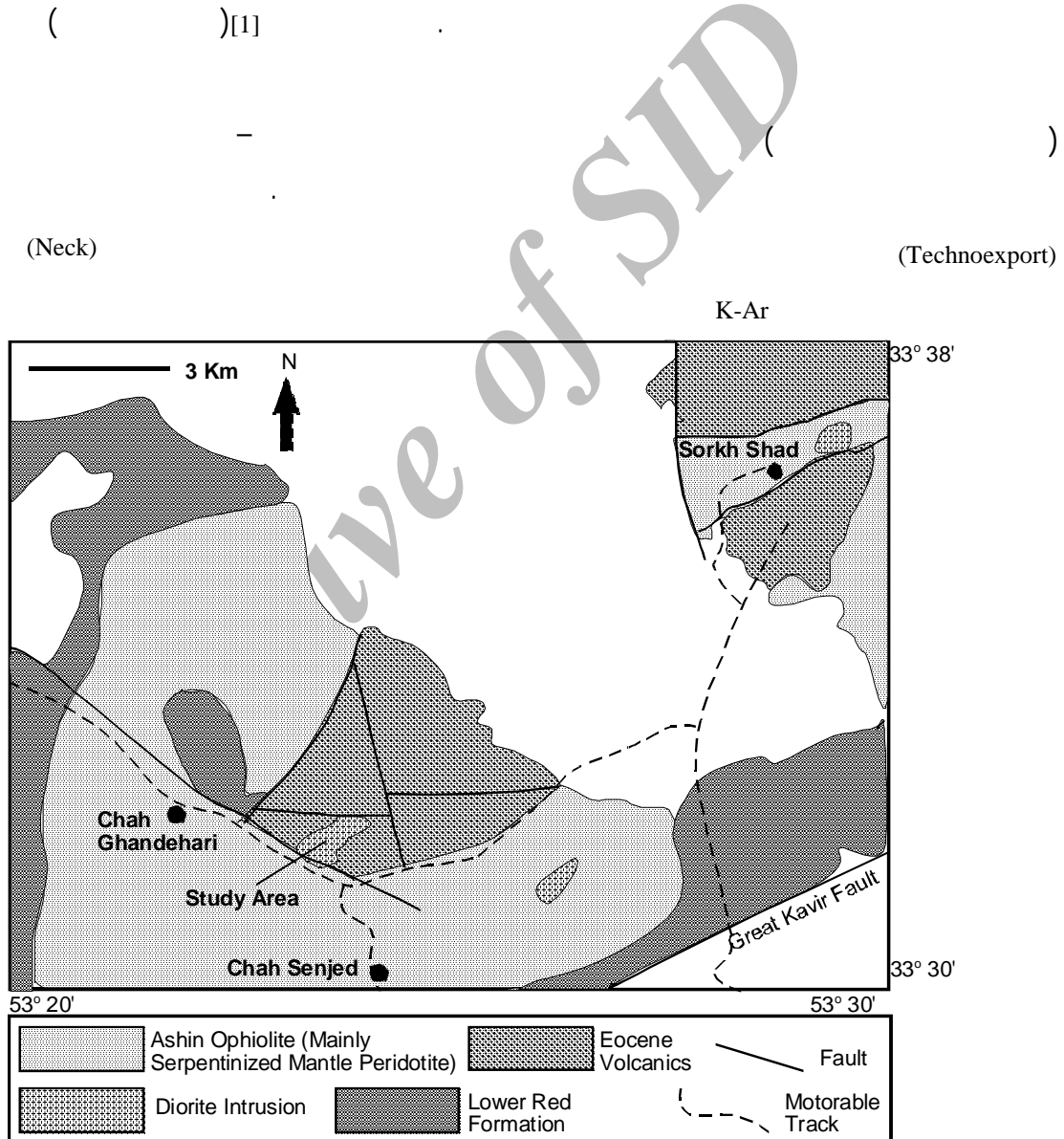
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Abstract

There are outcrops of Lower-Oligocene dioritic intrusions in south west of Sorkh Shad (NE of Isfahan province). One of these intrusions that is near to Chah Senjed and Chah Ghandehari, has many andesitic and pyroxenitic xenoliths. Studies conclude that these xenoliths are separated from wall rock during the melt ascending and carried to upper parts. Because of similar composition of andesitic xenoliths and ascending dioritic melt, the andesitic xenoliths are intact but a chemical potential gradient was established between the dioritic melt and ultrabasic xenoliths and calcium and aluminum added to xenoliths for new minerals and pyroxenite formation. The possible temperature of pyroxenites formation was 790 to 850 °C.

Keywords: Dioritic Intrusion, Xenolith, Eocene volcanic rocks, Pyroxenite



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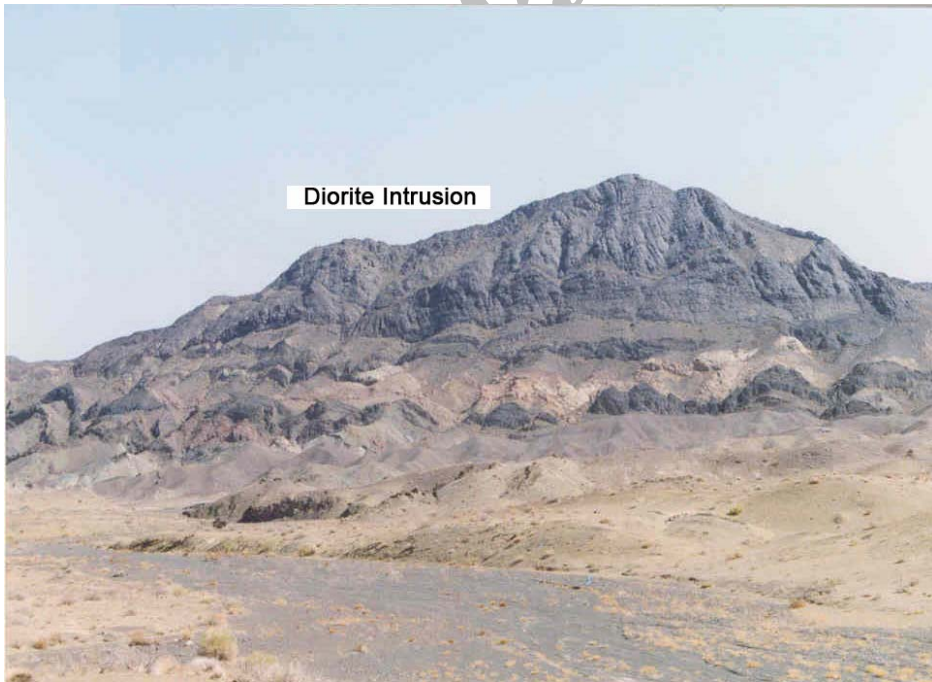
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(NAA)

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JEOL

20

JXA-8800 (WDS)

EPMA

12 nA

kV

[3, 4]

Fe³⁺

DO1, 214, 215

212

XUltra X215

51

211

XUltra X215

Al₂O₃ TiO₂ ()

Sample	DO1	215	214	X215	XUltra	211	212	51
SiO ₂	60.20	55.13	61.60	45.04	40.77	58.43	59.90	53.08
TiO ₂	0.47	1.28	0.42	2.07	2.75	0.72	0.83	0.67
Al ₂ O ₃	18.10	16.22	17.20	7.50	10.60	16.99	17.90	17.61
Fe ₂ O ₃ *	4.07	8.91	3.60	17.40	17.69	6.71	5.09	4.16
MnO	0.14	0.18	0.12	0.23	0.35	0.16	0.17	0.09
MgO	1.49	2.55	1.70	7.83	10.24	1.58	2.25	6.76
CaO	5.62	9.07	6.09	17.95	13.74	8.23	5.51	15.27
Na ₂ O	5.16	3.92	4.64	1.08	2.13	3.87	5.11	1.15
K ₂ O	2.59	1.81	2.59	0.30	0.63	1.83	2.41	0.86
LOI	2.16	0.93	1.99	0.59	1.11	1.50	0.86	0.36
Cr	99	30	3	121	70	2	4	1000
Co	8	24	6	55	54	14	9	35
Sc	6	22	4	73	86	11	8	44

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V	99	290	81	671	579	165	134	164
Zn	77	108	64	160	175	98	82	50
As	1.63	1.00	1.23	3.64	1.00	7.00	4.80	0.50
Rb	88	54	80	-----	-----	43	51	-----
Cs	1.22	1.65	1.85	-----	-----	0.72	1.37	-----
Ba	436	388	364	-----	-----	317	274	-----
Sr	876	534	541	-----	-----	362	483	-----
Ta	0.35	0.49	0.48	-----	-----	0.20	0.36	-----
Hf	3.31	2.94	3.98	0.50	2.89	3.41	3.70	-----
Th	5.67	3.93	5.98	-----	-----	4.39	4.88	-----
U	1.45	0.50	2.02	-----	-----	0.40	1.28	-----
La	28.07	21.97	28.48	3.10	10.78	20.12	22.28	1.00
Ce	46.49	39.25	43.88	6.17	30.80	35.56	38.84	2.00
Nd	20.07	-----	-----	-----	-----	-----	-----	-----
Sm	4.33	4.37	3.44	2.50	7.75	4.14	3.80	0.17
Eu	1.36	1.62	1.26	0.82	2.15	1.44	1.46	0.14
Gd	4.93	-----	-----	1.84	6.17	-----	-----	-----
Tb	0.94	0.73	0.77	0.72	1.45	1.15	0.76	0.24
Dy	4.09	4.07	3.28	4.48	6.49	4.43	5.15	0.79
Ho	0.52	-----	-----	-----	1.23	1.15	-----	-----
Tm	0.59	0.74	-----	0.96	0.72	0.59	0.61	0.10
Yb	2.68	2.49	3.33	1.44	3.49	3.56	3.55	0.30
Lu	0.46	0.42	0.48	0.28	0.64	0.52	0.57	0.10

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جدول شماره ۲- نتایج آنالیز نقطه ای کانی های موجود در توده دیوریتی نفوذی و زینولیت های آن. ترتیب ارایه نتایج بصورت دیوریت نفوذی (A)، زینولیت های اولترا بازیک (B)،

و زینولیت های ولکانیک ائوسن (C) است.

Sample	Mineral	SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	FeO*	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	NiO	Total %	
A	26	Plagioclase	54.93	0.02	28.13	0.00	0.41	0.03	10.60	5.20	0.34	0.09	0.00	99.77	
	27	Plagioclase	55.49	0.01	27.59	0.02	0.36	0.00	9.70	5.66	0.38	0.04	0.00	99.28	
	28	Plagioclase	54.95	0.00	28.01	0.00	0.40	0.02	10.56	5.19	0.33	0.10	0.00	99.59	
	29	Plagioclase	54.97	0.05	27.94	0.05	0.39	0.02	10.19	5.28	0.35	0.07	0.01	99.33	
	30	Plagioclase	54.73	0.03	27.69	0.03	0.41	0.01	10.27	5.24	0.36	0.10	0.00	98.92	
	31	Clinopyroxene	52.91	0.33	1.44	0.00	8.23	0.75	13.91	22.23	0.35	0.01	0.22	0.00	100.37
	32	Plagioclase	58.51	0.06	25.35	0.00	0.44	0.01	0.06	7.61	6.74	0.63	0.07	0.00	99.46
	33	Biotite	37.63	5.93	13.76	0.00	12.11	0.12	16.62	0.02	0.62	8.97	0.00	0.00	95.77
	34	Clinopyroxene	53.12	0.14	0.93	0.00	9.24	1.22	12.94	22.09	0.43	0.02	0.21	0.00	100.34
	35	Biotite	37.60	6.15	13.67	0.00	12.58	0.14	16.10	0.06	0.75	8.82	0.01	0.02	95.90
	36	Plagioclase	58.91	0.00	25.66	0.03	0.35	0.00	0.02	7.56	6.77	0.53	0.06	0.01	99.89
	37	Biotite	35.07	5.37	15.02	0.04	14.22	0.22	17.13	0.15	0.44	5.92	0.01	0.00	93.60
	38	Clinopyroxene	53.28	0.26	0.78	0.00	7.15	0.51	14.65	21.88	0.58	0.02	0.18	0.01	99.30
B	40	Plagioclase	53.13	0.05	29.42	0.00	0.52	0.00	11.91	4.31	0.27	0.08	0.01	99.74	
	44	Biotite	36.59	5.40	13.61	0.03	13.24	0.21	15.87	0.14	0.59	7.52	0.00	93.19	
	46	Plagioclase	58.60	0.07	25.65	0.03	0.50	0.02	7.62	6.63	0.58	0.07	0.00	99.79	
	48	Plagioclase	55.04	0.03	27.80	0.00	0.46	0.02	10.52	5.26	0.34	0.08	0.01	99.61	
	49	Clinopyroxene	52.48	0.64	2.30	0.01	7.34	0.40	14.65	21.36	0.40	0.00	0.19	0.01	99.78
	50	Biotite	37.42	6.00	13.71	0.00	13.27	0.16	15.54	0.02	0.78	8.72	0.00	0.00	95.62
	39	Magnetite	0.05	2.74	1.16	0.02	88.03	0.30	0.61	0.06	0.00	0.02	0.00	0.00	92.99
	41	Clinopyroxene	49.94	0.69	3.53	0.00	9.44	0.56	12.10	21.90	0.73	0.02	0.17	0.02	99.08
	42	Clinopyroxene	51.73	0.57	2.83	0.00	8.47	0.39	13.24	22.37	0.66	0.01	0.17	0.00	100.44
	43	Clinopyroxene	52.94	0.43	1.58	0.02	7.45	0.56	15.36	20.46	0.46	0.00	0.15	0.01	99.41
	45	Clinopyroxene	50.57	0.81	3.62	0.10	6.70	0.11	14.90	22.01	0.35	0.02	0.20	0.01	99.39
	47	Biotite	33.94	4.55	15.20	0.03	14.65	0.29	17.43	0.20	0.36	4.51	0.00	0.01	91.15

ادامه جدول شماره ۲. نتایج آنالیز نقطه ای کانی های موجود در توده دیوریتی نفوذی و زینولیت های آن. ترتیب ارایه نتایج بصورت دیوریت نفوذی (A)، زینولیت های اولترابازیک (B)، و زینولیت های ولکانیک ائوسن (C) است.

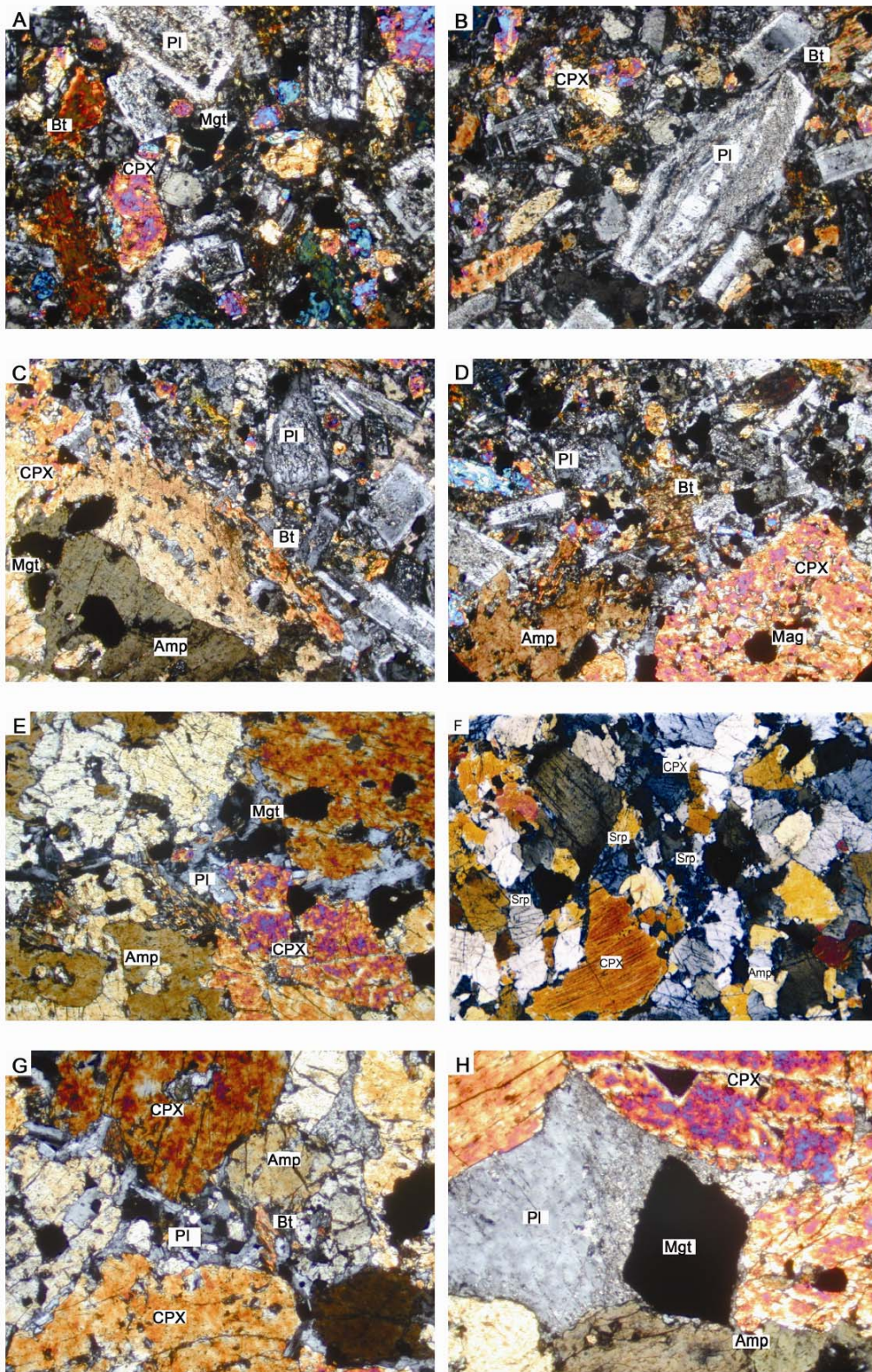
Sample	Mineral	SiO ₂	TiO ₂	Al ₂ O ₃	Cr ₂ O ₃	FeO*	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	NiO	Total %	
ادامه B	51	Amphibole	40.16	2.55	13.97	0.00	14.22	0.30	11.28	11.59	2.53	0.11	0.01	97.73	
	52	Clinopyroxene	49.30	0.88	5.14	0.00	7.44	0.16	13.31	22.30	0.36	0.20	0.00	99.11	
	53	Amphibole	40.06	2.34	13.80	0.00	11.10	0.16	13.10	11.69	2.45	1.29	0.12	0.00	96.10
	54	Clinopyroxene	49.97	0.77	4.07	0.00	8.14	0.20	12.75	22.58	0.31	0.01	0.17	0.00	98.97
	55	Plagioclase	54.74	0.03	27.90	0.04	0.24	0.00	0.03	10.28	5.20	0.32	0.06	0.00	98.83
	56	Amphibole	41.41	2.85	12.67	0.00	13.55	0.20	11.93	11.26	2.57	1.10	0.11	0.00	97.65
	57	Clinopyroxene	49.83	0.98	4.37	0.00	8.68	0.21	12.50	22.21	0.54	0.02	0.21	0.00	99.56
	58	Amphibole	40.77	2.42	13.83	0.00	11.41	0.11	13.59	11.85	2.38	1.26	0.09	0.01	97.73
	59	Amphibole	40.48	2.35	13.92	0.00	11.19	0.15	13.53	11.84	2.29	1.27	0.09	0.00	97.11
	60	Plagioclase	47.02	0.03	33.54	0.00	0.46	0.00	0.01	16.66	1.70	0.06	0.13	0.00	99.62
	61	Plagioclase	47.74	0.00	33.13	0.00	0.51	0.00	0.04	15.82	2.04	0.07	0.18	0.01	99.54
	62	Amphibole	40.77	2.43	14.20	0.00	11.53	0.15	13.62	11.75	2.53	1.10	0.05	0.00	98.12
	63	Clinopyroxene	48.18	1.10	6.07	0.05	8.23	0.19	12.32	22.39	0.40	0.00	0.23	0.01	99.17
	64	Amphibole	40.46	2.44	14.11	0.05	11.71	0.16	13.20	11.67	2.40	1.08	0.13	0.00	97.40
	C	66	Plag in	59.90	0.01	25.81	0.03	0.26	0.01	0.02	7.06	7.41	0.52	0.02	101.05
		67	Plag out	61.28	0.00	24.87	0.00	0.24	0.01	0.00	5.91	8.07	0.69	0.00	101.08
82		Plagioclase	55.12	0.05	28.05	0.00	0.40	0.01	0.02	9.88	5.63	0.31	0.00	99.46	
83		Amphibole	41.10	2.73	11.78	0.00	15.15	0.51	10.84	11.37	2.48	1.17	0.00	97.14	
84		Plagioclase	56.40	0.02	27.29	0.00	0.32	0.02	0.02	9.01	6.05	0.35	0.00	99.49	
85	Clinopyroxene	50.38	0.58	3.01	0.00	9.18	0.65	12.07	21.82	0.64	0.01	0.00	98.35		

جدول شماره ۳- نتایج محاسبه فرمول ساختاری کانی های جدول شماره ۲.

Sample	Mineral	Oxyg	Si	Ti	Al	Cr	Fe ⁺²	Fe ⁺³	Mn	Mg	Ca	Na	K	P	Ni	Total	
A	26	Plagioclase	8	2.49	0.00	1.50	0.00	0.02	0.00	0.00	0.51	0.46	0.02	0.00	0.00	4.99	
	27	Plagioclase	8	2.52	0.00	1.47	0.00	0.01	0.00	0.00	0.47	0.50	0.02	0.00	0.00	5.00	
	28	Plagioclase	8	2.49	0.00	1.49	0.00	0.02	0.00	0.00	0.51	0.46	0.02	0.00	0.00	4.99	
	29	Plagioclase	8	2.50	0.00	1.49	0.00	0.02	0.00	0.00	0.50	0.47	0.02	0.00	0.00	4.99	
	30	Plagioclase	8	2.50	0.00	1.49	0.00	0.02	0.00	0.00	0.50	0.46	0.02	0.00	0.00	4.99	
	31	Clinopyroxene	6	1.97	0.01	0.06	0.00	0.25	0.01	0.02	0.77	0.89	0.03	0.00	0.00	4.00	
	32	Plagioclase	8	2.64	0.00	1.34	0.00	0.02	0.00	0.00	0.00	0.37	0.59	0.04	0.00	4.99	
	33	Biotite	22	5.02	0.60	2.16	0.00	1.35	0.00	0.01	3.31	0.00	0.16	1.53	0.00	0.00	14.14
	34	Clinopyroxene	6	1.99	0.00	0.04	0.00	0.28	0.01	0.04	0.72	0.89	0.03	0.00	0.00	0.00	4.00
	35	Biotite	22	5.02	0.62	2.15	0.00	1.41	0.00	0.02	3.21	0.01	0.19	1.50	0.00	0.00	14.13
36	Plagioclase	8	2.64	0.00	1.35	0.00	0.01	0.00	0.00	0.00	0.36	0.59	0.03	0.00	0.00	4.99	
37	Biotite	22	4.78	0.55	2.41	0.00	1.62	0.00	0.03	3.48	0.02	0.12	1.03	0.00	0.00	14.03	
38	Clinopyroxene	6	1.99	0.01	0.03	0.00	0.20	0.02	0.02	0.82	0.87	0.04	0.00	0.00	0.00	4.00	
40	Plagioclase	8	2.41	0.00	1.57	0.00	0.02	0.00	0.00	0.00	0.58	0.38	0.02	0.00	0.00	4.99	
44	Biotite	22	5.02	0.56	2.20	0.00	1.52	0.00	0.02	3.25	0.02	0.16	1.32	0.00	0.00	14.06	
46	Plagioclase	8	2.63	0.00	1.36	0.00	0.02	0.00	0.00	0.00	0.37	0.58	0.03	0.00	0.00	4.98	
48	Plagioclase	8	2.49	0.00	1.48	0.00	0.02	0.00	0.00	0.00	0.51	0.46	0.02	0.00	0.00	4.99	
49	Clinopyroxene	6	1.95	0.02	0.10	0.00	0.23	0.00	0.01	0.81	0.85	0.03	0.00	0.00	0.00	4.00	
50	Biotite	22	5.03	0.61	2.17	0.00	1.49	0.00	0.02	3.11	0.00	0.20	1.50	0.00	0.00	14.13	
B	39	Magnetite	4	0.00	0.08	0.05	0.00	1.03	1.79	0.01	0.04	0.00	0.00	0.00	0.00	3.00	
	41	Clinopyroxene	6	1.89	0.02	0.16	0.00	0.21	0.09	0.68	0.89	0.05	0.00	0.00	0.00	4.00	
	42	Clinopyroxene	6	1.92	0.02	0.12	0.00	0.21	0.06	0.73	0.89	0.05	0.00	0.00	0.00	4.00	
	43	Clinopyroxene	6	1.97	0.01	0.07	0.00	0.23	0.00	0.85	0.82	0.03	0.00	0.00	0.00	4.00	
	45	Clinopyroxene	6	1.88	0.02	0.16	0.00	0.15	0.06	0.83	0.88	0.03	0.00	0.00	0.00	4.00	
47	Biotite	22	4.73	0.48	2.49	0.00	1.71	0.00	0.03	3.62	0.03	0.10	0.80	0.00	0.00	13.99	

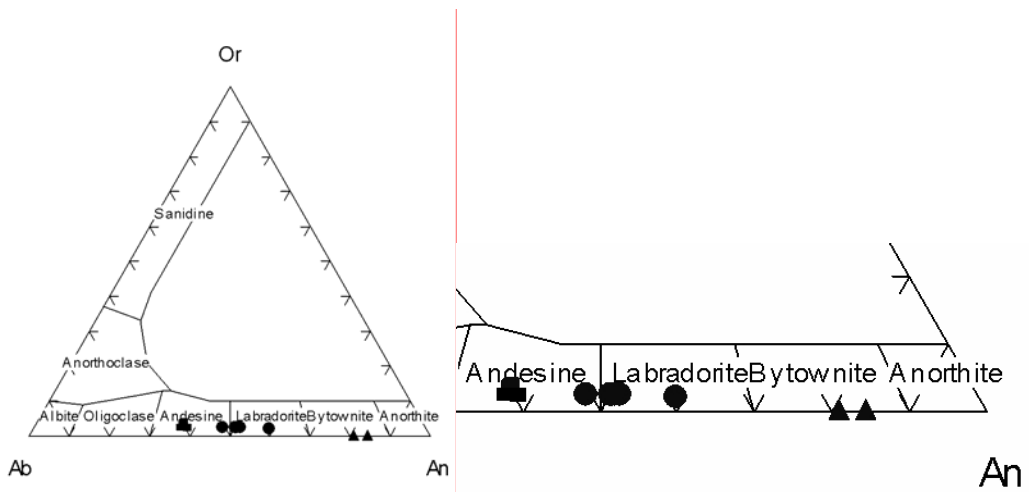
ادامه جدول شماره ۳- نتایج محاسبه فرمول ساختاری کانی های جدول شماره ۲.

Sample	Mineral	Oxyg	Si	Ti	Al	Cr	Fe ²	Fe ³	Mn	Mg	Ca	Na	K	P	Ni	Total	
ادامه B	51	Amphibole	23	5.97	2.45	0.00	1.33	0.44	0.04	2.50	1.85	0.73	0.19	0.00	0.00	15.77	
	52	Clinopyroxene	6	1.85	0.23	0.00	0.17	0.06	0.01	0.74	0.90	0.03	0.00	0.00	0.00	4.00	
	53	Amphibole	23	5.99	2.43	0.00	1.01	0.38	0.02	2.92	1.87	0.71	0.25	0.00	0.00	15.83	
	54	Clinopyroxene	6	1.88	0.02	0.18	0.23	0.03	0.01	0.72	0.91	0.02	0.00	0.00	0.00	4.00	
	55	Plagioclase	8	2.50	0.00	1.50	0.01	0.00	0.00	0.00	0.50	0.46	0.02	0.00	0.00	4.99	
	56	Amphibole	23	6.13	0.32	2.21	0.00	1.31	0.37	0.03	2.63	1.79	0.74	0.21	0.00	0.00	15.73
	57	Clinopyroxene	6	1.87	0.03	0.19	0.00	0.22	0.05	0.01	0.70	0.89	0.04	0.00	0.00	0.00	4.00
	58	Amphibole	23	5.97	0.27	2.39	0.00	0.89	0.51	0.01	2.97	1.86	0.68	0.24	0.00	0.00	15.77
	59	Amphibole	23	5.96	0.26	2.41	0.00	0.86	0.52	0.02	2.97	1.87	0.65	0.24	0.00	0.00	15.76
	60	Plagioclase	8	2.17	0.00	1.82	0.00	0.02	0.00	0.00	0.00	0.82	0.15	0.00	0.00	0.00	4.99
61	Plagioclase	8	2.20	0.00	1.80	0.00	0.02	0.00	0.00	0.00	0.78	0.18	0.00	0.00	0.00	4.98	
62	Amphibole	23	5.93	0.27	2.43	0.00	0.80	0.60	0.02	2.95	1.83	0.71	0.20	0.00	0.00	15.75	
63	Clinopyroxene	6	1.81	0.03	0.27	0.00	0.19	0.07	0.01	0.69	0.90	0.03	0.00	0.00	0.00	4.00	
64	Amphibole	23	5.94	0.27	2.44	0.01	0.86	0.58	0.02	2.89	1.84	0.68	0.20	0.00	0.00	15.72	
C	66	Plag in	8	2.65	0.00	1.35	0.00	0.01	0.00	0.00	0.34	0.64	0.03	0.00	0.00	5.01	
	67	Plag out	8	2.70	0.00	1.29	0.00	0.01	0.00	0.00	0.28	0.69	0.04	0.00	0.00	5.01	
	82	Plagioclase	8	2.50	0.00	1.50	0.00	0.02	0.00	0.00	0.48	0.50	0.02	0.00	0.00	5.01	
	83	Amphibole	23	6.19	0.31	2.09	0.00	1.62	0.29	0.06	2.44	1.84	0.72	0.22	0.00	0.00	15.78
	84	Plagioclase	8	2.55	0.00	1.45	0.00	0.01	0.00	0.00	0.44	0.53	0.02	0.00	0.00	0.00	5.00
85	Clinopyroxene	6	1.92	0.02	0.14	0.00	0.24	0.05	0.02	0.68	0.89	0.05	0.00	0.00	0.00	4.00	

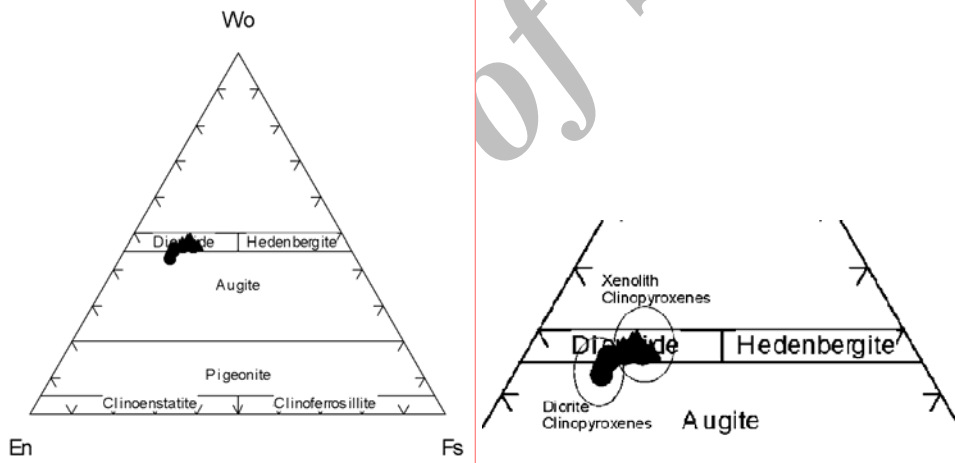


شکل شماره ۳- تصاویر میکروسکوپی توده نفوذی دیوریتی (A, B)، زون کنتاکت با زینولیت های پیروکسنیتی (C, D)، و زینولیت های پیروکسنیتی (E, F, G, H) (X25, XPL).

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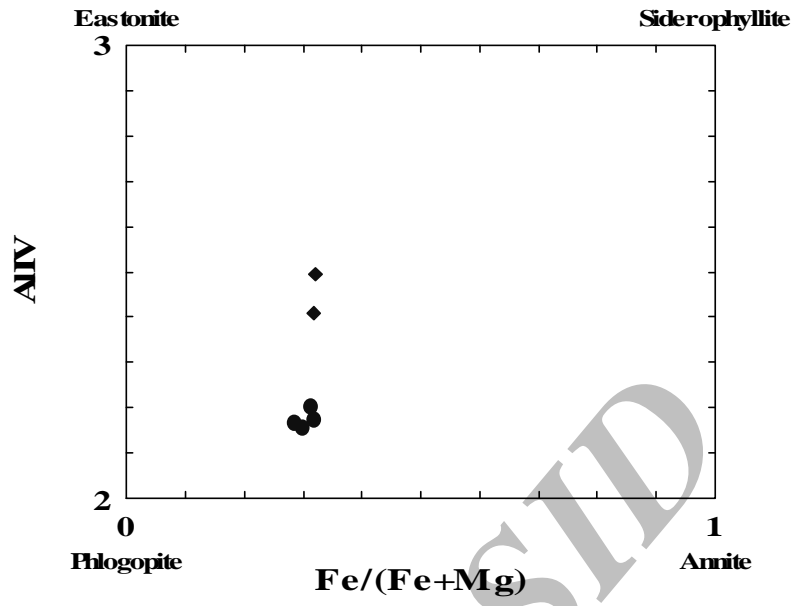
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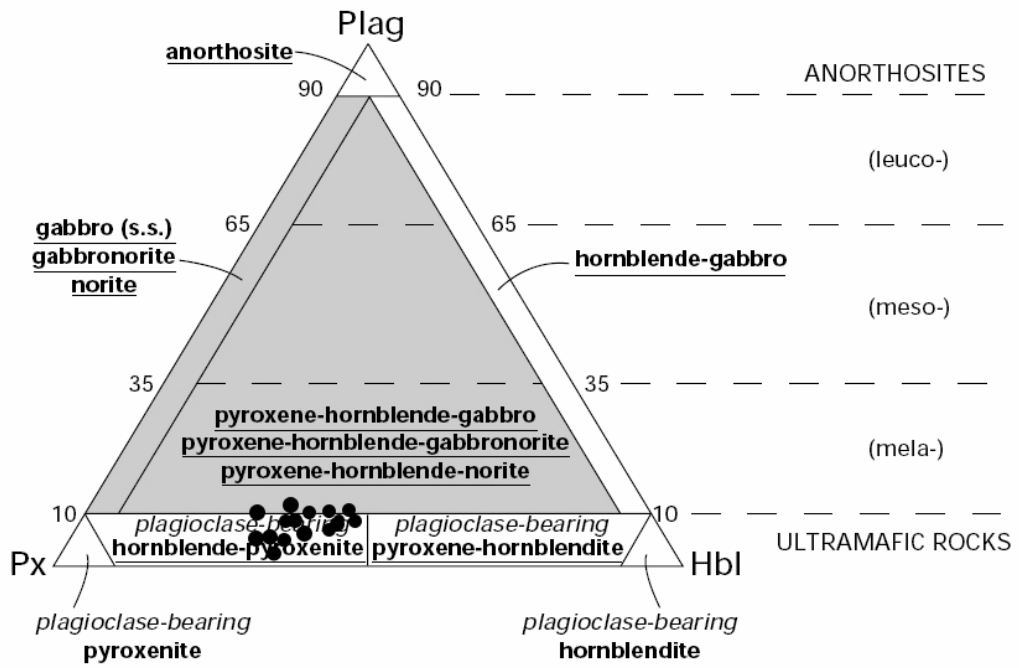
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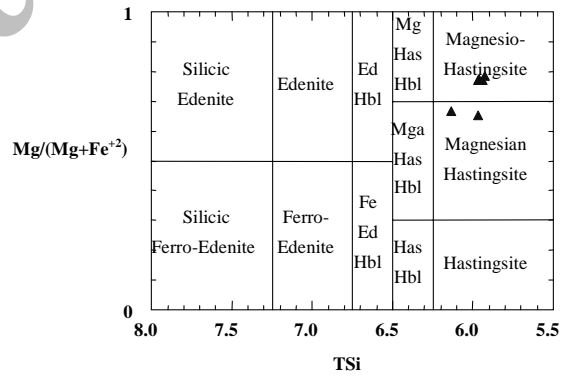
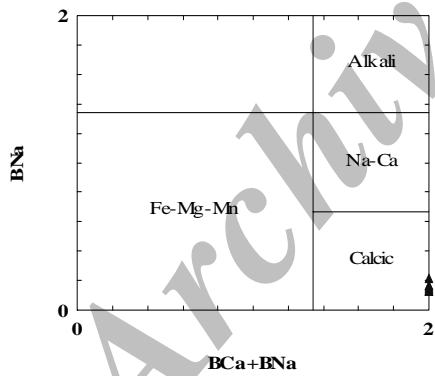
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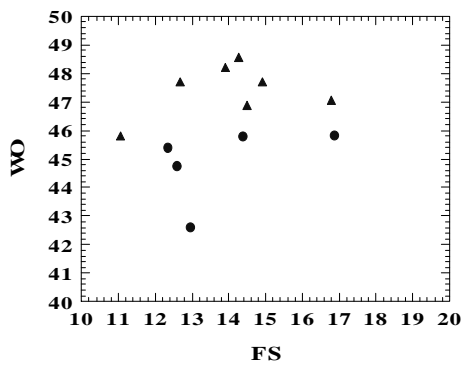
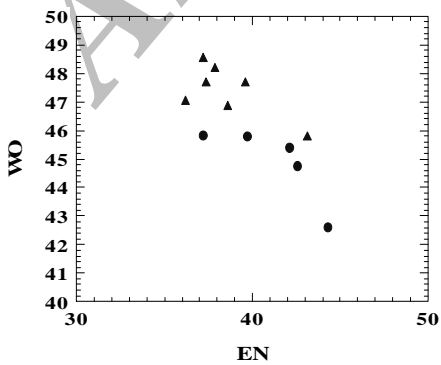
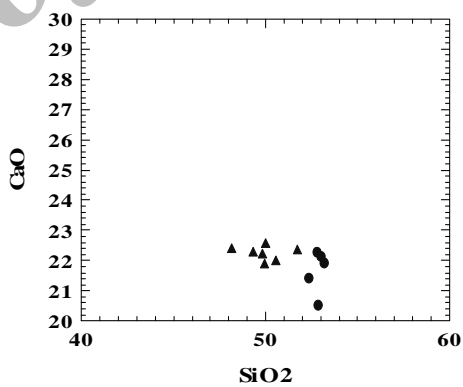
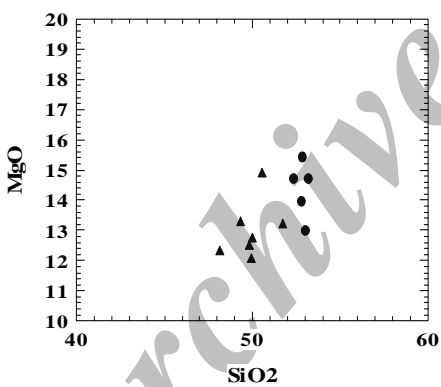
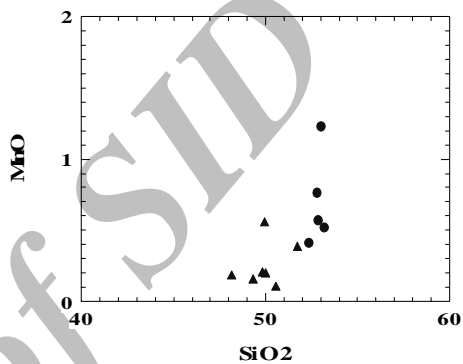
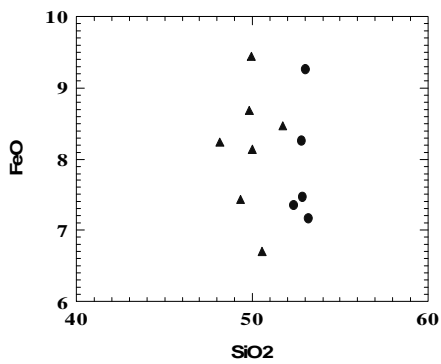
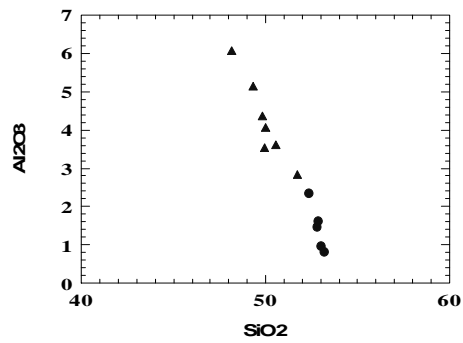
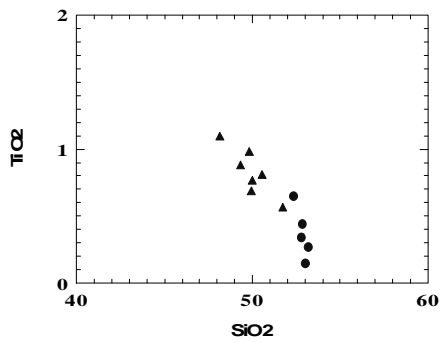
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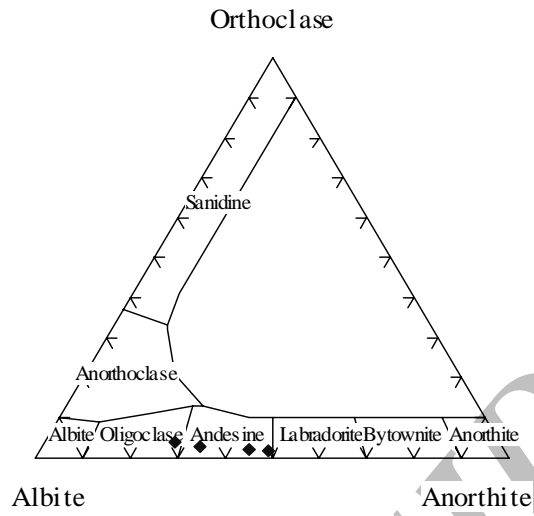
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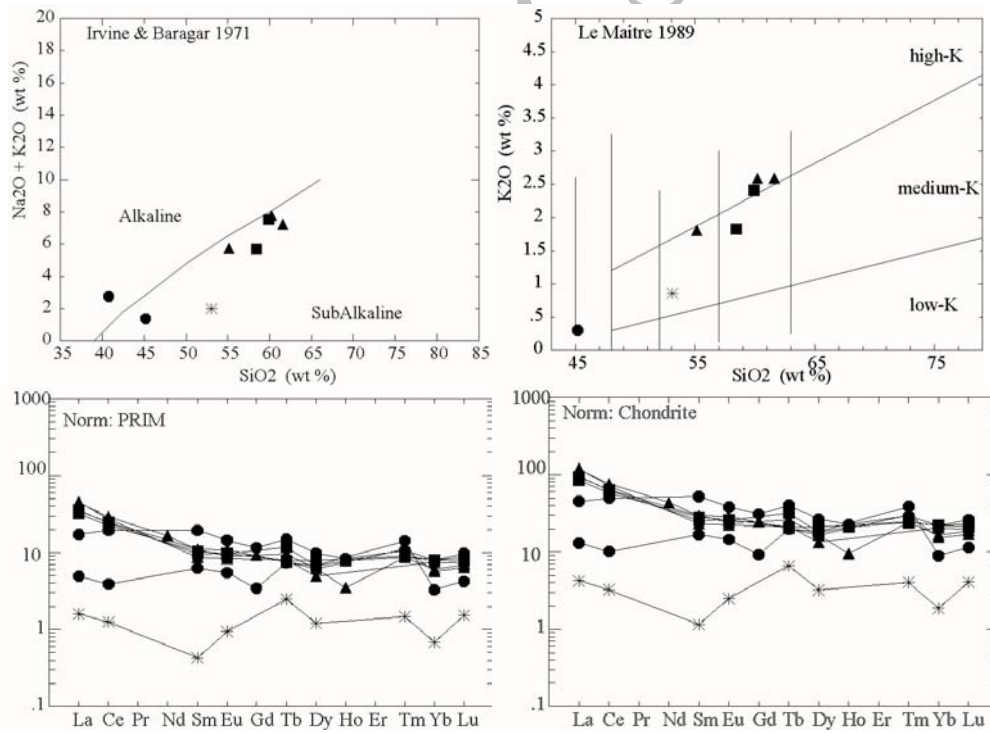
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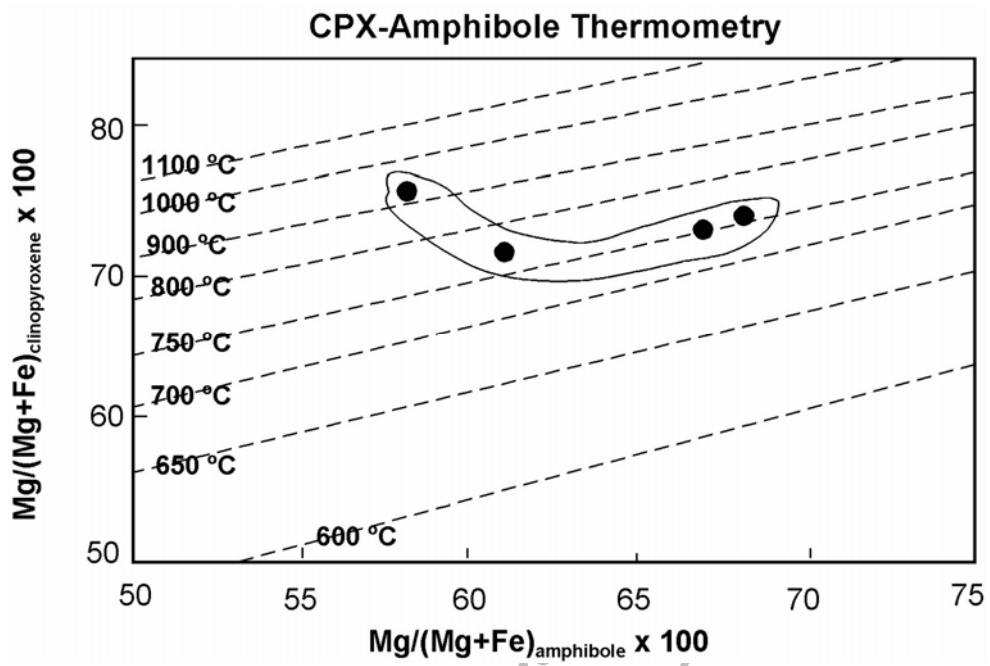
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