

.



(Slack et al, 1984, Henry and Guidotti, 1985)

((O,OH) . NAA (Nicholson, 1980, .Slack, 1982, Willner, 1992) .(Slack, 1982) % .(Henry and Guidotti, 1985) (Leeman and Sisson, 1996, .Sperlich et al, 1996) .() .(Torres- Ruiz et al., 2003) .() Olympus BH2 : :) Cameca SX50





.**(a)**

.(b)

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	تورمالينيت استراتي فرم				سنگھای پگماتیتی					رگەھاي كوارتز- تورمالين								
SiO ₂	179/97	1°V/10	۲۷/۱۲	۳۷/۰۹	15/01	rv/1r	۲۷/۰۳	10/01	۳۷/۰۷	TV/90	19/91	19/91	17/17	1.1/.4	rv/•r	36/68	36/08	19.00
TiO ₂	•/97	•/**	•/*A	•/11	•/9V	٠/٢٨	•/9V	•/٧1	•/179	• /9 •	•/09	•/97	•/17	•/11	•/10	•/٢٢	•/91	1/19
Al ₂ O ₃	۲۳/۸۰	177/99	177/71	14/+1	177/9/	117/70	177/99	דד/דד	TT/A¥	177/41	177/97	177/10	177/19	177/00	TT/9A	17/19	177/01	11/01
FeO	٧/٢٢	N01	V/YO	٧/•۶	V/90	٧/٩٨	AVY	9/17	9/1A	91.9	8/14	۲۸\Y	81.9	F/TT	9/•9	\$/1¥	٩/•٨	NAY
MgO	1/10	۲/۸۶	17/47	1/11	¥/•V	۳/۸۹	17/99	۵/۳۳	۵/۰۳	0/1"7	0/11	¥/V.	0/91	۵/۸۳	8/17	۵/۳۷	۵/۰۵	۳/۸۳
CaO	•/1*9	1/11	•/*1	•/04	•/۴١	• <i>N</i> 9	•//M	•/90	•/99	• <i>/</i> \/*	•/9V	•/91	•/AY	•/٧٩	•/۵۸	1/•1	•/**	•/AY
MnO	•/•۵	•/•V			۰/۰۱۳	•/•۵	۰/۰۸	•/•V	•/•۵	•/•¥		•/•*		•/•۵	•/•٢		•/•Y	•/•9
Na ₂ O	۲/۳۱	1/40	۲/۲۹	1/01	۲/۰۱	۲/۱۷	1/51	۲/۳۱	۲/۲۶	۲/۰۹	1/1/	1/01	۲/۲۸	7/19	۲/۰۴	1/٨٣	1/41	7/97
K ₂ O	•/•)*	•/• ٢	•/•1	•/•٣	•/• ٢	•/•1	•/•¥	•/•1*	•/•*	•/• ٢	•/•٣	•/•1	۰/۰۴	•/•1	•/•1	•/• ٢	•/•1	•/•*
H ₂ O	۳/۶۷	۲/۶۴	۴/۶۸	۴/۶۶	۴/۶۶	٣/۶۵	۲%	۲/۷۰	۳/۶۸	۳/۶۸	۴/۶۷	۲/۶۲	ዮ/ቶለ	۴/۶۹	۳/۶۹	۳/۷	¥7/¥A	۴/۶۰
B ₂ O ₃	1./99	1./00	1./99	1./91	1.19.	1./09	1./00	1.//1	1./97	1.199	1./94	1./19	۱۰/۶۸	۱۰/۶۸	1./99	1•/V1	1./9.	1./99
Total	1/11	99/97	1/17	99/17	99/VA	99/91	99/109	1/*1	1++/+V	99/20	99/0V	99/91	1/11	1/11	1/.9	1/17	1/97	99/17
فرمول ساختماتی بر اساس (۲۱(O,OH																		
Si	0/9.41	9/119	91.01	91.49	9/.11	91.90	9/1+1	91.9.	91.9.	9/18.	9/.17	91.98	9/•OA	91.00	9/. 11	0/990	0/990	91
Al	•/• IV				Constant of											./0	./0	
В	۲/۰۰۰	۲/۰۰۰	۲/۰۰۰	۲/۰۰۰	17/	۲/۰۰۰	۲/۰۰۰	۳/۰۰۰	۲/۰۰۰	۴/۰۰۰	۲/۰۰۰	۲/۰۰۰	۲/۰۰۰	۴/۰۰۰	۳/۰۰۰	۴/۰۰۰	۴/۰۰۰	۲/۰۰۰
Al(Z)	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/	9/
Al(Y)	·/*9Y	.1.4.4	·/0Y1*	+/09A	·/09V	·/YY1	+/9++	·/٣٧1	·/*٩٨	·/170	·/#17	.110	•/1919	• / ۴۱۴۴	·/f09	·/۵۸۳	•/YYY	27111
Ti	./110	./.01	./.09	./.10	•/•At	./.10	•/• Al	•/•/٩	./. **	·/·YY	·/·Yř	·/·W	•/•٣٩	./.10	•/•1٨	·/· TV	•/111	•/191
Mg	1/•۸۴	•/9YA	•/9.01"	1/ *	•/990	·/90Y	•//49	1/190	1/111	1/191	1/1-4/	1/191	1/191	1/111	1/۴۸۴	1/177	1/117	1/14A
Mn	•/••V	+/+1+			•/••¥	•/••V	•/•11	•/•1•	۰/۰۰۷	•/••9		•/••9		•/••٧	•/••*		•/••٣	•/• 11
Fe	1/+ 19	1/174	1/+19	+/4.9V	1/+ 44	1/-90	1/1.4	۰/۸۳۰	·/٨٣٢	·/AY9	•///119	1/111	•///٢٩	•/A¥P	•/AY¥	• /٨٣٣	1/140	1/191
Y total	۲/۷۱۵	X1017	۲/۶۰۱	T/00¥	۲/۶۹۸	۲/۵۶۰	7/097	۲/۵۶۵	۲/۶۱۳	1/014	T/VYV	7/VAT	7/979	7/914	۲/۷۸۵	۲/۷۱۷	7/۸۷۲	7/770
Ca	•/•91	1/199	•/•VY	./.90	•/•VY	•/1178	•/100	•/111	•/11.	•/1YA	•/11V	•/1•٨	•/181	•/۱۳۸	•/1•1	•/179	•/•Vf	•/100
Na	·/VIT	•/977	·/V00	•/V9V	•/919	•/991	*/0T1	•/VTV	• <i>N</i> VV	•1991	·/00A	•/1991	•/\.	•/991	•/988	·/0V9	•/9•V	•/VA*
K	•/••9	•/••*	•/••٣	•/••*	•/••*	•/••*	•/••*	•/••9	•/••٨	•/••*	•/••9	•/•••	•/••\$	•/••*	•/••٣	•/••*	•/••٣	•/••٨
X total	•/٨•١	•/٨٢¥	•/٨٣١	•///1	·/Y10	•/ATV	•/979	•///19	•/٩٠٥	• /\41"	•/۶۸۱	•/9•1	•/٨۶٩	•/۸۳۱	·//¥9	·/Y09	•/۶۸۳	•/٩٣٧
X- Vac.	•/199	•/179	•/199	•/1•9	·/TAD	•/171	•/1"1"	•/101	•/•90	•/٢•٧	•/119	•/199	•/111	•/199	•/101	•/1111	•/ĩ°1V	•/•01
Fe/Fe +Mg	•/*^*	•/001*	•/019	./19.	•/011	•/010	•/077	•/*49	•/*•1	• /17.4	•/170	•/011	۰/٣٧٨	•/170	• /*OY	•/190	•/0•1	•/0•9
Na/Na +Ca	•/911	•/V91	•/911	·//\97	•//	•/ATV	•/٧٧١	•/٨٩٥	•/٨۶۶	•/٨٣٨	•/ATV	•///19	•////*	•/٨١٣	•/٨94	•/٧۶٧	•///٩١	•/٨٣٥

Mg

Al

(London and Manning, 1995) Fe

Al

Y

Li

Al in R_2

Ζ

∑(Fe+Mg)<3 .(f) . . R₂* (Henry and Guidotti, 1985, Pesquera and Velasco, Fe-Mg-Ca Fe-Mg-Al .1997)

Al Ca

Fe³⁺

C

.(Henry and Guidotti, 1985)

Mg Fe

Al

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(ppm)						
As	/	/	/	/	/	< /
W	/	/	/	< /	< /	<
Со	/	/	/	1	/	/
Cr						1
Zn	/	/		/	1	
Hf	/	/	/	1	1	1
Sc	/	/	/	/	Y	1
Та	/	/	/	< /	< /	< 1
Th	/	/	1	/		< /
U	1	/	1	< /	<	<
La	1	1	1	1	1	/
Ce		/	/	7	/	/
Nd	1	1	/	T	1	/
Sm	/	/		/	1	/
Eu	/		1	/	1	/
Tb	/		/	/	1	/
Tm		\mathcal{V}	/	1	/	/
Yb		1	/	1	/	/
Lu		1	/	1	/	/
∑REE		/	/	/	/	/
(La/Yb)N	/	/	/	/	/	/
(La/Sm)N	/	/	/	/	/	/

(Slack et al., 1984)

.(Gallagher, 1988)

(Torres-

(Slack et al., 1993)

Ruiz et al., 1996)

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(Slack et al., 1984, Plimer, 1988)

1 Exhalative





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LREE

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