MEMOIR GEOLOGICAL SOCIETY OF INDIA
No.33, 1995, pp.375-389

Geochemistry and Tectonic Significance of Acid and Basic Dykes Associated with Jalor Magmatism, West Rajasthan

N. KOCHHAR, S. DHAR AND RAJNI SHARMA
Department of Geology, Panjab University, Chandigarh - 160 014

ABSTRACT

The paper describes the petrology and chemistry of acid and basic dykes associated with Jalor magmatism. Chondrite normalised abundances of selected major and trace elements show that the mafic rocks resemble some rift-related quartz normative continental tholeiites. The rhyolite dyke samples appear to have originated from a source fairly enriched in Rb, K, La, Ce, Nd, Sm, Zr, Y, Yb. Role of halogens in concentrating elements such as Zr, Ga, Y and Zn is also discussed. It is suggested that the chemistry of basic dykes, and the ponding of the crust by basaltic magma coupled with extensional tectonic rift environment of the Malani terrain mark an abortive attempt by the Indian lithosphere to rift some 750 Ma ago.

INTRODUCTION

The Jalor Igneous Complex is a part of the Malani Igneous Suite (750 Ma) and is located on the southeastern side of the Siwana ring structure (30 km, east-west, 25 km north-south). The area is characterised by bimodal suites of peraluminous-peralkaline granite, rhyolite, gabbro and basalt with interrelationship between volcanism and plutonism.

LITHOLOGIC UNITS OF THE JALOR AREA

According to their stratigraphic position, the various rock types in the area can be broadly grouped as follows:

Dyke phase	-	Rhyolite and olivine dolerite.
Intrusive phase	-	Olivine gabbro, biotite hornblende granite, biotite granite, alkali granite.
Extrusive phase	-	Basalt and rhyolite.

The area is characterised by cauldron subsidence structure of volcanic rocks and is invaded by concordant intrusions of granite. A perusal of the geological map (Fig.1) indicates that the Jalor area

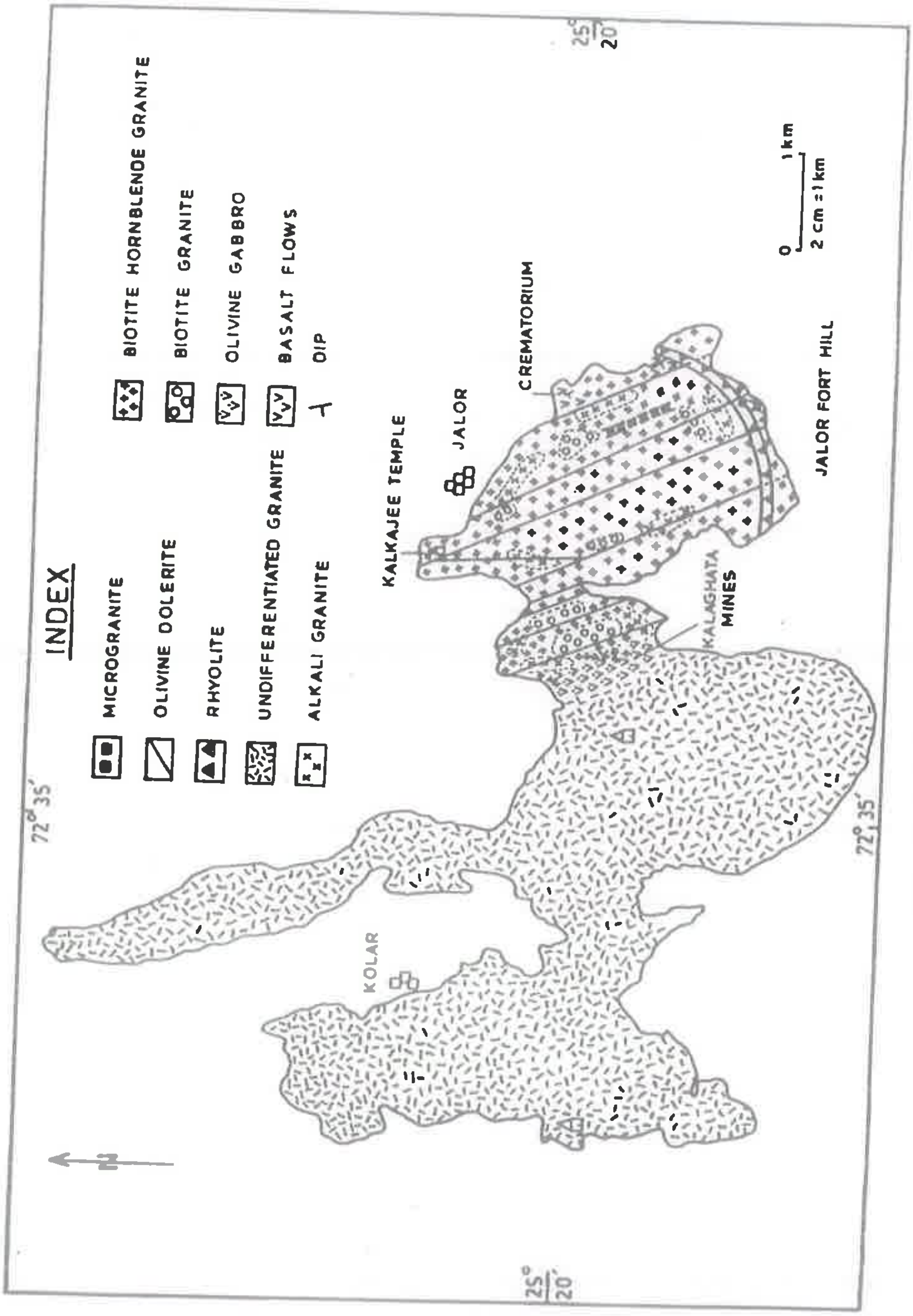

Fig.1. Geological map of the Jalor area, India.

forms two linked ring structures which overlap in the east-west direction. The eastern structure is marked by peripheral arcuate rhyolite dyke. Geological traverses in the adjoining Kolar area have shown the continuation of this rhyolite dyke in the western structure also. Besides, the Kolar area itself forms an arcuate structure. Both the ring structures are marked by number of granitic intrusions viz., biotite granite, alkali granite, emplaced as sheets in an arcuate fashion. The limits of outcrops lie along smooth arcuate lines and it is inferred that the whole complex is contained inside steep ring faults within which cauldron subsidence has taken place. There is no exposure of country rocks in the complex (Dhar, 1990).

FIELD CHARACTERS AND PETROGRAPHY OF THE DYKES

Rhyolite

Rhyolite occurs in the form of an arcuate band which intrudes the south side of the Jalor Fort hill and extends into the Kolar area. It is pink, yellowish pink and brownish blue in colour, and porphyritic. The phenocrysts of quartz and feldspars can be identified in hand specimen. At places it becomes non-porphyritic and shows flow structure. The average width of the dyke is 3m and the length is about 1 km in the Fort hill. The trend of the dyke is N70°E and S70°W and it dips away from the granite.

Olivine dolerite

Several dolerite dykes occur intruding granite and rhyolite in N15°W-S15°E direction. The rock is blackish green, medium grained and shows typical spheroidal weathering. The dykes form gullies because of differential weathering.

Olivine gabbro

This occurs on the western side of the Fort hill and predates the granite, as enclaves of gabbro occur in the adjacent granite. It is half a kilometer in length, 100 meters wide and trends in N10°W-S10°E direction.

Porphyritic varieties of rhyolites show phenocrysts and microcrystalline matrix. The non-porphyritic types usually exhibit flow and spherulitic textures. Minerals present are: alkali feldspar, quartz,

Table I. Major element analyses and CIPW norms for Jalor Dykes, W. Rajasthan

Rock	Rhyolite									Basalt			Olivine Dolerite		Olivine Gabbro	
Sample No.	$J1_3$	$J1_{4b}$	$J1_{12}$	$J1_{19}$	KO_8	JS_{21}	RS_1	RS	R	$J1_{13}$	K_{32}	J_{15}	I	JS_3	B_1	JS_{22}
Oxides																
SiO_2	69.81	73.25	72.83	71.35	74.18	72.53	73.09	68.75	72.27	48.35	49.65	51.85	50.71	49.29	52.58	52.08
TiO_2	0.17	0.20	0.08	0.66	0.67	0.45	0.07	0.47	0.31	2.16	1.87	1.33	2.15	1.75	1.79	2.17
Al_2O_3	11.48	10.63	11.20	12.15	11.91	13.76	12.78	13.71	11.31	18.32	17.69	16.27	19.14	18.94	19.64	18.35
Fe_2O_3	4.62	4.58	1.33	0.72	1.13	1.37	1.31	3.25	2.25	6.03	8.49	7.62	6.21	7.25	6.05	6.57
FeO	1.96	2.23	2.19	3.24	1.54	1.23	0.78	1.73	1.31	7.25	6.63	8.94	5.94	6.13	6.53	7.31
MnO	0.01	0.05	0.09	0.07	0.09	0.03	0.05	0.04	0.01	0.18	0.16	0.17	0.15	0.18	0.17	0.23
MgO	0.62	0.38	0.46	1.34	1.45	0.15	0.31	0.64	0.97	2.46	1.97	2.11	2.81	2.73	1.49	1.71
CaO	0.60	0.30	0.06	0.09	0.01	0.43	0.38	0.37	0.51	7.23	6.82	6.11	6.36	7.01	5.25	5.43
Na_2O	4.20	3.47	3.81	3.29	3.54	3.71	3.51	4.12	4.05	3.22	2.66	2.65	3.41	3.03	3.25	3.22
K_2O	5.20	3.46	5.53	4.15	3.53	4.72	5.21	5.36	5.13	1.50	0.75	0.42	0.69	1.50	0.81	0.73
P_2O_5	0.09	0.05	0.16	0.02	0.01	0.03	0.80	0.03	0.02	0.48	0.49	0.51	0.61	0.47	0.36	0.44
H_2O^+	1.58	1.68	2.34	1.84	1.67	1.68	1.94	1.86	1.97	1.96	2.21	2.35	2.15	1.58	1.67	1.86
Total	100.34	100.28	100.08	98.92	99.73	100.79	100.23	100.33	100.11	99.14	99.39	100.33	100.32	99.86	99.59	100.10
CIPW Norms																
Q	24.87	44.54	28.73	30.93	51.42	31.62	33.57	22.61	27.62	4.10	14.06	16.27	11.02	6.92	16.14	15.41
C	-	2.39	-	1.06	5.81	1.84	2.59	0.53	-	-	1.28	1.56	2.70	0.71	4.72	3.44
Ab	30.10	2.54	32.68	24.53	20.86	27.89	30.79	31.68	30.32	8.86	4.43	2.48	4.08	8.86	4.79	4.31
An	-	1.17	-	3.21	-	1.94	-	1.63	-	31.11	30.63	27.00	27.52	37.71	23.69	24.06
En	1.48	1.01	5.20	7.74	4.57	0.81	1.10	1.59	2.70	1.57	7.28	13.50	9.50	9.51	8.06	9.10
Mt	4.30	6.64	0.46	1.04	1.64	1.99	1.90	4.35	1.21	8.74	12.31	11.05	9.00	10.51	8.77	9.53
Il	0.32	0.38	0.16	1.25	1.27	0.85	0.13	0.89	0.59	4.10	3.55	2.53	4.08	3.32	3.40	4.12
Ap	0.20	0.11	0.36	0.45	0.27	0.07	1.85	0.07	0.04	1.11	1.14	1.17	1.41	1.09	0.83	1.02
Ratios																
DI	85.70	85.98	88.23	83.30	85.31	90.90	94.06	89.15	87.56	40.21	41.10	41.17	43.95	41.42	48.43	46.97
AI	1.07	0.88	1.09	0.82	0.81	0.82	0.88	0.91	1.08	0.37	0.28	0.29	0.32	0.34	0.31	0.33
OR	69.56	75.30	36.12	16.66	40.34	50.34	62.92	92.30	61.12	43.12	53.58	43.68	49.12	51.78	46.10	44.86

hornblende, biotite, aegirine and riebeckite. The accessories are zircon, fluorite, apatite and iron oxides.

Olivine dolerite

The rock is medium grained. The plagioclase crystals penetrate into, but are not enclosed in the pyroxenes resulting in subophitic texture. The minerals present are: plagioclase, augite, olivine; the accessories include, chlorite, opaques, zircon and apatite.

Olivine gabbro

The rock is coarse grained, showing ophitic texture. Minerals present are: plagioclase, augite, olivine and chlorite. The accessories include interstitial quartz, iron oxide, rutile and green spinel. Augite is the most dominant mafic mineral and encloses the plagioclase laths to form typical ophitic texture.

GEOCHEMISTRY

The various geochemical parameters recorded for the dykes of Jalor are given in Tables I, II and III. The data obtained for the

Table II. Trace element (in ppm) for Jalor Dykes, W. Rajasthan

Rock	Rhyolites					Basalts		Olivine Dolerite		Olivine Gabbro	
Sample No.	$J1_3$	$J1_{4B}$	$J1_{12}$	$J1_{19}$	K_8	$J1_{13}$	K_{32}	J_{15}	I	K_{32}	JS_3
Ba	61	57	126	60	90	130	112	77	91	65	88
Sr	143	92	70	88	46	76	87	96	105	121	117
Th	0.2	0.8	3.0	4.0	3.0	0.1	0.2	0.2	0.3	0.8	0.4
U	0.31	0.12	0.23	0.48	0.14	0.43	0.71	0.21	0.51	0.16	0.32
Zr	456	337	932	421	412	316	307	336	316	337	321
Y	81	63	50	3	25	38	25	18	21	20	27
Ga	25	12	20	17	21	21	19	18	24	15	22
Zn	8	8	9	11	17	62	71	40	54	64	63
Ni	21	29	29	13	29	29	32	16	25	29	31
Hf	9	7.0	9.0	112	1.3	0.8	0.6	0.2	0	0.7	0.6
Ta	-	-	-	1.3	1.0	-	-	-	-	1.7	-
Cr	30	29	28	31	27	34	36	38	40	40	38
Ratios											
Th/U	0.61	6.50	13.24	7.83	21.83	0.32	0.33	1.23	0.60	4.72	1.34
Zr/TiO_2	0.28	1.94	0.10	0.10	0.02	0.02	0.02	0.02	0.04	0.02	-
Ba/Sr	0.42	0.60	1.80	0.67	1.95	1.69	1.27	0.80	0.86	0.53	0.75
Ga/Al	4.17	2.16	3.39	2.60	3.33	2.16	2.02	2.09	2.10	1.44	2.30