ULTRAPOTASSIC POST-COLLISIONAL DYKE FROM THE LADAKH BATHOLITH, NORTHWEST HIMALAYA

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We report here petrographic and bulk geochemical characters of an ultrapotassic dyke from the Ladakh batholith, NW Himalaya, for the first time, and attempt to compare it with similar dykes from SW Tibet which are typical of post-collisional magmatism. Post-collisional shoshonitic and ultrapotassic dykes have been reported from north Karakoram (Pognante, 1990) and potassic and ultrapotassic lavas from SW Tibet by Miller et al. (1999). They have been linked to large scale tectonic reactivation involving the lithospheric mantle during the continued India-Eurasia collision since ~50 Ma.

Field Setting

The dyke is located near Taru on the Leh-Nimu road (Lat 34°10'48"N, Long 77°25'22"E, Fig.1). It is a melanocratic rock with megaphenocrysts of dark mica in an aphanitic groundmass. The dyke is not clearly exposed but *in-situ* parts of it are observed to occur intruding into a ~5 m wide subvertical dyke of microgranite porphyry trending N70°E (Location X-2B, Fig.1). The dyke appears to be restricted within the microgranite porphyry and much of it now occurs as rubble at the base of the granite porphyry dyke. The microgranite porphyry dyke along with other doleritic and andesitic dyke swarm, trend ~N70°-80°E, and intrude the dominant component of the Ladakh Plutonic Complex composed of metaluminous, calc-alkaline, biotite-hornblende granite to granodioritic rocks (Sharma 1992).

Petrography and Mineral Chemistry

The rock has a panidiomorphic texture with large euhedral phenocrysts of zoned phlogopite along with slender prisms of clinopyroxene and sphene, and microphenocrysts of apatite laths and magnetite crystals set in a crystalline groundmass of sanidine (Fig.2). The rock is devoid of feldspathoids, amphiboles and plagioclase.

Electron microprobe analyses of the phases were carried out on a CAMECA SX-51 probe at Faridabad

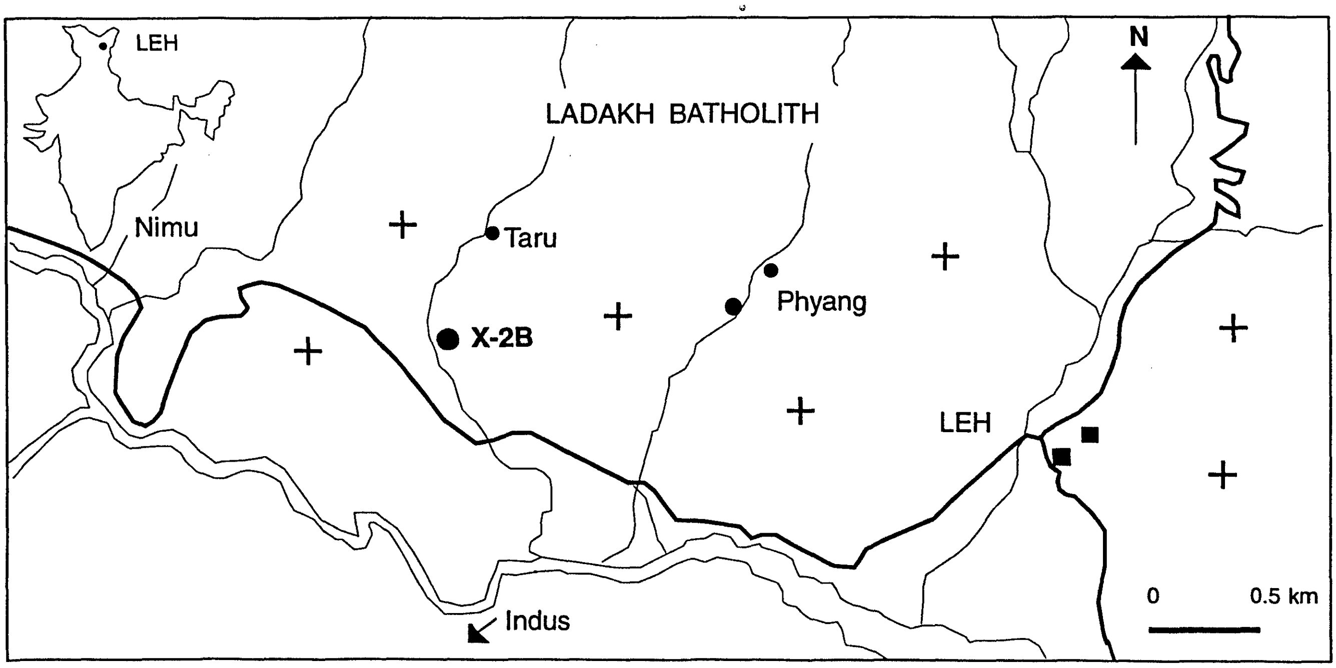

Fig.1. Location of the sampled dyke within the Ladakh batholith (X-2B).

Laboratories of the Geological Survey of India and the representative mineral analyses are given in Table 1.

Phlogopite

The phlogopite (X_{Mg} 0.79 core to 0.71 rim) phenocrysts are Ti-rich (4.28-4.52 wt%) and are normally zoned with FeO increasing from 8.77 (core) to 12.13 wt% (rim). They contain minor amounts of BaO (0.39-0.68 wt%) and Cr (0.16-0.26 wt%).

Clinopyroxene

The clinopyroxene phenocrysts are diopside with the composition range $Wo_{50.8-54.2}$ $En_{36.6-44.4}$ $Fs_{4.8-10.5}$.

K-feldspar

The groundmass is a Ba-bearing sanidine (K-feldspar) having a composition range of $Or_{94.5-94.8}$ $Ab_{3.1-3.3}$ $An_{0.2}$ $Cn_{1.9-2.1}$.

Sphene, apatite and magnetite have near stoichiometric compositions.

Table 1. Whole rock chemistry and representative microprobe analyses of mineral phases from the ultrapotassic dyke

Mineral	Phlogopite phenocryst (core)	Phlogopite phenocryst (rim)	Clinopyroxene phenocryst	Clinopyroxene phenocryst	K-feldspar groundmass	Whole Rock (wt%)
SiO_2	38.20	37.20	48.25	51.05	62.94	49.62
TiO_2	4.33	4.39	1.17	0.97	-	3.04
Al_2O_3	13.64	12.93	2.39	1.43	18.64	13.24
Cr_2O_3	0.26	0.16	-	-	-	-
Fe_2O_3	-	-	7.74	3.25	0.14	3.75
FeO	9.47	12.13	4.56	2.69	-	3.24
MnO	-	0.11	0.49	0.14	-	0.08
MgO	18.35	16.53	10.42	14.82	0.02	5.03
CaO	-	0.03	21.45	23.93	-	8.90
BaO	0.39	0.67	-	-	1.09	-
Na_2O	0.18	0.24	1.44	0.40	0.31	2.75
K_2O	9.10	8.89	0.29	0.04	14.08	7.70
P_2O_5	-	-	-	-	-	0.44
H_2O	4.04	3.95	-	-	-	1.55
Total	**97.97**	**97.23**	**98.21**	**98.72**	**97.26**	**99.34**
O	22	22	6	6	8	
Si	5.66	5.64	1.86	1.91	2.98	-
Al^{iv}	2.34	2.31	0.11	0.06	-	-
Al^{vi}	0.04	-	-	-	1.04	-
Cr	0.01	-	-	-	-	-
Ti	0.48	0.50	0.03	0.03	-	-
Fe^{3+}	-	-	0.22	0.09	-	-
Fe^{2+}	1.173	1.54	0.15	0.08	-	-
Mn	-	0.01	0.01	-	-	-
Mg	4.05	3.74	0.60	0.83	-	-
Ca	-	-	0.89	0.96	-	-
Ba	0.02	0.04	-	-	0.02	-
Na	0.05	0.07	0.11	0.03	0.03	-
K	1.72	1.72	0.01	-	0.85	-
OH	4.00	4.00	-	-	-	-
Total	**19.55**	**19.59**	**4.00**	**4.00**	**4.93**	-
Wo/Or			54.20	51.28	0.95	
En/Ab			36.64	44.18	0.03	
Fs/An			9.16	4.54	-	-
X_{Mg}/Cn	0.79 ($Mg/Mg+Fe^{2+}$)	0.71($Mg/Mg+Fe^{2}$)	-	-	0.02	0.43($Mg/Mg+Fe^{2+}+0.8995Fe^{3+}$)

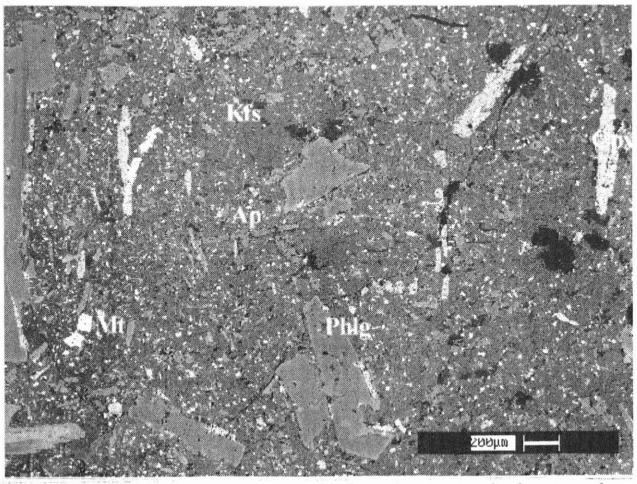

Fig.2. BSE Photomicrograph of the ultrapotassic lamprophyre dyke, exhibiting panidiomorphic texture.

A representative whole-rock sample analysed at the Central Chemical Laboratory of the Geological Survey of India, Kolkata is given in Table 1.

DISCUSSION

The mineral assemblage and texture classifies the rock as minette (Streckeisen, 1979). On the basis of K_2O *vs* SiO_2, K_2O/Na_2O ratios and MgO, CaO and Al_2O_3 contents, this rock is not only shoshonitic but ultrapotassic (Group III, Fig.3a, b, c; Foley et al. 1987). The Ti-content in both phlogopite and bulk rock is high. Comparable ultrapotassic lavas from SW Tibet are of Miocene age (17-25 Ma). As the whole-rock CaO/K_2O ratio of the ultrapotassic dyke is ~1, the bulk rock $^{87}Sr/^{86}Sr$ isotopic ratio of 0.70951 may be close to the initial Sr-isotopic composition. This approximation would be close to initial $^{87}Sr/^{86}Sr$ median values compiled for Group III ultrapotassic rocks (Foley et al. 1987). The low Mg# (0.43) indicates that the rock is a product of fractional crystallization, consistent with the general observation for a majority of Group III ultrapotassic rocks. Considering the available geochemical and mineral chemistry data, it is possible that this ultrapotassic dyke may have been derived from partially melted enriched mantle. The Group III ultrapotassic rocks are observed to occur exclusively in orogenic environments, particularly convergent-type/subduction related zones.

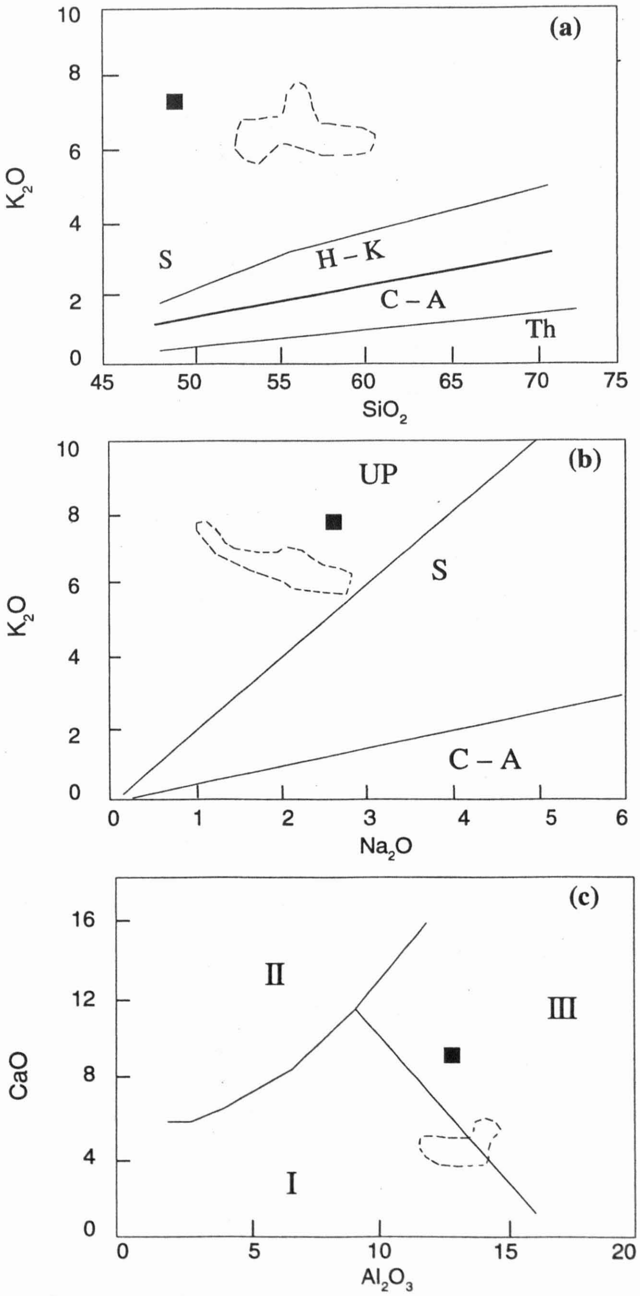

Fig.3. (**a**) K_2O *vs* SiO_2 plot showing shoshonitic (S) affinity of the dyke (H-K high K rocks, C-A calcalkaline rocks, Th tholeiitic rocks) (**b**) K_2O *vs* Na_2O plot showing their ultrapotassic nature (UP) (**c**) CaO *vs* Al_2O_3 plot showing the dyke to be Group III ultrapotassic rocks (Foley et al. 1987). The dashed field in the above plots represent compositions of ultrapotassic volcanics from SW Tibet (Miller et al. 1999)

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