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SHORT COMMUNICATIONS

Physical, Optical and Chemical Characterization of Brannerite from the Ladikabas Area, Sikar District, Rajasthan

Brannerite occurs as subrounded to subangular grains (0.05mm to 20mm) in marble, quartzite, carbonate rock, quartz biotite schist and albitite, and in soils derived from these lithounits of Ajabgarh Group of metasediments around Kachera dam-Ladikabas area of Sikar district, Rajasthan. It alters to rutile along the margins and fractures. The analysis shows 30.6-36.9% UO_3, 0.9 to 3.2% UO_2, 33-40% TiO_2 and 3.4% total $(REE)_2O_3$.

Introduction: Reconnoitary and detailed radiometric surveys conducted in the Parushottampura-Raipur-Ladikabas area of Jaipur and Sikar districts of Rajasthan during 1986-88 have identified uranium mineralization in quartz biotite schist, carbonate rock, marble, quartzite and albitite. Brannerite, uraninite and uranophane are the main radioactive minerals responsible for the uranium mineralization in these areas (Ramanamurthy, *et al.* 1994). In the present study, brannerite from the Kachera dam-Ladikabas area of Sikar district has been taken up for characterisation in terms of its physical, optical and chemical data, based on which its genesis has been inferred.

Mode of Occurrence: Brannerite occurs in a variety of rock types in the study area. The one in marble, quartzite, carbonate rock and soil as at Parushottampura, Kachera dam and Jitala is coarse-grained (1-20mm) and that in quartz biotite schist and albitite at Ladikabas is fine-grained (0.05 to 0.2mm). In the Parushottampura area, brannerite grains are disseminated in marble, whereas in the Kachera dam area they occur in quartzite and in soil (Fig.1) capping the quartzites on the hill tops and along the slopes of the quartzite hillocks. Radial cracks and a brown halo are prominent around brannerite in quartzite. These cracks are due to stress induced by increase in volume accompanying metamictization (Ellsworth, 1932). Near Jitala village, brannerite (1 to 4mm) occurs in carbonate rocks containing calcite, microcline, tourmaline, ferruginous material and minor quartz. A rim of rutile is common around the brannerite (Fig.2).

In the Ladikabas area fine grained brannerite, in association with ilmenite, occurs as subrounded grains along the biotite-rich foliation planes of quartz biotite schists, whereas in albitites it occurs as disseminated brown to light brown grains with irregular margins.

Physical, Optical and X-ray Characteristics: Brannerite (*sp.gr.* 4.69) is black coloured with a vitreous lustre and hardness of 5 in the Moh's scale. When treated with 50% HNO_3 and potassium ferrocyanide, it has given a positive chromogram test for leachable uranium.

In transmitted light, brannerite is either opaque, due perhaps to metamictization, or translucent with a reddish brown colour. Along the cracks and fractures, it is yellowish brown in colour, perhaps due to oxidation. During autoradiography with Kodak CN-85 film, the unaltered brannerite has registered high-density alpha tracks, whereas its altered portions have recorded moderate to low density alpha tracks indicating the loss of considerable amount of

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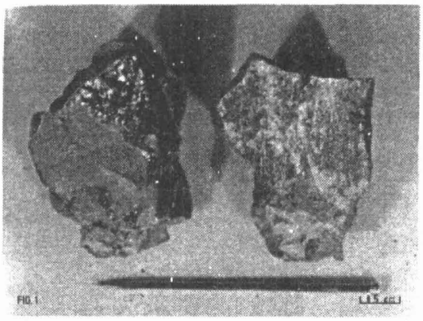
uranium from the latter. After heating brannerite in air at 1000°C for three hours, it has lost its lustre, with the altered portions also becoming opaque.

In reflected light, brannerite, whether coarse or fine grained, is light grey coloured and isotropic (due to metamictization), with 14.5 to 15% reflectance in air at 546nm and VHN of 588 to 688. Its altered portions, however, show reddish yellow internal reflections and slightly



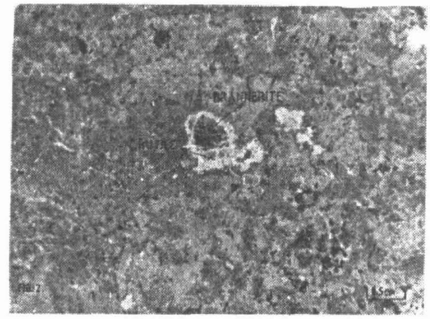


Fig.1. Hand picked Brannerite crystals from the soil of Kachera dam area.

Fig.2. Rutile rim around brannerite in carbonate rock (hand specimen), Locality: Jitala. Slab of carbonate rock exposing brannerite crystals with a rutile rim (hand specimen). Locatlity : Jitala.

higher reflectivity of 15-15.5% at 546nm.

X-ray Diffraction Study: The samples have been diffracted using Siemens D-500 Micro-processer controlled diffractometer (35 KV and 20 mA : Cu Kα; = 1.5418Å, using crystal monochromator). X-ray diffraction pattern of unheated brannerite did not show any reflections, except a weak reflection at 36.925° 2θ (d=2.44324Å) indicating the amorphous nature of the sample due to metamictization. When it was heated in air at 1000°C for three hours and diffracted again, the pattern obtained (Table I) matches well with one of the standards of brannerite (Data card No.8-2 of ICDD) from Mono County, California, USA. Alongwith brannerite, traces of rutile are also present, as indicated by its three 'd' spacings (3.2328, 2.4931 and 1.6860 Å) in the X-ray pattern. The cell parameters (Table I), calculated using the revised version of Benoit (1986) of Appleman and Evans (1973) Programme are in the same range of values for brannerite from Mono Country, California, USA.

Chemical Analysis: Chemical analysis of two samples of brannerite, one each from the Kachera dam and Ladikabas, is compared with those from USA (Table II). The samples from the study area have analysed higher values for UO_3/UO_2 (11-30) and lower values of Th and REE, compared to the one from USA.

Conclusion: Brannerite normally alters to a TiO_2 phase, (anatase). This alteration can be attributed to leaching of uranium from brannerite, with the corresponding titanium no longer fitting into the structure of brannerite, and is released to form rutile or anatase (Ramdhor, 1980). Such leached-out uranium can then form secondary uranium minerals, as evidenced by the presence of abundant secondary uranium minerals in quartz biotite schists and albitites of Ladikabas.

Coarse grained nature of the brannerite is characteristic of pegmatites. Occurrence of brannerite in a variety of lithounits like quartzite, marble, albitite and quartz biotite schist point towards epigenetic, hydrothermal nature of the brannerite. From these observations it is

Table I. X-ray diffraction data on Brannerite from Ladikabas, Sikar District, Rajasthan, compared with the standard (ICDD Data Card No. 8-2).

Brannerite from Ladikabas			Brannerite from Mono County, Calif. USA ICDD Card No. 8-2	
d Å	I/I_0	hkl	d in Å	I/I_0
5.9844	62	001	6.07	30
4.7227	73	201	4.70	50
4.3084	36	200	4.31	20
3.4072	100	110	3.42	100
3.3149	66	202	3.32	60
3.0022	39	002	3.02	30
2.9089	59	201	2.91	50
2.7517	41	111	2.76	40
2.5006	40	112	2.511	40
2.4531	52	311	2.455	70
2.4274	-	401	2.426	20
2.274	41	310	2.276	70
2.1493	-	400	2.151	20
2.0677	-	112	2.080	10
2.0243	29		2.029	40
2.0043	-		2.017	20
1.9028	36		1.903	80
1.8587	30		1.861	60
-	-		1.776	10
1.7262	-		1.7229	30
1.7054	-		1.700	40
1.6178	40		1.623	60
1.6017	28		1.609	40
1.5788	-		1.585	20
1.5642	27		1.569	50
1.5513	-		1.557	30
1.4805	-		1.489	10
-	-		1.481	20
1.4515	-		1.461	18
1.4375	-		1.440	25
1.4085	16		1.411	8
1.3604	19		1.371	45D
1.3088	-		1.308	25
1.2873	-		1.289	14D
-	-		1.268	18
1.2504	19		1.255	30
-	-		1.242	8
1.2239	-		1.230	30
a	9.795 ± 0.015 Å		9.79 Å	
b	3.718 ± 0.006 Å		3.72 Å	
c	6.854 ± 0.009 Å		6.87 Å	
β	118°35'		118°25'	
Volume	219.197 ± 0.397 $Å^3$		-	

Table II. Chemical Analysis of Brannerite from the Kachera Dam Ladikabas Area, Sikar District, Rajasthan, Compared with those from USA.

	1 Kachera dam, Sikar dist., Rajasthan	2 Ladikabas Sikar dist., Rajasthan	3 Custer County, Idaho USA	4 Mono Country, California USA
TiO_2	40.00	33.15	39.00	32.9
UO_2	3.23	0.90	10.30	8.2
UO_3	36.87	30.55	33.50	32.0
ThO_2	3.6	3.50	4.10	5.0
RE_2O_3	3.38	ND	3.90	6.5
FeO	1.26	ND	Traces	2.40
Fe_2O_3	2.6	ND	-	-
CaO	2.83	ND	2.90	2.80
MgO	0.24	ND	-	-
PbO	2.88	ND	-	-
SiO_2	1.20	ND	0.60	0.50

REE data (in ppm) for 1 : Y-7500, La-579, Ce-3325, Pr-665, Nd-3505, Sm-1920, Eu-508, Gd-2281, Tb-647, Dy-4005, Ho-746, Er-2357, Tm-292, Yb-1588, Lu-166.
Stoichiometric formula = 1.02 X, 1.94 Y, 6.0 'O', where X=Mg, Ca, Fe^{+2}, Pb, RE, U^{+6}, U^{+4} and Si; Y=Ti and Fe^{+3}.
(taking Molecular weight of combined oxides to be 350; as given by Hess and Wells, 1920)
ND = Not determined
1 and 2. Analysed at Chemistry Laboratory, AMD, Hyderabad. Data on REE by ICP-AES and Y by X-ray fluorescence.
3. Hess and Wells (1920), analysis by R.C. Wells.
4. Analysis by J.J. Rowe (Pabst, 1954).

concluded that brannerite of Ladikabas area has its origin in pegmatitic/hydrothermal solutions.

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References

BENOIT, P.H. (1987). Adaptation to microcomputer of the Appleman-Evans Programme for indexing and least-squares refinement of powder-diffraction data for unit cell dimensions, Am. Min., v.72, pp.1018-1019.

ELLSWORTH, H.V. (1932). Rare-element minerals of Canada, Can. Geol. Surv., Econ. Geol., Ser. 11pp.

HESS, F.L. and WELLS, R.C. (1920). Brannerite, a new mineral : Journal Franklin Institute, 189, pp.225-237.

PABST, A. (1954). Brannerite from California: Am. Min., v.37, pp.137-157.

RAMANA MURTHY, K.V., RAJIV VIMAL, VERMA, M.B., GOVIND SINGH, SWARNAKAR, B.M. and BANERJEE, D.C. (1994). Uranium Mineralization in the Middle Proterozoic rocks of Ladikabas area, Sikar district, Rajasthan, India. Exploration and Research for Atomic Minerals, v.7, pp.51-58.

RAMDHOR, P. (1980). The ore minerals and their intergrowths, Pergamon Press Publication, v.2, p.1043.