SHORT COMMUNICATION

NATIVE ANTIMONY FLOAT-ORE FROM THE PRECAMBRIAN OF RAJASTHAN

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Placer concentrations of rolled chunks of heavy, silvery-white, metallic mineral occur along a rivulet (N25°40.013'; E75°20.851') 15 km east of Jahazpur town of eastern Rajasthan. The float-ore occurs in the Precambrian phyllite that is profusely traversed by vein quartz. Its physical, optical, XRD, EPMA data show that the mineral is native antimony (averaging 97.12%Sb) having ~2% As; minor grains of PbTe are also recognized. Prospecting by the Department of Mines and Geology, Rajasthan has not yet resulted in the discovery of the mother lode. This report describes the mineralogy of the float-ore that has scientific value and is a new occurrence in India.

Introduction

The state of Rajasthan in western India is an important metallogenic province that has a wide variety of mineral deposits — metallic, non-metallic, dimensional and decorative stones (Ranawat, 2004). The Precambrian rocks of the State host several mineral occurrences some of which are of non-commercial but scientific value — one such is the float-ore of the Jahazpur area (Fig. 1). The mineral is silvery white with metallic lustre and high specific gravity (Fig. 2). Local populace mistook it for silver ore and kept the 'discovery' a secret for a very long time. It was only after repeated smelting proved futile that the 'discovery' was disclosed and the sample sent to us for identification and comment on its significance.

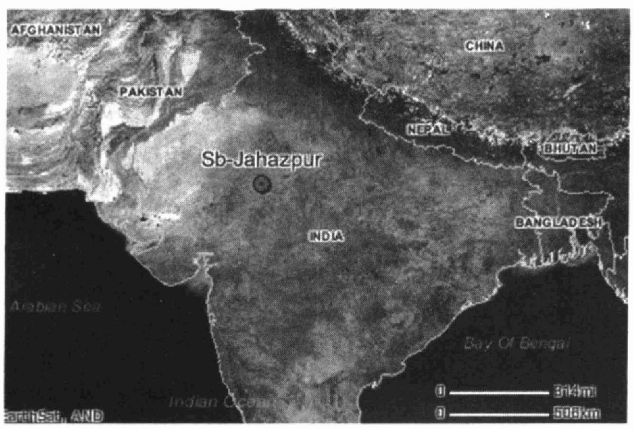


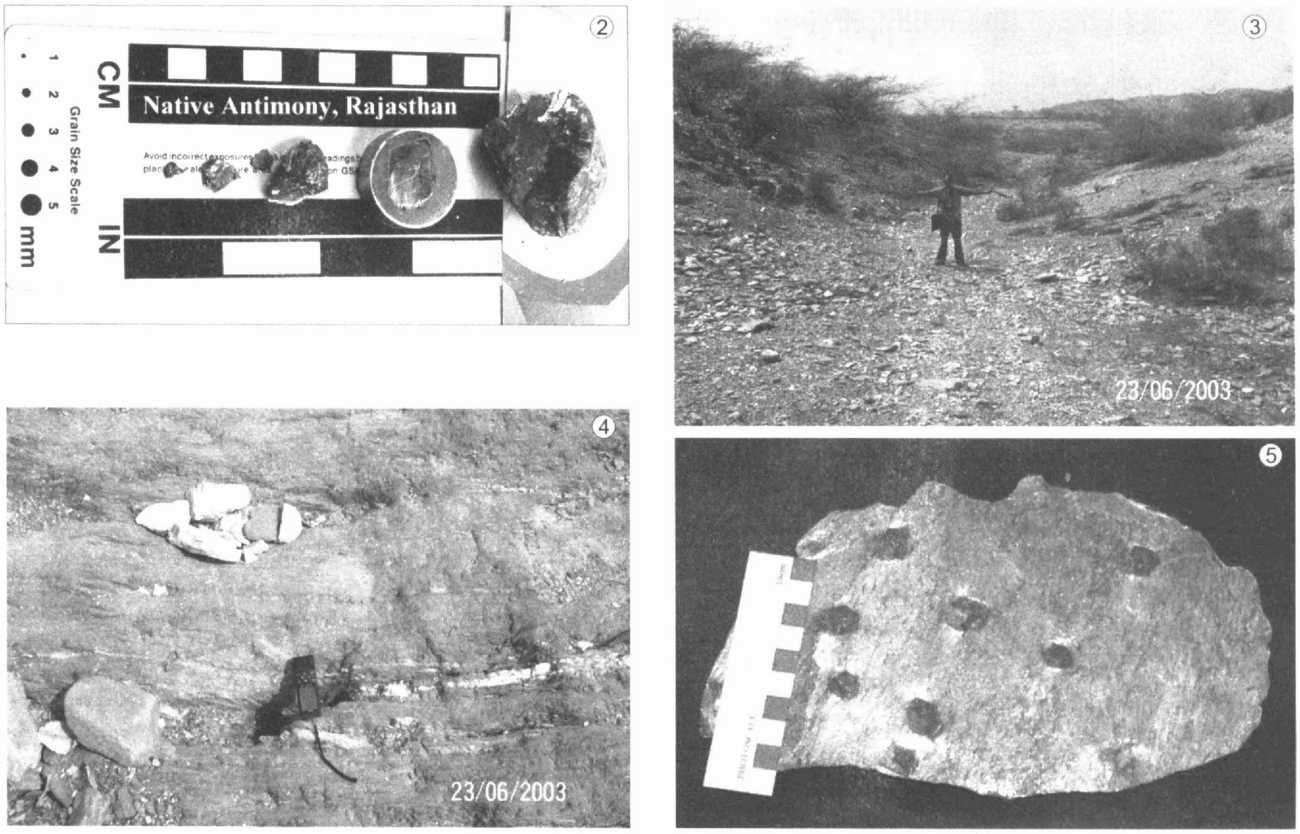
Fig.1. Location Map of Jahazpur.

Department of Mines and Geology, Government of Rajasthan, unsuccessfully carried out prospecting in the area to locate the primary mother lode. Chemical analysis of ~97% Sb and small occurrence resulted in abandonment of its prospecting. Physical, optical, XRD and EPMA (microprobe) studies of the mineral were undertaken to identify the mineral and to find out other mineral phases, if any, present in it; the same are presented in this communication. In geologic environments, antimony commonly occurs as sulphides and sulphosalts (stibnite, tetrahedrite, bournonite, boulangerite, jamesonite) and rarely as oxides (valentinite, stibiconite, senarmonite). Antimony is very rare as native metal or in its elemental state, which is reported from several countries, notably Mexico, Canada, and USA (www1, 2004).

Geologic Setting of the Float Ore, its Physical and Optical Properties

The ore occurs in a small narrow valley (Fig. 3) in the Precambrian phyllites of the Sujanpura Formations of the Hindoli Group of the Bhilwara Supergroup (> 2500 Ma, Gupta et al. 1997). Phyllite is profusely traversed along its foliation by vein quartz (Fig. 4) trending NE (N 55 ± 10° E) dipping steeply towards SE. The phyllite, at places, has disseminated crystals of almandine garnet ranging from small specks to 12 mm across (Fig. 5). Scattered grains of slag are also present in the area (25°40.053' N; 75°20.813' E at 373 m) indicating ancient smelting activity for the mineral; it is pointed out here that Rajasthan is world-famous for its recorded oldest metal smelting activity (Gandhi, 2003).

Placer concentrations of rolled lumps (nuggets) of antimony up to 5 cm across (Fig.2) occur in pocket and pay-streaks in phyllite traversed by rivulet (Figs. 3, 4) located at 25°40.013' N; 75°20.851' E and at an altitude of 384 m



Figs.2-5. (**2**) Sample of native antimony float ore showing earthy white encrustation on tin-white interior displaying metallic lustre. (**3**) Rivulet in which the placer antimony float ore occurs. Jahazpur area. Rajasthan. (**4**) Phyllite traversed by veins of quartz along its foliation; placer antimony is trapped in its pockets and 'riffles' (**5**) Phyllite with disseminated crystals of garnet, Jahazpur area. Rajasthan.

(the 3D location readings were taken with the help of GARMIN 12XL GPS). The nuggets have earthy white thin encrustation over the coarse crystallized silvery white mineral, which has metallic lustre that gives grey streak with shining particles. It has a set of perfect cleavage with sp. gr. of ~6.7, and hardness of ≥3. Melting aspect determined in muffle furnace and high-temperature heating stage gave a melting point of ~ 640 °C.

Polished section of the mineral under the incident light microscope displays bright white colour having high reflectivity, with a set of cleavages; it has low polishing hardness and displays distinct anisotropism.

XRD Data

Samples for X-ray diffraction study were prepared by grinding the mineral to -400 mesh (~37μ) size and mounting in aluminum holders. Approximately 1g of material was used. The diffractograms were obtained on a Rigaku Miniflex tabletop diffractometer employing 30kV, 15mA, Ni filter, Cu Kα X-ray radiation was utilized. The spectrum was obtained at room temperature for a range of angles of 2θ over 5° to 90° with a step size of 0.1° and a scan speed of 2° per minute. Instrumental calibration was done by running a standard silicon sample over the same range of 2θ and step size before and after running the mineral sample. Comparison with standard ICDD cards was made to ensure proper calibration. Diffractogram obtained for the sample was also checked for the presence of any aluminum lines due to the holder. None were found. XRD parameters obtained are given in Table 1.

X-ray spectrum recorded for the sample with the (hkl) values corresponding to each peak shows well spaced, narrow and fairly intense peaks with very little background. On comparison with diffractogram of standard, pure antimony using ICDD Card # 35-0732, it was observed that almost all the peak positions, except the one at 2θ corresponding to 75.935 (hkl = 009), matched fairly well although the relative intensities have minor difference. Using the Powder Diffraction Package program (Calligaris, 1990, the cell parameters were calculated for the sample using the experimental values of 2θ. The crystal system was determined to be trigonal.

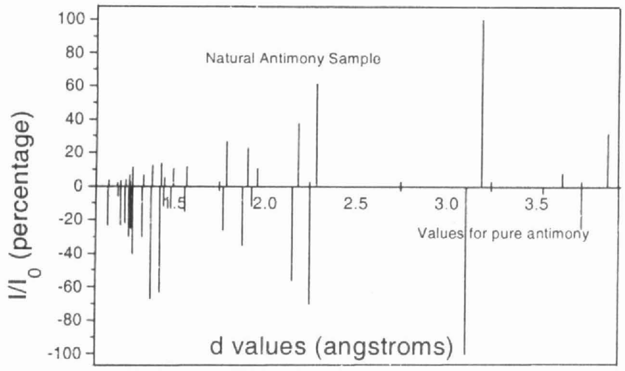


Fig. 6. Plot of peak positions and intensities for native antimony from Rajasthan compared with those for the pure standard antimony sample ICDD 35-0732. (Diagram drawn for data of Table 1 using graphic software: ORIGIN 4.0).

EPMA Data

Microprobe analyses were carried out for several spots on the polished sections to confirm the mineral and minor phases present in it. The data were obtained on a CAMECA SX 50 Microprobe at the BRGM-CNRS Laboratory, Orleans, France. A focused electron beam of ca. 1 μm accelerated at 20 kV, and a 20 nA beam current with 10 seconds counting time was used. Stibnite (Sb_2S_3) and AsGa standards were used for calibration and the routine analytical procedure was adopted using Sb Lα line on a PET crystal and As Lα line on a TAP crystal. As per the data, the mineral is nearly pure antimony having a composition averaging 97.12% Sb and 2.76% arsenic (average of 41 spot analyses, details could be obtained from the corresponding author). Small inclusions of bright white PbTe phase are rarely present in native antimony (Fig. 7A, B).

Table 1. X-ray diffraction data of native antimony, Rajasthan, compared with pure Sb-standard (ICDD:35-0732)

Natural Sb sample		Sb standard ICDD Card No. 35-0732		hkl
d (Å)	I/I_0	d (Å)	I/I_0	
3.896	31.2	3.753	25	003
3.6434	7.8	3.538	4	101
3.1951	100	3.109	100	012
2.285	61.1	2.248	70	104
2.1841	37.5	2.152	56	110
1.9592	10.3	1.929	12	015
1.905	22.9	1.878	35	006
1.7892	26.6	1.77	26	202
1.5666	11.7	1.555	15	024
1.4912	10.3	1.479	13	107
1.4429	4.9	1.437	12	205
1.4258	13.4	1.416	63	116
1.2739	12.4	1.368	67	122
1.3243	6.7	1.318	30	018
1.2638	11.2	1.261	40	214
1.2469	6.5	1.252	25	300
1.2235	3.6	1.243	30	027
1.1967	3.1	1.219	22	125
1.17603	2.0	1.1955	23	303
1.129036	3.2	1.1802	6	208
a=b=4.317Å and c=11.1Å		a=b=4.307Å and c=11.273Å		

Conclusion

The physical, petrographic, XRD, and microprobe data of the silvery white metallic mineral from Jahazpur area conclusively prove that it is native antimony (*cf.* www2, 2004) containing ~2% arsenic and having microinclusions

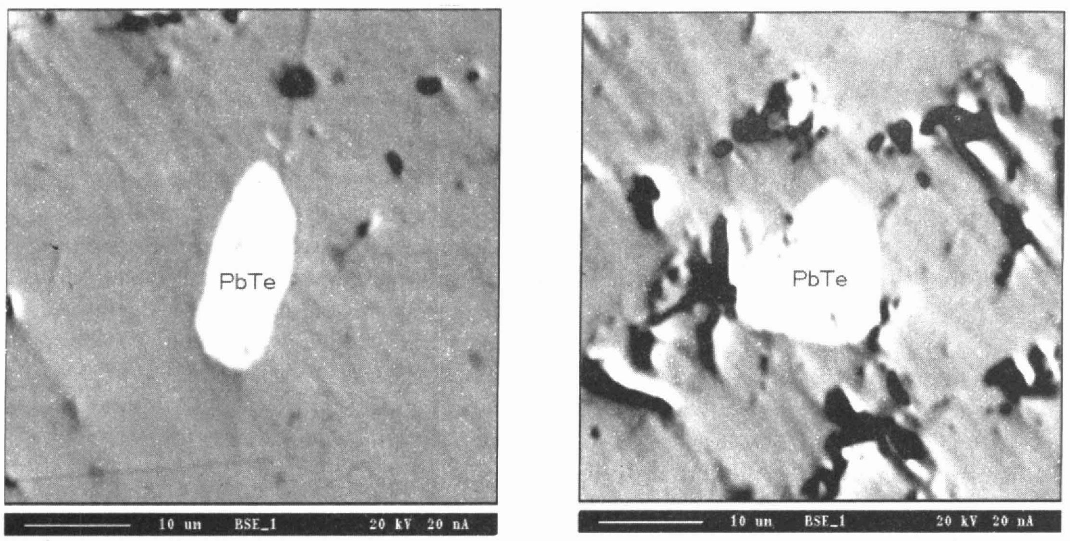


Fig.7A, B. Microscopic grains of PbTe phases displaying higher reflectivity occurring in native antimony.

of PbTe phase in it. The mineral is not of economic significance but it adds one more unique presence of a metallic mineral in the metallogenic province of Rajasthan, India. Although native antimony may not be of commercial significance, its association with stibnite-bearing gold veins (Ramdhor, 1980,p374) warrants prospecting in the region. Detailed study of the associated minor phases in the mineral and the slag is being pursued.

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ANNOUNCEMENT

NE HIMPROBE UNDER DEEP CONTINENTAL STUDIES PROGRAMME, DST: INVITATION OF RESEARCH PROPOSALS

The Department of Science and Technology under its Deep Continental Studies Programme proposes to support a geotransect in the NE region covering the NE Himalayan syntaxis. The PAMC has recommended the following three corridors in the NE region. 1. Kameng Corridor: Bhalukpond-Bomdilla-Tawang 2. Subansiri Corridor: Daporijo-Tahlia and beyond 3. NE Syntaxis.

Proposals on multidisciplinary geological and geophysical studies focusing on Deep Continental Studies are invited from individuals/groups working in national institutes/ Universities in the above chosen corridors in NE India. The proposals may be prepared in the DST format, which can be downloaded from the website www.serc-dst.org and five copies of the proposals indicating the name of the corridor may be submitted to Dr. Ch. Sivaji, Convener, DCS Programme, ESS Division, Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi-110016 (PH.: 011-20590342, Fax:011-6516076, E-Mail: sivaji@nic.in). The proposals should be sent on or before 31st March 2005. A workshop will be organized in NE region where the accepted proposals will be discussed to formulate three integrated proposals on the above corridors.