SHORT COMMUNICATION

ANOMALOUS CONCENTRATION OF SILVER IN URANIFEROUS SIWALIK SANDSTONES OF ROMEHRA, HAMIRPUR DISTRICT, HIMACHAL PRADESH

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For the first time, anomalously high silver content (4 to 100 ppm) is reported front uranium-rich, Middle Miocene to Early Pleistocene Siwalik sandstones of Romehra (Survey of India toposheet No. S3A/6: 31°32'49"N,76°26'09"E), Himachal Pradesh. The results of sequential heavy media separation, followed by magnetic separation, suggest the potential for upgradation of silver values from the Siwalik sandstones of the Romehra area, and hence, further work in this regard may prove to be rewarding.

Introduction

Middle Miocene to Early Pleistocene Siwalik sandstones and associated rocks have attracted the attention of the Atomic Minerals Directorate for Exploration and Research (AMD) since the early 1970's. Indeed after the discovery of significantly high concentration of uranium (0.011 to 0.34% U_3O_g) in the vertebrate fossils from Siwaliks of the Pinjore area, Ambala district, Haryana (Mahedevan, 1971), they were examined more seriously for uranium concentration in various parts of Himalayan foot hills. This resulted in locating widespread uranium mineralisation hosted in Siwalik sediments in parts of Himachal Pradesh, Uttar Pradesh (now Uttaranchal), Jammu and Kashmir and Haryana (Singh, 1993; Kaul et al. 1993). In the Siwalik sediments, primary uranium mineral phases present include uraninite, pitchblende and coffinite, besides a host of secondary uranium minerals *{see* Table V in Kaul et al. 1993).

Recently, during the course of X-ray diffraction (XRD) studies of uraniferous Siwalik sandstones of Romehra area (Fig.l), Hamirpur district, Himachal Pradesh, for the first time, two rare copper arsenide minerals, namely domeykite (Cu_3As) and koutekite (Cu_5As_2), have been identified in them (Singh et al. 2002). Already known association of native silver with the Kazakhstan cupriferous sandstones, containing domeykite and koutekite mineral assemblage (Abulgazina et al. 1991), prompted us to examine cupriferous (upto 1.2% Cu), copper arsenide-bearing Siwalik sandstones of Romehra for their silver potential. This attempt yielded very encouraging results of silver concentration, particularly in methyline iodide heavies of magnetic separates. The aim of this communication is to highlight the anomalous concentration of silver in the uraniferous sandstones of Romehra, which is being reported for the first time from the Siwalik sediments. The results show potential for upgradation of silver values from the studied sandstones.

Brief Geology

The sediments of the Middle Miocene to Early Pleistocene Siwalik Supergroup are divisible into Lower, Middle and Upper Siwaliks, and are represented mainly by conglomerates, sandstones and interbedded clays that predominantly represent fluviatile sediments. The provenance for these sediments comprises granitic and metamorphic rocks of Lesser Himalayan Crystalline zones. In Romehra area, Lower and Middle Siwaliks are exposed (Fig.l). The Lower Siwaliks are represented by compact, massive, fine-grained, calcareous/ferruginous sandstones containing interbedded, purple to greyish green mudstones, whereas the Middle Siwaliks are made up of coarse, friable, greyish sandstones. Lower Siwalik sandstones host uranium mineralisation with surface uranium values ranging from 0.004 to 1.80% U_3O_g and that of copper from 0.043 to 1.20%. Recently reported copper arsenide minerals (domeykite and koutekite) from Lower Siwalik of Romehra occur in intimate association with uranium minerals (uraninite, pitchblende, uranophane and metazeunarite) mainly in matrix of sandstones (Singh et al. 2002).

Methodology

The uranium-mineralised, cupriferous sandstone sample was examined first spectrographically, which showed the presence of silver in it. We studied the same rock sample after it was ground to about 60 mesh, followed by sieving. Sequential heavy media separation of-60 mesh fraction was done using bromoform and methyline iodide liquids.

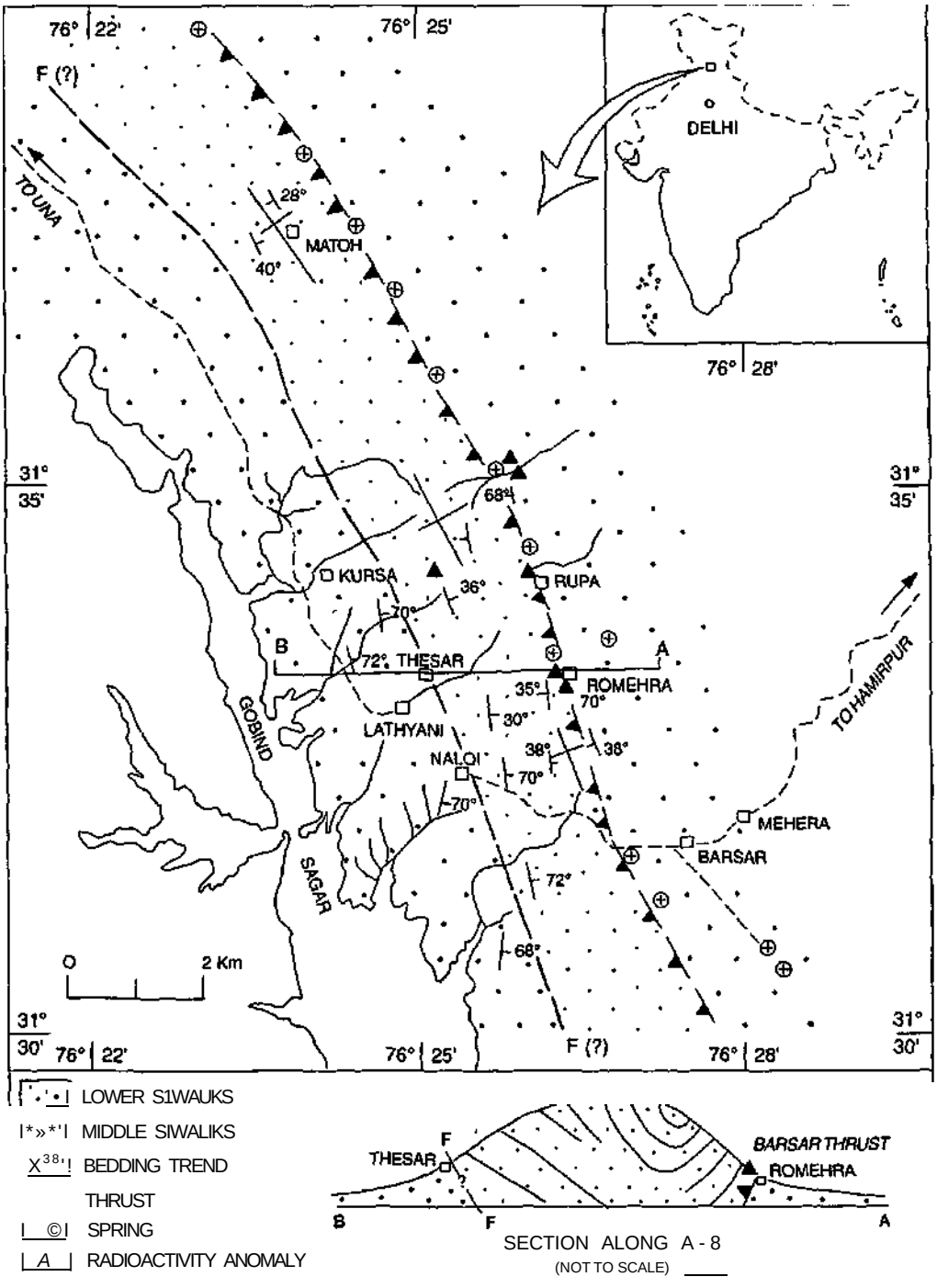

Fig.l. Geological map of Romehra-Barsar area, Hamirpur district, Himachal Pradesh. Line along F-F could be either a fault or a thrust counterpart of Barsar thrust.

Methyline iodide heavies (MIH) fraction was further subjected to magnetic separation using Frantz Isodynamic separator. Bromoform light (BL), methyline iodide light (MIL) and isodynamic separates at various field settings were analysed separately for silver contents (Table 1). The analysis of Ag was done by atomic absorption spectrometry (AAS) method with an accuracy of ±*10%*.

Results

Table 1 indicates a wide variation in silver content, in

Table 1. Silver content in sepaiated fractions of uraniferous Siwahk sandstone of Romehra

SI No	Fraction	*Ag (ppm)
1	Bromohght (BL)	4 0
2	Methyline iodide light (MIL)	8 2
3	Methyline idode heavies at 1 0 amp	60 0
4	MIH Mag at 1 2 amp	59 0
5	MIH Mag at 1 5 amp	100 0
6	MIH Non-mag at I 5 amp	93 0

"•Analysts G S Chowdary and P K Snvastava, Chemical Laboratory, AMD, Hyderabad Method of analysis AAS technique, except MIL fraction which was analysed by DC arc emission spectrograph

various fractions, ranging from 4 ppm to 100 ppm of Ag. The lowest content of silver is found in bromolights (4 ppm Ag), followed by methyline iodide lights (8.2 ppm Ag), whereas intermediate values have been recorded by MIH magnetic at 1.0 amp (60 ppm Ag) and 1.2 amp (59 ppm Ag) fractions. On the other hand, highest Ag values are contained in methyline iodide heavies magnetic (100 ppm Ag) and non-magnetic (93 ppm Ag) fractions at 1.5 amperes. The data indicate that, in general, Ag content tends to increase in successive magnetic fractions at higher current/ field settings. Incidently, increasing dominance of copper arsenides (domeykite and koutekite) has also been found in isodynamic magnetic separates containing progressively more Ag.

Discussion

Progressively increasing Ag contents in isodynamic separates of successively higher magnetic field suggest that Ag is intimately associated with copper arsenide (domeykite and koutekite) minerals. These have also been found to be present in increasing proportion in corresponding fractions containing higher Ag values. However, presence of appreciable amounts of silver in MIL (8.2 ppm Ag) and BL (4 ppm Ag) fractions, which have been found to be devoid of copper arsenides (Singh et al. 2002), argues for association of some amount of silver with non-copper arsenide minerals also.

XRD and microscopic studies of Ag-bearing sandstone samples of Romehra did not show the presence of either native silver or discrete Ag mineral phases. Such a situation might be due to the lack of enrichment of Ag in studied samples up to the desired level to make their silver phases detectable either by XRD or by microscopy. However, it is likely that, like cupriferous copper arsenide-bearing Kazakhstan sandstone which contains native silver in it *(cf* Abulgazina et al. 1991), in the studied sandstone of Romehra also Ag may be present in the native form. Nevertheless, interestingly, the results of sequential heavy media separation, followed by magnetic separation (Table 1), suggest the possibility for upgradation of Ag values from Siwalik sandstone of Romehra. In view of very encouraging results of our preliminary study and already known vastness of the sedimentary sequence of the Siwalik Supergroup of rocks, further investigations for Ag concentration in Siwalik sediments, particularly in cupriferous sandstones, may prove to be rewarding.

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