DISCUSSION

ANOMALOUS CONCENTRATION OF SILVER IN AURIFEROUS SIWALIK SANDSTONES OF ROMEHRA, HAMIRPUR DISTRICT, HIMACHAL PRADESH by Yamuna Singh, K D.P. Singh, S. Srinivasan, Jyotsna Chhabra and R K Gupta Jour. Geol Soc India, v 62, 2003, pp.495-497.

R.N. Sankaran, 6/24, Sheetal Bagh, Bhosari, Pune - 411 039, comments

Dr Yamuna Singh and co-authors are to be congratulated for their pioneering work in identifying interestingly high values of silver in uraniferous Siwalik sandstones of Romehra, Himachal Pradesh and attract the following comments

1 In a sandstone, bulk of the material would report as bromo lights and at 4 ppm so would Ag To complete the geochemical picture, one could have taken a look for organo-metal compounds or silver occurring as adsorbate in carbonaceous matter, since both will report as bromo lights
2 Hope that silver mineralisation in Siwaliks is not scanty and sporadic as other companion nuclides, to justify potential anticipation

Yamuna Singh and co-authors, AMD, Hyderabad reply

We sincerely thank Shri R N Sankaran for his encouraging words for our work and also for his invaluable suggestion The following are the specific replies to his two interesting comments

1 Presence of organic matter in Siwalik sediments is well documented However, during the course of our initial study, we did not examine Ag-bearing studied sandstone samples with a view to ascertain the presence of carbonaceous matter in them, and if so, then the association of silver with organic matter, i e , either in the form of organometal compounds or as adsorbate in carbonaceous matter
2 As apparent from the text of the short communication, our reporting is of preliminary nature, and is based only on the results of study of very limited samples of cupriferous Siwalik sandstones, containing domeykite and koutekite (copper arsenide) minerals (*cf* Singh et al 2002, *JGSI*, v 60(2), pp 695-699), from only one locality, i e , Romehra Therefore detailed work on several sandstone (and associated rock) samples having mineralogical and geochemical characteristics similar to those sandstone samples which were studied by us, collected systematically from various parts of the vast Siwalik basin, is needed to ascertain about the actual area extent and anticipated potential of silver mineralisation in Siwaliks

FACIES ASSOCIATION AND SEDIMENTARY PETROLOGICAL CHARACTERISTICS OF LAMETA SEQUENCES OF THE DONGARGAON AREA, CENTRAL INDIA by Vimal Singh and S.K. Tandon Jour Geol Soc. India, v.63(1), 2004, pp.39-50

J.P. Shrivastava, Department of Geology, University of Delhi, Delhi - 110 007, comments

1 XRD based identification of clay minerals indicated presence of illite, chlorite and smectite However, basic data that pertains to 2θ or d-values or diffraction patterns are missing and in the absence of these data, identification of minerals remains unconvincing
2 Further, XRD analysis by the authors of thinly smeared, extracted sediments on glass slides showed dominance of illite, followed by chlorite and smectite in different lithotypes of the Lameta sequence exposed around

Dongargarh area, Central India These results largely differ from the more recently published compositional data sets and XRD results on well oriented clay mounts obtained from the infra (Lametas)/intertrappean sediments from widespread areas, viz , Lameta Ghat (Type Area), Sivni-Lamethi Section, Chui Hill, Bara Simla, Chota Simla, Amokhoh and Tendukhera sections and several other intertrappean sections from the Deccan (Salil, 1993, Salil, et al 1994, Salil et al 1996, Salil et al 1997, Shrivastava et al 2000, Shrivastava and Ahmad, *in press*) It is important to note that the thinly smeared sediments on glass slides do not ensure uniform diffraction mounts Possibility of differential settling of clay particles cannot be avoided in thin smears on glass slides Therefore, results obtained under such conditions may be erroneous Moreover, no mention has been made about the method being used in the quantitative/semi-quantitative estimation of mineral phases Thus, the results that show illite being the dominant phase followed by chlorite and smectite are doubtful

3 It is stated in the paper that the illite may form by weathering of silicates or from alteration of smectites in the presence of K^+ ions But in the following lines it is stated that smectites may have formed directly from the mafic rocks or by the alteration of illite and chlorite These two statements are self-contradictory and not clear There is no data or reference to support either of these statements Moreover, in the absence of data, these statements stand out as mere speculations

Vimal Singh and **S.K. Tandon,** University of Delhi, Delhi reply

We thank Prof J P Shrivastava for the interest shown by him in our work His comments deal with one of the minor aspects of our study i e the clay mineralogical composition of the mudstone facies To place these comments in some kind of context, it is useful to recall that the main aspects of our study included facies analysis, petrographic analysis, and stable isotope compositional data of selected carbonate facies and fabrics These data were then used to interpret the deposition of the Lameta sequences of the Dongargaon area in overbank and shallow lake environments Significantly, we highlighted the contrasts in the facies and the sedimentary environmental milieus between the Dongargaon and Jabalpur areas of Central India Viewed against this background, the comments by J P Shrivastava are of scant relevance to the main findings and conclusions of our study

The central issue raised by J P Shrivastava is that the clay mineral composition of a few samples of the mudstone facies from the Lameta sequences of the Dongargaon area differs from the results on clay mineral composition obtained by him from different locations in the Narmada region (Jabalpur, Tendukhera etc) The clay mineral data presented in our study was based on a limited number of samples with the purpose of providing a preliminary characterisation of the mudstone facies In this context, the discussant has raised doubts on 'illite being the dominant phase followed by chlorite and smectite' This remark was based by us on the fact that illite is present in all the facies investigated in our study (Table 1, Singh and Tandon, 2004) and not based on sample wise quantitative estimates of clay minerals

In view of the present discussion, we requested Dr D K Pal (NBSSLU, Nagpur) to analyze four of these samples in his laboratory The following results giving the sample wise semi-quantitative estimates of clay minerals were provided by him (Pal, *written comm*)

From the Table below and our previous data, it is clear that the clay mineralogical composition shows significant

Sample no	Lithotype	Facies	Clay minerals Smectite (%)	Illite (%)	Palygorskite (%)	Quartz (%)	Felspar (%)
DG/3	Gypsiferous Clay	Lacustrine	52	18	25	5	-
DGH/3	Siltstone	Lacustrine	54	20	21		5
DGHI/I	Green Clay	Overbank	*	95			5
DGHI/3	Red silty Clay	Overbank		40	55	-	

* – Presence of smectite was recorded in our study (Singh and Tandon 2004)

Method (Pal *written comm*) Oriented clay fractions (<2 micrometre were subjected to XRD analysis using a Philips Diffractometer and Ni- filtered CuKα radiation at a scanning speed of 2 degree 2 theta per minute Samples were saturated with calcium and potassium solvated with ethylene glycol and heated to 110° 300° and 500°C Minerals present in the clay fraction were identified following the criteria of Jackson (1979) Semi quantitative estimates of clay minerals were made by the method of Gjems (1967) facies related variability These limited data show two siltstone/clay facies dominated by smectite, one by illite and one by palygorskite They also show that illite is present to a lesser or greater extent in all the analyzed samples The relative amount of clay minerals is to be understood in the framework of sedimentary facies, and relative abundance of the latter These data underscore the importance of studying clay mineral composition, quantitative or otherwise, of the Lameta Formation in properly developed framework of sedimentary facies

It is common knowledge that the clay mineral composition of mudstones is a function of provenance, sedimentary environmental conditions, and diagenesis (for example, Prothero and Schwab, 1996) The Lameta Formation has a patchy distribution over vast areas in Central India, and therefore, these sequences are influenced variably by different geological settings (provenance factor), also, we have in our study dwelt on the contrasting and different sedimentary environmental milieus of the Lameta sequences developed in the Jabalpur and Dongargaon areas Considering the above facts, variability in the clay mineral assemblages of mudstone facies of the Lameta sequences of different sub-regions is to be expected, notwithstanding the general presence of smectite because of their association with the Deccan volcanic rocks In Para 3, of the comments, it is contended that we have made some 'self-contradictory statements' We have re-examined these statements and do not find any self-contradiction in them These statements, based on common knowledge in the literature (for example, Weaver, 1989), point out some options for the genesis of illite and smectite

In conclusion, we emphasize that the comments by J P Shrivastava are disproportionately biased towards the aspect of clay mineral investigations of the Lameta Formation without any reference to the critical aspect of sedimentary facies We wonder whether it is advisable to 'miss the forest for the wood in the trees'

Acknowledgements We are very grateful to Dr D K Pal for readily agreeing to carry out the semi-quantitative clay mineral analysis of our samples in his laboratory

References

AHMAD, M and SHRIVASTAVA, J P (*in press*) Compositional studies on illite-smectite assemblages of Anjar and other volcano-sedimentary sequences from Deccan Palaeoenvironmental implications

GJEMS, O (1967) Studies on clay minerals and clay mineral formation in soil profiles in Scandinavia Meddeleser fra det Norske Skofgorsoksvesen 21, pp 303-415

JACKSON, M L (1979) Soil Chemical Analysis - Advanced course Published by author, University of Wisconsin, Madison, WI, USA

PROTHERO, D R and SCHWAB, F (1996) An introduction to Sedimentary Rocks and Stratigraphy W H Freeman and Company, New York, 575p

SALIL, M S (1993) Comparative mineralogy and geochemistry of infra-(Lametas)/intertrappean sediments and weathered Deccan volcanics M Phil Dissertation, Delhi Univ, 41p

SALIL, M S, PATTANAYAK, S K, SHRIVASTAVA, J P and TANDON, S K (1994) X-ray diffraction study on the clay mineralogy of infra (Lametas)-/intertrappean sediments and weathered Deccan basalt from Jabalpur, M P Implications for the age of Deccan volcanism Jour Geol Soc India, v 44, pp 335-337

SALIL, M S, PATTANAYAK, S K and SHRIVASTAVA, J P (1996) Composition of smectites in the Lameta sediments of Central India Implications for the commencement of Deccan volcanism Jour Geol Soc India v 47 No 5, pp 555-560

SALIL, M S and SHRIVASTAVA, J P (1996) Trace and REE signatures in the Maastrichtian Lameta Beds for the initiation of Deccan volcanism before KTB Curr Sci, v 70, No 5, pp 399-401

SALIL, M S, SHRIVASTAVA, J P and PATTANAYAK, S K (1997) Similarities in the mineralogical and geochemical attributes of detrital clays of Maastrichtian Lameta Beds and weathered Deccan basalt, Central India Chemical Geology, v 136, pp 25-32

SHRIVASTAVA, J P, SALIL, M S and PATTANAYAK, S K (2000) Clay Mineralogy of Ir-bearing Anjar intertrappeans, Kutch, Gujarat, India Inferences on palaeoenvironment Jour Geol Soc India, v 55, pp 197-206

SINGH, V and TANDON, S K (2004) Facies Associations and Sedimentary Petrological characteristics of Lameta Sequences of the Dongargaon Area, Central India Jour Geol of India, v 66, pp 39-50

WEAVER, C E (1989) Clays, Muds and Shales Development in Sedimentology 44 Elsevier Science Publishing Company Inc New York, 819p