Environmental Status of Heavy Metals (Trace Metals) in Rock and Soil of Duragapur Area District Chandrapur.

Dr S G Bisen[1], K M Mulay[2], B K Khade[2], R P Masade[2]

1 – Retired Professor, Department of Mining Engineering, RCERT, Chandrapur

2 – Associate Professor, Department of Mining Engineering, RCERT, Chandrapur

Abstract:

The rock formation of lower Gondwana group, Durgapur area comprise, from bottom to top, Talchir, Barakar and Kampthi formations. Coal occurs in Barakar and is being mined. Sampling of soil was done separately from two formations. Analysis of trace ions indicate that soil are affected by deposition of fly ash and have adsorbed substantial quality of toxic metals from it.

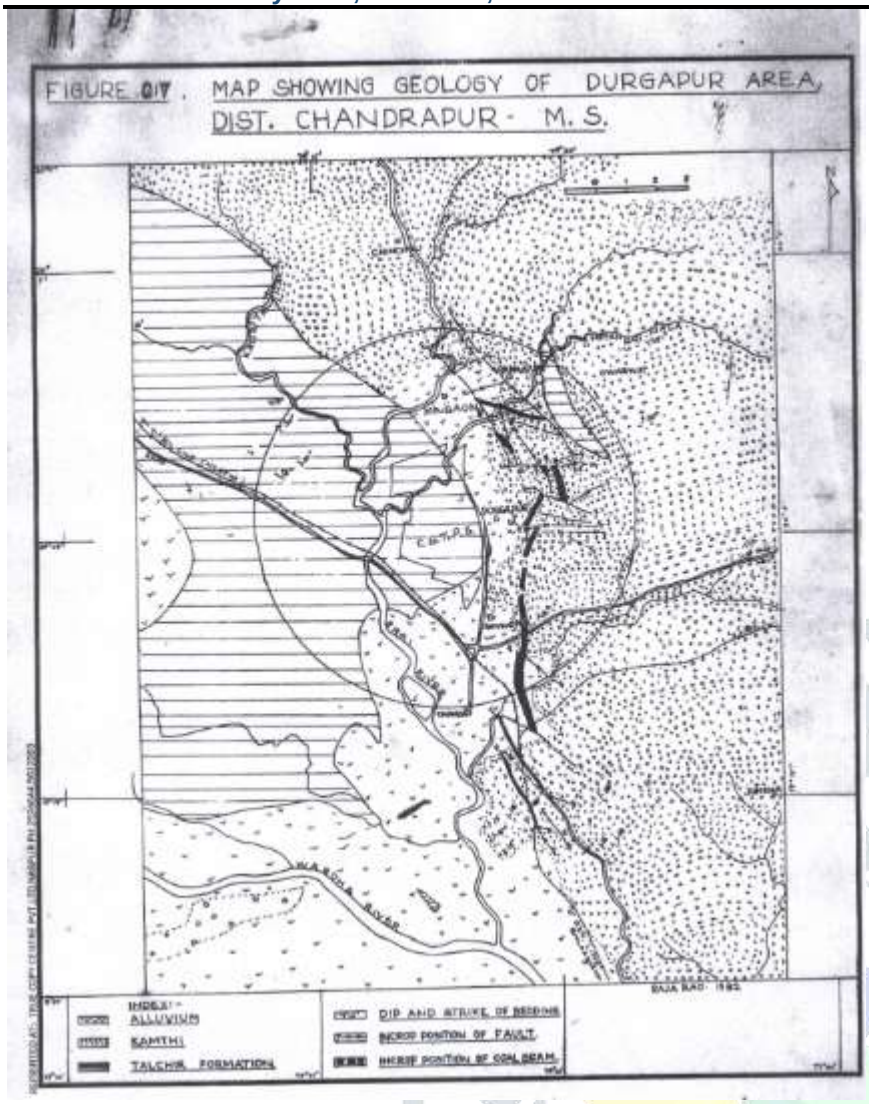
Introduction:

The Gondwana coal is mostly from Barakar sandstone. Talchir and Barakar sandstone both contain pockets of shales, ferruginous nodules and opaque heavy metals including pyrite. Therefore the source of arsenic in ground water has to be pyrite. Dissolution of pyrite may be the mechanism for arsenic to contaminate soil and groundwater of Durgapur Area.

Geological Setup:

The Chandrapur Durgapur area is underlined by Gondwana rocks comprising mainly sandstone and shales. These rock formations represents Talchir Barakar and Kampthi formations, from base to upwards of lower Gondwana sequence. The geological age of Talchir & Barakar is Permian where-as Kampthi is placed in upper Permian (Singh, 1987). The Talchir formation are fine to medium grained intercalated with shales. Barakar are medium to coarsed grained with bands of shales and intercalated clays. The shale bands in Barakar are grey and mostly carbonaceous. Some shales are sandy. The composite coalseams are found in Barakars. The Kampthi formation are medium to coarse grained and porous and friable. This sandstone are interbedded with variegated shales, some of which contain clays of bentonitic nature.

Chandrapur Super thermal Power Station (CSTPS) is a mine head plant. It is located adjacent to village Durgagpur about 10 Kms North of Chandrapur railway station junction (Figure: 1). The Chandrapur Durgapur region is underlined by Kampthi sandstones followed by Barakar coal bearing sandstones of lower Gondwana age. The Gondwana sequence rests unconformably over the Proterozoic sediments e.g. Pakhal limestone and Sullavai sandstones of Vindhyan age. The lower Gondwana formations are faulted at number of places mostly in the North of the study area (Rajarao, 1984). The Talchir formation consists mainly of tillites, shales, sandstones. The tillites are of glacier origin and composed of clasts of limestones, granites, quarzites, jasper and shales. The Barakar formation is coal bearing and rest unconfirmably over Talchir. It is essentially sandstone which is feldspathic and coarsed grained in nature. The ferruginus nudules are invariably associated with this sandstone (Rajarao, 1982). The rocks contain opaque heavy minerals such as magnetite, hematite, ilmenite and pyrite (Singh et. al, 1987).



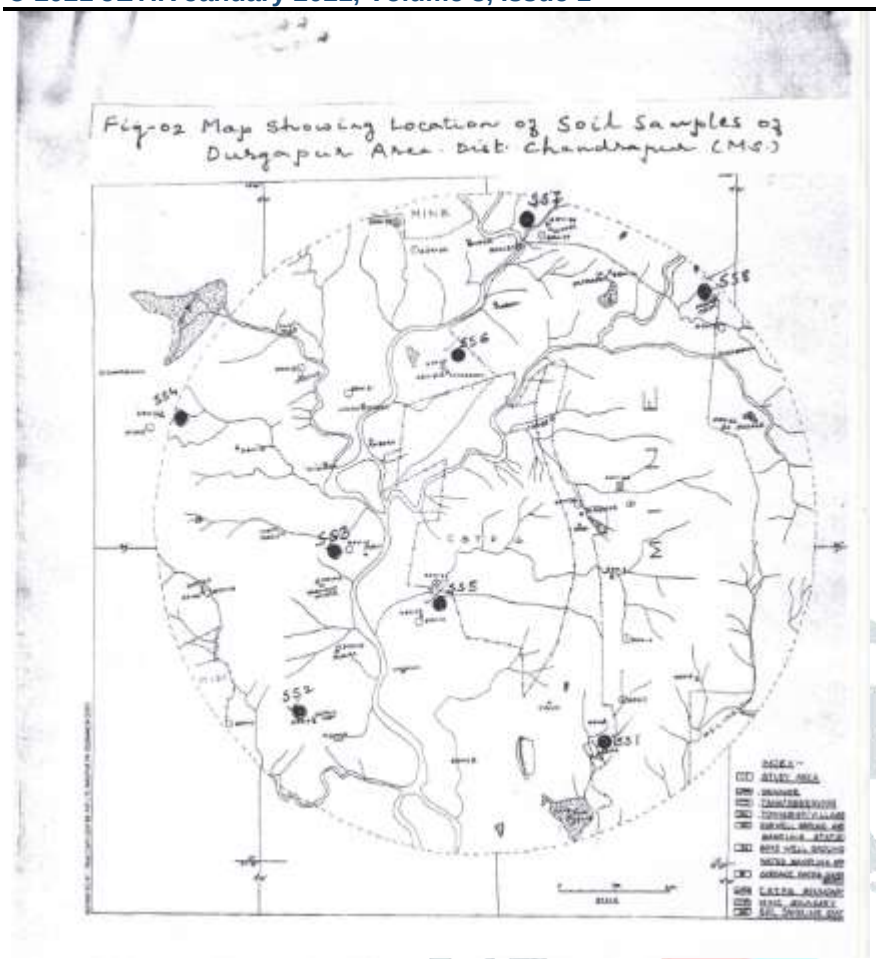
Lithology of Rock Formation and Soil Properties:

The sandstone and shales contain variety of heavy minerals such as Garnet, Zircon, Tourmaline, Rutile, Apatite, Staurolite, Kyanite, Chloride, Opaque, grains. The heavy minerals are found more abundantly in Talchir as compared to Barakars and Kampthis. The Opaque grains present in the formation are mainly magnetite, Hematite, Illiminite & Pyrite (Singh, 1987). Apatite minerals especially Flurapatite are known to contribute Fluride to water. Similarly the opaque grains, Pyrite is known to contain traced of arsenic which offer weathering is released in water.

The soil of the area which are mostly residual soils, are sandy and porous. The soils of flood plain area of Erai River are, how-ever, mixed with transported clays. The North Western portion of the study area where the fly ash is being dumped show white covering of coal ash. Eight soil samples are collected from different locations (Figure: 2) were analyzed for trace metal concentrations Arsenic, Lead, Cadmium. The trace metal concentration in soils are tabulated in **Table No: 1**

Table No: 1

Sr. No	Sample No	Arsenic (PPM)	Cadmium (ppm)	Lead (ppm)	Sellinium (ppm)
1.	SS1	63.37	5	40	Not Detected
2,	SS2	46.00	4	30	Not Dectected
3.	SS3	54.00	6	40	Not Dectected
4.	SS4	69.00	5	90	Not Dectected
5.	SS5	49.57	4	30	Not Dectected
6.	SS6	59.24	4	30	Not Dectected
7.	SS7	49.02	3	30	Not Dectected
8.	SS8	59.00	4	30	Not Dectected



Relation between Rock Formation and Toxic ions:

The aquifer rocks of the area are found varying in their porosity presence and absence of number of clay and shale bands, coal beds and heavy mineral composition. Besides these, the formations are affected by number of faults which impart secondary porosity to the aquifers. When the polarized coal is burnt at a temperature of above 1500^{O} Centigrade, as is produced in the slog tab furnace, of which about 50 percent of ash leaves the furnace as fly ash while other 50 percent fall to the bottom of the furnace. The analysis of various coal as concentrations of trace metals in the source hole also differs from the ash. The analysis of coal and various ashes are given in the following table. The table shows that the concentration of element such as F, As, Cd, Cu, Pb, Zn, etc in fly ash is greater than those found in the source coal. (Cavallanas, 1978)

Table No: 2 Analysis of coal and various coal ashes:

Elements	**Coal**	**Button Ash**	**Fly ash from precipitation**
As	1.1	1.1	11
Cd	< 1	< 0.7	< 1.6
Cl	4	20	60
Cu	14	53	80
F	44	17	100
Hg	0.08	0.06	0.13
Ni	4	20	30
Pb	6.3	26	62

Sb	0.13	0.08	0.4
Se	2.7	1.5	6.6
V	20	50	200
Zn	6	< 10	100
B	80	200	700
Mo	0.8	3	10
Li	50	200	200

(After Cavallaro, 1978)

From the above table it indicates that coal and derived fly ash from the coal both are the potential source of pollutants like As, F in the area. The As concentration generally found in Indian coal and fly ash range respectively, between 0.65 and 2.1 ppm and 2.4 and 3.5 ppm (Fulekar, 1989).

Table No: 3 Ash Concentration:

Sr. No	**Geological Formation**	**Range Concentration (ppm) of Toxic elements in Geological Formation**	
		As ppm	**F ppm**
1.	Fly Ash	0.65 – 2.10 (Fulekar, 1989)	Data Not Available
2.	Soil	46 – 69	Data Not Available
3.	Kampthi Sandstone, Barakar Sandstone & Coal	2.4 – 3.5 (Fulekar, 1989)	Data Not Available
4.	Talchir Sandstone	Data Not Available	Data Not Available

Suggesstion & Conclusion:

I. Geological Investigations suggest that the Durgapur area is underlain by Gondwana rocks of lower Gondwana sequence, from base to top, Talchir, Barakar (Coal Bearing and Kampthi Formation).

II. The chemical investigations suggest that the soils contain Arsenic in the range of 46.0 ppm to 69.0 ppm and Lead 30 – 90 ppm and Cadmium 3.0 – 6.0 ppm.

III. The soil (SS4) from location near the ash pond shows maximum Arsenic 69 ppm. This indicates that the soil are affected by deposition of fly ash and have adsorb substantial quantity of toxic metals from it.

Remedial Measures:

Many remedial measures**,** to check air pollution have been taken already by CSTPS like the installation of electrostatic precipitators (ESP) and raising the chimney height to 275m are chief amongst them. The dumping of ash produced in the furnace is the great problem for CSTPS. Following the normal practice, the ash in the form of slurry is carried 10 kms away from the power plant with the help of ash disposal pipes and it is being dumped in the ash pond.

This certainly helps in reducing the high level of suspended particulate matters on the atmosphere in an around power plant but it is of no help in checking the contamination of surface and groundwater. More effective measures are therefore required to be searched in the interest of saving the resources from deterioration and thus protect public health.

References:

I. Adyalkay, P G, Ayangar R S and Tikekar S S, 1996, Hydrology of the Gondwana Supergroup of Eastern Maharashtra with type area of Nagpur and Chandrapur through satellite imagery. NU, Department of Geology, Golden Jubilee Symposium Volume pp 227 – 234

II. Fulekar, M H & Dave J M, 1989, Arsenic Pollution due to Fly ash IJEP, Volume 9 No 11, pp 815 – 818

III. Rajarao C S, 1982 Coalfields of India, Coal resources of Tamilnadu, AP, Orissa, Maharashtra Bulletin, GSI Series A No 45 pp 62 – 73

IV. Singh M P, Singh R M, 1987, On the heavy Metals of Lower Gondwana Sediments of Ghughus Coalfields, Wardha Valley, Maharashtra, Journal, GSI, Volume 29 pp 567 – 583.