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Soil pH & Electrical Conductivity of Unconformity related Uranium mineralization in Narayanpur area, in the part of Srisailam sub basin, Nalgonda District, Andhra Pradesh (INDIA).

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Abstract- Pedogeochemical sampling over an area of 24 Sq.Km taken up in the Narayanpur, which is in the part of Srisailam Formation NW of Cuddapah basin, to assess the soil pH and EC of the unconformity-related uranium mineralisation of the area . The area mainly consists of the basement granite, dolerite dikes, basal pebbly quartzite and intercalated shale. Pedogeochemical sampling is carried out on a grid of 1 Km x 1 Km out of 24 Sq.Km and 24 soil samples collected from - different geological -formations. It is observed that the pH is high along the unconformity where we also observe uranium mineralization, whereas EC is low. The low pH & high EC is observed in the soil samples away from the unconformity indicating mobile nature of uranium.

Index Terms- Srisailam sub-basin, pedogeochemistry, unconformity, uranium, pH, EC.

I. Introduction

Narayanpur is located in the Srisailam sub basin NW of Cuddapah basin. The Srisailam sub basin is formed geologically mid to late Proterozoic in age and it is unconformably overlying the the Archean basement granite (Senthil kumar, P. et al., 2002).). The sediments are essentially arenaceous and are represented by basal pebbly quartzite, followed by a grey medium grained quartzite with grey buff coloured shale as intercalations (Jayagopal, A.V. et al., 1996)). The basement is represented by coarse to medium grained fractured granite. Srisalam sub basin and Cuddapah basin geology with known uranium mineralization (Sinha, R.M. et al., 1995). The present study area will describe soil profile, influence of unconformity related uranium on soil pH & EC of Narayanpur. Important radioactive anomalies located in the study area related with unconformity contact basement granitoid with the Srisailam formation, around the Narayanpur.

II. Geology

Unconformity type uranium deposits are well known for their high grade and large tonnage in the Athabasca basin of Canada and the Pine creek Geosyncline- of Australia (Hoeve,J. et al., 1980). In India, consistent efforts are being made by AMD to target similar geological environs in middle Proterozoic cover sequences which overly the Archean/lower Proterozoic basement schist, gneiss and granitoid in Purana basins. The crescent shaped Cuddapah basin, covering 44,500 Sq.Km and being the second largest -among the Purana basins in peninsular India is the most promising in the country (Dhana Raju, R., et al., 1993). The present study area is located in the Srisailam sub basin NW of Cuddapah basin (Figure 1), where Srisailam Formation unconformably overlies the basement granitoid (M.B. Verma et al., 2009), At places part of the cover rocks has been eroded exposing the non-conformity contact with the granitoid. Weathering and erosional processes are need for soil formation, While that processing may be the uraniferous substances melted and particles are mixed up with in the soil, such type of soil particles may be contaminated, effect the influence on the pH & EC.

III. Soil profile in the study area

Soil profile varies in make-up within wide limits according to their genetic and geographic environment. Most well developed profiles however can be divided into four principal horizons, and are designated into A, B, C and R in descending order (Levinson, - 1980). Further division of each layer into sub horizon differs in composition, texture, color, and layer boundaries are transitional over 2.5 to 15 cm (M.A., et al., 2002). The A and B horizons together constitute the solum (or) true soil, while the C- horizon is the partly weathered parent material from which the solum has been transported by soil forming process Chaudary.

In the study area, A - Horizon nearly contains pure organic matter with a steady decrease in the organic matter with depth through soil profile. The A horizon has undergone extensive leaching, there by removing soluble mineral salts and colloidal material to lower horizon (Nohon, D.B., 1991). The A horizon (pH range is between 5.1 – 6.55 in the study area) also contains carbonic acid and other organic acids (Richard, A. et al., 2010). Which - moves downward, where they react with and carry a variety of cations and compounds in solution, suspension or colloidal form,. The subdivision of - A horizon occurs under a variety conditions. Hence, sampling of A horizon must be avoided.

The leached material transported from A horizon accumulates at B Horizon, which is alluvial. This horizon has a prismatic or blocky structure that is caused by high concentration of iron and aluminum oxides in association with organic matter and manganese oxide in the study area. A well drain soil allows removal of many of the soluble compounds and elements that have been leached from A horizon. The B horizon is the layer of the soil-profile that is usually sampled as part of exploration surveys for mineral deposits. The soil horizon is not well matured in the study area; B horizon is not developed and not differentiated from C (Figure 2).

The C- Horizon consist more or less weathered parent material for the overlying A and B horizons. The C horizon have weathered bedrock base of the soil profile. It is important to appreciate that the parent material may be rock, transported alluvial, glacial or windblown or even soil of past pedogeochemical cycle in the study area. R – Horizon is the underlying rock material, which is unaltered bed rock.

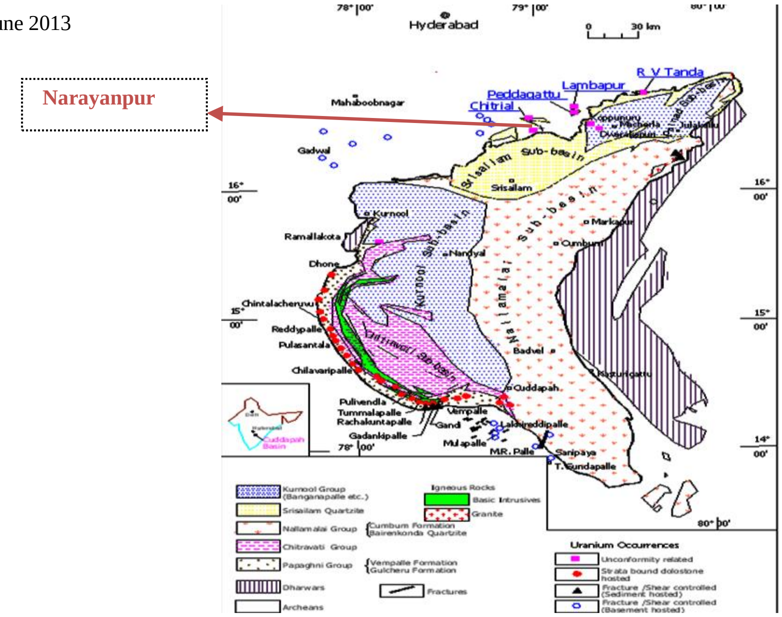


Figure 1. Location of Narayanpur in Cuddapah basin

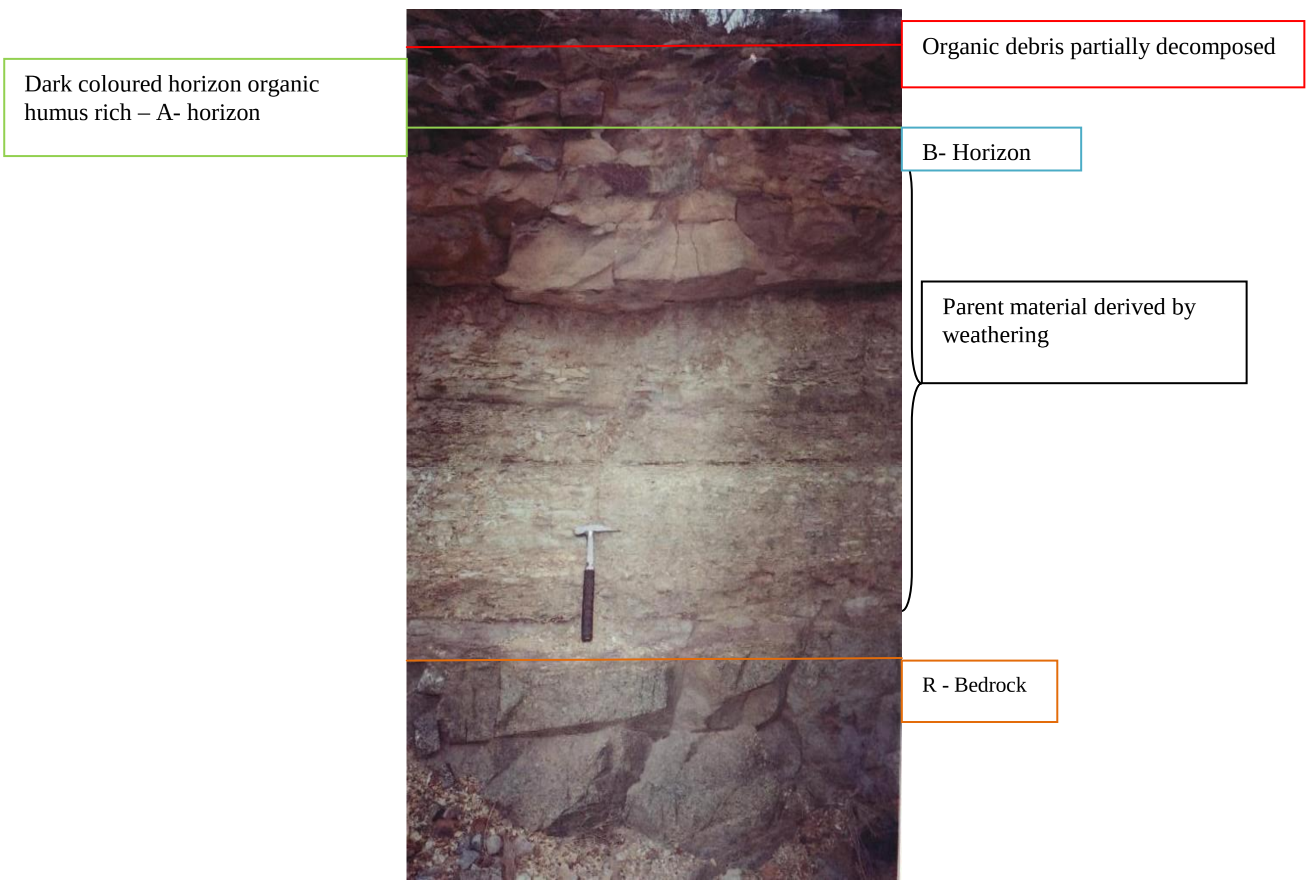


Figure 2. Soil profile of the Narayanpur

Figure 3. Soil sampling at Narayanpur on grid.

IV. Materials and Methods

Narayanpur area is a part of Srisailam sub basin in the northwest fringe of Cuddapah basin. The area is essentially under agriculture fields and natural biodiversity. Pedogeochemical survey was conducted about 24 Sq.Km. as per grid pattern 24 samples were collected with GPS locations from different geological terrains. Basement granite, Dolerite dykes and quartzites are the predominant rock units in the area. The pedogeochemical sampling is carried out on 1 sq. km X 1 sq. km. according to grid pattern (figure 3), samples collected from center of grid except in valley positions. The B - horizon is not well developed in the study area, instead of immature samples the termite mounds were collected (Chaudary, M.A. et al 2002). The pedogeochemical samples were collected B horizon only (Levinson, 1980). The samples were sundried and sieved to -80 mesh size in the field itself to save time and avoid the contamination. pH and Electrical Conductivity were determined with the help of digital portable analyzer kit manufactured by Systranics model 365, India (Gardner, C.M.K. et al., 1991). The uranium element content in the representative samples were analyzed by ICP-MS at NGRI following the procedures given in Balaram et al., 2003.

Table 1. Pedogeochemical analysis results of Narayanpur

longitude	latitude	sample no	**Rock type**	**U (ppm)**	pH	**EC µs/cm**
79.008476	16.514419	NP/S-1	Dyke	1.58	5.77	707.50
79.008336	16.503078	NP/S-2	Quartzite	1.89	5.73	786.11
79.008406	16.494024	NP/S-3	Granite	7.89	5.68	786.11
79.010549	16.48625	NP/S-4	Dyke	4.08	5.94	707.50
79.018026	16.513139	NP/S-5	Quartzite	6.68	5.81	707.50
79.018934	16.505936	NP/S-6	Quartzite	2.38	5.10	786.11
79.018329	16.494664	NP/S-7	Dyke	1.52	5.20	786.11
79.020868	16.485815	NP/S-8	Quartzite	1.57	5.92	832.35
79.025084	16.511927	NP/S-9	Granite	1.21	5.38	744.74
79.026714	16.505044	NP/S-10	Quartzite	1.46	5.87	832.35
79.026458	16.494778	NP/S-11	Quartzite	0.84	5.90	944.74
79.029113	16.48785	NP/S-12	Quartzite	6.57	5.89	744.74
79.035938	16.51179	NP/S-13	Quartzite	9.73	5.72	786.11
79.035799	16.503398	NP/S-14	Quartzite	2.05	5.65	832.35
79.036591	16.493886	NP/S-15	Granite	1.32	5.40	832.35

79.035472	16.486318	NP/S-16	Quartzite	2.53	5.15	832.35
79.044883	16.511927	NP/S-17	Quartzite	1.97	5.30	744.74
79.044696	16.503078	NP/S-18	Quartzite	1.11	5.17	786.11
79.044953	16.495098	NP/S-19	Quartzite	1.65	5.55	786.11
79.047026	16.486638	NP/S-20	Granite	1.61	5.70	744.74
79.055784	16.512315	NP/S-21	Granite	22.77	6.55	644.74
79.053129	16.50301	NP/S-22	Quartzite	5.95	5.86	832.35
79.057741	16.494207	NP/S-23	Dyke	2.40	5.76	744.74
79.056646	16.484603	NP/S-24	Granite	1.30	6.03	786.11
			Minimum	**0.84**	**5.10**	**644.74**
			Maximum	**22.77**	**6.55**	**944.74**
			Average	**4.45**	**5.68**	**781.08**

V. RESULTS AND DISCUSSIONS

Physical parameters like pH, EC and uranium around the Narayanpur area is reported in Table 1, whereas the isochemical maps will explain the concentration of pH, EC & Uranium mineralization of the study area.

The pH (figure 4) of pedogeochemical samples of study area is between 5.1 to 6.55 with an average value of 5.68. As per the United States Department of Agriculture and Natural Resources Conservation Service (2011), soil conservation service classifieds pH ranges follows as <3.5 is Ultra acid, 3.5-4.4 Extreme acid, 4.5-5.0 very strong acid, 5.1-5.5 strong acid, 5.6-6.0 moderate acid, 6.1-6.5 slight acid, 6.6-7.3 neutral, 7.4-7.8 slightly alkaline, 7.9-8.4 moderately alkaline, 8.5-9.0 strongly alkaline, >9 very strongly alkaline. six samples fall in (NPS-6,7,9,15,16,17,18) strong acid range, one sample (NP/S-21) falls in slightly acid range, . The remaining samples fall in moderate acid range.

EC concentration (figure 5) is maximum value 944.74 µs/cm, minimum value is 644.74 µs/cm and the average value is 781.08 µs/cm, As per USDA (2011),the permissible limit of EC is 2320 µs/cm in soils, and the present samples do not exceed the permissible limit.. The average abundance of uranium is 1 ppm in soils (Levinson, 1980), the study area consisting of U concentration (figure 6) is maximum is 22.77 ppm and minimum 0.84 is ppm, the average value of all samples 4.45 ppm, some samples have high values compare with average abundance of uranium in soils.

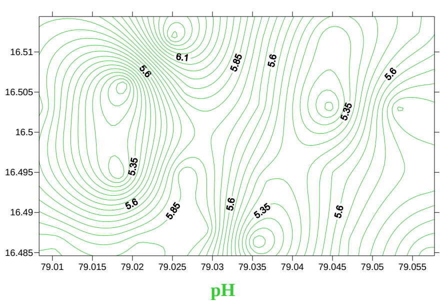


Figure 4. Concentration of pH

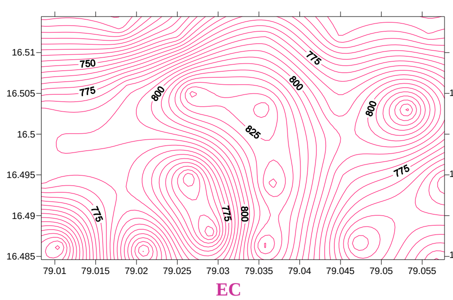


Figure 5. Concentration of EC

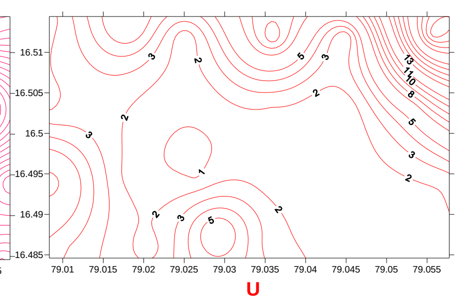
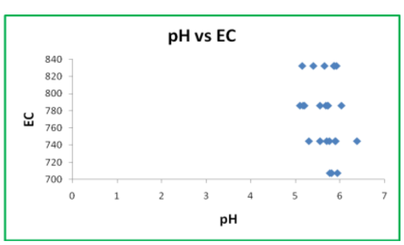
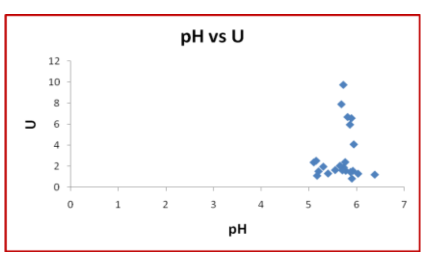


Figure 6. Concentration of U





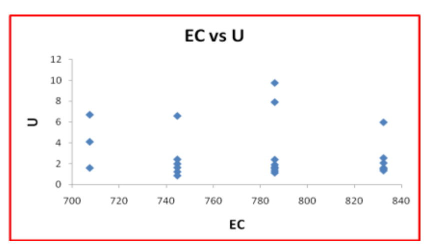


Figure 7 . Concentration of pH vs EC **Figure . 8. Concentration of pH vs U** **Figure 9. Concentration of EC vs U**

Above scatter plots illustrate that as pH increases, the concentration of EC decreases (figure 7 uranium increases (figure 8) near the unconformity zone, the properties of oxidation and reduction of oxides (F. Lidman et al, 2012). The uranium shows the influence on the pH & EC.

Figure 9 shows that concentration between EC and uranium, therefore the EC increases, along with that the concentration of uranium decreases. EC shows reciprocal relation with pH in Narayanpur soils.

Over half of the world, current production is from so called "unconformity type" deposits. These deposits were typically formed between 1800 to 1200 Ma, generally uranium shows higher concentration at neutral level of pH in primary environment (Daryl Hockley et al., 2010). Chemical speciation of uranium (VI) in soils is highly dependent on soil composition on the pH in the soil solution (Guillaume et al., 2001) the uranium was transported under unexpectedly low pH conditions and at the higher concentrations recorded in crustal fluids (A. Richard et al. 2010). There is needed significant positive positive correlation between pH and the export of uranium but not for thorium. Higher pH tends to leads to higher export of uranium and higher average concentration of uranium in stream water, there is negative correlationship between pH and wetland coverage of uranium

VI. Conclusion

Narayanpur area is located at Srisailam sub basin in Cuddapah Basin, As per the United States Department of Agriculture and Natural Recourses Conservation Services norms, the study of pedogeochemistry in Narayanpur area shows the pH & EC does not exceed the permissible limit.. If the pH is below neutral, uranium is stable in oxide form; EC shows a reciprocal relation with pH in Narayanpur soil. It has been observed that the pH more than 6.0 (sample no NP/S – 21 is near the unconformity) is in proximity zone and pH ranging from less than 6.0 (Sample no NP/S - 6,7,9,15,16,17,18) is away from the unconformity zone. It can be concluded that along the unconformity zone, the uranium mineralization is observed and have the pH is above 6.0 and low value of Electrical Conductivity. Away from the unconformity zone the pH indicates low that the uranium is mobile and EC is decreases. Based on the above information concluded that the unconformity related uranium mineralization slightly influenced on soil pH and Electrical Conductivity.

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