

Profile of a Geo-Icon

A detailed biodata and life account of Prof. Dr. K.C. Sahu, a distinguished professor of IIT, Bombay (Retd.) whose lifelong contributions have left an indelible mark in the field of geology and allied sciences.

Born in 1934, Krushna Chandra is the 7th. Of the 9 children of Shri Suru and Srimati Sehati Sahu, a sweet vendor family of Barpali, a Zamindari village in western Odisha. His early education till Matriculation was in the village school during which period he also had to help parents in their daily business and at the same time attended the school. A poor student in the class, even once failed at the Upper-Primary level, therefore was destined to be a sweet vendor in the village like his parent. However, exposure to Science and Mathematics subjects in the High school level stimulated him and he came out with high rank in the Matriculation examination of the then Utkal University. Even amidst the rigorous sweet vending duty in street or festival fairs he would day dream of a future scientific career. The excellent Matriculation result encouraged him to go for science stream education. He left the village and joined MPC College at Baripada for I.Sc. Course.

High ranking result in I.Sc. enabled him to enter the prestigious Institute like the IIT-Kharagpur, which has just opened a couple of years ago in 1951 and graduated in Geology & Geophysics in 1957, followed by an M.Tech. Program in Applied Geology in 1960. In between, joined the Orissa Mining Corporation (OMC) and had a taste of field life and experience to live in the tribal area of Mayurbhanj on prospecting duty.

Initially the field life of a Geologist demanding living away from civilization, away from electricity and running water seemed frustrating. But subsequently with further studies and research, the grandeur of Earth Science slowly opened up vistas of knowledge on the planetary history that ranges from cosmochemistry, evolution of Earth and life, plate tectonic and impacts of use and abuse of planetary resources. Not to be lost in the vastness of Geological Science, I delved and focussed my doctoral research in a narrower field of Geochemistry and Mineralogy when I took up the Ph.D. program in Univ. of Sheffield under a scholarship awarded by CSIR. My research program was on Olivine & Pyroxenes of a bench mark suits of rocks of Africa, namely the basalts of Kilimanjaro and was a part of a larger assignment the University had undertaken to evaluate the state of art (Passivity) of the Kilimanjaro volcano. The mineral chemistry of the intratelluric minerals like Olivine and Pyroxenes helped in understanding the Pressure/Temperature of the magma chamber and the parasitic cones of the volcano are indicative of the nature of the residual injection.

After a rigorous training in geological research techniques and applications while in UK, the first impression I got on return to home country that the CSIR had National/Regional Laboratories in all fields of science except "Minerals". GSI, the "God Father" of Geology in India overshadowed the issue. Enthusiastically I circulated a humble note to knowledgeable personalities suggesting that CSIR may establish a Mineral Research Laboratory in a mineral rich State like Odisha, particularly in Bhubaneswar. Positive response was received from several technical quarters, one of which of great importance was from Mr. Biju Pattanaik, Chairman Planning Board & former CM, who called me for a discussion and revealed that an agenda of establishing a RRL is already on the anvil. He asked me to submit the type of projects the proposed laboratory would undertake and advised me to join the Institution when it comes. I complied with his order and after a year when the RRL was established in Bhubaneswar, I was the first Scientist to join the Laboratory.

Teething problems and lack of vision of the leadership of the new Laboratory made me to leave the CSIR Laboratory and join IIT-Bombay as a Faculty Member. It is only joining a teaching department, I realised that teaching needs a large amount of pre-lecture reading specially when the young students expect a full confidence and clear presentation from a qualified teacher. An ideal academic career needed increased visit to Library, jotting down lecture themes and articulated presentation. Every lecture delivered made the teacher wiser. The academic freedom of IIT also enabled R & D works through its academic programme and encouraged undertaking of national and international projects. Students at PG and doctoral levels were added resource for the project work.

Sheffield Univ., where I worked for 3 years for doctoral program had the Sorby Laboratory, which still preserves the original Sphalerite slide on which Fluid Inclusion was detected by Sorby. For technical reason I could not pursue my doctoral program on Fluid Inclusion there. On joining IIT-B I tried to initiate Fluid Inclusion studies in minerals with the help of a fabricated heating stage fitted to a Swift microscope. I am pleased to record that the technique developed at IIT-B in 1970s has laid a strong foundation in the Earth Science Department by my students and has spread to other important laboratories and universities in India.

The Sukinda Ni-Laterite project, I had started in RRL, Bhubaneswar was restarted in IIT-B and the Geochemistry of deuteric alteration that led to enrichment of Ni over ultrabasic rocks was extended to the dynamics of Water-Rock Interaction (WRI), a purely secondary process of chemical Mobilization, Transportation and Dispersion (Accumulation) of elements. The process when looked in an anthropomorphic environment for a select group of elements like Pb, Zn, Cd, Ni, Mn, Cr, Hg, etc. around industrial and mining belts are considered to be modern days pollution of Heavy Metals in Environment. This concept of Toxic Heavy Metal Pollution of air, water, soil, plants and biota was applied in many hot spots of Indian locales, Mumbai, Delhi, Rourkela, Zawar mines, Sukinda valley, Rushikulya, Bramhani and Subarnarekha river courses.

Casual observation on the mechanism of coal formation shows that coal deposits ought to be rich in many toxic heavy metals. The higher the ash, the higher the enrichment of deleterious elements. Conspicuous consumption of coal/lignite in power plants for power generation disperses a considerable amount of toxic heavy metals to the environment besides disposal of fly ash in tailing ponds and increase SPM and sulphurous fumes in the atmosphere. With the expertise generated in IIT-B, an international project on "Environmental Impact of Coal Consumption in India" was undertaken with collaboration of Univ. Of Ontario, Canada, funded by International Development Research Centre (IDRC), Ottawa.

Consequently, NTPC, a nodal public sector undertaking assigned us 2 successive large consultative projects on Coal Ash and for siting of Ash Ponds.

While we were busy with environment of the anthropomorphic niche in terms of pollution or contamination of the natural ecosystem, the DST entrusted us to look into the PreCambrian Environment which started the Great Oxidising Event some 3 billion years before as indicated by extensive deposition of Banded Iron Formation (BIF). Scientists from Calcutta Univ., Indian School of Mines, NGRI and Dharwad Univ. Were advised by DST to join the "PreCambrian Environment" project on Oxygen evolution on Earth.

Studies of Heavy Metal Pollution considered to be life and death issue for modern human society, when treated as a part of Water-Rock-Interaction (WRI), the fallout opens up to wider issues like (a) formation and importance of Soil, (b) formation of Clay minerals which shows primeval properties of life (Did life started as silicate ?) and (c) the role of Water in making up the planetary architecture and kick

starting life from the inert silicate mineral. Considerable thought has been given on each of the issues through publications and for soil formation limited laboratory experiments have been done.

- (a) It takes several thousand years to form a few mm thick layer of residual soil from the parent rock. Soil is essential for sustenance of agricultural productions to feed burgeoning population. Besides, the green plant cover enabled over it is the only sustainable process of Carbon sequestration in the present dilemma of global warming and climatic change. Therefore it is a significant earth resource, more important than gold, diamond, coal and ores. No wonder the vernacular term for the soil is “*Mati*” and in slow utterance “*Ma’a Ti*” (The Mother). However its value is little understood and the top soil is rampantly dug for various developmental works, degraded or polluted by application of chemical fertilizers and pesticides. The modern Man has become a “Neo-Kalidas” cutting the very branch on which he is sitting.
- (b) Clay mineral formed by Water-Rock-Interaction assumes a network of layered structure (Phyllosilicate) as against the parental Tectosilicate, a 3D network of Si-O tetrahedra and develops strong properties of adsorption, desorption and Cation Exchange Capacity (CEC) something equivalent to eating and excreting in “living things”. Besides Clay mineral has Species and sub-Species with atomic substitution in the mineral structure. When suspended in water containing different ions, it grows symmetrically with high fidelity of replication. With such display of the primeval life signs, it is natural to hypothesise that life on a siliceous earth ought to have started as a Silicate. Transformation of the silicate life to a Carbonaceous form is an important issue in Co-ordination Chemistry and may be considered in Geological Science equivalent to the Great Oxidising Event of Anoxic-Oxic transformation leading to appearance of Cyanobacteria and blue and green algae in PreCambrian time.
- (c) “We discuss about water always with a sole mission of an Exploitative Model either for Drinking (Domestic use), Industry, Agriculture, Transportation or Sewage dilution, each vying with other. Exploitative model invariably ends up with Pollution, Paucity (Draught), and Paradox of Plenty (Flood). Water is not different from us, rather we are a part and “particle of the ocean of this elixir” and mimic the hydrological cycle by birth and death. Assignment of a “Human Face” to water reconnects humans to the parental material, and to a realization that water is not a commodity to live on but a community to live with. All humans are connected through water. Being what we are (75 % of water in whole body-weight and 90 % in blood) exploitation and abuse of water in any form is exploitation and abuse of self. In short, when we pollute water, it ends up with “Societal pollution” and when we interfere with natural hydrological cycle in the name of development and progress we fiddle with “Societal genome”.

The role of water in making up a lively Earth is well known. At molecular level the vibrations of the atoms in a molecule of water are described to mimic the symmetrical movements of a classical dance. The impact of the danseuse molecule on terrestrial rocks and minerals like Feldspars, for example, has been illustrated in the mechanism of water-rock interaction in Nature. The molecular vibration has developed a large number of anomalous properties in water which in turn, supports and sustains the living system in the biosphere in a variety of ways, but with excess, abuse and freaks of natural cycle, water is known to be a universal agent of destruction in geological time.. A critical account has been presented regarding the impact of splitting water for Green Hydrogen generation The travesty of energy need of modern Man and at the same time, desire to decarbonize the energy source through Green Hydrogen can be summed up as follow:

“Nature created Water from the Ribs (H_2 & O_2) of the Earth. Water, the divine elixir, in spite of its internal turmoil (valence/Valentine perturbation) kick started Life, nurtured and sustained the “Seedlings” to the point of appearance of the intelligent ones (The Homo sapiens). The modern Man is set to split the Water to satiate his energy need.”

In the trajectory of evolution of the human society, the present system of Industrial and Consumer Capitalism weighs heavily on the Earth and its biodiversity and considered inappropriate and unsustainable. Many Futurologists, particularly Palaeontologists feel that the Sixth Extinction may not be too far, this time not ushered by Nature but by the pioneer species Man himself.

In pursuit of supremacy and excellence, mankind is cruising in a Time Machine on a transformation Super Highway at speed approaching the velocity of light, when Red (Danger) appears Green (Safe) and now, have reached a Cross Road, wherefrom the gate of the Sixth Extinction at the other end of the Highway has been observed by many visionaries including experienced Palaeontologists.

To avoid the disaster of Sixth Extinction which awaits on the Super Highway ahead, we need to change track to the Left to run away (Flight) or turn Right to Fight the adverse situation.

Stephen Hawkins once said “Let us pack up to migrate to another planet, we have made a trash of the Earth.” There is no place or planet where humans can be settled since our metabolism is earth bound. We have only one home Earth A and Flight is not an existential solution.

To Fight the adverse situation, two alternatives are possible. 1. Take up the technological sword as the weapon of fighting. Our present dilemma of neck deep water is consequent to the technological reliance. Besides, the new panacea of AI, a by-product of Sc. and Technology, makes Man redundant, therefore not acceptable for self integrity. 2. Adopt to the new environment and take up a new *Avtar*. Homo Sapiens become Cyborg; a new Species as stated earlier. With all that said, Geologists may stand confused at the cross road of the anthropocentric transformation. It is wiser to leave the matter to Darwin’s’ biological evolution instead of meddling with the Natural selection and run after a blinding technological track.

The Board of Trustees of CEHESH TRUST OF INDIA expresses its profound gratitude in honouring Prof. K.C. Sahu, Retired Professor of IIT Bombay, for his spectacular and lifelong contributions to the field of earth and allied sciences.

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