Significance of particle size distributions for size-dependent hematite nanomineral reactivity

A.S. MADDEN[1]* AND M.F. HOCHELLA[2]

[1]School of Geology and Geophysics, University of Oklahoma, Norman, OK 73019 USA
(*correspondence: amadden@ou.edu)
[2]Dept. of Geosciences, Virginia Tech, Blacksburg, VA 24060, USA (hochella@vt.edu)

Nanomaterials exhibit size-dependent properties below threshold sizes. For minerals, these property changes lead to a size dependence of nanomineral geochemical reactivity. Natural and laboratory-synthesized minerals typically do not exhibit uniform size distributions. The significance of particle size distributions (PSD)s was explored for heterogeneous Mn(II) oxidation on hematite surfaces. Measured rates of surface-area-normalized heterogeneous manganese oxidation rates as a function of average particle diameter and pH (7.3-7.9) used in the analyses included those previously reported for hematite mineral suspensions with average diameters of 7 nm and 37 nm [1] and additional data for 8 nm average diameter suspensions. After accounting for pH variations with a 2nd order relationship, a power-law function was generated to fit the rate data as a function of mineral size. The continuous power law size-dependent reactivity function was then applied to each of the individual 7 nm, 8 nm, and 37 nm average diameter sample PSDs along with hypothetical mixtures of the 7 nm and 37 nm average diameter suspensions. For a binary mixture of the 7 nm and 37 nm samples, the calculated mass percentage of 7 nm sample at which it contributes more than half of the moles of Mn(II) reacted per time was 1.8% (using the full PSDs), 0.7% using mean diameters and reaction rates only, and 18% considering surface area only but not size-dependent reactivity. Thus, only a small mass fraction of <20 nm hematite is necessary to significantly influence the Mn oxidation rate due to size-dependent reactivity, far exceeding the influence of surface area alone.

[1] Madden & Hochella (2005) *GCA* **69**(2), 389-398.

Exploration of hydrocarbons in Mehsana, Cambay Basin, India Using geochemical techniques

T. MADHAVI*, T. SATISH KUMAR, G. KALPANA AND A.M.DAYAL

Stable Isotope & Surface Geochemical Prospecting Lab, National Geophysical Research Institute, Hyderabad - 500007, India
(*correspondence: madhavit19@gmail.com)
(dayalisotope@yahoo.com)

The hydrocarbons generated and trapped at depth in petroliferous basins seep in varying quantities to the surface through the processes of diffusion, effusion & buoyancy and are retained in the surface soils/sediments, producing the anomalous surface expressions. The soil gas survey for adsorbed light gaseous hydrocarbons gives direct and promising evidence of the seepage of subsurface hydrocarbons. It helps in demarcation of anomalous hydrocarbon zones and the compositional ratios of same predict the probable oil or gas potential of the region of interest [1].

Surface geochemical survey for the detection of adsorbed light gaseous hydrocarbons has been carried out recently in Mehsana region of Cambay Basin in north-western India. The stratigraphy of the basin extends from Paleocene to Recent with thick Cenozoic sediments of ~8-9 km overlying the Deccan basalts. The Eocene-Oligocene source rocks, reservoir facies, cap rocks and significant overburden maintained ideal relation for the generation and accumulation of large amount of hydrocarbons [2]. The soil samples have been analyzed for light gaseous hydrocarbons by Gas chromatograph equipped with flame ionization detector. The observed concentrations (in ppb) of some of the initial 37 samples vary from: CH_4 =2 - 276; C_2H_6 = 2 - 113; C_3H_8 = 1 - 59; i-C_4H_{10} =1 - 6; and n-C_4H_{10} = 1-12 respectively. The statistical treatment of the data obtained for these samples indicates excellent correlation ($r>0.9$) among the hydrocarbon variables (C_1, C_2, C_3, & C_4), suggesting that these are genetically related and are not altered during migration. As per Pixler plot (1969), all the samples are falling in Oil zone. The geochemical survey carried out in the region attempts to present the adsorbed soil gas results and discussion of other geochemical parameters.

[1] Jones & Drozd (1983) Prediction of oil and gas potential by near surface geochemistry, *AAPG* **67**(6), 932-952. [2] Dhar & Bhattacharya (1993) Status of Exploration in the Cambay Basin, Proc. *Second Seminar on Petroliferous Basins of India* **2**, 1.