Solute transport and bioturbation models of the downward migration of radionuclides in soils

G. MATISOFF[1]*, M. KETTERER[2], K. ROSEN[3], J.W. MIETELSKI[4], L.F. VITKO[1], H. PERSSON[3] AND E. LOKAS[4]

[1]Case Western Reserve Univ., Cleveland OH 44106 USA (*correspondence: gerald.matisoff@case.edu)
[2]Northern Arizona University, Flagstaff AZ 86011 USA (michael.Ketterer@nau.edu)
[3]Swedish University of Agricultural Sciences, Uppsala Sweden (klas.Rosen@mv.slu.se)
[4]The Henryk Niewodniczanski Institute of Nuclear Physics, Krakow Poland (jerzy.mietelski@ifj.edu.pl)

Vertical profiles of ^{137}Cs and $^{239,\ 240}$Pu in soils collected from 2 sites in Sweden and 3 sites in Poland were simulated using both a solute transport model and a bioturbation model to better understand their downward migration into the soil. A time series of ^{137}Cs profiles indicates that the maximum ^{137}Cs activity occurred at the soil surface in 1986, but has migrated downcore 4.5 to 25.5 cm since and serves to provide excellent constraints on model parameters. Both the solute transport and the bioturbation models accurately simulate the downward concentration and activity profiles of the radionuclides at some sites but describe poorly the distributions at other sites. The distribution coefficients required by the solute transport model are about one hundred times lower than literature values indicating that even though the solute transport model can simulate the profile shapes, transport as a solute is not the primary mechanism governing the downward migration of either Cs or Pu. The bioturbation model uses appropriate values of the distribution coefficients and can simulate the downward migration because that model buries the fallout by placing soil from depth on top and homogenizing it throughout the mixing zone (0.6-2% per year of mixing). However, mixing in that model predicts concentrations in the top parts of the soil profiles which are too high in some cases suggesting that bioturation may not thoroughly homogenize the mixed soil. Future progress at understanding the downward migration of radionuclides and other tracers will require a more comprehensive approach, combining solute transport with bioturbation and including other important soil processes.

Heavy metal sediment concentration patterns within the Texas river system, USA and Hii river system, Japan

I. MATSUMOTO[1]*, D.HOFFMAN[2], J. MCALISTER[2], J. WOLFE[2] AND H. ISHIGA[3]

[1]Faculty of Education, Shimane University, Matsue, 690-8504, Japan (*correspondence: chromim@edu.shimane-u.ac.jp)
[2]Texas Agricultural Experiment Station/Blackland Research Center, Texas A&M University System, Temple Texas, USA
[3]Faculty of Science and Engineering, Shimane University, Matsue, 690- 8504,Japan

Heavy metal sediment concentration patterns of major rivers which are the Trinity, the Colorado, the San Antonio rivers and the Buffalo bayou, Texas USA and the Hii (including lakes Shinji and Nakaumi) river system have been examined. Purpose of our study is clarify the quantitative estimation of ratio of influence given to river sediment of nature and human activity by using of heavy metals [1, 2, 3, 4].

Sediment samples collected from various points along the upper and lower streams were subjected to content analysis and elution analysis (using liquate (flow) out test) on the heavy metals like Cd, Pb, Cr, As, Hg, Ni, Zn and Cu from the river sediment for the purpose of environment assessment. Results show that heavy metal content through out the river stream is almost all below the recommended limits of Japan. However, the experimental results show clear influence of human activity in some bigger cities on heavy metal concentrations in the river sediments as compared to smaller cities with low human population. It could be seen from the analysis that some heavy metals show relatively high content and high elution value in Dallas-Fort Worth, Huston, Tokyo, Osaka and Nagoya areas. In contrast to above rivers, there is a natural increase in sediment-bound heavy metal concentration by lake effect that is differentiation by gravity, Hii river system, Japan.

[1] Matsumoto *et al*. (2008): *GCA* **72**, A604. [2] Watanabe & Matsumoto (2008) *AGU Fall Meeting* ***2008***, Abstract #GC43B-0736. [3] Matsumoto *et al*. (2009): *GCA* **73**, A847. [4] Matsumoto (2009) *LAGUNA*,**16**, 53–62.