REE in Konza Prairie LTER Site (USA) Soil — Allochthonous?

G.L. MACPHERSON[1], W.C. JOHNSON[2] AND L.W. GATTO[3]

[1]Dept. of Geology, Univeristy of Kansas, Lawrence KS (USA) 66045 (glmac@ku.edu)
[2]Dept. of Geography, University of Kansas, Lawrence KS (USA) 66045 (wcj@ku.edu)
[3]U.S. Army Engineer Research and Development Center/Cold Regions Research and Engineering Laboratory, Hanover NH (USA) 03755 (Lawrence.W.Gatto@erdc.usace.army.mil)

The Konza Prairie NSF-LTER Site is a 35 km^2 tallgrass prairie located in the central USA with a mid-continental temperate climate. Most of the site has never been plowed, making it a rare remnant of once extensive grasslands in North America. The early Permian-aged bedrock has eroded into a bench (limestone)-and-slope (mudstone) type landscape. Bedrock is overlain by thin (2m or less) Pleistocene-aged loess or patchy alluvium/colluvium. Soils are mature, with thin O-, variable A-, and thick B- (or Bt-) horizons. Aeolian dust flux at the site is at least 50 kg/hc/mo [1] and weathering of this modern flux may be evident in shallow ground water in the limestone aquifers [2]. We investigated REE in sequential chemical leaches of soil profiles to characterize the REE distribution, evaluate effects of soil processes, and explore the possibility that dust imparts a REE signature different from the loess-based soils. Results show that the chemically resistant, oxidizable, reducible, and acid-leachable fractions of the soil at all depths (to 38 cm) have similar normalized REE patterns resembling UCC, although abundances vary over more than two orders of magnitude. The normalized REE pattern of the exchangeable fraction is significantly different from other fractions, suggesting that there is addition of labile material with recognizable REE signature or that fractionation during ion exchange has occurred. If fractionation has occurred, it differs from REE fractionation documented in similar environments. We suggest that the REE pattern in the exchangeable fraction of the Konza Prairie soils reflects input of allochthonous material.

References

[1] Smith, R. M., Twiss, P. C., Kraus, K., and Brown, M. J. (1970) Soil Sci. Soc. Amer. Proc. **34**, 112-117.

[2] Macpherson, G. L., and Wood., H. K. (2001) GSA Absts. w Prgms, **33** A-343.

Variability of nitrate sources in a regional aquifer: Role of soil processes and land use

P.B. MCMAHON[1] AND J.K. BÖHLKE[2]

[1]U.S. Geological Survey, Denver, CO, USA (pmcmahon@usgs.gov)
[2]U.S. Geological Survey, Reston, VA, USA (jkbohlke@usgs.gov)

Understanding sources of nitrate in regional aquifer systems (>50,000 km^2) is complicated by spatial variability in the controlling factors inherent in regional studies and by temporal variability that may span thousands of years, as indicated by ground-water age distributions. On the other hand, spatial and temporal variability at these scales provides an opportunity to observe systematic changes in the relative importance of controlling factors that otherwise may not be apparent at smaller scales of investigation. The unconfined High Plains aquifer underlies an area of about 450,000 km^2 in the western United States and supports one of the largest areas of irrigated agriculture in the country. Radiocarbon dating indicates that the aquifer contains a stratified sequence of ground-water ages spanning Holocene time.

Investigations of the soil zone, deep vadose zone, and aquifer indicate that nitrate in the aquifer was related to soil processes and land use that varied spatially and temporally. Prior to the widespread development of irrigated agriculture in the late 1950's, nitrate in ground water was derived from natural soil nitrogen. Volatilization and leaching of nitrogen in the soil zone produced systematic regional variations in the $\delta^{15}N$ composition of nitrate in recharge. The relative importance of volatilization and leaching in the soil zone, evaluated on the basis of $\delta^{15}N[NO_3]$ values in paleorecharge, was related to climate, with volatilization being more predominant in warmer, drier regions. A clear shift in the sources and larger fluxes of nitrate to the aquifer were apparent after the onset of irrigated agriculture. The new sources included applied fertilizer, manure, and naturally-accumulated nitrate stored in the vadose zone that was mobilized by irrigation. The greatest potential for irrigation-driven mobilization of natural nitrate was in warmer, drier regions because leaching was a relatively minor sink for soil nitrogen in those areas during the Holocene. Results from this study demonstrate the value of regional investigations in understanding linkages between soil-zone processes and ground-water chemistry.