

Contamination by arsenic and other trace elements in tube-well water and its risk assessment to humans in Hanoi, Vietnam

Agusa T., Kunito T., Fujihara J., Kubota R., Minh T.B., Kim Trang P.T., Iwata H., Subramanian A., Viet P.H., Tanabe S.

Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan; Department of Environmental Sciences, Faculty of Science, Shinshu University, 3-1-1 Asahi, Matsumoto, Nagano 390-8621, Japan; Research Center for Environmental Technology and Sustainable Development, Hanoi University of Science, VNU Hanoi, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam; Department of Legal Medicine, Shimane University, School of Medicine, 89-1 Enya, Izumo, Shimane 693-8501, Japan

Abstract: Concentrations of As and other trace elements and their association were examined in groundwater ($n=25$) and human hair ($n=59$) collected at Gia Lam District and Thanh Tri District, suburban areas of Hanoi, Vietnam, in September 2001. Concentrations of As in the groundwater ranged from Author

Keywords: Arsenic; Barium; Groundwater; Hanoi; Human hair; Manganese; Vietnam

Index Keywords: Barium; Groundwater; Manganese; Potable water; Risk assessment; Trace elements; Water wells; Hanoi; Human hair; Vietnam; Arsenic; arsenic; drinking water; ground water; trace element; well water; arsenic; groundwater; pollution exposure; risk assessment; trace element; article; concentration (parameters); dry weight; hair analysis; health hazard; human; human tissue; intoxication; practice guideline; risk assessment; Viet Nam; water contamination; world health organization; Arsenic; Barium; Drinking; Environmental Exposure; Family; Female; Fresh Water; Hair; Humans; Iron; Male; Manganese; Rain; Risk Assessment; Suburban Health; Trace Elements; Vietnam; Water Pollutants, Chemical; Water Supply

Year: 2006

Source title: Environmental Pollution

Volume: 139

Issue: 1

Page : 95-106

Cited by: 47

Link: Scopus Link

Chemicals/CAS: arsenic, 7440-38-2; Arsenic, 7440-38-2; Barium, 7440-39-3; Iron, 7439-89-6; Manganese, 7439-96-5; Trace Elements; Water Pollutants, Chemical

Correspondence Address: Tanabe, S.; Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan; email: shinsuke@agr.ehime-u.ac.jp

ISSN: 2697491

CODEN: ENPOE

DOI: 10.1016/j.envpol.2005.04.033

PubMed ID: 16009476

Language of Original Document: English

Abbreviated Source Title: Environmental Pollution

Document Type: Article

Source: Scopus

Authors with affiliations:

1. Agusa, T., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan
2. Kunito, T., Department of Environmental Sciences, Faculty of Science, Shinshu University, 3-1-1 Asahi, Matsumoto, Nagano 390-8621, Japan
3. Fujihara, J., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan, Department of Legal Medicine, Shimane University, School of Medicine, 89-1 Enya, Izumo, Shimane 693-8501, Japan
4. Kubota, R., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan
5. Minh, T.B., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan
6. Kim Trang, P.T., Research Center for Environmental Technology and Sustainable Development, Hanoi University of Science, VNU Hanoi, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam
7. Iwata, H., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan
8. Subramanian, A., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan
9. Viet, P.H., Research Center for Environmental Technology and Sustainable Development, Hanoi University of Science, VNU Hanoi, 334 Nguyen Trai, Thanh Xuan, Hanoi, Viet Nam
10. Tanabe, S., Center for Marine Environmental Studies (CMES), Ehime University, Bunkyo-cho 2-5, Matsuyama 790-8577, Japan

References:

1. Abernathy, C.O., Liu, Y.-P., Longfellow, D., Aposhian, H.V., Beck, B., Fowler, B., Goyer, R., Waalkes, M., Arsenic: Health effects, mechanisms of actions, and research issues (1999) *Environmental Health Perspectives*, 107, pp. 593-597
2. Agusa, T., Kunito, T., Kubota, R., Monirith, I., Tanabe, S., Tana, T.S., Arsenic pollution in Cambodia (2002) *Biomedical Research on Trace Elements*, 13, pp. 254-255
3. Agusa, T., Kunito, T., Nakashima, E., Minh, T.B., Tanabe, S., Subramanian, A., Viet, P.H., Preliminary studies on trace element contamination in dumping sites of municipal wastes in India and Vietnam (2003) *Journal de Physique IV*, 107, pp. 21-24
4. Anan, Y., Kunito, T., Watanabe, I., Sakai, H., Tanabe, S., Trace element accumulation in hawksbill turtles (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*) from Yaeyama Islands, Japan (2001) *Environmental Toxicology and Chemistry*, 20, pp. 2802-2814
5. Anonymous, Barium (1988) *Review of Environmental Contamination and Toxicology*, 107, pp. 13-23
6. Arnold Jr., H.L., Odom, R.B., James, W.D., (1990) *Andrew's Diseases of the Skin: Clinical Dermatology*, Eighth Ed., , W.B. Saunders Company, Philadelphia
7. Bagla, P., Kaiser, J., India's spreading health crisis draws global arsenic experts (1996) *Science*, 274, pp. 174-175

8. Barceloux, D.G., Manganese (1999) *Journal of Toxicology Clinical Toxicology*, 37, pp. 293-307
9. Bates, M.N., Smith, A.H., Hopenhayn-Rich, C., Arsenic ingestion and internal cancers: A review (1992) *American Journal of Epidemiology*, 135, pp. 462-476
10. Berg, M., Tran, H.C., Nguyen, T.C., Pham, H.V., Schertenleib, R., Giger, W., Arsenic contamination of groundwater and drinking water in Vietnam: A human health threat (2001) *Environmental Science and Technology*, 35, pp. 2621-2626
11. Cebrian, M.E., Albores, A., Aguilar, M., Blakely, E., Chronic arsenic poisoning in the north of Mexico (1983) *Human Toxicology*, 2, pp. 121-133
12. Chittleborough, G., A chemist's view of analysis of human hair for trace elements (1980) *The Science of the Total Environment*, 14, pp. 53-75
13. Chowdhury, U.K., Biswas, B.K., Chowdhury, T.R., Samanta, G., Mandal, B.K., Basu, G.C., Chanda, C.R., Chakraborti, D., Groundwater arsenic contamination in Bangladesh and West Bengal, India (2000) *Environmental Health Perspectives*, 108, pp. 393-397
14. Chung, J.S., Kalman, D.A., Moore, L.E., Kosnett, M.J., Arroyo, A.P., Beeris, M., Mazumder, D.N.G., Smith, A.H., Family correlations of arsenic methylation patterns in children and parents exposed to high concentrations of arsenic in drinking water (2002) *Environmental Health Perspectives*, 110, pp. 729-733
15. Das, D., Chatterjee, A., Mandal, B.K., Samanta, G., Chakraborti, D., Chanda, B., Arsenic in ground water in six districts of West Bengal, India: The biggest arsenic calamity in the world. Part 2. Arsenic concentration in drinking water, hair, nails, urine, skin-scale and liver tissue (biopsy) of the affected people (1995) *Analyst*, 120, pp. 917-924
16. Foy, H.M., Tarmapai, S., Eamchan, P., Metdilogkul, O., Chronic arsenic poisoning from well water in a mining area in Thailand (1992) *Asia-Pacific Journal of Public Health*, 6, pp. 150-152
17. Frisbie, S.H., Ortega, R., Maynard, D.M., Sarkar, B., The concentrations of arsenic and other toxic elements in Bangladesh's drinking water (2002) *Environmental Health Perspectives*, 110, pp. 1147-1153
18. Some Metals and Metallic Compounds (1980) IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man 23, , IARC, Lyon
19. Ikemoto, T., Kunito, T., Watanabe, I., Yasunaga, G., Baba, N., Miyazaki, N., Petrov, E.A., Tanabe, S., Comparison of trace element accumulation in Baikal seals (*Pusa sibirica*), Caspian seals (*Pusa caspica*) and northern fur seals (*Callorhinus ursinus*) (2004) *Environmental Pollution*, 127, pp. 83-97
20. Kaltreider, R.C., Davis, A.M., Lariviere, J.P., Hamilton, J.W., Arsenic alters the function of the glucocorticoid receptor as a transcription factor (2001) *Environmental Health Perspectives*, 109, pp. 245-251
21. Karim, M.M., Arsenic in groundwater and health problems in Bangladesh (2000) *Water Research*, 34, pp. 304-310
22. Kondakis, X.G., Makris, N., Leotsinidis, M., Prinou, M., Papapetropoulos, T., Possible health effects of high manganese concentration in drinking water (1989) *Archives of Environmental Health*, 44, pp. 175-178
23. Kubota, R., Kunito, T., Tanabe, S., Arsenic accumulation in the liver tissue of marine mammals (2001) *Environmental Pollution*, 115, pp. 303-312
24. Kurttio, P., Komulainen, H., Hakala, E., Kahelin, H., Pekkanen, J., Urinary excretion of arsenic species after exposure to arsenic present in drinking water (1998) *Archives of Environmental Contamination and Toxicology*, 34, pp. 297-305
25. Kurttio, P., Pukkala, E., Kahelin, H., Auvinen, A., Pekkanen, J., Arsenic concentrations in well water and risk of bladder and kidney cancer in Finland (1999) *Environmental Health Perspectives*, 107, pp. 705-710
26. Lewis, D.R., Southwick, J.W., Ouellet-Hellstrom, R., Rench, J., Calderon, R.L., Drinking water arsenic in Utah: A cohort mortality study (1999) *Environmental Health Perspectives*, 107, pp. 359-365
27. Nickson, R., McArthur, J., Burgess, W., Ahmed, K.M., Ravenscroft, P., Rahman, M., Arsenic poisoning of Bangladesh

- groundwater (1998) *Nature*, 395, p. 338
- 28. Okamoto, K., Morita, M., Uehiro, T., Fuwa, K., Zhen, K., About environmental standard materials NIES No. 5 Hair (1985) *Kankyo Kenkyu*, 55, pp. 109-117
 - 29. Paschal, D.C., Dipietro, E.S., Phillips, D.L., Gunter, E.W., Age dependence of metals in hair in a selected U.S. population (1989) *Environmental Research*, 48, pp. 17-28
 - 30. Smedley, P.L., Kinniburgh, D.G., A review of the source, behaviour and distribution of arsenic in natural waters (2002) *Applied Geochemistry*, 17, pp. 517-568
 - 31. Smith, A.H., Lingas, E.O., Rahman, M., Contamination of drinking-water by arsenic in Bangladesh: A public health emergency (2000) *Bulletin of the World Health Organization*, 78, pp. 1093-1103
 - 32. Stoica, A., Pentecost, E., Martin, M.B., Effects of arsenite on estrogen receptor-? expression and activity in MCF-7 breast cancer cells (2000) *Endocrinology*, 141, pp. 3595-3602
 - 33. Takeuchi, T., Hayashi, T., Takada, J., Hayashi, Y., Koyama, M., Kozuka, H., Kusaka, Y., Tomiyama, T., Variation of elemental concentration in hair of the Japanese in terms of age, sex and hair treatment (1982) *Journal of Radioanalytical Chemistry*, 70, pp. 29-55
 - 34. Tondel, M., Rahman, M., Magnuson, A., Chowdhury, I.A., Faruque, M.H., Ahmad, S.A., The relationship of arsenic levels in drinking water and the prevalence rate of skin lesions in Bangladesh (1999) *Environmental Health Perspectives*, 107, pp. 727-729
 - 35. Tsunetoshi, Y., Epidemiological study of arsenic exposure with special reference to the health effect of environmental pollution (2000) *Biomedical Research on Trace Elements*, 11, pp. 54-63
 - 36. (1996) Guidelines for Drinking Water Quality, Second Ed., pp. 156-167. , World Health Organization International Program on Chemical Safety, Geneva
 - 37. (2001) Environmental Health Criteria 224: Arsenic and Arsenic Compounds, Second Ed., , World Health Organization, Geneva
 - 38. Woolf, A., Wright, R., Amarasiriwardena, C., Bellinger, D., A child with chronic manganese exposure from drinking water (2002) *Environmental Health Perspectives*, 110, pp. 613-616
 - 39. Wu, M.M., Kuo, T.L., Hwang, Y.H., Chen, C.J., Dose-response relation between arsenic concentration in well water and mortality from cancers and vascular diseases (1989) *American Journal of Epidemiology*, 130, pp. 1123-1132
 - 40. Yoshida, T., Yamauchi, H., Arsenic poisoning in China (2000) *Biomedical Research on Trace Elements*, 11, pp. 45-53