ADVANCES IN LEAD ISOTOPES IN THE HEALTH FIELD.  B.L. Gulson, Graduate School of the Environment Macquarie University Sydney NSW 2109 Australia (bgulson@gse.mq.edu.au) and CSIRO Exploration and Mining Sydney.

Introduction: Since the pioneering studies of Manton [1] and Rabinowitz and Wetherill [2] in the early '70s, limited use has been made of Pb isotopes in the health field until recent years. Most investigations have focused on source apportionment of Pb in blood, with varying degrees of success depending on the complexity of sources and concentration of Pb in blood. In adult humans, >90% of the body burden of Pb is stored in the bones. There is concern that times of physiological stress such as pregnancy and lactation during which the bones undergo resorption and accretion, Pb is released and transferred to the fetus at a critical time of development of the central nervous system. Over the past decade, this hypothesis has been verified in two major studies supported by the U.S. National Institute of Environmental Health Sciences, one on primates in Ottawa [3] and the other in humans in Australia [4-6]. Only the results of the human study will be given here.

Methods: Subjects (n=15) were from other countries (CIS, former Yugoslavia, Bulgaria, Poland, Albania, China) whose skeletal Pb isotopic composition (i.c.) was different to that currently prevailing in Australia. They were compared with a control group (n=8) of multi-generational Australian subjects. Samples analyzed with TIMS for Pb i.c. (208/206, 207/206, 206/204) and concentration (202 spike) included: blood, urine, breast milk, food, gasoline, air particulates, water, house dust.

Results: Blood lead concentrations in 14 of the 15 immigrant subjects and for all Australian controls were less than 5µg/dl. Predicted changes in isotopic composition are shown in Figure 1. Minimal changes in isotopic composition were observed for the Australian controls. The mean change for each individual in skeletal lead contribution to blood lead based on the isotopic composition ranged from approximately 50% to 91%. During the first 6 months of the post-pregnancy period, the mean increases for each individual in skeletal contribution to blood lead based on the isotopic composition ranged from approximately 40% to 99%. As the pregnancy progressed, the contribution of skeletal lead showed an approximately linear increase. During the post-pregnancy period, the elevated percentage of skeletal lead mobilized, reflected by the lead isotopes, remained essentially constant for up to 6 months in spite of variations in length of breastfeeding ranging from <1 week to >6 months. Consistent, clear-cut changes in blood lead concentration during pregnancy and the post-pregnancy period were not identified for individuals. Environmental factors, especially diet, were not the major determinants of blood lead because of the low 206Pb/204Pb ratios in house dust, air, water and gasoline[4-6]. Only two subjects consumed dietary supplements for calcium and mobilization of skeletal lead to blood lead was the lowest of all the subjects.

Conclusion: Endogenous sources of lead especially from the maternal skeleton can be mobilized during pregnancy and even more so during the post-pregnancy period. Increased mobilization is consistent with increased bone resorption and may be associated with an inadequate calcium intake observed in quarterly 6-day duplicate diets. Calcium supplementation may be an important means of limiting fetal exposure to lead.

Figure 1. Prediction of potential changes in isotopic composition (206Pb/204Pb) during pregnancy for an Eastern European subject. The data shown in bar form are those obtained during a pilot study; the left column at each time is for “spot” urine, the right column is for blood. The ratio decreases exponentially after arrival in Australia, related to clearance of lead from the blood compartment, and then an equilibrium is reached between skeletal lead and Australian environmental lead. Predicted trends for mobilization of lead from the skeleton, no mobilization, and rapid exchange of skeletal lead with Australian lead (Aussie Lead) are shown as dashed lines.