Localization and speciation of mercury in brown rice

Cultivation of paddy rice for human consumption is a dominant agricultural activity throughout Asia. High levels of mercury (Hg) in rice grain pose a potential threat to human health, although the extent of risk is dependent on the chemical speciation of Hg inside the grain. Financed by the National Basic Research Program of China and National Natural Science Foundation of China, the research group headed by Prof. Feng Xinbin at the Institute of Geochemistry, Chinese Academy of Sciences reported speciation and localization of Hg in three fractions of rice grain (hull, bran, and white rice), which was recently published in *Environmental Science & Technology* (2014, 48, 7974—7981).

On a mass basis, the majority of inorganic mercury (IHg) in a rice grain is found in hull and bran. However, the majority of the more toxic species MeHg is found in edible white rice. During grain processing, most of the IHg (~78%) is eliminated, but the majority of the MeHg remains in the food product (~80%). Synchrotron radiation microscopic X-ray fluorescence (SR-μXRF) mapping reveals strong localization of Hg at the surface of brown rice grains, corresponding to the pericarp and aleurone layer. Based on X-ray absorption near-edge spectroscopy (XANES) data, the researchers proposed that IHg in bran is primarily bound to cysteine, and is associated with phytochelatins. Consequently, IHg is largely immobile and restricted to the outer layers of rice grain. MeHg in bran is primarily bound to cysteine and is associated with proteins. However, this MeHg-cysteine association behaves like a mobile nutrient and is actively transported to the endosperm during seed ripening. Concentration of MeHg-cysteine in white rice has implications for public health. There is growing evidence for Hg contamination of rice throughout Asia due to point and diffuse sources of Hg pollution.

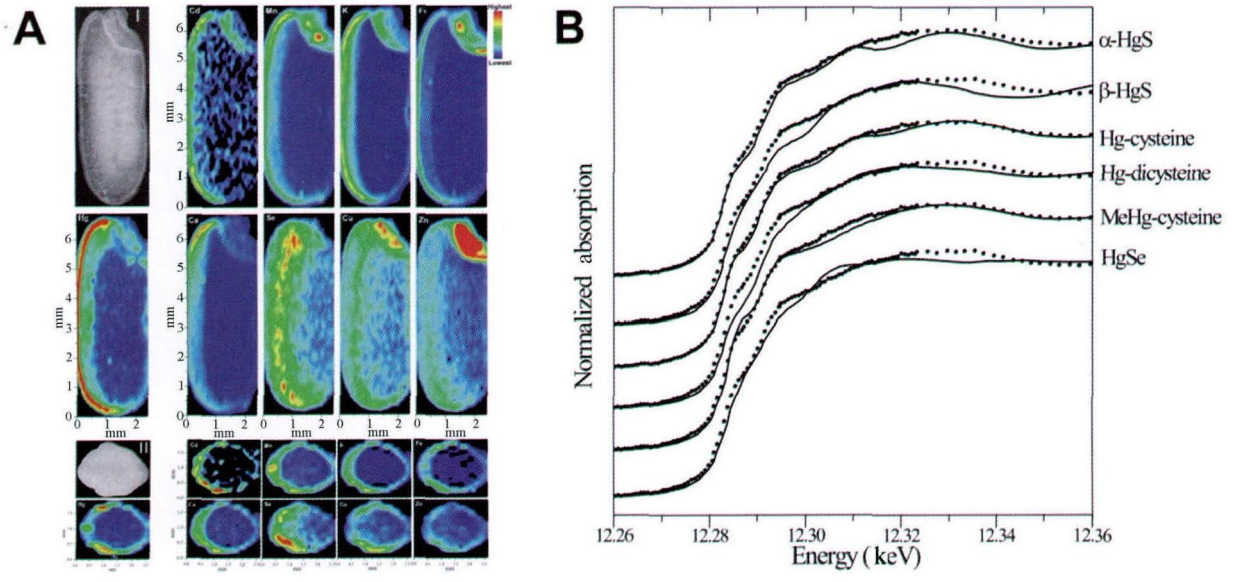

Figure Elemental maps (A) of longitudinal (I) and latitudinal (II) sections of rice grain (ventral side on right). The SR-μXRF signals for map (I) and (II) were collected at 50 μm and 100 μm steps, respectively; Comparison of the mercury L_{III} XANES spectra of rice bran with the spectra of selected standard compounds (B). The points show the superimposed spectrum of the rice bran sample on the spectra for the standard compounds (solid lines).