**Abstract**: Saccharomyces cerevisiae and many other microorganisms have the remarkable ability to accumulate vast amounts of metallic elements. This ability has been exploited for the production of yeast based mineral supplements which have been used for decades. However, the efficacy/toxicity of trace element is depends on its chemical form (i.e. speciation). The primary form of Se supplementation is selenium enriched yeast which is able to convert inorganic Se to organoselnium species. Using high resolution molecular and atomic  spectrometry approaches the key components of the selenium metabolic pathway have been identified. An ion mobility FT MS protocol enabled the simultaneous monitoring of all Se and Se metabolites. Employing the developed analytical methods the stress response of Saccharomyces cerevisiae to H2O2, and various toxic metals were studied. Apart from conventional molecular species of selenium such us selenometionine, selenocysteine or selenoglutathione here we report the presence of nanometer sized metallic deposits in yeast cells grown in the presence of selenium. Using a combination of synchrotron based micro X-ray fluorescence and hard X-ray microscopy and nano secondary ion-, electrospray- and inductively coupled plasma-mass spectrometry 3D imaging and localization of these intracellular selenium deposits was carried out.