

Expanding our methods to trace the isotopic signature of early cancer

EMMA U HAMMARLUND¹, JULHASH U KAZI¹, DR. PER MALMBERG, PHD.² AND KENNETH J PIENTA³

¹Lund University

²Chalmers University of Technology

³Johns Hopkins University

Geochemical principles can be applied to detect cancer in the human body. This disease remains a tremendous health hazard to humans, annually killing 10 million worldwide. To limit this toll, early diagnostics are key and current methods utilize biological markers in blood, urine, or tissues. However, it has not yet been explored how an isotopic signature of cancer cell proliferation gets preserved in ‘fossilized’ tissue like hair. Cancer cells use bio-essential elements at higher rates than normal cells. As known from the geosciences, a changed cell turnover rate may discriminate between isotopes and provide the mechanisms for tracing this change - even when the source of change is small (as a tumor) and distant from the sampling site (as hair). Here, we use an expanded panel of fractional abundances of majors and minors measured with IRMS and ICP-MS. Our preliminary results show that early prostate cancer leaves a geochemical signature that can be detected in both tissue and hair. Machine learning allows us to develop predictive models that then identify hair from a person with prostate cancer that significantly supercedes the accuracy of current PSA-based screening. In parallel, high-resolution spatial chemical mapping of the corresponding isotopic alteration in tissues is performed with ToF-SIMS analyses of biopsies from human patients and mouse models. This transdisciplinary effort bridges geochemistry with medical oncology, spanning academic research to a regulated laboratory environment.