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Preliminary study on multi-element profile mapping of crustal and mantle zircons by using Synchrotron Radiation X-ray Fluorescence (SR-XRF)

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Zircon (ZrSiO4) is a mineral of singular importance in the geosciences. Zircon microanalysis has greatly contributed to our understanding of key events in earth's history as certain radioactive heavy elements and their daughter products are well-preserved within the exceptionally stable inorganic matrix of the mineral. A prevailing notion in this field is that zircon, as a mineral, is predominantly a crustal mineral; this has been contested in the last few years with more reports of mantle-derived zircons (Siebel et al., 2009). Zircons enriched from different parts of the upper mantle to lower crust from Turkey (Hasozbek et al. 2010) and Germany (Siebel et al., 2009) will be presented in this study using SR-XRF mapping carried out at beamline 2-IDE at the Advanced Photon Source synchrotron facility (Argonne National Laboratory, USA).

The high-resolution (5-10 μm) elemental maps were obtained with collimated and linearly polarized synchrotron radiation (10 to 17 keV) and possess the advantage of being a completely non-destructive technique. Elemental maps of various trace and rare-earth elements along the cross-section of the zircons reveal a zonation-related distribution, which may be used to reveal factors affecting the growth history and dynamics of the crystal formation. Further, abrupt changes in elemental distribution or concentration were found to correspond to faults or inclusions within the zircon crystal. If such observations are found to be applicable for a wide range of samples, elemental mapping with this technique may serve as an important qualitative diagnostic to locating μ-meter inclusions that may be challenging to identify using other techniques (ICP-MS LA, SHRIMP,...) Through these preliminary elemental profile mapping studies of crustal and mantle zircons using SR-XRF methods, we aim to highlight a relatively quick and promising analytical method that may be used to study various geological problems.