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PIXE elemental micromaps of gold-uranium-carbon associations in seam carbon of the “C” –reef in the Witwatersrand Basin, South Africa

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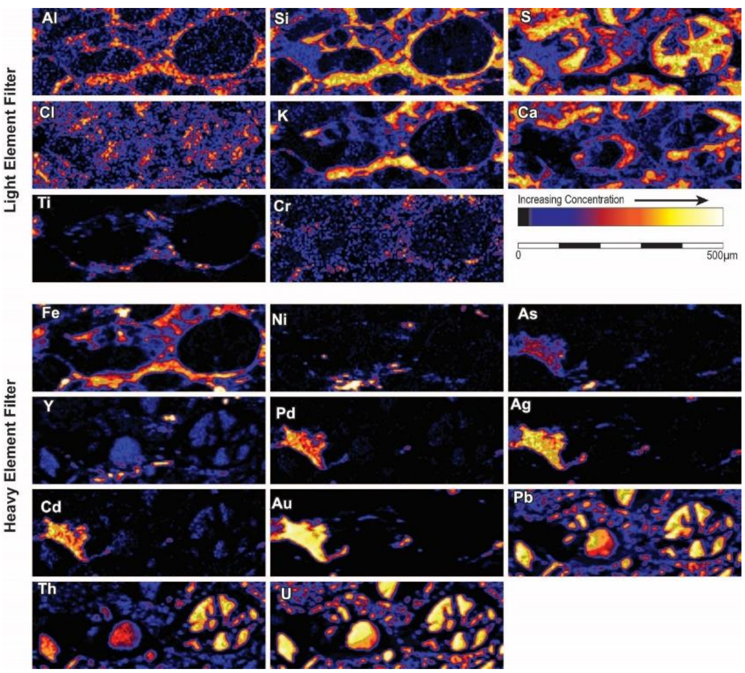
PIXE micro maps from in-situ analyses of carbon seam material are shown below. The seam carbon was sampled from the “C” –reef in the Witwatersrand Basin in South Africa. The sample is prepared as a section perpendicular to the long axis of the carbon spindles. PIXE micro-maps clearly show the association between Au-U-C in the “C”-reef.



Originally detrital uraninite grains were highly fractured and displaced by carbon in spindles in the carbon seam. The uraninite grains contain U, Pb, Th, and trace amounts of Y. Local small scale U and Pb remobilization was seen as trails between small U grains. The spindles of the carbon were surrounded by silicate materials in the form of muscovite, quartz, and minor monazite. The muscovite contained trace amounts of Cr, and Y in veinlets. The silicate materials contain significant Ti, Ce, and Pm as rims surrounding carbon spindles. The carbonaceous material was peculiar, as besides the uraninite grains, only Ca and S were present in the carbonaceous material.

The gold in the carbon seams is present in quantities of up to 20%, and formed structures surrounding the carbon spindles and is not associated with the silicate mass between the spindles. Gold in this sample included Pd, Ag, and Cd, and the gold is clearly differentiated from the carbon that contained little to no gold within the carbon structure.

The uraninite in the carbon seam was originally detrital and as the carbon formed, fractured then displaced the grains, small amounts of U and Pb were remobilized. The remobilization of heavy radiogenic metals is seen in trails and indicates higher temperatures and pressures at the time the carbon formed [1]. The presence of a hydrothermal evcent is supported by the Ti, Cr, and Y in minerals and veinlets surrounding the carbon spindles. The strong association of S with carbon indicates that complex high temperature organic complexes were key in forming Au-U-C associations in the carbon seam. The Ti, Cr, and Pm rims surrounding the carbon seams could only have formed at high temperatures with some form of complexing agent. We propose that a fluid rich in carbon and sulfur and an additional chloride complex were responsible for this, and that some interaction with the U-bearing phases triggered the formation of solid carbon structures, similar to the mechanism shown by other workers [2]. What is not clear from the PIXE images is the elements that played a role in the re-precipitation of the gold. There is a distinct lack of S, As, or Cl associated with the gold, and these elements are traditionally associated with gold transport.

References:

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