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On July 15 and July 16, 2004 several wire samples were taken to the TD SEM in IB3. Donna Hicks and Deepak Chichili operated the equipment. On August 6, 2004 a follow up study was done with Donna to check some of the measurements and to look at an aged wire in the region of the center support.

The July wire samples were mounted on an aluminum holder that was 2 inches in diameter. For the July set of measurements the wire samples were in the following order on the holder:

- Reverse aged in SS tube in COT exhaust gas (with O<sub>2</sub>)
- Aged wire taken from east end of SL2
- New wire taken directly from a spool
- Reverse aged in GMC in Ar/CO<sub>2</sub>.
- Additionally aged in GMC in Ar/Ethane plus isopropanol

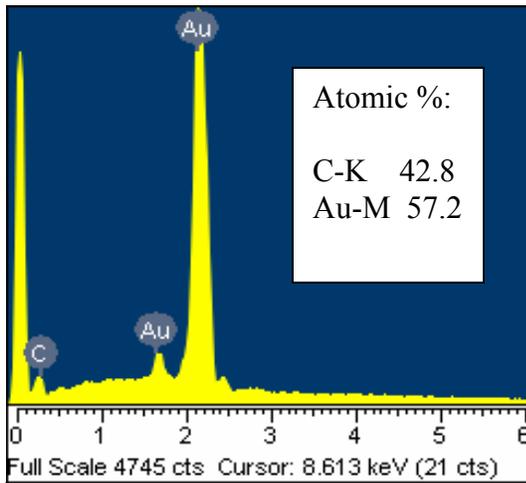
The new wire (in the center of the holder) was taken directly off a spool of new wire. All the aged and reverse aged wires started with a piece of wire taken from the higher z region (east) of the wire plane that was removed from SL2 of the COT in March 2004. All the reverse aging was done with a Sr90 source. Under all conditions the Sr90 source was found to reverse age the wires directly under it. The reverse aging in the SS tube was done in exhaust gas from the COT in early July (argon/ethane plus 1.7% isopropanol and with an O<sub>2</sub> level of about 100 ppm). The reverse aging in GMC for the wire in this study was done with argon/CO<sub>2</sub> (80/20). The wire that was additionally aged in the GMC was positioned away from the Sr90 source with argon/ethane plus 1.7% isopropanol with no added oxygen. It should be noted however that in all cases we did not have the ability to directly measure the O<sub>2</sub> level in the test chamber gas.

All the SEM measurements were made with a 10 keV electron beam which always shows considerable gold which is present beneath whatever coating there is on the surface of the wire. This electron beam was not energetic enough to see the tungsten of the wire unless the gold coating had been removed. The basic COT wire is 40 micron tungsten with about 0.5 micron gold coating (5% by weight).

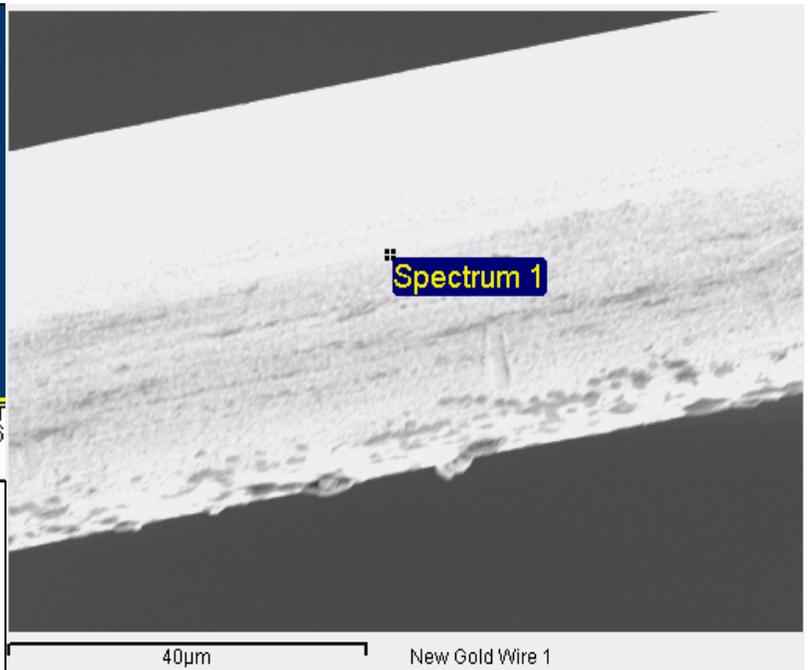
The following pages show the EDS analysis of the wires. The following atomic percentages are observed:

- New wire: Atomic percentages are about 50% carbon and 50% gold. In July (shown below) we measured 43% carbon and 57% gold. When this was redone in August one measurement gave 46% carbon and a second gave 55% carbon. Note that the carbon appears to have been on the gold coating for a long time. An analysis of a new wire from both July and August are shown. A quick EDS on the back of a piece of gold coating that had been stripped from the tungsten wire and that had been sitting in air for three weeks suggested a lower percentage of carbon (should recheck).
- Aged wire directly from the COT: about 85% carbon, 4% oxygen, and 11% gold. Three analysis points are shown. One is in a crater where presumably the gold coating had been removed. For this point, tungsten was seen instead of gold.
- Additionally aged wire from the COT: This wire was additionally aged in a GMC while it was away from the source in the standard COT gas: argon/ethane 50/50 plus 1.7% isopropanol. The EDS indicated that the coating is very similar to a standard aged wire from the COT.
- Reversed aged SS tube in exhaust gas from the COT: about 65-75% carbon, 25-35% gold and very little oxygen at the center. There are two analyses shown of general areas. Surface looks bright, but a little more carbon than on a new wire. At 20mm from the center of irradiation, there appear a mixture of light and dark areas. The darker areas appear to have a more carbon.
- Reverse aged GMC: Less carbon but significantly more oxygen than the wire reverse aged in the COT exhaust gas. The extra oxygen was still there three weeks later on August 6, 2004. Both samples had over 20% oxygen compared to the negligible oxygen on the new wire and the wire reverse aged in the SS tube.

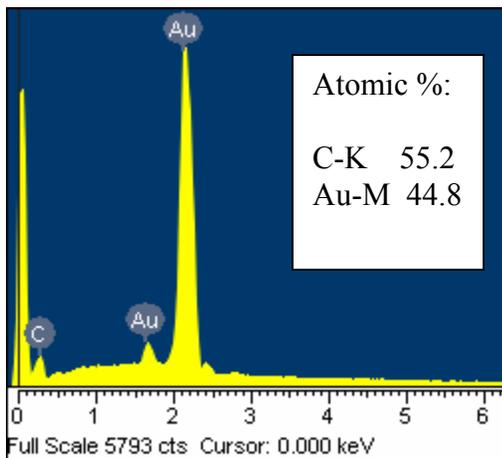
### New wire measured in July



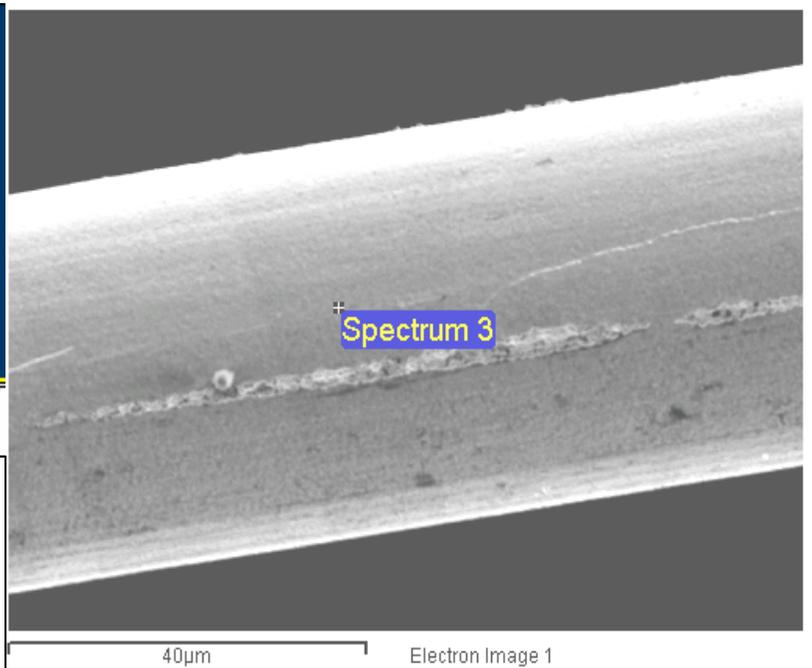
EDS analysis of a new wire directly from the spool. The surface appears bright. Mostly gold is seen; the carbon is appears to be background.



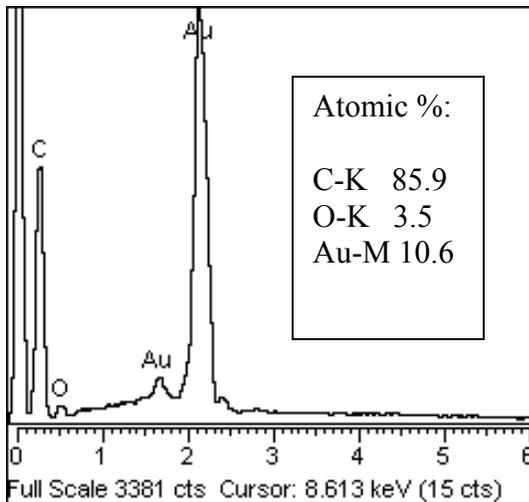
### New wire measured in August



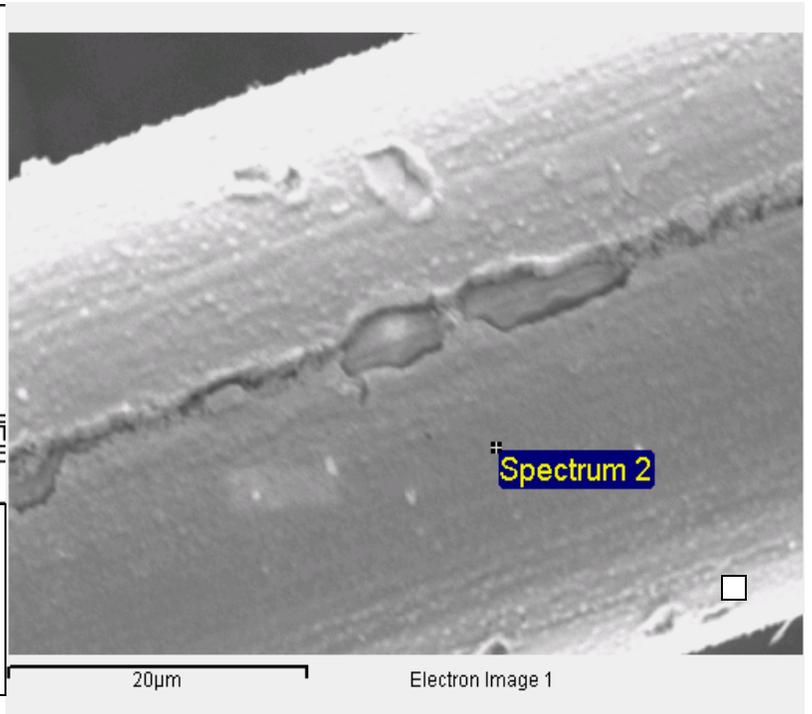
EDS analysis repeat in August of the same piece of new wire analyzed above in July. Similar results are seen: roughly 50% carbon and 50% gold.



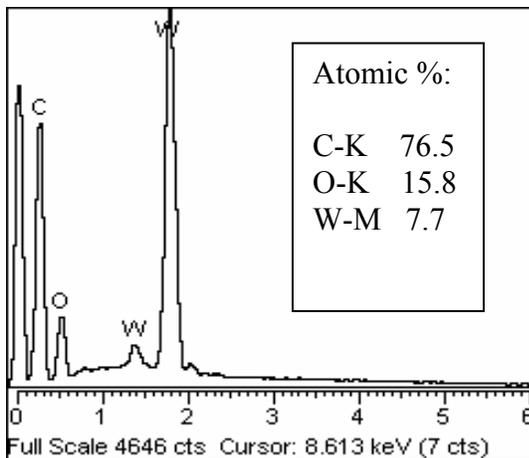
## Aged Wire directly from COT--general area in July



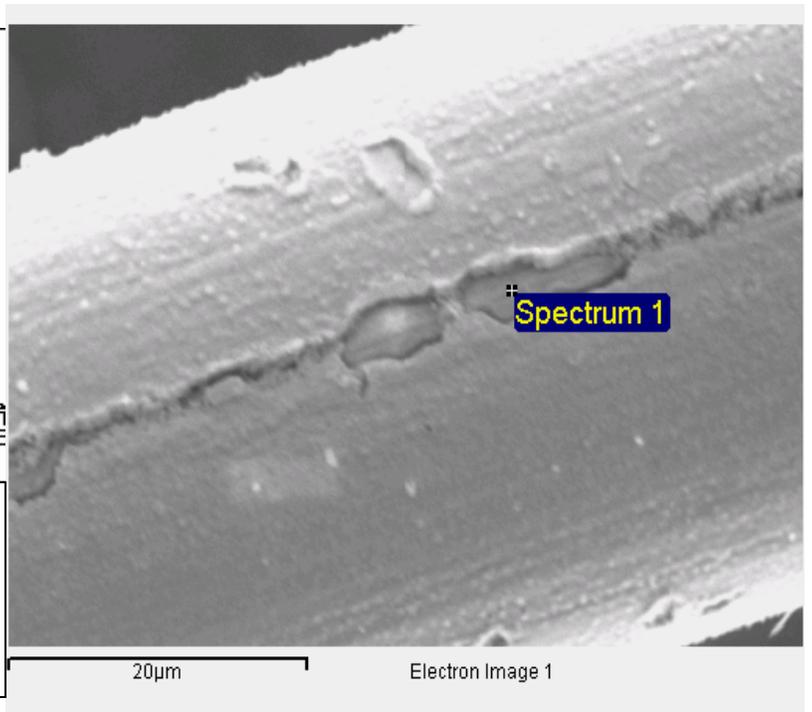
EDS analysis of the aged wire near the center in a general area. The surface is duller. Mostly carbon with a little gold and oxygen are seen.



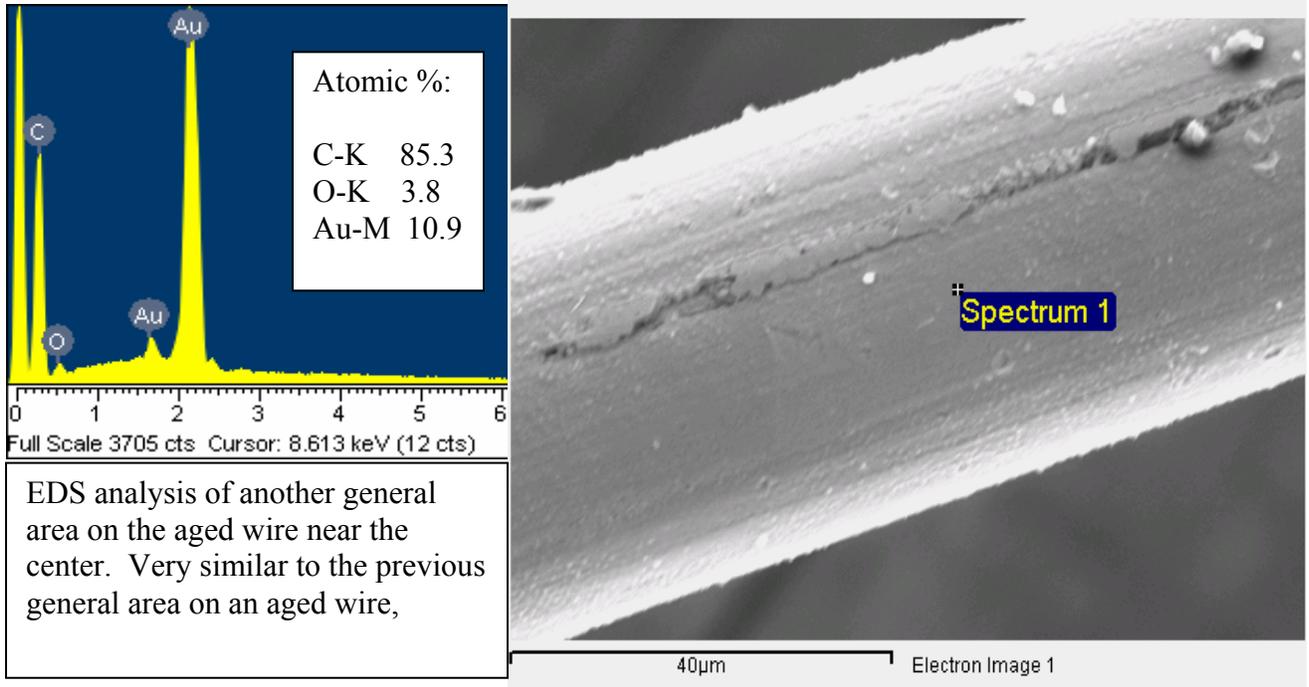
## Aged wire directly from COT--crater in July



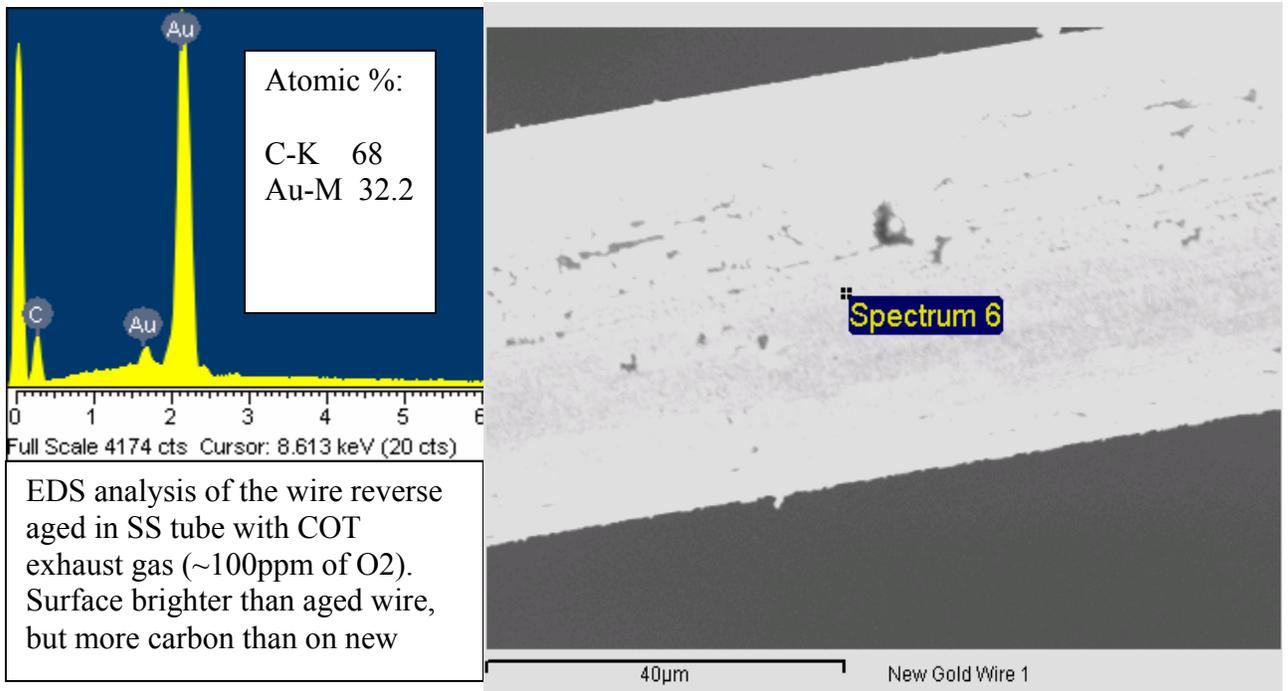
EDS analysis of a crater near the center of the aged wire. Tungsten is seen instead of gold. The carbon polymer coating is still seen. Also the oxygen level is high (WO?).



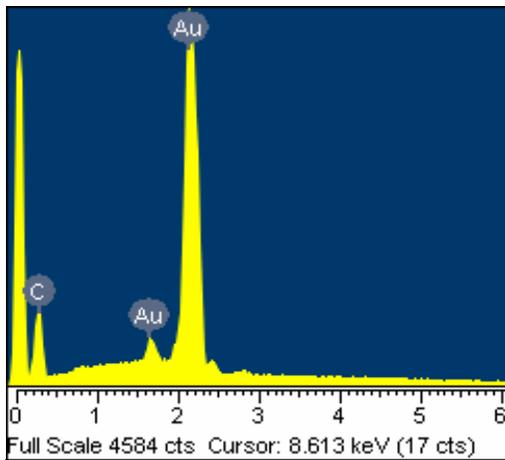
## Aged wire directly from COT--general area in July



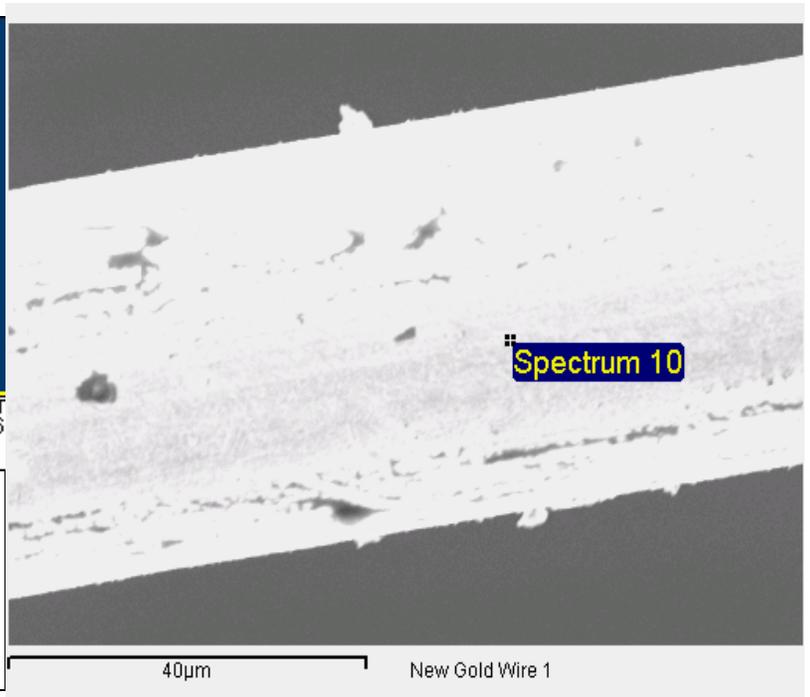
## Reverse aged in SS tube in COT exhaust gas--at center in July



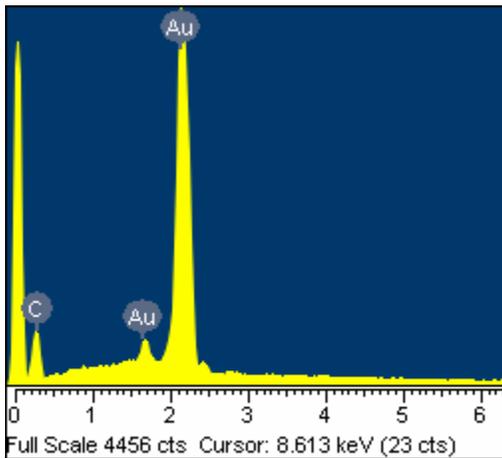
### Reverse aged in SS tube in COT exhaust gas--at center in July



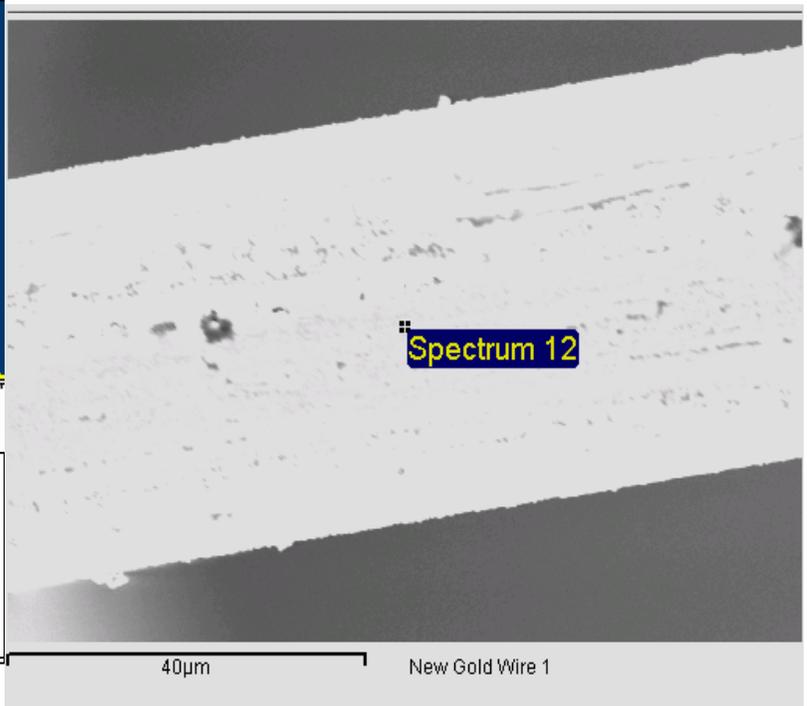
EDS analysis of the wire reverse aged in SS tube with COT chamber exhaust. Wire surface looks brighter than age wire, but more carbon seen than on new wire.



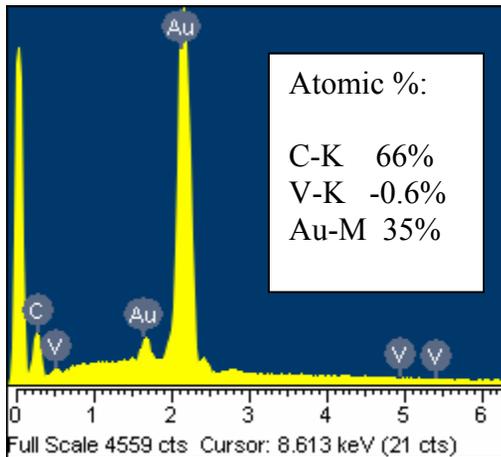
### Reverse aged in SS tube in COT exhaust gas--6mm to right in July



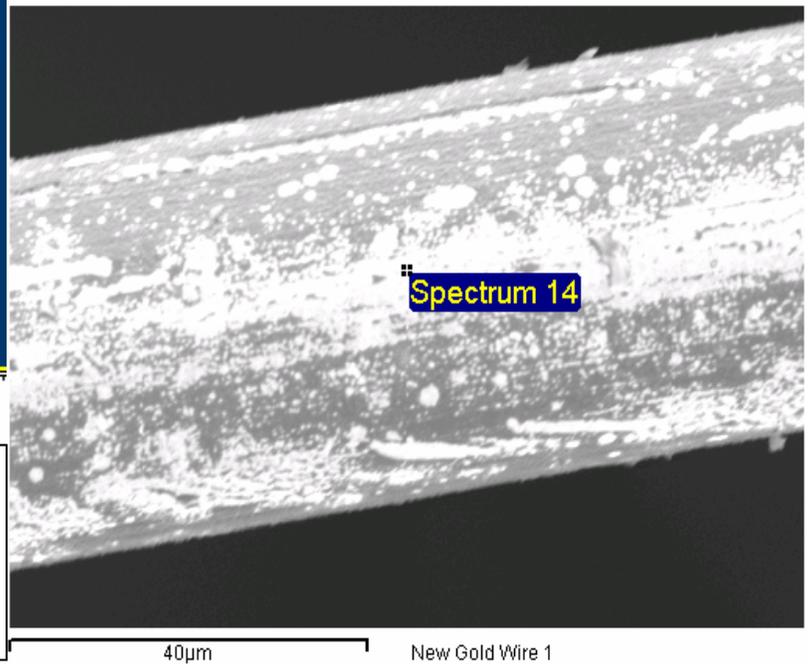
EDS analysis of the wire reverse aged in the SS tube chamber with COT exhaust gas. Wire surface looks brighter than aged wire, but more carbon than new wire.



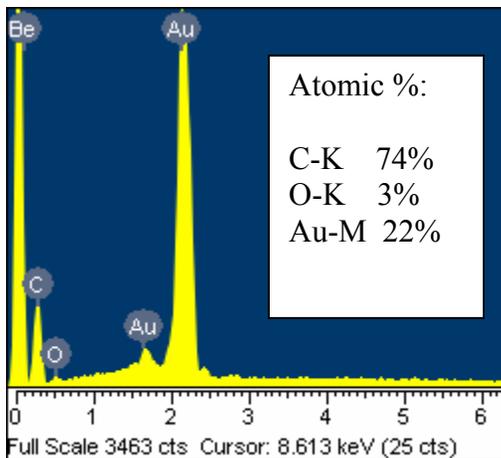
## Reverse aged in SS tube in COT exhaust--20mm to right in July



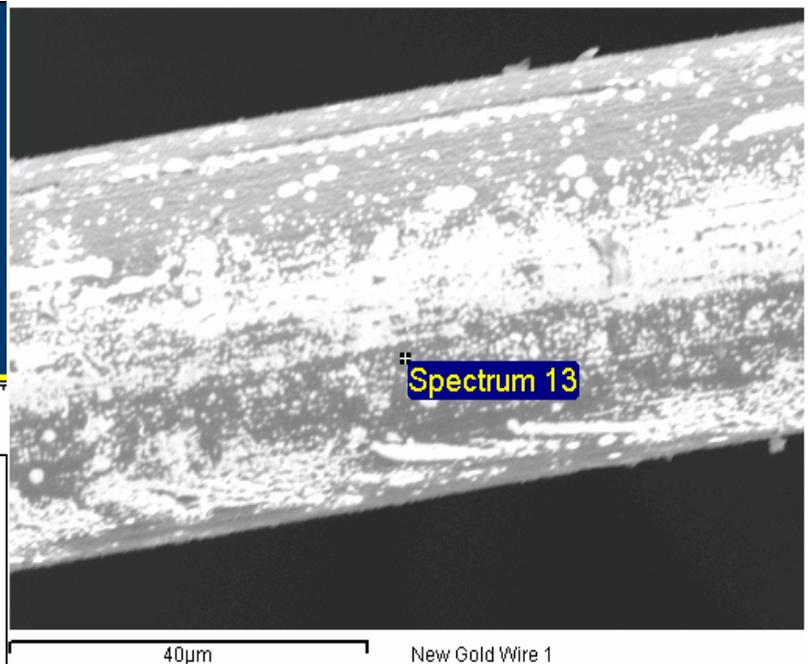
EDS analysis of the wire reverse aged in the SS tube 20mm from the center. There are bright and dark areas on the surface. Analysis of the bright area shows less carbon.



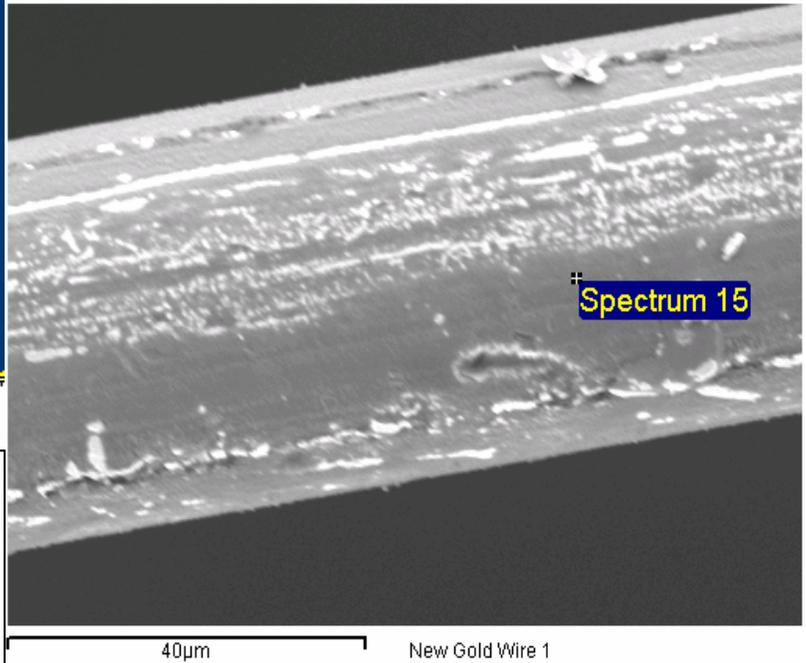
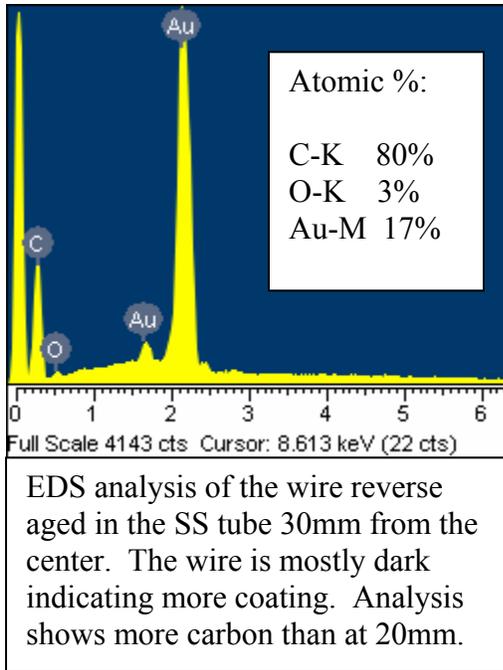
## Reverse aged in SS tube in COT exhaust gas 20mm to right in July



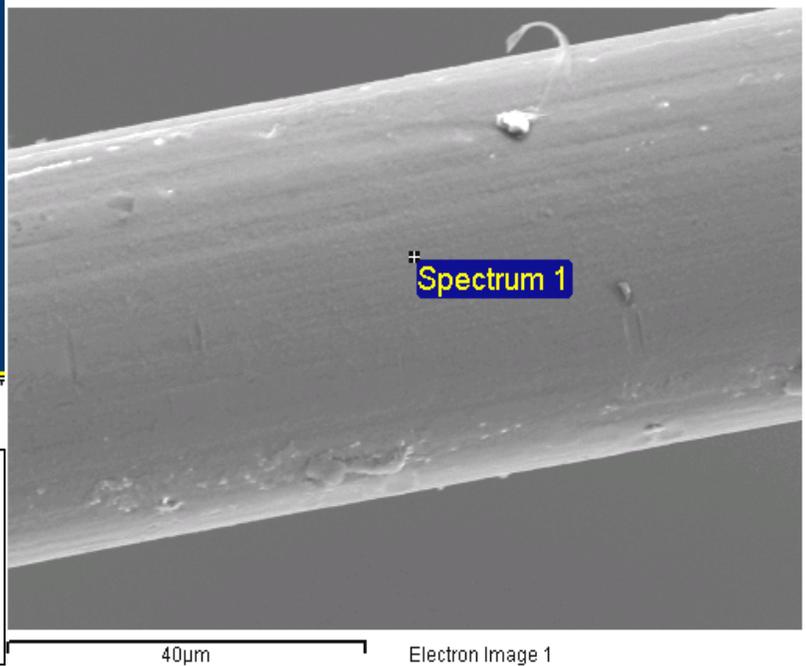
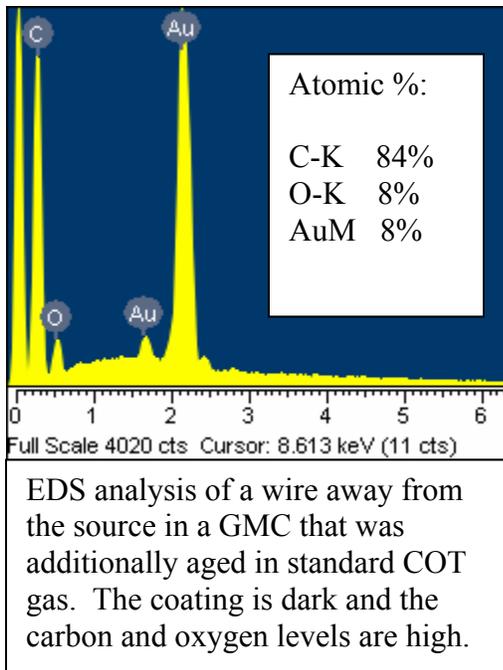
EDS analysis of the wire reverse aged in the SS tube 20mm from the center. The bright areas have been reverse aged more. The analysis of the dark area shows more carbon.



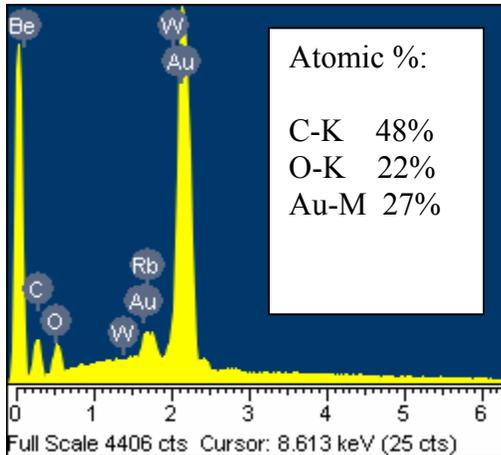
### Reverse aged in SS tube 30mm right of center dark area in July



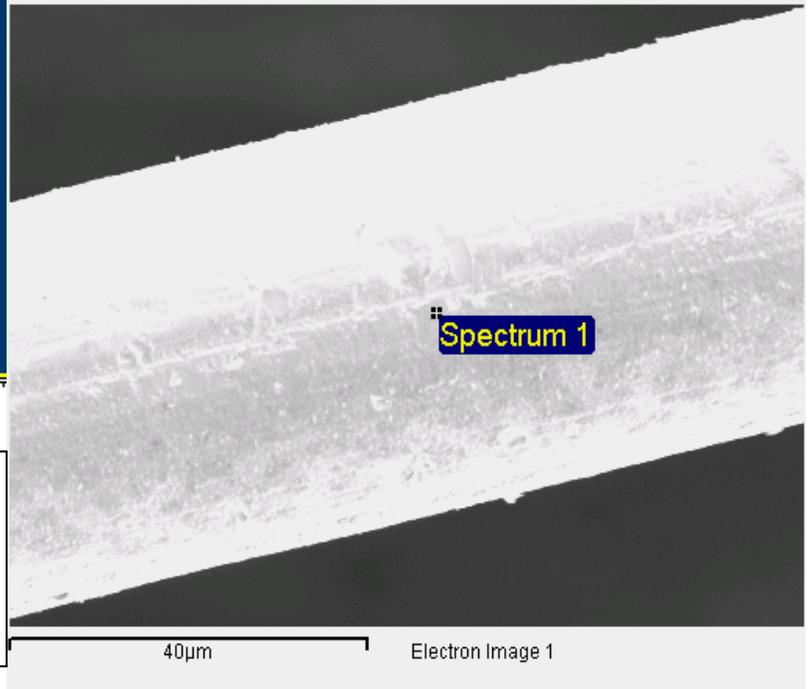
### GMC wire with more aging shown at its center in July



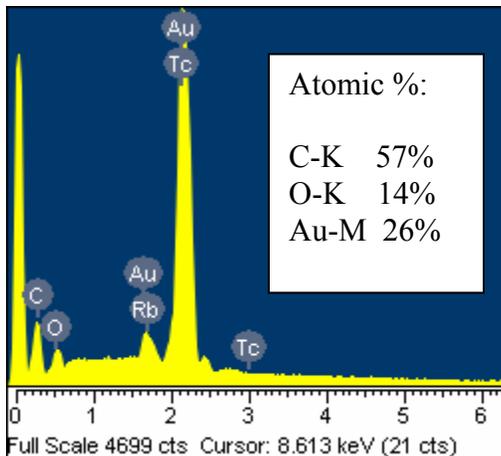
### GMC wire reverse age in Ar/CO2 at the center (avg2) in July



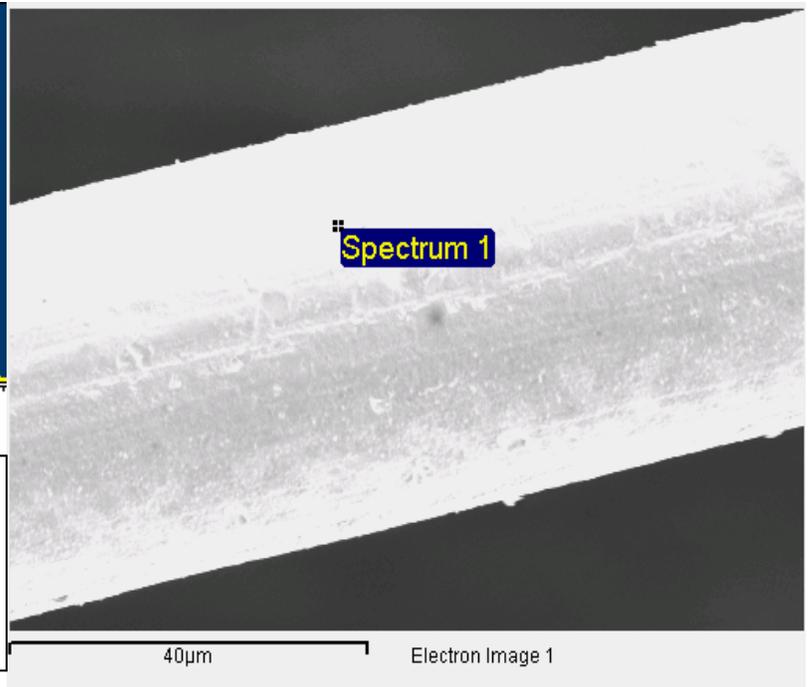
EDS analysis of the wire reverse aged in the GMC (Ar/CO2) at the center. The surface is bright and the carbon level is relatively low, but the oxygen level is higher.



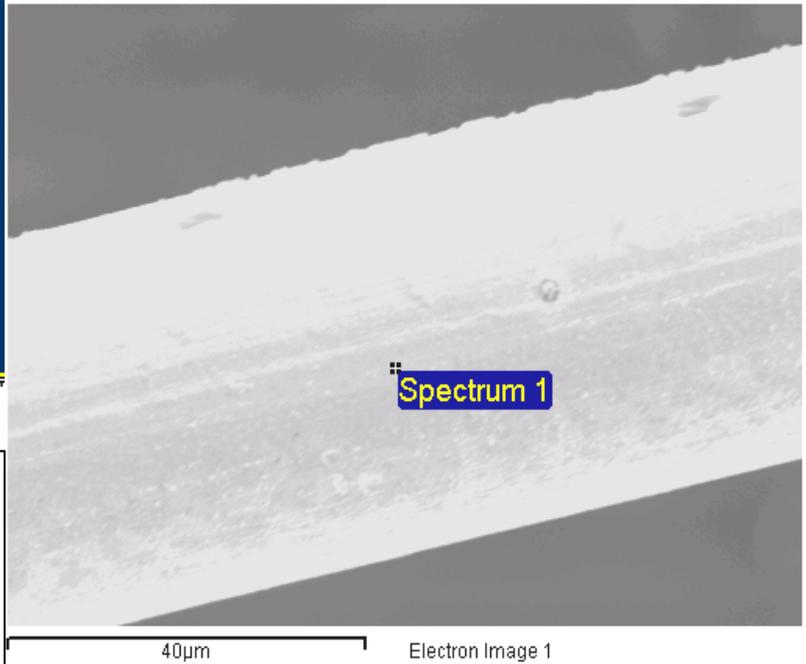
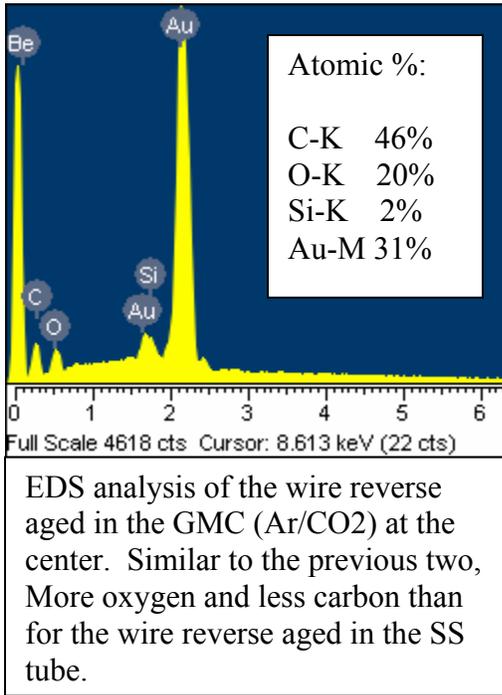
### GMC wire reverse aged in Ar/CO2 at the center (avg3) in July



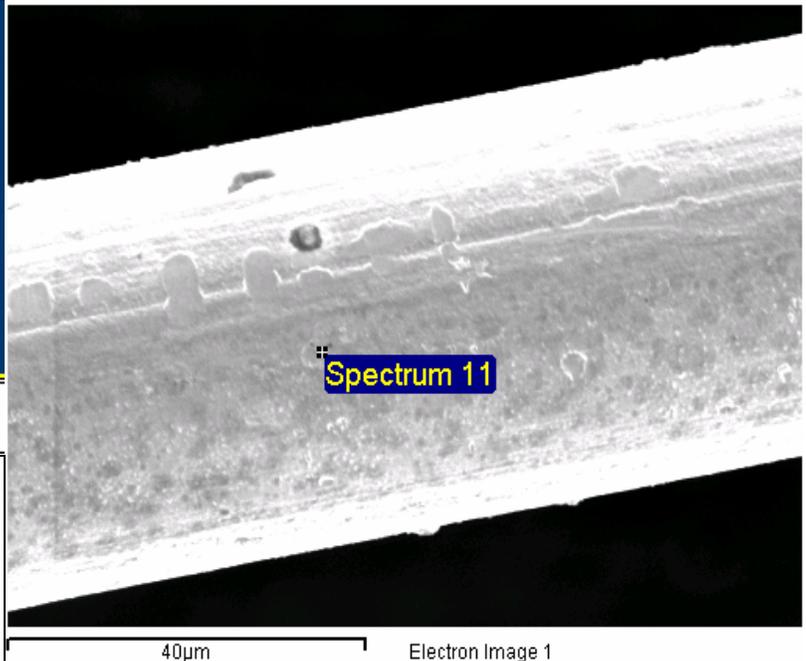
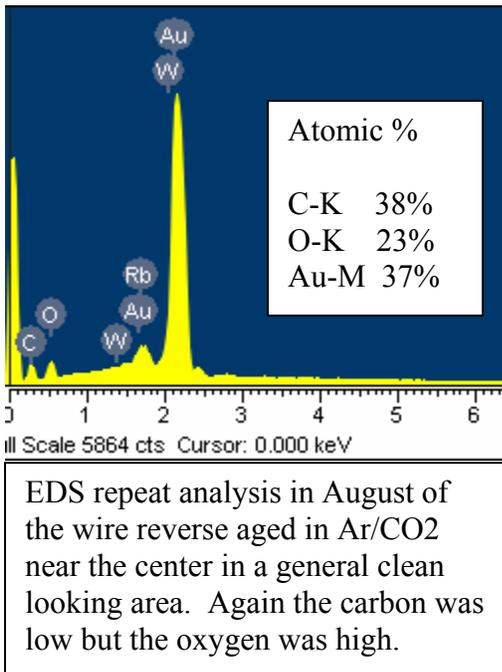
EDS analysis of the wire reverse aged in the GMC (Ar/CO2) at the center. Similar to above, but a little less oxygen. Possible traces of Rb and Tc at the 1% level.



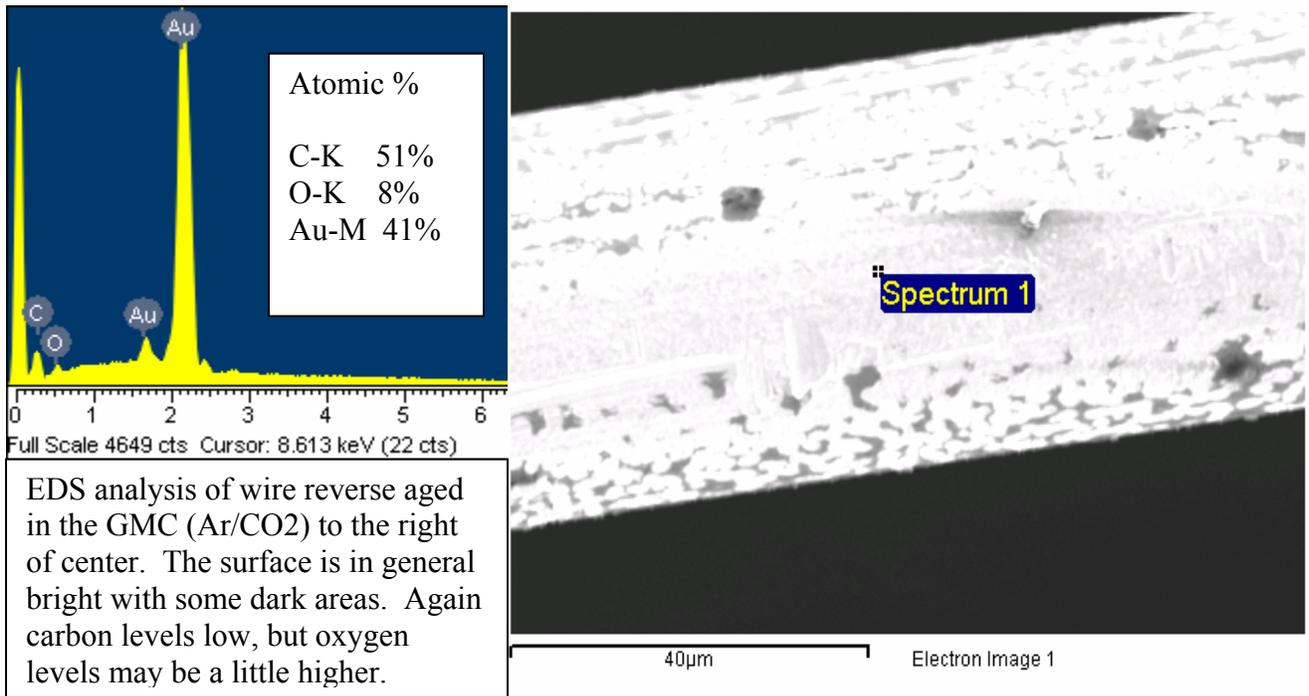
### GMC wire reverse aged in Ar/CO2 at the center (avg) in July



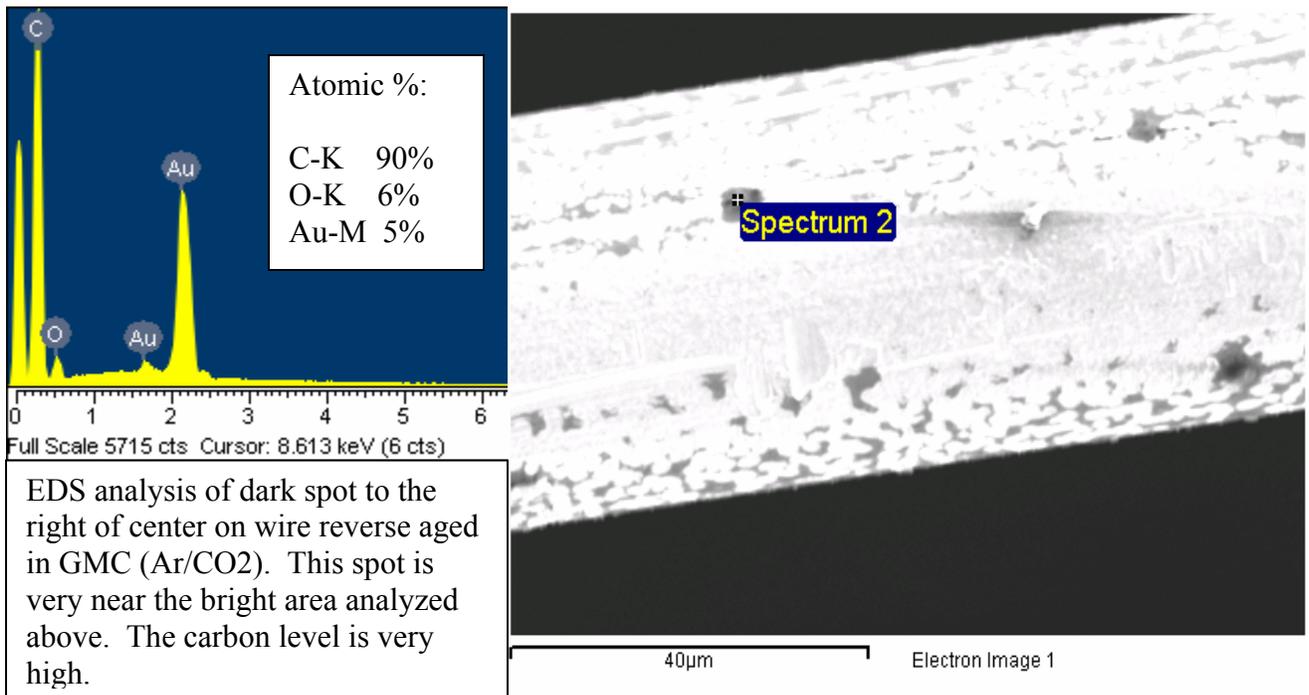
### GMC wire reverse aged in Ar/CO2--general area near center in August



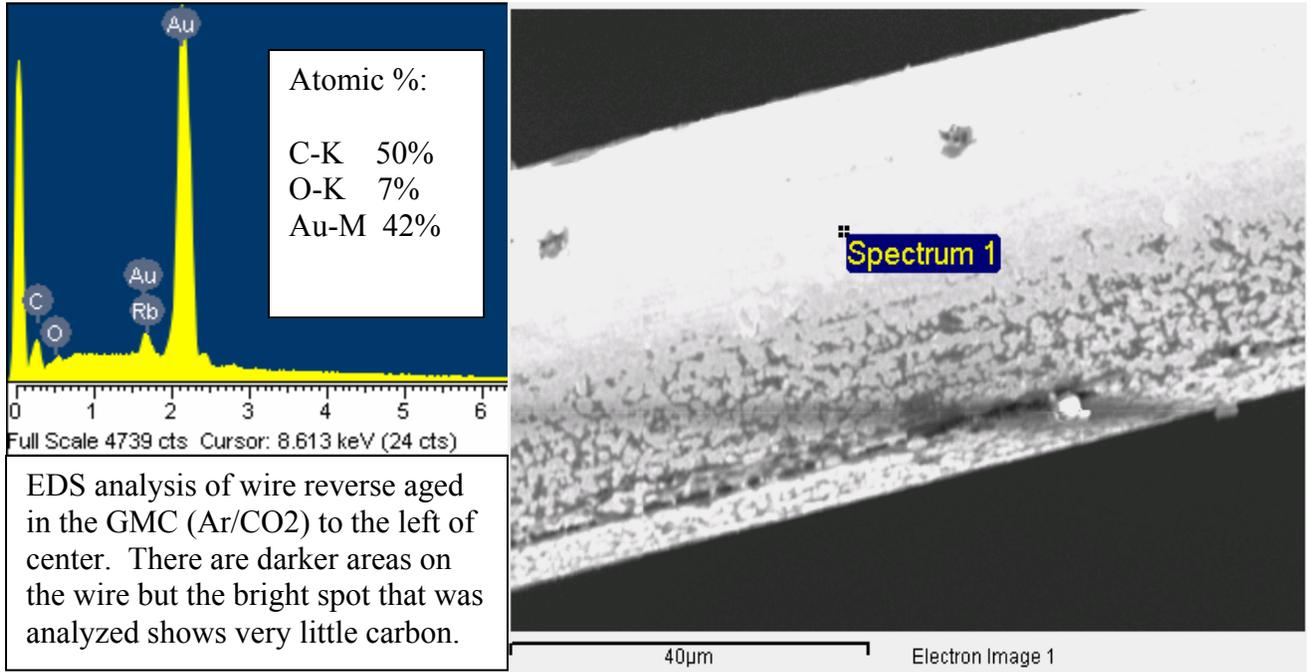
## GMC wire reverse aged in Ar/CO2 to the right of center in July



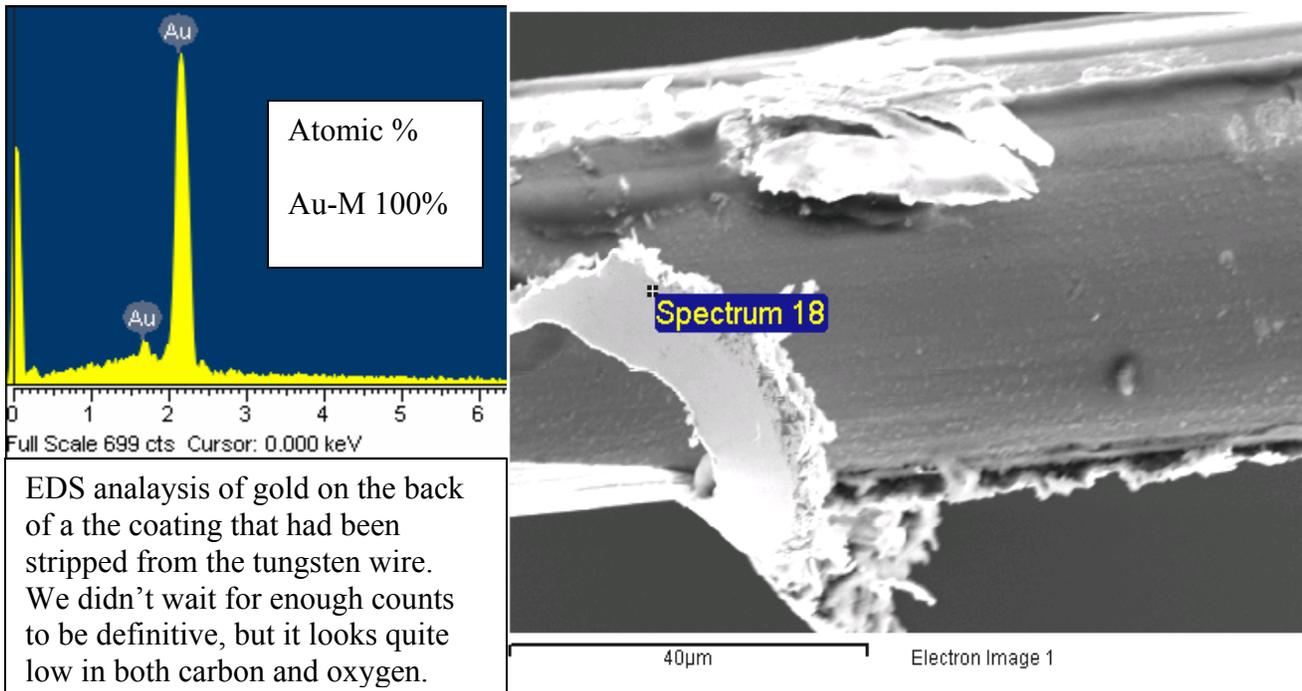
## GMC wire reverse aged in Ar/CO2 -- dark spot to right of center in July



## GMC wire reverse aged in Ar/CO2 – to the left of center in July



## Aged wire from the COT that had been scrapped – in August



The following picture taken in July shows a piece of the aged wire that had been scrapped to remove some of the coating. The upper right hand side of the pictures shows a fairly clear edge of the coating. Underneath the dark coating is a bright line that is presumably the gold coating. Typically when the wire has been scrapped, the gold comes off with the coating. The last EDS analysis shown above is an example of that. The scale on the picture is given by both the scale on the lower left and the diameter of the wire, both of which are 40 microns. Using this to scale the thickness of the coating gives about 1.7 microns. The thickness of the gold is consistent with the expected 0.3 microns (5% gold by weight).

