Microbial nanowires and their possible role in metal oxidation

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Electrically conductive appendages known as bacterial or microbial nanowires have been detected in organisms ranging from oxygenic photosynthetic cyanobacteria to thermophilic methanogenic cocultures [1]. Nanowires produced by dissimilatory metal reducing bacteria, such as *Shewanella* and *Geobacter* [2], facilitate extracellular electron transfer to iron and manganese oxides and to the surfaces of electrodes in microbial fuel cells. Recent evidence suggests that iron oxidizing microorganisms present in acid mine drainages and hydrothermal vent communities produce branched appendages that are morphologically indistinguishable from nanowires produced by other groups of microorganisms. Data collected using conventional and cryo scanning electron microscopy revealed that these nanowire-like structures span 10s to hundreds of microns and are intimately associated with freshly precipitated nanoparticulate oxide minerals. This presentation will provide an update on recent microscopic and spectroscopic analyses that support our hypothesis that microbial nanowires bridge electrochemical gradients and facilitate extracellular electron transfer from reduced iron and sulfur species to oxygen in metal oxidizing microbial communities.

We dedicate this abstract to our dear friend and colleague, Dr. Terry Beveridge and his scientific leadership into the world of microbe-mineral interactions.

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Regional geochemical mapping – Ecological significance

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Introduction

During regional geochemical prospecting in the area of Vrsac-Bela Crkva (Vojvodina-Serbia), hydrogeochemical, lithogeochemical and radiometric research were carried out. Several anomaly zones with increased U, Ra and Rn concentrations were detected. Along with sample collecting from different geochemical milieus, overbank sediments were gathered from the costal parts of the rivers Nera and Karas.

Discussion and Results

In the north part of Carpathian-Balkan arc, samples were taken from the two localities. According to the results of the chemical analysis, there are significant differences between content from both drainage areas and other milieus (Table 1).

Values (ppm)		**Pb**	**Zn**	**Cu**	**Cd**	**Ni**
Nera River	A	95	98	185	1.3	2763
	OB	270	988	60	3.8	754
	S	180	468	40	1.9	715
Karas River	A	70	75	55	2.1	65
	OB	75	62	40	0.8	78
	S	25	94	65	0.7	104
Values (ppm)		**Cr**	**Mg**	**Ti**	**Ag**	**U**
Nera River	A	986	66772	2363	5	5
	OB	589	85605	1820	5	4.5
	S	673	236270	501	5	4.4
Karas River	A	79	114140	1922	5	2.3
	OB	38	111857	1952	5	5
	S	71	11072	2940	10	2.6

A=alluvium; OB=overbank sediments; S=stream sediments

In comparison with average contents of elements in the soils, overbank and stream sediments, measured contents of elements from certain sampling levels are up to 70 times increased. Contents of Pb, Zn, Cu, Cd, Ni, Cr, Mg and Ag from the Nera River are 40 times higher in comparison to the same elements from the Karas River, and they are several times higher in relation to average.

Conclusion

Anomaly concentrations of elements in the geochemical profiles of Rivers Nera and Karas do not correspond to geochemical composition of Quaternary formations made of gravels, sands, silts, peat, loess and porous soils. Increased concentrations of elements most probably have origin from Rastica-Moldava area in Romania, with numerous deposits and ore occurrences of Pb, Zn and U.