



## Certificate of Participation

This is to certify that the person named below participated  
as participant at the

***21<sup>st</sup> International Biohydrometallurgy Symposium (IBS 2015)***

held in Sanur, Bali, Indonesia during October 5<sup>th</sup> – 9<sup>th</sup>, 2015

Miroslav Vrvic

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Chairperson of IBS 2015



Dr. mont. M. Zaki Mubarak



## Certificate of Participation

This is to certify that the person named below participated  
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Miroslav M. Vrvic

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For presenting poster, entitled “**Flotation Concentrates of  
Polymetallic Sulfides from Serbian Ore Deposits as  
Biohidrometalurgical Substrates: Laboratory Tests**”

Chairperson of IBS 2015



Dr. mont. M. Zaki Mubarak



October, 5-9, 2015  
Grand Inna Beach Hotel,  
Sanur, BALI, INDONESIA

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Bandung, October 5, 2015

**To Dr. Miroslav Vrvic**

**Faculty of Chemistry, University of Belgrade  
11158 Belgrade, Studencki trg 16**

Dear Dr. Miroslav Vrvic,

On behalf of Organizing Committee of the **21<sup>st</sup> International Biohydrometallurgy Symposium (IBS 2015)**, I would like to ask for your apologies profusely for the mistakes made by the IBS 2015 Organizing Committee.

Your extended abstract entitled "**Flotation Concentrates of Polymetallic Sulfides from Serbian Ore Deposits as Biohydrometallurgical Substrates: Laboratory Tests**" written by Jelena S. Acdalović, Vladimir P. Beškoski, Srdjan B. Miletić, Biljana P. Ddojčinović, Vlastimir Trujić, Vesna Conic, Miroslav M. Vrvic was received to be presented as poster presentation and has been accepted to be included in The 21<sup>st</sup> International Biohydrometallurgy Symposium 2015 Abstract Book. The symposium took place in **Grand Inna Beach Hotel, Bali, INDONESIA, on October 5-8, 2015**. However, based on the IBS 2015 Organizing Committee mistakes, the abstract was not included to the abstract book and CD. Thus, we would like to state the truth that the abstract has really been **accepted and presented** in IBS 2015 by the author himself.

For the correction, we will revise the abstract book and upload it to the IBS 2015 website as well as send to all participants of all IBS 2015 participants by e-mail.

Yours sincerely

Dr. mont. M. Zaki Mubarak, ST., MT.  
IBS 2015 Chairman

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# FLOTATION CONCENTRATES OF POLYMETALLIC SULFIDES FROM SERBIAN ORE DEPOSITS AS BIOHIDROMETALURGICAL SUBSTRATES: LABORATORY TESTS

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There are three ore deposits of polymetallic sulfide ores that are of economic value in Serbia. Only ore deposit "A" (in central part of Serbia) is mine in exploitation (underground and surface), including and floatation plant. Dominant ore minerals at deposit "A" are: galena, sphalerite and chalcopyrite, with accompanying pyrrhotite, and some arsenopyrite. Lead, zinc and copper concentrates are obtained in particular. Approximately three million tons of reserves have been confirmed at deposit "A". About one million tons of reserves have been confirmed at ore deposit "B", which is located in Eastern Serbia. Important ore minerals at this deposit are: chalcopyrite, enargite, sphalerite and galena. Accompanying mineral is pyrite including pyrrhotite. Ore deposit "C" is located in Western Serbia, and has confirmed reserves of more than one million tons. Galena (with some anglesite), sphalerite and tetrahedrite are dominant ore minerals, and pyrite as accompanying mineral. Ore deposit "C" has legitimately exploitative amounts of industrial mineral barite. All three sites have significant amounts of silver, while deposit "B" has gold as well.

This paper presents preliminary results of bacterial leaching of flotation concentrates from afore mentioned ore deposits obtained by shake flask test technique during four weeks, with pure culture of acidophilic and mezophilic allochthonous strain of the *Acidithiobacillus* sp. B2 (the isolate was identified using the EzTaxon server on the basis of 16S rRNA sequence data). Deposit "A" was tested, in this investigation step, only for copper concentrate while other two deposits were examined polymetallic bulk concentrates (obtained in pilot flotation plants).

Based on the metal concentration in the solution from "A" chalcopyrite concentrate bioextraction is about 16 % of copper. Concentration of copper and zinc in solution (lead is insignificant due to deposition of lead sulfate) from "B" and "C" show leaching of copper from approx. 21, *i.e.* about 65 % and for zinc about 70, and *cca.* 67 %, respectively.

First results show that all three flotation concentrates of polymetallic sulfides are potential substrates for biohydrometallurgical processes in application, which will be further thoroughly examined in testes that are currently being undertaken.

## References

1. B.C. Patel, M.K. Hinte, D.R. Tipre, A. Pillai, S.R. Dave, A novel biphasic leaching, approach for the recovery of Cu and Zn from polymetallic concentrate, *Biores. Technol.* **157** (2014), 310-315.
2. J.S. Jekić, V.P. Beškoski, G. Gojgić-Cvijović, M. Grbavčić, M.M. Vrvic, Bacterial generated  $Fe_2(SO_4)_3$  from pyrite as leaching agent for power plant electrofilter ash from lignite combustion process, *J. Serb. Chem. Soc.* **72** (2007) 615-619.
3. J. Avdalović, V. Beškoski, G. Gojgić-Cvijović, M.-L. Mattinen, M. Stojanović, S. Zidžović, M.M. Vrvic, Microbial solubilization of phosphorous from phosphate rock by iron-oxidizing *Acidithiobacillus* sp. B2, *Miner. Eng.* **72** (2015) 17-22.

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## Introduction

There are three ore deposits of polymetallic sulfide ores that are of economic value in Serbia. Only ore deposit "A" (in central part of Serbia) is mine in exploitation (underground and surface), including and flotation plant. Dominant ore minerals at deposit "A" are: galena, sphalerite and chalcocopyrite, with accompanying pyrrhotite, and some arsenopyrite. Lead, zinc and copper concentrates are obtained in particular. Approximately three million tons of reserves have been confirmed at deposit "A" (Rudnik-Rudnik). About one million tons of reserves have been confirmed at ore deposit "B" (Čoka Marin – Bor), which is located in Eastern Serbia. Important ore minerals at this deposit are: pyrite, chalcocopyrite, enargite, sphalerite and galena. Accompanying mineral is pyrite including pyrrhotite. Ore deposit "C" is located in Western Serbia (Bobija-Ljubovija), and has confirmed reserves of more than one million tons. Galena (with some anglesite), sphalerite and tetrahedrite are dominant ore minerals, and pyrite as accompanying mineral. Ore deposit "C" has legitimately exploitative amounts of industrial mineral barite. All three sites have significant amounts of silver, while deposit "B" has gold as well.

## Experimental

This paper presents preliminary results of bacterial leaching of flotation concentrates from aforementioned ore deposits obtained by shake flask test technique during four weeks, with pure culture of acidophilic and mezophilic allochthonous strain of the *Acidithiobacillus sp. B2* (the isolate was identified using the EzTaxon server on the basis of 16S rRNA sequence data). Deposit "A" was tested, in this investigation step, only for copper concentrate while other two deposits were examined polymetallic bulk concentrates (obtained in pilot flotation plants).

Table 1. Chemical analyses of ores

	% Cu	% Zn	% S	% Cuox		% Znnox	
				(0,05% of Cu total)	(3,67% of Zn total)		
A	24,01	3,05	31,03	0,0131	0,11		
B	9,12	2,08	29,38	0,5567	0,41	(6,10% of Cu total)	(19,71% of Zn total)
C	1,66	4,86	39,23	0,1232	1,02	(7,42% of Cu total)	(20,98% of Zn total)

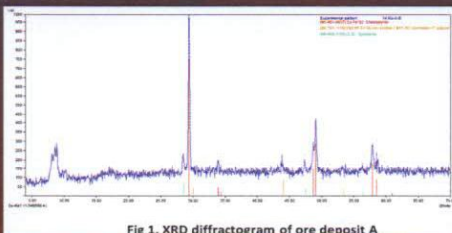
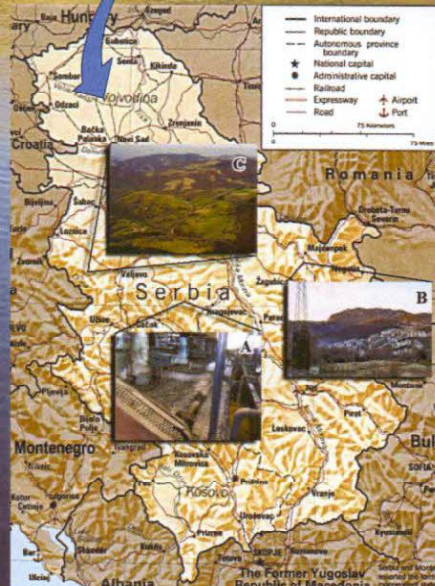


Fig 1. XRD diffractogram of ore deposit A

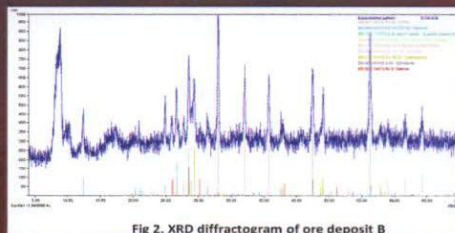


Fig 2. XRD diffractogram of ore deposit B

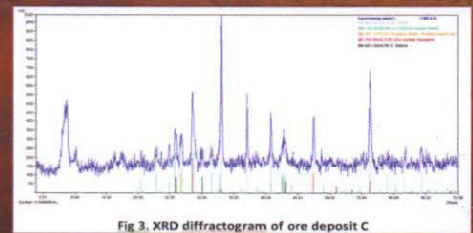


Fig 3. XRD diffractogram of ore deposit C

Table 2. Amount of Cu and Zn leached during the incubation process on shaker

	Zn (%)		Cu (%)	
	control	At.f.	control	At.f.
Day 0	1,83	4,89	0,22	1,01
Day 28	8,87	45,14	1,95	15,91

Table 3. Amount of Cu and Zn leached during the incubation process on shaker

	Zn (%)		Cu (%)	
	control	At.f.	control	At.f.
Day 0	2,31	4,25	3,50	3,60
Day 28	17,86	70,5	6,05	37,63

Table 4. Amount of Cu and Zn leached during the incubation process on shaker

	Zn (%)		Cu (%)	
	control	At.f.	control	At.f.
Day 0	7,22	7,19	6,32	6,16
Day 28	20,91	67,11	15,69	65,23

## Results and Conclusions

Based on the metal concentration in the solution from "A" chalcocopyrite concentrate bioextraction is about 16 % of copper. Concentration of copper and zinc in solution (lead is insignificant due to deposition of lead sulfate) from "B" and "C" show leaching of copper from approx. 38, i.e. about 65 % and for zinc about 70, and cca. 67 %, respectively.

First results show that all three flotation concentrates of polymetallic sulfides are potential substrates for biohydrometallurgical processes in application, which will be further thoroughly examined in testes that are currently being undertaken.

## References

- B.C. Patel, M.K. Hinte, D.R. Tipre, A. Pillai, S.R. Dave, A novel biphasic leaching, approach for the recovery of Cu and Zn from polymetallic concentrate, *Biores. Technol.* **157** (2014), 310-315.
- J.S. Jekić, V.P. Beškosi, G. Gojgić-Cvijović, M. Grbavčić, M.M. Vrvic, Bacterial generated Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> from pyrite as leaching agent for power plant electrofilter ash from lignite combustion process, *J. Serb. Chem. Soc.* **72** (2007) 615-619.
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