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## BOR / KRIVELJ AIR QUALITY MONITORING REPORT

TO:

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### Results of the Air Quality Monitoring Campaign in BOR/KRIVELJ Joint Campaign

Location: BOR/KRIVELJ (near Bor, about 5 km on the hill between Bor and Krivelj)

Coordinates of the AQM stations:

- UPT Mobile laboratory and TFMP AIRPOINTER: 44°070297 N, 22°060838 E, altitude 391m

Start on: 13 September 2011 and ended in 19 September 2011

Experts for Romanian team: Francisc Popescu, Nicolae Lontis, Dorin Lelea, Virgil Stoica

Experts for Serbian team: Milan Pavlovic, Slobodan Jankovic, Aleksandar Djuric, Aleksandar Pavlovic, Milan Nikolic, Branko Davidovic

#### 1. Overview of the Bor monitoring sites:



Spatial location of the AQM stations



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Bor (Serbian Cyrillic: **Бор**, Romanian: *Bor*) is a town and municipality located in eastern Serbia, with one of the largest copper mines in Europe and it has been a mining centre since 1904, when a French company began operations there. It is the administrative center of the Bor District of Serbia.

Since the mid-1990s and during the time of sanctions on the Federal Republic of Yugoslavia, production in this mine dropped significantly from the very prosperous 1970s and 1980s. This has been due to both diminishing reserves and the inability to obtain new equipment that would most efficiently gather the remaining ore no longer of high grade. Copper mining is the key basis of Bor's economy and the effects of decreased production can be seen all over the town.

On March 6, 2007, RTB Bor (Bors mining company) was sold to Romanian Cuprom for US\$400 Million. Cuprom has pledged to modernise the production facilities in RTB Bor and Majdanpek mines, in order to improve the productivity levels. This is seen as the breakthrough deal that the city of Bor needed to speed up its much needed economic reforms. However, due to Cuprom's failure to meet a deadline regarding the financing, the Serbian government had cut the deal and the complex was put up for privatization once again.

On February 7, 2008, the Austrian consortium A-TEC acquired the eastern Serbia based copper mining and smelting complex for USD 466mn with a further USD 237mn to follow in the next two years. The buyer is also obliged not to lay off any of the company's 4,691 employees which is seen as a major breakthrough in the revitalization of the Bor economy.

In the 1991 census, Bor municipality had 59,900 residents, the absolute majority declaring themselves as Serbs.

In the 2002 census, the population of the Bor municipality numbered 55,817 residents, and was composed of: Serbs = 39,989 (71.64%), Romanians (Vlachs)= 10,064 (18.03%) Roma = 1,259 (2.26%) and others = 4,505 (8.07%).

According to the 2002 census, the settlements in the Bor municipality with Serb ethnic majority are: Bor, Brestovac, Donja Bela Reka, and Oštrej. The settlements with Romanian (Vlach) ethnic majority are: Bučje, Gornjane, Krivelj, Luka, Metovnica, Tanda, Topla, and Šarbanovac. Ethnically mixed settlements are: Zlot (with relative Serb majority) and Slatina (with relative Romanian(Vlach) majority).

Source: [http://en.wikipedia.org/wiki/Bor,\\_Serbia](http://en.wikipedia.org/wiki/Bor,_Serbia)

Air pollution from the smelter—which uses 1970s smelting technology—is the company's most serious environmental problem; the presence of SO<sub>2</sub> from smelter emissions is constant and SO<sub>2</sub> concentrations can reach 12,000 µg/m<sup>3</sup>, compared with a Serbian regulatory limit of 350 µg/m<sup>3</sup>. During the past several years, smelter emissions have periodically caused severe damage to crops, orchards and vineyards, with the latest event occurring as recently as July 2010. However, the smelter is being rebuilt to employ modern technology from Outotec. The smelter and new sulphuric acid plant construction are being financed by loans from the World Bank, with the Serbian government as guarantor.

Overall, a century of mining has left its mark on the Bor area landscapes. Almost 1,000 hectares (2,500 acres) have been degraded by surface mining operations and waste or tailings



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disposal. The Serbian government initiated a regional development project, financed by the World Bank, which includes reclamation and remediation of degraded areas. The Dutch company Witteveen+Bos has been retained to conduct site investigation, design work, development of an environmental impact assessment, preparation of an environmental management plan, and a plan for stability, rehabilitation and remediation of several older tailing dumps and dams in the area.

A major environmental concern is the Krivelj River collector, which reroutes the river beneath a tailings dump at the Veliki Krivelj flotation plant and which was severely damaged, creating a possibility for tailings from the dump to enter into the collector and contaminate downstream waters. It has been repaired but construction of a new collector is part of the regional development project. The Spanish consulting company Eurostudios-IK has been engaged to investigate sites and design the remediation and construction of the collector.

Localized environmental issues include the seismic effects of blasting at the Veliki Krivelj open-pit. The proximity of the nearby village and the likelihood of ground vibration causing damage to village structures have led to development of a seismic monitoring system. The system is currently in the design phase but when completed will combine ground vibration monitoring, crack response monitoring, structural health monitoring and Internet technology into a reliable, accurate and transparent system. It will provide necessary data for changes in blast design that will result in optimal blasting results with minimum effect to surrounding structures.

Source: "RTB Bor: The Comeback of Serbian Copper" , Engineering and Mining Journal, <http://www.e-mj.com/index.php/features/1357-rtb-bor-the-comeback-of-serbian-copper.html>



View of the site location



Industry in Bor, copper



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## 2. Results obtained during Bor/Krivelj AQM campaigns:

The AIRPOINTER and UPT Mobile Laboratory were located on the hill situated on the road between Bor and Krivelj, ~ 5 km from Bor. Instruments characteristics, performances and principles of operations were described in previous reports. In the next figures the concentrations measured for relevant air pollutants are presented.

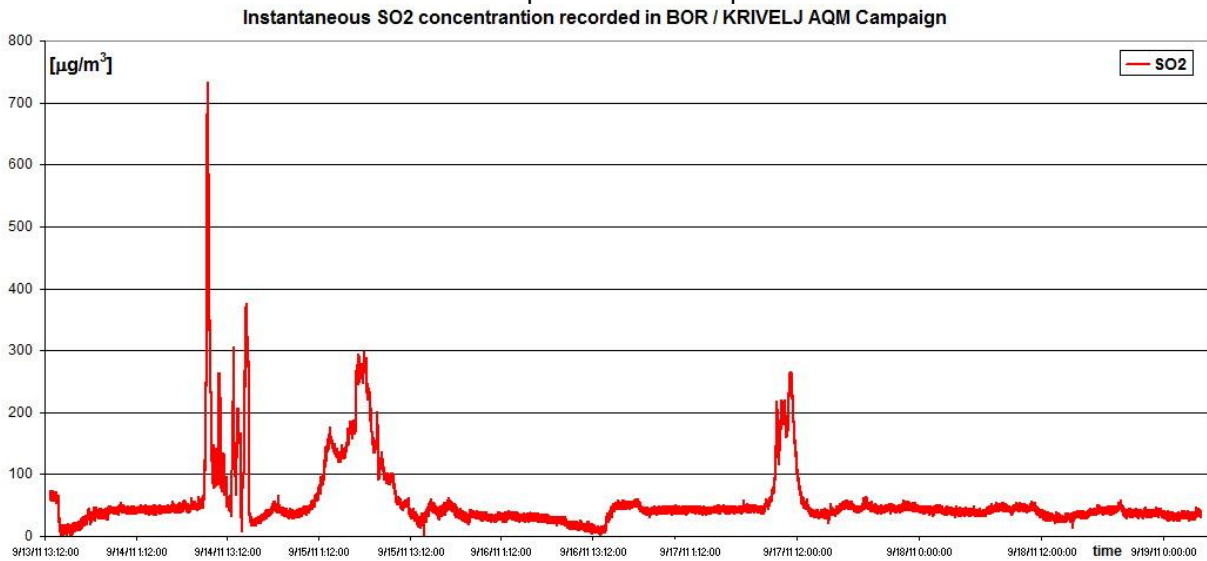


Fig 1. Instantaneous values recorded for SO<sub>2</sub> in BOR/KRIVELJ, with UPT Mobile Laboratory

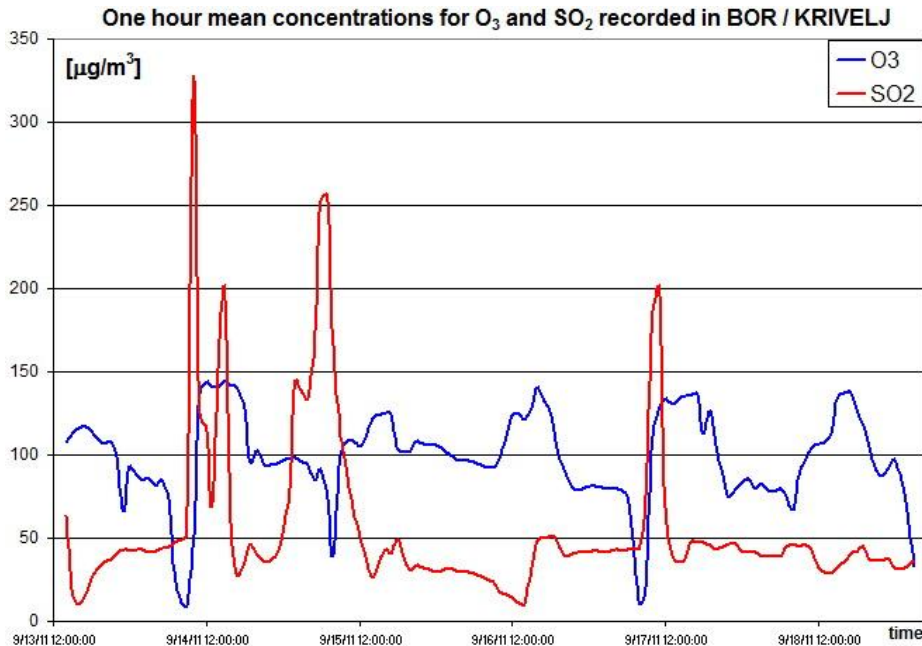


Fig 2. Hourly mean values recorded for SO<sub>2</sub> and O<sub>3</sub> in BOR/KRIVELJ, with UPT Mobile Laboratory



### One hour mean concentrations for CO, CO<sub>2</sub>, CH<sub>4</sub>, VOC (NMHC) and THC recorded in Krivelj - Bor

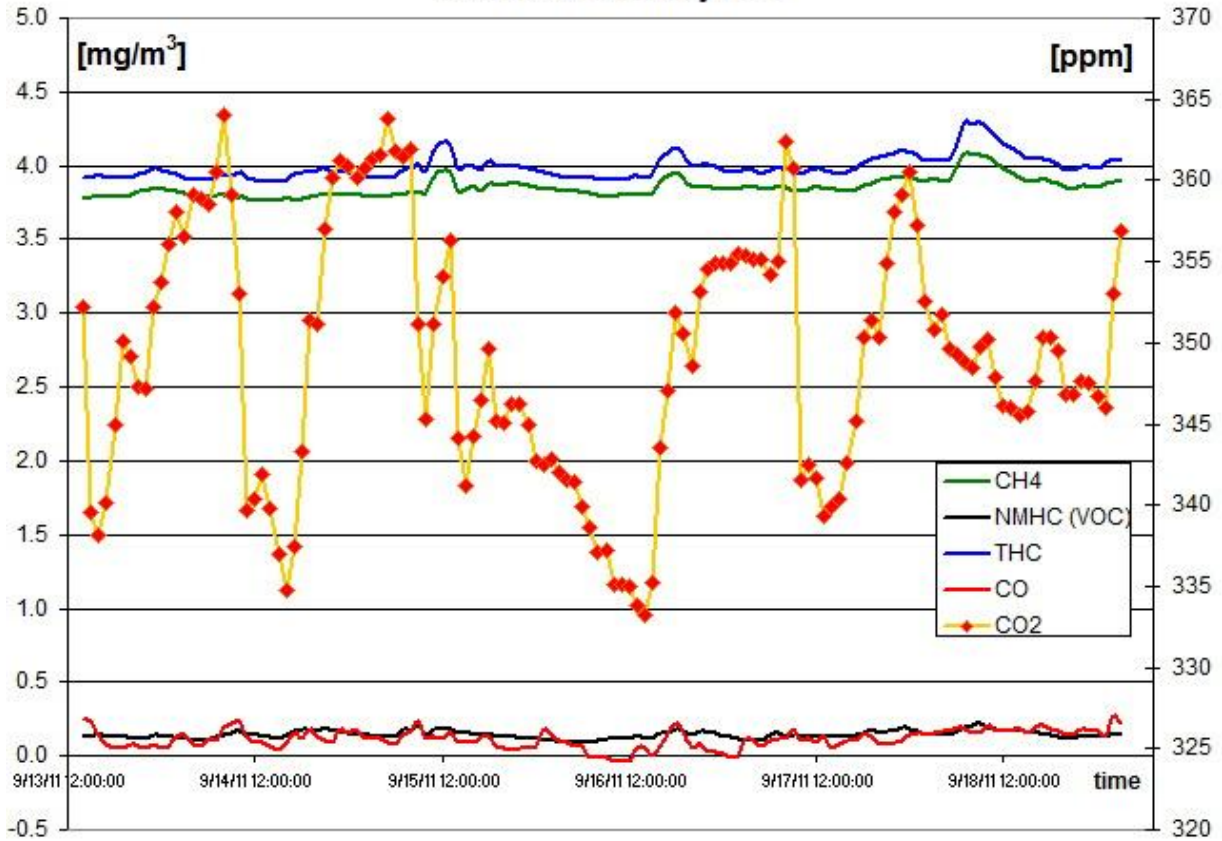


Fig 3. Hourly mean values recorded for CO<sub>2</sub>, CH<sub>4</sub>, NMHC, THC and CO in BOR/KRIVELJ, with UPT Mobile Laboratory

Table1. Daily mean values recorded for BOR / KRIVELJ site

Time	O <sub>3</sub> mg/m <sup>3</sup>	SO <sub>2</sub> mg/m <sup>3</sup>	CH <sub>4</sub> mg/m <sup>3</sup>	NMHC mg/m <sup>3</sup>	THC mg/m <sup>3</sup>	CO mg/m <sup>3</sup>	PM10 mg/m <sup>3</sup>
09/13/11	90.55	58.62	3.80	0.13	3.93	0.12	35.12
09/14/11	103.34	101.02	3.81	0.16	3.97	0.13	32.01
09/15/11	106.53	29.46	3.84	0.12	3.95	0.06	44.53
09/16/11	91.76	56.22	3.85	0.14	3.99	0.09	55.08
09/17/11	97.57	42.02	3.93	0.17	4.10	0.14	43.22
09/18/11	103.07	36.03	3.88	0.14	4.02	0.18	38.94



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### One hour mean values for NO, NO<sub>2</sub> and NO<sub>x</sub> concentration recorded by AIRPOINTER in Krivelj/Bor AQM Campaign

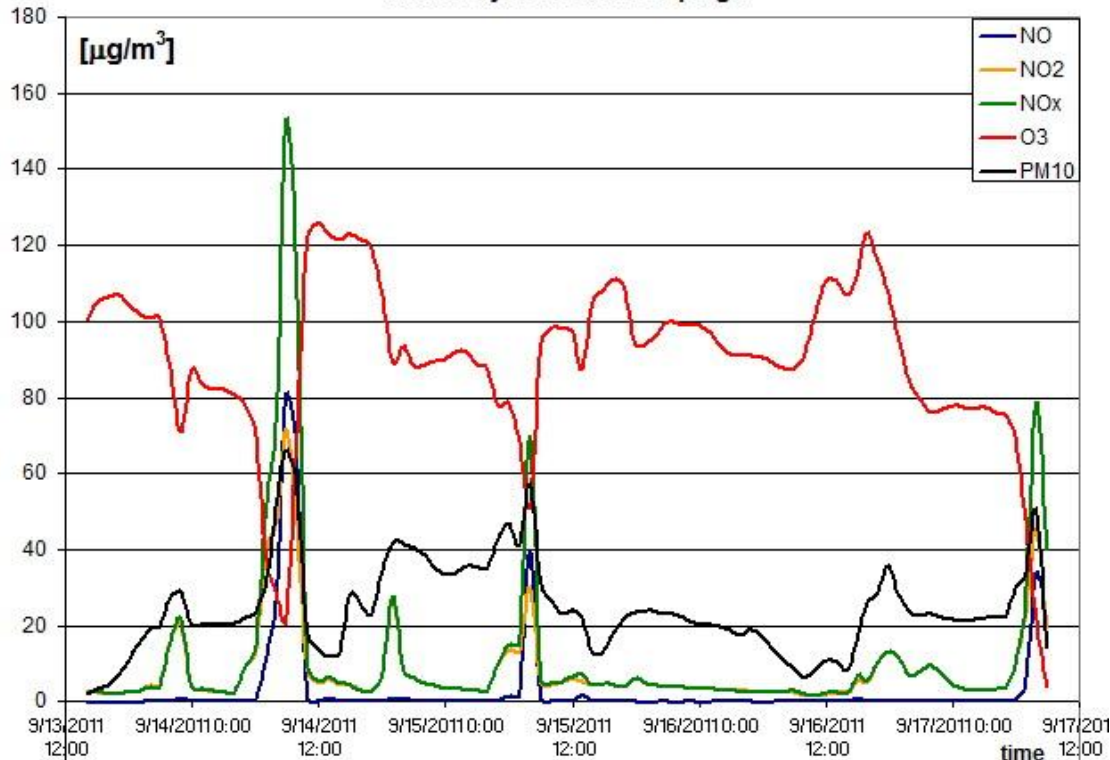


Fig 4. Hourly mean values recorded for SO<sub>2</sub> NO, NO<sub>2</sub>, NO<sub>x</sub>, PM<sub>10</sub> and O<sub>3</sub> in BOR/KRIVELJ, with AIRPOINTER

### 3. Conclusions for BOR / KRIVELJ AQM campaigns:

For the values recorded at BOR / KRIVELJ site we can draw following conclusions:

1. the SO<sub>2</sub> concentration are very high.
2. the PM<sub>10</sub> concentration are relatively high for a green area but under the EU limits
3. the NO and NO<sub>2</sub> concentrations were not measured by the UPT mobile laboratory due to a instrument failure and the SO<sub>2</sub> concentration were not measured by Airpointer due to a sensor failure.
4. CO is insignificant due to the fact that the monitoring site was far away from any road traffic.
5. Ozone concentrations are high but under the admissible limit

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