
 BioMinE - FP6 Project IP NMP2-CT-2005-500329 	
<h2 style="margin: 0;">BioMinE Deliverable DI.2</h2>	
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The Deliverable DI.2 of the BioMinE Integrated Project is a report entitled:

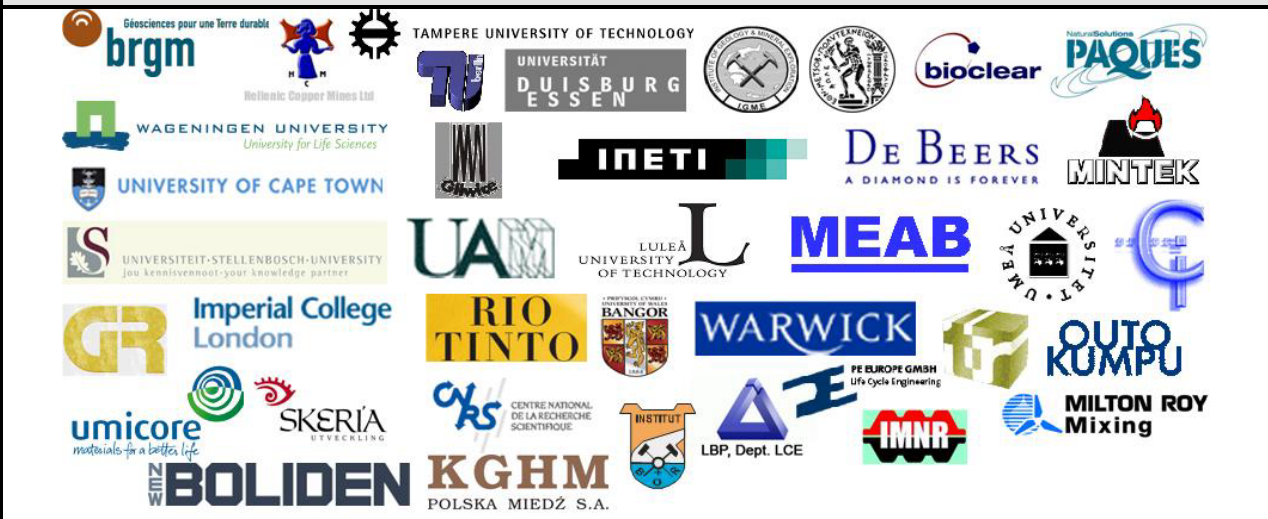
Characterisation of "specific resources proposed by partners" and preparation for process evaluation

The level of dissemination of this deliverable is public. A summary is proposed hereafter.

Summary:

This deliverable summarises the primary and secondary metal bearing resources that are in use, or available for possible future use, in the BioMinE project. The deliverable can be considered as the "BioMinE catalogue" and will be updated and extended during the project to track the progressive evolution of the resource targets, their associated RTD potential and RTD advancements, and the BioMinE partners working, or having worked, on these resources.

Currently the table contains the name, location, metal content, and valuable and penalising metal targets of the metal bearing resource. The available volume, the provider and the user of the resource complete the left page of the table. The right page summarises the technical, economic, environmental, socio-economic & political and other potential RTD impacts associated with the respective resources.





BioMinE



Project NMP2-CT-2005-500329

Acronym BioMinE

Project Title Biotechnology for Metal bearing materials in Europe

Instrument Integrated Project

Thematic Priority Priority 3 – NMP
Nanotechnologies and nanosciences, knowledge-based multifunctional materials, and new production processes and devices

Deliverable reference number and title

BioMinE DI.2

Characterisation of "specific resources proposed by partners" and preparation for process evaluation

Due date of Deliverable	April 2005 (M6 - version 1) April 2006 (M18 - version 3)
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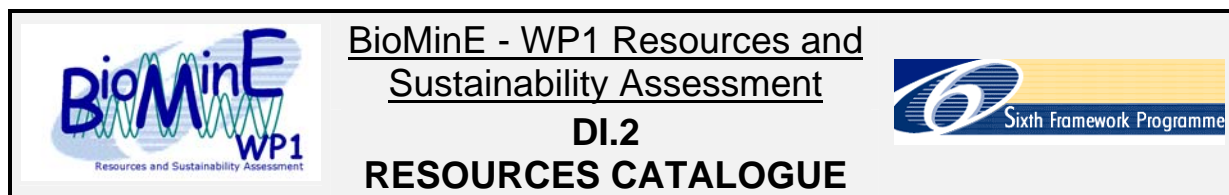
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This deliverable summarises the primary and secondary metal bearing resources that are in use, or available for possible future use, in the BioMinE project. During the project the deliverable will be extended towards the "BioMinE catalogue" and updated regularly to continuously monitor the evolution of the resource targets, their associated RTD potential and RTD advancements, and the BioMinE partners working, or having worked, on these resources.

Currently the table contains the name, location, metal content, and valuable and penalising metal targets of the metal bearing resource. The available volume, the provider and the user of the resource complete the left page of the table. The right page summarises the technical, economic, environmental, socio-economic & political and other potential RTD impacts associated with the respective resources.

MODEL

LEFT PAGE

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		

- **Resource** Type of resource, filled by "resource provider"
- **Provided by** Partner name that can / will make available the metal bearing resource to BioMinE
- **Location** Origin of resource (mine site, district name, or industrial plant description), filled by "resource provider"
- **Volume available: 10-100 kg / > 1 tonne** Volume that could be made available to other members of the consortium (list YES/NO in the subcolumns), filled by "resource provider"
- **Metal Content** General listing of metal characteristics (+ concentrations), filled by "resource provider"
- **Metal Targets: Valuable Metals / Penalising Metals** Listing of target metals, filled by "resource provider" and/or Management Committee
- **Used by** Partner name that is / will be using the metal bearing resource, filled by Management Committee
- **WP** Lists respective WPs that deal or have dealt with the resource.

RIGHT PAGE

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others

- **Resource** Type of resource, summarised from left page
- **BioMinE challenges / potential:** General (qualitative) comments about challenges / potential of the referred resource within BioMinE, listed by sub theme, filled by "resource provider" and/or WP coordinators. "What do we expect as outcome of this resource in the light of BioMinE ?"
 - **Technical**, Engineering, biological and other RTD challenges
 - **Economic**, Presumed economic effects
 - **Environmental**, Presumed (positive and negative) environmental effects
 - **Socio-economic & Political**, Presumed (positive and negative) socio-economic effects and resulting political spin-offs
 - **Others**

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Primary resources in use

- COPPER polymetallic ores and concentrates
(combinations of Cu, with Ni, Zn, Pb, Ag and Au)
- ZINC polymetallic ores and concentrates
(combinations of Zn, with Ni, Cu, Pb, Ag and Au)
- Ores and concentrates with precious metals - focus on GOLD
(but also with combinations of PGE, Co, etc.)

Secondary resources in use

- FLOTATION TAILINGS (Cu, Ni, Zn);
- REFINERY SLIMES AND SLAGS (Pb, Zn, Cu);
- ASHES AND DUSTS, and other co-processing substances

Primary resources at disposition

Secondary resources at disposition

■ COPPER POLYMETALLIC ores and concentrates
(combinations of Cu, with Ni, Zn, Pb, Ag and Au)

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Cu-Ni-PGE concentrate	Rio Narcea > TR > MINTEK	Aguablanca, Spain (Rio Narcea)	Y	No	<p>First flotation concentrate (Spring 05) 5.5% Ni (pentlandite) 7.0% Cu (chalcopyrite) 30 %Fe (pyrrhotite)</p> <p>Second flotation concentrate (Spring 06) 7% Ni - 7% Cu to come</p>	Cu Ni PGE	-	MINTEK, TR, BRGM	WP2, WP4, WP1
Cu-Ni-PGE concentrate	MINTEK	Nkomati, RSA	Yes	No	<p>3.99%Cu (chalcopyrite) 38.6%Fe (pyrrhotite) 9.05%Ni (pentlandite) 1.4%Zn 30.6%S²⁻ 24.7 g/t PGE</p>	Cu Ni PGE	-	MINTEK (Bioclear)	WP2
Cu-Zn-Pb concentrate	SOMINCOR > INETI	Neves Corvo, Portugal	Y	N	<p>23-24% Cu, 30% Fe, 2-3% Zn, 0.2%Pb, 0.2%As, 0.5%Sn, 30-34% S, 0.1%Sb</p>	Cu	Hg Sb As	INETI	WP2
Low-grade serpentinitic Ni sulfide ore	ORC	Hitura, Finland	Y	Y	Ni 0.50%, Cu 0.17%, S 1.10%	Ni Cu	Mg	ORC TUT	WP2

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Cu-Ni-PGE concentrate (Aguablanca)	[MINTEK] Use of thermophilic bacteria; improved copper & nickel extraction; process for PGE recovery	[MINTEK] Reduced operating costs	[MINTEK] Development of a cleaner bio-hydrometallurgical process	-	[BRGM] The largest Cu-Ni basic-ultrabasic deposit in Europe (Geological resources: 31 Mt @ 0.46%Cu 0.62%Ni) EXTENSIVE REPORT PRODUCED IN WP2
Cu-Ni-PGE concentrate (RSA)	[MINTEK] Use of thermophilic bacteria; improved copper & nickel extraction; process for PGE recovery	[MINTEK] Reduced operating costs	[MINTEK] Development of a cleaner bio-hydrometallurgical process	-	[MINTEK] The Nkomati concentrate has served as a proxy until European resources become available >> Aguablanca Cu-Ni
Cu-Zn-Pb concentrate (Neves Corvo)	[INETI] Bioleaching yields and selectivities are enough to allow a feasible industrial application ?	[INETI] Possible biometallurgy application would give added value for the Company		[INETI] The implementation of a copper metallurgy in Portugal would be of socio-economic interest	
Low-grade serpentinic Ni sulfide ore (Hitura)	[ORC] Leaching/ Passivation	[ORC] Potential continuation of mine life			[BRGM] although Ni carries the dominant metal value in this resource, the ore has been tentatively put with the Cu polymetallic ores.

■ COPPER POLYMETALLIC ores and concentrates - continued
(combinations of Cu, with Ni, Zn, Pb, Ag and Au)

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Sulfidic copper concentrate	ORC	Pyhäsalmi, Finland	N	N	Cu 29.6%, Zn 1.7%, Pb 0.2%, S 35.7%, Fe 30.5%	Cu Zn		ORC, TUT	WP2
Cu concentrate	HCM > IGME	Skouriotissa mine, Cyprus	Y ?	Y ?	?	Cu ?	?	IGME	WP2
Polymetallic concentrate	MINTEK	RSA	Yes	No	Cu 22.1 % Fe 27.2 % Pb 4.21 % Zn 2.34 % S ²⁻ 25.6 % Ag 884 g/t	Cu Ag Pb Zn	-	MINTEK	WP2
Polymetallic concentrate	MINTEK	RSA	Yes	No	Cu 21.2 % Fe 23.9 % Pb 2.73 % Zn 3.57 % S ²⁻ 25.5 % Ag 0.15 %	Cu Pb Zn Ag	As Bi	MINTEK	WP2

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Sulfidic copper concentrate (Pyhäsalmi)	[ORC] Passivation/ Leaching				
Cu concentrate (Skouriotissa)		[BRGM] improved recovery and lower energy consumption may turn the Cu extraction profitable		[BRGM] HCM is a SME and its operations are regularly threatened to be put on hold.	
Polymetallic Concentrate (RSA)	[MINTEK] To be used for bacterial consortium studies.	[MINTEK] Reduced operating costs	[MINTEK] Development of a cleaner bio-hydrometallurgical process	-	[BRGM] Serves as proxy until identification of European resource. [MINTEK] European resources to be used when they become available
Polymetallic concentrate (RSA)	[MINTEK] Optimisation of bioleach parameters for metals extraction	[MINTEK] Reduced operating costs	[MINTEK] Development of a cleaner bio-hydrometallurgical process	-	[BRGM] Serves as proxy until identification of European resource. [MINTEK] European resources to be used when they become available

- ZINC POLYMETALLIC ores and concentrates
(combinations of Zn, with Ni, Cu, Pb, Ag and Au)

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Zn/Pb bulk Concentrates	TR	CBM 1, COV 1	N	N	Galena, Sphalerite & silver 25%, 7% & 0.024% 14%, 26% & 0.020%	Zn Pb Ag	?	TR	WP4
Zinc concentrate	Ltu	Skelleftea area, Sweden (Boliden)	Yes	Yes	52%Zn, 2.1ppmAu, 100ppmAg, 0.5%Cu, 9.9%Fe, 0.001%Co, <0.001%Ni, 1.0%Pb, 0.16%Cd, 0.14%Hg, 35%S, 0.4% SiO ₂ , 0.003%F, <0.001%Cl	Zn	Hg?	Ltu	WP2
Lead Sulphides	IMNR	Cavnic, Herja, Şuitor (Baia Mare district, Romania)	Yes	No	62%Pb, 4%Zn, 1.4%Cu, 7.7%Fe, 19.5%S, 3.5 g/t Au, 1000 g/t Ag	Pb Au Ag		IMNR	WP2

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Zn/Pb bulk Concentrates (CBM / COV)	[TR] Current technologies are not able to deal with Zn/Pb bulk concentrate. The process produces high Pb, Zn & Ag recoveries and sulphur could be recovered without sulphuric acid production.	[TR] Lower concentration costs by means to the use of bulk concentrates, a potential lower processing cost by applying bio-hydro processes for metals recovery.	[TR] Conventional pyro-metallurgical processes produce slag, gasses and sulphuric acid. A new unique residue will be composed of the non-soluble gangue inside the raw material.	[TR] The development of a process able to deal with this material may start up currently uneconomic mines with resources difficult to treat by selective-flotation. Creation of jobs.	[TR] Lead and zinc market are growing due to high demands on metals. Requests resources that were rejected in the past due to a lack of a suitable technology.
Zinc concentrate (Skelleftea area)					[Ltu] Intended to be mixed with the pyrite conc. listed below in order to simulate a bulk zinc conc.
Lead Sulphides (Baia Mare District)	[IMNR] Integration of innovative biotechnology for metals recovery	[IMNR] establishment of environmentally friendly biotechnology	[IMNR] establishment of biotechnology which is economic particularly at a small scale and will provide an alternative to current technologies	[IMNR] Integration of innovative biotechnology for metals recovery taking in account the EU policy and significant benefits regarding quality and health of humans, animal and plant life	[BRGM] the lead concentrates are added to the Zn polymetallic group.

▪ ZINC POLYMETALLIC ores and concentrates - continued
(combinations of Zn, with Ni, Cu, Pb, Ag and Au)

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Zinc concentrate (Renberg)	BOLIDEN > TR / MINTEK	Renberg, Sweden (Boliden)	Yes	Yes ?	Renberg: 26.6%Zn, 1.6g/tAu, 104g/tAg, 0.19%Cu, 0.55%Pb, 31.5%S, 16.8%Fe	Zn Au Ag Cu Pb	As ?	TR Mintek Boliden	WP2 WP4
Zinc concentrate (Garpenb.)	BOLIDEN > TR / MINTEK	Garpenberg Sweden (Boliden)	Yes	Yes ?	Garpenberg: 15.8%Zn, 0.7g/tAu, 200g/tAg, 0.13%Cu, 1.59%Pb, 29.6%S, 21.8%Fe	Zn Au Ag Cu Pb	As ?	TR Mintek Boliden	WP2 WP4
Zinc concentrate (Petiknäs S)	BOLIDEN > TR / MINTEK	Petiknäs S, Sweden (Boliden)	Yes	Yes ?	Petiknäs South (17% Zn) 17.1%Zn, 2.0g/tAu, 196g/tAg, 0.52%Cu, 1.57%Pb, 39.8%S, 32%Fe Petiknäs South (19% Zn) 18.9%Zn, 0.45%Cu, 1.34%Pb, 38.4%S, 27.4%Fe, 1.07%As	Zn Au Ag Cu Pb	As	TR Mintek Boliden	WP2 WP4
Zinc Flotation tails & bulk concentrate (Petiknäs N)	BOLIDEN > MINTEK	Petiknäs N, Sweden (Boliden)	Yes	Yes ?	Petiknäs North (tails) 0.75%Zn, 3-4g/tAu, 20-25g/tAg, 0.15%Cu, 0.23%Pb, 14-15%S, 3.4%As Petiknäs North (bulk concentrate) 3%Zn, 12g/tAu, 120g/tAg, 0.65%Cu, 0.6%Pb, 37%S, 11-12%As	Zn Au Ag Cu Pb	As	Mintek Boliden	WP2 WP4

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Zinc concentrate (Renberg)	To be completed				
Zinc concentrate (Garpenb.)	To be completed				
Zinc concentrate (Petiknäs S)	To be completed				
Zinc Flotation tails & bulk concentrate (Petiknäs N)	To be completed				

- Ores and concentrates with precious metals - focus on Au (but also with combinations of PGE, Co, etc.)

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Refractory gold concentrate	Rio Narcea > TR > MINTEK	Salave (Rio Narcea - Spain)	YES	NO		Au			
Refractory pyrite-arsenopyrite concentrate	MINTEK	RSA	Yes	Yes	23.9%FeS ₂ , 10.6%FeAsS 140 g/t Au	Au	As	MINTEK	WP2
Cobaltiferous pyrite concentrate	BRGM	Kasese, Uganda	N	N	Pyrite 80% Co 1.37% Cu, Ni & Zn a few 100ppm	Co		BRGM, (+ UDE, BIOCL., MINTEK, UCT, St'Bosch, UWB, WARW., UAM CELLF., TUT	WP2
Åkulla Östra Refractory pyrite-arsenopyrite concentrate	BOLIDEN	Åkulla Östra	To come ?	N	Gold tellurides	Au		Boliden Mintek	WP2 WP4

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Refractory gold concentrate	Acceptable stability of arsenic in waste residues is largely dependent on ensuring that As(V) is maximised during the bioleaching stage.	[BRGM] Rio Narcea decides early 2006 to reduce its activities in Carles, El Valle (close to Salave) and stop all activities in the district at the end of 2006 after political obstruction to develop the Salave project	the downstream impact arising from the use of cyanide can be significantly alleviated if bioleaching reaction products (S) are minimised	[BRGM] The Salave operation has been put on hold after the political decision not to grant a permit for mineral extraction.	
Refractory pyrite-arsenopyrite concentrate (RSA)	[MINTEK] Use of thermophilic bacteria; improved sulphide oxidation level; shorter residence time	[MINTEK] Reduced operating costs	[MINTEK] Reduced elemental sulphur formation & lower thiocyanate formation; arsenic stability	[MINTEK] Wider acceptance of established biotechnology	[MINTEK] European resources to be used when they become available
Cobaltiferous pyrite concentrate (Uganda)	Fundamental study of pyrite degradation in continuous bioleach conditions				Comparison with industrial plant performances
Åkulla Östra Refractory pyrite-arsenopyrite concentrate	To be completed when / if resource becomes available				

Secondary Resources in use

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Flotation tailing of low grade Ni sulfide ore	ORC	Hitura, Finland	Y	Y	Ni 0.23%, Cu 0.16%, S 1.75%	Ni Cu	Mg	ORC	WP2
Flotation tailings	Rio Narcea > TR > MINTEK	Aguablanca, Spain (Rio Narcea)	YES	NO	0.2% Ni, 0.03% Cu, PGM 's not determined	Ni, Cu, PGM		Umu Mintek	
Lead slime from wet de-dusting of copper shaft furnace emission	IMN	KGHM Polska Miedz (Poland)	yes	yes	46.5%Pb, 1.96%Cu, 0.57%Fe, 5.08%Zn, 0.009%Co, 0.084%Cd, 2.52%As, 0.066%Mo, 0.7%CaO, 0.36%MgO, 0.47%Al ₂ O ₃ , 2.56%SiO ₂ , 0.098%Sb, 0.023%Se, 14ppmHg, 0.0027%TI, 0.014%Te, 12.67%S, 3.35%Cl, 0.22%F, 9-18%C _{org}	Pb Cu Zn	As Hg TI Cl F PAH	IMN	WP2
Pyrite concentrate	Ltu	Aitik mine, Sweden (Boliden)	Yes	Yes	33%Fe, 38.6%S, 28%SiO ₂ , 3.0%CaO, 1.24%MgO, 8.7%Al ₂ O ₃			Ltu	WP2

- FLOTATION TAILINGS (Cu, Ni, Zn);
- REFINERY SLIMES AND SLAGS (Pb, Zn, Cu);
- ASHES AND DUSTS, and other co-processing substances

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Flotation tailing of low grade Ni sulfide ore (Hitura)	[ORC] Leaching	[ORC] Potential recovery of Ni and Cu from tailings			
Flotation tailings (Aguablanca)	[Rio Narcea] Annual throughput: 1,300,000 t/y; [Umu] - pelletising-heap bioleach work	[BRGM] Flotation tailing contain about 0.15% Ni, which may carry substantial revenues if recovered extensively.	[BRGM] Additional studies on leach capacity of tailings help to understand & determine environmental stability of future tailings		Flotation tailings from rougher and cleaning stages are mixed in one thickener and sent to tailings pond; water is partly recycled
Lead slime from wet de-dusting of copper shaft furnace emission (KGHM)	[IMN] Technology development for organic matter removal by biodegradation process.	[IMN] Costs reduction in lead smelting process.	[IMN] Elimination at TMF slime landfilling processing of stored material	[IMN] Preservation of employment	
Pyrite concentrate (Aitik)	[Ltu] Intended to be used as acid producing substrate in order to study neutralizing effect of slags, ashes, etc.				[Ltu] Also to be mixed with Zn conc. see above

Primary Resources at disposition

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Zn/Pb bulk concentrate	IMN	ZGH Boleslaw	yes	yes	Zn (45÷51), Pb (6÷11), Fe (3÷8), SiO ₂ (0.5), CaO (0.81), MgO (0.33), Al ₂ O ₃ (0.1), S (29.2), Cl (0.1), Cd (0.16), Cu (0.022), As (0.079), Sb (0.007), Ni (0.0012), Ge (0.0022), Mn (0.005), Tl (0.033), Ag (0.0071), F (0.009)	Zn Pb	Cd As Ni Ge Tl		
Pyrite concentrate	IMNR subcontractor	Certej Deposit (Romania)	YES	YES	8-10 g/t Au, 130-150 g/t Ag, 1-3% C, 2-2.5% Zn, 1-1.5% Pb, 45-49.5% S	Au, Ag, Zn, Pb			
Bulk Pb-Zn-(-Ag) concentrate	SOMINCOR	Aljustrel (Portugal)				Pb, Zn, Ag			

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Zn/Pb bulk concentrate (Boleslaw)					
Gold concentrate (Certej deposit)		[IMNR] Low actual recovery of precious metals		Many similar deposits exist in the region.	[IMNR] annual production 3000t/year. Deposit 5.5 Mt @ 0.5 g/t Au, 14.5 g/t Ag, 0.28% Pb, 0.75% Zn
Bulk Pb-Zn-(-Ag) concentrate (Aljustrel)				[SOMINCOR] Subject to project commitment	[SOMINCOR] Available 14 months after project commitment

Secondary Resources at disposition

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Copper flotation tailings	IMN	KGHM Polska Miedz	yes	yes	Cu (0.13÷0.21), Pb (0.02÷0.07), As (0.003÷0.005), CaO (12÷27), MgO (3.5÷6.5), SiO ₂ (19÷53), Al ₂ O ₃ (3.5÷10), Co (12÷52 ppm), Ag (5-13 ppm), Ni (8 – 30 ppm)	Cu Ag	Pb As		
Zinc - lead flotation tailings	IMN	ZGH Boleslaw	yes	yes	Zn/Pb sulphides and oxides (1.6÷2), Fe sulphides (10÷15), dolomite (55÷60), calcite (4÷5), SiO ₂ (2÷5), clay (1.5÷3), limonite (4÷8), gypsum (2÷5)	Zn Pb	dolomite calcite		
Zinc - lead flotation tailings	IMN	ZG Trzebionka	yes	yes	Zn/Pb sulphides and oxides (1.0÷1.7), Fe sulphides (< 2.5), dolomite (81÷86), calcite (4÷6), SiO ₂ (< 2.0), clay (<1.5), limonite (<1.5), gypsum (< 2)	Zn Pb	dolomite calcite		
Copper Flotation tailings	SOMINCOR	Neves Corvo (Portugal)							
Bulk Cu-Pb-Zn residue	SOMINCOR	Neves Corvo (Portugal)							
Complex flotation tailings	SOMINCOR	Aljustrel (Portugal)							

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Copper flotation tailings (KGHM)					
Zinc - lead flotation tailings (Boleslaw)					
Zinc - lead flotation tailings (Trzebionka)					
Copper flotation tailings (Neves Corvo)					
Bulk Cu-Pb-Zn residue (Neves Corvo)					[SOMINCOR] Available from July 2006
Complex flotation tailings (Aljustrel)				[SOMINCOR] Subject to project commitment	[SOMINCOR] Available 14 months after project commitment

Secondary Materials at disposition - cont'd

Resource	Provided by	Location	Volume Available		Metal Content	Metal Targets		Used by	WP
			10-100 kg	> 1 tonne		Valuable	Penalising		
Short rotary furnace lead slag	IMN	HC Miasteczko Slaskie	yes	yes	Pb (3÷5), Sb (1÷7), As (0.5÷5), Sn (0.5÷3), Cu (0.5÷5), Na (5÷20), SiO ₂ (5÷10), Fe (3÷15), S _{og} (1÷7)	Pb Sn Cu	As Sb		
Lead slag	IMN	KGHM Polska Miedz	yes	yes	Pb (5÷15), Cu (3÷5), As (0.1÷1), Fe (12÷18), Zn (6÷12), SiO ₂ (7÷15), S _{og} (7÷15), Na ₂ O (5÷8), K ₂ O (3÷5), CaO (3.5÷8), MgO (1.0), Al ₂ O ₃ (2.5)	Pb Cu	As		
Lead slag	IMN	ZGH Orzel Bialy	yes	yes	Pb (5÷15), Fe (30÷40), S (5÷8), Na (<10), Mg (0.8), Ca (6.5), SiO ₂ (10.5) Al (1,5), Cl (0.7), Sb (0.3), Sn (0.4), As (0.1), Cu (0.1), Zn (0.9)	Pb	As		
Slime from off-gases wet dedusting	IMN	KGHM Polska Miedz	yes	yes	Cu (1÷2), Pb (40÷50), Ag (~0.005), As (2÷4), Zn (10÷20), S (6÷9)	Pb Zn	As		
Goethite	Umicore	Balen, BE	YES	YES	10% Zn, 32% Fe? 2,6% Pb, 0,6 % Cu				
Gypsum from WWTP	Umicore	Hoboken, BE	YES	YES	60% CaSO ₄ , 10% Cd, 4,4 % As + Cu, Pb, < 1% PGM, Ag 60 g/t, Au 0,8 g/t	PGM Ag Au			

Resource	BioMinE Challenges / Potential				
	Technical	Economic	Environmental	Socio-economic & Political	Others
Short rotary furnace lead slag					
Lead slag (Polska Miedz)					
Lead slag (Orzel Bialy)					
Slime from off-gases wet dedusting (Cu-Fe-Pb alloy converting)					
Goethite (Balen)			[Umicore] At present, this is dumped		
Gypsum from WWTP (Hoboken)			[Umicore] At present, part of this is dumped		