MODULE 11- ZINC MINING IN KAZAKHSTAN

This module is more or less some housekeeping to ensure I have not missed a monster in some far off godforsaken place that will upset the zinc supply/demand balance.

I realized there was sufficient information in the public forum to make some educated estimates of zinc mining in Kazakhstan going forward in order to come closer to completing a full review of all non-Chinese zinc mines in the world.

What makes this review possible is that both major zinc miners in Kazakhstan, Kaz Minerals and KazZinc (69.7% Glencore), are listed on stock exchanges hence there is some reasonable information available. Some reading between the lines however is still required in both cases.

Summary

Table 1 illustrates my summary of zinc mining in Kazakhstan.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Kaz Minerals	145,476	131,560	121,887	94,300	75,400	73,503	88,335	104,815	109,215	108,135	105,975
KazZinc	227,300	216,200	197,300	193,400	187,600	198,190	188,400	195,804	192,600	165,900	134,750
CZP JSC	34,252	34,810	36,158	36,770	36,500	20,000	30,000	35,000	35,000	35,000	35,000
Subtotal	**407,028**	**382,570**	**355,345**	**324,470**	**299,500**	**291,693**	**306,735**	**335,619**	**336,815**	**309,035**	**275,725**
Other	15,000	15,000	15,000	15,000	15,000	12,000	12,000	12,000	12,000	12,000	12,000
Unallocated	2,972	19,430	7,655	29,530	51,500	50,000	50.000	50,000	50,000	50,000	50,000
Total	**425,000**	**417,000**	**378,000**	**369,000**	**366,000**	**353,693**	**368,735**	**397,619**	**398,815**	**371,035**	**337,725**
ILZSG	**425,000**	**417,000**	**378,000**	**369,000**	**366,000**						
USGS	**369,700**	**361,500**									

"Other" includes an allocation for KazZinc tailings retreatment, RCC's Priorsky mine and Cuprum Holding Abzy mine.
"Unallocated" is merely my attempt, against my better judgement, to balance numbers with the ILZSG since I assume some government statistician in Astana has a better handle on most recent mine supply than I do. But I could be wrong!

Quite frankly, I don't know whether I missed a producer here or not. My figures above are consistently below recent International Lead and Zinc Study Group figures (and for a handful of other countries) and the difference is getting worse. But my figures are greater than US Geological Survey figures (who I think missed CZP JSC). Such is the perils of statistics for ex-communist countries. (The ILZSG by the way are attempting to tell us this week that there was no impact on cumulative world zinc mine supply due to the closure of Century and Lisheen and the cutbacks at Glencore (+1,000,000 tpa) recently since the Chinese miraculously increased zinc production by 877,000 t last year (while their smelters run out of concentrate). The ILZSG aggregates information provided by various country entities and in the particular case of China this data is often notorious and fraught with inconsistencies. China likely has their own agenda here. Likewise, figures for Peru include unrecoverable zinc in the lead concentrates…. yada, yada, yada. I could ramble on about the ILZSG but I digress yet again.

What I see in Kazakhstan is a pile of very tired mines fighting to maintain production. There is some scope for new mines but the grades are not breathtaking. There is one deposit with large zinc output

potential, Shalkiya, but the grades are relatively low and the metallurgy is difficult so it will be attempting to use economies of scale to counter this. This was a past producer. There is no financing in place currently so I can't see any production here prior to 2022.

Table 2 summarizes my findings to date. I have now looked at over 85% of the zinc output by miners in the world ex-China.

Table 2 A Summary of Actual and Forecast Mined Zinc Production Reviewed to Date

Mod.	Region	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2	**Canada**	622.6	412.8	332.5	295.6	316.1	332.0	320.0	319.0	264.0	160.0	105.0
3	**USA**	738.0	774.0	812.0	817.0	769.0	751.0	736.0	721.0	682.0	662.0	659.0
4	**India**	738.5	764.7	758.7	744.2	546.0	854.0	683.0	652.0	750.0	729.0	688.0
5	**Australia**	1,541.2	1,524.5	1,561.1	1,547.0	840.3	841.8	1,016.5	1,078.0	1,051.7	1,011.0	972.7
7	**Peru**	1,204.3	1,262.5	1,250.1	1,342.0	1,273.2	1,408.6	1,415.5	1,425.0	1,447.7	1,416.1	1,422.0
8	**Europe**	1,000.8	988.3	990.2	907.1	911.7	902.0	906.3	931.5	958.5	980.5	986.5
9	**Mexico**	660.3	642.5	659.9	687.7	651.1	744.3	784.3	812.3	817.3	820.3	824.3
10a	**Africa**	310.0	304.2	312.8	322.8	368.2	441.5	455.8	620.5	789.4	766.0	761.0
10b	**Bolivia* (partial)**	230.0	237.0	239.0	259.0	285.0	295.0	295.0	295.0	295.0	295.0	295.0
11	**Kazakhstan**	425.0	427.0	378.0	369.0	366.0	354.0	369.0	398.0	399.0	371.0	338.0
		7,470.7	**7,337.5**	**7,294.3**	**7,291.4**	**6,326.6**	**6,924.2**	**6,981.4**	**7,252.3**	**7,454.6**	**7,210.9**	**7,051.5**
			-1.8%	-0.6%	0%	-13.2%	9.4%	0.8%	3.9%	2.8%	-3.3%	-2.2%

***San Cristobal and Illapa/Sinchi Wayra only.**

Kaz Minerals

You may know Kaz Minerals by its previous name: Kazakhmys. A 2014 restructuring of the company led to the disposal of numerous coal mines, power plants and low grade underground copper mines. The company was left with four operating underground base metal mines in Kazakhstan, one small copper mine in Kyrgyzstan and two major open pit copper development projects (Aktogay and Bozshakol).

The company clearly identifies itself as a copper miner producing by-product zinc, silver and gold. After reading their recent annual reports Kaz Minerals strikes me to some extent to be like Hudbay Mining (and numerous others) from the perspective that they have fallen in love with open pit copper porphyry deposits and out of love with management intensive volcanic massive sulphide (VMS) deposits requiring underground mining with a temperamental workforce. The impact of this is that many companies have been indifferent to the price and supply of zinc to world markets since they are focused on the copper grades in VMS deposits. The number of VMS deposits being mined has fallen dramatically in the past twenty years meaning a greater proportion of the worlds zinc supply in no longer considered to be a by-product. Supply is therefore much more price sensitive than in the past. As for Kaz Minerals, I expect a gradual wind down of underground zinc mining over the next 10-15 years with little effort applied (ie. exploration or growth capital) to maintain current zinc production rates.

The four underground base metal operations: Orlovsky, Irtyshsky, Artemyevsky and Yubileyno-Snegirikhinsky are referred to as the East Region Mines. The Yubileyno-Snegirikhinsky illustrated above closed weeks ago, in late December 2016 following reserve depletion. Zinc production from this mine

was insignificant in 2016. A fifth mine, Nikolayevsky, ceased production in 2012 for economic reasons. However, its concentrator is used to process the ore from the Irtyshsky and Artemyevsky mines. The Orlovsky mine has its own concentrator.

Reserves at the three remaining mines appears ample to maintain existing mining rates beyond 2022. Kaz Minerals has not indicated any intention to increase production at any of the operations since they are focussed on open pit copper mine development instead. The mines are getting deeper so even maintaining production requires substantial sustaining capital. Therefore, annual zinc production will largely be a function of zinc grades in the ore which is a function of mine sequencing.

Zinc recovery at the concentrators has been relatively poor and in the 70% range. There has been a steady deterioration in annual zinc output as both mined grade and tonnage has decreased. This deterioration is expected to continue in 2017 due to the loss of the Yubileyno-Snegirikhinsky mine and guidance from the company that zinc grade at Artemyevsky will remain well below reserve grade due to mine sequencing. Production rates at the Orlovsky mine are also expected to stay below historic averages through 2017 and into 2018 since mining is now occurring only six days a week instead of seven to allow maintenance work in the ventilation shaft.

Unfortunately, Kaz Minerals does not breakout reserves and resources for the East Region by mine annually. But in order to get a sense of the relative size of each resource base, Table 3 illustrates the figures reported in the 2011 prospectus for listing on the Hong Kong Stock Exchange. Based on those figures, the life of Orlovsky and Artemyevsky is at least until 2022 and Irtyshsky much longer. So no closures are assumed in the study period. Kaz Minerals also states they are taking steps to extend to life of Artemyevsky which I assume means underground exploration programs.

Cash costs per pound of copper after by-product credits for 2015 for the East Region are stated in the 2015 Annual Report as $US1.11/lb. The local currency, the tenge, has depreciated further since that time.

Table 3 Resources and Reserves for Kaz Minerals VMS Mines

2011

	Mineral Resources						Ore Reserves					
Mine	**Category**	**'000 t**	**Cu%**	**Zn%**	**Au g/t**	**Ag g/t**	**Category**	**'000 t**	**Cu%**	**Zn%**	**Au g/t**	**Ag g/t**
Artemyevsky	Measured	8,156	2.37	7.40	1.55	121.73	Proved	8,427	2.13	6.76	1.41	111.02
LOM 11 Years	Indicated	16,981	1.93	5.68	0.86	106.59	Probable	3,047	2.64	1.28	0.36	21.97
	Total	25,137	2.07	6.24	1.08	111.5	Total	11,474	2.27	5.31	1.13	87.37
Belousovsky	Measured	4,326	0.75	4.18	0.66	57.95	Proved	264	1.85	1.12	0.38	27.50
LOM 3 Years	Indicated	8,027	0.41	3.58	0.35	46.79	Probable					
	Total	12,353	0.53	3.79	0.45	50.70	Total	264	1.85	1.12	0.38	27.50
Irtyshsky	Measured	7,833	1.98	5.47	0.33	73.02	Proved	10,944	1.35	3.72	0.22	49.65
LOM 23 Years	Indicated	4,326	2.06	3.99	0.31	72.29	Probable	6,044	1.40	2.71	0.21	49.16
	Total	12,159	2.01	4.94	0.32	72.76	Total	16,988	1.37	3.36	0.22	49.48
Nikolayevsky	Measured	3,114	1.31	4.96	0.25	28.57	Proved	3,410	1.05	3.97	0.20	22.86
LOM 11 Years	Indicated	4,311	1.28	3.47	0.43	41.92	Probable	4,583	1.03	2.78	0.34	33.53
	Total	7,425	1.29	4.10	0.36	36.32	Total	7,992	1.03	3.29	0.28	28.98
Orlovsky	Measured	17,817	4.12	3.67	0.89	40.76	Proved	18,007	3.88	3.45	0.84	38.31
LOM 12 Years	Indicated	3,763	3.68	3.94	0.81	36.22	Probable					
	Total	21,580	4.05	3.45	0.84	38.31	Total	18,007	3.88	3.45	0.84	38.31
Yubileyno-	Measured	1,177	3.41	5.22	0.61	41.05	Proved	1,353	2.73	4.18	0.49	32.84
Snegirikhinsky	Indicated	318	3.59	1.72	0.29	17.94	Probable	365	2.87	1.37	0.23	14.35
LOM 4 Years	Total	1,494	3.45	4.47	0.54	36.14	Total	1,718	2.76	3.58	0.43	28.91
East Region	**Measured**	**42,423**	**2.82**	**4.91**	**0.84**	**63.15**	**Proved**	**42,405**	**2.60**	**4.23**	**0.73**	**54.20**
Total	**Indicated**	**37,726**	**1.74**	**4.58**	**0.63**	**74.78**	**Probable**	**14,039**	**1.59**	**2.39**	**0.29**	**37.25**
	Total	**80,148**	**2.31**	**4.75**	**0.73**	**68.62**	**Total**	**56,444**	**2.35**	**3.77**	**0.62**	**49.99**

East Region reserves and resources as of December 31, 2015 are listed in Table 4.

Table 4 Reserves and Resources for the East Region as of December 31, 2015

Summary of ore reserves

		Reserves[1] kt		Copper %		Zinc %		Gold g/t		Silver g/t		Lead %		Molybdenum %	
		2015	2014	**2015**	2014	**2015**	2014	**2015**	2014	**2015**	2014	**2015**	2014	**2015**	2014
East Region	Proved	**16,289**	18,087	**2.53**	2.40	**5.28**	4.84	**0.91**	0.78	**71.66**	62.65	**1.15**	1.05	–	–
	Probable	**3,600**	2,357	**2.72**	2.21	**3.83**	2.04	**0.51**	0.32	**70.92**	34.63	**0.81**	0.54	–	–
	Total	**19,889**	20,444	**2.57**	2.38	**5.02**	4.52	**0.84**	0.73	**71.53**	59.42	**1.09**	0.99	–	–

Summary of mineral resources

		Resources[1] kt		Copper %		Zinc %		Gold g/t		Silver g/t		Lead %		Molybdenum %	
		2015	2014	**2015**	2014	**2015**	2014	**2015**	2014	**2015**	2014	**2015**	2014	**2015**	2014
East Region	Measured	**30,512**	22,872	**2.79**	2.90	**5.54**	4.71	**1.04**	0.83	**86.95**	61.93	**1.44**	1.03	–	–
	Indicated	**9,747**	20,924	**2.97**	2.08	**3.21**	5.05	**0.58**	0.80	**59.05**	91.63	**0.83**	1.54	–	–
	Total	**40,259**	43,796	**2.83**	2.50	**4.98**	4.87	**0.93**	0.82	**80.20**	76.12	**1.29**	1.27	–	–

A corporate presentation lists measured and indicated resources as of December 31, 2015 of 15.6 Mt, 5.5 Mt and 18.4 Mt at Orlovsky, Irtyshsky and Artemyevsky respectively. No breakout of grades were provided by mine site.

Orlovsky

Per the 2011 document for the Hong Kong listing:

> *Orlovsky is an active underground mine exploiting a large (18.7 Mt), polymetallic, high grade, and gold rich VMS deposit. It comprises the Main Orebody, which comprises an upper and lower part with an irregular pod-like shape, 20° to 30° dip to the SW, average thickness of 35m and down-dip extent of 600 m. It is now almost worked out, with the remaining resources consisting of remnant blocks distributed in the lower part of the orebody and representing some 25% of the whole deposit. A 0.85 Mt oxidised cap on the upper part of the orebody has been excluded from the resources since until now, no technology has been successfully developed to treat it.*
>
> *350 m to the SW of the lower part of the Main Orebody is the New Orebody comprising a southern portion with a 10° to 15° dip to the SW and thickness of up to 56m and a northern portion with very high grade and thickness of 5-20 m. The combined New Orebody occupies a surface area in long section of some 250 m by 150 m and accounts for the rest of the resources in the deposit.*

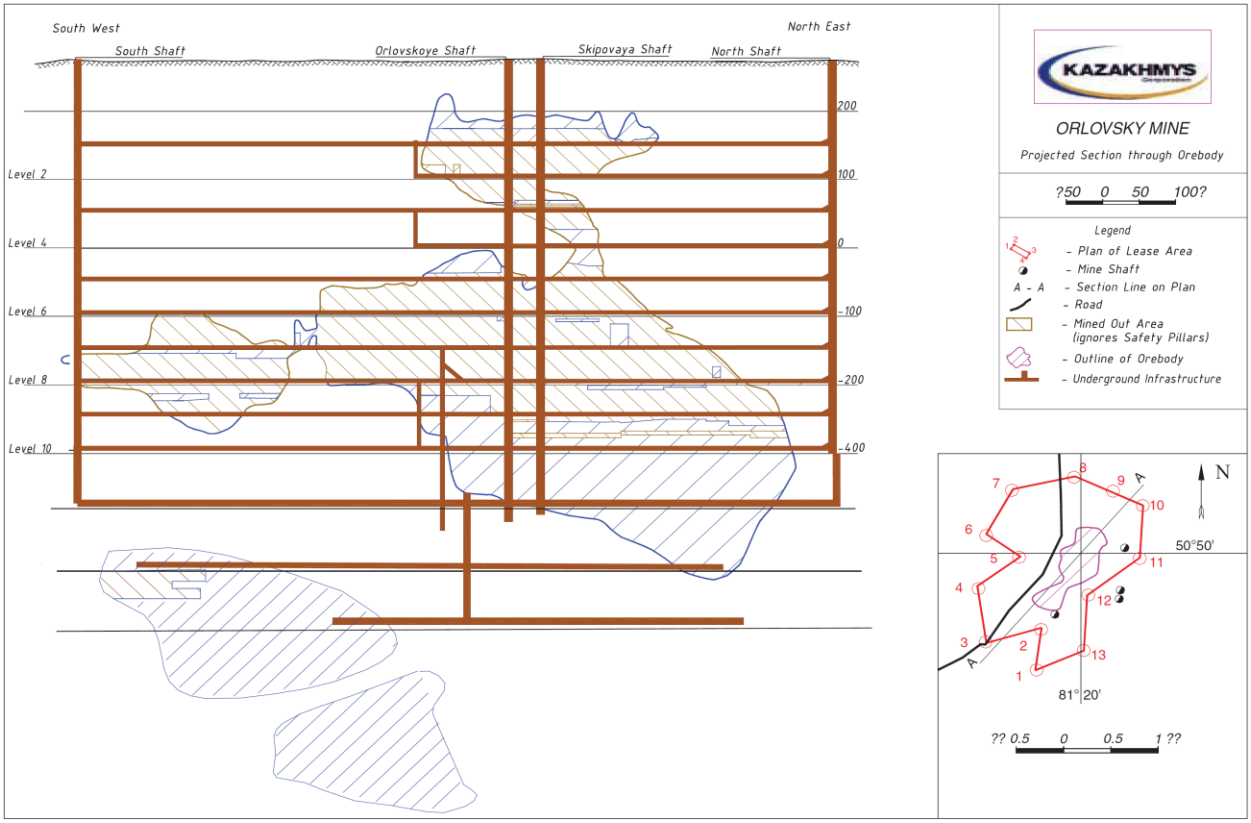
Due to the relatively flat nature of the ore, mechanised drift and fill is the mining method used. The mine and mill capacity is in the 1.5 million tonne a year range. Shaft hoisting of ore is used. A rudimentary figure provided in the IPO indicates that mining has been concentrated above 500 m depth prior to 2011 but is now focused on resources up to 1000 m in depth. The high copper grade is no doubt the breadwinner here with zinc coming along for the ride. Table 5 illustrates recent production performance. Table 6 assumes that the zinc grade will gradually trend towards reserve grade and that the mining rate will pick back up to 1.5 mtpa in 2019. Mill recovery of 72% zinc is assumed. I could be generous here.

Table 5 Recent Production Performance for the Orlovsky Mine

Year	Tonnes	Cu%	Zn%	Au g/t	Ag g/t
2016	1,260,000	3.67	4.38	1.02	58.0
2015	1,417,000	3.69	4.52	1.18	64.4
2014	1,548,000	3.66	5.48	1.35	74.8
2013	1,557,000	3.45	5.31	1.27	66.8
2012	1,580,000	3.04	4.29	1.09	56.0

Table 6 Forecast Production Performance for the Orlovsky Mine

Year	Tonnes	Zn%	Zn Recovery	Zinc Produced
2017	1,250,000	4.2	72%	37,800
2018	1,350,000	4.0	72%	38,880
2019	1,500,000	3.9	72%	42,120
2020	1,500,000	3.8	72%	41,040
2021	1,500,000	3.7	72%	39,960
2022	1,500,000	3.5	72%	37,800



Artemyevsky

Per the 2011 document for the Hong Kong listing:

Artemyevsky is an operating underground mine exploiting a large (14.59 Mt), high grade, polymetallic, gold and silver-rich VMS deposit. A number of different steeply dipping ore bodies have been identified in the deposit, the most important of which is the Main Orebody, with a strike length of 1,300 m and maximum thickness of 200 m. This is the sole source of ore at the present time, with working on the 7, 8, 9 and 10 Levels. The higher-grade but less continuous Talovskaya Orebody is located 50-150 m in the footwall of the Main Orebody, while the Kamishinskaya orebody forms a protective pillar below an old open pit and to protect the underground workings from flooding.

There are a further six orebodies that form a series of sub-parallel lenses gently pitching to the east of the Main and Talovskaya orebodies. They comprise some 55% of the total resource but are less well explored through deep surface drill holes. A prefeasibility study for the mining of these orebodies was completed in 2007.

The ore shows a vertical gradation through the individual bodies of polymetallic ores at the top, barite/polymetallic ores, polymetallic ores, copper/zinc ores and copper ores at the base. There are copper rich mineralised zones below these orebodies within the footwall volcanics of the Talovka formation.

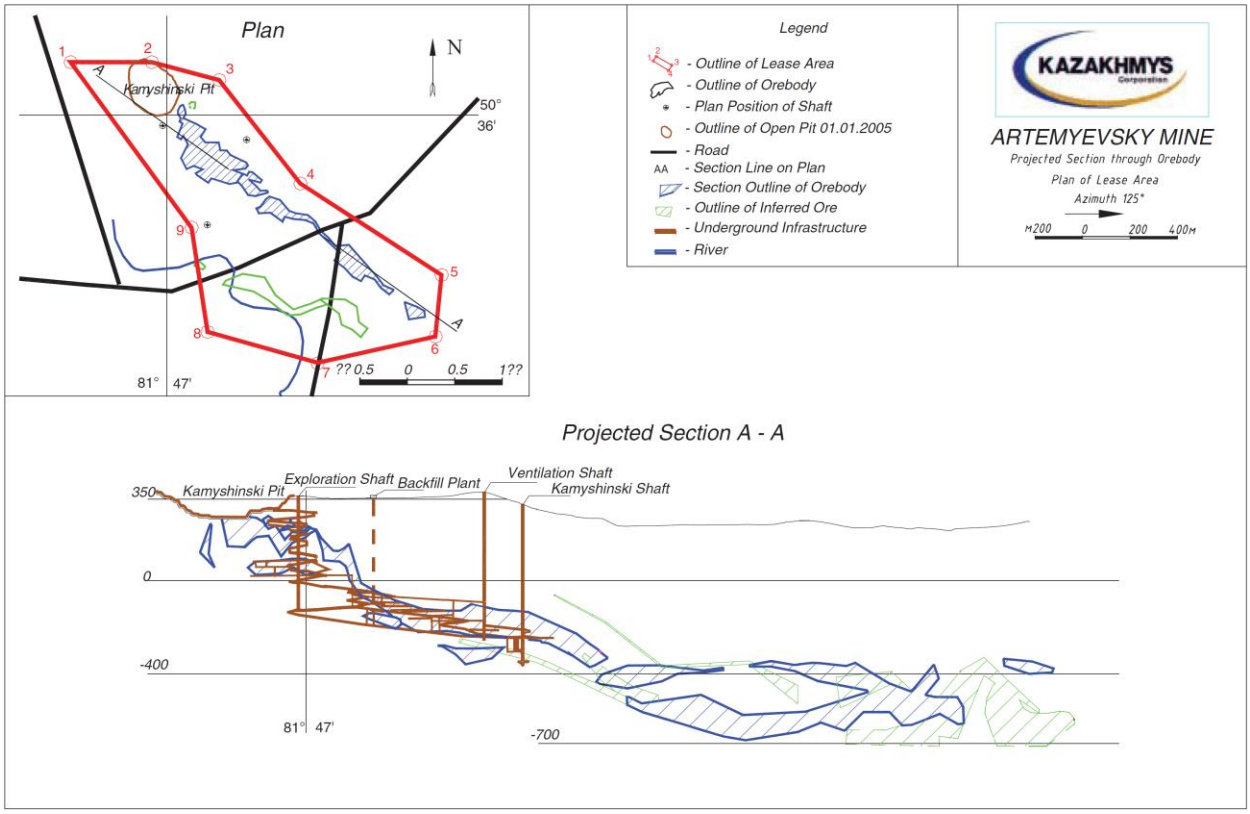
This mine has been in operation since 2005. The mine utilizes mechanized blasthole stoping and cut and fill mining methods and has a rated capacity of 1.6 mtpa. Ore is delivered to the Nikolayevsky mill 20 km away. The mine is accessed by three shafts and a decline from a previous open pit. Hoisting and backfilling capacity have been the mines bottlenecks. The figure below indicates that mining is progressing to a depth over 1000 m so there will be plenty of challenges maintaining production rates as development chases the ore. Recent production performance is listed in Table 7. Zinc grade will remain depressed for 2017 at least and I have assumed that it will trend back up to the 5% range after this time to arrive at the production forecast in Table 8 using 72% zinc recovery in the mill.

Table 7 Recent Production Performance for the Artemyevsky Mine

Year	Tonnes	Cu%	Zn%	Au g/t	Ag g/t
2016	1,309,000	1.48	2.10	0.37	38.9
2015	1,289,000	1.62	2.96	0.38	35.1
2014	1,358,000	1.78	4.04	0.64	63.8
2013	1,332,000	1.68	4.65	0.92	90.8
2012	1,540,000	1.92	6.31	1.09	115.4

Table 8 Forecast Production Performance for the Artemyevsky Mine

Year	Tonnes	Zn%	Zn Recovery	Zinc Produced
2017	1,300,000	2.3	72%	21,528
2018	1,400,000	3.5	72%	35,280
2019	1,500,000	4.5	72%	48,600
2020	1,500,000	5.0	72%	54,000
2021	1,500,000	5.0	72%	54,000
2022	1,500,000	5.0	72%	54,000



Irtyshsky

Irtyshsky is an operating underground mine exploiting a polymetallic volcanogenic massive sulphide (VMS) deposit of average size (8.66 Mt) and grade. The mineralisation is of lenses with extensive strike extents but more limited down-dip persistence. There are three principal ore bodies with the dimensions and percentage share of the Measured and Indicated resource shown below.

Irtyshsky Principal Orebodies

	Orebody Strike length (m)	*Down-dip length (m)*	*Thickness (m)*	*Resource %*
Main	*2,500*	*750*	*3.5*	*17*
South East	*3,000*	*400*	*2.7*	*75*
No 2	*1,600*	*300*	*1.35*	*8*

The orebodies pitch slightly to the NW with their long axes roughly parallel. The average strike of the Irtyshsky ore body is NW-SE and the dip of the ore body is steep to sub-vertical (70-80°). The ore body is gently folded with secondary thickening of the ore lenses in the fold axes. The copper and zinc grades increase with increasing depth from surface.
Most mining is currently taking place in the lower parts of the Main (12 and 13 levels) and SE (11 level) orebodies. The No 2 Orebody is not being mined at the present time.

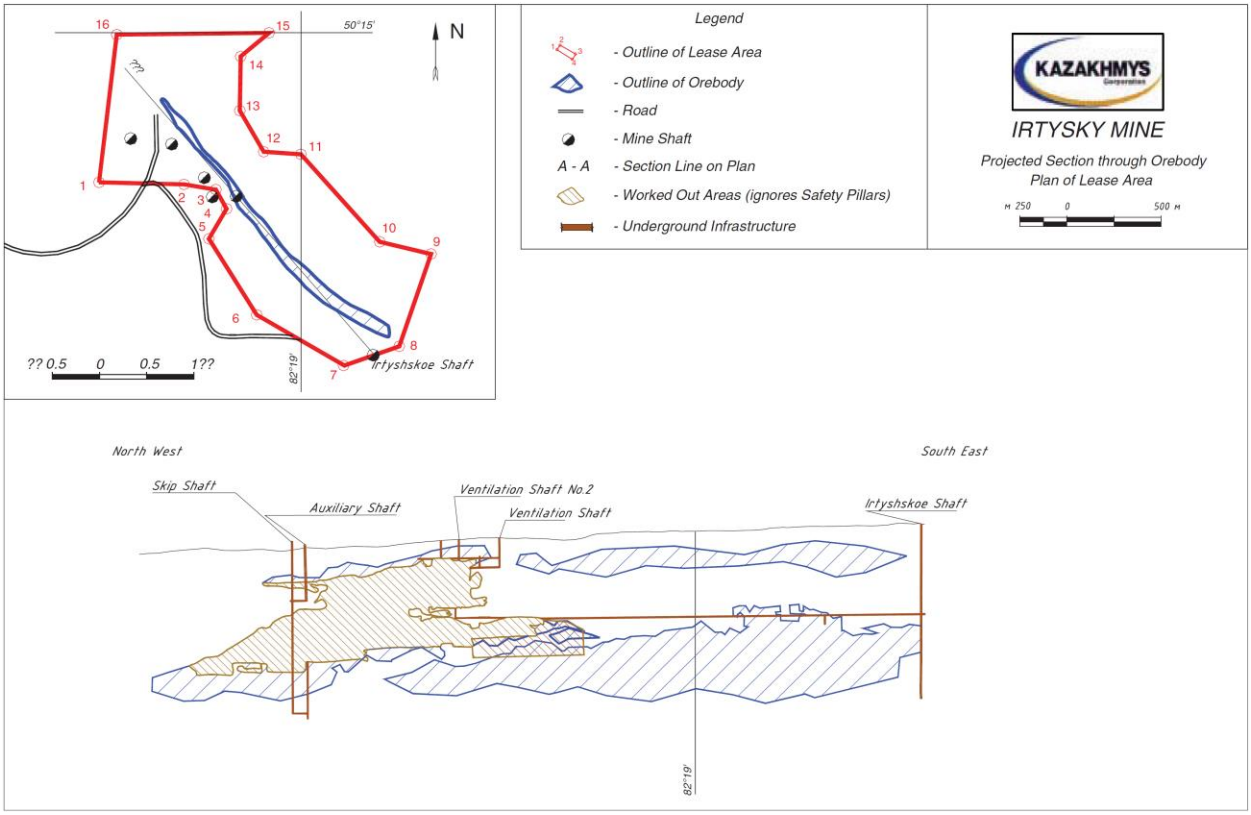
Mining commenced in 2001. The issue here is clearly the narrow thickness of the ore zones. Labour intensive shrinkage stoping is used with high ore dilution (32%). Some sublevel caving and room and pillar mining is also conducted. Jackleg drills and slushers are used for mining with rail haulage to the ore pass leading to a jaw crusher. Hoisting in a 650 m deep shaft is conducted with 10 t skips. Attempting to increase mine capacity is very difficult in these types of situations due to narrow ore width and lack of mechanization so I do not foresee any changes to current operating rates. Table 9 illustrates recent production performance. Table 10 assumes it is steady as she goes with 72% zinc recovery at the mill.

Table 9 Recent Production Performance for the Irtyshsky Mine

Year	Tonnes	Cu%	Zn%	Au g/t	Ag g/t
2016	632,000	1.54	3.12	0.29	53.6
2015	655,000	1.67	3.13	0.28	62.2
2014	637,000	1.49	3.21	0.29	49.6
2013	626,000	1.49	3.31	0.27	50.8
2012	610,000	1.39	2.91	0.26	50.8

Table 10 Forecast Production Performance for the Irtyshsky Mine

Year	Tonnes	Zn%	Zn Recovery	Zinc Produced
2017	625,000	3.15	72%	14,175
2018	625,000	3.15	72%	14,175
2019	625,000	3.15	72%	14,175
2020	625,000	3.15	72%	14,175
2021	625,000	3.15	72%	14,175
2022	625,000	3.15	72%	14,175



Yubileyno-Snegirikhinsky

Production statistics up to recent mine closure are listed in Table 11.

Table 11 Recent Production Performance for the Yubileyno-Snegirikhinsky Mine

Year	Tonnes	Cu%	Zn%	Au g/t	Ag g/t
2016	528,000	1.98	1.68	0.27	17.5
2015	625,000	1.94	0.98	0.28	16.4
2014	659,000	2.13	1.65	0.43	21.6
2013	835,000	2.30	1.85	0.46	25.2
2012	769,000	2.82	2.50	0.42	26.1

Nikolayevsky

As illustrated in Table 12, this mine closed in August 2012 for economic reasons. Difficult ground conditions were also mentioned in one document. The low grades are apparent. Workers were transferred to other mines.

Table 12 Recent Production Performance for the Nikolayevsky Mine

Year	Tonnes	Cu%	Zn%	Au g/t	Ag g/t
2012	208,000	0.83	1.65	0.36	20.8

Kaz Minerals Summary

Actual total zinc production for Kaz Minerals is illustrated in Table 13.

Table 13 Cumulative Production Performance for Kaz Minerals

Year	Tonnes	Cu%	Zn%	Au g/t	Ag g/t	Contained Zinc	Recovered Zinc	Zinc Recovery
2016	3,729,000	2.30	2.98	0.56	44.8	111,124	**75,400**	68%
2015	3,986,000	2.42	3.23	0.63	47.0	128,748	**94,300**	73%
2014	4,202,000	2.48	4.07	0.82	59.1	171,021	**121,887**	71%
2013	4,350,000	2.41	4.16	0.86	63.9	180,960	**131,560**	73%
2012	4,707,000	2.33	4.36	0.84	68.3	205,225	**145,476**	71%

Forecast production is illustrated in Table 14. A partial recovery in zinc production is predicted based upon an eventual increase in zinc grade at Artemyevsky and an increase in production rate at Orlovsky.

Table 14 Forecast Production Performance for Kaz Minerals

Mine	2017	2018	2019	2020	2021	2022
Orlovsky	37,800	38,880	42,120	41,040	39,960	37,800
Artemyevsky	21,528	35,280	48,600	54,000	54,000	54,000
Irtyshsky	14,175	14,175	14,175	14,175	14,175	14,175
Total	**73,503**	**88,335**	**104,895**	**109,215**	**108,135**	**105,975**

References: Various reports located here . The Hong Kong listing document is in 2011 and the LSE IPO document is in 2005.

KazZinc (Glencore 69.7%)

I never thought too highly of these assets but after a thorough review I have gained more respect. Glencore controls a number of mines and smelters in Kazakhstan.

Maleevskoye (Maleevsky)

This mine is located in the same region as Kaz Minerals East Region mines. Since I have a lazy streak in me I will just copy/paste what Wardell Armstrong stated in their technical report for the mine submitted as part of the Glencore Initial Public Offering document:

Maleevskoye is the largest underground mine in the Kazzinc group in terms of ore production. Operations at Maleevskoye started in 2000 at a rate of 1.5Mtpa, with full scale production of 2.25Mtpa being reached in 2002. Two ore types are mined at Maleevskoye, copper-zinc ore and polymetallic ore. Both products are transported by road to the Zyryanovskiy Mining and Concentrating Complex ("ZGOK") located some 25km to the south of the mine site. The mine utilises modern high capacity trackless mining methods combined with a traditional tracked haulage system. The main mining methods in operation are sub-level caving, which accounts for approximately 5% of production, and sub-level open stoping with backfill, which accounts for the remaining 95% of production.

Both mining methods utilise mechanised development with electric-hydraulic face-jumbos and diesel LHDs for drilling and ore extraction. Ore and waste is transported either directly to ore/waste passes using LHDs or loaded into trucks and transported to a central ore/waste pass. Tailings are used for backfill.

Despite the fact that the mine is located 25km from the processing facility, the modern high productivity mining methods allow a good overall mining cost (approximately US$18/t of ore mined). The reserves appear sufficient to maintain operations at the present level until 2015, but after that production rate drops as a result of fewer faces being available.

Wardell was wrong with that last statement since Glencore has done a good job of converting resources into reserves. Shaft skipping of ore is used. Table 15 illustrates recent production results.

Table 15 Recent Production Performance for the Maleevsky Mine

Year	Tonnes	Zn%	Pb%	Cu%	Ag g/t	Au g/t	Assumed Zn recovery	Assumed Zn output
2016	2,300,000	5.8	0.9	1.5	55	0.5	89%	118,700
2015	2,200,000	5.7	0.8	1.9	55	0.6	89%	111,600
2014	2,100,000	6.2	1.1	1.9	66	0.7	89%	115,900
2013	2,300,000	6.0	1.0	1.9	60	0.6	89%	122,800
2012*	2,137,000	6.1	1.0	1.66	58	0.5	89%	116,000

*planned production according to IPO document page 1003. Actual results not located. Other years tonnage is rounded to the nearest 100,000 T. Assumed zinc recovery and output are the authors estimates only based on past mill performance.

What is apparent is that this mine is quickly running out of ore and zinc reserve grade is deteriorating. This is illustrated in Table 16 and Figure 1. I assume the increase in zinc resource grade in 2016 is related to a new zone that they have not put a mine plan around yet in order to move it into the reserve column (while removing lower grade resources). Or it could be the inclusion of pillars where they expect very high dilution (or it could be a typo). Resources are undiluted and do not reflect mining tonnage losses.

Table 16 The Resource and Reserve Situation at the Maleevsky Mine

Year	M +I Resources	Zn%	P + P Reserves	Zn%
2016	10,000,000	8.4	7,600,000	5.0
2015	12,000,000	6.6	10,000,000	5.2
2014	14,000,000	6.9	12,000,000	5.3
2013	16,000,000	6.9	14,000,000	5.5
2012	20,000,000	6.9	17,000,000	5.9

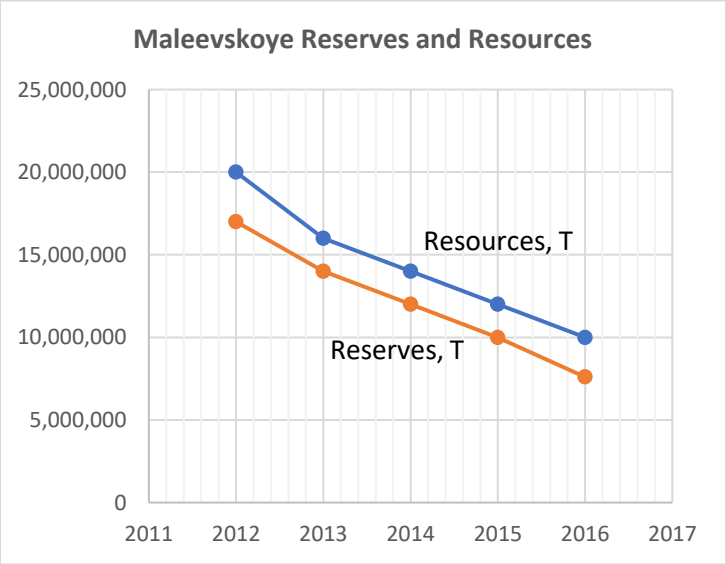
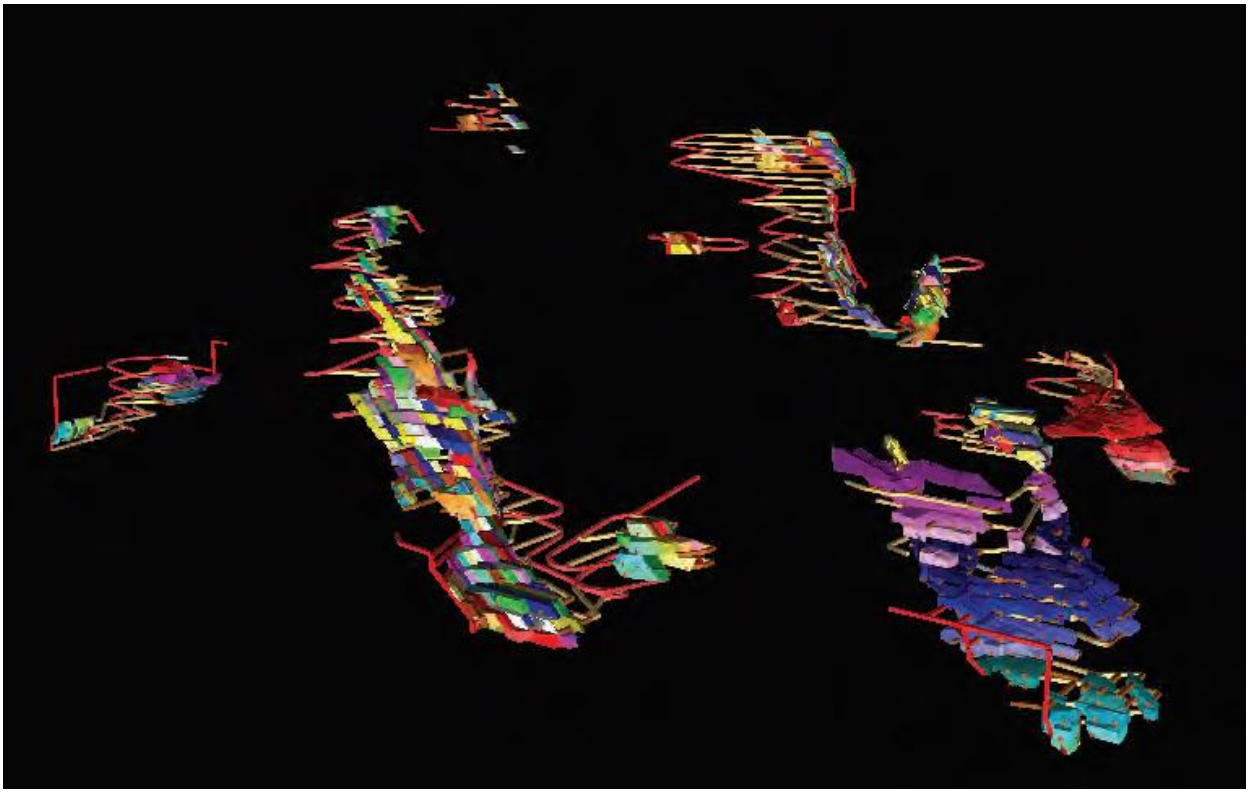


Figure 1 The Resource and Reserve Situation at the Maleevsky Mine

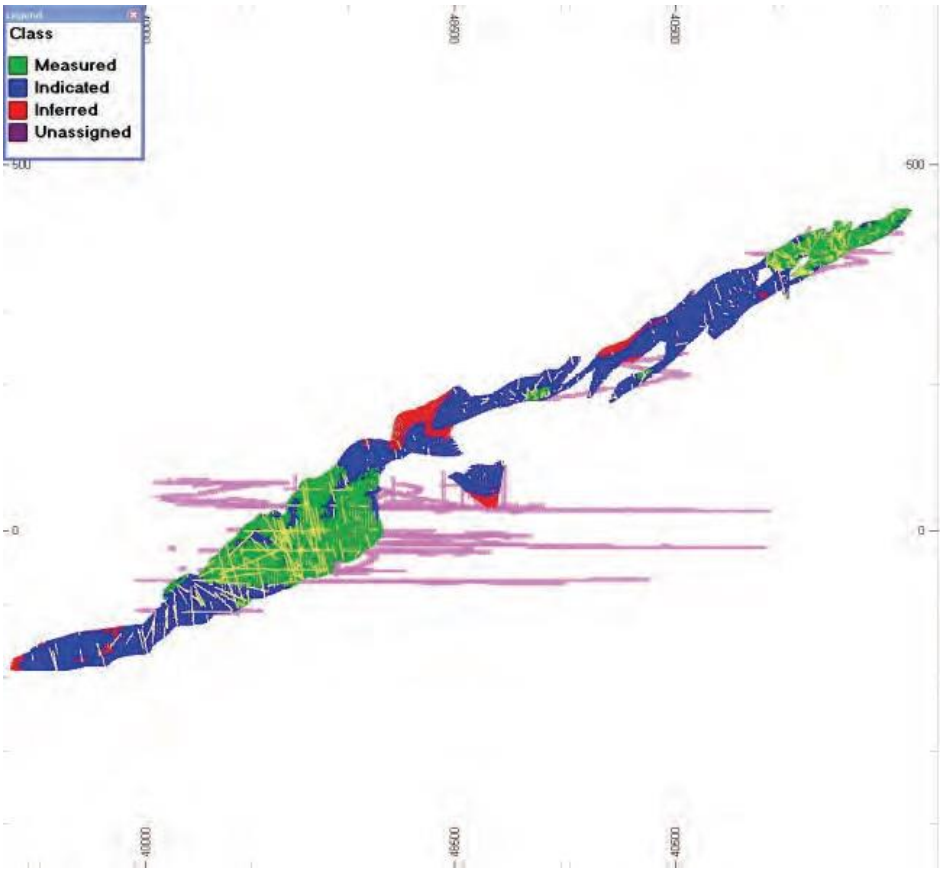
I have assumed the rot will start to set in in 2018 with both a grade and tonnage rate decline. The mine has obviously been cherry picking since this is reflected in the continually decreasing reserve grade versus mining grade. Since Glencore is essentially a closed shop when it comes to providing decent disclosure, Table 17 is my estimate of zinc production through to 2022 using 89% mill zinc recovery as illustrated on page 1156 of the IPO document. I have also assumed a modest addition to reserves. KazZinc does not separate out zinc production by mine in quarterly and annual reports. If indeed the 2016 resource grade of 8.4% does translate into the reserve grade post-2017, I may be 1% to 1.5% low on my zinc grade estimates.

Table 17 Forecast Production Performance for the Maleevsky Mine

Year	Tonnes	Zn%	Zn Recovery	Zinc Produced
2017	2,200,000	5.5	89%	107,690
2018	2,000,000	5.5	89%	97,900
2019	1,800,000	5.2	89%	83,304
2020	1,800,000	5.0	89%	80,100
2021	1,200,000	5.0	89%	53,400
2022	500,000	5.0	89%	22,250



This isometric collage illustrates that there are multiple zones being mined by blasthole stoping at the mine. Wardell lists 18 separate orebodies in three major zones (page 1141 of the IPO) but only three orebodies appear to be of significance tonnage wise (orebodies 3,6,7).



Zone 3 cross section showing the relatively flat dip but substantial width of the zone as of 2011.

Ridder-Sokolniy

There is no disputing that this mine has a long future ahead of itself based upon known reserves. Zinc grade however is low. Wardell states:

Ridder-Sokolniy has a long mining history with underground operations commencing in 1791. Originally there were three separate mines: '40 Years of VLKSM', 'Ridder' and 'Leninogorskiy', which eventually merged into one operation to enable a combined access to the ore. Mining operations have been conducted in the 17 major lodes and future plans are to develop the eastern flank of the Perspectivnaya Lode at the Bakhrushinsky deposit. The mine has an extensively developed underground infrastructure on 11 haulage levels and in 11 different deposits. The deposits are accessed by 12 shafts (10 in operation), with a maximum depth of 460m.

The main hoisting shafts are Skipovaya (for Pb-Zn ore) and Novaya (for Cu ore and development waste). The mine has a staffing of approximately 1,500 and most of the production is performed using hand-held equipment and scrapers and the main haulage is tracked. Trackless methods have been approached recently, and are now focused in the Pobeda area (narrow high-grade gold vein) in the southern part of the mine. It is proposed to implement 30% trackless mining machinery (especially in development and haulage) in 2011 and to increase utilisation to 50% of overall production by 2013. The majority of the ore is extracted using Sub-Level Open Stoping method or Open Stoping method, which are relatively similar. Where conditions require, Sublevel Open Stoping with Backfill is used to prevent caving of empty stopes or where the risk of potential damage to buildings on surface exists. Shrinkage stoping (<5% of production) is applied in thin steeply dipping ore bodies.

Table 18 illustrates recent production performance. It appears that the mine focuses on gold rich zones. Table 19 lists current reserves and resources.

Table 18 Recent Production Performance for the Maleevsky Mine

Year	Tonnes	Zn%	Pb%	Cu%	Ag g/t	Au g/t
2016	1,500,000	0.50	0.20	0.70	6.00	2.1
2015*	1,600,000	1.90	0.20	0.60	8.00	1.9
2014	1,900,000	0.50	0.20	0.40	10.00	2.0
2013	2,100,000	0.60	0.30	0.30	13.00	2.3
2012	nr	nr	nr	nr	nr	nr

*the zinc grade reported by Glencore for 2015 appears to be a typo. nr- not reported

Table 19 Measured and Indicated Resources with Proven and Probable Reserves as of Dec. 31,2016

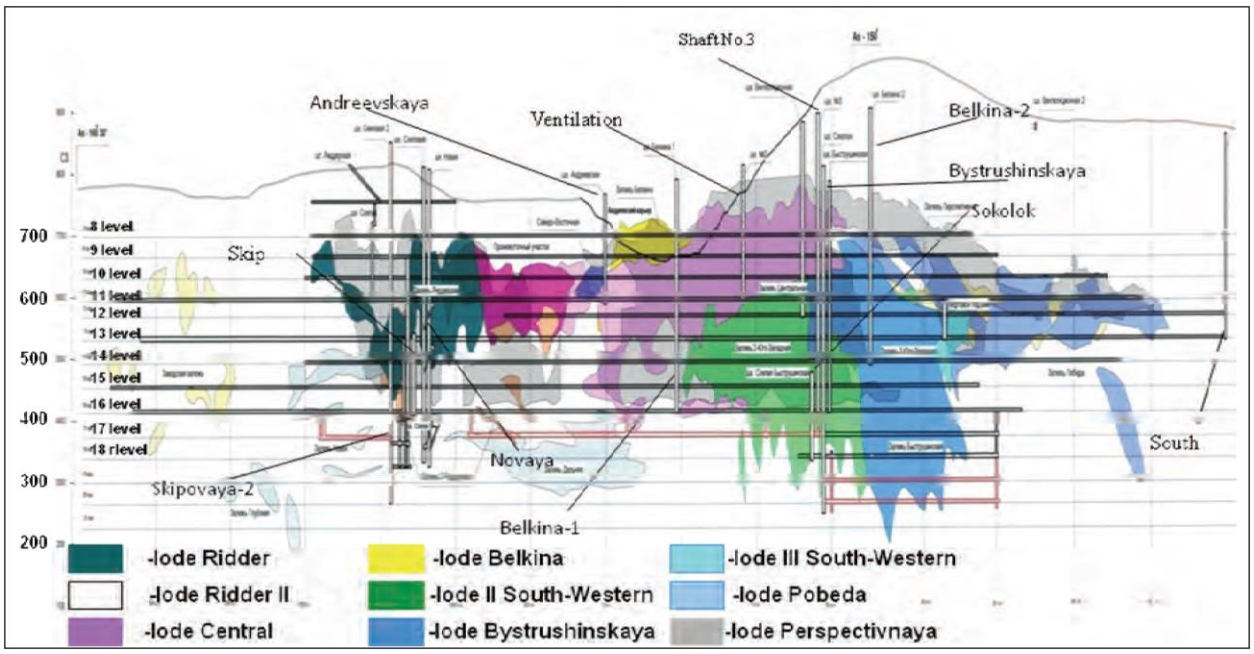
	Tonnes	Zn%	Pb%	Cu%	Ag g/t	Au g/t
M + I Resources	31,000,000	1.4	0.6	0.7	25	1.7
P+P Reserves	14,000,000	1.1	0.5	0.5	19	1.3

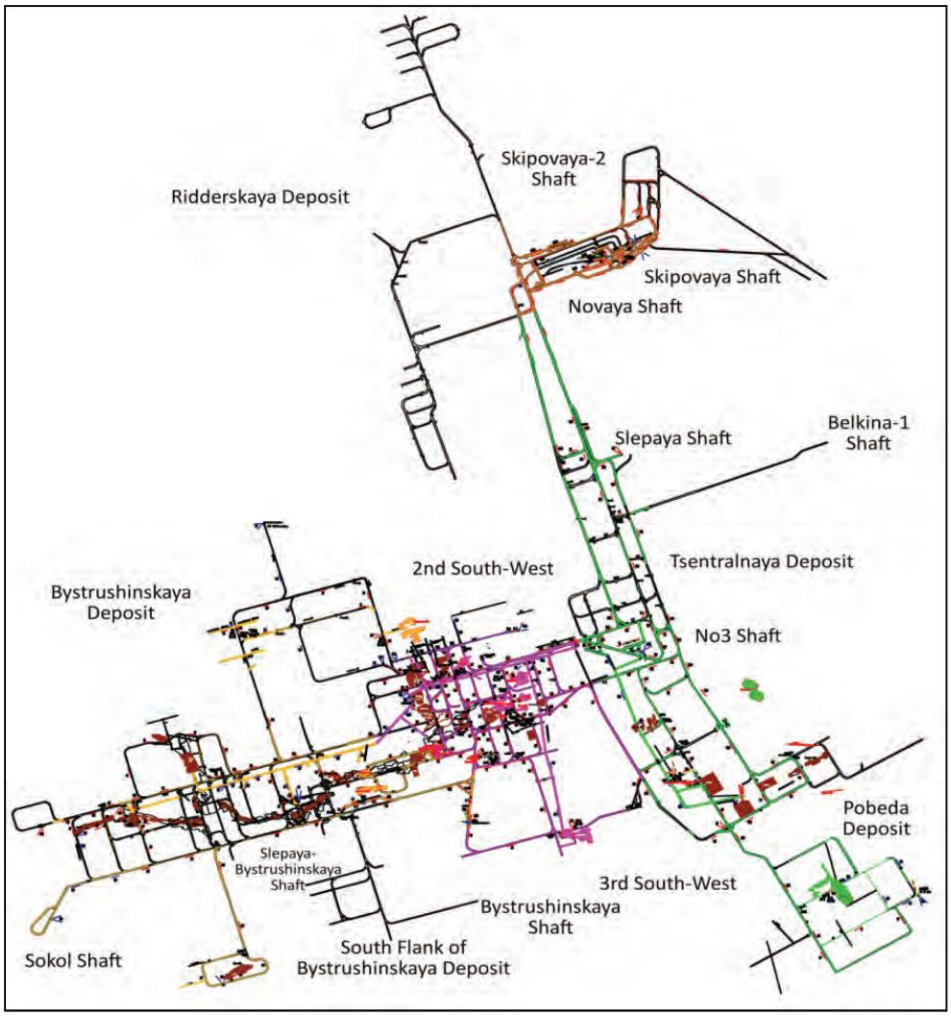
Zinc recovery in the mill appears to be only in the 55% range (at least prior to the IPO anyways). So crunching all the numbers and using a mining rate of 1.8 mtpa going forward at a zinc grade of 0.6% results in the actual and estimated zinc production in Table 20 using historic mill recoveries.

Table 20 Estimated Actual and Forecast Mined Zinc Output

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
6,000*	6,900	5,200	5,500*	4,100	6,000	6,000	6,000	6,000	6,000	6,000

*my placeholders only.


Shaft No 3
Andreevskaya
Ventilation
Belkina-2
Bystrushinskaya
Sokolok
Skip
8 level
9 level
10 level
11 level
12 level
13 level
14 level
15 level
16 level
17 level
18 rlevel
700
600
500
400
300
200
Novaya
South
Skipovaya-2
Belkina-1
-lode Ridder
-lode Ridder II
-lode Central
-lode Belkina
-lode II South-Western
-lode Bystrushinskaya
-lode III South-Western
-lode Pobeda
-lode Perspectivnaya


Skipovaya-2 Shaft
Ridderskaya Deposit
Skipovaya Shaft
Novaya Shaft
Slepaya Shaft
Belkina-1 Shaft
2nd South-West
Tsentralnaya Deposit
Bystrushinskaya Deposit
No3 Shaft
Pobeda Deposit
Slepaya-Bystrushinskaya Shaft
3rd South-West
Bystrushinskaya Shaft
Sokol Shaft
South Flank of Bystrushinskaya Deposit

Tishinskiy

The mine is located 18 km from Ridder and ore is sent to Ridder for processing. Wardell states in the 2011 IPO:

The Main Orebody, also known as Orebody No 1 extends over a strike length of 1,250m from surface to a depth of 1,270m corresponding to Level 22 at the absolute elevation of minus 590m. The central part of this body, about 500m in strike length and up to 60m in width, contains three subvertical lenses of massive sulphides (Western, Central and Eastern) with a combined strike length of about 200m, enveloped in disseminated mineralised ore. The Western and Central lenses peter out downwards on Levels 14 to 18 at the absolute elevations of -110m and -350m respectively and the Eastern lens pinches out at about the zero datum (10m below Level 12). Average widths range from 6.5m to 17m. Lower grade disseminated mineralised ore with much reduced widths (generally less than 10m) occurs in the Western Shaft section of the mine on the western flank of the deposit above Level 8 and on the eastern flank, where it peters out rapidly towards a major transverse fault.

Orebody No 67 has a strike length of 1,000m, dip extent of 700m and an average width of 3.7m. Orebody No.1011 has a strike length of 550m, dip extent of 400m and an average width of 1.7m. On its flanks, the Main Lode divides into a number of parallel tapering branches to the east and west and gradually fades out. Lenses and small vein-like bodies on the flanks of the deposit range from 25m to 50m in strike length and from 40m to 150m in down dip extent.

Mining operations at the Tishinskiy mine started in 1975 using both surface and underground mining methods. To date, approximately 49Mt of ore have been extracted (including open pit ore).
Historically, the main mining method employed in the underground mine has been underhand open stoping with hydraulic cemented backfill. Trackless mining equipment is employed for the development and stoping activities, but a track haulage system is used to transport ore and waste from drawpoints, and ore passes to the main hoisting shaft. The current ore production rate is between 1,300-1,400ktpa.

The mining method utilises jumbo development, electric over hydraulic production drilling and diesel load haul dump (LHD) loaders. The mine has its own backfill preparation plant, where backfill is mixed and pumped to a pipeline connected to the underground infrastructure. From this pipeline the backfill is distributed to stopes via backfill boreholes (normally one for the backfill, and an additional borehole for control) and pipeline extensions.

With depletion of the ore reserves from the central part of the deposit, the mine will be developed towards its flanks, and towards the bottom. Current exploration programmes are aimed at bringing the levels between 18 Level to 22 Level into production. An additional resource estimation study is currently being conducted for the eastern flank of the deposit, with production from this area due to commence in 2012.

Table 21 lists recent production performance. Table 22 lists reserves and resources.

Table 21 Recent Production Performance for the Tishinskiy Mine

Year	Tonnes	Zn%	Pb%	Cu%	Ag g/t	Au g/t	Assumed Zn Recovery	Assumed Zinc
2016	1,000,000	5.10	1.00	0.50	11.00	0.7	90%	46,000
2015	1,200,000	4.60	0.90	0.40	10.00	0.7	90%	50,000
2014	1,200,000	4.40	0.70	0.40	5.00	0.4	90%	47,500
2013	1,300,000	4.40	0.70	0.40	10.00	0.8	90%	51,500
2012*	1,187,500	5.08	0.57	0.35	9.00	0.7	90%	55,000

*planned as illustrated in the IPO. Zinc recovery used is from 2010. Zinc production rounded to nearest 500t.

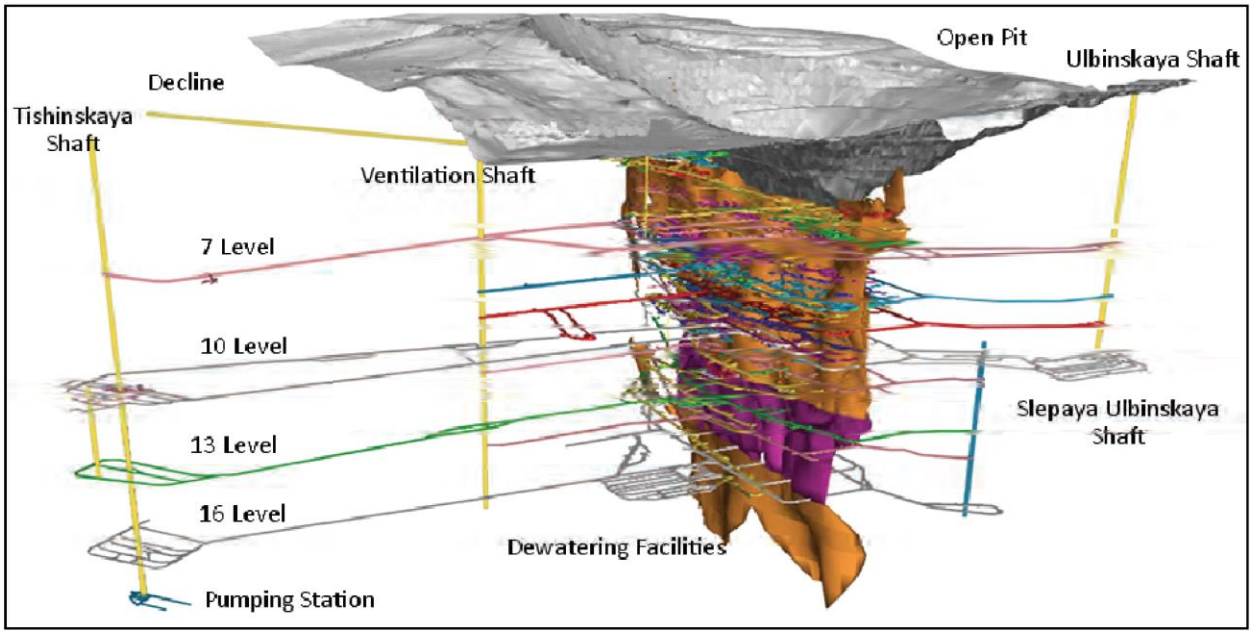
Table 22 Measured and Indicated Resources with Proven and Probable Reserves as of Dec. 31,2016

	Tonnes	Zn%	Pb%	Cu%	Ag g/t	Au g/t
M + I Resources	7,400,000	6.0	1.0	0.7	13	0.9
P+P Reserves	4,000,000	4.9	0.8	0.5	10	0.7

Reserves and resources have bounced around quite substantially from year to year. Reserves of 28 MT in 2012 became only 9.1 MT in 2013 for instance and the justification was fuzzy. It is difficult therefore to estimate mine life remaining since it may be based on cut off grade decisions. Although reserves are only sufficient for just over 3 years of mining I have assumed resources will be converted successfully. Table 23 therefore illustrates an annual mining rate of 1,100,000 T grading 5% Zn with 90% mill recovery to 2022. The mine may very well be exhausted of economic ore at this point however.

Table 23 Estimated Actual and Forecast Mined Zinc Output

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
55,000	51,500	47,500	50,000	46,000	49,500	49,500	49,500	49,500	49,500	49,500



Shubinskiy

This small deposit only mines 150,000- 200,000 T a year with zinc grades in the 2.0% range. It is not really worth the cost of ink or my time to discuss since this translates into only around 3,000 T of zinc a year once milled. I have assumed resources will be converted to reserves successfully to sustain the zinc output illustrated in Table 26. Pages 1309 to 1342 of the IPO describes this operation for those with a burning desire to know more.

Shaimerden

Wardell states:

The deposit is hosted in a massive, clean Carboniferous limestone and has resulted from the in-situ oxidation during the Triassic-Cretaceous period of a body of massive sphalerite mineralisation. The deposit occurs within a weathered depression measuring 450m east-west, 150m north-south with mineralisation occurring to a depth of 240m below the surface topography.

Emplacement of the orebody is thought to have resulted from the circulation of ore-bearing geothermal solutions in the period after deposition of the rocks and prior to the Triassic weathering. The tectonic structures present in the area provided a channelling device and an extensional zone during emplacement. The limestone rocks are likely to have acted as a geochemical barrier resulting in the deposition of the ores.

The deposit was mined from 2005 to 2011 and stockpiled.

Shaimerden appears to be KazZinc's ace in the hole. It is a zinc oxide deposit that was mined out in 2011 yet Glencore still reports a reserve in stockpile of 1,800,000 T grading 22% Zn. Ore is railed to the zinc plant at Ridder where there are three Waelz kilns that can convert the ore into a calcine. Wardell was comfortable with assuming 300,000 T could be processed annually producing over 60,000 T of zinc a year. (I assume very high recovery of zinc in the kilns and plant for this ore but could not confirm it.) The zinc plant at Ridder is rated at roughly 110,000 T slab zinc annually and treats the concentrate from ores in the area. Shaimerden by all appearances therefore is used to top up the plant only as required.

KazZinc has a second zinc plant at Ust-Kamenogorsk which also treats company and third party concentrates to produce slab zinc. This plant is much larger at about 200,000 T of slab zinc capacity annually. The IPO states that KazZinc has been processing about 60,000 T zinc for third parties annually which I assume is largely Kaz Minerals feed but some comes from as far away as Mexico. Table 24 is my best estimate of zinc output from Shaimerden ore. KazZinc does not breakout annual zinc production by mine.

Table 24 Assumed Zinc Output from Shaimerden Stockpiles

Year	Tonnes	Zn%	Assumed Zn Recovery	Assumed Zinc T
2016	89,000	20.6	98%	18,000
2015	151,000	20.6	98%	30,500
2014	104,000	22.0	98%	22,400
2013*	200,000	22.0	98%	43,100
2012**	100,000	23.0	98%	22,500

*tonnage processed derived by change in annual stockpile reserves. Estimate only.
**planned tonnage as listed in 2011 IPO, no actual figures located.

Estimating processing rates going forward is a bit of a crapshoot, so I will assume 150,000 T a year at 22% Zn for 32,000 T of recovered zinc for 2017 and 2018 then 250,000 T a year (54,000 T Zn) post-2018 to partially make up for lost production at Maleevskoye. This still leaves 500,000 T of ore for processing post-2022. Assumed actual and forecast production is listed in Table 25.

Table 25 Assumed Actual and Forecast Mined Zinc Output

2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
22,500	43,100	22,400	30,500	18,000	32,000	32,000	54,000	54,000	54,000	54,000

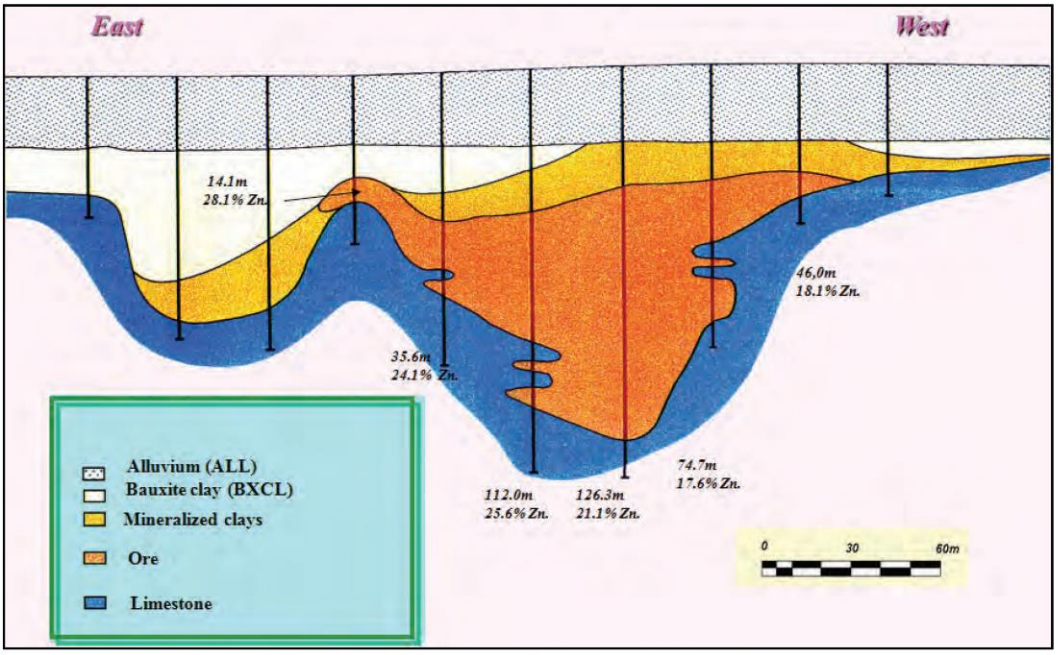
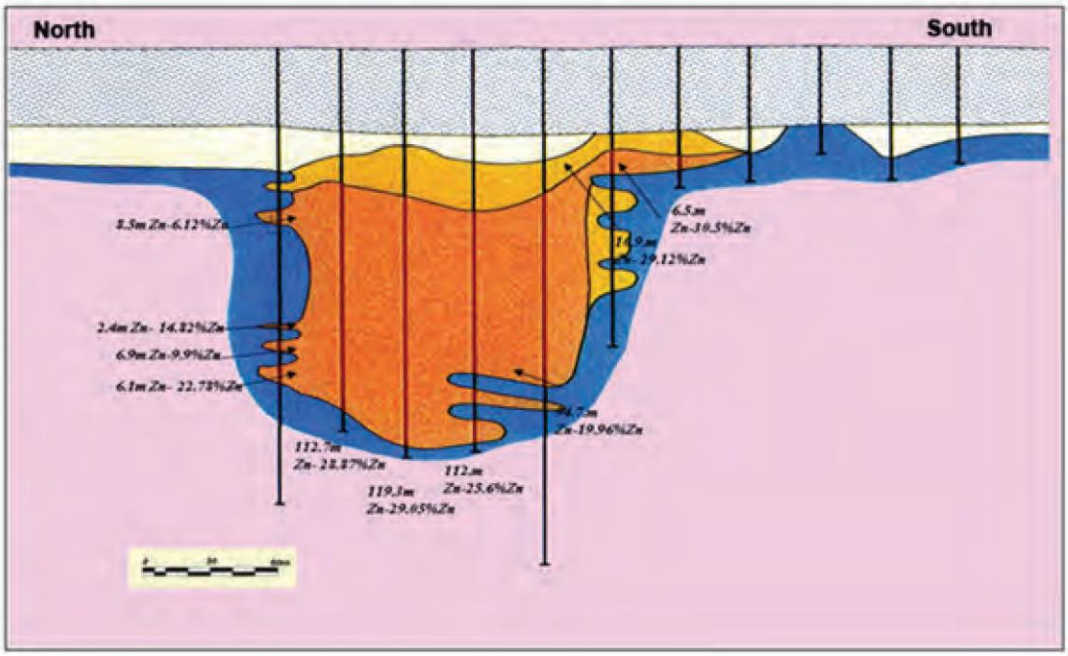
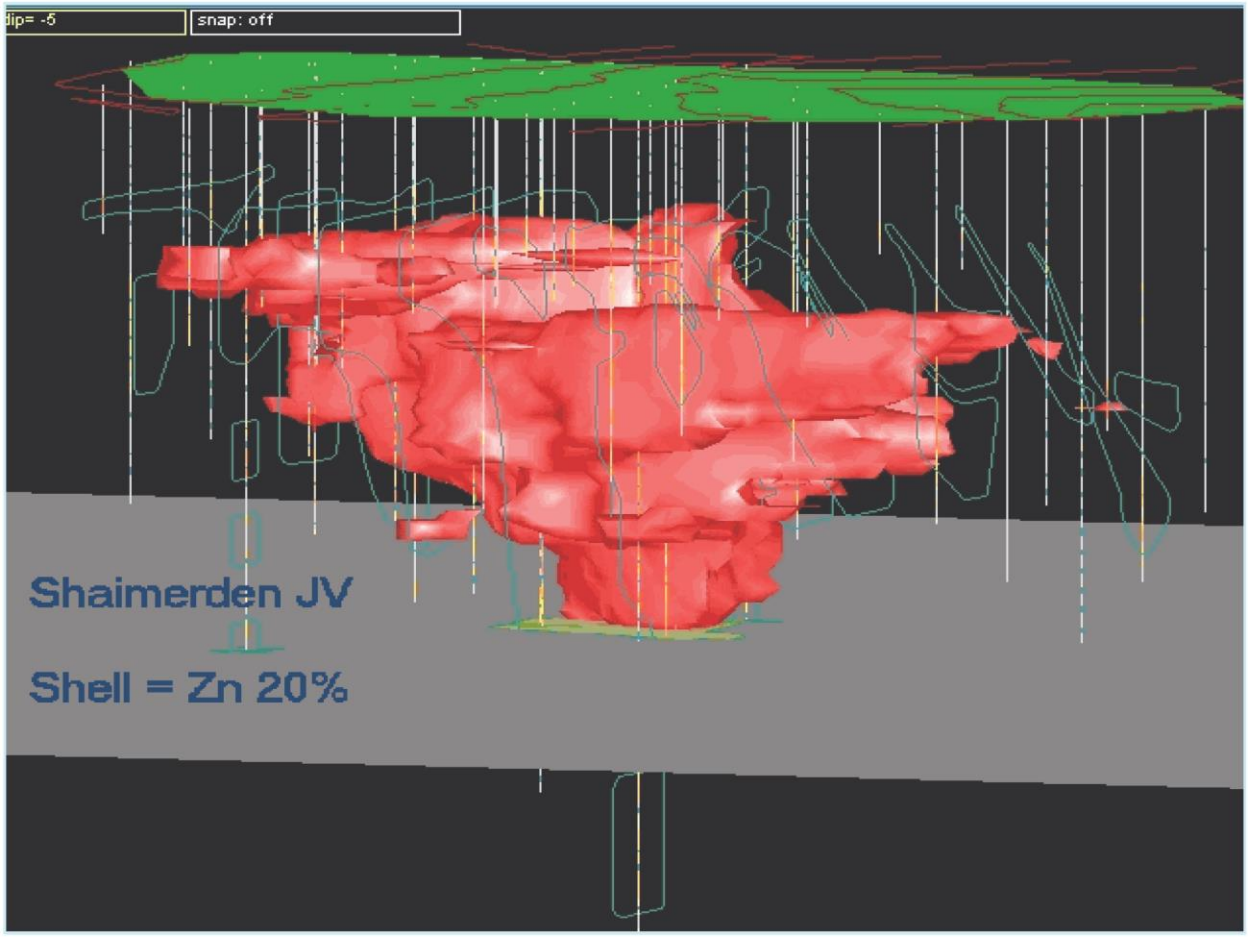
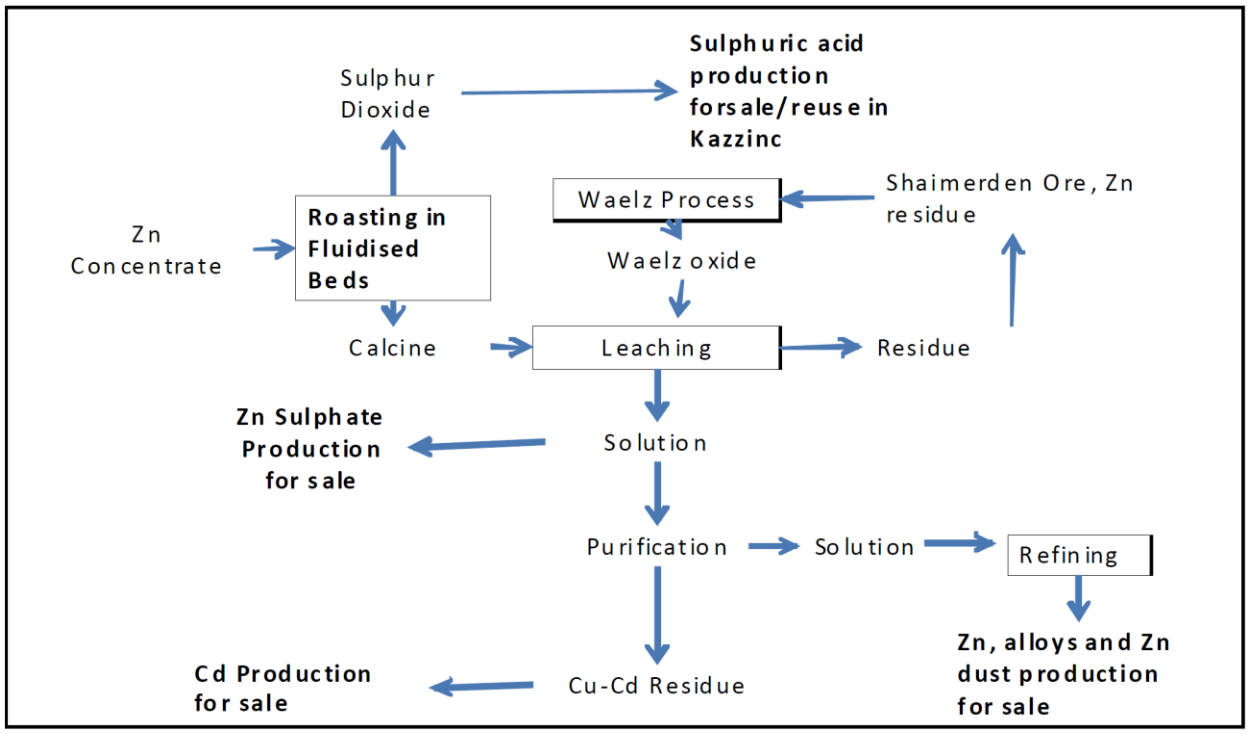
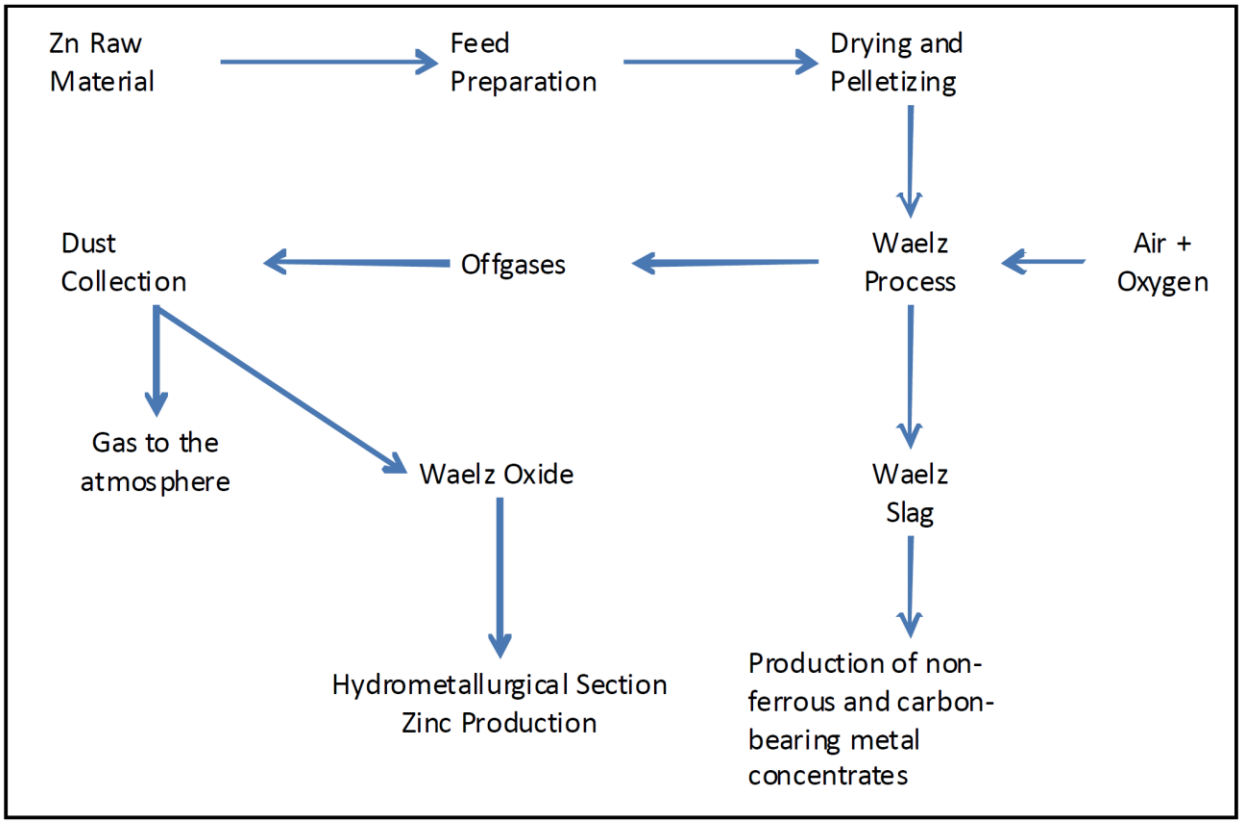


Figure 14.5: Geology of the Shaimerden Pit Area – East-West Section




dip= -5
snap: off
Shaimerden JV
Shell = Zn 20%


Sulphur Dioxide
Sulphuric acid production forsale/reuse in Kazzinc
Zn Concentrate
Roasting in Fluidised Beds
Waelz Process
Shaimerden Ore, Zn residue
Waelz oxide
Calcine
Leaching
Residue
Zn Sulphate Production for sale
Solution
Purification
Solution
Refining
Zn, alloys and Zn dust production for sale
Cd Production for sale
Cu-Cd Residue


Zn Raw Material
Feed Preparation
Drying and Pelletizing
Dust Collection
Offgases
Waelz Process
Air + Oxygen
Gas to the atmosphere
Waelz Oxide
Waelz Slag
Hydrometallurgical Section Zinc Production
Production of non-ferrous and carbon-bearing metal concentrates

Three 5m diameter Waelz kilns (70 and 75m long) are present at Ridder. The newest kiln was installed after a US$30M investment in 2008. The kilns can each produce up to 77t of Zinc per day and are equipped with waste heat boilers and a bag-house to collect dust with particulate emissions to atmosphere reported at 0.02g/m³. The kilns are inclined at 2.5% and rotate at up to 1rpm. The additional investment in 2008 was primarily so that Shaimerden ore (and zinc residues) can be processed.

KazZinc Summary

Table 27 attempts to reconcile KazZinc output from 2012 to 2016 with zinc metal output reported by Glencore from own sources is Kazakhstan.

Table 27 Estimated Actual Zinc Mine Output for KazZinc

Source	2012	2013	2014	2015	2016
Maleevskoye	116,000	122,800	115,900	111,600	118,700
Ridder-Sokolniy	6,000	6,900	5,200	5,500	4,100
Tishinskiy	55,000	51,500	47,500	50,000	46,000
Shubinskiy	3,000	3,500	1,200	3,000	4,000
Shaimerden	22,500	43,100	22,400	30,500	18,000
Total	**202,500**	**227,800**	**192,200**	**200,600**	**190,800**
Reported by Glencore*	227,300	216,200	199,300	193,400	187,600
Variance	- 24,800	11,600	- 7,100	7,200	3,200

*slab zinc from own feed.

The variance over five years is 9,900 T (1%). Reasons for annual variances include the assumptions made, stockpiling and destocking of concentrate and smelter losses. Some minor tailings reprocessing has also occurred. Table 28 illustrates forecasted zinc mine production for KazZinc.

Table 28 Forecast Zinc Mine Output for KazZinc

Source	2017	2018	2019	2020	2021	2022
Maleevskoye	107,690	97,900	83,304	80,100	53,400	22,250
Ridder-Sokolniy	6,000	6,000	6,000	6,000	6,000	6,000
Tishinskiy	49,500	49,500	49,500	49,500	49,500	49,500
Shubinskiy	3,000	3,000	3,000	3,000	3,000	3,000
Shaimerden	32,000	32,000	54,000	54,000	54,000	54,000
Total	**198,190**	**188,400**	**195,804**	**192,600**	**165,900**	**134,750**

It should be noted that the October 9,2015 announcement by Glencore to curtail zinc production by 500,000 t annually worldwide included an allocation of 40,000 t for KazZinc. But there is no evidence this cutback was actually made.

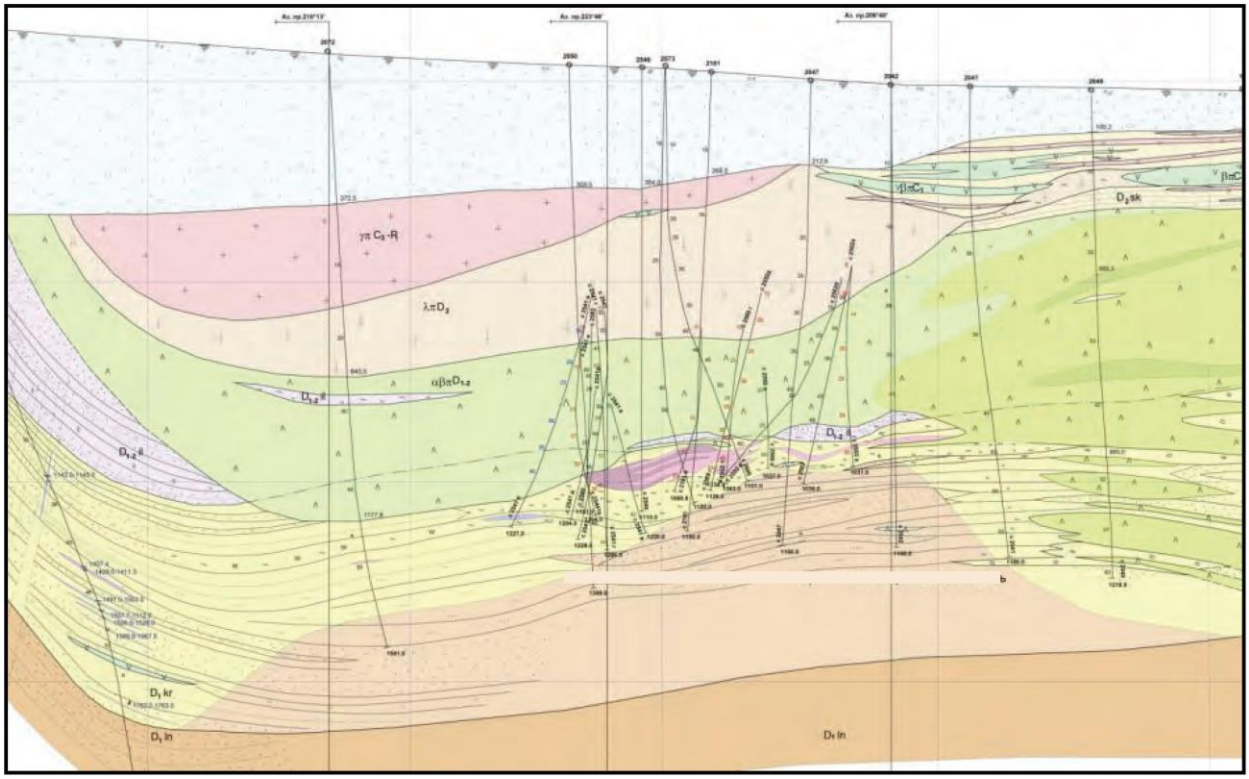
KazZinc Development Opportunities

It is doubtful that KazZinc will be able to fully arrest the slide in production indicated in time. However, a feasibility study was recently completed for three separate deposits at Zhairemsky. Proven reserves total 57.9 MT at 4.2% Zn with significant lead and silver credits for Zapadny and Dalnezapadny combined. Tonnes and zinc grade at the third deposit, Ushkatyn is insignificant. No potential project parameters have been provided.

Glencore states:

The various iron, manganese, barite and polymetallic deposits of the Zhairemsky area, central Kazakhstan were discovered by geological and geophysical prospecting between the 1930s and 1960s. Between 1978 and 1995, some 22 million tonnes of low-grade zinc-lead ore including barite-dominated mineralisation were mined. As of 1996, focus was set on manganese and iron ore production. Resource and reserve data was generated from a feasibility study completed this year.

Hmm, manganese. Glencore has also had the Dolinnoe and Obruchevskoe deposits in the resource column for many years. Both deposits are relatively small but zinc grade at the later deposit (4.1 MT M + I) is greater than 10% with excellent by-product credits. Details are provided in the IPO document on pages 1343-1399. A quick production decision here may go a long way to offsetting the eventual loss of Maleevskoye. This orebody is deep.



A section through the Obruchevskoe deposit.

References: Glencore IPO document here

Various production and reserve reports here and here

Chelyabinsk Zinc Plant (CZP) JSC

This Russian company owns and operates the Akzhal (Nova-Zinc LLP) open pit mine in Kazakhstan and a large zinc plant in Russia. (This company is going private shortly so the information available on its website may disappear. There is a good presentation from a 2008 ILZSG meeting in the presentation section discussing the Russian zinc industry.)

Information on the mine has been quite sparse of late apart from annual zinc output which is holding steady at about 36,000 T per year. The latest information I could find on resources was from 2011 and these are listed in Table 29.

Table 29 2011 Resources using the Russian C1 + C2 Classification System

Area	Tonnes	Zn %	Pb %
Open Pit	9,462,400	3.2	0.5
Eastern Area Underground	9,751,000	3.67	2.09
Central Area Underground	8,202,000	4.43	1.24

The open pit should pretty much be exhausted by now. As best as I can tell the underground mine was approved in April 2015. You would think they would mention this in their 2015 Annual Report. But I had to locate this fact buried in the footnotes of the accounting statements. When all else fails look at the depreciation expenses.

Prior to May 2015 management of the Group calculated depreciation of the mining assets applying the units-of production method based on the ratio of the ore mined by means of open pit from the balance, off-balance reserves and ore from production stockpiles. Starting from April 2015 after approval of the

underground mining project, balance ore reserves relating to the underground mining are additionally used in the depreciation calculations.

Production in 2011 was 1,628,000 T grading 2.4% Zn and 0.39% Pb. Likewise, 2012 results were 1,673,000 T grading 2.35% Zn and 0.27% Pb. But the company has pretty much clammed up since then on tonnes and grades. Table 30 lists zinc output for the mine for 2012-2016. This seems to imply that the open pit resources are almost exhausted. Table 30 therefore assumes a drop in production for 2017 and 2018 while underground mining is ramped up. Guesstimate only.

Table 30 Actual and Assumed Zinc Output

2012	2013	2014	2015	2016*	2017	2018	2019	2020	2021	2022
34,252	34,870	36,150	36,770	36,500	20,000	30,000	35,000	35,000	35,000	35,000

*planned.

Reference: Various presentations and reports here and here .

Other Potential Zinc Production

Shalkiya Zinc

This past producer operated from 1982 to 1994 and again from 2004 until the financial crisis in 2008. The company is attempting to raise funds to operate again following a major expansion. Proposed project details may be found by downloading the ESIA document here.

There are reportedly 105 MT of zinc/lead mineralization that would be mined at up to 4 mtpa. No grades are provided in the document but the mass balance provided below indicates the average head grade would be 4% Zn (5.1% x 55%/70%) and 1.5% Pb (1.7% x 43%/49%).

Product name	Output, %	Content, %		Recovery, %	
		Pb	Zn	Pb	Zn
Lead concentrate	1,7	43,0	2,0	49,0	1,0
Zinc concentrate	5,1	1,8	55,0	6,0	70,0
Middlings zinc concentrate	2,0	1,5	20,0	2,0	10,0
Tailings	91,2	0,7	0,8	43,0	19,0
Ore	100,0	1,5	4,0	100,0	100,0

Apparently, the mineralization is fine grained which led to poor concentrate quality and/or recoveries in the past. Fine grinding using IsaMills is proposed. No information is provided with respect to mining method but the production rate is extremely aggressive. Large scale blasthole stoping or caving methods would be the only means of supporting this underground production rate which implies the orebody is massive. If maximum output is achieved, annual zinc production in the zinc concentrate could be 4 Mt x 4% x 70% = 112,000 T Zn. Additional zinc would be in the middlings concentrate (which smelters likely would not care for).

Without some deep pocket backing here, I do not see this mine returning to production prior to 2022. The ore grades are not spectacular so success would likely depend on economies of scale which implies a hefty capital investment. Capital they do not currently have.

Russian Copper Company (Aktubinsk Copper Company)

Apparently this company mines minor quantities of zinc at the Priorsky mine but do not provide any grade/recovery information. The mine processes 1.9 mtpa grading 1.05% Cu as discussed here. I note though that CZP has smelted up to 21,000 tpa of zinc contained in zinc concentrates from RCC in the past but the company also has a copper-zinc mine in Russia so the split between mines is unknown. RCC could also ship to KazZinc's smelters I suppose. I have attempted to account for minor zinc production in the "Other" row of Table 1.

RCC has recently signed a deal with the Eurasian Development Bank to develop an open pit copper/zinc mine at Kundyzdy with a capacity of 2 mtpa. No project information was located and it is assumed significant zinc production would be post-2022.

Kaz Minerals

Re-activation of the Nikolayevsky mine is possible. Also resources remain at Belousovsky.

Cuprum Holding

When Kaz Minerals restructured, the copper mines were spun out to Cuprum Holding who were the major shareholder in Kazakhmys. Two of these copper mines had minor zinc with the copper (Abyz and Akbastau). Zinc was not recovered at Akbastau (2 mtpa at 1% Zn) and Abzy (0.4 mtpa at 2% Zn) only had two years of life left. Its zinc output was trivial at the time. I have attempted to account for Abzy production in the "Other" row of Table 1. Since this is a private entity now, perhaps they are recovering some zinc at Akbastau which would partially explain my discrepancy with the ILZSG.

Well, that is it folks. Seeing as the golf courses will not be opened here for a few more weeks I will likely find the time to have a look at some of the orphans out there in Honduras, Chile etc. It would be nice to get my assessment level up to 90% (ex-China) but I do not have much hope of finding decent information for Russia and Iran in particular.

DISCLOSURE

The author had received no compensation for the generation of this report. The author may, from time to time have a long or short position in securities mentioned and may make purchases and/or sales of those securities in the open market. Unlike Module 8, the author drank no beer during the research for this module.

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