

Exploration potential of Russian Far East in general with focus to the Magadan Region

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North Eurasia SEG Regional VP 2009-2011)



PDAC «Presentation of the Magadan Region of North East Russia»
March 9. 2010. Toronto.



Topics

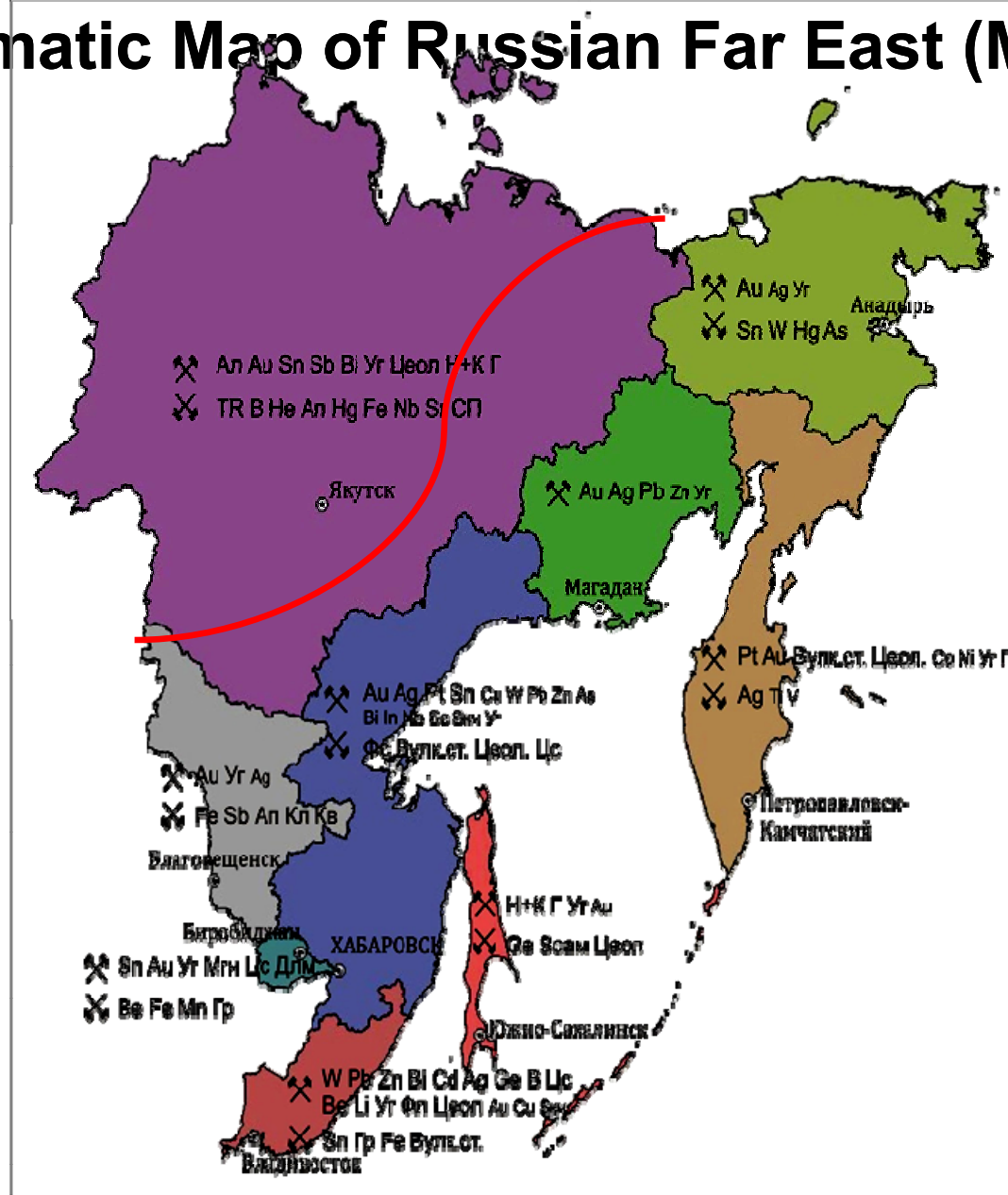
- Russian Far East
 - Mining situation
 - Exploration situation
 - Potential
- Magadan Region
 - Mining situation
 - Geology and Metalogeny
 - Exploration situation
 - Potential
- Conclusion



Russian Far East exploration potential



Schematic Map of Russian Far East (Mineral..., 2007)

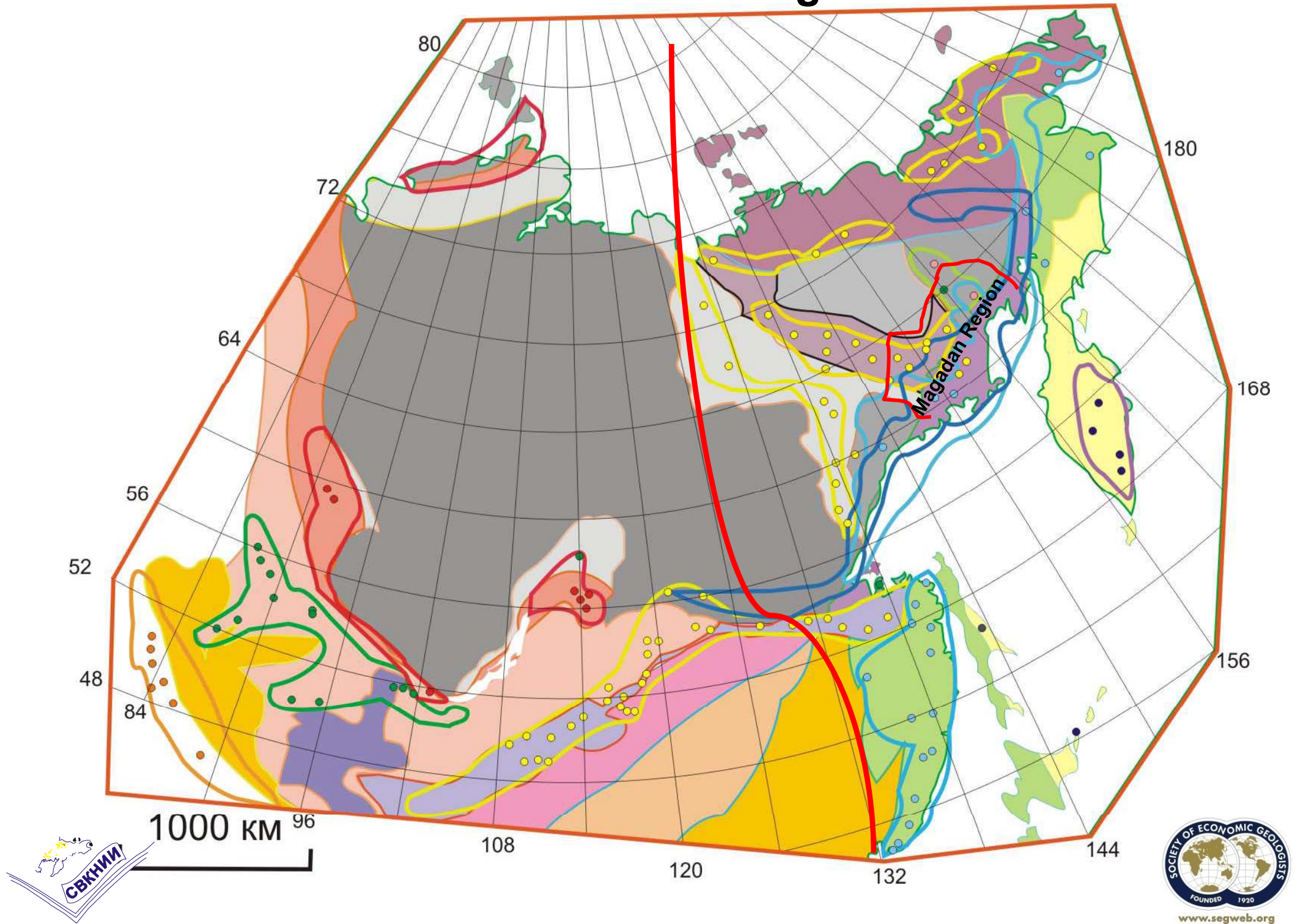


- Получаемые (obtained)
- ✂️ добываемые (obtained)
 - ✂️ недобываемые, со значимыми запасами (not obtained, with significant reserves)

Ал - алмазы, Ал - апатиты, Вулк.ст. - вулканическое стекло, Г - газ, Gr - графит, Длм - доломит, Кл - каолин, Кв - кварцевое сырье, К - конденсат, Мн - магнетит, Брусит, Н - нефть, СП - соль поваренная, Yr - уголь, Фл - флюорит, плавиковый шпат, Фс - фосфориты, Цепл. - целиты, Цс - цементное сырье, St - сера газовая, Sn - сера колчеданная, Scam - сера самородная, TR - редкие земли



Russian Far East Metallogenic Belts



Gold Production of Russian Far East Regions 1999-2009

Год	Magadan Region	Yakutia (Sakha) Region	Chukotka Region	Amur Region	Khabarovsk Region
1999	28,8	12,6	5,7	11,4	8,9
2000	29,6	16,7	6,5	11,8	9,2
2001	30,5	16,6	6,4	12,9	13,5
2002	33,6	17,5	4,8	12,7	15,2
2003	24,9	20,3	4,8	13,1	17,7
2004	22,6	20,2	4,3	14,2	20,9
2005	22,6	18,8	4,7	14,7	18,2
2006	18,0	19,9	4,8	14,5	15,7
2007	15,8	19,0	4,3	14,7	14,8
2008	<i>14,5</i>	18,9	18,5	18,7	16,2
2009	15,7	18,6	31,2	21,9	14,6



Mining Enterprises of Russian Far East 2009

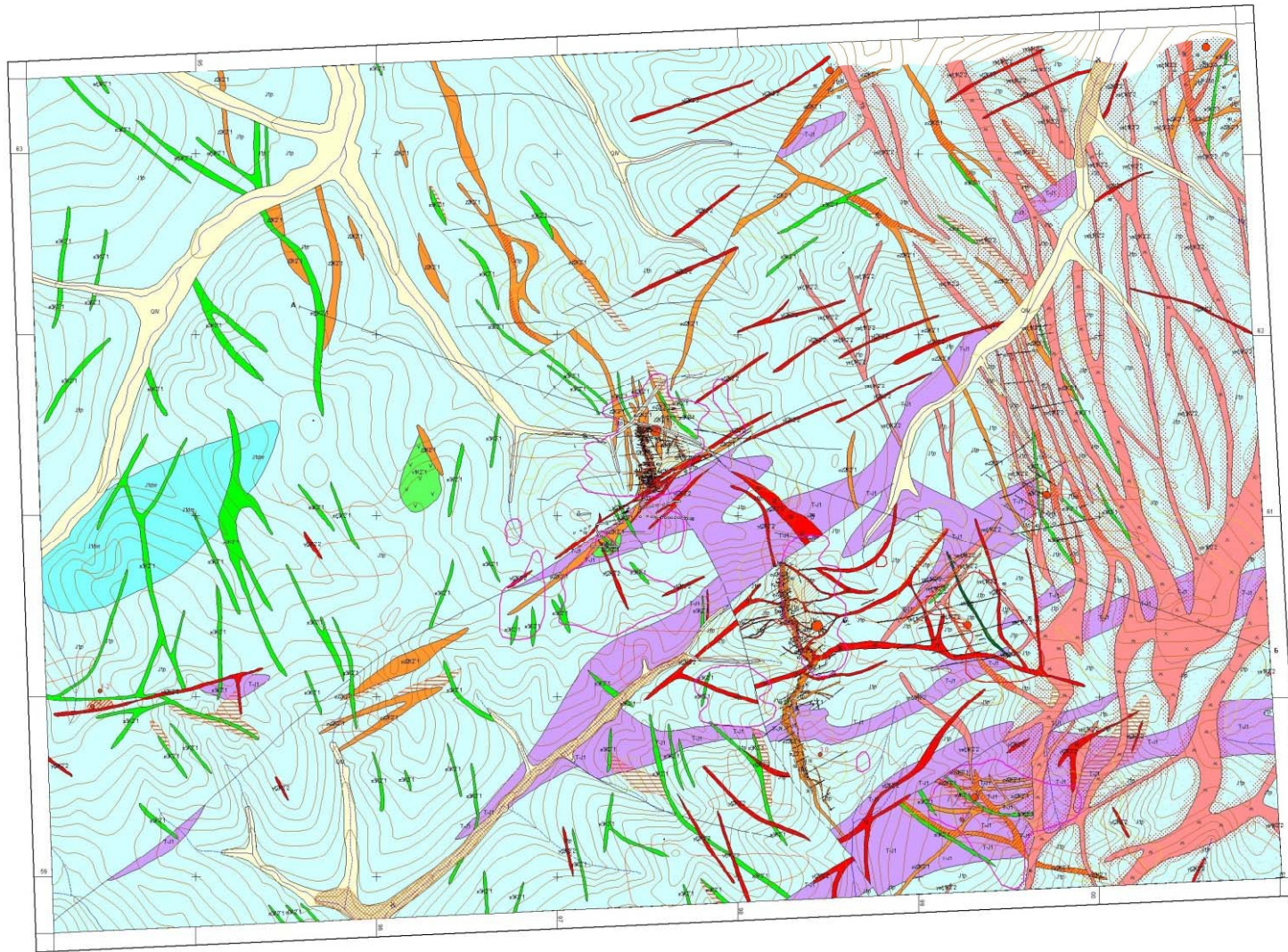
Region	Prospect, deposit	Company	Foreign Investment
Chukotka	Kupol Valunistoye Karal'veem	Chukotka GGK Chukotka Group Karal'veem Mine	Kinross
Magadan	Jul'etta Nyavlenga Agatovskoye Vetrenskoye Lunnoye Dukat Arylakh	Northern Mines Nyavlenga Mine Agat Susumanzoloto Serebro Magadana (Polymetal) Omsukchanskaya GGK	
Kamchatka	Aginskoye	Kamgold	Anglo Gold
Khabarovsk	Khakandja Mnogovershinnoye	Okhotskaya GGK (Polymetal) Mnogovershinnoye Mine	
Amur	Pokrovskoye Pioner Berezitovoye	Pokrovsky Mine Pioner Mine Berezitovoye Mine	Petropavlovsk Group High River Gold



Examples of Exploration Activities of the Russian Far East 2009

Region	Prospect, deposit	Company	Foreign Investment
Chukotka	Moroshka Mayskoe Pepenveem	Chukotka G GK Mayskaya (Polymetal) Chukotka	Kinross, B2Gold
Magadan	Teply Entery Degdekan Zolotaya Rechka Birkachan Stakhanovets a.o. Igumenovskoye	Magadangeologiya Dukatgeologiya Rudnik Matrosova Magadanskaya GRP (Polyus Gold) Omolonskaya (Polymetal) Geocenter	 Ovoka Gold Zijin Mining Group
Kamchatka	Asachinskoye	Trevozhnoye Zarevo	Anglo Gold
Khabarovsk	Albazino, Avlayakan, Agnie- Afanas'evskoye Svetloye Kutyn Belaya Gora	Polymetal PD RUS GRK Lantarskaya Zabaykalgeologorazvedka	 Fortress Minerals Corp Zijin Mining Group Highland Gold Mining Amur Minerals Corp Barrick Gold Corp Phelps Dodge Corp
	Kirovskoye Malomyr Bamskoye	Dal'geologiya Pokrovsky Mine Polyus Gold	Amur Mineral Petropavlovsk High River Gold

Examples of Exploration Claimes of Russian Far East



Albazino Au deposit –
Khabarovsk Region

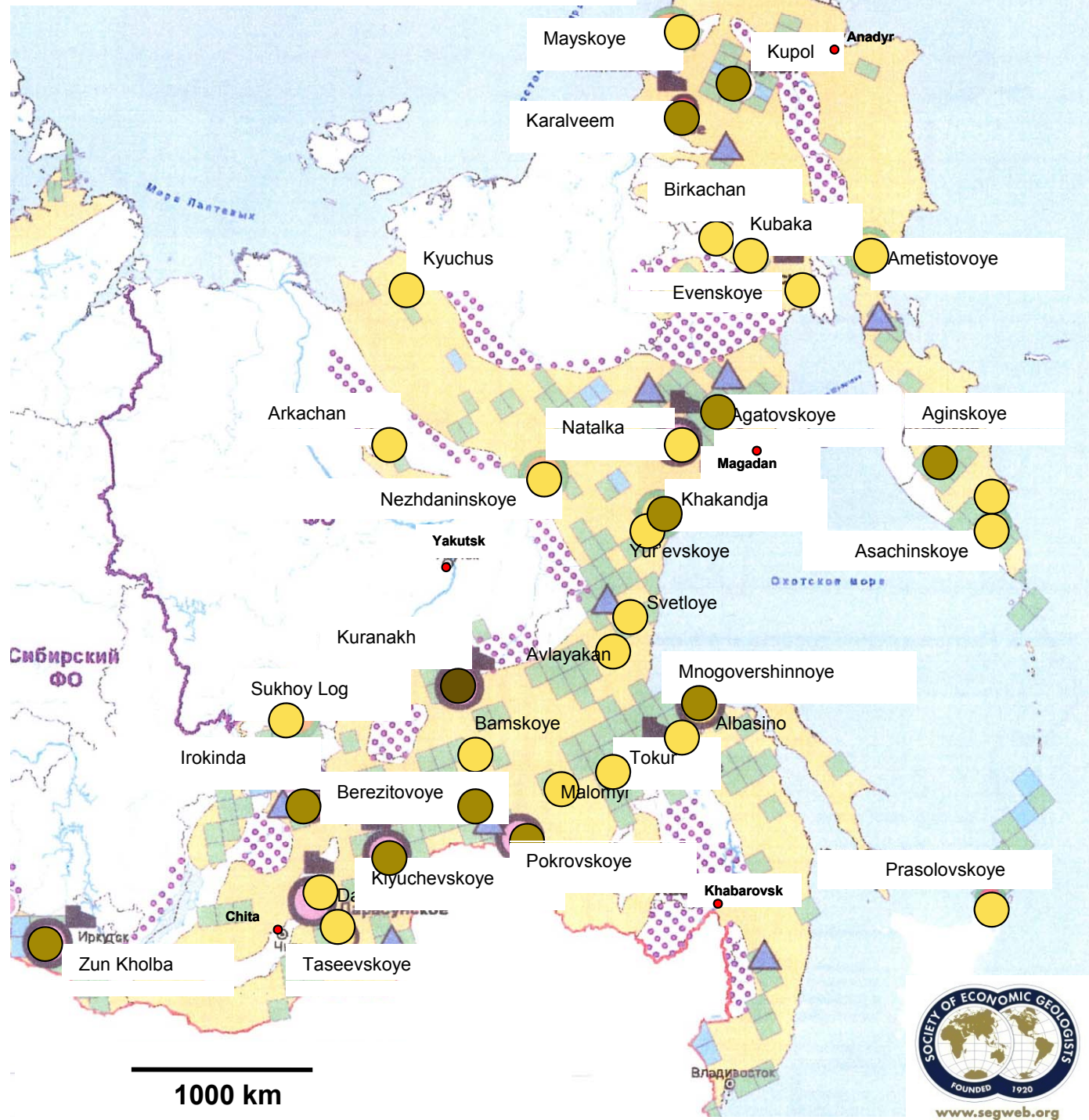
Reserve – 65 t of Au

Data of Polymetal



Noble Metal Potential of Russian Far East

(modified from Migachev, 2005, with my additions)

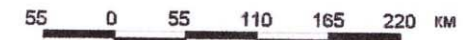


Gold lode potential of Eastern Russia

	Past production 2001-2009, t	Estimated Potential, t
• North Eastern Russia	– 176,7	6000
Magadan Region	- 88,2	3500
• Russian Far East	– 145,0	1000

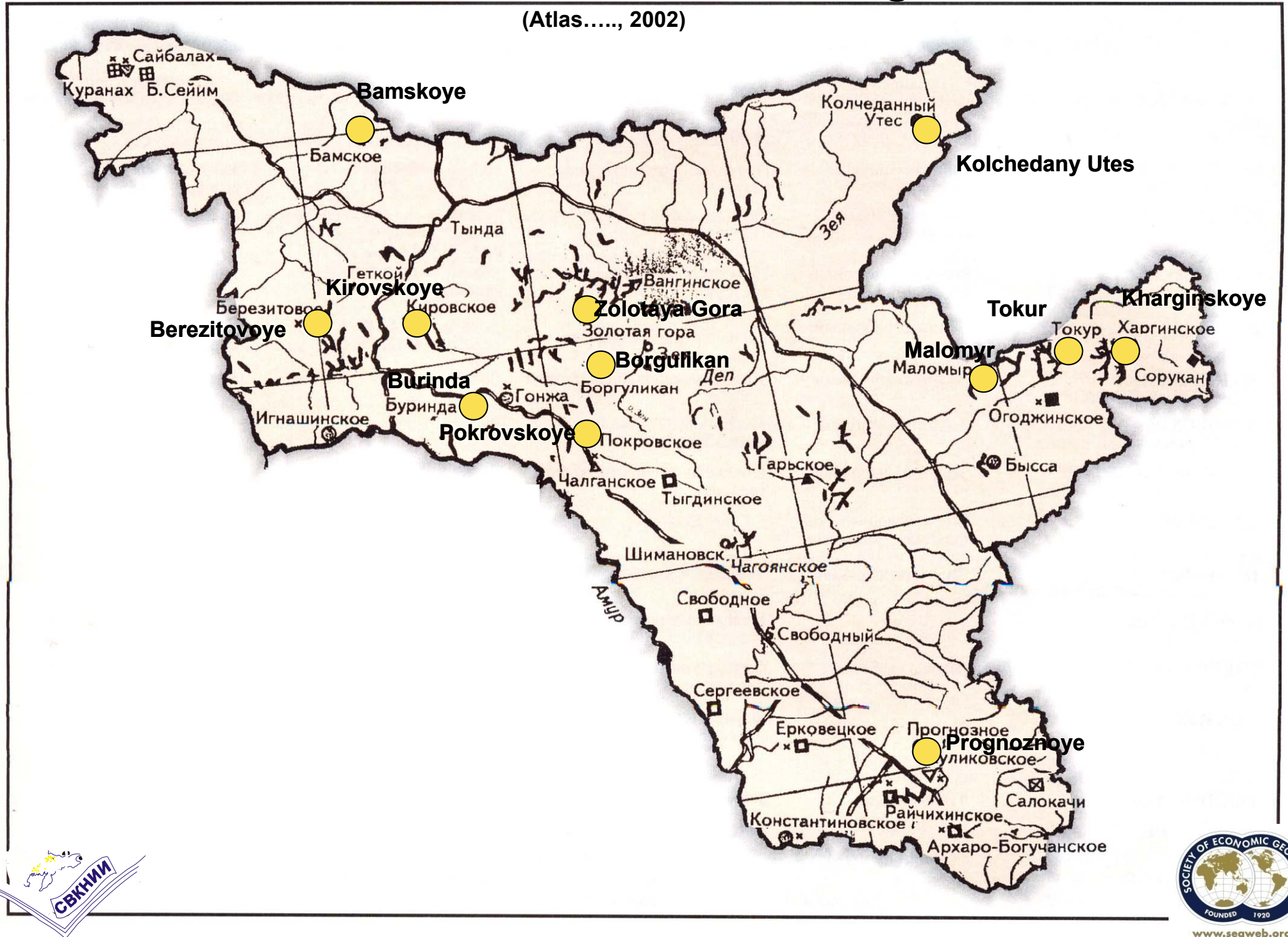


(According TSNIGRI MNR RF, modified from Migachev, 2005)

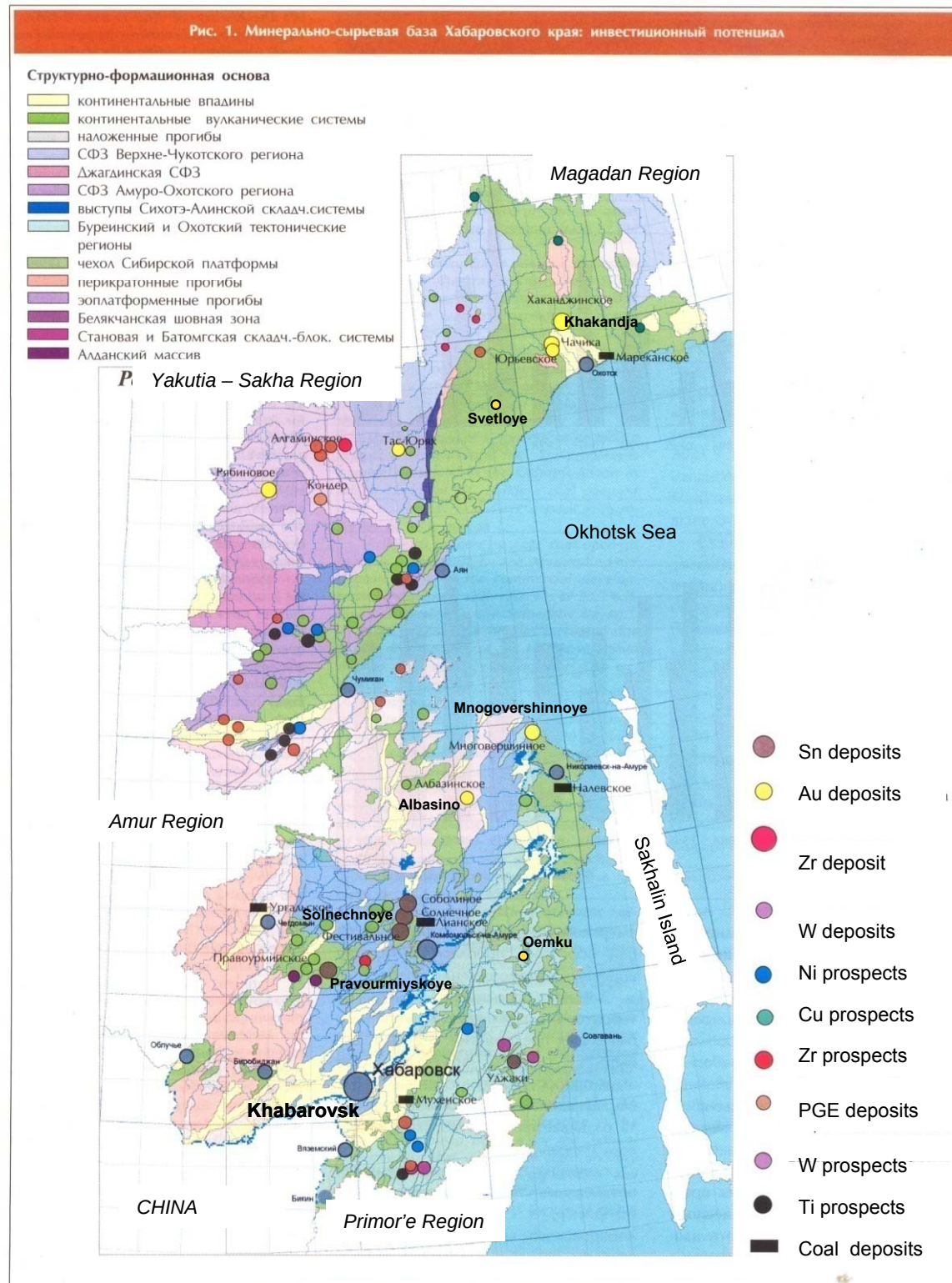


Gold Potential of Amur Region

(Atlas....., 2002)



(Kochetkov V.V. & Ekimov A.A., 2003)



Mineral Potential of Kamchatka Peninsular

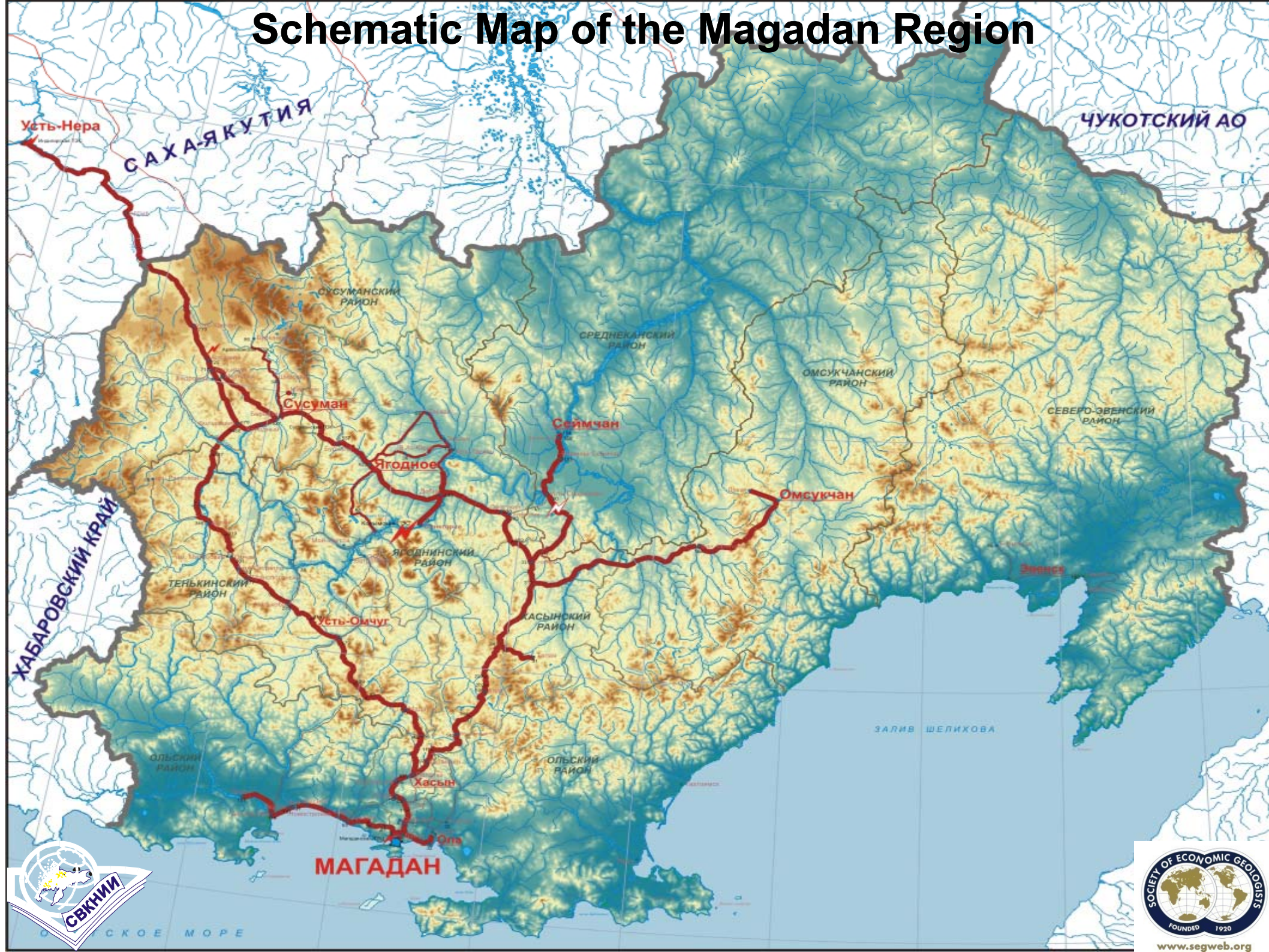
(Raikhlin A.I., Litvinov A.F., Orlov A.A., 2004)



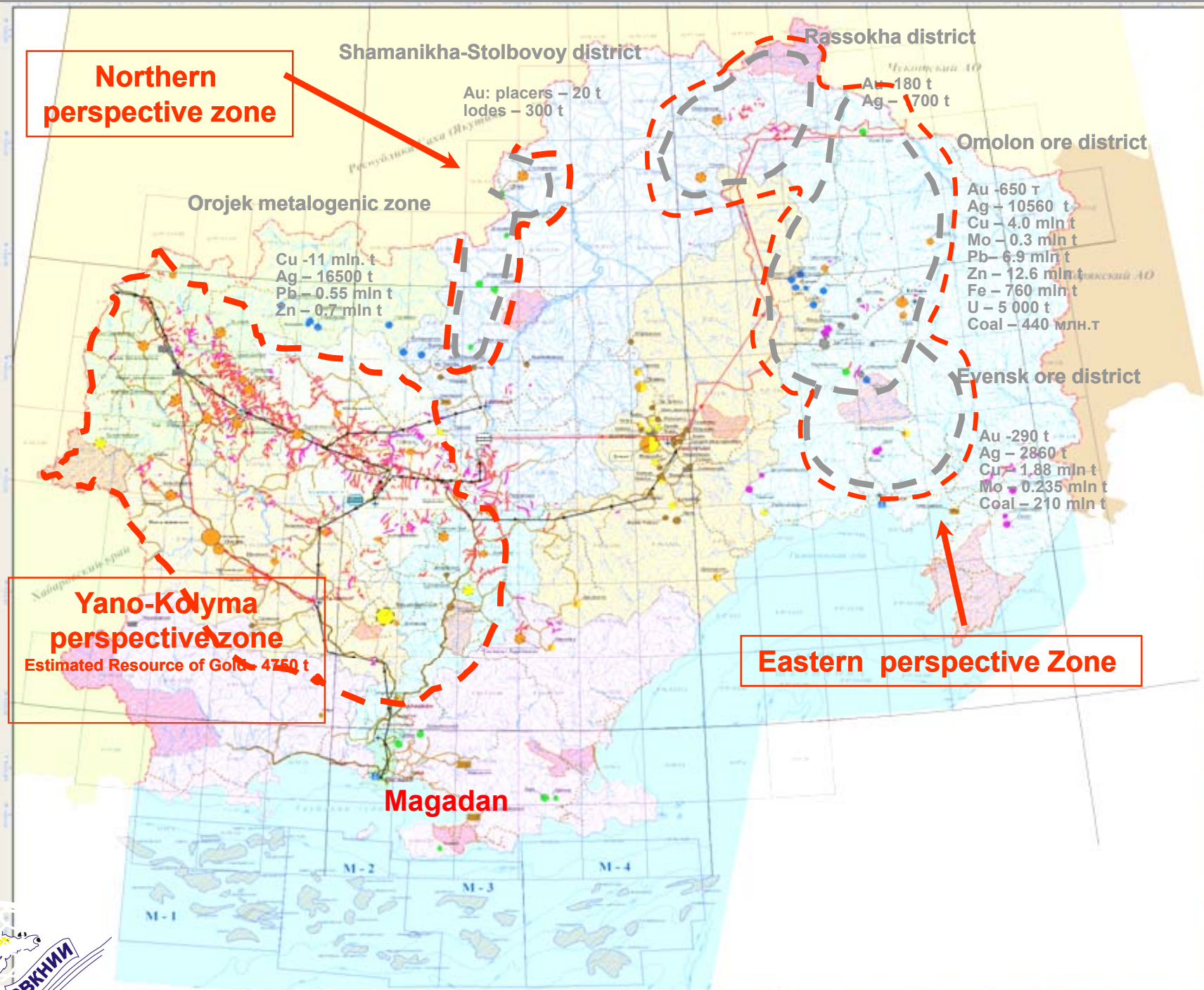
Magadan Region exploration potential



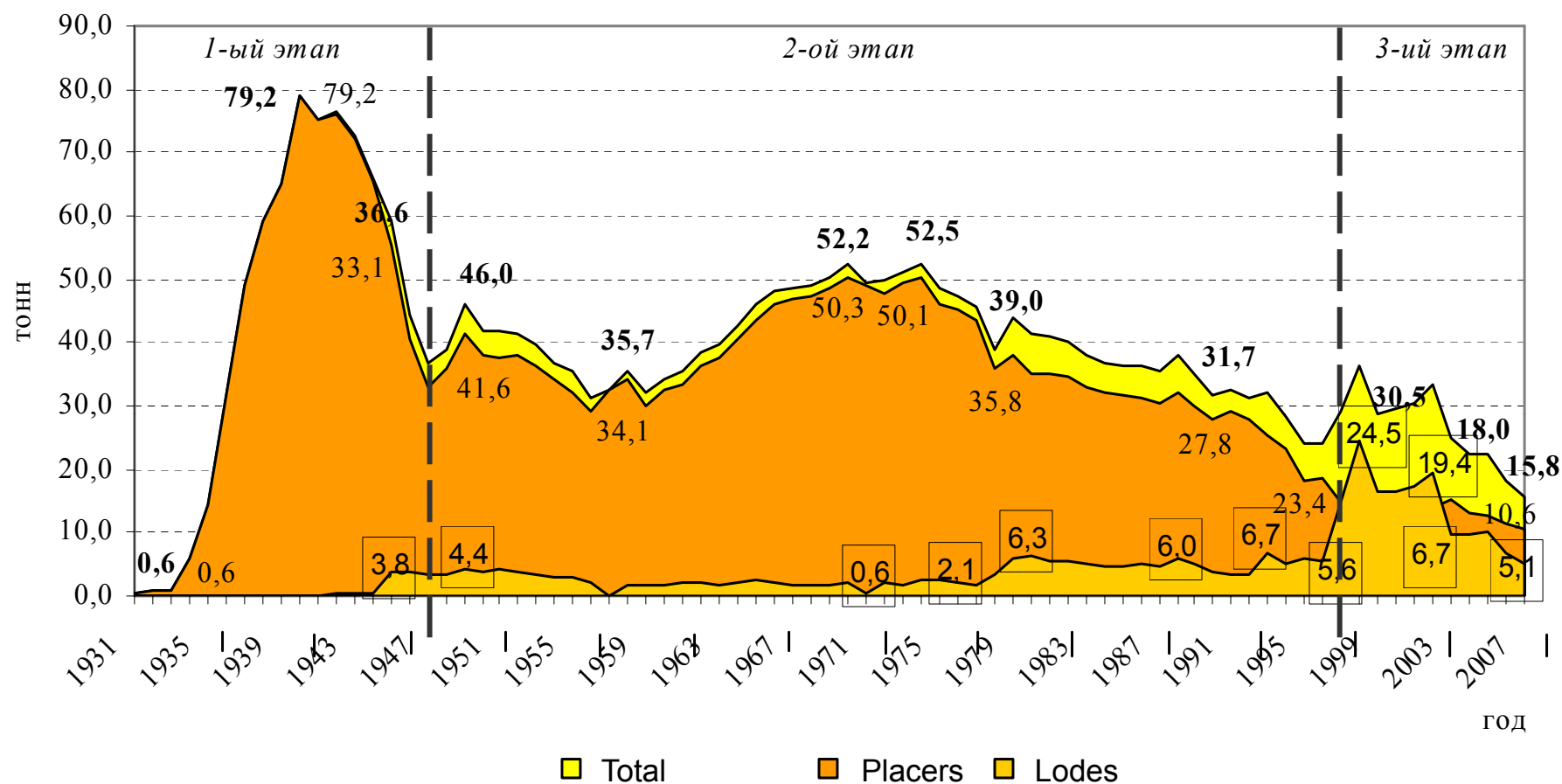
Schematic Map of the Magadan Region



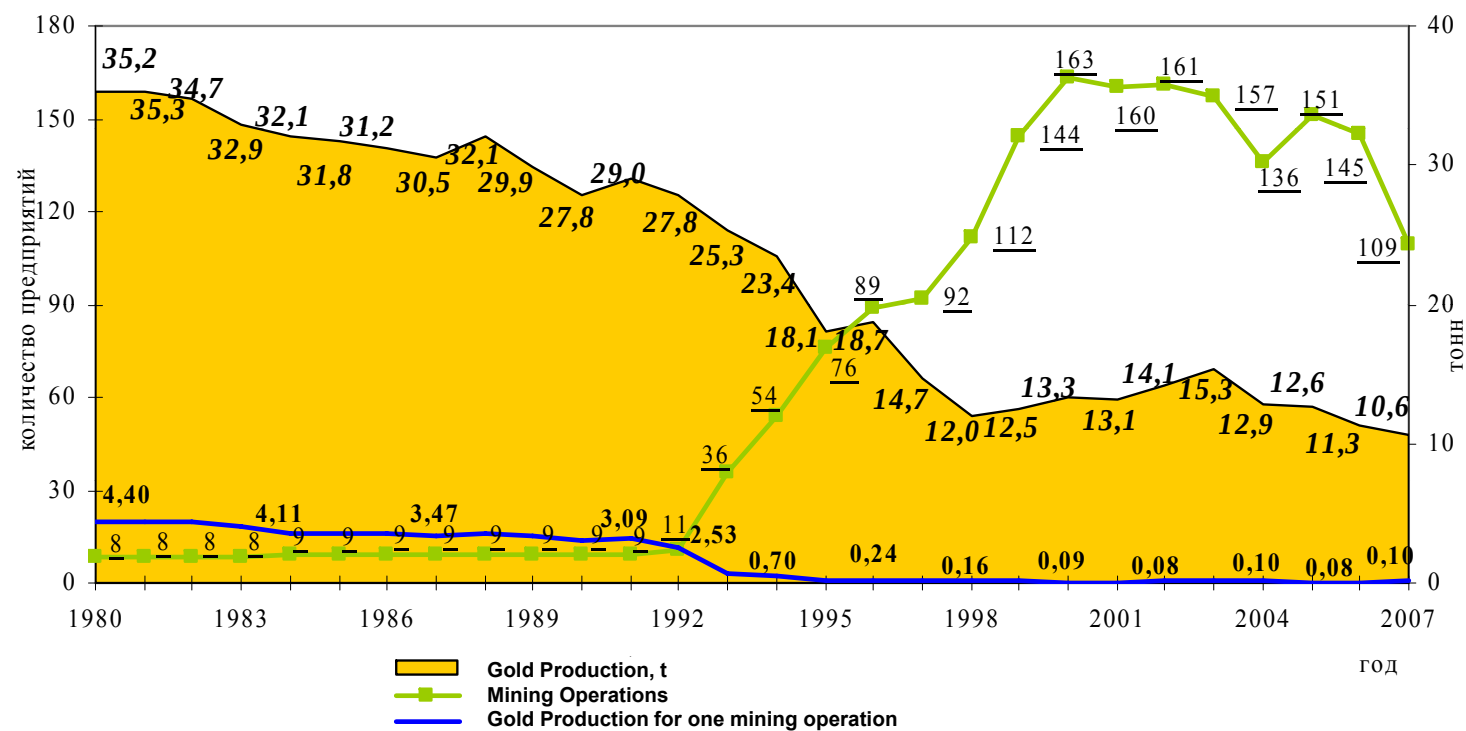
Magadan Region Mineral Resource Potential



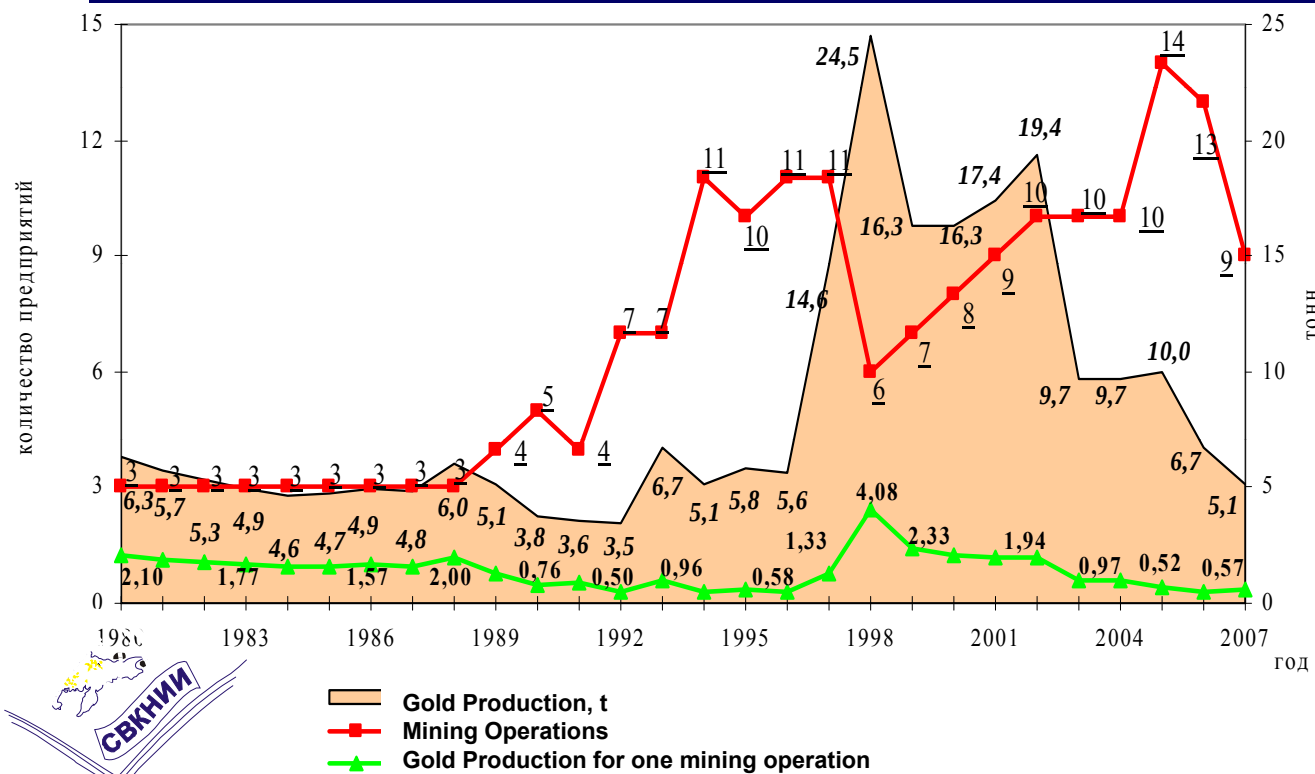
Gold Production of Magadan Region, t



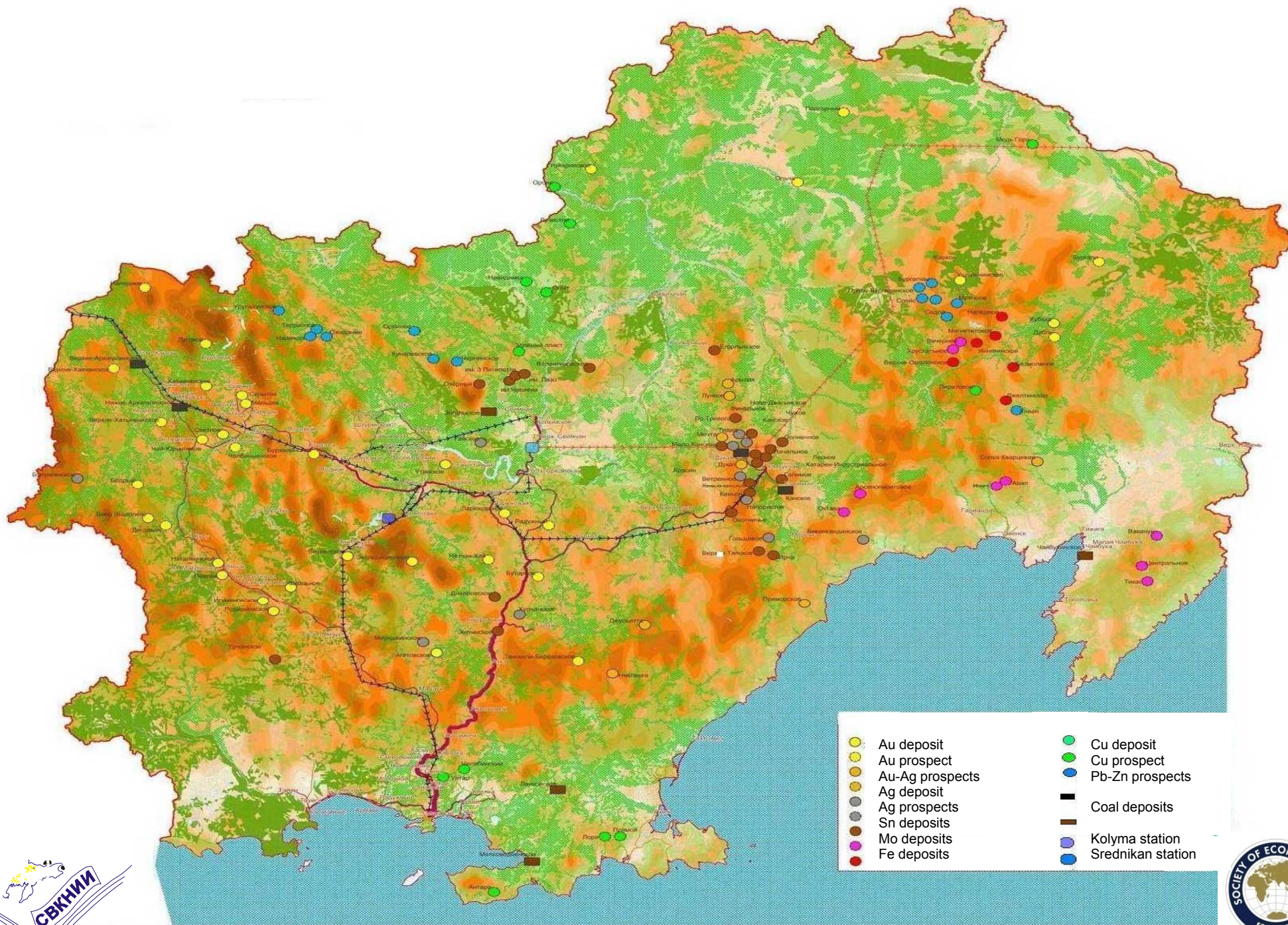
Gold Placer Production



Gold Ore Production



Mineral Resources of Magadan Region



PAST PRODUCTION OF AU (2001-2009 Y.) FROM LODE DEPOSITS OF THE NORTH-EAST OF RUSSIA

№№	Lode deposit	Past production 2001-2009 y.	Type	Gold belt
1	Kubaka	40,1	Au-Ag epithermal	Kedon, PZ₃
2	Julietta	22,8	Au-Ag epithermal	Okhotsk-Chukotka, MZ₃
3	Dukat	6,2	Au-Ag epithermal	Okhotsk-Chukotka, MZ₃
4	Lunnoye	2,7	Au-Ag epithermal	Okhotsk-Chukotka, MZ₃
5-6	Agatovskoye, Nyavlenga	2,9	Au-Ag epithermal	Okhotsk-Chukotka, MZ₃
7	Shkolnoye	4,9	Au-Q	Yana-Kolyma, MZ₃
8	Vetrenskoye	2,4	Au-Q	Yana-Kolyma, MZ₃
9	Natalka	3,2	Au-Q	Yana-Kolyma, MZ₃
10	Svetloye	3,0	Au-Q	Yana-Kolyma, MZ₃
	Total	88,2	Historical total (1900-2009)	2000 t (about 300 t from lodes)



Major Tectonic units of the North-East of Asia

(combined from Nokleberg et al., 1998 and Geodynamics..., 2006)

Verkhoyansk passive continental margin (pink)

Kularo-Nera turbidite Terrane (light blue)

Omulevka carbonate platform and Prikolyma terranes (blue)

Kolyma-Omolon superterrane (brown)

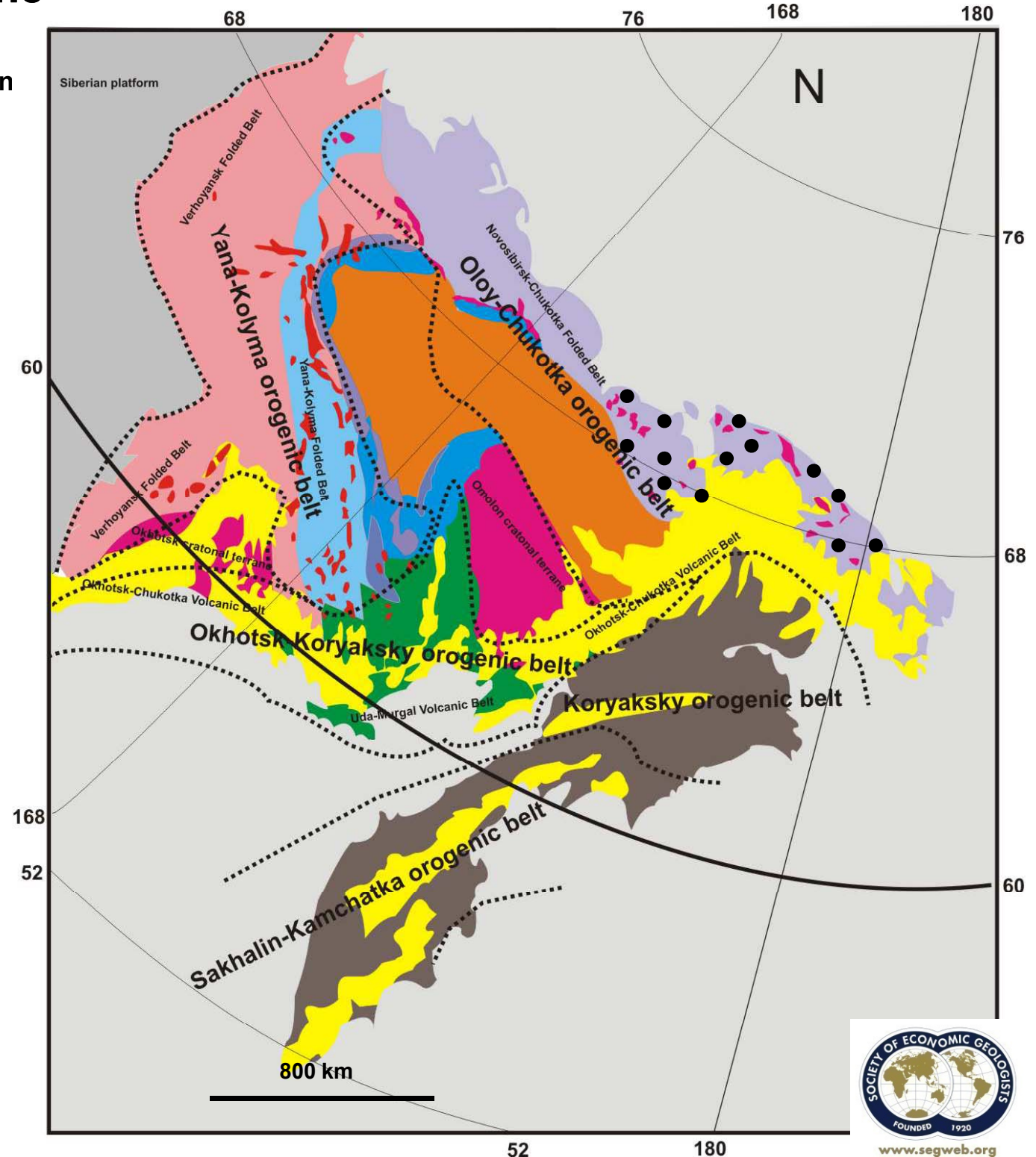
Chukotka shelf Terrane (light violet dashed)

Viliga shelf Terrane (green)

Koryack Terrane collage (grey)

Granitoid belts (red)

Post-accretionary volcanic belts (yellow)



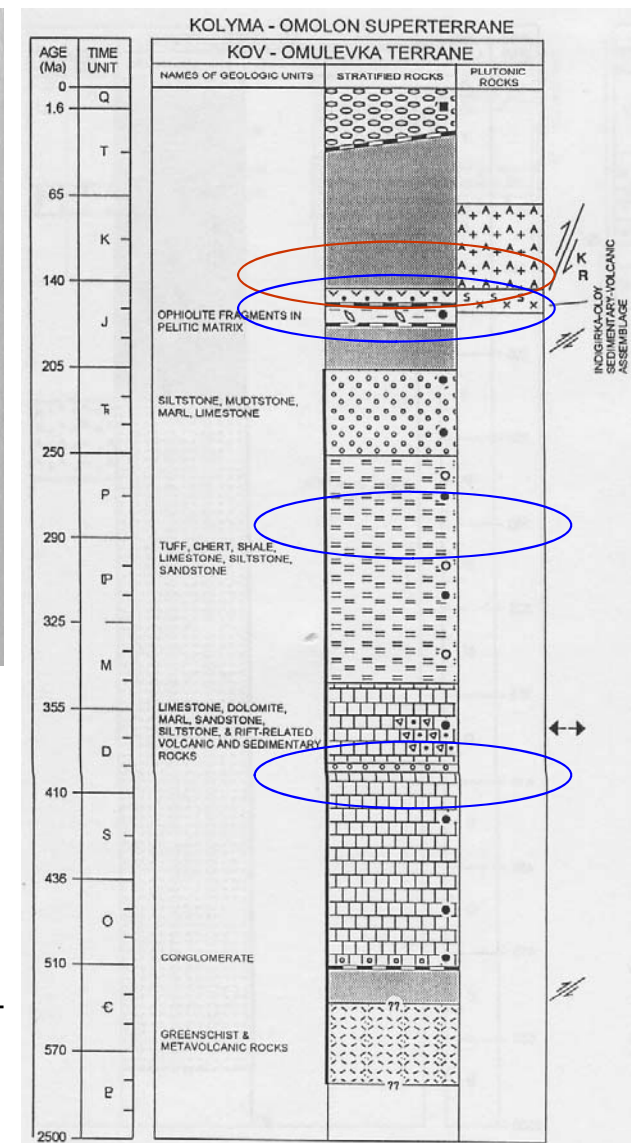
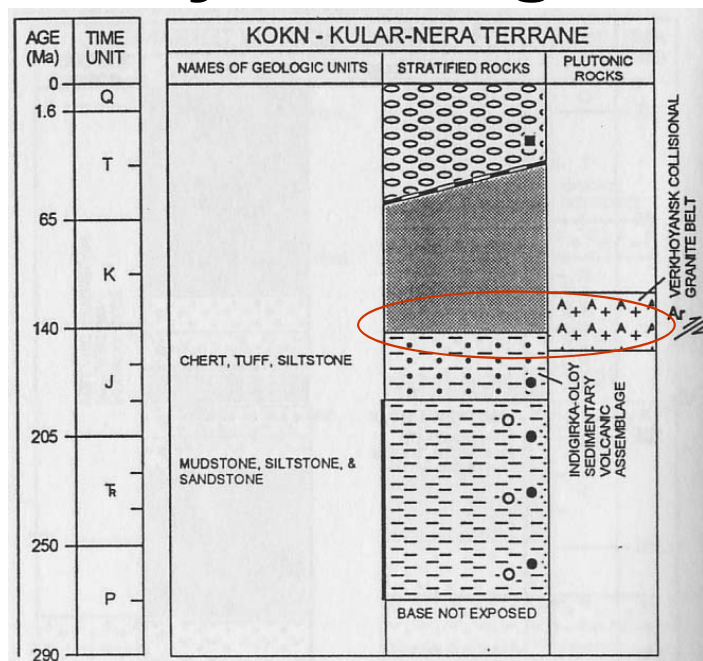
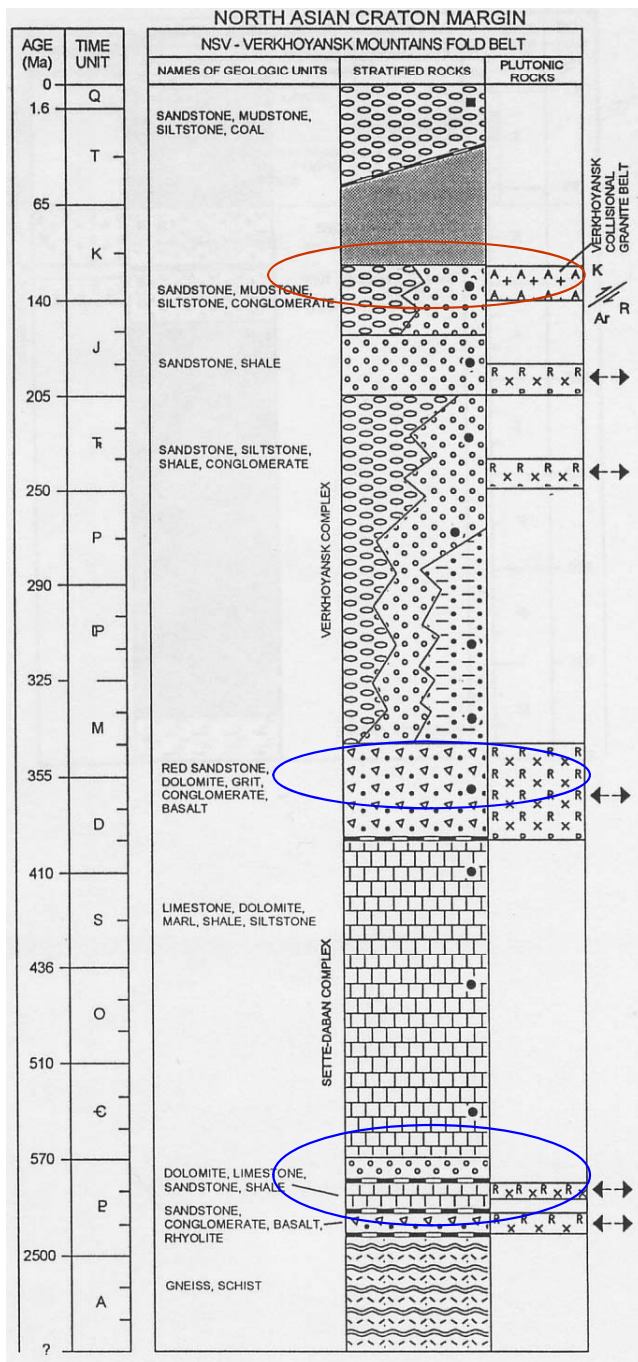
Magadan Region – General Metallogeny

1. **three major periods in metallogenic history of the Magadan Region and Russian North East : (1) pre-accretionary – pre-Late Mesozoic (main ore deposits of Cu, Pb, Zn, Au and Fe); (2) orogenic – Late Mesozoic (Au, Sn, W), and (3) post-accretionary – Late Mesozoic – Cenozoic (Ag, Au, Sn, Mo). But the typical ones for this territory are lode deposits of gold, silver, tin, tungsten, copper, zinc, molybdenum.**

2. **Geological factors affecting the distribution of lode deposits are as follows: for Au, Sn – terrigenous host rocks and orogenic granitoid associated, or volcanic belts; for Pb-Zn-Cu –terrigenous and carbonate host rocks and riftogenic basalts associated; Ag – volcanic belts and perivolcanic zones are characterized by Au-Ag and Ag-Sn deposits, but the back arc setting is more characterized by Ag-Sb and Ag-Pb-Zn deposits.**



Yana-Kolyma orogenic belt



Major orogenic event - Late Jurassic – Early Cretaceous (dislocations, zoned metamorphism, granitoid intrusion).

The time of intrusion of the collisional granitoids (Main Kolyma granitoid belt, according to SHRIMP data, 149-153 Ma – Akinin et al., 2006; Ar-Ar data: 137-149 Ma – Newberry et al., 2000, Leyer et al., 2001)

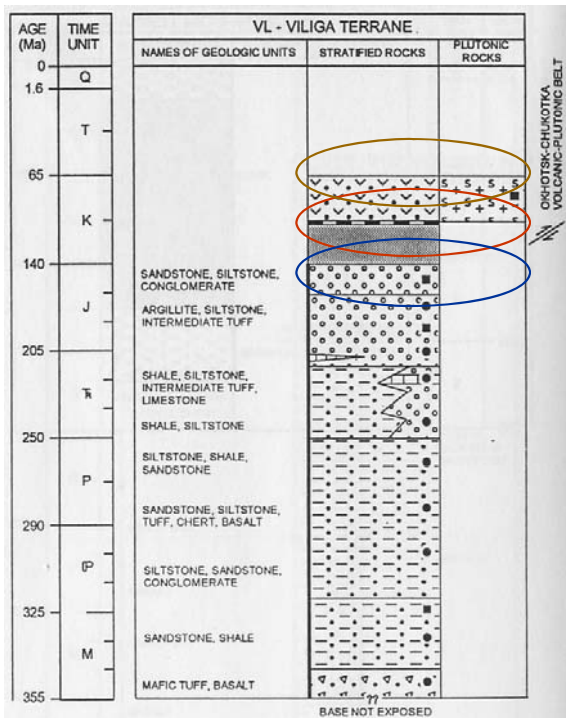
The positions of ore deposits and metallogenic levels of different metallogenic epochs in tectonic-stratigraphic columns of major tectonic blocks of the Yana-Kolyma orogenic belt

Orogenic ores – Au, Sn, W

Pre-accretionary ores – Cu, Pb, Zn

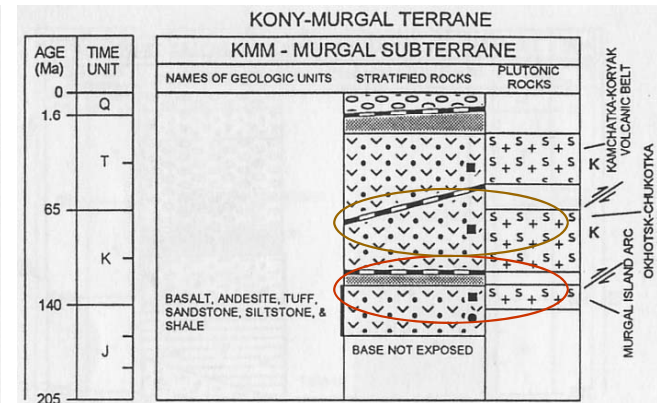
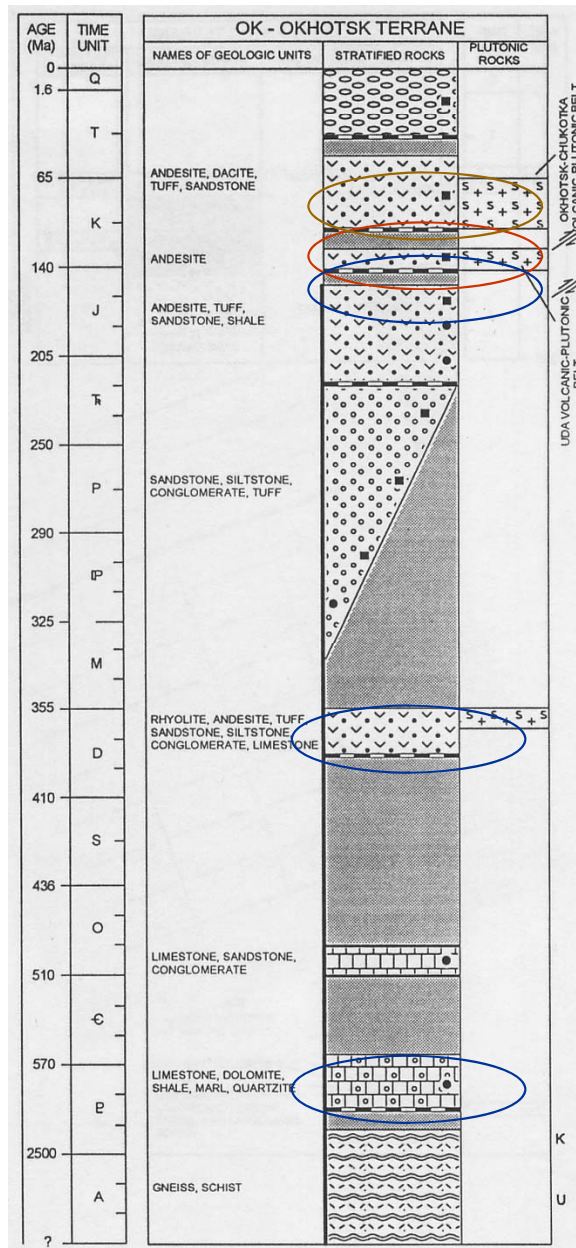


Okhotsk-Koryak orogenic belt



Major orogenic event - Early Cretaceous (dislocations, zoned metamorphism, granitoid intrusion).

The time of intrusion of the collisional granitoids, according to K-Ar data, 134-110 Ma – Akinin, Kotlyar, 2001)



The positions of ore deposits and metallogenic levels of different metallogenic epochs in tectonic-stratigraphic columns of major tectonic blocks of the Okhotsk-Koryack orogenic belt

Orogenic ores – Au, Sn, Co, Li, Be

Pre-accretionary ores – Cu, Mo, Au-Ag

Post-orogenic ores – Au, Ag, Sn, W, Mo, Cu, U



Magadan Region – General Metallogeny

3. Metallogenic characteristics of the major volcanogenic belts of the Magadan Region of North-East of Russia are:

(1) Pre-accretionary

Uyandina-Yasachnensky island arc belt: Ag-Cu-Pb,Zn-Au
(carbonate basement)

Uda-Murgal continental margin belt: Au-Ag-Cu-Mo-Co
(volcanic-terrigenous basement)

Back arc metallogeny: Ag-Sb-Au-Pb-Zn

4. Metallogenic characteristics of the major orogenic belts of the Magadan Region of North-East of Russia are:

(1) Yana-Kolyma belt: Au-W-Sn-(Pb,Zn,Mo) predominantly terrigenous shelf terranes;

(2) Okhotsk-Koryak belt: Sn-Au-Co-Li-Be predominantly terrigenous shelf terranes and volcanoclastic sediments back arc.

5. Metallogenic characteristics of the major post-accretionary belt of the Magadan Region of North-East of Russia are:

Okhotsk-Chukotka continental margin belt: Au-Ag-Sn-W-Mo (terrigenous and metamorphic basement, rarely volcanic)

Back arc metallogeny: Ag-Sn-Sb-Au-Pb-Zn-Mo



Major Lode Deposits Types

The total mining production is estimated today as about 4 kt Au (mainly recovered from placers), 90 kt Sn, 40 kt W, 2 kt Ag, 30? kt Sb, and 1 kt Co.



Types of the Gold Lodes of Magadan Area

Gold-sulfide-disseminated and veinlets zones (early orogenic – Degdekan, Nataalka)

Gold-quartz (early orogenic veins, late orogenic veins, granitoid hosted, and shear zones – Svetloye, Utinka, Igumenovskoye)

Granitoid-related (skarns, greisens and veins – Chistoye, Teutedzhak)

Gold-silver epithermal (pre-, and post-accretionary – Julietta, Karamken)



Igumen creek placer – the overall production has been more than 30 t Au



GOLD DEPOSITS OF MAGADAN REGION

Major Au lodes are localized in terrigenous sediments of Verkhoyan passive continental margin, Kular-Nera slate belt, Chukotka and Viliga shelf Terrane (collisional setting), and in volcanic rocks of Uda-Murgal and Okhotsk-Chukotka continental margin magmatic belt (subduction setting).

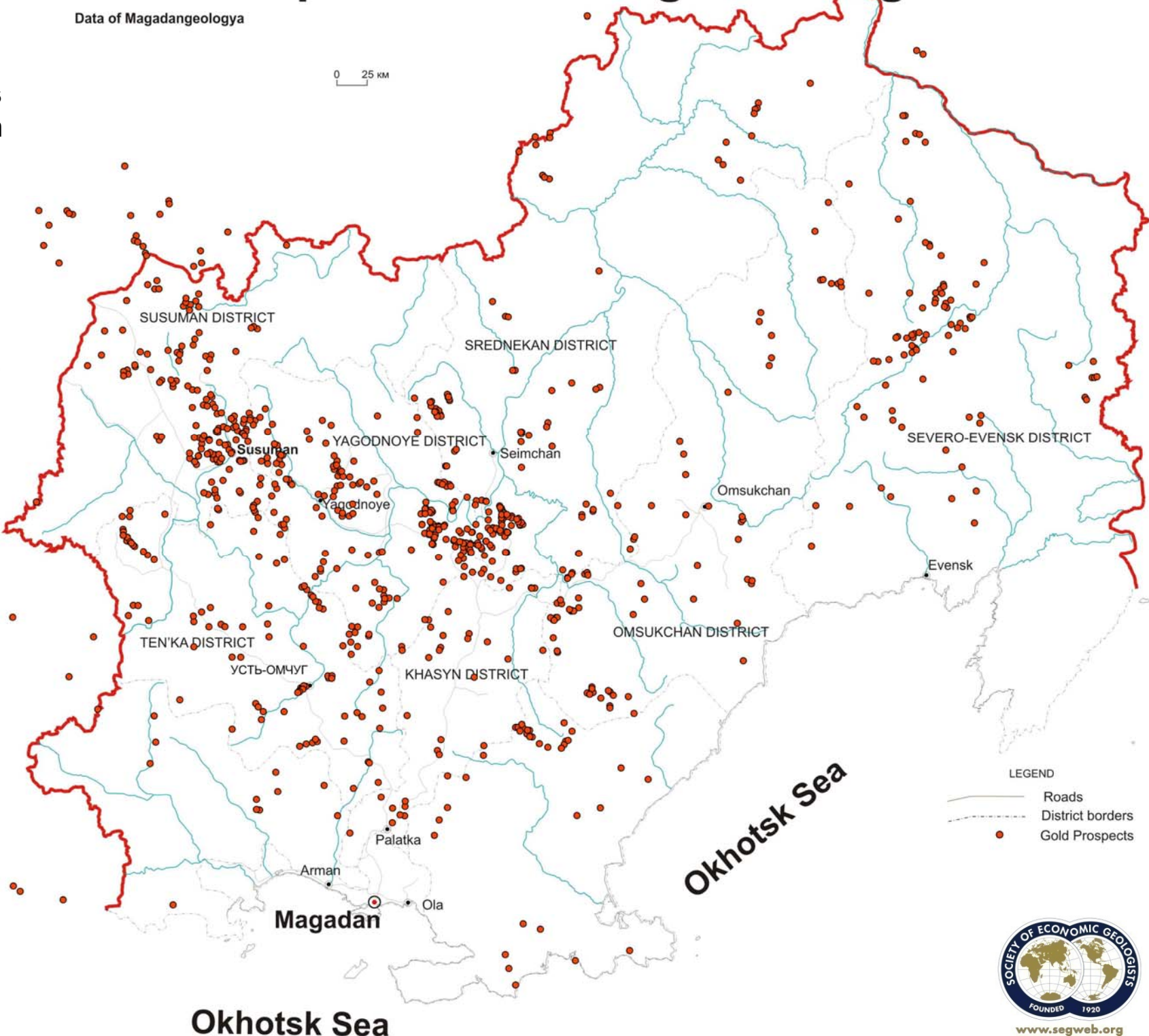


Gold Prospects of the Magadan Region

Data of Magadangeologya

0 25 KM

Major Au lodes are localized in terrigenous sediments of Verkhoyan passive continental margin, Kular-Nera slate belt, Chukotka and Viliga shelf Terrane (collisional setting), and in volcanic rocks of Uda-Murgal and Okhotsk-Chukotka continental margin magmatic belt (subduction setting).



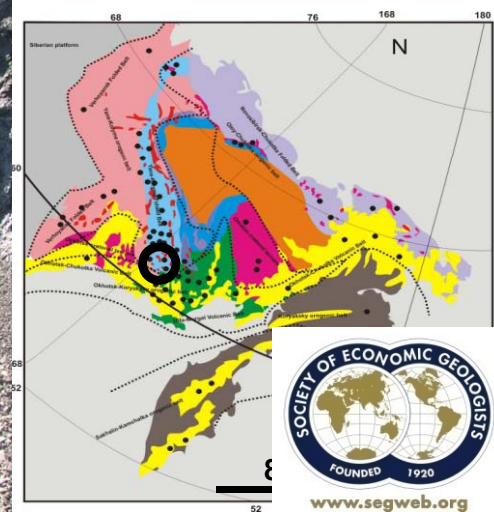
LEGEND

- Roads
- District borders
- Gold Prospects



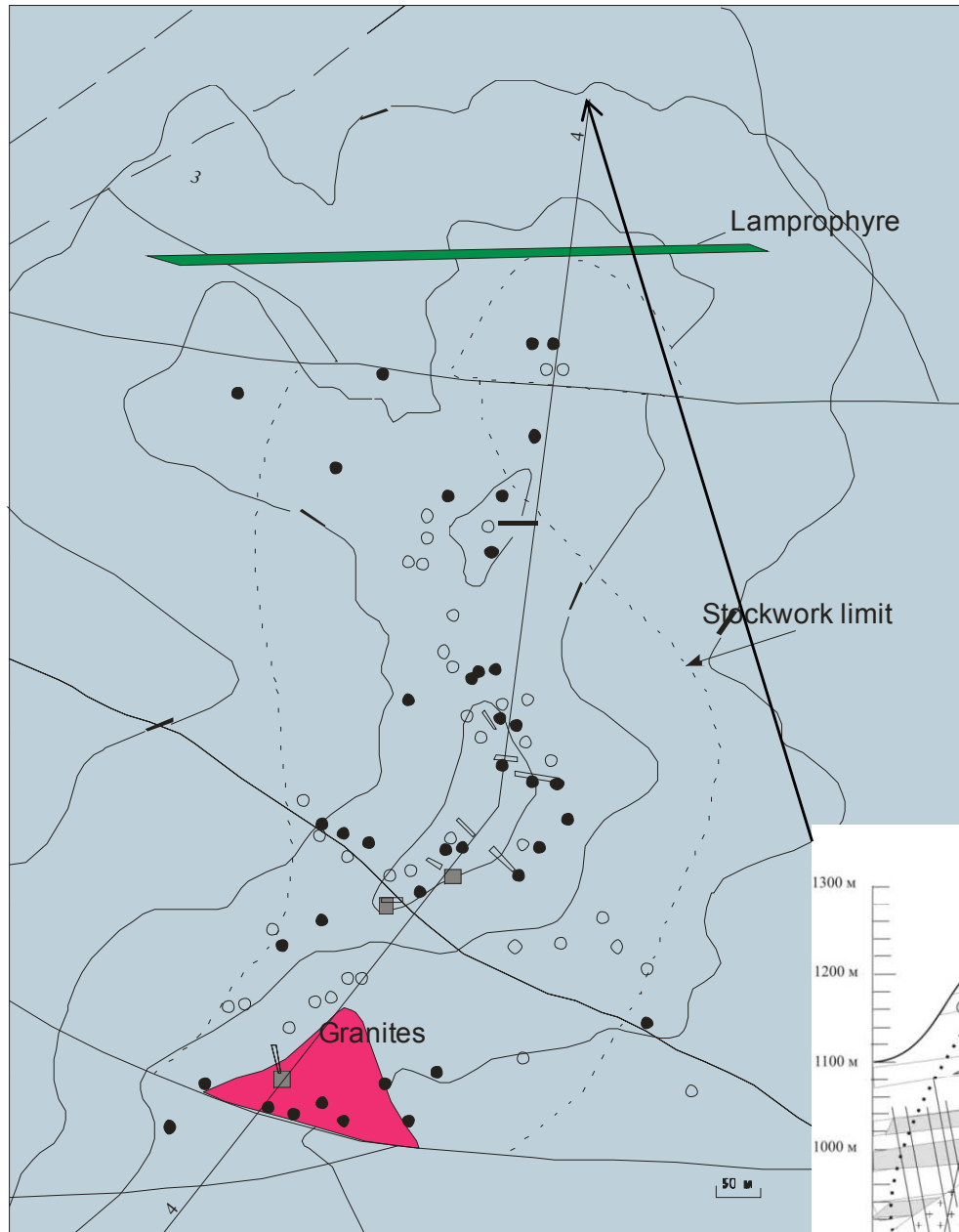
www.segweb.org

Au-sulphide disseminated and veinlets orogenic Degdekan deposit



Resources 260 t of gold with grade 12 g/t

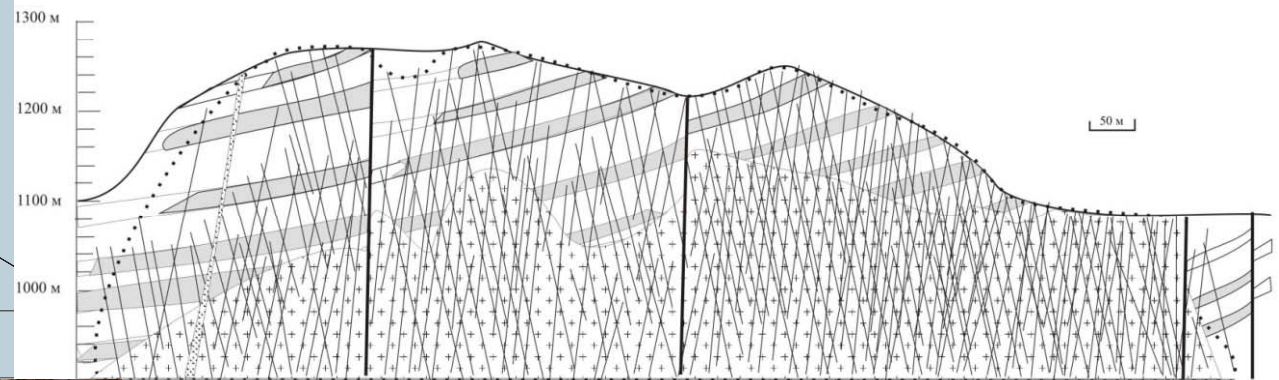
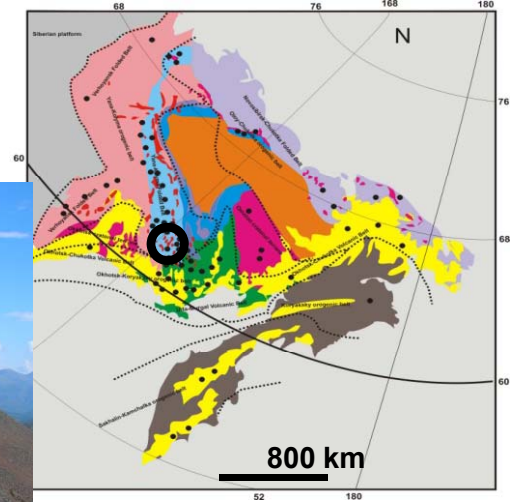
Schematic geological map of Chistoye prospect



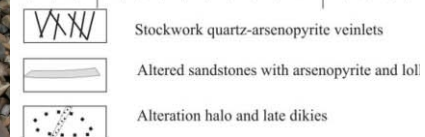
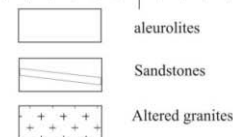
Granitoid related Au lode



Longitudinal cross-section 4-4' of Chistoye prospect

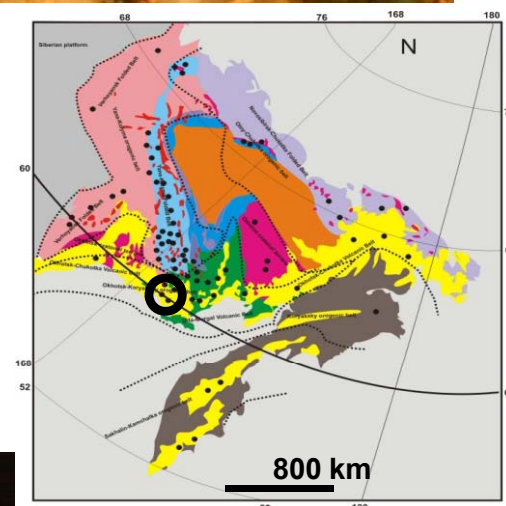
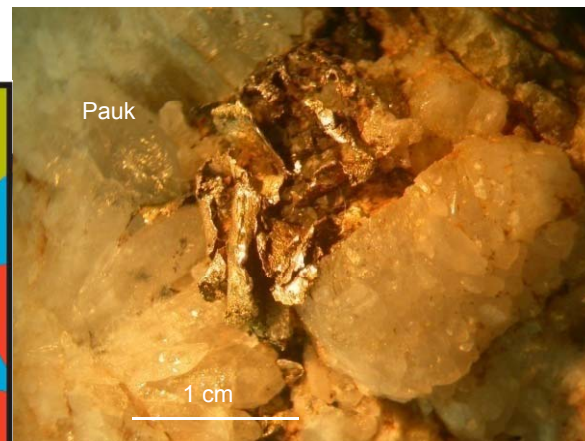
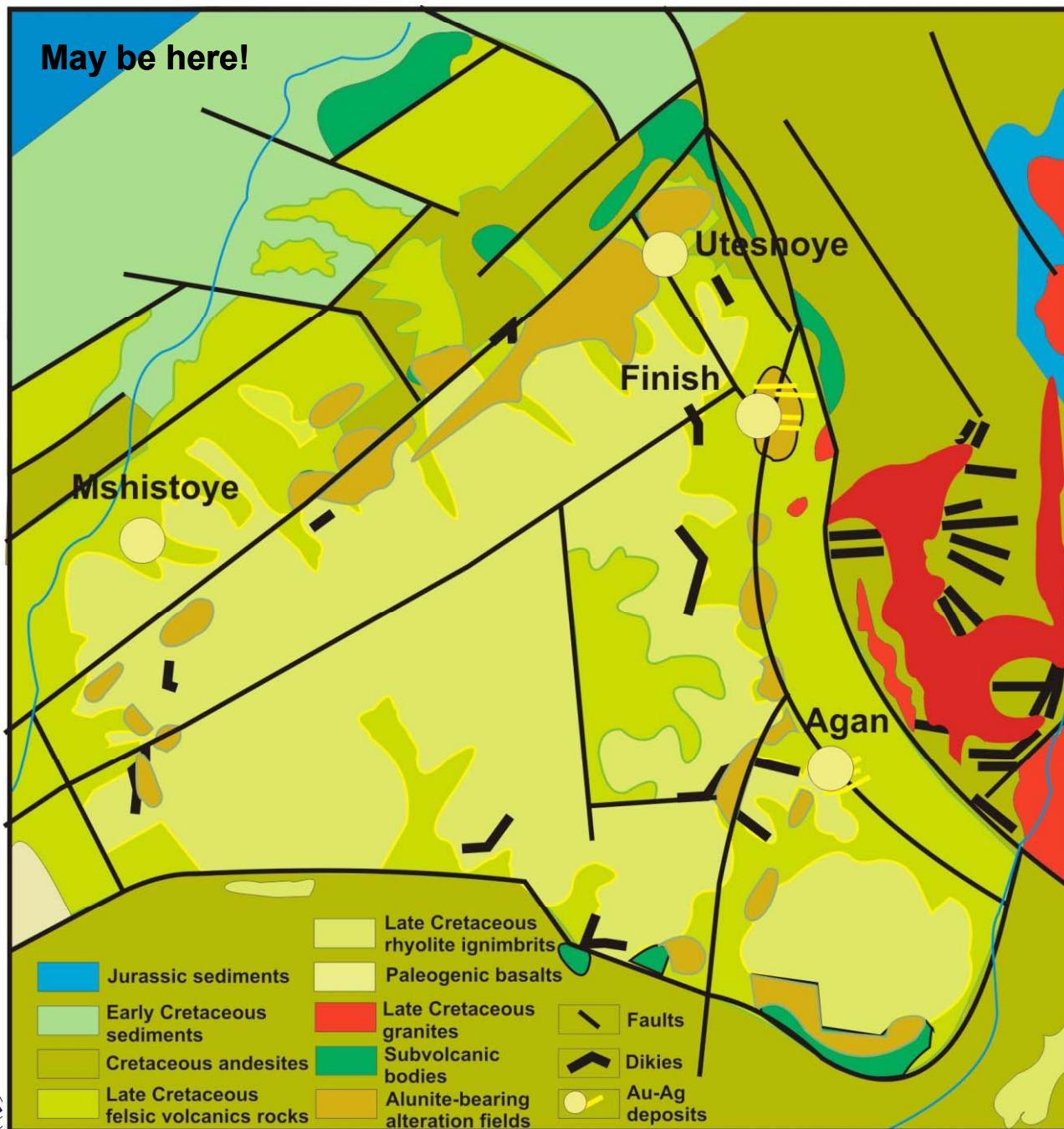


● Samples with Au grade more than 1 ppm
○ Trenches

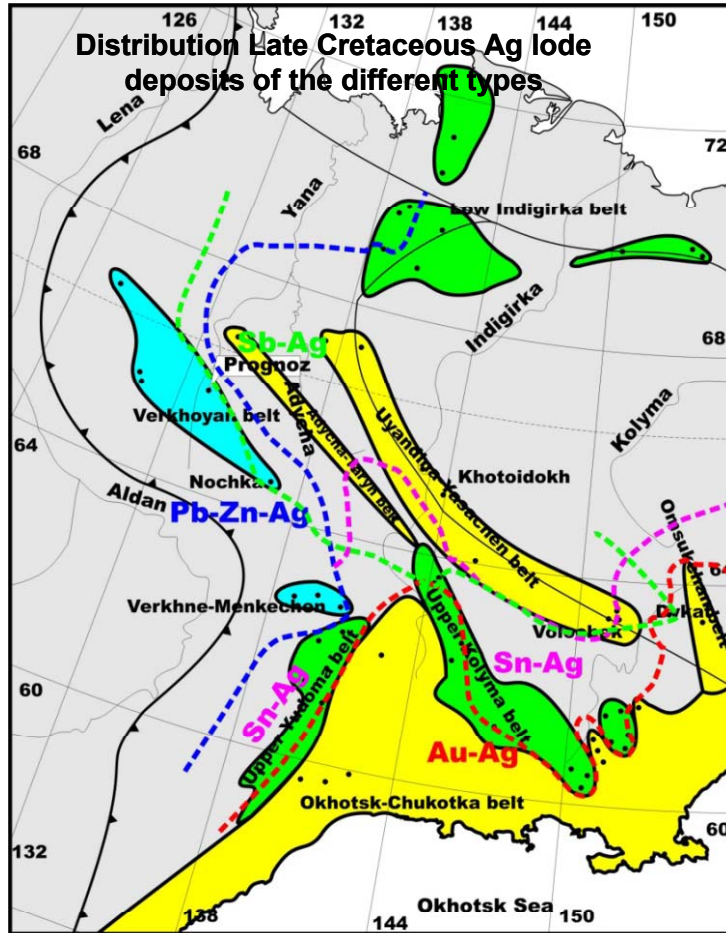


www.segweb.org

Where are High-Sulphidation Au-Ag epithermal lode deposits in Magadan Region?



Distribution of major Ag lode deposits



Major Ag lodes are localized in terrigenous sediments of Verkhoyan passive continental margin, Kular-Nera slate belt and Viliga terrane (back arc setting), and in volcanic rocks of Uda-Murgal and Okhotsk-Chukotka continental margin magmatic belt.



Silver lode deposit types

- Ag-Au epithermal
- Ag-Sn subvolcanic
- Ag-base metallic
- Ag-Co-arsenide
- Ag-Sb

SILVER DEPOSITS OF MAGADAN REGION

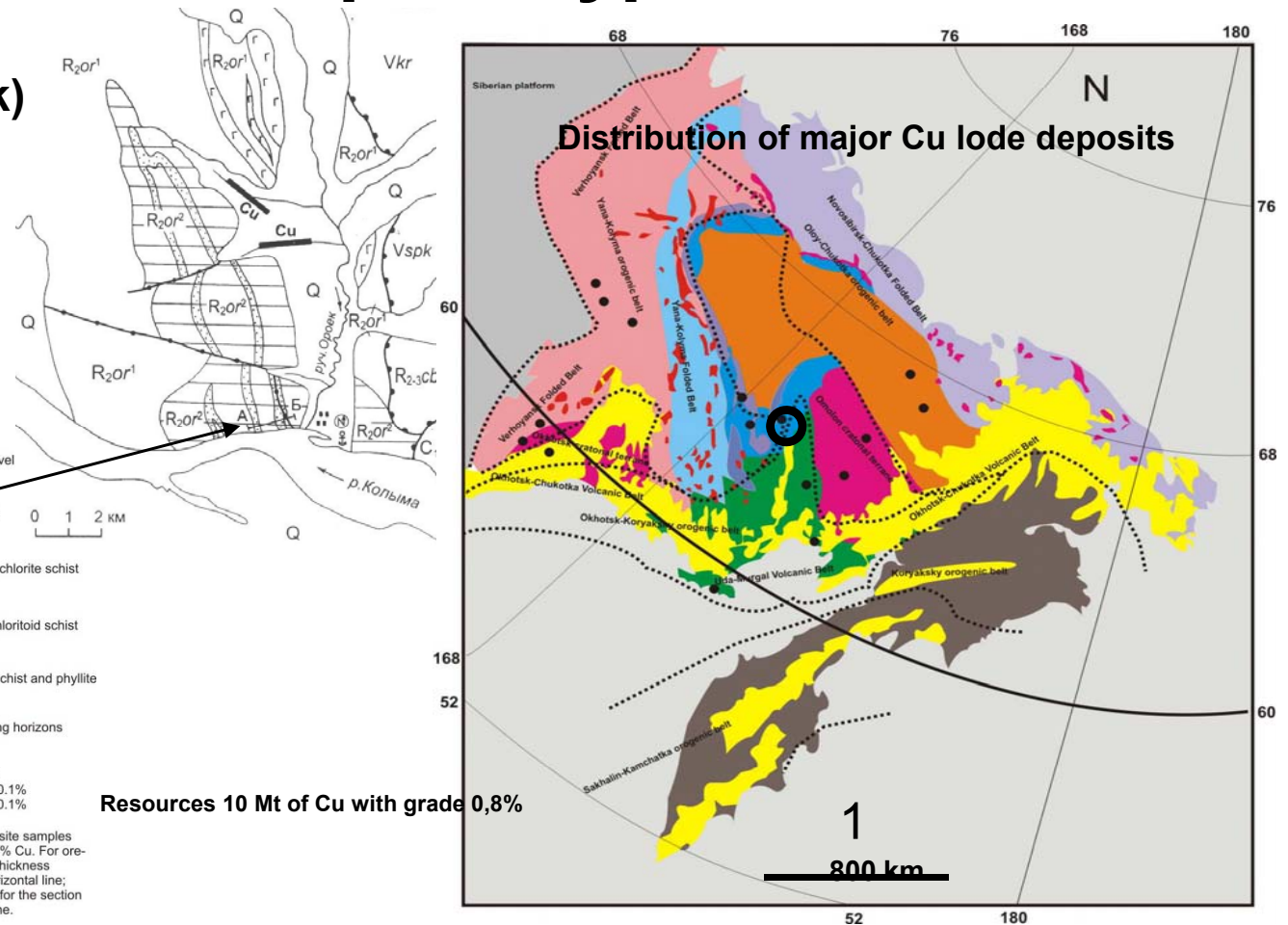
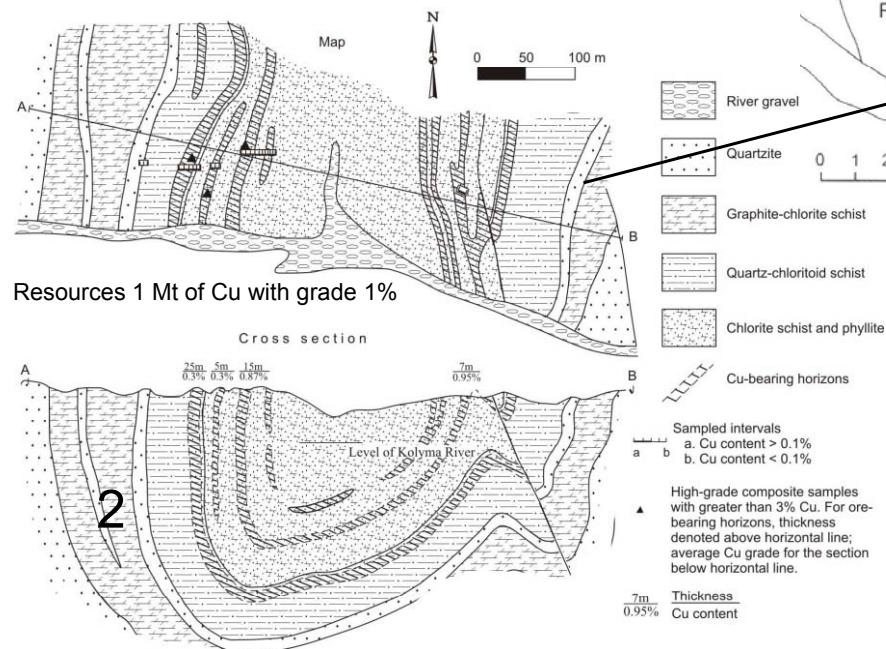


Copper lode deposit types

Cu-sandstone and shists (Oroek)

Cu-Mo-porphyry (Lora)

Cu-Mo skarns (Medgora)



Resources 10 Mt of Cu with grade 0,8%

Major Cu lodes are localized in terrigenous-carbonate sediments and Devonian basalts of Verkhoyan passive continental margin and Omulevka terrane. Cu-Mo porphyry and skarns are localized in Mesozoic island arc and back arc terranes and settings

- The Magadan Area of the Russian North-East are characterized by many lode deposits. But the typical ones of this territory are lode deposits of gold, silver, tin, tungsten, copper, zinc, molybdenum, cobalt.
- Lode deposits of iron, rare and earth elements, lead, antimony, mercury and other elements are less frequent.



Conclusion

Exploration Perspectives in Magadan Region

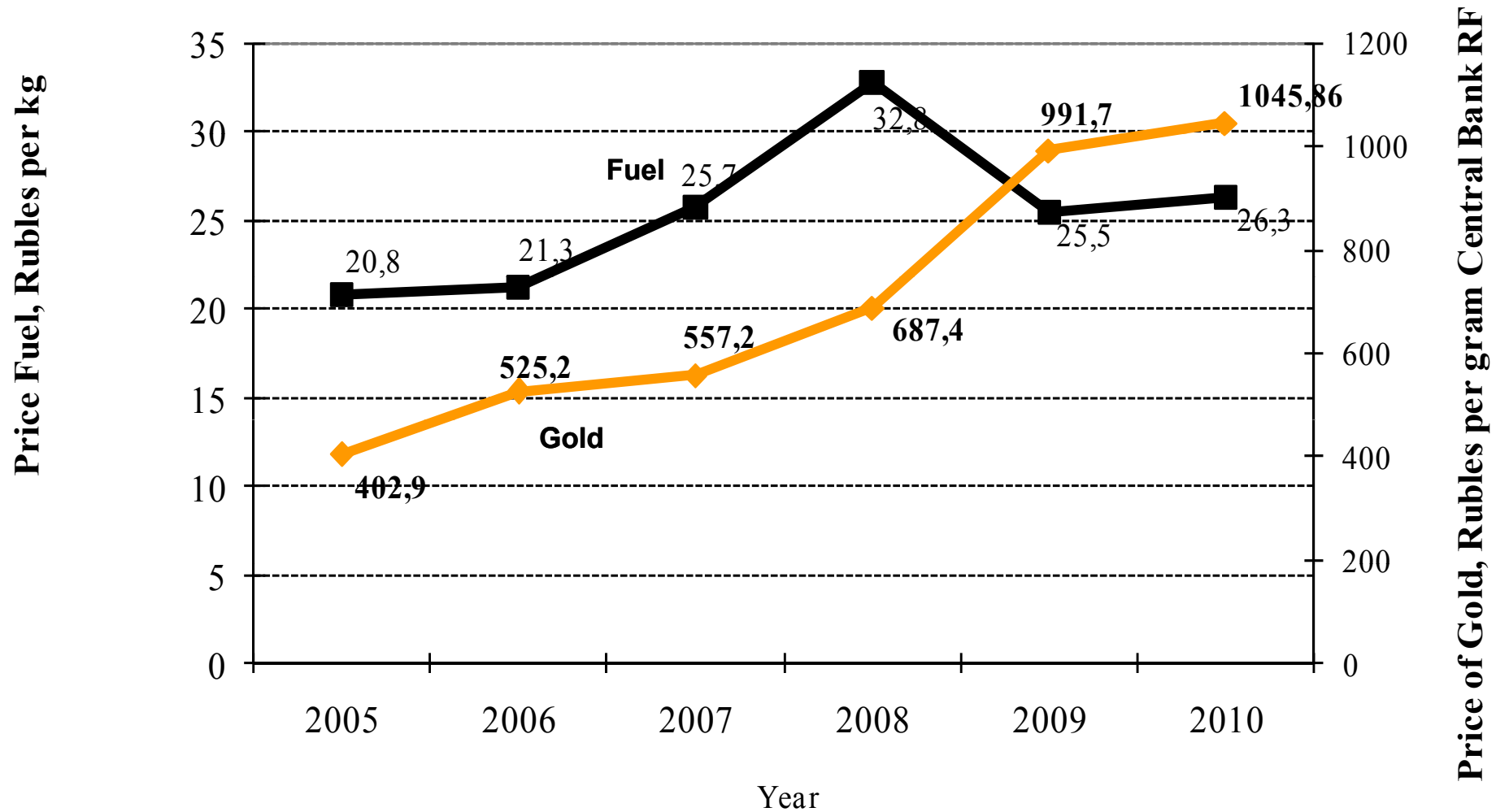
Good perspectives are:

- (1) high mineral potential;
- (2) employers – Magadan State University,
- (3) developed infrastructure;
- (4) deep water sea port Magadan;
- (5) good perspective oil in shelf;
- (6) good resources of coal;
- (7) low regional price of electrical power;
- (8) long-lived Russian government plans for road construction in North East Russia

and others



Gold and Fuel Price in Magadan Region 1999-2009



**Thanks for your attention!
and
Welcome to Kolyma Region!**

