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## MINERAL TYPES OF ORES OF EUROPE

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Books on minerals and deposits of various geological provinces (the Urals) and countries (Germany, RSA, USA) are numerous, but such books on whole continents are rare. Series of monographs «Mineral deposits of Europe» (Mir, 1982, etc.) do not include Eastern part of Europe, especially Russia.

This article represents brief tables with the main mineral types of ores of the territory from Portugal to the Urals. East Europe, and first of all Russia, has besides oil and gas the great number of other types of valuable ores, unknown in West Europe. Types of ores are determined according to the mineral concentrate: pyrochlore, columbite, loparite, which have different genesis (carbonatite, granite, nepheline-syenite), but not according to the countries, metals (for example, niobium, as it is accepted in the series «Mineral deposits of Europe»).

There are a lot of deposits of cinnabar (mercury), apatite (phosphorus), magnetite (iron), eudialyte and baddeleyite (zirconium) in Europe.

Large, world-range deposits of uraninite (as in Canada and Australia), tantalite, diamonds, non-ferrous metals, gold are absent here.

Tetragonal dipyramidal crystal of tin dioxide, cassiterite, can be suggested as a mineral symbol of Europe. It was the mineral that used for tin

extraction to make bronze in England (Cornwall) («Bronze Age» of Humanity).

As is concerned to chemical element europium, in minerals (allanite, monazite) from one of the most widespread European rocks, leucocratic granites, it usually strongly yields in abundance to such rare-earth elements as samarium and gadolinium. Only in oolitic monazite from schists and their placers in Normandy (France) and at the Timan europium prevails.

Minerals, determining types of ores	Formulas	Deposits
<b>Oxides</b>		
Magnetite	$\text{Fe}_3\text{O}_4$	Kursk, Russia, quartzites Kiruna, Sweden, syenites Magnitogorsk, Urals, skarns
Titanomagnetite	$(\text{Fe}, \text{V}, \text{Ti})_3\text{O}_4$	Kachkanar, Urals, pyroxenites
Chromite	$\text{FeCr}_2\text{O}_4$	Saranka, Urals, ultrabasites
Ilmenite	$\text{FeTiO}_3$	Irsha, Ukraine, placers
Rutile	$\text{TiO}_2$	Irsha, Ukraine, placers
Perovskite	$\text{CaTiO}_3$	Afrikanda, Kola Peninsula, pyroxenites
Baddeleyite (technical)	$\text{ZrO}_2$	Kovdor, Kola Peninsula, ultrabasites
Cassiterite	$\text{SnO}_2$	Cornwall, Great Britain, greisens
Pyrolusite	$\text{MnO}_2$	Nikopol, Ukraine, sedimentary rocks
Uraninite	$\text{UO}_2$	Prshibram, Czech Republic, hydrothermalites Krivoi Rog, Ukraine, albitites
Loparite	$\text{NaCe}(\text{Ti}, \text{Nb}, \text{Ta})_2\text{O}_6$	Lovozero, Kola Peninsula, foidites
Pyrochlore	$\text{NaCaNb}_2\text{O}_6\text{F}$	Vishnevogorsk, Urals, carbonatites Sebl'yavr, Kola Peninsula, carbonatites
Pandaite	$\text{BaNb}_2\text{O}_6 \cdot \text{H}_2\text{O}$	Sokli, Finland, crusts of carbonatites
Microlite	$\text{NaCaTa}_2\text{O}_6\text{F}$	Echassier, France, granites
Tantalite	$\text{MnTa}_2\text{O}_6$	Voron'ya Tundra, Kola Peninsula, pegmatites*
Columbite	$\text{FeNb}_2\text{O}_6$	Vigo, Spain, granites
Fergusonite	$\text{Y}(\text{Nb}, \text{Ta})\text{O}_4$	Vigo, Spain, granites
Scheelite	$\text{CaWO}_4$	Felbertal, Austria, skarns
Wolframite	$\text{MnWO}_4$	Panasqueira, Portugal, hydrothermalites
Chrysoberyl (precious)	$\text{BeAl}_2\text{O}_4$	Malyshevo, Urals, pegmatites

\*Pegmatites and hydrothermalites mainly derived from granites.

Semibold – elements of economical value. Isostructural minerals are included in brackets.

**Hydroxides**

Gibbsite	$\text{Al}(\text{OH})_3$	Visokopole, Ukraine, sedimentary rocks
Bohmite	$\text{AlO OH}$	Krasnaya Shapochka, Urals, sedimentary rocks
Diaspore	$\text{HAlO}_2$	Krasnaya Shapochka, Urals, sedimentary rocks
Goethite	$\text{HFeO}_2$	Kerch, Crimea, sedimentary rocks
Montroseite	$\text{HVO}_2$	Padma, Karelia, hydrothermalites

**Silicates**

Quartz (technical)	$\text{SiO}_2$	Puiva, Urals, hydrothermalites
Spodumene	$\text{LiAlSi}_2\text{O}_6$	Voron'ya Tundra, Kola Peninsula, pegmatites
Pollucite	$\text{CsAlSi}_2\text{O}_6$	Voron'ya Tundra, Kola Peninsula, pegmatites
Petalite (technical)	$\text{LiAlSi}_4\text{O}_{10}$	Polokhovo, Ukraine, pegmatites
Nepheline	$(\text{Na}, \mathbf{K}, \mathbf{Rb})(\mathbf{Al}, \mathbf{Ga})\text{SiO}_4$	Khibiny, Kola Peninsula, foidites
Microcline (technical)	$\text{KAlSi}_3\text{O}_8$	Belomor'e, Karelia, pegmatites
Muscovite (technical)	$\text{KAl}_3\text{Si}_3\text{O}_{10}\text{F}_2$	Belomor'e, Karelia, pegmatites
Phlogopite	$\text{KMg}_3\text{AlSi}_3\text{O}_{10}\text{F}_2$	Kovdor, Kola Peninsula, ultrabasites
Topaz (precious)	$\text{Al}_2\text{SiO}_4\text{F}_2$	Volyn', Ukraine, pegmatites
Beryl (precious)	$\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$	Malyshevo, Urals, pegmatites
Genthelvite	$\text{Zn}_4(\mathbf{BeSiO}_4)_3\text{S}$	Perga, Ukraine, microclinites
Leucophane	$\text{NaCaBeSi}_2\text{O}_6\text{F}$	Zhitkovichi, Byelorussia, hydrothermalites
Aegirine	$\text{Na}(\mathbf{Fe}, \mathbf{Sc}, \mathbf{V})\text{Si}_2\text{O}_6$	Krivoi Rog, Ukraine, albitites
Kyanite	$\text{Al}_2\text{SiO}_5$	Keivy, Kola Peninsula, schists
Titanite	$\text{Ca}(\mathbf{Ti}, \mathbf{Nb})\text{SiO}_5$	Khibiny, Kola Peninsula, foidites
Eudialyte	$\text{Na}_{16}\text{Ca}_6\text{Fe}_3\mathbf{Zr}_3\text{Si}_{26}\text{O}_{74}\text{Cl}_2$	Lovozero, Kola Peninsula, foidites
Zircon (technical)	$\text{ZrSiO}_4$	Mariupol, Ukraine, syenites Verkhnedneprovsk, Ukraine, placers

**Hydrosilicates**

Chrysotile (technical)	$\text{Mg}_6\text{Si}_4\text{O}_{10}(\text{OH})_8$	Bazhenovo, Urals, ultrabasites
Kaolinite (technical)	$\text{Al}_4\text{Si}_4\text{O}_{10}(\text{OH})_8$	Cornwall, Great Britain, crusts of granites
Chamosite	$\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_{10}(\text{OH})_8$	Elzas, France, sedimentary rocks
Talc (technical)	$\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$	Trimouns, France, sedimentary rocks
Sepiolite (technical)	$\text{Mg}_4\text{Si}_6\text{O}_{15}(\text{OH})_2 \cdot 6\text{H}_2\text{O}$	Madrid, Spain, sedimentary rocks
Clinoptilolite (technical)	$\text{KNaAl}_2\text{Si}_7\text{O}_{18} \cdot 6\text{H}_2\text{O}$	Sokirnitsa, Ukraine, sedimentary rocks

**Carbonates etc.**

Siderite	$\text{FeCO}_3$	Kremikovtsy, Bulgaria, hydrothermalites
Rhodochrosite	$\mathbf{MnCO}_3$	Kremikovtsy, Bulgaria, hydrothermalites
Magnesite (technical)	$\text{MgCO}_3$	Satka, Urals, sedimentary rocks
Calcite (technical)	$\text{CaCO}_3$	Urals, sedimentary rocks
Bastnasite	$\mathbf{CeCO}_3\text{F}$	Zhitkovichi, Byelorussia, hydrothermalites
Strontianite	$\mathbf{SrCO}_3$	Westfal, Germany, hydrothermalites
Ulexite	$\text{NaCaB}_5\text{O}_9 \cdot 4\text{H}_2\text{O}$	Studenitsa, Serbia, sedimentary rocks

**Phosphates**

Amblygonite	$\mathbf{LiAlPO}_4\text{F}$	Caceres, Spain, greisens
Monazite	$(\mathbf{Ce}, \mathbf{Eu})\text{PO}_4$	Normandy, France, placers
Apatite	$(\mathbf{Ca}, \mathbf{Sr}, \mathbf{Ce})_5(\text{PO}_4)_3\text{F}$	Khibiny, Kola Peninsula, foidites
Francolite	$\text{Ca}_{10}(\mathbf{P}, \mathbf{C})_6\text{O}_{24}\text{F}_2$	Vyatka, Priuralie, sedimentary rocks

**Sulphates**

Gypsum (technical)	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Donbass, Ukraine, sedimentary rocks
Thenardite	$\text{Na}_2\text{SO}_4$	Madrid, Spain, sedimentary rocks
Kainit	$\text{KMgSO}_4\text{Cl} \cdot 3\text{H}_2\text{O}$	Stassfurt, Germany, sedimentary rocks
Barite (technical)	$\text{BaSO}_4$	Meggen, Germany, sedimentary rocks
Celestine	$\text{SrSO}_4$	L'vov, Ukraine, sedimentary rocks
Alunite	$\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$	Beregovo, Ukraine, hydrothermalites

**Haloids**

Cryolite (technical)	$\text{Na}_3\text{AlF}_6$	Ivigut, Greenland, greisens
Fluorite	$\text{CaF}_2$	Pokrovo-Kireevo, Ukraine, hydrothermalites
Halite	$\text{NaCl}$	Donbass, Ukraine, sedimentary rocks
Sylvite	$\text{KCl}$	Solikamsk, Urals, sedimentary rocks
Carnallite	$\text{KMgCl}_3 \cdot 6\text{H}_2\text{O}$	Solikamsk, Urals, sedimentary rocks

**Carbides etc**

Diamond (precious)	C	Arkhangelsk, Russia, kimberlites Koiva, Urals, granulites
Graphite (technical)	C	Zavaliye, Ukraine, granulites
Amber (precious)	$\text{C}_{10}\text{OH}_{16}$	Palmniken, Russia, sedimentary rocks
Coal (energetic)	(C,H)	Pechora, Russia, sedimentary rocks
Lignite (energetic)	(C,H,O)	Tula, Russia, sedimentary rocks

**Sulphides etc**

Sulphur	S	Rozdol, Ukraine, sedimentary rocks
Chalcopyrite	$\text{CuFeS}_2$	Riotinto, Spain, hydrothermalites
Pyrite	$\text{FeS}_2$	Riotinto, Spain, hydrothermalites
Chalcosine	$\text{Cu}_2\text{S}$	Lyublin, Poland, schists
Acanthite	$\text{Ag}_2\text{S}$	Saxony, Germany, hydrothermalites
Sphalerite	$\text{ZnS}$	Blyava, Urals, hydrothermalites
Galena	$\text{PbS}$	Rodopy, Bulgaria, hydrothermalites
Cinnabar	$\text{HgS}$	Almaden, Spain, hydrothermalites
Molybdenite	$\text{MoS}_2$	Yaurioki, Kola Peninsula, greisens
Pentlandite	$\text{Ni}_4\text{Fe}_5\text{S}_8$	Outokumpu, Finland, hydrothermalites
Sperrylite	$\text{PtAs}_2$	Pechenga, Kola Peninsula, basites
Cobaltite	$\text{CoAsS}$	Saxony, Germany, hydrothermalites
Sylvanite	$\text{AgAuTe}_4$	Sekertimb, Romania, hydrothermalites

**Metals**

Gold	<b>Au</b>	Berezovsk, Urals, hydrothermalites
Silver	<b>Ag</b>	Kutna Gora, Czech Republic, hydrothermalites
Palladium	<b>Pd</b>	Monchegorsk, Kola Peninsula, basites
Platinum	<b>Pt</b>	Nizhnii Tagil, Urals, placers
Antimony	<b>Sb</b>	Senyaioki, Finland, hydrothermalites

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