



METALLOGENIC POTENTIAL OF THE DEEP SEA MINERAL DEPOSITS

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More than 10-times increase of resources of mineral deposits (up to level 33 billion tonnes in the year 2000, and in 2010 to 45 billion tonnes), with the forecast in the current half century, even double increase, raises limit economic development in the countries of the European Union, including in Poland. In China, which is the largest consumer of metals in the World, copper consumption in the past decade has increased from 12 to 40%. In the situation of the currently limited resource base of the strategic metals mineral deposits on the continents, increasing the rate of demand and consumption of metals and varying levels of prices intensify in many countries of the world geological studies documentary alternative deep sea mineral deposits. Among the identified potential ocean mineral deposits, more important are polymetallic nodules, cobalt rich manganese crusts and massive sulphides, which can be an alternative source of critical metals. Regulations for prospection and exploration of the oceanic polymetallic deposits and terms for registration of the most promising mining areas are carried out in accordance with Convention of the Law of the Sea of 1982 (UNCLOS), as well as regulations of the International Seabed Authority – ISA. Increase the competitiveness of the EU countries economy and dependence on imports and supplies of mineral raw materials affect the limitations for the development of companies and economic growth and employment. Effective acquisition of commodities including rational use of both secondary and primary raw materials and also waste, will expand the capabilities of applications and the implementation of innovative technology. In particular, the above condition relates to rare metals and other raw materials which are important to the Polish economy. Innovative solutions to reduce import dependence of key metals and to ensure security of supply over 50 different elements are currently a priority task of the Republic of Poland. Similar needs see also the European Commission, which since from 2008 is undertaking appropriate action (Raw Materials Initiative RMI). Comprehensive research of the oceans, which are carried out with the active participation of the Poland, in the framework of international cooperation of Poland under the ISA supervision. Poland as registered contractor is going to explore and documentation and finally to rational use of alternative resources of mineral deposits in the area according to the UNCLOS Convention, terms of contract and in accordance with the provisions of the Programme of Geological Reconnaissance of the Oceans-PRoGeO, which forms an integral part of the Policy Raw Materials.

A group of the deep sea mineral deposits is an important alternative source of obtaining the deficit critical metals, including rare earth elements (REE), PGE and others. Special industrial value, due to the high concentration of such metals as: Ni, Cu, Co, Ag, Au, Mn, Mo, Zn and Pt and REE have sulphide and polymetallic concretion deposits. Recently concentrations of metals in ocean deposits (Ni, Co, Cu and Ag) in comparison to their content in the similar operated land-based deposits are higher. It should be noted that the average contents of metals in the polymetallic concretions are also higher than the concentration found in the minerals mined on land, respectively, for about: Ni-1.1; CU-1.14; MN-1.3, and in cobalt rich manganese crusts even more than 5 times. At the same time in the oceanic mineral resources (both oxide and sulphide), apart from of the main metals practical significance have also: Mo, Au, Ag, Zn, PGE-PGM, REE-rare earth elements, mostly Ce, Nd, Y, La. Mineralogical-geochemical investigations show, in the different types of resources variable concentration of metals, and metal resources in deposits in different regions. Documentation results show of Fe-Mn deposits, indicate that about 80% of the estimated resources is located in sediments of the Pacific, and significantly less in the Atlantic and the Indian Oceans. The estimated resources of metals in Pacific minerals, in comparison to the identified resource deposits, are larger for manganese 57 times for nickel 87 times, and cobalt 359 times (records of ISA, 1997).



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In the composition of mineral concretions: ocean-going and cobalt rich manganese crusts, dominate a hydrated manganese and iron oxides, which affects significantly by the volume and content of other metals and also for an economic value of the mineral resources. Investigation of the nodules indicate direct genetic depending on the formation of geodynamic mobilization of components, including metals, delivered into the ocean waters from endogenous sources. In polymetallic nodules and cobalt rich manganese crusts, found high concentrations of elements belonging to the iron group of metals and non-ferrous metals and REE. Nodules cover huge ocean surfaces, and the economic concentrations are located within the abyssal basins, in the interval the depth of 3500-5500 m. Unique is the nodules field Clarion-Clipperton in the Pacific (2000 km west from Mexico), which reach of 3.8 million km² and the similar is located in the central basin of the Indian Ocean. The economic value of the polymetallic nodules is depending not only with the quality of the raw materials, but also the possibility of their applications as efficient sorbent for the purification of gas or the raw material for the synthesis of inorganic ion exchange material. Processing products of concretions can replace very expensive synthetic pitches used for deactivation of waters, special materials used in industrial waste water treatment in metallurgy and metal recovery.

Perspective accumulation of the cobalt rich manganese crusts, occur on the surfaces of the peaks of the mountains offshore/conical seamount and on the mountains with cut upper part (gujot) in the northern part of the chain of Lain, of the Marshall Islands and Magellan gujots in the Tuamoto archipelago, in the area of Wake-Necker, as well as on the Rio Grande in the Atlantic Ocean. Cobalt crusts which occur in the interval depth from 500 to 2500 m, contain concentrations of Mn, Co and Ni and REE and Pt.

Perspective sulphides targets occur in the rift valleys of the in zones of the midocean ridges with different rate of accretion of oceanic crust (the Pacific Ocean, the Atlantic Ocean and the Indian). In the Pacific the massive sulphides are also volcanic arcs and in marginal basins. Depth interval of the economic accumulations ranges from 1500 to 3500 m. Accumulation of the deposit size exist in the form of isolated hydrothermal cones and different spatial size dikes within the ridges characterized with slow spreading. Mineral resources in deposits range from several hundred thousand to a million tonnes of sulphide ores, often with extremely varied amounts of major metals Zn, Cu, Pb and elevated concentrations of Ag and Au. The zone of enrichment in the deposits date back up to dozens of feet. The ore is a solid, massive with high hardness.

No longer doubt that deep sea deposit are an alternative source of many mineral commodities. To what extent they will be used in the near future. Metal resources in the recognized perspective deposits metal-Fe-Mn and massive sulphide deposit, may lead in the future to significant changes in supply and demand on the world market for strategic metals. A condition for the rational management of mineral deposits "open sea" is to preserve the ocean environment conditions. Fifty years of geological research of the Baltic Sea and the oceans, including the 30-year Polish active cooperation within the framework of the IOM and ISA, confirms the legitimacy of continuing the research deep sea deposit.

Poland as a Contractor to ISA has an exclusive rights for a perspective exploration area of massive sulphides on the Middle-Atlantic Ridge. The exploration contract area of massive sulphide mineralization has 10,000km², 100 blocks each 10 km² each, at the depth 1400-2800m.