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GEOTHERMAL ENERGY, AN ALTERNATIVE FOR ROMANIA

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Zusammenfassung: ***Geothermale Energie, eine Alternative für Rumänien.*** Geothermale Energie kann mit Hilfe von Bohrungen aufgefangen werden, falls dabei heißes Wasser oder Dampf unter Druck in die höheren Schichten der Erdkruste gelangen. Geothermale Kraftwerke nutzen Dampf mit hoher Temperatur und Druck, welchen sie in elektrische und geothermale Energie umwandeln. Die Nutzung geothermaler Energie reduziert die Suche nach fossilen Brennstoffen, sie ist erneuerbar und hat geringe Auswirkungen auf die umgebende Umwelt.

Schlüsselbegriffe: geothermale Energie, Bohrung, erneuerbare Energie, geothermale Kraftwerke

Connected to a large extent with volcanic activity, geothermal energy can be attracted in conditions when hot water or fumes under pressure reach the artificial stratums of terrestrial crust. The energy emitted by volcanic eruptions reaches inconceivable amounts so that the power of Perbuatan volcano from Krakatua Island from 1883 was calculated to 5000 megatons. In Kamceatka peninsula, the Bezimianîi volcano, which erupted between the years 1955-1956 threw on surface materials which in total were 2.4 millions tons and the emitted energy was evaluated to 40000 milliards KWh. What a volume of power resources would have been saved through the catching of this enormous energy is easy to imagine. In the same time, the geysers and some thermal waters can be catched in order to be used in electrical energy production and for the warming of different spaces or water.

Geothermal energy is already used in certain countries as Russian Federation, Hungary, Iceland, Italy, New Zeeland, Japan, Romania etc.

Geothermal power plants use fumes at high temperature and pressure which are found in terrestrial crust and they are brought to surface through drilling. These fumes have a temperature as high as 230^0 C and a pressure of 5 to 30 atmosphere. The most important power plant of this type was built to Larderello (Toscana in Italy), this having a power installed of 370 MW and an annual production of 2 milliards KWh. There were also built power plants of small and medium capacity which are put in function by the energy emitted by hot fumes and water extracted through drilling, or which appear at surface in some countries as SUA, where they ensure an annual production of 615 millions KWh especially in stratums from mountains from West (Geyser power plant) and with big perspectives in California where, starting with 1960 were advantaged the geysers from there in power plants with a power installed of 400 mw; in the New Zeeland at Wairakei there is a power plant since 1958 with a power installed of 290 MW.

In Iceland where the geothermal energy ensures some home necessities it also supports facilitates for the production of cultures in green houses. In Kamceatka peninsula from Russian Federation and in Budapest, in Hungary, but also in Romania, it is used geothermal energy for power plants.

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Also, there are daring projects to pump in the water at high depths and its recursion on surface under the form of warmed fumes which could be used in the production of electric power.

Nevertheless, the research having as object both the upper parts and lower parts of the Earth was possible in an indirect way and allowed the knowledge of structure and phenomenology of those parts but also their understanding in detail and with a surprising accuracy.

The methods used in physics and mathematics used for this purpose proved to be extremely efficient. Through their adaptation to the object of study, to the nature, their dimensions and its framework, but also through the ensemble of obtained results, it reach to the creation of a coherent group of physical disciplines through method and „geo" through content which represent today the quantitative science of Earth: geophysics.

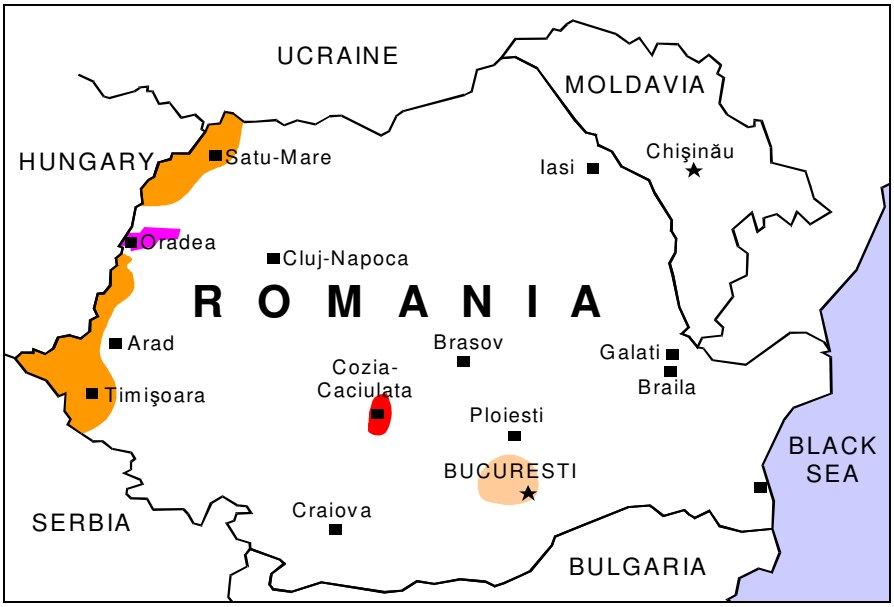

Fig. 1. The localization of geothermal deposits from Romania (source: Roşca, M., 1999)

The hydro-geothermal deposits are, in general, divided in two categories:

-*geothermal deposits of low temperature*, with temperatures <150^0 C, one kilometer deep situated in general in sedimentary basins from areas with relatively small thickness of the crust, situated in the vicinity of tectonic plates' margins (for example, the Parisian Basin, Panonic Basin and the great sedimentary basin from north-western and central China). The deposits of low temperature can be found also in old volcanic inactive areas, having as source of heat, intrusions with magma of big depth or already cold.

-*geothermal deposits of high temperature,* with temperatures > 150^0 C, over one kilometer deep, situated only in active volcanic regions, in regions of contact of tectonic plates (fissures and rifturi). The source of heat is constituted by young magmatic intrusions, situated at relatively small depth.

Geothermal resources represent the totality of existent geothermal deposits. The evaluation of geothermal resources presupposes the estimation, at a certain moment, of geothermal energy contained in terrestrial crust in a certain region and the fraction of it which can be recuperated in economic, technological, legislative data. The terminology

utilized for geothermal deposits was proposed by Muffler and Cataldi in 1978 and it is based on McKelvey Diagram, utilized at the evaluation of other types of resources.

The diagram is not represented at scale, it having only a character of orientation. On all the horizontal axis is represented the degree of geological safety, and on the vertical axis the degree of economic feasibility.

The physical manifestations of our planet are numerous and extremely varied in nature, class of dimension, as a distribution in space, as evolution in time. The gravity, the terrestrial magnetism, the radioactivity of the Earth, the phenomenon connected with the emitted heat of the Earth, the earthquake and the series of associated phenomenon, all these represent a great variety in the way in which there are perceived by humans and in which they are accessible to the specifically geophysical disciplines' quantitative study: gravimetry, geomagnetism, geo-electricity, geo-radioactivity, geothermy, seismology, geophysical prospecting.

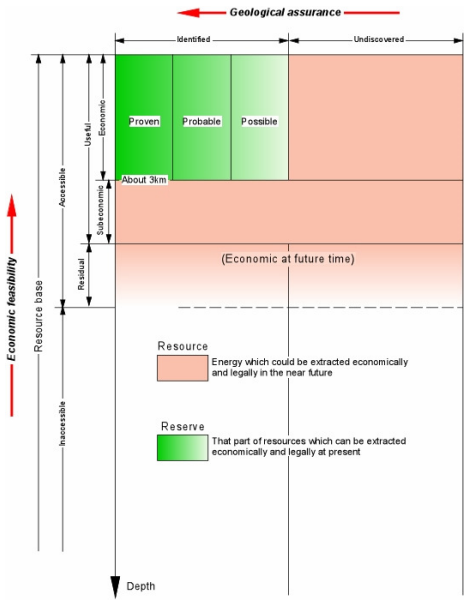

Fig. 2. Diagram of McKelvei for geothermal resources (source: www.sondex.ro)

A closer examination of physical substratum of these so diverse manifestations allows, however, to be acknowledged a certain unity in variety and to simplify the approach of their knowledge and understanding. As different as phenomena such as oscillation of a pendulum and the orientation of magnetic lifter, emission of heat from subsoil in a thermal region and the effects of an earthquake, or the radioactive manifestations from above of some formations containing uranium and magnetic storm connected with the perturbations of ionosphere are, they present, still, something common in the physical mechanism of their production: in the first pair of phenomena they manifest field effects, in the second there are acknowledged effects from where, in the third appear effects of particles.

The geothermal energy the energy transported from underground to surface by the hot water and hot, wet or dry fumes. The term is used in present for indicating that part of planet's heat which can or could be identified and exploited. This is reflected through thermal terrestrial field or geothermal field. By geothermal field we understand the totality of the values of terrestrial substance' temperature from all the directions of space occupied by them and for each moment of time.

Geothermal energy is thermal energy of molten magma, found in the center of the Earth. The heat is brought close to the surface through thermal conduction or to the entrance of magma in the vicinity of terrestrial crust. Because they are not involved fossil combustible, the geothermal energy produces negligible emissions of CO_2 comparative with the conventional sources of energy.

The expression of geothermal gradation means the increase of temperature inside the terrestrial crust directly proportional with the depth. The rate of geothermal gradation is around 2.5÷3°C/100 m, which allows an appreciation of temperature around 65÷75°C at 2000 m, 90÷105°C at 3000 meters. But there are extended geological surfaces where the

geothermal gradation is different from these medium rates. Some have smaller values, others, surpass a lot the mentioned rate.

Those who utilize the heat of the Earth can extract until 75% of heat from the soil at convenient prices. The inexhaustible sources of energy are those which stay at disposal for free day and night, any time, which regenerate permanently in the interior of the Earth and in solar radiation and can be used by techniques certified thousand of times.

In Romania, the degree of utilization of the sources of energy of geothermal origin is reduced, the main cause being determined by the lack of a proper financial support which is not in favor of development of this power sector with superior economic – financial effects.

The advantages of geothermal energy

Firstly, the utilization of geothermal energy reduces the demand of fossil combustibles. The geothermal systems can continuously operate, without taking into consideration the climatic conditions. Moreover, when such systems of heating are used, the transportation costs are reduced to zero because the catching of energy is realized exactly in the place where the consumer is placed. Being regenerative, the geothermal energy has a low impact on the environment.

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