

EARTH SCIENCES IN THE 21ST CENTURY SERIES

MAN AND THE GEOSPHERE

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EDITOR

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The cover shows the painting "On the Heights (Tumo)" by Nicholas Roerich (1936) from the collection of the Latvian National Museum of Art, Riga, Latvia.

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PREFACE

In the early 1970s, UNESCO had launched the international ecological program “Man and the Biosphere” to establish biosphere reserves and to protect genetic resources (Di Castri et al., 1981). The program has been initiated due to the public and scientific concerns about the growing impact of modern civilization on the environment. Indeed, by the mid-20th century, the human impact on the planet had reached such a level, that Vernadsky (1945) stated: ‘*man becomes a large-scale geological force*’. Subsequent advances in nuclear and space technologies have strengthened an illusion about the might of mankind. It overshadowed the obvious fact that ‘*civilization exists by geological consent*’¹.

Indeed, humanity is under the permanent influence of the geosphere². Roles of some geological biotrophic factors are obvious and have been well studied. A list of such factors includes:

- Catastrophic manifestations of the geodynamics (i.e., volcanic explosions, strong earthquakes, tsunamis, and seismically triggered landslides); and
- Geochemical anomalies responsible for the occurrence of both endemic diseases and deposits of therapeutic mineral resources.

However, little is known about biotrophic effects of other geogenic factors. Among these are geomagnetic activity, magnetic anomalies, natural background radiation, isotopic fractionation, fluid migration and gas emission within fault zones, mild seismicity causing local variations of geophysical and geochemical parameters, the Earth’s deep degassing modulating biologically important atmospheric characteristics, cyclicity of tectonic and climatic processes, gravity, solid tides, etc. Biological effects of these factors are not well known in the broad scientific community.

This book is the first attempt to close the gap, synthesizing the knowledge on all known geogenic factors influencing humans, society, and civilization. With this aim in mind, a group of scholars has been assembled from a wide variety of disciplines – geology, geochemistry, biophysics, biochemistry, psychology, neurophysiology, botany, and mathematical modeling – to examine the problem from an interdisciplinary perspective.

The book is divided into two parts. Part I represents the state-of-the-art in the field of geo-bio-interactions. Part II introduces particular examples of direct and indirect influences of the geological environment on the bio- and anthroposphere.

¹ Anonymous (frequently attributed to W. Durant – Hirst, 2006).

² We take the word *geosphere* to mean the entire interior of the Earth.

Part I comprises four chapters.

Chapter 1 conceptually outlines a hydrogen-hydrocarbon-organic evolutionary direction, which is mutually connected with processes encompassing the entire interior of the Earth. The endogenous evolution of our planet is controlled by impulses of fluid degassing of the liquid outer core. Each pulse begins with extension of the crust and mantle and terminates with their compression. Geomagnetic activity is inversely related to the endogenous activity: the higher the fluid degassing rate, the lower the geomagnetic reversal rate. Released from the Earth's liquid core, fluids lose hydrogen during the extension phase. However the compression regime, impeding the hydrogen migration from fluids, promotes the development of hydrocarbons in magma chambers within the crust and mantle. Upward migration of hydrocarbons from magma chambers leads to their accumulation in the Earth's crust as gas and oil deposits. Cooling of uprising hydrocarbon fluids and their interaction with the hydrosphere provides the abiogenic generation of organic compounds using nitrogen-hydrocarbon precursors. Complexes of life came into existence during interactions of these abiogenic substances. All of this naturally produces a chemical basis for the subsequent embedding of genetic instructions that makes life possible. Thus the chapter, for the first time, demonstrates relationships between the global fluid degassing and the origin of oil, life, and the biosphere.

Stable and radioactive isotopes play a key role in the formation of chemical and physical properties of a chemical element. Isotopes, being subsystems of the element, allow nature to create biosystems, which are marked by a wide range of adaptive properties, at various hierarchical levels. Chapter 2 mainly looks at stable isotope fractionation in the human organism. The authors consider isotopic composition of body tissues and dependence of human isotope fractionation on diet, geographical context, the state of health, and age. It is proposed that a living organism and each of its systems can be characterized by a typical composition of natural isotopes, "an isotopic card", whose content is mutually connected with the environment. In the signature, typical isotope ratios may fluctuate supporting the state of isotopic homeostasis, an integral part of the general homeostasis of the organism. The authors also review a role of natural radioisotopes in speciation and biological evolution. It is demonstrated that natural background radiation is important for vital activity of living beings, whereas dramatic periods of speciation have regularly occurred in periods of high radioactivity of the environment. Possible mutagenic effects of the cosmic radiation increased during geomagnetic reversals and excursions are also discussed.

Chapter 3 looks at natural geochemical anomalies, which can influence the balance of trace elements in the human organism, causing both adverse and positive impact on human health. The authors show that fluid degassing via faults is the main factor responsible for the development of geochemical anomalies. As a result, a major portion of both endemic-disease areas and balneological resorts are located within geodynamically active regions. The authors comprehensively review health effects of natural abnormal concentrations of trace elements and gases in the environment, as well as healing effects of natural geological products including mineral waters, muds, moor, sands, and some minerals.

The geomagnetic field – generated in the liquid outer core, maintained by the geodynamo, and modulated by solar activity – permanently influences all living beings. Chapter 4 investigates the potential of geopsychology, which studies the impact of geophysical and geochemical variables on human behavior. The authors' emphasis is on the effects of geomagnetic activity on vascular events and brain function. Capabilities of the

geopsyche concept are exemplified by two field-scale case studies. The authors argue that the optimal creativity and adaptability of populations may require determination of the empirical congruence between the person's neurocognitive profile and the geophysical environment.

Part II consists of six chapters. Each chapter describes biotrophic effects of geogenic factors associated with a particular spatial scale. A sequence of chapters is arranged according to a range of scales: "field – city – region – continent – globe".

Plant domestication has given a strong impetus to the development of early agricultural societies. It is well known that such societies have commonly been located in regions of genetic and phenotypic intra- and interspecific variability of plants. Chapter 5 considers the impact of active faults on plant intrapopulation variability exemplified by blue honeysuckle. The authors found that the diversity of fruit shape and the occurrence of bitter-free fruits (a recessive trait important for domestication) are sharply increased within fault zones. These effects are probably associated with the influence of local seismicity (a chronic stressor), and a seismically induced groundwater-driven release of geochemical mutagenic agents within fault zones.

Chapter 6 probes into geological and geophysical factors influencing human health in the urban environment. The authors established statistically significant relationships between spatial distribution of cancer incidence rates in apartment buildings and zones of enhanced permeability of the crust, which comprise faults and areas of increased rock fracturing. Mechanisms of such adverse effects on human health may be connected with a disturbance of mitosis and cell development due to geomagnetic fluctuations within fault zones and a specific gaseous and geochemical regime associated with the deep-fluid degassing via faults.

Chapter 7 considers the impact of geological environment on the health of people living in seismically active regions. The author demonstrates that distinct geogenic agents influence human health at different temporal scales. At a long-term scale, prevalence rates of some diseases depend on the level of terrestrial γ radiation and the occurrence of intrusions, magnetic anomalies, and active faults. At a medium-term scale, an earthquake preparation process begins to influence incidence rates of certain nosologies 2–3 years ahead of the main shock. This effect is connected with a gradual change of a dynamic stress field, which results in increased fracturing, the rise of radon emission, and changes in the regional hydrogeological situation. At a short-term scale, an earthquake preparation process triggers geomagnetic fluctuations, which lead to an increase in emergency calls before the earthquake and during aftershocks.

Altered states of consciousness are a phenomenon, which have influenced and continue to influence the development of personality, culture, and civilization. Chapter 8 investigates the role of geophysical activity in the occurrence of mystical experience in particular places on the Earth's surface and subsequent sacralization of such places. It is suggested that the following complex of geogenic factors is necessary for place sacralization: regional and local active faults, local lithospheric magnetic anomalies, regional and local lithospheric stresses, and regional seismic activity. The author assumes the following cause and effect chain: There is increased permeability of the crust along faults. This creates conditions conducive to the occurrence of ore concentrations and magmatic bodies generating local magnetic anomalies. Geomagnetic storms modulate the intensity of the geomagnetic field at these anomalies. Before an earthquake, the rise of regional lithospheric stresses leads to electric currents. Propagating along faults, they also modulate the intensity of magnetic anomalies. Local fluctuations of the geomagnetic field influence the human brain and can lead to a mystical

experience. An analysis of the statistically representative regional sample of sacred places and geological and geophysical data lends credence to this hypothesis.

It is well known that natural processes – biological, climatic, and geological – are marked by cyclicity with periods ranging from seconds, minutes, and hours (e.g., physiological cycles) to hundreds, thousands, and millions of years (e.g., Milankovitch cycles). Interference between biological, climatic, and geological cycles may lead to regular results in the sociosphere. Chapter 9 examines this problem from a regional and continental perspective. The author presents a broad picture of the historical development of societies within the vast territory of the Alpine-Himalayan orogenic belt and the East European Platform during the Middle and Late Holocene. At a centennial scale, multiple-of-11-yr cyclicity is the most important among the short-period fluctuations of climatic and tectonic activity. These cycles influence the economic activity of the society. At a millennial scale, historical development – including the five key historical crises – displays a periodicity, which is largely in synchrony with the 1,200-yr cycle of climatic and endogenous activity. The author argues that although the crises were marked by social unrest, mass migrations, and political perturbations, they maintained the “sociodynamo”, offering new forms of economic and political relations. Such a conclusion is consistent with the Molchanov law: During the course of evolution, the ability to “survive” is unique to oscillating systems. “Stable” inflexible systems turn into inert parts of the environment, whereas unstable systems collapse (Molchanov, 1967). Synchronism of climatic and tectonic events in both short- and medium-term oscillations is possibly caused by the difference in the rotational velocity of the liquid outer core and the mantle, periodic changes in the Earth’s orbital parameters, and solar activity. Multiple-of-11-yr cycles correlate with the periodic changes in solar activity, whereas the 1,200-yr cycle is associated with the precession of the geomagnetic axis around the Earth’s rotational axis.

Finally, Chapter 10 discusses multiple impacts of the deep hydrogen degassing of the Earth on the bio- and anthroposphere. The process of inner core crystallization leads to the release of hydrogen, which is accumulated at the boundary of the liquid outer core and the mantle, and then diffuses outward to the Earth’s surface via rift and fault zones. The author demonstrates that the gas flow causes intensification of seismic and volcanic activity, decline of aerobic biota in the oceans, and ozone layer depletion. A surplus flux of ultraviolet-B, adversely affecting biota, reaches the Earth’s surface through the negative ozone anomalies. They also pass a surplus flux of infrared energy that leads to abnormal heating of local parts of the Earth’s surface. This increases frequency of regional extreme meteorological events, causes El Niño and general destabilization of the atmosphere and ocean. The author argues that the list of geological driving forces for speciation includes topographic barriers, millennial-scale climatic fluctuations caused by the precession of the geomagnetic axis, geomagnetic reversals and excursions, geochemical anomalies, seismicity, radon emission via faults, and ultraviolet radiation over the degassing centers.

The scientific intrigue of the book resides in the fact that most geogenic biotropic factors (except for gravity and radiation) are functions or manifestations of two “meta-agents”: the deep degassing of the Earth and the geomagnetic field. The deep degassing is responsible for seismic and volcanic activity, fluid migration and gas emission within fault zones, the occurrence of geochemical anomalies, and key atmospheric and climatic processes. The geomagnetic field manifests in lithospheric magnetic anomalies, geomagnetic storms, reversals, and excursions, and the precession of the geomagnetic axis. Both meta-agents are

generated by processes in the liquid outer core. These processes are probably mutually related to each other, and this problem invites further investigation.

This book demonstrates that the life of individuals, societies, and all of humanity is essentially regulated by geological forces in wide ranges of spatial and temporal scales. It is irrational to ignore this fact. I hope that this book will provide ‘*a further basis by disposing of certain inner obstacles which prevent many people from seeing themselves as part of the universe*’ (Lorenz, 1966, p. xiii).

REFERENCES

- Di Castri, F., Hadley, M. and Damlamian, J. (1981). MAB: The Man and the Biosphere Program as an evolving system. *Ambio*, 10, 52–57.
- Hirst, K.K. (2006). Will Durant on geological consent. In *About.com: Archaeology*, <http://archaeology.about.com/od/quotations/qt/quote84.htm>
- Lorenz, K. (1966). *On aggression*. London, UK: Methuen.
- Molchanov, A.M. (1967). Possible role of oscillating processes in evolution. In G.M. Frank (Ed.), *Oscillating processes in biological and chemical systems* (pp. 274–288). Moscow, USSR: Nauka (in Russian).
- Vernadsky, V.I. (1945). The biosphere and the noösphere. *American Scientist*, 33, 1–12.

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