MICHAEL D. DERMITZAKIS[1]

SCIENTIFIC TERMINOLOGY: THE CASE OF GEOLOGICAL TERMS

A FIRST APPROACH: THE WONDER OF LANGUAGE AND THE ROLE OF NEOLOGISMS IN SCIENCE AND EVERY DAY LIFE[2]

Every living language has the ability to adjust and enrich its vocabulary so as to meet evolutions in the scientific, technological and cultural field. We could consider, for example, all the changes brought by modern technology in the vocabularies of European languages since 1945. Before that date "transistor" and "cosmonaut" did not exist as words, whereas "nuclear disarmament" could scarcely make of any meaning.

Latin and Ancient Greek form a particular source of technical neologisms in European languages. English words like "Microbiology" and "dolichocephalic" were formed according to Greek morphological and lexical rules and not taken directly from Greek, since there are no records of *mikrobiologia* and *dolichokephalikos* in Ancient Greek. The long lasting, since the Renaissance, treatment of Greek and Latin as the languages of Western civilization explains, to a certain degree, the reason for their having been (and still being) used as source languages for the formation of new scientific and technological words.

Greek language, the oldest in Europe, with an oral tradition of over 4000 years and a written one of about 3500 years, has supplied European languages with hundreds of lexical (*macro-cosm, micro-cosm, meta-theory, poly-clinics*) and grammatical morphemes (*-gnosy: geognosy,-logy: geology, -philus: geophilus*) for the formation of new words.

In an attempt to show the influence of Greek on scientific language, I would like to quote a small passage from Xenophon Zolotas, former Governor of the Bank of Greece and former Prime Minister, famous speech delivered at the closing joint session of the International Monetary Fund (Washington, 26th September, 1957) which consists of only Greek words, apart from articles, pronouns and some functional words: «*Our critical problems such as the numismatic plethora generate some agony and melancholy. This phenomenon is characteristic of our epoch. But,*

---

1. University of Athens, Faculty of Geology & Geoenvironment, Dept. of Historical Geology-Paleontology, Panepistimiopolis 157 84, Athens, Greece

2. ΕΠΙΣΤΗΜΟΝΙΚΗ ΟΡΟΛΟΓΙΑ: Η ΠΕΡΙΠΤΩΣΗ ΤΩΝ ΓΕΩΛΟΓΙΚΩΝ ΟΡΩΝ. Πρώτη προσέγγιση: Το θαύμα της γλώσσας και ο ρόλος των νεολογισμών στην επιστήμη και στη καθημερινή ζωή.

to my thesis we have the dynamism to program therapeutic practices as a prophylaxis from chaos and catastrophe».

Loanwords are words borrowed from another language (the term *borrowing* is used to indicate the process). *Borrowing* is, obviously the result of *language contact*, when a native speaker of a certain language, communicating with a speaker of another, enriches his knowledge and experience with new things. This process is part of every language's history, except for those that are spoken by the members of a completely isolated community. "Tea" from Chinese, "coffee" from Arabic, and "tomato," "potato," and "tobacco" from American Indian are familiar examples of loanwords added to English vocabulary in order to name those new products.

Terminology (the term first appears in 1801) plays an important role in science and mutual understanding. The basic meanings of the word are: **1.** the technical or special terms used in business, art, science, or in a special subject, **2.** nomenclature as field of study. Standardization of terminology makes communication between scientists from different countries easier, so that misunderstandings arising from the use of the same terms but with different meanings can be avoided.

Taking into account the urgent need of a whole picture of the terminology used in Geology and relative sciences, I myself, with the collaboration of G. E. Theodorou, compiled a *Glossary of geological concepts with 40.000 entries in several foreign languages and in Modern Greek*, Athens 1994.

The Earth Sciences - Geological sciences

An introduction to geochemical and geophysical sciences logically begins with *mineralogy* since Earth's rocks are composed of minerals, inorganic elements or compounds which have a fixed chemical composition and are made up of regularly aligned rows of atoms. Today, one of the principal concerns of mineralogy is the chemical analysis of the about 3,000 known minerals which are the main constituents of the three different rock types: *sedimentary* (formed by diagenesis of sediments deposited by surface processes); *igneous* (crystallized from magmas either at the depth or at the surface with the form of lavas); *metamorphic* (formed by a re-crystallization process at temperatures and pressures in the Earth's crust high enough to destabilize the parent sedimentary origneous material). *Geochemistry* is the study of the composition of these different types of rocks.

Geomorphology is concerned with those surface processes that result in the creation of world's landscapes -namely, weathering and erosion.

Geologic history provides a conceptual framework and overview of Earth's evolution. An early development of the subject was *stratigraphy*, the study of the order and sequence in bedded sedimentary rocks. Today, *biostratigraphy* uses fossils to characterize successive intervals of geologic time, but as relatively precise time markers only to the beginning of the Cambrian Period, about 540,000,000 years ago. Geologic time scale, back to about 3,900,000,000 years for the oldest rocks, can be quantified by isotopic dating techniques. This constitutes the purpose of the

science of *geochronology*, which in recent years has revolutionized scientific perception of Earth history relying heavily on the measured parent-to-daughter ratio of radiogenic isotopes.

Paleontology < *palæo-, paleo-* + *-logy* is the study of fossils and it is concerned not only with their description and classification but also with the analysis of the evolution of the organisms involved[3]. Simple fossil forms can be found in early Precambrian rocks as old as 3,500,000,000 years. It is widely considered that life on Earth must have begun before the appearance of the oldest rocks. [palæontologic, -ical adjs., pertaining to palæontology; relating to extinct organisms; hence palæontologically adv., in relation to palæontology; palæontologist, one versed in palæontology. 1854 R. G. Latham Native Races Russian Emp. 199: *We get at it by that *palaeontologic line of reasoning which characterizes geology and archaeology*].

Several geologic disciplines benefit the society. Geologist's task is to discover Earth's main economic resources (i.e. minerals, oil, gas, and coal), to apply knowledge of subsurface structures and geologic conditions to the building industry and to prevent natural hazards or at least to provide early warning of their occurrence.

Astrogeology's importance lies on the understanding of Earth's development within the solar system.

Geology: Etymology, first appearance of the term and its meaning

Geology < med. L. geologia, from Gr. *geo-* + *-logy*. The med. Latin word was perhaps first used by Richard de Bury (14th c.) with the peculiar meaning 'science of earthly things', applied to the study of law as distinguished from the arts and sciences which are concerned with the works of God. In 1687 *Geologia* appears as the title of a work in Italian by F. Sessa, intended to prove that the 'influence' ascribed by astrologers to the stars, comes, in fact, from the earth itself. A work entitled *Geologia Norwegica*, containing a description of Hecla, is referred to in 1686 by Plot Staffordshire iii. 145; however, *Geology* with its present meaning, that is, indicating a distinct branch of physical science, first occurs in English]. Its basic meanings:

1. The science which treats of the earth in general. Obsolete. E. Warren (title) *Geologia: or, A Discourse concerning the Earth before the Deluge.*]
2. The science which has for its object the investigation of the earth's crust, of the strata which enter into its composition, with their mutual relations, and of the successive changes to which their present condition and positions are due. 1795 J. Hutton Theory Earth I. 216 *A person, who has formed his notions of geology from the vague opinion of others.*

3. All lexicographical references, citations and quotations are from the Oxford English Dictionary.

Cf. *Geologist* > *geolog-y* + *-ist*. One versed in geology; one who pursues geological investigations. First appearance of the word, 1795 J. Hutton Theory Earth I. 269 *The opinions of other geologists should be clearly stated.*

Geology is the scientific study of the Earth, including its composition, structure, physical properties, and history. The term geology is broadly inclusive and is often regarded as embracing all the geologic sciences.

Geology is commonly divided into a number of subdisciplines:

1. those concerned with the chemical makeup of the solid Earth, which include the study of minerals (*mineralogy*) and rocks (*petrology*);
2. those dealing with the structure of the solid Earth, as, for example, the study of the relationships of rocks and geologic features in general (*structural geology*) and the science of volcanic phenomena (*volcanology*);
3. those concerned with landforms and the processes that produce them (*geomorphology* and *glacial geology*);
4. those dealing with geologic history, including the study of fossils and the fossil record (*paleontology*), the development of sedimentary strata (*stratigraphy*), and the evolution of planetary bodies and their satellites (*astrogeology*); and
5. *economic geology* and its various branches--e.g., *mining geology* and *petroleum geology*. Some major fields closely related to *geology* are *geodesy*, *geophysics*, and *geochemistry*.

The various subdisciplines of geology are in continuous interaction not only with one another but also with other branches of the Earth sciences and with such fields as physics, chemistry, biology, and mathematics. *Paleontology*, for instance, requires at times the use of organic chemistry, physical chemistry, and statistics. Data analysis based on statistical methods is also an important facet of *geomorphology* and *stratigraphy*, as is the use of mathematical models too.

Besides providing a better understanding of the Earth's evolution and its present features, geology serves society in a variety of practical ways. The exploration of deposits of commercially valuable minerals is broadly guided by geologic principles and conducted with the use of geophysical and geochemical methods. Additionally, the search of fossil fuels (coal, oil, natural gas) is strongly influenced by aspects of geology dealing with the deposition and deformation of sedimentary rocks and with the flow of underground fluids. Worth mentioning is also the contribution of seismological research, whose findings have enabled engineers to design structures better able to withstand earthquakes.

Some of the main fields of Geology

Economic geology

Scientific discipline concerned with the distribution of mineral deposits, the economic considerations involved in their recovery and the assessment of the reserves available. Economic geology consists of several principal branches which include the study of ore deposits, petroleum geology, and the geology of nonmetallic deposits (petroleum not included), such as coal, stone, salt, gypsum, clay and sand, and other commercially valuable materials. A large number of geologists work in

that specific field. On worldwide basis, probably more than two-thirds of persons employed in geologic sciences are engaged in work that involves economic aspects of geology. Those include geologists whose main interests lie in diverse fields of the geologic sciences. For example, petroleum industry, which is collectively the largest employer of economic geologists, attracts individuals specialized in *stratigraphy, sedimentary petrology, structural geology, paleontology,* and *geophysics.*

Marine geology

Also called *Geologic Oceanography*, scientific discipline concerned with all the geological aspects of the continental shelves and slopes and the ocean basins.

Environmental geology

Geologic field concerned with the application of the findings of geologic research to the problems of land use and civil engineering. It is closely related to *urban geology* and is concerned with the impact of human activities on the physical environment (e.g., contamination of water resources by sewage and toxic chemical wastes).

Engineering geology

also called Geological engineering, scientific discipline concerned with the application of geological knowledge to engineering problems--e.g., to reservoir design and location, determination of slope stability for construction purposes and determination of earthquake, flood, or subsidence danger in areas destined for roads, pipelines or other engineering works.

Terms with the lexical morpheme geo-[4]:

geoblast

geobotanic, geobotanical; 1904 Pop. Sci. Monthly May 71 *The immense region on *geo-botanic maps has not the uniformity which one would be inclined to attribute to it.*

geobotany = phytogeography; 1904 Pop. Sci. Monthly May 68 (title) *The geology and *geo-botany of Asia.*

geobotanist; 1901 U.S. Dept. Agric. Bur. Plant Industry Bull. III. 18 *The most thorough investigations have been given to the Chernozem soils by Russian *geo-botanists.*

geochronic, of or pertaining to geological time.

geochronometry, (a) an extension of geometry conceived as taking time into account as the fourth dimension; the 'geometry' of space-time; (b) absolute geochronology, in which events are assigned (approximate) dates in relation to the present instead of to other events; 1923 C. D. Broad Sci. Thought xii.

4. Some of the words cited do not belong to the geological terminology

457 *A sense-history and the physical world are both four-dimensional spatio-temporal wholes, and we must therefore talk of their *geo-chronometry rather than their geometry.*

geocratic: (a) applied to earth-movements which reduce the area of the earth's surface covered by water: opp. hydrocratic a.; (b) of or pertaining to the predominant influence of the natural environment on man; 1898 Geogr. Jrnl. Feb. 133 *Hydrocratic and *geocratic movements alternated during Jurassic times.*

geodynamic, of or pertaining to the (latent) forces of the earth; 1885 Harper's Mag. Feb. 494/1 *The Central *Geodynamic Observatory at Rome.*

geodynamics, the study of geodynamic forces; 1885 Nature 22 Oct. 609/2 *Full scope was given to seismology, vulcanology, and *geodynamics.* Cf. 1887 G. H. Darwin in Fortn. Rev. Feb. 271 *A *Geodynamical Observatory'.*

geogenous, (said of certain fungi) growing or springing directly from the ground;

geoisotherm, an underground isotherm;

geomorphogeny, the science dealing with the genesis of the physical features of the earth's surface; 1894 A. C. Lawson in Univ. Calif. Bull. Dept. Geol. I. viii. 241 (title) *The *geomorphogeny of the coast of Northern California.*

geomorphogenic, geomorphogenist; 1896 Nature 18 June 147/1 *After the *geomorphogenic introduction, two lessons are given to geological principles.* 1904 Amer. Geologist Mar. 159 *Very few of the *geomorphogenists have carried their new science forward into a geographical relation.*

geonomy, the science of the physical laws relating to the earth, including geology and physical geography' (Ogilvie 1882); hence geonomic; 1854 Mayne Expos. Lex., Geonomia, *geonomy.

geophysiognomy, 1896 Pop. Sci. Monthly Apr. 819 *The significance of landscape contours or *geophysiognomy.*

geoplanarian, one who believes the earth to be flat, a flat-earther'; 1930 Proc. Arist. Soc. XXX. 114, *I am thinking, say, of the earth as flat, as when I want to refute a geoplanarian.*

geopotential, the work that must be done against gravity to raise unit mass to a given point from sea level; 1914 V. Bjerknes in Q. Jrnl. Meteorol. Soc. XL. 161 *It should be borne in mind that in dynamical meteorology gravity-potential (or *geopotential as it is now proposed to call it) has to be used as a co-ordinate.*

geoselenic, relating to the earth and the moon; 1860 Worcester, *Geoselenic.

geosphere, any of the more or less spherical concentric regions that together constitute the earth and its atmosphere; 1898 W. J. McGee in Nat. Geogr. Mag. IX. 436 *The atmosphere is one of the *geospheres, the outermost of the four.*

geostatic, [causing to stand], only in geostatic arch, an arch of a construction suited to bear the pressure of earth (Ogilvie 1882);

geostatics pl., 'the statics of rigid bodies' (Cent. Dict.);

geostationary, of, pertaining to, or designating an artificial satellite that revolves round the earth in one day and hence remains above a fixed 'point on the earth's surface; 1961 Aeroplane CI. 16/2 *Raising a communication satellite from a low-circular orbit into a *geostationary orbit at 22,300 miles.*

geostrategy, strategy as applied to the problems of geo-politics, global strategy'; hence geostrategic(al) adjs.; 1944 G. B. Cressey Asia's Lands & Peoples ii. 32 *The function of *geostrategy is to understand a nation's problems and potential and to suggest a program of internal development and international cooperation that will be of mutual value.* 1958 New Statesman 26 Apr. 517/1 *Pearl Harbour, indeed, provides the point of departure for American geostrategy.*

geotechnic, of or pertaining to geotechnics; 1914 Geddes & Thomson Sex x. 241 *Our aims are not only synthetic, as men-philosophers say, but applied---that is *geotechnic, as with practical women, who, as the anthropologists confess, had the first word in cultivation.*

geotechnics, the art of modifying and adapting the physical nature of the earth to the needs of man;

geotechnology, 'the application of scientific methods and engineering techniques to the exploitation and utilization of natural resources (as mineral resources)' (Webster 1961); 1942 Sci. News Let. 12 Dec. 370 *A new word, _*geotechnology', has been coined to include all the mineral arts and sciences from metallurgy to ceramics.*

geotectonic, of or pertaining to the structure of the earth; structural; 1882 Geikie Text-bk. Geol. iv. 474 **Geotectonic (Structural) Geology, or the architecture of the earth's crust.*

geotectonical; 1881 Nature XXIV. 363 *The study of the *geotectonical conditions of the localities where they [earthquakes] occur.*

geothermal, of or pertaining to the internal heat of the earth; 1875 J. H. Bennet Winter Medit. i. i. 13 *The peculiar mildness of the winter may also be partly accounted for on *geothermal grounds.*

geothermic, 1882 Ogilvie, *Geothermic.

geothermometer, 1855 Ibid. Suppl., **Geothermometer, an instrument for measuring the degree of terrestrial heat at different places, especially in mines and artesian wells.*

Some terms with the morpheme *geo-* with their equivalent in Modern Greek

geanticline - γεωαντίκλινο
geoanticline - γεωαντίκλινο
geoastronomy - γεωαστρονομία
geobiology- γεωβιολογία
geobiont - εδαφόβιος οργανισμός
geobotany - γεωβοτανική
geochemical Classification - γεωχημική ταξινόμηση
geochemical Cycle - γεωχημικός κύκλος
geochemistry - γεωχημεία

geochronologic interval - γεωχρονολογική ενότητα
geochronologic unit - γεωχρονολογία
geocratic - γεωκρατική περίοδος
geodesy - γεωδαισία
geogenesis - γεωγένεση
geognosy - γεωγνωσία
geogony - γεωγονία
geographic - γεωγραφικός
geographical barrier - γεωγραφικός φραγμός
geographic distribution - γεωγραφική κατανομή
geography - γεωγραφία
geography mathematic - μαθηματική γεωγραφία
geohydrology - γεωυδρολογία
geoid - γεωειδές
geoidal horizon - γεωειδής ορίζων
geological column - γεωλογική στήλη
geological importance of climate - γεωλογική σημασία του κλίματος
geological thermometer - γεωλογικό θερμόμετρο
geology dynamic - δυναμική γεωλογία
geology mathematic - μαθηματική γεωλογία
geomagnetism - γεωμαγνητισμός
geomechanical - γεωμηχανική
geophilous - γεώφιλος
geophysical Log - γεωφυσική κατάσταση
geophytes - γεώφυτα
geosphere - γεώσφαιρα
geosynclinal - γεωσυγκλινές
geosyncline - γεωσύγκλινο
geotactism - γεωτακτισμός
geotaxis - γεωτακτισμός
geotectonic zones of Greece - γεωτεκτονικές ζώνες της Ελλάδας
geotectonics -γεωτεκτονική
geothermal energy - γεωθερμική ενέργεια
geotropic - γεωτροπικός
geotropism – γεωτροπισμός

REFERENCES

A.C.S.N.: American Commission on Stratigraphic Nomenclature (1967) - Records of the Stratigraphic Commission for 1964-1966. *American Association of Petroleum Geologists, Bulletin*, v. 51, p. 1862-1868 (Its note 34), Tulsa.

AMERICAN GEOLOGICAL INSTITUTE (1957): Glossary of Geology and Related Sciences (prepared by the *Glossary Review Committee, Chairman J. M. Weller*). Washington D.C. (cum lit.).

ARNTZ R., PICHT H. & F. MAYER (2002): *Einführung in die Terminologiearbeit.* 4th edition, Hildesheim: Georg Olms Verlag.

DERMITZAKIS M.D. (1976): *Vocabulary of Paleontological terms about Foraminifera.* pp. 96, Athens.

DERMITZAKIS M.D. (1976): *Guide for the Classification and Nomenclature of the Fossils.* Editions of the Department of Geology and Paleontology, Athens University, series A, No 8, ps.37, Athens.

DERMITZAKIS M.D. (1979): The geochronological units. *Geologos*, fasc. 1, p.12-15, Athens.

DERMITZAKIS M.D. (1979): Code of Greek stratigraphic nomenclature and Glossary of Useful Stratigraphic terms. *Bulletin de la Societe Speleologique de la Grece*, vol. XIV, fasc. 2, p.127-146, Athens.

DERMITZAKIS M.D. & S. LEKKAS (1982): *Understanding the Earth - Introduction to General Geology*. ps. 596, Athens.

DERMITZAKIS M.D. (1983): *Guide for the classification and nomenclature of the Fossils.* ps. 112, Athens.

DERMITZAKIS M.D. (1985): *Contribution to the Nomenclature of Stratigraphical, Paleontological and Paleoecological Terms: Glossary of selected Geological Concepts*, ps.420, Athens. (in coll. with G. Theodorou).

DERMITZAKIS M.D. (1987): *Basic rules and terms of Stratigraphic classification.* Editions of Athens University, ps. 94, Athens.

DERMITZAKIS M.D. (1994): *Glossary of Geological concepts.* Edit. of the University of Athens, ps. 1096, Athens (in coll. with G.Theodorou).

WEISLER, S.E. & S. MILEKIC (2000): *Theory of Language.* The MIT Press, ps. 344, Cambridge, Massachusetts.