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Overview paper

# CENTENARY ANNIVERSARY OF THE THEORY OF CONTINENTAL DRIFT BY ALFRED WEGENER AND ITS SIGNIFICANCE FOR GEOSCIENCES AND THE HUMAN SOCIETY

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On January 6, 1912 at the Senckenberg Museum in Frankfurt on Main, a completely new concept of the origin of the Earth's continents was presented to the scientific community. It was a very brave speech by the German meteorologist and polar explorer Alfred Wegener at the session of the geologists association and news of it spread quickly first through Germany, later the rest of the Europe, and finally worldwide. However, like some other revolutionary ideas, the controversial notion was almost completely rejected. It needed half a century and the development of science, techniques and new methods for his idea to be accepted. Today, the concept of continental drift by Alfred Wegener represents one of the most important cornerstones of the theory of plate tectonics, a widely accepted model of the origin of continents and oceans. Additionally, it provoked and initiated the development of many other disciplines, primarily in the field of geosciences, and strongly influenced the overall development of human society in the second half of the twentieth century.

**Key words:** Alfred Wegener, continental drift, sea floor spreading, plate tectonics, geosciences, human society

## INTRODUCTION

In the history of human society, there are well-known examples of educated people whose appearance and very intriguing ideas and theories have shaken or even completely disturbed the scientific community of their time. And the epilogue was invariably the same: conservative science managed to reject the idea. Furthermore, sometimes in addition to scientific defeat, these founders even lost their own lives. But the development of civilization, science and technology cannot be stopped, so after a long time such ideas and theories become fully recognized: consider the examples of Nicholas Copernicus, Leonardo da Vinci, Giordano Bruno, Galileo Galilei, Milutin Milanković and others during the last five centuries.

The similar story shares the creator of **the theory of continental drift**, German meteorologist and polar explorer, geophysicist and climatologist Alfred Wegener (Wegener Alfred Lothar, 1880-1930). The theory of continental drift (German "*Kontinentalverschiebung*") was first presented orally on January, 6 1912 at the session of the Geological Association of Senckenberg Museum (Frankfurt am Main, Germany). Subsequently, three articles were published in the journal *Petermanns Geographischen Mitteilungen* (Fluegel 1980, Jacoby 1981). Although Wegener's ideas found few supporters in the realm of official science of that time, he was not discouraged and adapted his theory in the book "*Die Entstehung und der Continent Ozean*" ("The Origin of Continents and Oceans"), published for the first time in 1915 (Wegener 1915) and followed in the next fifteen years by four modified and revised editions (Wegener 1966).

The essence of his idea of the continental drift is that the continents are slowly moving ("floating") through the Earth's mantle. The rock formations, their origin and stratigraphic range, as well as fossils found in some continents strongly support such a model. Wegener thought that in the geological past (200 million years ago) all the continents were joined in a giant supercontinent named Pangaea ("all Earth"). Afterwards, during the younger geological evolution of our planet, it was split into the existing continents. In fact, the deficiency in his theory was that he did not-and could not-know how to explain the mechanisms of this movement (no one else could explain it either - Jacoby 1981). Therefore, he was too easily understood and his ideas almost completely discarded. The world of official science and geologists in particular regarded him contemptuously as an ignorant non-geologist.

However, almost half a century later, with the advent of new methods and knowledge (sea floor spreading) and the discovery of paleomagnetism (1950), this concept was fully revived and fully accepted, upgraded and improved. The model of the motion of large planetary plates (continental and oceanic) gave birth to **the theory of plate tectonics**. Acceptance of this theory over the last 50 years has radically changed scientific knowledge about the mechanisms and types of movements that have led to global changes on the Earth (climate change, melting glaciers, creating a system of mountain, ocean circulation, earthquakes, volcanoes and other geological phenomena). Therefore, together with Milutin Milanković, Wegener founded roots of some new scientific disciplines and made a huge contribution to the development of geosciences and the entire human society in the last 100 years.

## GEOSCIENCES AT THE BEGINNING OF THE 20TH CENTURY

In the first decades of the twentieth century, research in the field of science and particularly in the geosciences was marked by interruptions brought about by World War I and the subsequent rapid development that ensued after peace was attained in 1918. In such a milieu, in the area of Western Europe and Russia a wide front of research was opened. This was especially true for the Earth-research projects and the search for mineral resources as the entire continent after World War I was exhausted and "used up" in terms of mineral and energy reserves (e. g. coal seams, gold reserves, the metal industry and others). So, it was necessary for some major economies, particularly Germany, who had lost the war, to recover as much as possible and cover losses as soon as possible. At that time, many research projects have been initiated, for example marine research, both in Germany and in other countries and regions of the world.

At the beginning of the twentieth century, generally two main schools existed among geoscientists, most of whom were geologists. One clung to the traditional ideas of James Hutton and Charles Lyell, and the other was devoted to understanding Abraham Werner, Georges Cuvier and Eduard Suess. But none of them could provide satisfactory explanations of some key dilemmas of geology at that time. First, there was no agreement concerning the formation of mountain systems, in particular the Alps, which were the most studied by European geologists. Secondly, shapes of the coast on the opposite sides of many oceans (e.g. convex coast of Brazil to the concave coast of West Africa) were intriguing. Thirdly, there was no adequate explanation for the strong similarities in the rock complex located on opposite shores of the ocean. Rock studies on the east coast of South America as well as on the west coast of Africa pointed to the similarity of the rocks and the resemblances between their similar (same?) geological histories over the past 200 million years. Occurrences of paleoglaciation and an ancient volcanism were similar on both continents. And finally, most geologists were unable to explain the similarities between the fossil remains of the continents (e.g. small reptiles such as *Mesosaurus*, extinct plant genus *Glossopteris* in coal seams of South America, South Africa, Australia, Madagascar, India, Antarctica, etc.). In addition, there was an opinion that the continents were at rest ("fixism") and that these similarities were caused by migration via land bridges that once existed between the continents. So, there were insufficient acceptable answers to such questions and insufficient viable theory to explain these phenomena.

## SHORT BIOGRAPHY

Alfred Wegener was born in Berlin, on November 1, 1880. He graduated high school at the top of his class and later studied physics, meteorology, and astronomy in Berlin, Heidelberg and Innsbruck. During his studies, Wegener worked as an assistant in an astronomical observatory, and pursued his doctorate in astronomy. He defended his PhD thesis in 1905 at the Friedrich Wilhelm University (now the Humboldt University in Berlin). He had always had a strong interest in meteorology and climatology, and it became his main preoccupation. Soon he was employed at the Lindenberg's aeronautic observatory where his older brother Kurt was already working as a meteorologist and polar explorer; together they began to research the movement of air masses in special balloons. In the same year, Alfred Wegener participated in his first expedition to Greenland, which completely changed his life and career. During this expedition, he designed the first weather station and measured the parameters of the arctic climate. He returned to Germany two years later where, until the beginning of the war, he was professor of Astronomy and Space Physics at the University of Marburg. There he wrote the first textbook in meteorology *Thermodynamik der Atmosphäre* (1909) which was based on data collected over a number of polar expeditions.

Wegener introduced his concept of a continental drift in a very provocative lecture entitled "*Die Heraushebung der Großformen der Erdrinde (Kontinente und Ozeane) auf geophysikalischer Grundlage*" (The uprising of large features of the Earth's crust (Continents and Oceans) on a geophysical basis) on January 6$^{th}$ 1912 to a session of the Geological Association in Senckenberg Museum, Frankfurt am Main. For the first time, he proclaimed the hypothesis of an ancient supercontinent called *Pangaea*, from which all the modern continents split. However, time was too short for further discussion as another expedition took him away from 1912-1913 to collect more data on the state of the ice sheets, weather conditions and the movement of air masses.

Upon returning home, he married Elsa, the daughter of his former teacher and mentor Vladimir Kepen. They lived in Marburg where Wegener started a university career as a teacher. As a reserve infantry officer, he was immediately called at the beginning of the war in 1914 and spent a lot of time on the Western Front, and in the Balkans and the Baltic as part of a military weather service. Nonetheless in 1915 he had already, completed the first version of his main paper entitled *Die Entstehung und der Kontinente und Ozeane* ("The Origin of Continents and Oceans"). After the war, Wegener was employed in the German Naval Observatory (*Deutsche Seewarte*) and in 1921 he and his family moved to Hamburg to the chair of the University of Hamburg. During these years, together with his father in-law Vladimir Kepen he published the book entitled *Die Klimate der geologischen Vorzeit* ("The climate from the geological past"). The third, completely revised English edition of his book *Die Entstehung der Kontinente und Ozeane* was published in 1924 (Oreskes 1999). It was then that disputes about his theory began, first in Germany and later elsewhere. Generally, experts offered negative reviews. In 1924 he moved to Graz, where he was appointed to the University as a Professor of meteorology and geophysics. In November 1926, he presented his theory at the Symposium of the Association of American Petroleum Geologists in New York, and was criticized by the American geologists again. Finally, the fourth and expanded edition of his book was out of print in 1929.

Wegener's fourth and the last expedition to Greenland took place in 1930. He led the team of 14 in order to set up a permanent station for measuring the thickness of Greenland ice and felt responsible for the success of the expedition that cost the German government more than a million dollars. But the success of the expedition primarily depended on weather conditions; while returning from a rescue mission that brought food to a party of his colleagues camped in the middle of the Greenland Ice cap, Wegener died, few days after his fiftieth birthday. His body was discovered under the ice one year later (May 12$^{th}$ 1931) and Wegener's followers re-buried his remains in an area that has been renamed the Wegener Peninsula in his memory. The precise location of his grave has been lost, as it was not marked well enough to survive the accumulation of ice.

## THE THEORY OF CONTINENTAL DRIFT

A long time before Wegener pieced together the hypothesis of continental drift, some geographers and philosophers had recognized that the coasts of Africa and South America snugly fit together like a child's jigsaw puzzle. As early as 1596 the geographer Abraham Ortelius suggested that the Americas were once conjoined with Europe and Asia, but later separated by earthquakes. Recently, historians of science have uncovered nascent hints of continental drift in the works of Francis Bacon, and Comte de Buffon. But it was the genius of Wegener that assembled widely divergent lines of evidence into the first coherent model of continental motion. He promoted the idea that in the geological past the continental areas of the Earth could have made one large supercontinent, which he called Pangaea (about 200 million years ago). What led him to this opinion? First of all, the continental outlines that merge a single continental mass may fit very well into each other. Coastal margins in America are well-matched with the margins of the continents of Africa, Europe, Antarctica, Australia, India and Madagascar. His theory was based on four main elements: the appearance and contour coastline of South America and Africa, similar rock formations on both continents, similar fossils found in these rocks, and the position of the old glaciers on both continents (Fluegel 1980, Oreskes 1999). These were the basic elements of Wegener's studies from which he seemed to draw conclusions about the existence of Pangaea.

Initially, Pangaea was broken into two large continental blocks: the Gondwana (all of today's southern continents and India) and the Laurasia (North America and Eurasia). Later, Mesozoic and Cenozoic "division" and changing of these great continents in both hemispheres led to their present form. He noticed a very strong likeness between fossil plants on both continents, and this was one of the main pieces of evidence. In addition, the position, composition and appearance of old glaciers (tillites, glacial tracks) clearly indicated to him that the material was derived from a single ice sheet that covered the former supercontinent (Chander 1999). Moreover, the distribution of coral reefs pointed to the position of the warm seas near the equator. Furthermore, he argued that there are gender migrations over time caused by continental drift. He believed that the continents are movable and that the oceanic crust is inactive. However, Wegener could not explain the forces required to move the continents through the crust. He imagined the continents like gigantic ice sheets swimming on and surrounded by the much denser oceanic crust. He proposed gravitational pull, tidal and centrifugal forces, but the English geophysicist Harold Jeffreys demonstrated that either these forces are too weak or, if strong enough, had to stop Earth's rotation. Wegener himself reacted to the critics and tried to respond in various editions of his books. He had moderate success. The greatest problem remained the lack of direct evidence for the movements of continents and the desired explanation for the mechanism and the immense energy supply. Most importantly Wegener considered his work as a starting point and stimulus for other or even future scientists, a message that wasn't fully understood at the time.

It remained misunderstood until a half of century later, when the appearance of plate tectonics enabled these mechanisms to be explained. Newly discovered methods and procedures such as the mapping of the ocean floor, the morphology and position of the oceanic ridge, and paleomagnetism additionally supported it. Today, satellite and GPS navigation allows very precise measurements (e.g. the plate-movement of several millimeters per year).

## THE INFLUENCE OF CONTINENTAL DRIFT IDEAS ON THE THEORY OF PLATE TECTONICS

At the time when this theory appeared, it was almost mercilessly rejected by the official scientific community. It seems the biggest problem was that it originated from someone who was not a geologist, but the main reason for rejecting the idea was that Wegener thought that the continents "float" through the oceanic crust following the mechanism provoked by the centrifugal force, gravity and the Earth's rotation. Such a mechanism was the object of review and several experiments showed it to be insufficient to move continents (Rolf *et al.* 2012). Because the elite were not ready to accept this new theory, everything else was, logically, unworthy as well (Wegener's theory is popularly known as "mobilism", while the opposite is "fixism"). American geologists were united in their opposition to his theory and simply declared it as "unscientific". The theory was so revolutionary that it impinged on the fundamental postulates and standards of American geology and undermined the entire basis of U.S. traditional sciences (Oreskes 1999). Until the end of World War II, this idea was formally rejected by geologists, physicists and geophysicists. However, there were individuals who continued to advocate this idea (e.g. Alexander Du Toit of South Africa, Arthur Holmes in England).

The real confirmation and the reaffirmation of the whole theory occurred by the late 1950's when ocean research expanded (Chander 1999). Although the explanation of the mechanism of movement of the continents was unconvincing, it was impossible to ignore all the other evidence. When the ocean research showed that there is a margin of the continental slope, the movement of continents became quite certain. It is compared to the shoreline as the edge of the continents, an even better match when compared to Africa and South America. Similarly, it was confirmed by the example of glacial tracks and their same orientation in both Africa and America. The re-joining of these continents would lead these glacial marks to match perfectly. However, the turning point occurred when Harry Hess, an American geologist and professor at Princeton University, published the theory of seafloor spreading (Hess 1962). In fact, as a captain of a U.S. ship with sonar technology during World War II, Hess spent a lot of time in the Pacific. As a geologist, he used sonar to record very carefully routes through the northern Pacific, measure the topography of the sea-floor and draw underwater profiles, volcanoes and plateaus. After the war, he worked on research projects and on the mapping of the ocean floor. He determined the areas in the ocean where there is an expansion and lateral movement of the Earth's crust in the ocean as significant and comparable to elongated ridges (Fig. 1). His teachings and understanding of underwater structure and the morphology of the ocean floor, known as sea floor spreading, was the springboard for a new beginning of the theory of continental drift. This moment marked a revolution in the Earth sciences. New data on magnetic fields in the rocks of the ocean floor confirmed that the strength and direction of the fields followed striped patterns that are the same on both sides of the oceanic ridges. Later research directly dated the rock of the sea-floor, and found that the absolute ages were also symmetrical around the ridges, and that rocks become older with increasing distance from the virtual spreading center. From these ideas, the theory of the plate tectonics was finally developed. Today, the concept of the mobility of tectonic plates as well as the mechanisms by which continents are currently moving is accepted worldwide.

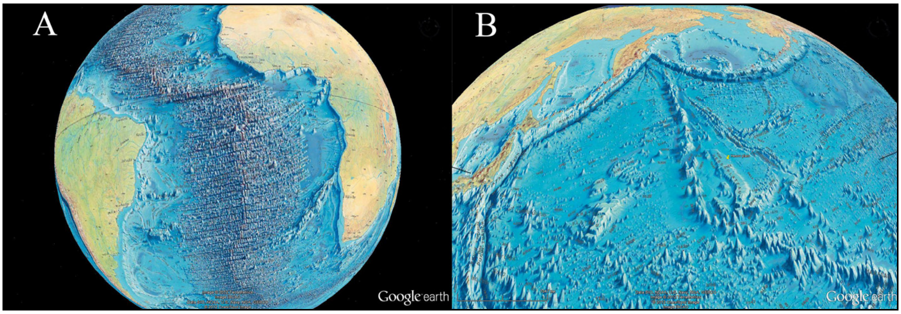


Fig. 1. - A. The Middle-Atlantic Ridge, the zone of rifting and the creation of new oceanic crust; B. The North Pacific and underwater volcanoes and plateaus (Old maps of oceanic floor by Marie Tharp, Google Earth 2012).

One of the cornerstones of modern geology is a model of plate movements called **the theory of plate tectonics**. It was concluded that the Earth's crust (lithosphere) is "separated" on tectonic plates, the continental and the oceanic, which float over the semi-fluidal asthenosphere (the upper part of the Earth's mantle). In total, there are some 20 distinct plates, eight major plates and a large number of small plates (Eurasian, Indo-Australian, Philippine, Pacific, Cocos, Nazca, Caribbean, North American, South American, Arabian, African, Antarctic, etc.). They are rigid but deformable at their margins. Contacts between them are different. When two plates meet, one of three basic interactions may occur: they can move away from each other, move toward each other, or slide by each other. When the plates move away from each other (divergent boundary), then sea-floor spreading takes place and a new oceanic crust forms. This type of contact is essentially constructive and involves the formation of new structural forms. For example, the divergence on the continental plate leads to formation of the rift valley (e.g. the East African Rift). Very active areas of ocean ridges are places where the relationship between oceanic plates is very divergent (e.g. the Middle-Atlantic Ridge, see Fig. 1A). When the plates move toward each other (convergent boundary), the result is more complicated. If denser oceanic crust meets lighter continental crust, it will subduct beneath the continent giving rise to volcanism. Subduction leads to breakage and the destruction of a part of the lithosphere, which is sinking into the Earth's mantle. For example, the collision of the Indian and Eurasian plates, both continental plates, took place 70 million years ago and initiated the formation of the Himalayas. It is similar to the Andes in South America (Fig. 2A). In the Pacific, the famous "Ring of Fire" (volcanic range) is the result of collision. Finally, when two plates slide past each other (transform boundary), earthquakes frequently occur, as manifested by the San Andreas Fault of California. These are usually horizontal (left or right) movements that are very active in the areas of ocean ridges and on the mainland. While these movements in the middle-ocean ridges are very deep and almost invisible, on land or at the edges of tectonic plates they are very strong, visible and destructive. For example, the Pacific Plate is moving northwest relative to the North American Plate at a rate of 45 *mm*/year (Fig. 2B).

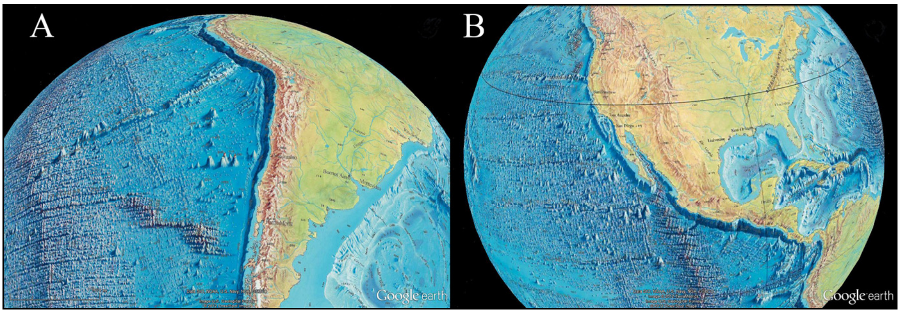


Fig. 2. - A. The collision between the Nacza Plate and the South American Plate resulted in the building of the Andes; B. Transform contact between the Pacific Plate and the North American Plate created a very active rupture zone along the Pacific coast of the North America (Old maps the ocean floor by Marie Tharp, Google Earth 2012).

Each tectonic plate is made of oceanic crust and of the significantly thicker continental crust. The plate, in its final, highest part has its own "crust". The average thickness of the oceanic crust is about 10 *km*, the continental crust between 20-80 *km*. The thickness of the entire plate is 50-

-250 *km*. Chemically, continental crust is much lighter than the oceanic, but both of them "float" above the Earth's mantle. Oceanic crust is much younger and is produced in the areas of oceanic ridges. Plates move in both the horizontal and in the vertical direction at different speeds (from 1 to 15 *cm* per year). Which mechanism has driven plates? What was it that Wegener could not explain? Plates move because the lithosphere is stronger and less dense than the asthenosphere that lies beneath it. They constitute the outer layer of the Earth. In the upper part of the Earth's mantle, there are lateral differences in the density that led to convection currents which are transmitted through the asthenosphere and which represent the main driver of moving plates. The convection is more intensive if the difference in the density of material as well as the temperature is larger (Milovanović & Boev 2001). The modern, three-dimensional display of the Earth's interior using seismic tomography showed that there is difference in the density within the Earth's mantle. It depends, for example, on different mineral composition and different thermal energy. So, whether the thrust forces in the Earth's mantle through the convection currents may directly or indirectly affect the movement of plates and how they are conveyed in the lithosphere is still the subject of research (Torsvik *et al.* 2010, Rolf *et al.* 2012). Today, however, it is believed that forces such as friction and gravity also affect the plate movements. The friction mechanism involves the relationship between the convection currents in the asthenosphere and the quite rigid lithosphere, which floats above. Gravity is related to the collapse of slab in subducted zones and "falls" in the Earth's mantle and thus supports the process of convection. All these processes and the search for the real causes of the movement of tectonic plates are the subject of modern science and numerous projects across the planet.

Today, 50 years after the occurrence of a generally accepted concept of the plate tectonics (originally called the new global tectonics) and 100 years after the revolutionary ideas of Alfred Wegener, many consider him the founder of the modern theory of plate's movement. Many phenomena and terms that are used today within modern geology are mentioned by Wegener much earlier (spacing between the ocean floor, the functional dependence of bathymetry and age and temperature below the ocean floor, convection, etc.). He was led by his intuition and discernment, but he knew to draw the line between fact and speculation (Jacoby 1981). Plate tectonics was a result of the above-mentioned events and of the fact that many of the scientific disciplines and methods began to establish and develop in this period (meteorology, paleomagnetism, petrology of underwater rocks, volcanism of the ocean's floor, seismic stratigraphy, paleogeography, the ocean floor mapping, biogeography, isotope geochronology, paleoclimatology, cyclostratigraphy and many others).

## THE IMPORTANCE OF THE THEORY OF CONTINENTAL DRIFT TO THE DEVELOPMENT OF HUMAN SOCIETY

Opposed to the standard stereotype and learning of that time, the emergence of the theory of continental drift opened the door to new ideas that, although delayed, made a real turnaround not only in geology but also in other sciences. It was a revolutionary step, the same that brought Darwinism and the theory of evolution in biology a century earlier. In his relatively short life, Wegener experienced embarrassment and rejection of ideas. But he always tried to supplement established learning with his own observations and field measurements. This has established one of the basic tenets of modern science and has suggested that not only are facts important but so too are the charisma and intuition of each researcher.

During his life, Wegener was lucky to collaborate with many renowned scholars and people of that time. For example, he was a good friend of Milutin Milanković, who was one year older. From him he discovered mathematical and astronomical confirmation of the theory of Ice Ages in Europe where, in contrast to other continents, traces of Paleozoic glaciations are lacking. After meticulous investigations for about 5 years, Milanković found affirmative answers. The rotary axis and both poles did not change their position although the continents were moving. In the geological past, during the Carboniferous, the Earth's equator was dislocated to Europe, so circumstances favorable to the occurrence of Ice Ages were not possible there. On the other hand, Wegener and Kepen's joint paper entitled "Climate of the geological past", published in 1924 served as the basis for the astronomical theory of climate fluctuation by Milanković and announced the Milanković insolation curve.

What has developed from the seed which was planted in 1912? Today, it is hard to fully detect. Certainly many contemporary hypotheses about the Earth and its evolution over a long geological time, tectonic cycles of consolidating and separating the continents and oceans, organic evolution of plant and animal species including the human evolution have historical and scientific roots in Wegener's idea. From all of this, as part of the progress over the past 100 years, many scientific disciplines, methods and techniques were developed. Without that, the progress of our civilization would be completely different - climatic fluctuations, melting glaciers, weakening of the ozone layer, prediction of weather phenomena and their genesis, earthquakes, volcanoes and other forms of geohazards, ocean's circulation, tsunami - all these natural phenomena are now better analyzed thanks to the scientific background provided by the idea of continental drift.

An undoubtedly great contribution to the development of human society has been the idea that the continents are not "fixed" but are in fact very mobile and move around according to the scenario signed by the powerful endogenous forces from the Earth's interior. Those who continue to explore the Earth, especially geologists, will be witnesses to numerous scientific discoveries, new methods and disciplines that will appear in the future. The questions are: how deep within them will be the background of the continental drift and how great was the work of Alfred Wegener? Today, numerous awards and medals bear his name. A crater on the Moon and one on Mars, an asteroid and a peninsula in Greenland (where he died) were named after him. On the centenary of his birth (1980), the Institute for Polar and Marine Research was established in Bremerhaven (Germany) and named after Alfred Wegener. A fund of the European Geophysical Union and one of its most valuable prizes are dedicated to him.

## REFERENCES

Chander, R. (1999): Wegener and his Theory of Continental Drift. **- Resonance**: 24-41.

Fluegel, von Helmut W. (1980): Wegener – Ampferer – Schwinner Eine Beitrag zur Geschichte der Geologie in Ostereisch. **- Mitteilungen der Osterreichischen. Geologischen Gesellschaft 73**: 237-254.

Hess, H. (1962): History of Ocean Basins. In: A. E. J. Engel, Harold L. James, and B. F. Leonard (*ed.*): Petrologic studies: a volume in honor of A. F. Buddington, Boulder, CO.: 599-620. – Geological Society of America, New York.

Jacoby, W. R (1981): Modern concepts of Earth dynamics anticipated by Alfred Wegener in 1912. **- Geology 9**: 25-27.

Milovanović, D., Boev B. (2001): Zemlja, Tektonika ploča i magmatizam: 1-174. – Nauka, Beograd. [In Serbian]

Oreskes, N. (1999): The Rejection of Continental Drift: Theory and Method in American Earth Science: 1-432. – Oxford University Press, New York & Oxford.

Rolf, T., Coltice N., Tackley P. J. (2012): Linking continental drift, plate tectonics and the thermal state of the Earth's mantle. **- Earth and Planetary Science Letters 351-352**: 134-146.

Torsvik, T., Steinberger, B., Gurnis, M., Gaina, C. (2010): Plate tectonics and net lithosphere rotation over the past 150 My. **- Earth and Planetary Science Letters 291**: 106-112.

Wegener, A. (1915): Die Entstehung der Kontinente und Ozeane. [In: Sammlung Vieweg, 23]. – Friedr. Vieweg & Sohn, Braunschweig.

Wegener, A. (1966): The Origin of Continents and Oceans. – Courier Dover Publication, New York.

# 100 ГОДИНА ОД ПОЈАВЕ ТЕОРИЈЕ КОНТИНЕНТАЛНОГ ДРИФТА АЛФРЕДА ВЕГЕНЕРА И ЊЕН ЗНАЧАЈ ЗА ГЕОНАУКЕ И ЉУДСКО ДРУШТВО

ЉУПКО РУНДИЋ

## РЕЗИМЕ

Почетком 1912. године, научном свету представљен је потпуно нов концепт о настанку континената на нашој планети. У то доба револуционарно и контраверзно схватање немачког метеоролога и поларног истраживача Алфреда Вегенера, геолози су скоро потпуно одбацили као ненаучно. Требало је да прође пола века да се, захваљујући развоју науке и технологије, ова идеја поново афирмише и коначно прихвати.

У време кад је Вегенер изложио своју теорију, геолошки експерти нису могли да дају адекватне одговоре на бројна питања: како су настали планински системи, посебно Алпи, због чега постоје подударности између обала и стенских маса на супротним странама океана, подударности појава старих глацијација и вулканизма у Африци и Јужној Америци, као и велика сличност појединих фосила, откривених на различитим континентима (фосилизовани остаци малог рептила *Mesosaurus,* као и изумрлих представника голосеменица *Glossopteris* из угљених слојева Јужне Америке, Африке, Аустралије, Мадагаскара, Индије и Антарктика).

По Вегенеровој теорији, у геолошкој прошлости (пре око 200 милиона година) постојао је један суперконтинент, кога је назвао Пангеа. Током мезозоика, Пангеа се прво ’распала’ на два велика континента, Лауразију и Гондвану, да би њиховим распарчавањем крајем мезозоика и у току кенозоика, настали нови континентални блокови који и данас постоје. Пангеа је била кључ за решење и уједно Вегенеров одговор на питања која до тада нису могла успешно да се објасне.

Данас, 100 година од појаве теорије континенталног дрифта и 50 година од настанка теорије тектонике плоча, већина научника сматра управо Вегенера за утемељивача идеје о померању континената. Многи термини у савременој геологији, могу се наћи и код Вегенера. Осим геологије, теорија континенталног дрифта утицала је и на развој многих других научних дисциплина: савремене метеорологије, магнетостратиграфије, сеизмичке стратиграфије, тектонофизике, палеогеографије, изотопне геохронологије, циклостратиграфије. Нова сазнања управо у овим научним областима допринела су нашем бољем разумевању савремених процеса и догађаја на планети Земљи, укључујући климатске промене, оштећење озонског омотача, метеоролошке појаве, вулкане, земљотресе и цунамије.