Geoethics

Subjects: Geology

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Geoethics is a field of knowledge currently in full development. Researchers in geoethics are primarily concerned with the anthropogenic interaction with the Earth system. Due to its nature, geoethics holds particular importance in sustainable development due to its nature as it aims to promote ethical human behaviour that does not negatively impact the Earth system.

Keywords: geoethics teaching ; geoethics syllabus ; higher education

1. Introduction

The relationship between society and planet Earth is becoming increasingly urgent, given the significant global problems we currently face, such as dwindling drinking water, the overexploitation of non-renewable resources, high consumption and production patterns, and climate change. The choices we make every day have a direct or indirect impact on the Earth system [1]. For this reason, decision making must always be accompanied by reflection on the positive and negative consequences of our future actions. Human beings are considered “geological agents”, as it was scientifically proven that they impact the Earth system with their actions [2][3]. Morally, humanity must protect planet Earth and avoid behaviours that harm it. The impact of human beings on the Earth system is widely recognised, particularly by organisations of various kinds, such as NATO and the United Nations [4][5]. To better understand the impact of human actions on the Earth system, it should be noted that it comprises five distinct subsystems—atmosphere, biosphere, cryosphere, geosphere, and hydrosphere. The last is interdependent and shares cycles of matter and energy flow [1][6], demonstrating a deep interconnection. This particularity results in the fact that actions taken in one of the subsystems will affect the others. As such, the Earth system is characterised as a holistic, complex, and adaptive system [1][7][8], with its dynamic equilibrium affected by and affecting human actions, a dynamic that results in severe disturbances that reflect current global challenges.

The progressive concern for the Earth’s sustainability led the United Nations to develop the 2030 Agenda for Sustainable Development, published in 2015. This agenda should guide the nations involved towards sustainability. To this end, the fulfilment of human rights for all individuals, society’s prosperity, and the need to ensure the planet’s future must be considered. Thus, to fulfil the Sustainable Development Goals (SDGs), it is essential to reflect on and understand human actions on the Earth system to know what needs to change to ensure sustainability [9]. To this end, the solutions to the problems faced require the reflection of each citizen, making it very important that decisions are made on an ethical basis [10][11][12][13]. Consequently, it is vital to investigate geoethics, which is concerned with improving and reflecting on the relationship between human beings and the Earth, and sustainable development, which aims to ensure that we have a habitable and prosperous planet in the future.

In geosciences, geoscientists study the Earth system, and the knowledge and practices of this scientific field have proven to be essential in enabling us to understand the planet’s limits so that it remains habitable [10][14]. Thus, the role of the geoscientist is fundamental to the beginning of a more sustainable future. Geoethics can play a role in solving problems by considering different aspects, such as the environmental and social impact of different solutions, helping geoscientists, for example, to decide on a more geoethical solution. In addition, geoscientists should collaborate with professionals from other areas from an interdisciplinary perspective that allows them to take advantage of more diverse knowledge that can complement each other [15], as well as being aware of the responsibility and social role that they also have beyond scientific practice [16], which are principles that geoethics defends.

Sustainable development is already widely recognised by society [17] and is even included in the educational curriculum of some countries. The same is not true regarding geoethics, a developing disciplinary area little known by society, even among geoscientists. Therefore, geoethics must be included in school curricula so that it can be increasingly practised by as many citizens as possible [18][19]. It also requires integration into higher education geoscience curricula or even lower education levels, so everyone can understand geoethics. It should be noted that geoethics also contribute to the fourth

SDG, whose motto is the promotion of quality education for all, enabling citizens to acquire knowledge, competencies, principles, and values that are vital for promoting sustainability in the present and the future [19][20][21].

Based on this gap in the curriculum, the Erasmus + Geoethics Outcomes and Awareness Learning (GOAL) project was born, an international project that brought together experts from six countries with different expertise that gathered different perspectives during the work. The project created a comprehensive syllabus and educational program for imparting geoethics within higher education [22]. This initiative encompassed the development of educational resources, drawing upon the diverse expertise of the project's participating experts, thereby converging multiple scientific disciplines, including mineral resource management, geological risk assessment, the preservation of geological heritage, and water sciences. Every educational resource, along with the core curriculum, is specifically designed to emphasise the intricate connection between geoethics and sustainable development. This initiative encompassed the development of educational resources, drawing upon the diverse expertise of the project's participating experts, thereby converging multiple scientific disciplines, including mineral resource management, geological risk assessment, preservation of geological heritage, and water sciences. These educational materials are adaptable for use across various countries, although they are primarily tailored to cater to the educational needs of geoscience students in higher education [22].

2. Geoethics: Origins and Evolution

Given the long history of the development of geoethics, this section was limited to presenting the aspects considered most relevant to its evolution as a still-emerging scientific area.

Ethical thinking about the relationship between human beings and planet Earth originated thousands of years ago [23][24]. However, geoethics is a recent and developing scientific area [10][25], given the outstanding commitment to its research and reflection. In its early days, geoethics focused its research on the specific ethical conduct of geoscientists. Nowadays, geoethics extends its research to the ethics that ordinary citizens should have regarding the Earth system. According to geoethics, human beings are responsible for caring for and preserving planet Earth, and this can be carried out via actions that mirror and respect this responsibility. It can be hypothesised that the application of geoethics could have a positive influence on planetary sustainability, both at a biotic and abiotic level [26][27].

In the works of Socrates (469 BC–399 BC) and from an environmental ethics perspective, reflections on the role humans, animals, and plants have throughout their existence were referred to. Socrates concluded that there are no essential differences between them, integrating the human being as an element of nature itself [27]. Some Roman philosophers also shared Socrates' ideas [28]. Later came Stoicism, a philosophical school founded by Zeno of Scythia (333 BC–263 BC), whose main idea was respect for all forms of life and nature itself [24][29][30]. According to the Stoics, there has to be equity between human beings, and they should not worry about material goods or money. Everyone should achieve self-sufficiency, moral integrity, and intellectual freedom, and, as Socrates argued, all living beings should be seen as equal and worthy of respect [24][31]. Nevertheless, these values seem almost forgotten in Western civilisation as Christianity grew and expanded. At the time, it was believed that God had given humans dominion over nature and the right to exploit it. Thus, the relationship between humans and the environment was not considered ethical [32].

This relationship of human domination over nature continued as science and technology developed in the modern period [23][31]. Over the years, the demand for natural resources grew, leading to an imbalance between what humans exploited and what the planet could provide. Even before the Industrial Revolution in the 16th century, some thinkers were already aware of this unbalanced relationship between humans and the Earth system. In the 17th century, authors such as Matthew Hale (1609–1676) and William Petty (1623–1687) warned of the dangers of population growth and the subsequent exhaustion of natural resources [24].

In some presented cases, concern for the abiotic elements of the Earth system is undervalued; the inanimate part of the planet that sustains all life and allows it to exist has been the object of less concern for much of history. Ethical issues focused more on the biotic world, and in environmental ethics, the abiotic elements were mainly in the background. However, in the 19th century, the Italian geoscientist and expert geoscience communicator Antonio Stoppani (1824–1891) emphasised geosciences and their role in the progress of society, revealing ethical concerns for both biotic and abiotic elements. Stoppani considered humans to be "geological agents", given their ability to alter the dynamics of the Earth system [2][33][34]. As such, Stoppani considered that society's awareness of this fact gave it the responsibility to respect planet Earth. Stoppani is a true forerunner of geoethical thinking, and several authors call him one of the "fathers of geoethics" [2][24][35]. It should be noted that Stoppani argued that humanity must contribute to the ethical management of geo-resources. He introduced the concept of the "Anthropozoic Era" to characterise the period of geological time in which human behaviour changed and continues to change the evolution of the Earth's dynamics. This concern with the changes

that human behaviour has on the dynamic balance of the planet can be considered a preamble to the current definition of geoethics [2][24]. It is easy to compare Stoppani's suggestion of a new "Anthropozoic Era" with the concept of the Anthropocene, a geological epoch proposed by Paul Crutzen (1933–2021) that is still being discussed by the scientific community [2][7]. The latter is a concept created following scientific evidence that human actions have significantly impacted planet Earth since at least the latter part of the 18th century, at the start of the Industrial Revolution [33][36]. Antonio Stoppani formulated some geoethics criteria that should underpin the decisions made by geoscience experts. His ideas came from observing the beauty and harmony of nature, and he emphasised the need for experts from various disciplines to work together, including the humanities, giving human beings an ethical duty to manage the environment well. Stoppani had a vision of the planet very similar to the contemporary holistic perspective of the Earth system described above, which is now essential for resolving geoethics issues and for the geoethical management of the environment, geo-resources, and geological risks [2][37].

In the last decade of the 20th century, the first references to the word geoethics appeared. The report "Adult Education for International Understanding, Human Rights and Peace" resulted from a meeting held at the United Nations Educational, Scientific and Cultural Organisation. From the Institute for Education in Hamburg, Kaisa Savolainen reflected on the right to an education that includes bioethical and geoethics approaches and classifies the latter as environmental ethics, warning of the urgency of having these ethical considerations in the education system [38]. On the other hand, Cronin [39] used the word geoethics at the annual meeting of the Geological Society of America, referring to the ethical responsibility of geoscientists regarding a scenario of potential geological risk and associated economic interests.

Another reference that gave direct attention to ethical concerns about the geosphere was made in 1991 at the 70th anniversary of Professor Adam Trembiecki's symposium in Krakow by geological engineer Václav Němec who used the word geoethics in connection with ethics for geology. The term geoethics was born out of the need for ethical principles for mining [35][40][41][42][43]. The same year saw the emergence of the new scientific field of geoethics [26][43], with some authors considering Němec as the father of geoethics [26]. Thus, in 1992, the first association dedicated to geoethics was created —the International Association for Geoethics (IAGETH) in Czechia [44].

The five-day conference in 1997 conducted by the Geological Society of America was a very relevant effort to access geoethics since geologists saw great value in developing their core values of professionalism in geoscience. Despite many differences in geologist professionals, all of them agreed that the core values should include scientific studies of the Earth, the development and production of resources, identifying hazards, applying knowledge to environmental issues, and providing education to the public, new geoscientists, and the profession [45].

In 1998, UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology emerged, whose main concern was to create ethical principles so that decision-makers would not rely solely on economic aspects and would consider the ethical implications of their decisions [26].

In 2008, the first definition of geoethics was proposed, reflecting various aspects of ethical concerns regarding Earth and Planetary sciences, and the respect of space exploration can also be the behaviour of specialists studying the abiotic world [40]. The inclusion of planetary sciences in geoethics was justified because the current development is subject to ethical and scientific integrity issues, and the planetary protection required in these studies goes beyond the terrestrial planet [26][40]. In 2009 and 2011, two conferences followed, and geoethics was promoted.

In 2012, during the 34th International Geological Congress in Brisbane, Australia, the International Association for Promoting Geoethics (IAPG) was founded as a non-profit international multidisciplinary scientific association based in Italy, dedicated to research, reflection, and the dissemination of geoethics [10][45][46]. The IAPG thus proposed a second and expanded definition of geoethics, which focused on research and reflection on values that should guide behaviour and practices in the relationship between human beings and the geosphere [34][45]. The latter definition includes the habits of all citizens in the abiotic world and does not only assign ethical responsibility to geoscience experts. It gives all humankind the ethical responsibility to care for the planet [10].

The number of scientific publications on geoethics is growing, and in 2015, the first book on the subject edited by the IAPG was published, *Geoethics: Ethical Challenges and Case Studies in Earth Sciences* [47]. Despite this, geoethics experts have found it challenging to materialise contributions to the literature in quality scientific publications to contribute to the recognition of geoethics by the scientific community. The relevance of geoethics was high, but this last obstacle limited its research and dissemination, and few geoscientists devoted their work to this scientific area [10][14][26][27][28][34][41].

In 2017, Peppoloni and Di Capua proposed a definition of geoethics that is used in this research: "research and reflection on the values that underpin appropriate behaviour and practices whenever human activities interact with the Earth

system” [14] (p. 2). This definition already covers the need to conserve all the Earth’s subsystems, not just the geosphere, adding the holistic dimension of the Earth’s system to this scientific area.

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