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Ethical considerations about the geological profession in Italy (and beyond)

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Abstract

This work explores several ethical challenges associated with the geological profession, focusing on the Italian Deontological Code of Professional Geologists. Potential ethical conflicts related to the obligations outlined in the code are examined within, though not exclusively limited to, the broader perspective of geoethics. These conflicts include tensions between personal convictions and professional duties, as well as between the responsibility to preserve the environment and, at the same time, the interests of clients. The paper also discusses possible amendments to the code and tools to alleviate these tensions and promote ethical behaviour within the profession. The analysis aims for broader applicability, considering that the Italian Deontological Code of Professional Geologists shares similarities with other codes of ethics and that some of the identified conflicts may arise in contexts beyond the geology profession.

Keywords: Professional geologists; Deontology; Geoethics; Ethical conflicts; Guaranteed minimum income; Insurance mechanisms

1. Introduction

In Italy, the geologist profession is regulated and promoted, alongside the law, primarily by the Consiglio Nazionale dei Geologi (National Council of Geologists, referred to as CNG hereafter) and each Ordine Regionale dei Geologi (Regional Council of Geologists) of the twenty-one Italian regions.

These councils, among other activities, manage the Albo Professionale dei Geologi (Italian Register of Geologists). Being listed in the Register is, in most cases, a legal precondition to practice the profession of geologist within the Italian territory. This listing is currently granted, upon request, after graduating in geological sciences and passing a state examination. At present, the Register lists over 11,139 geologists, representing the majority of the country's geological workforce [CRESME and Fondazione Centro Studi CNG, 2024]. In other cases, registration is not necessary, although passing the state examination still is. This applies, for instance, to some of the small percentage of professional geologists working exclusively for public administrations. Outside these cases, a graduate in geology can participate in a number of professional activities, even as a consultant, but with specific and often significant limitations on the responsibilities that can be assumed and the type of documents that can be signed.

The Norme Deotontologiche per l'Esercizio della Professione di Geologo (Deontological Code of Professional Geologists) is a self-discipline and professional ethics code, approved by the Consiglio Nazionale dei Geologi [CNG, 2023], that every member of the Register of Geologists has the duty to respect. It resonates with other codes of ethics, such as those of the European Federation of Geologists [EFG, 2016] and the American Institute of Professional Geologists [AIPG, 2019].

This paper explores various ethical challenges primarily related to the Deontological Code. It examines, for instance, potential conflicts that may arise from balancing different provisions of the code, such as the obligation to protect the environment while considering the interests of clients, as well as tensions between the personal and professional spheres. Furthermore, the paper considers possible amendments to the code and financial tools that might help in addressing some of the identified conflicts and promoting ethics within the profession. The analysis aims to be broadly relevant, given that the Italian Deontological Code of Professional Geologists is similar to other ethical codes, as noted above, and that some of the conflicts considered may also arise in other professions.

Geoethics inspired this paper and is summarized in broad terms later on; however, it will not always be at the forefront. As detailed below, the Italian Deontological Code of Professional Conduct emphasizes values found in the Italian Constitution, such as equality and solidarity, along with environmental protection and other responsibilities

that align with geoethical principles, despite possibly originating from an anthropocentric perspective. Thus, upholding these values and responsibilities represents a significant step towards embracing the goals of geoethics, even without explicit study or direct adherence to its principles.
Furthermore, behaviors that are deontologically and geoethically correct may stem from other ethical viewpoints, such as environmental ethics, which may or may not be partially or fully encompassed by geoethics and could even be influenced by, or derive from, religious beliefs. Finally, and perhaps most importantly, directly or indirectly imposing geoethics contradicts the principles of geoethics itself. In what follows, then, we will often and simply use the word "ethics".

2. The Italian Deontological Code of Professional Geologists

The Italian Deontological Code of Professional Geologists comprises forty articles. The contents of the code most relevant to our discussion are described below. The numbers in square brackets indicate the pertinent articles.
The geological profession is declared to be of paramount public and general interest and must be practiced in strict compliance with current regulations, as well as the provisions of the code. The geologist must embrace and recognize the fundamental constitutional principles of freedom, equality, solidarity, democracy, safeguarding of health, and protection of the environment. Furthermore, the geologist works for the preservation and safeguarding of the geological integrity of the territory. This includes the prevention, containment, mitigation, and resolution of natural or anthropogenic risks, the enhancement of natural resources, the minimization of energy waste, and the avoidance of ecological imbalance and damage to cultural, artistic, historical, and landscape assets [1, 34].
Geologists are personally accountable for their work to both clients and the community. The information they provide must be truthful and accurate and must not concern confidential information or matters covered by professional secrecy. Moreover, they must maintain confidentiality unless explicitly authorized by the clients, even after their relationship with the latter has ended [2, 13, 20].
Importantly, the code rules also apply to geologists who practice their profession within the European Community or abroad, without exempting them from complying with the deontological rules of the host country, where compatible. Furthermore, non-Italian geologists working in the national territory are also required to comply with the code rules [3].
The fundamental deontological principles include diligence, professional competence, efficiency and effectiveness in professional performance, continuous

professional training, autonomy and objectivity, and professional decorum. They also encompass fairness in client and colleague relations, fairness in societal interactions, confidentiality and privacy compliance, comprehensive information sharing, and support for social initiatives in intellectual professions [5].
Geologists are mandated to continually improve and update their professional skills through various training and certification programs, as well as cultural and scientific initiatives at all levels. They should only accept assignments they are confident in handling, either on their own or with collaborators [6].
A geologist must adhere to the client's interests, provided these do not conflict with the public interest, safety, or professional duties, and must always work to protect the environment from natural and anthropogenic risks. Geologists should not comply with the client's requests if they undermine their own or the profession's prestige, dignity, or decorum. They must protect the client and third parties from any harm caused by their work. The relationship with the client demands clarity, loyalty, fairness, diligence, and promptness [20, 21].
Geologists may withdraw from an assignment even during the course of the work for just cause, but without causing harm to the client or colleagues in the case of services provided in a corporate or associated form. Finally, they must report to the Council any attempt to impose behaviors that do not conform with the Deontological Code, regardless of the source, and are obligated to report all violations of the code rules [23, 26].

3. Geoethics

Geoethics can be defined [Di Capua and Peppoloni, 2023] as a field of theoretical and applied ethics focused on studies related to human-Earth system nexus. Geoethics is the research and reflection on the principles and values which underpin appropriate behaviours and practices, wherever human activities interact with the Earth system. Geoethics deals with ways of creating a global ethics framework for guiding individual and social human behaviours, while considering human relational domains, plurality of human needs and visions, planetary boundaries, and geo-ecological tipping points. Geoethics deals with the ethical, social, and cultural implications of geoscience knowledge, education, research, practice and communication, and with the social role and responsibilities of geoscientists.
Di Capua and Peppoloni [2023] further characterize geoethics as universal and pluralist, in that it defines an ethical framework for humanity, acknowledging that respecting the plurality of visions, approaches, and tools is essential to assure dignity for all agents and guarantee a wide range of opportunities for developing

more effective actions to face common threats. Geoethics covers an extensive variety of themes, and is multidisciplinary, favoring cooperation and overcoming the sectoral languages of individual disciplines to reach the intersection and integration of knowledge. Moreover, it expresses a synthesis, that can be defined as ecological humanism, between various existential concepts and different conceptions regarding the nexus between human beings and the Earth system. It is local and global, addressing topics that concern both local and regional dimensions, as well as the global one related to the entire Earth system. Geoethics is pedagogical, proposing a reference model to cultivate one's ethical dimension. This model aims to reach greater awareness of the value of human identity, not in terms of exercisable power over others, but in terms of respect for the dignity of all that exists. Furthermore, geoethics is also political, criticizing the materialism, egoism, and consumerism of capitalism, envisioning a profound cultural change in economic paradigms. It supports the right to knowledge as the foundation of society [Di Capua and Peppoloni, 2023]. Finally, geoethics can also be characterized, although not exclusively, as an actor-centric virtue ethics, where great importance is attributed to an individual's experiences, common sense, education, predispositions, preferences, and worldviews [Bohle and Di Capua, 2019; Bohle and Marone, 2019].

It is beyond the scopes of this paper to discuss in depth the geoethical framework, and the reader is referred, e.g., to Di Capua and Peppoloni [2022], Di Capua and Oosterbeek [2023], Peppoloni and Di Capua [2024], and to the website of the International Association for Promoting Geoethics (IAPG[1]).

The Geoethical Promise is a Hippocratic-like oath for geoscientists, originally proposed by Matteucci et al. [2014]. The current version is part of the Cape Town Statement on Geoethics [Di Capua et al., 2017], which was approved in October 2016 by the Executive Council of the IAPG during the 35th International Geological Congress, held in Cape Town, South Africa. The text of the promise is the following:

I promise… I will practice geosciences being fully aware of the societal implications, and I will do my best for the protection of the Earth system for the benefit of humankind. I understand my responsibilities towards society, future generations, and the Earth for sustainable development. I will put the interest of society foremost in my work. I will never misuse my geoscience knowledge, resisting constraint or coercion. I will always be ready to provide my professional assistance when needed, and will be impartial in making my expertise available to decision makers. I will

[1] https://www.geoethics.org (accessed 6 November 2024).

continue lifelong development of my geoscientific knowledge. I will always maintain intellectual honesty in my work, being aware of the limits of my competencies and skills. I will act to foster progress in the geosciences, the sharing of geoscientific knowledge, and the dissemination of the geoethical approach. I will always be fully respectful of Earth processes in my work as a geoscientist. I promise!

The Geoethical Promise provides a broader ethical vision that enhances some of the professional guidelines detailed in the Deontological Code, and shares common ethical foundations with the latter.

An ethical dilemma occurs when an individual faces a decision-making situation involving conflicting moral principles, making it difficult to determine the right course of action. This conflict arises because adhering to one ethical principle might lead to the violation of another, creating a situation where any decision taken could potentially compromise some ethical values. A geoethical dilemma occurs when geoscientists (or others) face decision-making situations involving conflicting (geo)ethical principles related to the Earth and its systems. For instance, establishing a mine in an economically depressed region could provide significant benefits to the local community by generating employment, improving infrastructure, increasing community services, and supporting local businesses. However, this development may also negatively impact the natural environment, degrade the landscape, and potentially introduce new hazards to the area [Marone and Peppoloni, 2017; see also Peppoloni, 2019; Bohle, 2020; Bellaubi and Arasa, 2021; Canseco and Bellaubi, 2022; Peppoloni and Di Capua, 2022, ch.6].

Deontological dilemmas may be considered a special kind of ethical dilemma that occurs when rules, duties, and obligations are involved. For instance, these dilemmas often emerge when the professional responsibilities of geoscientists to protect the environment, public safety and societal welfare conflict with economic interests or client demands.

Approaches to manage ethical dilemmas have been devised [e.g., Figar and Đorđević, 2016], but a real dilemma is a problem with no perfect solution in absolute terms, offering only acceptable solutions based on specific contexts [Marone and Peppoloni, 2017]. In these cases, the duty of geoscientists is to explain the choices and consequences of each option, without assuming or claiming that geoethical dilemmas can be solved solely based on geoscience knowledge. Geoscientists, instead, can suggest geoethical decisions by adequately justifying them scientifically and technically, clearly indicating the pros and cons, including cost/benefit analyses in societal and environmental terms, and incorporating both probabilities and uncertainties. Decisions, however, should ultimately be made by decision-makers [Marone and Peppoloni, 2017].

4. The geologist as a professional: some ethical challenges

4.1 Introduction

In what follows, several ethical issues that professional geologists may face will be discussed. These issues are briefly summarized in the Table 1. This list, naturally, is not intended to be exhaustive.

Professional duties may conflict with personal values, or the obligation to protect client interests may be at odds with the responsibility to safeguard the environment and the geological integrity of the territory (Sect. 4.2)
Adhering to local regulations can present ethical challenges when these regulations do not meet internationally recognized standards (Sect. 4.3)
Professional autonomy may conflict with compliance requirements set by employer policies, especially when these policies do not fully align with ethical or environmental standards (Sect. 4.4).
The commitment to transparency can conflict with the duty to maintain confidentiality, particularly when public safety or environmental concerns may be involved (Sect. 4.5)
Limited resources for data collection, or the need to collect data in sensitive areas, can lead to ethical challenges (Sect. 4.6)
Defining risk scenarios, setting degrees of precaution and determining acceptable risk levels involve scientific, technical, economic, ethical, and political considerations, often accompanied by external pressures (Sect. 4.7)

Table 1. Some ethical challenges for professional geologists, detailed in the sections of this paper, as indicated in brackets.

4.2 The personal, professional and public spheres

This section considers the possible tension between a geologist's personal convictions and the professional duties outlined in the deontological code. Personal convictions refer to subjective beliefs, opinions, and views that are largely independent of technical evaluations.
For example, imagine a situation where a geologist is asked to consult on an expansion project that will replace a green area with a developed one. This project

complies with local and environmental regulations and has been duly approved by the relevant authorities.

For many, the project's legal and procedural soundness may be sufficient to justify accepting the professional assignment, and there is nothing inherently wrong with this perspective. Others, however, may feel uncomfortable with the nature and characteristics of the project itself and may experience a growing tension, which intensifies due to certain factors. These factors may include the desire to avoid soil consumption, the attribution of certain naturalistic or landscape values to the area affected by the project, place attachment (whether collective or personal), the fact that the project may entail some form of pollution, the belief that local regulations or technical standards do not sufficiently protect the environment, and receptiveness to social and cultural concerns, criticisms, or oppositions that were not considered in the project and the approval process. A notable instance of these circumstances is discussed in Marshall [1989] and involved a geologist at the U.S. Geological Survey who faced potential consequences for criticizing, as a private citizen, another federal agency's plan to establish a track for motorcyclists in a national forest and for advising a group opposing the project.

Adhering to the tenets of geoethics, and even to the Geoethical Promise, is likely to increase this tension. This is primarily because it involves embracing a broader ecological perspective, a heightened respect for both the biotic and abiotic components of the Earth, a critical stance toward exploitative economic paradigms, and an enhanced consideration for the diversity of cultures, perspectives, and communities, including indigenous ones. Such an approach often contrasts with the short-term objectives of many projects aimed at immediate economic gains and lacking a systemic, long-term vision.

The conflicts we are considering here may become real (inner) geoethical dilemmas when a project has both significant negative and positive potential impacts on the environment and/or society. This situation is frequently encountered in mining and dam construction [e.g., Veldt et al., 2016; Andrés Domínguez-Gómez and González-Gómez, 2021; Canseco and Bellaubi, 2022; Handl et al., 2022; Vasconcelos et al., 2022]. Moreover, mining projects, in particular, has led to a wide range of negative impacts on indigenous peoples, often resulting in the violation of the human rights of the affected populations [Hostettler, 2015].

If all conflicting factors are present, known, and irresolvable when a work proposal is advanced, a geologist may - after weighing them - choose to accept or refuse the work. The first decision entails enduring an unresolved conflict. The second decision implies renouncing financial gain and possibly suffering professional repercussions, such as not being called again by the client and possibly facing bad publicity. However, some of these factors (related, for instance, to previously

undisclosed information or project variants) may emerge or become clear only after the geologist has accepted the work. The geologist is then obligated to follow not only the provisions of the contract with the client but also the deontological code described above.

One of the main sources of ethical tension within the code is the commitment to serve the legitimate interests of the clients while also fulfilling the duty to preserve the environment and the geological integrity of the territory, which includes avoiding ecological imbalances and preventing damage to cultural, artistic, historical, and landscape assets. The public relevance of the geological profession and this duty take precedence over the clients' interests (Article 20). One might think, then, that an irresolvable conflict between such interests and the preservation duties would represent a just cause for withdrawing from a professional assignment.

Article 23 of the code establishes that geologists may withdraw from an assignment even during the course of the work for just cause, but does not specify what constitutes a just cause. Furthermore, the same article also states that the withdrawal must not damage the client, or colleagues when services are provided in a corporate or associated form. This appears to be a very strict constraint since, for instance, any delay due to the geologist's withdrawal may represent damage to the client, while colleagues and associates might encounter professional consequences.

It seems, then, that it is difficult to rescind an assignment for just cause in cases where the geologist believes, after the initiation of the work, that the public and general interest of the profession and the duty to preserve the environment and the geological integrity of the territory are no longer being served. The problem, once again, may be even more acute for professionals who adhere to the tenets of geoethics. The code appears to delegate the question entirely to external evaluations. In litigations, deciding what constitutes just cause in a specific situation often becomes a juridical problem that, for example, a judge must resolve. Although this is certainly justified, it must be noted that it may be problematic to establish objectively whether and to what extent the aforementioned duty is no longer being fulfilled, and that geoethics is also rooted at the personal level.

On the other hand, though, a geologist (for instance due to adherence to certain political worldviews) may be critical of regulations aimed at protecting the environment, even if these regulations are consistent with recognized standards. Moreover, they may believe that the client's legitimate interests should have precedence. This position cannot simply be deemed illegitimate or mocked. Obviously, however, professionals cannot disregard existing regulations or the deontological code; otherwise, they can be formally held responsible, and rightly so.

4.3 Local regulations, non-local standards and rules enforcement

A geologist is required to respect local regulations, yet these may fall short of internationally recognized regulatory, technical, and ethical standards. This situation can arise especially in regions where environmental protections are limited or where regulatory frameworks do not provide clear standards, mandates, or local relevance. Furthermore, even when safety and environmental laws are in place, they may be weakly enforced or lack sufficient institutional support, leaving critical environmental and public health concerns only partially addressed [UN Environment 2019]. Although the situation has improved in recent years gaps still remain and were in some instances exacerbated by the COVID-19 pandemic [UN Environment 2023]. Clearly, this can lead to (geo)ethical conflicts.

The Italian Deontological Code of Professional Geologists sets a clear direction to tackle this problem, as it is adamant that the code rules also apply to geologists practicing outside Italy, without exempting them from complying with the deontological rules of the host country, where compatible. There might be doubts in interpreting what 'where compatible' means, but it can safely be assumed that the highest professional standards must be employed and that the duty to preserve the environment and the geological integrity of the territory must be fulfilled. Geoethics also entails following the utmost scientific and technical criteria as well as best practices [Di Capua and Peppoloni, 2022], setting the code obligations in a wider and possibly even more demanding context.

Geologists may be pressured to accept lower quality requirements, particularly if maintaining high standards incurs additional costs or conflicts with other interests. This issue may be further exacerbated when the professional is inclined to use best practices and guidelines that are not mandatory. What is more, a body responsible for resolving work controversies might decide that respecting the local, albeit less stringent, regulations is all that the geologist would have had to do. Indeed, international standards and regulations can prevail over local ones under specific circumstances, such as when countries have committed to international agreements or when supranational entities (e.g. the EU) possess some legal authority over member states. What is more, guidelines issued by different bodies are generally not mandatory.

In certain circumstances, a geologist may conclude that upholding deontological duties - particularly those related to protecting the public interest and the environment - is no longer feasible. This may constitute just cause for withdrawing from an assignment. However, a stringent obligation remains not to damage the client or colleagues.

4.4 Professional autonomy and employer compliance

According to the Deontological Code geologists must be autonomous, objective and intellectually independent (Articles 5 and 7). However, they may also be employees of private or public entities, required to conform to their visions and missions, regulations and codes of conduct, and even expected to adapt to unwritten group rules and behaviors. The more an entity's work and activities entail a departure from the duty to preserve the environment and the geological integrity of the territory, from high scientific, technical and professional standards, and from adherence to the tenets of geoethics (for the professional who wishes to follow them), the more acute the deontological, ethical or geoethical tension becomes. This is particularly true when voicing concerns is perceived as problematic [e.g., Milliken et al., 2003].
If this tension is too great, the geologist is generally free to resign, perhaps after notifying the employer in due time, without the restrictions illustrated above that apply to withdrawing from a professional assignment. However, this again also implies renouncing a financial gain and possibly suffering professional repercussions.

4.5 Transparency and confidentiality

Distinguishing what information a geologist can or must reveal and what information they have the duty to keep confidential can be very complex and context-dependent. We consider here only two circumstances. The first occurs when the professional becomes aware of a situation that entails a yet undisclosed risk to individuals or groups, to the environment, or to valuable or protected assets. The second concerns attempts to impose behaviours that conflict with the Deontological Code of Professional Geologists or violations of its rules.
In the first case, it is safe to say that the geologist has a duty to notify the situation to the appropriate officials or bodies, regardless of the personal and professional consequences. In the second case, the code itself establishes the duty to report violations to the national or regional councils of geologists. Even in this situation, however, there may be personal and professional consequences, which the geologist might have to bear alone.

4.6 Data and resources

In geology, as in all scientific and technical fields, drawing sufficiently reliable

conclusions necessitates the collection of enough data. This process initially involves determining the type and amount of data required. Subsequently, it becomes an economic issue, involving the calculation of the amount of resources - typically time and money - needed to gather these data.

Geologists, like other professionals, may find themselves involved in projects where the resources made available are insufficient to some extent. In civil engineering projects, for instance, geotechnical investigations may receive inadequate funding and limited time due to a misguided attempt to save costs [e.g., Littlejhon et al., 1994; Collingwood, 2003; Zumrawi, 2014].

If no negotiation on resources is possible or fails, a geologist must decide whether to proceed with the data that can be collected, which often entails taking full responsibility for less reliable conclusions, or to withdraw from the project. This decision inherently involves (geo)ethical considerations. If the constraints are so severe that the geologist is entirely unable to perform the work, there may be just cause to withdraw from the assignment. However, in most cases, the problem is more nuanced, as it also depends on the amount of resources actually provided.

Furthermore, data collection may entail geological sampling in sensitive areas (e.g. natural reserves and sacred sites). Appropriate preservation and conduct regulations may be in place - particularly if an area is protected - and there are guidelines on how to responsibly perform geological fieldwork and sampling [e.g., Di Capua et al., 2022; Ryan-Davis and Scalice, 2022; Chan and Mogk, 2023]. However, such regulations may not be established, and there may be pressures not to follow these guidelines if they are not mandatory, particularly if compliance would require additional spending or more time. This issue grows even more complex – and the ethical problem intensifies - in situations where the status of the area is contested.

The Italian Deontological Code of Professional Geologists does not explicitly mention the issues considered here. However, it is clearly aimed at supporting high professional standards. It also recalls the fundamental principles of freedom, equality, solidarity, and democracy written in the Italian Constitution and requires fairness in relations with the various components of society (Article 5). Furthermore, as noted above, the code compels geologists to avoid causing alterations to the environment in which they operate that could negatively affect the ecological balance, as well as the conservation of cultural, artistic, historical, and landscape assets. Collecting enough data is clearly part of professional standards, and the code implicitly encourages to design geological sampling not only in order to avoid negative alterations and preserve assets, but also to respect equality in relations with the different components of society, including indigenous communities[2].

[2] There are no indigenous communities in Italy; however, as mentioned earlier, the Italian Deontological Code of Professional Geologists specifies that its rules also apply to geologists practicing outside the country.

4.7 Precaution and risk

Precaution essentially involves taking measures to prevent possible harm before it occurs, in the face not only of stochastic uncertainty but also of incomplete knowledge. Even without invoking the Precautionary Principle, this approach is used in contexts where safety and risk management are essential and, often informally and perhaps unconsciously, in various everyday situations.

For instance, a common challenge for geologists is constructing a conceptual model of complex underground geological bodies from data marked by varying uncertainties. Even when a substantial amount of reliable data is available, it can be interpreted differently and be compatible with several possible models [e.g., Bond et al., 2007]. Furthermore, many geological hazards are characterized by a spectrum that ranges from low-frequency, high-magnitude events to high-frequency, low-magnitude ones. More precaution may involve choosing models that correspond to higher-risk scenarios or considering increasingly high-magnitude events. Usually, this entails using additional resources for risk mitigation.

In risk analysis and management, it is often subject to debate and negotiation to decide which risk scenario to use, what level of risk is acceptable and for whom, which risk mitigation actions should be implemented, and how these choices should be influenced by a precautionary approach in dealing with uncertainty and potential unforeseen situations. This inevitably involves not only scientific, technical, and economic aspects but also ethical and often political considerations [e.g., Aven, 2007; Di Capua and Peppoloni, 2014; Guzzetti, 2016; Zack, 2023]. In some cases, scientists and professionals may feel pressured to support, tolerate, or at least not publicly criticize, decisions that they consider debatable - if not outright wrong - from a scientific, technical, and ethical perspective.

Again, the Italian Deontological Code of Professional Geologists does not explicitly mention the issues considered here, but Article 1 establishes that geologists have a duty to pre-emptively mitigate risk. This may require a degree of precaution, if not the full application of the Precautionary Principle and consequent practices. Furthermore, precaution and the Principle may be explicitly mentioned in regulations that geologists must follow (e.g. Article 191 of the Treaty on the Functioning of the European Union).

5. Enhancing ethics in the geologists' profession

In this section, we discuss some possible tools for enhancing ethics in the geologists' profession that are focused on, or related to, the Deontological Code, but that may have a more general scope. The aim, especially for the guaranteed

minimum income and insurance-like mechanisms discussed below, is not to present ready-made solutions but to show that some ideas are not intrinsically illogical or unfeasible, and to open and promote a debate on potential pathways, some of which may require changes not only to existing norms but also, perhaps, to mindsets. This debate, naturally, may lead to devising other and very different pathways from those imagined here.

The reason for enhancing the presence and application of ethics - and particularly geoethics - in the geological profession, as well as in others, is not only a matter of wanting to adhere to principles regarded as right and desirable, but is also indirectly methodological. Geoethics almost inevitably imply broadening the horizon by placing a scientific and technical problem in a wider transdisciplinary, social, cultural, economic, and political context, which may highlight the limits of existing problem-resolution strategies and reorient research. Geoethics, then, provide a further impetus to adopt more comprehensive - and potentially more appropriate - scientific and technical models of situations, devised through the collaboration of different disciplines. This is particularly important for sustainability studies and objectives [e.g., Pande and Sivapalan, 2017; Stewart and Gill, 2017; Prévot et al., 2024].

Below, we shall consider four lines of action: training and continuous professional development, explicit recognition of (geo)ethics within the deontological code and conflict management, financial compensation measures and insurance-like tools, and promotion of ethics within professional bodies and corporations.

5.1 Training and continuous professional development

Without ethical training, it may be more difficult to understand and manage ethical problems, and sometimes even to recognize their existence. Training in geoethics, as well as in sustainability, should be part of the education and continuous professional development (CPD) of those working in the geosciences (and, indeed, not only them). Members of the Italian Register of Geologists have a CPD duty that essentially requires them to achieve, during their active professional careers, a minimum of fifty training credits every three-year period. These credits correspond to approximately fifty hours of instruction or other activities recognized as part of the CPD, such as teaching scientific and technical courses, participating in technical committees, or publishing papers[3].

[3] There are exceptions to this rule, such as for geologists who work exclusively abroad, and for periods of pregnancy, paternity, and maternity. Additionally, active professional geologists who have been listed in the register for more than thirty years have a reduced CPD requirement of twenty hours in recognition of their extensive professional experience.

The national and regional councils of geologists approve CPD courses and assign the corresponding credits to each course and to the geologists who complete them. Among the 608 courses listed on the National Council of Geologists' portal website, a significant number are related to sustainability, a few pertain directly to the deontological aspects of the geological profession, and only one concerns geoethics. Increasing the number of CPD courses on deontology and geoethics - as well as on social responsibility and sustainability standards and certifications - would enable geologists to better understand their profession within a broader context. It also has the indirect methodological motivations mentioned above and may help shed light even on conflicts between that the personal and professional spheres.

5.2 Integrating the Deontological Code

We consider here some possible modifications to the Italian Deontological Code of Professional Geologists that particularly refer to the prevailing and fundamental public duties of the geological profession, the objectives of geoethics, and the management of ethical conflicts. We emphasize, again, that the aim is not to offer ready-made solutions, but to initiate and encourage a discussion on potential pathways.

To begin with, the code (in particular Article 23) could be amended to state that just causes for resigning from an assignment include, but are not limited to, situations of irreconcilable conflicts between the assignment and: 1) the duty to uphold constitutional principles (freedom, equality, solidarity, and democracy), to protect health and the environment, to preserve geological integrity, to prevent and mitigate risks, to enhance natural resources, to minimize energy waste, and to avoid ecological imbalance and damage to cultural, artistic, historical, and landscape assets; 2) ethical positions consistent with the aforementioned duties, such as geoethics. Furthermore, the duty to avoid any damage in case of resignation may be relaxed by stating that a geologist must avoid or minimize any damage to the client or colleagues resulting from renouncing an assignment, including communicating the intention to renounce in due time.

In order to mitigate arbitrariness and protect the interests of clients and employers, it should further be specified that, in order to invoke just cause on deontological or ethical grounds, a geologist must verify, to the extent possible, the existence of deontological and ethical conflicts prior to accepting an assignment and clearly communicate them to the client.

As mentioned earlier, in litigation, it is generally up to a judge or another arbiter to evaluate what constitutes just cause and whether it can be invoked in specific

situations. However, the proposed amendments define instances of just cause that would need to be considered and evaluated in such cases, and that are currently lacking in the Deontological Code.
The application of these amendments is facilitated by deontological and ethical training, the definition of ethical standards, the production of guidelines with specific examples, the establishment of clear and standardized communication procedures, the availability of advisory bodies, and, possibly, the specification of what "due time" means. Additionally, geologists should have access to resources and advice on navigating conflicts between public, private, and environmental interests, as well as conflicts involving the ethical dimension. In cases of conflict, thorough documentation and transparent communication with clients and stakeholders are crucial. This helps demonstrate that the geologist has acted in accordance with ethical, legal, and professional standards. Furthermore, training in conflict resolution can equip geologists to handle difficult situations more effectively.
Moreover, the Italian regulations permit the violation of professional secrecy for just cause, which means a reason or an interest of higher importance to protect compared to professional secrecy. This permission could be explicitly stated in the code, specifying that the duties mentioned in point 1) above represents such interest of higher importance. This would tailor the permission to the deontological context applicable to geologists. Clearly, an exception would be when such permission violates a law applicable in the country where the geologist is working. In such cases, the professional may withdraw from an assignment if the reasons of higher importance for violating professional secrecy arise only after the work has started.

5.3 Guaranteed minimum income and insurance-like mechanisms

One of the reasons professionals may accept or retain assignments despite deontological and ethical reservations is financial necessity, along with the desire to avoid other possible negative consequences. We consider two mechanisms that could offer financial protection to geologists (and other professionals) to help them feel more secure in choosing assignments or rejecting those that do not sufficiently comply with their deontological duties and ethical positions. Our primary aim, once again, is to show that these mechanisms are neither intrinsically irrational nor unfeasible, and to initiate a debate. This is separate from the decision to implement them and from working out the practical details of how they would be applied. Additionally, many other similar or entirely different solutions could

certainly be developed.

Guaranteed minimum income (GMI) is a social welfare system, adopted in different variants in several countries, designed to ensure that all citizens or families receive a basic income sufficient for living. This system requires individuals to meet specific eligibility criteria, which typically include citizenship and not already having an income that meets the minimum living standards.

In our case, a basic GMI-like mechanism would ensure that a professional geologist receives a minimum monthly or yearly contribution of *x*, provided their income falls below *y*. The contribution could be granted after the recipient has completed a CPD course on deontology and ethics, oriented toward practical application and supported by the illustration of example cases. During the course, it should be emphasized that one of the objectives of this support is to provide a safety net aimed at enhancing geologists' ability to make decisions less influenced by financial pressures and more aligned with high deontological and ethical standards. This support may be particularly beneficial for early career geologists[4] and could help reduce the presently strong gender income disparities (see Appendix A); moreover it could also - though not necessarily - lead to improved professional conducts, which serves the public interest.

It may be roughly estimated that, in Italy, implementing a GMI-like scheme for geologists under 35 years of age, for example, could require a few million euros in funding (see Appendix A).

The goal here is not to provide precise minimum income thresholds, resource estimates, or implementation details, as that would also far exceed the author's expertise. Instead, the aim is to suggest that this scheme, even if extended to other professional categories, would likely involve amounts that are hundreds or even thousands of times smaller than the expenditures many states, including Italy, allocate for other purposes, such as military spending or environmentally problematic subsidies [e.g., Damania et al., 2023]. Therefore, implementing this or similar systems through public funding (with the possibility of additional sources such as solidarity contributions from geologists themselves) seems more about reallocating a modest portion of existing resources rather than seeking substantial new funding, for instance through increased taxation.

Undoubtedly, having more money does not necessarily equate to greater ethics, and it may be argued that GMI-like mechanisms might reduce incentives to work or be perceived as an undue privilege. However, this concern can be mitigated by appropriately structuring the contribution, including selecting the correct sum, setting

[4] According to CRESME and Fondazione Centro Studi CNG (2024) the average income for male geologist significantly decreases with younger age groups compared to the 50 – 59 age group, with the 30 – 39 and 20 –29 groups experiencing the steepest decline (-44.7% and -66.5%, respectively).

the income levels required to receive the benefit, and defining a time period within which the contribution can be received. Additionally, a pilot program and continuous monitoring can help assess the effectiveness of the measure and address any potential problems in a timely manner. Furthermore, appropriate governing bodies and procedures would be needed. In Italy, the governing body could be EPAP, the agency that collects contributions from professionals belonging to various categories, including geologists, and offers social security and assistance protection.

Let us now consider an insurance-like mechanism. This would involve a geologist paying a premium X to an insurance provider and receiving a sum Y if they withdraw from an assignment due to deontological or ethical reasons that only become apparent after accepting the assignment. If the provider believes that the probability of withdrawal is P, then underwriting the policy would be advantageous if X exceeds the expected loss $P \times Y$.

The details of this scheme concerns, among other things, the conditions under which the payout Y is granted, the actual value of Y and the premium X, and the estimation of P (which may be based on data regarding the actual withdrawal frequency, whether general or specific to a particular professional, even though such data may not initially be available). The payout Y may cover only the expenses for litigations or a more or less significant part of the financial loss, with a consequent adjustment of the premium X. Prior to signing the policy, the insurance provider would likely request a declaration from the professional that all relevant deontological and ethical aspects have been reviewed and found sound before accepting the assignment. This may serve as an incentive to thoroughly check these aspects.

Generally, insurance policies are designed to cover unintentional and unforeseen events, while standard professional liability insurances typically cover negligence, errors, and omissions, rather than decisions based on deontological or ethical considerations. However, the reasoning above is intended to demonstrate that such an insurance scheme is not inherently unreasonable, though implementing it may require approval of relevant regulations. Its appeal to potential subscribers will also depend - among other factors - on X, Y, and the details of the insurance contract and the assignment under consideration.

5.4 Promoting ethics in professional bodies and corporations

Respecting and promoting deontology and ethics should become cornerstones of the geology profession, as well as others. Professional and public bodies, as well as corporations, should take sustainability, ethical education, and social responsibility seriously. They should implement programs that recognize and reward professionals and employees engaged in activities that uphold ethical principles and professional integrity. These rewards do not necessarily have to be financial. These programs will inevitably involve reporting on a professional's or employee's contribution, and it is crucial that they feel confident that such reporting will be used for their benefit, not as a tool for control.

6. Conclusions

In many cases, high-quality technical work, adequate resources, and an open, constructive dialogue among professionals, clients, decision-makers, and stakeholders can lead to solutions that are mutually agreed as well as deontologically and ethically sound. However, this is not always the case. In this paper, we have explored various deontological and ethical tensions related, though not exclusively, to the geological profession, without claiming to be exhaustive. While the focus was on the Italian context, the issues addressed have broader implications. As mentioned earlier, respecting and promoting deontology and ethics should become cornerstones of every profession. We have discussed possible actions and mechanisms that may help achieve this objective. Many other approaches can be devised, which may require thinking "outside the box" and challenging the limits of what is currently deemed "realistic" (a term that often implies maintaining the status quo). Clearly, the pros and cons of each solution must be carefully evaluated.

The GMI-like and insurance-like schemes are essentially market-based mechanisms, illustrated to provoke thought. We believe there is nothing intrinsically wrong with promoting (geo)ethics also through markets. In fact, as argued by Herrmann-Pillath [2021], under appropriate conditions markets may even be mobilized to orchestrate a geocentric turn in our societies.

Ensuring a guaranteed minimum income for geologists and other geoscience professionals could be seen as an undue privilege. However, depending on the implementation details, it primarily serves as a financial measure to support young professionals, reduce gender gaps, and help protect the environment and public interests by alleviating the pressure to accept problematic assignments due to

financial necessity. Naturally, many other solutions are possible, and the time has come to think about them. Clearly, implementing these solutions does not conflict with other welfare obligations.

What is more, acting at the professional level is not enough. Sustainability and Earth-oriented ethics should be promoted throughout the education system, from primary schools to universities, not as impositions of a worldview but as reference frameworks to be carefully considered. However, Frodeman [2023] advocates for the need to reorient university education towards sustainability also by integrating environmental change courses into the core intellectual curriculum. This curriculum should include multiple interdisciplinary courses in geoethics, covering topics from science to risk assessment to restorative justice. The central aim of these initiatives, Frodeman writes, is to acknowledge that we now share a common goal that should take precedence over all other values: protecting our planet.

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Appendix A

The funding required to implement the GMI-like scheme mentioned in Section 4 can be estimated using data from CRESME and Fondazione Centro Studi CNG (2024), particularly Sections 11.4, 11.5, 12.2, and 12.3. Let us focus on geologists under 40 years of age in 2022, the most recent year for which income data are provided.

In 2022, the Italian Register of Geologists listed 228 geologists in the 20–29 age group and 1,361 geologists in the 30–39 age group. Since female geologists account for approximately 18.6% of the total, there were 186 male geologists and 42 female geologists in the 20–29 age group, while these numbers were 1,108 and 253, respectively, for the 30–39 age group.

The estimated yearly average income for males was €14,401 in the 20–29 age group and €23,773 in the 30–39 age group; for females, these figures reduce to €9,409 and €15,532, respectively. Note that an income of €9,409 is below the poverty threshold for 2022 (ISTAT, 2024).

To bring these geologists to an income level comparable to, say, that of a school teacher—around €22,000, though this can vary depending on various factors—additional income support would be necessary. Specifically, in the 20–29 age group, each male geologist would need €7,599, and each female geologist €12,591. In the 30–39 age group, male geologists would not require any support, while each female geologist would need €6,468. The total support, therefore, would be calculated as 186×7,599+42×12,591+253×6,468 = €3,578,640.

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