

Socioeconomic Repercussions of Biohazard on Geoscientific Activities with Regression Analysis for Oil Demand: Impact of Pandemic COVID-19

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ABSTRACT

The Coronavirus epidemic has a long-term impact on geosciences' interests and has important consequences for the socio-economic front. This paper aims to discuss the alterations in geoscience's academic and industry operations because of this pandemic spread and its ramifications on global oil demand and its socio-economic consequences. The coronavirus outbreak could be the most defining event for the socio-economic incident of this decade. It has profound consequences on the industry, community, corporations, the environment, and governments. Coronavirus is a type of biohazard that has adversely affected all the fields of science, including geosciences. The online methodologies suspend or replace the teaching, research, training, and lab activities. International geoscience conferences, seminars, student education weeks, and geological fieldwork are delayed or postponed. In the oil, mining, and geotechnical industries, more than 90 percent of field operations are delayed to remain safe from a pandemic disease. Oil prices slashed to more than 20 percent in a single day, the lowest in three decades. Low demand for some mining and mineral goods also reduces their market prices to about 10 percent or more. Geotechnical projects related to the establishment of emergency health units were done at a rapid pace. In contrast, other infrastructure projects were put to a halt to decrease the human impact and mitigate the epidemic's extension. The socio-economic implications are discussed with the oil market, traveling and aviation, and services and industry sector. Oil industry contracts due to reduced factory production, which hampered the industry and the economy. In comparison, the p-value of the oil market is below 0.05, and this analysis shows a negative regression coefficient. Owing to lower economic operations and reduced demand, manufacturing and services have also been affected. Consequently, all these sectors resulted in huge employee layoffs, work-at-home trends, delays in construction and infrastructure projects, and reduced social interaction. However, this pandemic encourages us to pursue more creative virtual and online platforms for academic and industry activities by teaching artificial intelligence and advanced technological solutions.

1 Introduction

The coronavirus pandemic is undoubtedly a global health crisis that harms all science disciplines and impacts life's economic and social aspects [1], [2]. Government and other law enforcement agencies must make complicated and compromising decisions in case of any natural hazard, including pandemic situations, to cope with disaster management and operations. These decisions variably influence the socioeconomic development of the community around the globe [3]. Human life is connected directly to the planet Earth and its geoscientific studies. The geoscientific fields like geochemistry and hydrogeology address the minerals and metals content within the safe limit for clean drinking water to society [1]. The energy required for daily life activities relies on oil discovery and the production of hydroelectric power. These petroleum and hydropower sites are the result of geoscientific actions. Hence it is of prime significance to discuss the COVID-19 repercussions in geosciences and its impact on socioeconomic development. The regression analysis can be used in a variety of disciplines. The regression analysis and multiple linear regression are quite useful in quantifying raw data or regression coefficients for multivariate data compression and processing [4], [5]. Ordinal regression is used for data generation in medical sciences and human interaction [6]. Oil price was also analyzed by quintile regression to get its relationship with the stock market and business activities [7]. In contrast, regression analysis was applied to forecast energy demand combined with economic and population variables [8]. The energy demand is closely tied to energy efficiency and energy-saving principles of the current era, explicitly related to oil and energy demand [9]. Energy consumption determines the production and harvesting of energy avenues [10], [11]. The Coronavirus disease may come from the Hubei Province of China in early December 2019. The term COVID-19 is used for both the virus [12] (Fig. 1) and the disease [3]. COVID-19 was declared a global health emergency by WHO (World Health Organization) [12] and termed a pandemic disease on March 11, 2020 [3], [13]. The natural hazard due to infectious disease is of biological origin. This coronavirus disease could be classified as a biohazard where most of the natural hazards are physical, including earthquakes, tsunamis, volcanic eruptions, and floods [3]. However, these natural hazards often coincided with a detrimental impact on human life, for instance, the earthquake in Croatia in March 2020 in the presence of Coronavirus, compound the risk factor and fatalities by enhancing the transmission of disease.

The coronavirus pandemic's social and economic costs are influencing individuals, researchers, lab technicians, field, or site officials, investors, and industrialists in a broader picture. The uncertainty, volatility, and instability on the economic front will prevail for the medium to the long-term period [14], [15]. The socio-economic factors need to be understood to be vigilant and responsible for planning and initiatives in the coming years.

2 Impact of Coronavirus on Geoscience

The Coronavirus impacts research, particularly geosciences. This pandemic disease has resulted in many layoffs in geosciences and poses challenges in academic teaching and scholarly work. Furthermore, it is difficult to forecast that this disease's waves may affect human activity [16], especially in geoscientific movements. A brief and concise overview of these adverse effects is described as follows:

2.1 Academic Activities

The global pandemic scenario has led to complete or partial lockdowns around the globe and has significantly affected primarily tertiary education levels [2], [16], [17]. This situation of lockdown has been wide-ranging from many weeks to a few months in several countries. Academic institutions were unable to pursue the scheduled semester plans, study arrangements, and research outcomes. The travel restrictions and closure of university campuses hinder educational activities [18]. Furthermore, home policy work had dramatically eroded efficiency due to home distractions, limited internet access, and low workspace environments [18]. These academic activities are broadly classified into three categories: academic teaching, academic research, and professional events.

2.1.1 Teaching and Lab Operations

Academic teaching in the geoscience discipline is seriously affected by the COVID-19 pandemic. The instructional environment is widely changed from in-person to online mode [2], especially for spring 2020 and in some universities in the Fall 2020 semester. Moreover, interactive lab activities were also replaced

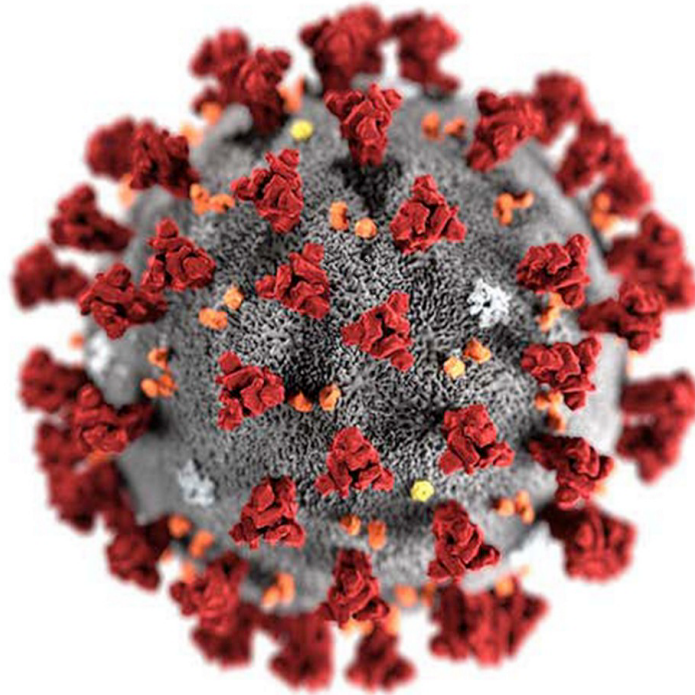


Figure 1: Illustration of the Virus [12]

by in-home actions or virtual lab demonstrations. In geosciences, another mode of teaching termed fieldwork was also influenced by the pandemic conditions, where most of the field movements were either canceled or transformed into the simulated environment. In a few cases, the field courses were confined to local excursions [19]. Even in this contemporary scenario, it is hardly possible to antedate exactly how this pandemic will ultimately evolve the geoscience field and lab practices [18].

2.1.2 Faculty and Student Research

The pandemic deferred student and faculty research work and resulted in the interruption of planned research projects. The undergraduate research activities were adversely affected by Coronavirus than graduate or faculty research tasks. Many research-mode geoscience programs were also replaced with computational or virtual modes [19]. It is hard to meet up the research timelines and peer review process for academic publications. As a result, many of the geoscience journals (for instance: *Mediterranean Geoscience Reviews* published by Springer) are mindful of the pandemic situation, and therefore, they now have more flexible policies for deadlines for manuscript editing and publication revisions [20].

2.1.3 Conferences and Professional Meetups

Like any other scientific discipline, geoscience activities are widespread around the globe. These events include conferences, lectures, meetings, seminars, workshops, field sessions, short courses or training, and student education weeks. Numerous geoscientific platforms like the American Association of Petroleum Geologists (AAPG), European Association of Geoscientists and Engineers (EAGE), and Society of Petroleum Engineers (SPE) are trendy for students, fresh graduates, faculty members, and industry specialists for collaborations and professional networking and connections. Many international events are postponed or canceled because of pandemic conditions. For instance, the 82nd annual EAGE conference previously scheduled in June 2020 has now been postponed to December 2020 [21]. Similarly, AAPG yearly conference and exhibition (AAPG ACE) was earlier scheduled in June 2020 has also been canceled [22]. These delays and cancellations are due to the ban on social and professional meetings, restrictions on international traveling, and un-authorization of the commencement of large gatherings by government and law enforcement agencies. The development of professional collaborations in these meetings and conferences is often across the institutions. It is multinational, which has resulted in the creation of additional opportunities and connects with foreign innovations. Consequently, scientific cooperation for research and industry operations is expected to decline to owe to delays or cancellations of such conferences and

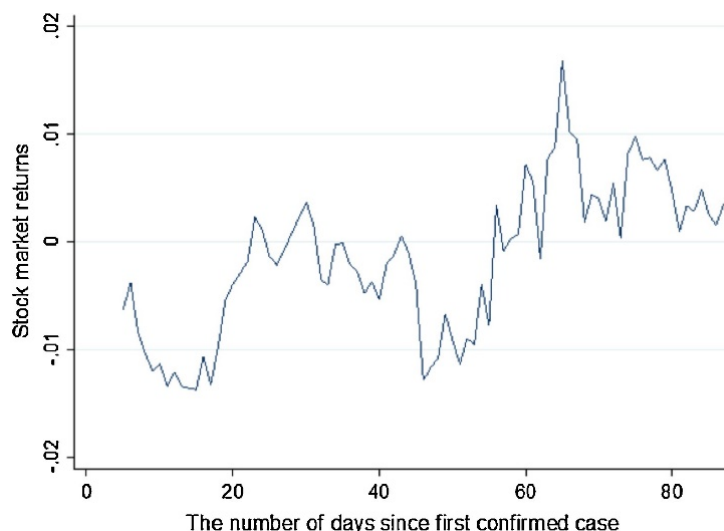


Figure 2: Stock market returns against the number of days from the date the first COVID-19 case was confirmed [25].

meetups dramatically. Besides, the keynote speakers, poster presenters, and oral presenters previously require in-person attendance, which will now be altered with online or virtual sessions or meetings [18]. Most of these events may be updated by live video sessions or virtual reality mode in the future. However, these virtual meetings could also cultivate professional collaboration with time [18].

2.2 Industry Ventures

According to the Geological Survey of Ireland (GSI), the COVID-19 pandemic had a significant effect on the geoscience industry. According to the report, most geoscience projects experienced delays or were scrapped during this lockdown phase, while over 90 percent of field operations related to geoscience remained suspended. Uncertainties in facilitating foreign travel, also take their toll to complete overseas ventures [23]. The employees working from home had their limitations in the form of a lack of professional workspace, poor internet, and home distractions at the expense of limited work output. They missed the deadlines for their projects [18].

2.2.1 Petroleum Exploration and Production

The worldwide pandemic has severe consequences on the crude oil market [15], [24]. A steep decline in global oil production as a result of the non-agreement situation during the Organization of Petroleum Exporting Countries (OPEC) meeting which was held in March 2020 [17], [25]. Even the reduced production of oil flushes the market with a larger volume of oil [25] (See Figs. 2 and 3), though the global oil demand was comparatively low [2], [17], [26]. The shrinkage in international crude oil prices (since the Gulf war three decades ago) [27] adversely impacts global oil exporters, resulting in a long-term slowdown of oil-exporting economies. It could also result in uncertain economic trends and an overall volatile financial market situation that eventually leads to an economic recession [14].

The strict lockdown policy and shutdown of industrial units in the global production hub of China (the second-largest oil consumer [27]) further deteriorates the oil demand and the global oil market [26], [28]. The reduced need for oil pushed the global crude oil price to sink. The West Texas Intermediate (WTI) petroleum price was initially above 50 USD per barrel in February 2020, which decreased substantially to about 20 USD in March 2020 [2] when the Coronavirus was spreading exponentially [14]. This massive drop in oil prices adversely affects petroleum production, especially in the USA, where oil shale players with a high cost of oil production (25 to 35 dollars) relative to the Middle East with a lower cost of crude oil production [28]. However, low oil prices negatively influence US and Middle East countries by shrinking economies [2]. The oil production industry was severely hampered by lower oil prices, where the high cost of production resulted in the shutdown of production facilities and staff layoffs from oil companies.

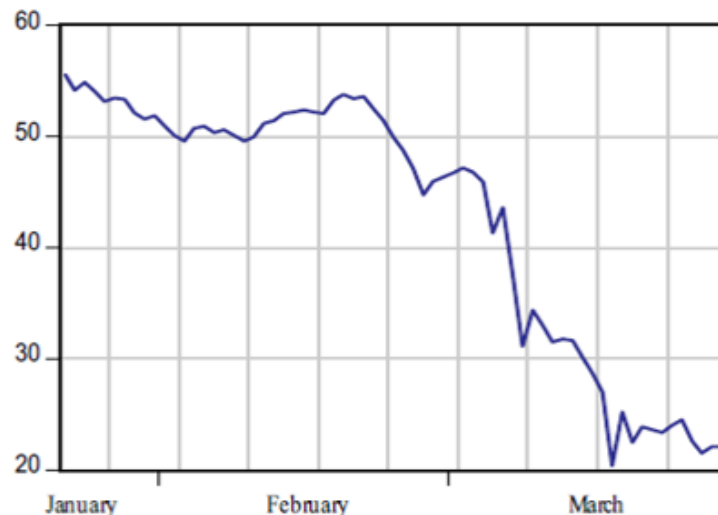


Figure 3: Time series trend of WTI price from January to March 2020 [25].

2.2.2 Mines and Minerals Production

The mining industry supplies the industry with raw materials and produces several products. Not only does the mining sector create business activities, but it also enhances the region's socio-economic revolution [29]. However, there is a significant challenge for the mining sector as physical or personal work is difficult to replace with the online or home-based positions [30]. There is a significant negative short-term impact on the mining industry but considerably ambiguous in the medium- to long-term [31]. Coronavirus's spread can devastate the mining sector since the building market and industrial materials are significantly limited. Some of the gigantic mining firms (Rio Tinto and BHP Billiton) in the world have lost almost half of their earnings because of the pandemic situation. Moreover, the price of minerals (copper, aluminum, lead, nickel) has been reduced to more than 10 percent due to a decline in demand after the coronavirus outbreak [31]. Besides, the raw material acquisition for construction, such as stone quarrying and crushing for domestic and commercial purposes, also decreased because of the suspension of construction and infrastructure projects due to the pandemic spread [32].

2.2.3 Geotechnical and Engineering Geology Activities

Geotechnical and geo-environmental projects and research work are seriously obstructed by the coronavirus epidemic [33]. Geotechnical engineering, geo-mechanical, and environmental sciences are closely linked to the impact of the COVID-19 pandemic. Most geotechnical and engineering geology operations are associated with natural resources and field sites in the lockdown phase to stop the virus's transmission. Most of the field projects were either suspended or delayed. The planned deadlines and timelines assigned for the projects are seriously disturbed by this pandemic condition. On the other hand, the emergency health units were also necessary for swift intervention to battle the pandemic outbreak. These units initiated the infrastructural development required for pandemic mitigation with geotechnical, structural, and environmental professionals. Likewise, these geotechnical researchers could collaborate with material and biological scientists to find possible remedial for the coronavirus outbreak [33].

3 Socio-economic Repercussions

The socioeconomic structure has been strongly influenced by the global coronavirus outbreak [34]. Economic disasters are hovering globally because of the coronavirus pandemic emergency. Besides, several preventive measures such as self-isolation, travel restrictions, and social distancing gradually evolve the social norms and cultures worldwide. The demand for commodities and products eventually decreased, resulting in unemployment and a decline in economic growth [17]. The uncertain impact of Coronavirus on the global economy is hindering policymakers to precisely constructing financial measures. The instability and confusion have generated market turmoil that inhibits economic growth [15], [34]. Consequently, a variety of pathways were planned according to the emerging situation caused by the current condition. This pandemic is estimated to contribute to the global economy [35], [36]. Besides the economy, the

coronavirus outbreak adversely affected social mobility and social interactions. Social isolation harms the lives of both children and adults because of insufficient social activities [17].

3.1 Oil Market

The oil market collapsed due to larger volumes of oil available [25]. Simultaneously, the buyers were willing to absorb the massive amount of oil that finally crash the oil price to a record level of more than 20 percent low in a single day, which had never occurred in the last 30 years [15], [17]. The decline in global oil demand because of the pandemic disease represented the economy's downturn, where businesses have limited or reduced development activities hampering the growth of the industrial and production sector [35]. However, in some cases, the cheap oil (energy) available to the community and industry significantly controls consumer products' inflation and cost. Oil markets at a lower price influence the oil industry revenues and reduce the economic size of oil-exporting countries [2].

3.2 Travel and Aviation

The closure of educational institutions and geoscientific field activities undoubtedly has socio-economic implications. The world's travel and tourism industry is predicted to lose over 50 million jobs because of the current pandemic outbreak, leading to corporate financial issues for companies and laying off a significant number of employees [2], [17]. Moreover, worldwide travel bans and stay-at-home orders affect more than 90 percent of the population [37]. Many oil field activities and mining sites have halted their operations to reduce the transmission of diseases. The cancellation of international geoscience programs and delays in overseas geoscience ventures also influenced the travel and aviation industry. Moreover, the closure of international boundaries from various countries [17] also restricts the flexibility of international collaboration and multinational and multicultural environments, which is vital for industry and academic cooperation. This situation has forced individuals to opt for online or social networking platforms for communication, scientific events, and professional correspondence.

3.3 Services and Industry Operations

The geoscience discipline broadly encompasses both operation and service companies. These service and operation corporations may exist in all sub-disciplines such as energy, mining, and geotechnical industries. The transport limitations and stay-home strategies immensely hampered both services and operation companies. Big businesses have plans to apply thousands of job cuts to overcome the economic damages incurred due to the pandemic. The ongoing projects and resource production significantly troubled many industry players. On a positive note, physical or in-person services are now being replaced by online or virtual assistance, leading to more technical deployment and more expense-effective and time-effective innovative solutions [27].

4 Discussion

The geoscience industry and research are severely affected by the Coronavirus. Student internships and graduate jobs are put to a halt and suspend the recruitment process for months due to the latest pandemic situation. The pro-active attitude of the industry is shattered with unforeseen problems, while research output is deeply disrupted. In most cases, the geoscientists must opt for online operations rather than face-to-face interaction to survive in this tricky set-up where one must keep social distancing and avoid frequent travel. This changing scenario will result in the emergence of new developments and requirements and creative technology-oriented solutions.

4.1 Evolving the Trends and Norms

The whole planet is now flying into uncharted territory due to the Coronavirus, which makes it difficult to quantify the harm in terms of social and economic practices. Therefore, it is very unclear about the duration of the restriction, length of prohibitions, and period of lockdown measures [16]. The commencement of many geoscientific events previously in-person and online will now be gradually shifted to a virtual environment that could cut greenhouse emissions by up to 50 percent [18]. This reduction will also positively influence the professionals to attend the session online with limited resources, and the ability to travel and will also save plenty of time. One can quickly join the professional event online

without extensive formalities of travel, expenditures, and other associated costs. Consequently, this pandemic scenario helps us think of the box solutions, use alternate methods, and enhance our instinct to work under challenging conditions and newly evolved circumstances. Moreover, the allocation of financial and social resources would now be revised and updated according to new and emerging situations and movements.

4.2 Development of Technology and Innovation

The pandemic circumstances have provided us with an opportunity to develop new creative technologies and reinvent new concepts that could encourage geoscience activities. It also enables us to reallocate our limited resources to create novel strategies and emerging ways of professional interaction, which will be more practical in the future. Social and economic issues should be carefully discussed while developing innovative solutions. The development expects a revolution in information technology and digital online communication of new learning modules, online teaching, discussion platforms, and internet usage for online courses and tutorials, and conducting virtual labs with supporting material would be an emerging trend to keep pace with the developing pandemic situation.

4.3 Lockdown Impact on Global Oil Demand

Due to the global pandemic outbreak, there is a considerable reduction in oil demand [38], specifically related to the number of reported COVID-19 cases [39], as shown in Table 1 and Fig. 4. The world was practicing lockdown policy and restricted travel guidelines, which significantly reduced oil consumption. This phenomenon can be noticed in Table 2 as the P-value is less than 0.05, and the regression coefficient shows that 167971.501 units decreased per month during the lockdown. Also, industry operations were suspended from restricting the pandemic's spread, which affected oil consumption for commercial production and manufacturing. Consequently, many layoffs occurred that negatively impact socio-economic activities.

Table 1: Number of Confirmed COVID-19 cases and global oil demand in a million barrels per day (Jan-Apr 2020) Number of Confirmed COVID-19 cases and global oil demand in a million barrels per day (Jan-Apr 2020)

Month	Reported Cases	Oil Demand (in a million barrels)
Jan	9826	96.98
Feb	85403	97.11
March	750890	98.93
April	3090445	79.15

Table 2: Oil demand during lockdown (Jan-April 2020)

-	Coefficients	P-Values)
Intercept	16234693.5	0.014101
Oil Demand	-167971.501	0.015834

4.4 The Way Forward

Presently, it is hardly possible to foresee the complete impact of Coronavirus, especially in geoscience [18]. However, this challenging situation will transform our way of working and inspire us to embark on new, innovative, and more advanced interactions. However, it is highly recommended that the survey and geological field practices should be facilitated with the implications of standard operating procedures (SOPs). There must be gradual ease in restriction in geotechnical and onsite construction works [23]. The professional gathering and teaching activities could be switched to online or virtual mode until or unless the remedial vaccination program is in service. The implementation of advanced technologies with artificial intelligence for automatic tracking and geofencing of coronavirus patients could lead in a positive way to eliminate the pandemic condition [24]. It is pertinent to mention here that the government should re-evaluate Coronavirus's impact on all industrial sectors and academics to implement preventive measures, but the socioeconomic attributes are right on the track and develop a comprehensive long-term plan for the future years.

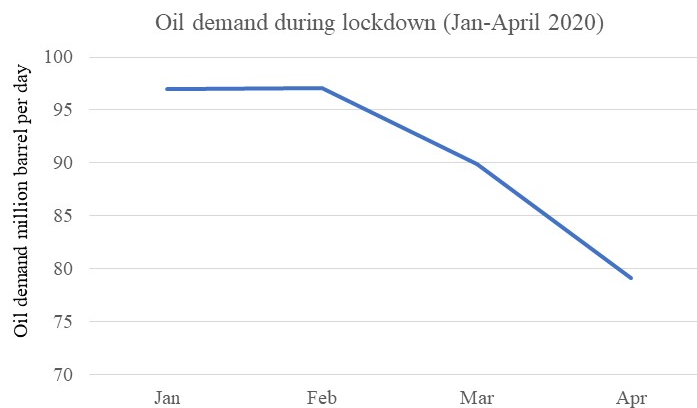


Figure 4: Oil demand during lockdown (Jan-April 2020).

5 Conclusion

Coronavirus has instigated diverse and distinct professional challenges for global research and industry, especially in the geoscientific field. Applied and field science relies heavily on the field, lab, and onsite industry and research operations, which have been ravaged by the current epidemic virus. In addition to this, the understanding of socio-economic ramifications should also be considered while planning the long-term plan and development strategy. The student training, fieldwork, lab, and teaching movements in the geoscience discipline are suspended for at least for months and will also be influenced by this pandemic outbreak shortly when online or virtual platforms gradually replace most of these actions. However, geoscience students' productivity and scholarly activities are substantially reduced due to the suspension of labs and experimental work and the closure of research project fieldwork due to work-at-home policy, travel restrictions, and the closure of academic institutions. Moreover, the geoscience-related industry experience low demand both in the mineral and petroleum sector which has resulted in the lowered market price of oil, minerals, and crushed stone. The geotechnical industry is primarily focused on developing emergency health units, while other constructions and geotechnical sites were barren because of pandemic states worldwide. Reduced and limited manufacturing and research activities take their toll in the form of unemployment and the business economy, which has a severe impact on geoscience professionals' socio-economic position and the entire society in general. The need of the hour is to design and adopt emerging and innovative technological capabilities and virtual professional platforms to incorporate into the geoscience discipline to modify the conventional ways of operations and develop new trends to reduce the negative socio-economic repercussions of the pandemic state. Therefore, governments worldwide should cautiously contemplate the socio-economic impact while designing new policies and strategies for the future.

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