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Development of Geo-tourism in the southeast Caspian seaboard With the special view of mud volcanoes

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Abstract
The development of geo-tourism in the southeast of the Caspian seaboard with a special view on the therapeutic potential of mud volcanoes by geochemical and mineralogical methods for the first time was studied (Case study: Naftlicheh mud volcano). The results of mineralogical and geochemical studies carried out by XRF&XRD methods show that Naftlicheh mud volcano has no significant toxic substances and its main minerals are quartz, calcite, dolomite, halite, clay minerals such as smectite and illite. There is a high amount of elements such as boron, copper, iodine, bromine, vanadium, magnesium, sodium, calcium, organic acids, aromatic hydrocarbons, and bicarbonate. So Naftlicheh mud volcano has a therapeutic aspect and can be one of the essential destinations for curative geo-tourism. In addition to therapeutic effects, mud volcano contains essential scientific information about evaluating gas and oil reservoirs, salt domes, and the tectonic situation of the region (faults and subduction) therefore as an educational geo-site can attract a large number of domestic and foreign tourists, and geo-tourists. Also, in line with the geo-tourism development of the Naftlicheh volcanic mud area, some guidelines are suggested, such as: Presenting media publicity nationally and internationally about the therapeutic potential of Naftlicheh mud volcano.

Keywords: Caspian seaboard; Geo-tourism; Geomorphology; Mud volcano.

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1. Introduction

The tourism development process, the strategies, approaches and policies of different countries show as regards the subject of tourism. This process must be based on sustainable, continuous, and executable methods internationally, nationally, and regionally and be effective as a part of the country's overall economic and social policy and complementary to it (Heydari, 2008). As geo-tourism is considered as one of the types of tourism being especially concentrated on geological and geo-morphological attributes (Dowling et al., 2010). In order to development geo-tourism, for the first stage, we need a concentrated identification of the country's geology and geomorphology. Considering that Iran is one of the few countries enjoying a wide variety of geo-tourism attractions requiring proper interpretation for tourists. For this reason Dowling and Newsome (2006) regard the offering of interpretation regarding geo-tourism attributes of a region as the primary solution for developing tourism. Geo-tourism development can, as a whole, lead to the sustainable development and utilization of the benefits of this industry, from among which one can allude to influencing economic boom and currency revenues, preventing geo-sites margin dwellers from migrating to big cities, raising culture and education levels, preventing geological attractions from being demolished, creating jobs for geography and geoscience researchers, developing geosciences, renovating culture of geosites' margin locals through monetary motivations ,etc. geo-tourism is the new branches the tourism industry only in countries with geological phenomena ; it can be used as a unique and exclusive industry. In this regard, Iran is a country that has been very apt and has countless attractions and incredible geological diversity, and it can attract many tourists and scientific tourists. Iran locates in the Middle East- Southeast Asia , and for years, its geological features have been studied by many researchers from around the world, it has also been called the "geologists' heaven"(Bayati, et al., 2010). Iran has diverse climates and diverse geographical features. Iran's particular climate and tectonic conditions have created varied geological and geo-morphological forms in different areas statewide (Yazdi, 2012).

2. Literature review

Mud volcanoes are among Iran's noteworthy geo-morphological attractions which appear in various geological environments. These scenic geo-morphological terrains have concentrated in two areas of Iran, one in the margin of Caspian Sea in Golestan province and another in Iran's southeastern coasts in Sistan and Baluchistan provinces. A mud volcano is a natural phenomenon similar to a volcano , which is in the form of a conical

hill ,and instead of lava coming out from its mouth, gas and mud .A mud volcano in cosmology culture defines as " mud and hot water which is thrown out of the volcano's mouth and generates temporary conical ,and sometimes natural gases combined with oily sediments are mixed with these materials as well" (Negaresh, 2006).The monitoring of the place of volcanoes and using satellite data can be used to predict the new position of possible mud volcano. There are many global studies about mud volcanoes, mechanism of formation, and paleo -activity. The most widely used name for this natural phenomenon nowadays is "mud volcano", where they vary in size, the larger types are known as mud volcanoes, and the smaller mud cones. The term "salse" uses to even smaller varieties than "cones" and they usually emit only argillaceous material without solid blocks. Still smaller occurrences are often designated diminutive expressions such as "mini-volcano"and "mini-salse" and finally "mini-griffin" or simply "gas vent" (Guliyev &Feizullayev, 1997; Jennerjahn et al., 2013). The South Caspian Basin (SCB) is giant oil and oil-gas-condensate field, and hydrocarbon appearances in mud volcanoes widely distribut here. The mud volcanoes accompany all oil-gas fields in the area. About 900 onshore mud volcanoes known on the Earth, about one -fourth are within the western and eastern flanks of the SCB, and more than 160 mud volcanoes are on the South Caspian Sea bottom. The sources of the mud volcanoes are located at significant depths and are the natural channels of the matter redeployment in the sedimentary basin (Huseynov & Guliyev, 2004; Huseynov, 2004).Submarine release of waters from mud volcanoes and ejection of various components are crucial in the saline balance of marine and bottom sediment water. So the annual release of salts into the sea increases the average salinity of marine waters. The gases of mud volcanoes have a hydrocarbon composition .they consist mainly of methane, a small admixture of ethane, propane, butane, pentane, and other non-hydrocarbon gases, such as CO2, N, H2S, Ar, and He (Huseynov & Guliyev, 2004).Petrography studies of the rock-ejects show that the ''roots'' of the majority of the mud volcanoes of the SCB are related to the Cretaceous and Paleogene-Miocene deposits. Most mud volcanoes locate in the coastal areas of the Caspian Sea and Golestan Province. Mud volcanoes are essential source of information about subsurface sediments and conditions. Mud volcanoes differ from magmatic volcanoes in activity areas astonished by their beauty, but their direct connection with the oil and gas system attracts the most significant attention for study (Guliyev & Feizullayev, 1997).

The mud volcanoes also exist on the floor of the sea and can form islands and banks that alter the topography and shape of the coastline and even trigger earthquakes. Mud volcanoes are classified to their location of

formation into: "continental mud volcanoes" that appear on sea coasts and are subject to erosion under the influence of flowing waters, wind, and rain (Fasl-e-Bahar et al., 2010; Fasl-e-Bahar, 2011).

Sub-sea mud volcanoes are mainly formed at a depth of 10 to 800 meters and are eroded by waves and seabed currents (Fasl-e-Bahar et al., 2008; Fasl-e-Bahar, 2011) and "island mud volcanoes" that gradually form islands in the shallow depths of seas, as a result of a high volume of outflowing materials (Negaresh, 2006).Classifying mud volcanoes based on geological environments and geological origin distribution of mud volcanoes is strictly controlled by the geological environments in which formed. In this regard, the origination of mud volcanoes is controlled by Neo tectonic activities, especially compressional. Sedimentary or tectonic load caused by swift sedimentation, connectivity, and over thrust, Active and continuous production of hydrocarbon. Presence of deep, soft, plastic, fine-grained, and thick sediments in sedimentary sequence (Negaresh, 2004; Negaresh, 2006; Dimitrov, 2002). The South Caspian Basin provides a unique possibility to study mud volcanism and fluid flow in an active pierced basin. Over 400 active mud volcanoes are present in this region, both on-shore and off-shore (Planke et al., 2003). Because of the large volume of sedimentary deposits concentrated in South Caspian basin, More mud volcanoes are located off-shore in this area. The erupted solid material is present as fall or flow deposits. Breccia flows are commonly emplaced during mud volcanic eruptions. About mechanisms of formation of mud volcanoes must say that at a certain depth, where intense gas- generation (main methane) takes place due to the decomposition of buried organic matter, the instability of the system becomes yet more pronounced and reaches a critical condition. With a sufficient density contrast between the overlying and underlying deposits and with the interaction of tectonic processes, the overlying deposits may lose their integrity, and the underlying argillaceous sequence may force upwards, resulting in the creation of a pier cement structure (clay diapir) or a mud volcano (Guliyev & Feizullayev, 1997). Mud volcanoes form either as clay diapirs that reach the ground-surface or as fluidized argillaceous sediments, along with structural weaknesses within subsurface sediments/rocks (Milkov, 2000). Significant factors causing the formation of mud volcanos in the South Caspian basin are Pliocene-Quaternary high sedimentation rates, super thick sedimentary cover and predominance of clayey rocks, and low temperatures. It suggests that mud volcanoes form by two primary mechanisms. The first mechanism is forming a mud volcano directly on top of a seafloor/surface-piercing shale diapir as a consequence of fluid migration along the body of the diapir. If the fluids do not migrate along the diapir, a mud volcano will not form, and only a seafloor shale

diapir will occur. Mud volcano may or may not eventually develop on top of such a diapir.

The second and the most common mechanism is the foundation of a mud volcano due to the rise of fluidized mud along faults and fractures. In this case, sediments with a high fluid content reach the seafloor and form a volcanic mud structure. The mud volcano may connect to shale diapirs located at depths below the seafloor. In general, the source of mud does not exceed 3 - 4 km (Feyzullayev, 2012).

Depths, where the liquid, gaseous and solid products of mud volcanoes obtain, appear to be different. The Gases come out from high depths (7 - 15 km), and present the information about activity of mud volcanoes (Feyzullayev, 2012). From among the most essential gases ascending from mud volcanoes can refer to CH4 that constitutes 85 to 89 percent of the overall gas volume. With a maximum of 10 percent, CO2 is ranked second, and other gases such as H2S ،N2، C5H12، C4H10، C3H8, and C2H6 found at minimal volumes. Quantitative assessments of the gases released from mud volcanoes show that they are one of the most important natural sources of atmospheric methane and annually produce about 10.3 to 12.6 Tg of methane gas (Dimitrov, 2002). According to mentioned subjects, mud volcanoes are one of the most exciting and unique geomorphologic processes in a world, which are highly important in a view of geology, environment, tectonic, therapeutic, geo-tourism,etc. In this article , for the first time ,the development of geo-tourism in the southeast Caspian seaboard with a special attitude to the curritive effects of Mud volcanoes was studied(case study Naftlicheh Mud volcano) that up to now, there has been no research related to this subject. Thus results of this project will have an essential role in attracting the maximum number of tourists.

3. Research methods

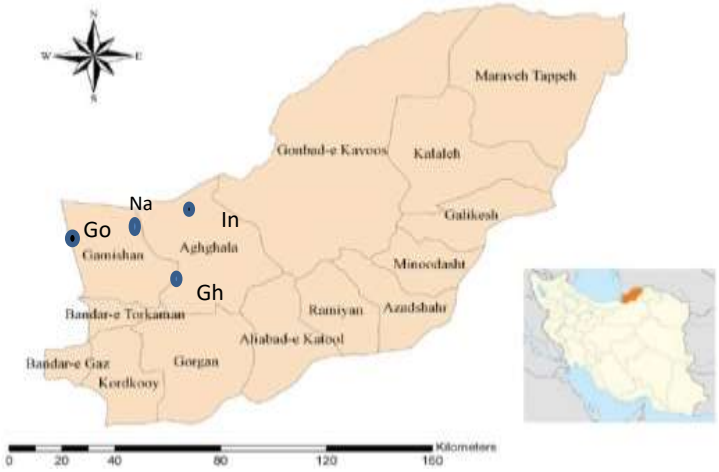
In order to study the development of geo-tourism in the southeast Caspian seaboard with a special attitude to the curative effects of Mud volcanoes, after library studies, several field studies were conducted on mud volcanoes of the caspian sea (during September 2020 and July 2021) and in the final Naftlicheh Mud volcano chose as a suitable mud volcano. In order to geochemical studies to find its therapeutic effects, several samples of water and mud were collected from a depth of about 10-20 cm from different parts of the mud volcano and placed in sterilized containers. The samples analyzed by XRD and XRF methods. Temperatures measured in situ with a thermocouple thermometer (25 -29 c).Mud and water were separated by settling, filtered ,and analyzed at the Geological Survey and Mineral

Exploration of Iran. Moreover the appearance characteristics of mud and water in the field were noted. The color of the curative mud exiting from Naftlicheh volcano was gray.

4. Result

4.1. Geologic setting of mud volcanoes in the Caspian seaboard

In total,Mud volcanoes in the margin of the Caspian Sea locate in Tertiary sequences of the coastal region. The geomorphology and degree of erosion at two mud volcanoes (Gharniaregh-Tappeh and Naftlicheh) suggest that it is older than the other mud volcanoes in the Province. The morphology of mud volcanoes also depends on the particular weight of outflowing materials or mud and their eruption or jump sequence (Negaresh, 2004). The mud volcanoes in the world are of two types, hot and cold. The hot mud volcanoes are associated with igneous volcanoes, and the temperature of the extruded water and mud varies from 70° to 90°C, much higher than the ambient temperature (Negaresh, 2008). The cold mud volcanoes are sedimentary-tectonic in origin and are entirely unconnected with the igneous activity with water and mud at the same or lower than ambient temperature. These eruptions are associated with seismic activity, fracture formation, ground deformation, and emplacement of mud breccia flows. There are many sub-sea mud volcanoes in the Caspian Sea, which mainly form at a depth of 10 to 800 meters and are eroded by waves and sea-bed currents (Yazdi, 2013).It seems that the origin of mud volcanoes in the Southeast Caspian Sea (Higgins & Saunders, 1973) is tectonic-sedimentary and is formed by the subduction of the oceanic crust of continental deposits. The number of spatial distribution mud volcanoes in the Southeast Caspian Sea is usual on a grand scale. As a result of continuing subduction, an increased thickness of the Cheleken, Aghchagyl, and Apsheron formation and Quaternary series in the South Caspian Sea. The formations are mainly calcareous, marl, clay, and sand and consist of gastropod fossils. Overlaying on each other conformity, there are more mud volcanoes in the southwest and southeast of the Caspian Sea. Based on studies done, mud volcanoes of the Caspian Sea are cold and sedimentary-tectonic type. Mud volcanoes dispersion in the southeast margin of the Caspian sea is between eastern longitudes of 54 to 55 degrees, and northern latitudes of 37 to 38 degrees, in Golestan province and includes Naftlicheh, Gharniaregh Tappeh , Inche Borun, Gomishan (Fig 1) all the mud volcanoes are very interesting on the point of geomorphology and eruption of mud and gas and, in total geo-tourism.



Gh- Gharniaregh mud volcano

In -Inche Borun mud volcano

Go- Gomishan mud volcano

Na- Naftlicheh mud volcano

Figure 1. Distribution of mud volcanoes in Golestan province

-Gharniaregh Tappeh Mud Volcano: The mud volcano place 18 kilometers southwest of Agh-Ghala and is externally 700 meters in diameter and has a cavity roughly 5 to 10 meters deep. There is a conical hill at the center of this hole, and another desolated hole at its top. There are two internal craters filled with water in between. Around the mud volcano there are salty sediments, methane, and traces of oil materials. the mud volcano is the largest Golestan mud volcano.

-Inche Borun mud volcano: This mud volcano place 25 kilometers north of Agh-Ghala, in the vicinity of a lake named the same and on the plain and salty lands. Its crater is 20 meters in diameter, its outflow mud is more running than the previous ones, morphologically different from ones.

-Gomishan mud volcano: New studies done on the southeastern bed of the Caspian Sea indicate that many developing diapirs are created in the form of mud volcanoes one of which has activated in 2007, 6 kilometers from Gomishan in the shallow part of the Sea (Fasl-e-Bahar, 2010&2011). The outflow mud is dark, smelling gas and sludge with an altitude of 1 and 2 meters.

-Naftlicheh mud volcano: In this research, the development of geo-tourism in Naftlicheh has discussed.The mud volcano is located 15 kilometers from

the northeast of Gomishan (Fig. 2) and recorded at 54° 23′ 50″E and 37° 0′ 03” N. It is 4 meters higher than the surrounding land, 160 meters in diameter. Its crater is nearly 10 meters in diameter. The mud of this mud volcano is flowing, and gas bubbles exist in it .around the crater, mud cracks are visible. Also, it is surrounded by salt water with traces of petroleum substances. Due to the salty soil, scarce or anomalous vegetation occurs nearby the
surrounding land(Fig 3).

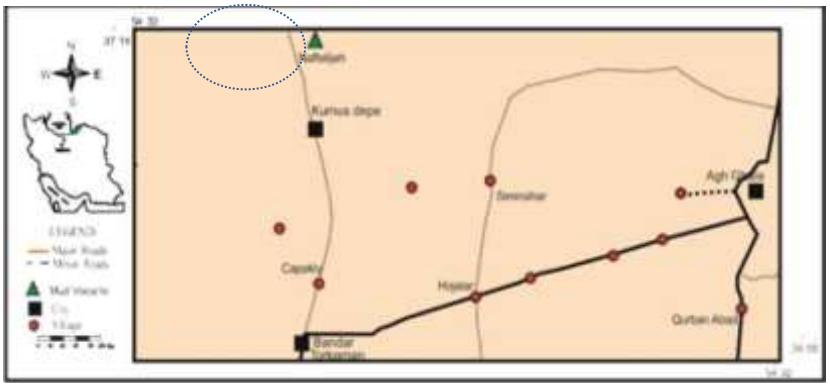
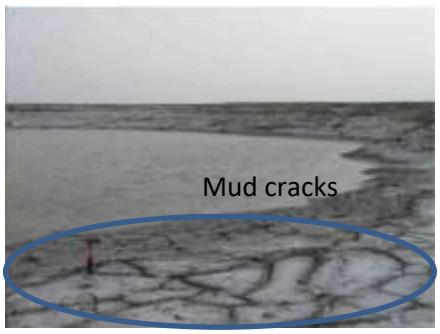


Figure 2. Situation of Naftlicheh mud volcano on the southeast of the Caspian sea coast



4.2. Composition and main elements of Naftlicheh mud volcano

More than 100 minerals associated with mud volcanism have described .the minerals of volcanic mud origin reflect the complex multi-stage physical and chemical processes (Guliyev & Feizullayev, 1997). About 90 minerals (most the illite and chlorite clay minerals) and more than 30 trace elements are present in mud-volcanic breccia. The material ejected from these mud volcanoes consist of silt and clay suspended in liquids, water (often acidic or saline),and hydrocarbon fluids. The released gases are methane, carbon dioxide ,and nitrogen, but in much smaller amounts. sludge out of mud volcano has a brightly colored. The mineralogical analysis, X-ray powder diffraction (XRD) on bulk samples and <20 and < 2 μm fractions, has been undertaken to identify the constituent minerals of the sediments. Based on results of the bulk mineralogical and its variability, a group of samples was selected in order to determine clay mineralogy. The suspensions of <20 and <2 μm fractions separated by centrifuge. Oriented aggregates of <20 and <2 μm sizes over glass slides were analyzed through XRD on airdried, glycolate, and heated samples (Moore & Reynolds, 1997; Martín-Puertas, et al., 2007). The clay mineralogy of <20 and <2 μm fractions of all the samples characterized by illite, chlorite, kaolinite ,and smectite. The most abundant clay mineral at Naftlicheh mud volcano is smectite and illite. Furthermore, the most abundant carbonate is calcite and dolomite (based on XRD mineralogy of samples) (Table 1). The water properties of the Naftlicheh mud volcano have measured (all values in Ppm).The major element composition of the expelled waters controlled by the depositional environment (marine/non-marine, presence of evaporites), diagenetic processes, temperature, and mixing (Hanor 1994; Worden 1996). (Table 2, 3)

Table 1. XRD mineralogy of samples from Naftlicheh mud volcano

Minor Mineral	Major Mineral
Gypsum, Muscovite, Albite, Chlorite, feldspars,	Smectite, halite. illite calcite, quartz, dolomite,

Table 2. Geochemical results from Naftlicheh mud volcano (by XRF method- ppm)

Li	B	Na	Mg	Al	K	Ca	Cl	Br	Mn	U	Zn	As	Sr	Cu	Ni	Fe	Cr	Pb	Ba	Cd	No3	So4
44	-	**20900**	**11300**	**53600**	**17000**	**87200**	**7723**	**0.17**	**516**	**1**	**74**	**2**	**1608**	**29**	**58**	**36700**	**33**	**15**	**155**	**1.3**	0.06	0.9

Table 3. The water properties of Naftlicheh Mud volcano (all values in ppm).

Elements	Water sample No.1	water sample No.2	water sample No.3	water sample No.4
Na	2250	2198	1911	1893
Ca	35	31	34	35
Mg	123	117	133	139
Li	2.2	2.0	1.6	1.5
K	75	71	55	51
Pb	0.013	0.015	0.009	0.011
Fe	0.17	0.26	2.8	2.6
I	<5	<5	<5	<5
Cl	159	163	148	142
Br	28	39	29	33
Zn	0.005	0.007	0.004	0.004

The base of studies done, the mud solution has no significant toxic substances, and the mud ،has found to contain quantities of curative properties (iodine, bromine, calcium, magnesium, organic acids, and aromatic hydrocarbons). As it has recommended as a curative agent.

4.3. Tourism Potential of Naftlicheh mud volcano

4.3.1.Based on geochemical research, there is a high amount of elements boron, copper, iodine, bromine, vanadium, magnesium, sodium, calcium , and bicarbonate in this mud volcano that people ,by using this mud, can make up for the lack of some elements such as sodium, calcium, iodine ,and other substances their bodies need .In other words as regarding the presence of organic and inorganic substances in the mud and sludge of mud volcanoes, mud- therapy is nowadays of a special status ,and many physicians have realized its effectiveness. Due to the mentioned elements, many patients can go to this place for treatment. Due to its geochemical

composition, Naftlicheh mud volcano has a therapeutic aspect and can be one of the essential destinations for medical tourism for the treatment of arthritis and rheumatism.

4.3.2. Naftlicheh mud volcano attracts many tourists through the beautiful and unique scenes they exhibit. The outflow of mud and water accompanied with hydrocarbon gases that sometimes go into flames, as well as the forming of some lavers filled with mud and the manner bubbles burst to make some sounds, a downturn of mud volcanoes from mud volcanoes' craters are pretty excellent. These features can be noteworthy for scientific researchers and tourists

4.3.3. Mud volcanoes are well used in the pottery industry and enjoy particular attributes. Unlike clay, it doesnot take so long for this mud to be ready to use in pottery; it is polished better than clay, and it is stickier than clay, it is flexible, it does not curl, it does not get cracked, it has a fixed volume, endures high temperature even up to 800 degrees and it turns creamy and beautiful having baked (Negaresh, 2006). This potential, there is in the Naftlicheh mud volcano.

4.3.4. As mud volcanoes have a direct relationship with oil reserves and hydrocarbon gases, researchers regard them as natural exploratory estimations through which the regions' deep hydrocarbon reserves and information on oil and gas movement can freely access. Due to the presence of a slight smell of oil in the Naftlicheh area, it associate with oil and gas reserves, which is effective in attracting scientific tourists.

4.3.5. As mud flows come to the surface along joints and fractures, mud volcanoes are good clues for detecting the status of the region's faults and considering the constructions in the vicinity, significant structures such as firms and plants.

4.3.6. Mud volcanoes, especially in coastal zones, connect with volcanoes and subduction zones. Hence the presence of mud volcanoes in such areas and their continuous activities can be a sign of subduction in the region or the development rate of volcanic activities. Based on the field and geological studies, Naftlicheh mud volcano is a sign of subduction.

4.3.7. In total Naftlicheh mud volcano, apart from its morphological features and therapeutic effects, contains applied scientific information and, as a scientific educational geo-site, can attract many scientific tourists. Moreover, these features of mud volcanoes as geo-tourism phenomena are in line with the definition of modern tourism, which is tourism that corresponds to the acquisition of knowledge.

4.4. Ways of developing geo-tourism about Naftlicheh mud volcano

In order to develop geo-tourism in the area, some items should consider as follow:

4.4.1. Presenting media publicity, nationally and internationally, about the scientific and therapeutic benefits of the Naftlicheh mud volcano that geological and medical geochemical scientific research has proven it.

4.4.2. Establishing therapeutic centers in interaction with the traditional medicine group and the modern medicine group to take advantage of the therapeutic effects of Naftlicheh mud volcano.

4.4.3. Establishing educational& research centers in the vicinity of mud volcano to teach mud volcano and its therapeutic uses and carry out research

4.4.4. Creating lavers filled with mud and water for entertaining activities and games.

4.4.5. Establishing hotels and lodging places, cultural centers, etc., in the vicinity of mud volcano

4.4.6. Developing and reconstructing access roads to the mud volcano

4.4.7. Publicizing the culture of using natural phenomena by related organizations.

4.4.8. Carrying out complementary and up-to-date studies on the mud volcano and the geological environment around it by researchers

5. Discussion and Conclusion

Geo-tourism is one of the main factors of sustainable development at the economic, social, cultural, and environmental levels that, within the international, national, regional, and local frameworks, can be one of the essential tools in development, income generation, creating jobs, and removing deprivation. Therefore mud volcanoes, as one of the exciting and unique geomorphologic processes, can well play an important task in sustainable tourism development. Therefore, by changing attitude and having a practical attitude must pay attention to these phenomena. As in the studied area (Naftlicheh), development of geo-tourism in the southeast Caspian seaboard with a special attitude to the curative effects of Mud volcanoes was studied that up to now, there was no research related to this subject, and studies done in this project had significant results. Based on geochemical studies, there are no toxic substances in mud volcano, and they contain a high amount of elements boron, copper, iodine, bromine, vanadium, magnesium, sodium, calcium, and bicarbonate, and their correct and principled use compensates for the lack of these elements in the body thus this mud

volcano has therapeutic effects and can be one of the essential destinations for curative geo-tourism. As know, mud-therapy is nowadays of a special status in the world, and many physicians have realized its effectiveness. Based on geochemical research, thus Naftlicheh mud volcano, Due to its geochemical composition, and its therapeutic potential can be one of the essential destinations for medical tourism. Today, by traditional methods, not scientific methods, this mud volcano is used for the treatment of arthritis and rheumatism. While because of the presence of organic and inorganic substances in the mud and sludge of mud volcano and the existence of beneficial elements, its therapeutic aspects are numerous, and many patients can guide to this place for treatment.

In addition to therapeutic effects, the Naftlicheh mud volcano, is essential in other ways:

it is well-used in the pottery industry and enjoys special attributes., As mud volcanoes have a direct relationship with oil reserves and hydrocarbon gases, researchers regard them as natural exploratory estimations through which the regions' deep hydrocarbon reserves and information on oil and gas movement can access freely. Due to the presence of a slight smell of oil in the Naftlicheh area, it can associate with oil and gas reserves, which is effective in attracting scientific tourists. As mud flows come out the surface along fractures, mud volcanoes are good clues for detecting the status of the region's faults. Also, Hence presence of mud volcanoes can be a sign of subduction in the region or the development rate of volcanic activities. Based on the field and geological studies, Naftlicheh mud volcano is a sign of subduction. In other words, mud volcanoes are an identification, and interpretation tool for many geological processes. According to this, the Naftlicheh mud volcano well shows the presence of oil and gas fields - high salinity - fractures, and subduction in the region. Naftlicheh mud volcano attracts many tourists through the beautiful and unique scenes they exhibit.

morphologic, beautiful scenes Outflow of mud and water accompanied with hydrocarbon gases that sometimes go into flames, as well as the forming of some lavers filled with mud and the manner bubbles burst making some sounds, the downturn of mud volcanoes from mud volcanoes' craters are pretty excellent.Moreover, These can

be noteworthy for scientific researchers and tourists moreover, practical application in the exploration of hydrocarbon reserves& salt domes, recognition of earth fractures and subduction, and application in pottery can attract a large number of domestic and foreign tourists and geo-tourists. Thus, implementing geo-tourism development strategies in a mud volcanoes, and planning and making the right policies, can play a role in foreign exchange and entrepreneurship. Based on the studies, these items suggest for the development of geo-tourism in the region: Presenting media publicity nationally and internationally, about the scientific and therapeutic benefits of Naftlicheh mud volcano, Establishing therapeutic centers in interaction with the traditional medicine group and the modern medicine group , Establishing geo-tourism educational & research centers. We are creating lavers filled with mud and water for entertaining activities, and games, Establishing hotels and suitable lodging places, developing and reconstructing access roads, Publicizing the culture of using natural phenomena and Carrying out complementary and up-to-date studies on the mud volcano and the geological environment around it by researchers.

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