



Study of Environmental Chemistry and Therapeutic Properties of Ramsar Thermal Spring and Radiations from Thermal Springs of the Area on the Residents

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ABSTRACT

There are many thermal springs in Ramsar area located in north of Iran, having therapeutic properties for high concentration of sulfate, calcium, and radon. Quaternary and Alluvium deposits are exposed and extending on the Jurassic formations in Ramsar plain and is composed of fan and debris deposits and have thickness lower than 10 m in show springs. The annual precipitation in the Ramsar region is 976 mm. Khazar fault is normally and longest fault in south of Caspian sea, and has NW-SE trend, in junction locally fault with NS trend and Khazar fault thermal waters issue through these faults. There are increasing of usage of natural resources due to the population growth rate and convenient instruments used in everyday life. So there will be serious problems on sustainability and environment. They have been used for several years for treatment of diseases such as Rheumatism, Dermatologic and digestive complications. On the other hand, Ramsar is one of residential areas of the world which has naturally high radiations (HLNRA) (High Level Natural Radiation Area). In this regard, Yangjiang in China, Kerala in India and Guarpari in Brazil are some cases to be mentioned. In Ramsar area, the amount of annual radiation is 260mGy y⁻¹ while the radiation rate is 10Gy y⁻¹ for its 2000 population. Such radiation can be due to high radium rate in available thermal springs, rocks and soil of Ramsar area. For the presence of such thermal springs in the area and usage of radiating rocks in residential and administrative buildings, settlers in the area are subjected to radiations from radium and isotopes caused by destruction of radium as well as high rate of radon (more than 1000 MBq m⁻³). Some believe that there is a linear, no-threshold relation between radiation rate and carcinogenic effects, while no such effect has been definitely found yet in Ramsar area and all HNLRA areas. Therefore, more and thorough studies are required on the subject to fill in the gaps. The present research deals with the relationship between natural radiations of the springs and radiating materials used in buildings with different diseases and therapeutic and healing effects of Ramsar thermal springs.

Key words: HLNRA, Therapeutic Properties, Thermal Spring, Ramsar, Kazar Fault.

INTRODUCTION

There have been natural radiations from the early days of world that the rate of them has

been more than now. Human beings, animals and plants have been subjected to such radiations. Also, in the beginning days of life there have been possibly more than 100 natural reactors such as Oklo in

Gabon. Average rate of ionizing radiation (dose rate) around natural reactor had been 47 Gy/min¹. Such natural radiations have two natural and human sources with the annual rate amounted to 2.8 mSV, about 85% of which (2.4 mSV) is from natural radiations (radiations from 222 Rn)².

Ramsar is among the areas that have the highest natural radiation. Each year those living in this area are infected with more than 132 mSV from terrestrial sources. The highest credible radiation rate is 260mGy y⁻¹. The radiation rate in residential areas in Ramsar, China, India and Brazil are provided in table 1.

As well, Radon is one of uranium decomposition agents which is useful in treatment of diseases such as gout, skin diseases, rheumatism, and so on. Besides, sulphate, which is found in the form of sulphate minerals in different quantities and density in the springs, can be used in treatment of skin diseases, rheumatism, hepatic, gastric and intestine complications which indicate healing effects of thermal springs.

DISCUSSION

Geological Setting

Ramsar area is located across and between Alborze Mountain and Caspian Sea in North of Iran. About 30 spas are located south of the Ramsar and Sadatshar town. They are almost in between 20 to 70 m elevation. Paleozoic, Mesozoic and Tertiary rocks and alluvial deposit are exposed around the Ramsar area. Quaternary and Alluvium deposits are exposed and extending on the Jurassic formations in Ramsar plain and is composed of fan and debris deposits and have thickness lower than 10 m in show springs. The annual precipitation in the Ramsar region is 976 mm. Jurassic deposits are composed of conglomerate, sandstone, silt, shale bearing coal lens, marl, and limestone and dolomite units. In tertiary, acidic Plutonism was active and intrusion into the Paleozoic and Cenozoic formations. Khazar fault is normally and longest fault in south of Caspian sea, and has NW- SE trend, in junction locally fault with N-S trend and Khazar fault thermal waters issue through these faults³.

There are increasing of usage of natural resources due to the population growth rate and convenient instruments used in everyday life. So there will be serious problems on sustainability and environment. Geothermal resources are one of natural resources, thus sustainable management and wise-used are needed. It is necessary to have information of all geothermal resources in this area [3 and 4].

Origin of Natural Radiations (Radioactivity) in Ramsar Area

Rate of natural radiations in HLNRA area in Ramsar may be allocated to 226Ra and products of its decomposition which are brought to surface by present thermal springs in the area. Upon the latest researches by Atomic Energy Organization of Iran (AEOI), the radiations may be considered to be originated from two factors: First, due to the minerals and ingredients in water, second, because of carbonated sediments in which the thorium rate is more than their Uranium⁵.

As seen in figure 2, Uranium is an element with a high density in acidic igneous rocks and is insoluble in groundwater with the lack of oxygen. In contrast, Radium 226 which is the product of Uranium decomposition is found as a solution in underground water. Soluble Radium is brought to the surface being passed through the fissures and cracks in the rocks by underground water. At thermal springs, calcium carbonate proceeds to settle. Then, calcium is replaced with 226Ra forming radium carbonate (RaCO₃) in thermal spring sediments. Furthermore, as soon as reaching the groundwater to the surface and appearing as thermal springs, Radon gas (222Rn) releases⁶.

For it has such short half-life in open air (3.82 days) it is not dangerous for the health while its aggregation in closed spaces (like buildings in the construction of which radiation materials have been used or thermal spring bathes) may reach high density and be dangerous⁸.

Also, according to geological maps one gradient of washed radioactive materials made by deep north-south faults would create geochemical coronas from Uranium and Thorium around spas

sediments. In this regard there was a positive correlation between U and Th and also Uranium as daughter elements of Uranium-Radium family, which is in most cases Radium 226, ascends Radon 222⁹.

As these sediments and radiating rocks are used as materials in constructions and because of high rate of such natural radiations in the area (2000 times more than regular and normal areas)¹⁰, some experts recommend therapeutic and cautious operations for the buildings and dwellers of these areas¹¹. However, despite high natural radiation rate, no harmful side effect has been reported in Ramsar.

Study of Some Probable Diseases in Dwellers of HLNRA Areas in Ramsar

For using radioactive materials in buildings and their effects on the dwellers' health, some diseases with possible prevalence in the area were studied and the results are provided briefly as follow:

For the importance and fear from chromosomal mutation (aberration) among people, it has been given priority and studies have been performed on settlers of HLNRA in Ramsar and normal areas. Primary results indicate that there is no important difference between these two groups in terms of chromosomal mutation. Early studies on cells in these two groups have indicated no positive correlation between chromosomal mutation frequency and settlers in this area.

In these areas there was the possibility and fear of being infected with diseases and blood transformations. Therefore, experiments have been

done by laboratory experts on rats subjected under radiation which came to this conclusion that circulation of blood factors such as red cells, blood platelet, granulocyte, blood globule, and so on were decreased in their blood. However, radiations from materials the constructions have no significant effect on hematopoietic parameters of HLNRA settlers of Ramsar compared to other areas.

Global Studies on HLNRA Settlers

In addition to Ramsar area, there are other HLNRA areas in which epidemiological evidences indicate that the radiations are not harmful or dangerous for settlers. The findings are as follows:

Kerala in India

There are some areas in India where high radiation rate can be due to presence of Monazite, having naturally 9% Thorium and 3% Uranium 8% [12] along with other heavy minerals such as Ilmenite, Rutile, Zircon and Granite. There is 15-25 mGy radiation for 140,000 population of the area per year [13]. According to a comprehensive study on HLNAR residents of Kerala area in India, it was shown that there there are evidences indicating no relation between Gamma radiations and cancer prevalence in this area[14]. In another study on prevalence of congenital aberrations of the settlers, no positive correlation was shown between deformed, dead or twin delivery compared to other areas [7 and 15]).

Yangjiang in China

From 1972 there have been some studies on HLNRA settlers of Yangjiang area in China. The studies show that deaths caused by cancer (other than blood cancer) are 14.6% less than NBRA areas and mortality caused by blood cancer in male and

Table 1: Min and max rates of natural terrestrial radiations for different areas of the world, extracted from 2

Country	Area	Approximate population	Absorbed Dose rate in aira (nGy h ⁻¹)
Brazil	Guarapari	73 000	90-170 (street) 90-90 000 (beaches)
Iran	Ramsar Mahallat	2 000 70-17 000	800-4000
India	Kerala	100 000	200-4 000
China	Yangjiang	80 000	370 (average)

female are less than 15% and 60% respectively. As well no difference was seen in genetic diseases between HLNRA and normal areas¹⁶. Today, on the basis of data obtained from statistics and study of cancer victims and those having chromosomal mutations no correlation was found between the disease and the amount of natural high radiation [7 and 17].

Other HLNRA Areas or Radon Susceptible Areas

In Misasa city located in Tottori in Japan there is high Radon radiation rate. A study on prevalence of abdomen cancer in both sexes showed that the rate has been decreased and in these areas with high Radon rate pulmonary cancer in male showed increasing trend¹⁸. On this basis, studies were performed which did not lead to any possible pattern for pulmonary cancer and its possible correlation with settlers of HLNRA area [19]. The above data concludes that primary findings on biological effects of long term radiation in areas with high level of natural radiations (HLNRA) in Ramsar prove no harmful and unfavorable effect on the settler health, but more study and research should be done. After studying the possible effects of

radiations from radiating rocks and thermal springs, therapeutic and healing effects of Ramsar thermal springs are important issues to study.

Therapeutic Properties of Ramsar Thermal Springs

Thermal springs have long brought therapeutic effects and were used in treatment of different diseases. Such treatment properties can be allocated to minerals presented in thermal and mineral springs. There are some mineral and thermal springs in Ramsar such as Madarshah, Hotel Ghadim, Hotel Jadid, Zirpol, Safarod, Absiah, Sadat Mahaleh, Kesh and Sangboneh thermal and mineral springs. Therapeutic properties of the above mentioned springs are studied in the present section. In this regard, and on the basis of ICP-MS analysis, the hydrogeochemistry of the stated springs were studied and it was found that they contain high density of Radon, Calcium and Sulphate (table 2). The highest rate of Sulphate and Calcium is related to Absiah spring while the lowest rate is in Safarod spring. Relative figure for such elements are given in figure 3.

Table 2: Chemical composition of Ramsar thermal springs(Ansari, 2011[4])

Ramsar Thermal springs	Temperature of Springs(°C)	SO ₄ ²⁻	Ca ²⁺
Madare shah	48	216.71	726.545
Hotel ghadim	65	191.17	753.77
Hotel jaded	49	191.17	771.184
Zire pol	42	196.94	787.619
Safaroud	19	152	285.948
Abe siah	42	247.2	3635.254
Sadat mahalleh	40	220.89	422.175
Kash	47	200.23	502.758
Sange bone	45	220.89	421.744

Table 3: Comparison of Radon rate in Austria, Ramsar and Mahalat [7, 20 and 21]

Average Radon Concentration(Bq/l)	Number of springs	Location
555	30	Austria(Bad Gastein)
64.3	9	Ramsar
710	5	Mahallat

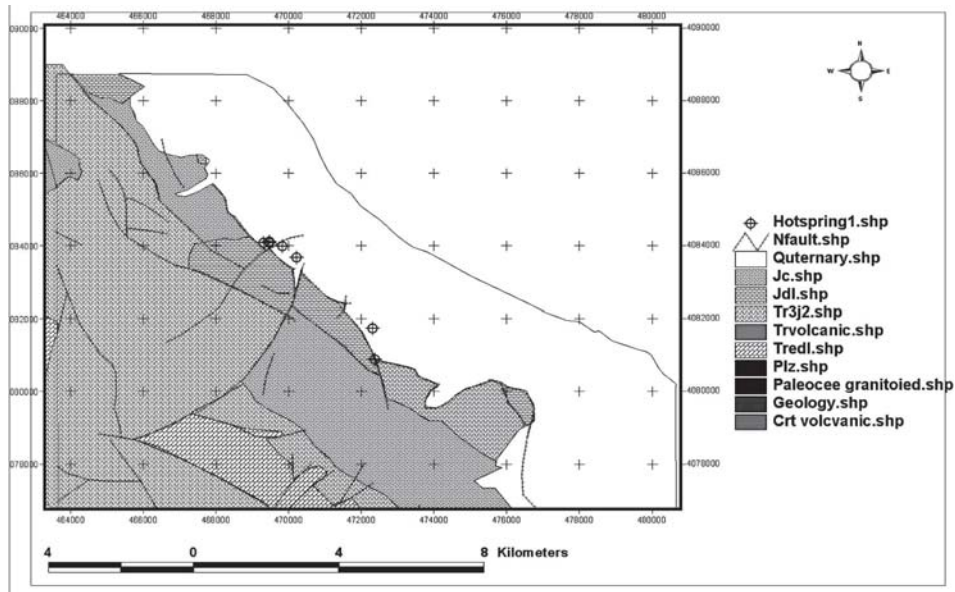


Fig. 1: Simplified geological map of Ramsar area, from [3] and our own observation, modified by [4]

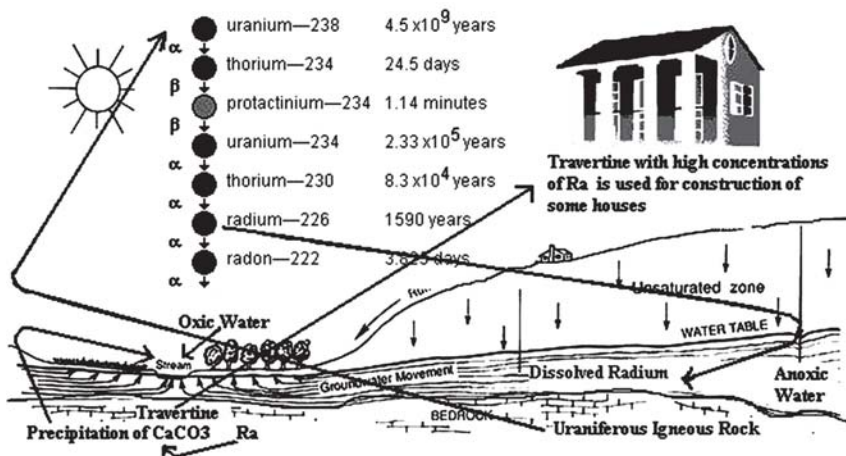


Fig. 2: Origin of high natural radiations in Ramsar [7]

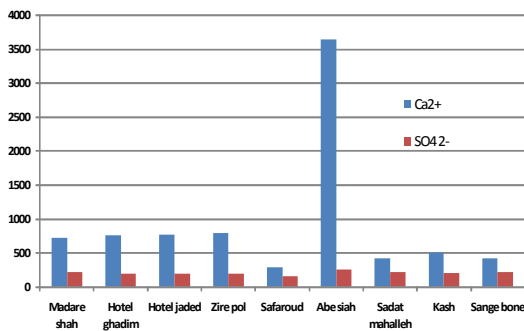


Fig. 3: Comparison of calcium and sulphate concentration in Ramsar thermal springs

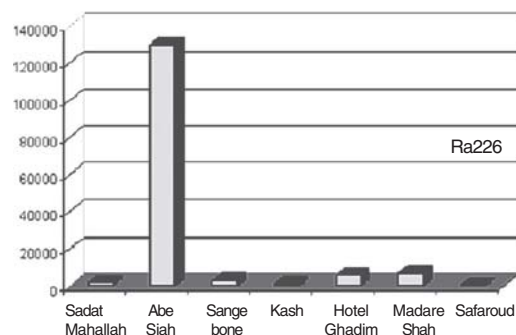


Fig. 4: Comparison of Radium concentration in Ramsar thermal springs

According to the figure 4, Ramsar thermal springs can be compared in terms of Radium 226 that the lowest rate belongs to Sadat Mahaleh spring and the highest is for Absiah spring. In table 3, the density of Radon radiation in Ramsar thermal springs have been compared with Mahallat thermal springs and that of Bad Gostoin in Austria.

Study of Radon, Sulphate, and Calcium Therapeutic Effects

Respiratory and digestive systems as well as skin are the routes for entrance of Radon and products of its destruction to body. Penetration of Radon to body is not dangerous at all, because in case of ingestion, before absorption by blood and entrance into liver, heart and lung, digestive system lets it out by exhalation. However, penetration of destruction products of Radon such as Plutonium 218 which emit alpha particles through inhalation would have side effects on lung tissues cause lung cancer. Therefore, carcinogenicity of Radon can be allocated to its destruction products²². Other than pulmonary cancer it has no other carcinogenic effect²³.

Radon would instigate steroid hormone in suprarenal thyroid gland and activate the processes similar to the effects of local steroids²⁴. Endomorphines and encephalines are two compounds found in blood having painkiller effect. Radon increases these compounds in blood and it can be said to have powerful effect on sedation²⁵. As well it increases the activity of SOD (Superoxid Dismutase) enzyme in liver and kidney²⁶. In addition, it is through Radon-therapy that the activity of killing cells in rheumatism are restored and increased. Hence, Radon-therapy in thermal springs may have long lasting effects in decreasing rheumatic pains^{24,26}. Reconstruction of cell nucleus DNA would be increased with radiation rate. As the result it can facilitate improvement of diseases related to DNA damage. Production of free radicals and increase in reconstruction power of DNA would increase body resistance against other dangerous factors (non-radiating factors)²⁴.

Based on the above mentioned findings, many springs of the world including Europe and Iran thermal springs, including Ramsar and Mahalat springs with high rates of Radon may be used in

treatment of diseases such as rheumatism, gout, peripheral and central nervous system, skin and gynecologic diseases, cardio-vascular complications and diabetes²⁵. One of thermal springs in the world with high Radon rate is Bad Gasetin spring in Austria which threatens rheumatic, arthritic, rheumatoid, joint and vertebral, cardiac, endocrine, imbalanced metabolism, mouth and geriatric diseases²⁵ (Table 3).

Sulphates also according to their chemical composition have therapeutic properties. There is calcium sulphate in Ramsar thermal springs which is a sedative and tranquilizer and act as pain killer for body. As drinking calcium sulphate carrying water would instigate biliary secretion, consumption of calcium sulphate carrying water is recommended to those having digestive problems. In Europe, drinking sulphate water is a common practice in treatment of kidney, intestine and gastric problems. Generally sulphate water is used in treatment of diseases such as chronic respiratory system (asthma, larynx inflammation), gynecologic, rheumatism and other motor system complications. Other than Ramsar and Mahalat thermal springs, other sulphate bearing springs through the world like Austria, Germany, Italy, America, Turkey, Japan, Russia and Australia are used in treatment of the mentioned diseases²⁵.

Ramsar thermal springs show calcium saturation as well. Based on the role of calcium in bone and teeth formation, adjustment of cell membrane penetration, muscle contraction, adjustment of heart beat and rate and facilitation of coagulation, the springs are important and bring therapeutic properties²⁵.

CONCLUSION

Ramsar area for its geological position and presence of thermal-mineral springs is among the HLNRA areas thorough the world, where settlers are subjected under natural radiations. For settlers' usage of radiating rocks and sediments of the area as construction material, there is a possibility of blood complications, chromosomal mutation and aberration and different cancers to prevail. Studies on the subject indicate that there is no correlation between such radiation and settlers health in

Ramsar. Besides, studies in other HLNRA areas of the world prove the findings to be correct.

In addition there have been studies on therapeutic effects of Ramsar thermal springs. As temperature has a significant role in treatment, and for optimum temperature of Absiah thermal water and saturation of the spring by calcium and calcium sulphate, it can be the most effective spring in Ramsar from therapeutic views, which still requires more studies. As sulphate concentration is in the same level in other springs in the same area, they are counted to be similar in terms of sulphate related therapeutic properties. As calcium concentration is similar in Madarshah, Hotel Ghadim, Hotel Jadid and Zir Pol springs, their therapeutic effects would be the same too. Sang Boneh, Kesh and Sadat Mahaleh thermal springs, for their close calcium rate, have the same therapeutic effects. In terms of therapeutic properties, Safarod would be placed in the forth group⁵.

Based on concentration of the said elements in Ramsar thermal springs and for its therapeutic properties of sulphate and calcium,

Ramsar thermal springs may be effective in treatment of digestive, nervous, gynecologic, rheumatic and skin disease such as eczema, and digestive system disorder. Moreover, considering Radon harmful effects and its risk in a closed space such as a bathroom located in thermal springs, it can be used for treatment of vascular, skin, rheumatic, gout and nervous problems in case there is suitable ventilation inside the bath to lower the internal Radon rate.

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