

Correlation between Breast Cancer and Radiation Level of Guarapari City - ES - Brazil

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Abstract

The city of Guarapari, located in the state of Espírito Santo - Brazil, has a beach called "black sand beach", whose characteristic is to present monazite sand composed with Thorium phosphate. Radiation levels at the beach are 8 up to 15 microSivert/h. An analysis of the official data from the National Health System of Brazil over the cities of the State of Espírito Santo between the periods 2008 to 2013 indicates that the city of Guarapari it shows the lowest number of cases of malignant breast cancer per capita in the state. This statistical reality, originating from official data reinforces the hypothesis of radiation hormesis.

Keywords: Monazite sand, radiation hormesis, radiation homeostasis, Thorium phosphate .

1. Introduction

Some beach sands from Espírito Santo have dark spots, which it are commonly classified as monazites[1,2]. The term monazite derives from Greek (monazein), it means to be lonely, in allusion to rarity of the mineral. Monazite is a phosphate of rare earths and tório3 essentially (Ce, La, Y, Th) PO₄, which are thus associated with other minerals resistant and heavy, such as magnetite (ideal formula Fe₃O₄), the ilmenita4 (FeTiO₃), rutile (TiO₂), and zircon (ZrSiO₄).

According to Coelho et al. [3] the sands were found to contain about 6 dag kg⁻¹ of rare earth and thorium that, if allocated to the monazite-(Ce) structure, lead to the averaged formulae Ce + La + Nd + Pr + Sm + Th + PO. The Guarapari sand are radioactive, with an average specific activity of ~ 4.1 Bq g⁻¹, for α and ~ 2.8 Bq g⁻¹ to β emissions.

The Applied Physics Group has been investigated all beach sand in the state of Espírito Santo since 2008. Our research have confirm that Guarapari beach called "black sand beach" present the highest radiation level (8 up to 15 microSivert/h) as compared with all others beach in the state.

2. Experimental and dates analysis

The sand was structural characterized by X ray diffraction in several points of called "black sand

beach". Radiation measurements were done in the sand and in the atmosphere near black sand beach

2.1 Equipment

The samples were sieved by a 20 μ m thin mesh to do X-ray measures. The measures were realized using Rigaku model Ultima IV, with copper tube (1.5418 Å), scanning from 4.00 to 120.00 degrees with a 0.01° step.

A Geiger-Müller from PHYWER was used to measure the nuclear activity. Fifteen measures in a time of 100s were made for each sample. It was measured the background nuclear activity of the room. Moreover, it was also used a GAMMA-SCOUT to measure the radiation level *in situ* near and closer the sand in the black sand beach.

2.2 Sand physical characteristics.

The figure 01 represents a typical visual pattern of monazitic sand presented in Guarapari.



Fig. 1- Monazitic sand Guarapari - black sand beach. The white shells in the sand are about 3 cm.

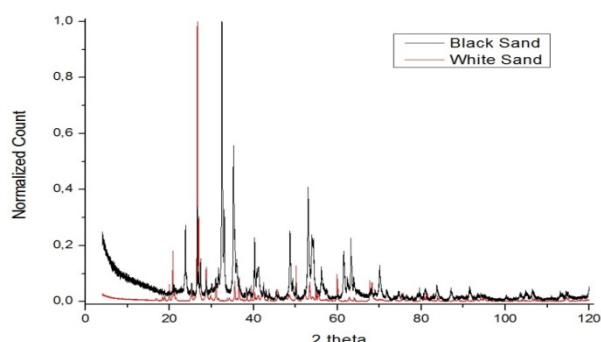


Fig.2- X-ray diffraction patterns of Black Sand and White Sand.

2.3 Structural analysis - Physical parameters.

The phase analysis of sand structural composition is shown in the Table 1 and 2 below.

Table 1: The identified phases by X-Ray measurements in black sand.

Compound	Name
(FeTiO ₃)	Ilmenite
(Fe _{1.874} Sn _{0.096} O ₃)	Iron Tin Oxide
(Ti _{0.08} V _{0.06} Sb _{0.02} W _{0.02} O ₂)	Rutile W-Rich
(SiO ₂)	α Silicium Oxide

Table 2: The identified phases by X-Ray measurements in white sand.

Compound	Name
(Ce)((Ce,La,Nd)PO ₄)	Monazite
(Ce _{0.9} U _{0.1} PO ₄)	Cerium Uranium Phosphate
(La _{1.64} Th _{2.36} O _{7.16})	Lanthanum Thorium Oxide
(SiO ₂)	α Silicium Oxide

2.4 Statistical analysis of official data from the National Health System of Brazil

In order to correlate the effect of radiation level of black sand beach Guarapari and the habitant health, we make a correlation between the detection of malignant breast cancer registered on the official database from the National Health System of Brazil. This data base indicated only confirmed breast cancer. The Table 2 shows the compilation results.

Table 2: Cases of Breast cancer in all cities of Espírito Santo state with more than 100,000 habitants - period from 2008 up to 2013 [4]

City	Habitants	Case/ 1000
Colatina	111,794	0.01789
Linares	141,254	0.01416
Serra	409,324	0.00977
São Mateus	109,067	0.00917
Vitória	325,453	0.00615
C. Itapemirim	186,878	0.00535
Vila Velha	414,420	0.00241
Guarapari	105,227	0.00019

No significant difference between breast cancers in all age groups was detected. However, the coefficient of per capita cases of breast cancer during 2008-2013 in Guarapari was lower than the other cities with ($p < 0.001$). It is important to note that actual number (not estimates) were used, comparing equivalent populations living in the same region with the same culture and habits.

3. Discussion

A similar behavior of the singular statistic of Guarapari cancers cases was observed by Calegari et al.[5]. In our opinion, this is an indication with agreement of the radiation hormesis hypothesis.

As reported by Dauer, L. T. et al. [6] it is important to continue the investigation about if the linear model, associated with effect of radiation, is good enough to describe low-dose radiation regime.

4 Acknowledgements

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5. References

- [1]. Carneiro, S. M.; *Boletim DFPM*: Rio de Janeiro. , v.35, **1962**, p113.
- [2]. Schobbenhaus, C.; Campos, D. A., coords.; *Geologia do Brasil*, MME/DNPM: Brasília, **1984**.
- [3] Coelho, F. S. et al., *Quim. Nova*, v28, No.2,**2005**, p233-237,
- [4] <http://tabnet.datasus.gov.br/cgi/defthtm.exe?siscolo/sismama> accessed April **2014**.
- [5] Calegari et al., *Alasbimn Journal* Year v54, No14, **2011**,p14,<http://www.alasbimnjournal.cl/alasbimn/index.php?option=com_content&task=view&id=1436&Itemid=370> accessed April **2014**
- [6] Dauer, L. T et al. *Radiation Protection Dosimetry* No.2, v140, **2010**, p103–136