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Journal Name:	Physical Science International Journal
Manuscript Number:	Ms_PSIJ_31782
Title of the Manuscript:	NATURAL RADIOACTIVITY LEVELS AND RADIOLOGICAL RISK ASSESSMENT OF SURFACE WATER FROM COASTAL COMMUNITIES OF NDOKWA EAST, DELTA STATE, NIGERIA.
Type of the Article	Original Research Article

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PART 1: Review Comments

	Reviewer's comment	Author's comment (if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)
Compulsory REVISION comments	<p>The Introduction of the article is very well written, although somewhat long. The social need and scientific interest of the study is well sustained in that Introduction.</p> <p>The section Experimental Procedure contains a sufficiently clear explanation of the study area, although it is necessary to say some characteristics of rocks and soil, in terms of composition. Sedimentary rocks usually have lower uranium contents than the igneous ones. Are the waters of the Niger River going through an uranium deposit before reaching the delta? Why is high uranium radioactivity expected? However, the "Gamma-ray activity measurements" section title is not clear: Gamma-ray activity is not measured, but the activity of radionuclides is measured by gamma-spectrometry. The sampling procedure is not perfect because the recommended method of acidification is with nitric acid instead of hydrochloric acid, but this is not serious if the measurement is not delayed after sampling.</p> <p>The serious procedural problem is related to the measurement itself.</p> <p>The first objection is that in general the water carries U-238, U-234 and Ra-226, all of the same natural family of disintegration. The amounts of these isotopes cannot be established by gamma spectrometry as easily as it appears. The 609 keV and 911 keV "peaks" indicated by the manuscript belong to the isotopes of Bi-214 and Ac-228, which are actually daughters of the</p>	<p>Thanks for your comments. There are some comments that I did not agree.</p> <p>Gamma ray spectroscopy using HPGE-detector or sodium iodide doped with thallium detector is a widely used technique in laboratories for monitoring environmental radioactivity. U-238 is a primordial radionuclide that decays by alpha decay to ^{234}Th which generates low energy gamma rays with very low emission probability. It can be measured with low detection limits using alpha particle spectrometry and mass spectrometry. However, in order to save time on sample preparation and analysis, it is very common to measure ^{238}U using gamma ray spectrometry. Gamma ray transitions in ^{234}Th (following the decay of ^{238}U) are too weak for this purpose. Instead the gamma-rays following the β-decays of ^{234}Th ($T_{1/2} = 24.1\text{d}$) and its daughter ^{234}Pa ($T_{1/2} = 1.17\text{m}$) are used for identification and quantification of ^{238}U. care must of course be taken to ensure that secular equilibrium exists b/w ^{234}Th and ^{238}U</p> <p>In pure uranium samples , the detection limits are low and the following gamma-ray can be used: 63 Kev (doublet), 92.5 Kev (doublet), 767 Kev and 1001Kev. The gamma-ray at 767 and 1001 Kev are robust for quantification but due</p>



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	<p>respective series of U-238 and Th-232. But before reaching Bi-214 and Ac-228, disintegrations occur to U-234 and Ra-226, in the Uranium chain, and Ra-228 in the Thorium chain. The solubility of U-234 and radium isotopes is entirely different than that of U-238 and Th-232, depending on the pH and the presence of other salts in the water, therefore the measurement of the peaks of 609 and 911 keV reports radium isotopes content dissolved in water, and DOES NOT report dissolved uranium and thorium.</p> <p>The second problem is due to the presence of the radioactive background. In the text we report a simple, essentially correct formula for the determination of the contents of Bi-214 and Ac-228 in water. But it is not explained that the area of the background is subtracted, although it can be "assumed" of the formula.</p> <p>The most serious thing is that substances taken as standard cannot reflect the radium contained in the water, nor of uranium and thorium. Substances acquired pure, such as nitrate-like salts, have been separated from the mineral substrate, where they are, if not interacting with water, in radioactive equilibrium. Therefore, it is impossible for these pure substances to reach radioactive equilibrium from the U-238 to the Bi-214, because the history of the entire planet must pass, not from the Ra-226 to the Bi-214, because you have to spend about 20 thousand years. The intensity of the 609 and 911 keV peaks of the standard substances reflects only the amount of Bi-214 that is in equilibrium with the Ra-226 and the Ac-228 in equilibrium with the Ra-228 that have been produced in the pure substances of U-238 and Th-232 for a few years. These quantities are much less than the those from the equilibrium of the whole chain.</p> <p>Therefore, all calculations of doses by ingestion of</p>	<p>to their low emission probabilities (0.317% and 0.842% respectively), they are often swamped by the background from other radionuclides in the environmental sample itself. It is thus necessary to use the two low energy gamma lines. This introduces some problems. 1.the four low energy peaks appear as two doublets in a normal HPGE- detector spectrum. In this work, we simply refer to the two doublet peaks as if they were singlet peaks at 63Kev and 92.5Kev.</p> <p>We took various analytical considerations which took care of the associated problems. 1. use of correct decay data 2) use of suitable detector ie the use of p-type HPGE detector with thin upper dead layer provides high detection efficiency for gamma ray energies over a wide range.3) optimising the samples 4.) use of suitable amplification 5) subtraction of interfering peaks 6) use of suitable reference materials 7) calculating efficiency transfer and absolute efficiency and finally control of the background is very important.</p> <p>In order to improve robustness in determination of ²³⁸U using gamma ray spectrometry, the following steps are involved.</p> <ul style="list-style-type: none"> - Use of underground laboratory to reduce background in order to have better control of the background and reduce detection limits - Use of two separate detectors optimised for determination of low energy and high energy gamma rays or alternatively
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	<p>water with uranium are meaningless. If the true uranium or radium content were known, something could be obtained, but not on the basis of the measurements made.</p> <p>The content of uranium and / or radium in water is determined by alpha spectrometry, in the simplest case, with the liquid scintillation method.</p> <p>See:</p> <ul style="list-style-type: none"> - Osmond, J. K.; Ivanovich, M.; (1992): Uranium-series mobilization and surface hydrology, in 'Uranium-series disequilibrium: Applications to Earth, Marine, and Environmental Science', (eds. Ivanovich, M. Harmon, R. S.), 259–289; Oxford, UK, Clarendon Press. - Uranium Series Geochemistry: Reviews in Mineralogy and Geochemistry (2003), Eds.: Bourdon, B.; Henderson, G. M.; Lundstrom, C. C. Turner, S. P.; Mineralogical Society of America. 	<ul style="list-style-type: none"> - Make use of one large volume p-type detector with thin dead layer with two chains of electronic with high amplification for low energies and low amplification for high energy gamma rays. - Use of correct decay data and being aware that the peaks interfering with the 63keV and 92.5 keV gamma rays vary depending on the sample matrix.
<u>Minor</u> REVISION comments	The details described above lead to avoid the publication of alarming results on the radiological quality of surface water, because they are not well supported.	
<u>Optional/General</u> comments	The effort to perform determinations of radioactivity that are useful to society is recognized.	