The global radioxenon background – an update

The 40-station IMS radioxenon network is now almost complete. During the last ten years nearly 100 000 radioxenon samples have been measured. We here present some selected results on isotopic composition from an analysis of more than 80 000 samples collected by the SAUNA and SPALAX systems between 2006 and 2015. The analysis is performed using new software developed at the Swedish NDC. The results can be used in the interpretation of specific samples, assessments of the capability of the IMS network, when developing categorization schemes, and in studies of the impact of background sources.

1. Xecon4
The analysis was performed using a new GUI-based software developed at FOI – Xecon4. The software can be used to analyze individual samples as well as data sets containing thousands of individual measurements. The software was designed to facilitate the verification work at the NDC. Examples of functionalities are spectrum review and re-analysis, summing of spectra, calculation of activity concentration data series with different calibration methods, comparison of data sets, filtering of data sets using many different criteria such as xenon volume, radon content, and different detection confidence levels. The data set analysis include frequency distributions, isotope correlations and time series, multi-isotope graphs and extraction of various statistical parameters.

2. The data set
Data from 26 IMS radioxenon systems was included in the analysis - 15 SAUNA- and and 11 SPALAX systems. The activity concentrations of $^{133}$Xe, $^{131m}$Xe, $^{133m}$Xe, and $^{135}$Xe for all IMS SAUNA – samples produced until December 31, 2014, were calculated using Xecon4 (66 581 samples). If applicable, energy drift correction was performed using the quality control spectrum. SPALAX data ranging from May 2010 until May 2015 was analyzed (14 959 samples), using only the gamma peaks, with the Unisam software.

3. Results – isotopic composition
The isotopic composition was studied using two different confidence levels, in order to identify possible outliers. Basic results is shown in Fig. 3. One important aspect of the background was quantified using the detections ending up in the most relevant multi-isotope plots (Fig. 4 and 5).

Summary and conclusions
An analysis of originally more than 80 000 radioxenon samples, probably the largest analysis of its kind, is presented. The analysis was facilitated by a recently developed interactive software. The extracted multi-isotope plots can be used in the sample interpretation performed by an NDC. 7 out of the 26 analyzed stations has detections in the most important 3-isotope plot on the 99% confidence level. The majority of detections are caused by isotope production facilities.

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